Title
Major Matters: Exploration of the Gender Wage Gap among STEM Graduates

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Publication Date
2016

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Major Matters: Exploration of the Gender Wage Gap among STEM Graduates

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy in Education

by Kyung Min Lim

2016

ABSTRACT OF THE DISSERTATION

Major Matters: Exploration of the Gender Wage Gap among STEM Graduates

By

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Doctor of Philosophy in Education

University of California, Los Angeles 2016

Professor Linda J. Sax, Chair

The gender pay gap has been a persistent issue in American workplaces, and the STEM fields have been no exception (Carnevale, Smith & Melton, 2011). For example, in the Silicon Valley, the heart of high-tech industries, the median salary of workers with a bachelor's degree was approximately $90,000 for men and $56,000 for women (Silicon Valley Institute for Regional Studies, 2015). Such observations are likely to discourage many young women from pursuing careers in STEM.

The majority of STEM workers are college graduates with degrees in STEM fields, as those credentials are typically required for individuals seeking STEM occupations (Graham & Smith, 2005). However, even students earning degrees in the same STEM field may face gender inequity in salary once they are on the job. Despite all that we know about the gender pay gap broadly speaking, few higher education researchers have empirically examined the gender wage inequality exclusive to STEM-trained college graduates.

The purpose of this study was to examine the gender wage gap that is specific to STEM college graduates, a population in high demand in the American labor market. To do so, this study used data from the National Center for Education Statistics (NCES), specifically the Baccalaureate and Beyond Longitudinal Study for the 2008-2012 cohort (B&B:08/12). Using this nationally representative data, this study examined how individuals' background characteristics, education-related experiences, and occupation-related experiences significantly predicted salaries of men and women with STEM degrees. In addition, the study assessed the degree to which these predictors of salary explained why female STEM graduates earned less than their male counterparts.

The results of this study showed that, in the early career stage, female STEM graduates earn less than their male counterparts, suggesting that women still face wage disadvantages (in comparison to men) even when they do select to study and receive a degree in the same STEM field. The study also found that some salary determinants such as the number of children and parents' income level impacted salaries of men and women in different ways. Lastly, the findings of this study showed that education-related experiences (i.e., college major, the extent to which college major and job were related, and the level of graduate degree earned) explained the majority of the gender wage gap among these STEM graduates, but a portion of the gender wage gap was still left unexplained. In light of these findings, this study considers implications for policy and practice related to the gender wage gap in STEM.

The dissertation of Kyung Min Lim is approved.

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2016

To My Parents, for believing in me

To Jeesoo, for his love, encouragement, and support

And to Aiden and Casey, our sons.

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ACKNOWLEDGEMENTS

The dissertation writing has been a very humbling experience, and this moment would not have been possible without the help and support of my family and the community of scholars at UCLA. Thank you Jeesoo Lee for the many mornings and nights that you took the sole parenting responsibilities to let me work on this study without interruptions. Next, I'd like to thank my HEOC colleagues for being such great supporters and friends. In particular, to my cohort Dayna Weintraub, Allison Kanny, Hannah Whang, Tanya Figueroa, Jen Berdan, and the NSF research teammates Laura Paulson, Kate Lehman, and Tiffani Riggers-Piehl, thank you for your wisdom, friendship, and humor. I have been so lucky to work with a group of talented and caring researchers like you.

I am also thankful to Kevin Eagan, Noreen Webb, and Sharon Traweek, for serving on my dissertation committee. Kevin, thank you for helping me get access to the data set and offering your wisdom in quantitative methods. Noreen and Sharon, thank you for sharing your knowledge to improve my dissertation study. Thank you all for being so generously flexible to work with my unusually tight timelines for both proposal and final defenses.

To my advisor and mentor, Linda Sax, I don't know where to start. Thank you for teaching me how to do research. Thank you for guiding me through this dissertation study. Thank you for showing me (and everyone else) that it's possible to balance work and family. Thank you so much for believing in me and encouraging me when I was about to give up. I have learned so much from you, and I will seek to put the learning in action for those I encounter in my life.

Lastly, I’d like to express my gratitude to UCLA Graduate Division (2015-16 Dissertation Year Fellowship) and to Association for Institutional Research (2015-16 Dissertation Grant) for the generous financial support.

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CHAPTER 1: INTRODUCTION

The Gender Wage Gap and STEM fields

Post-recession job growth and economic recovery have been heavily leveraged on the expansion of the high-tech industries. Termed "advanced industries" by the Brookings Institute, these science- and technology-based industries, such as pharmaceuticals or semiconductors, have been sizeable employers and sources of economic activity. High-tech companies employed 12.3 million U.S. workers as of 2013 and offer high wages averaging around $90,000 (Muro, Rothwell, Andes, Fikri, & Kulkarni, 2015). In the midst of the recent expansion and success of high-tech industries and jobs (Rothwell, 2014), one persistently disappointing issue is becoming more visible: the gender pay gap in the science, technology, engineering and mathematics (STEM) fields.

In the Silicon Valley, the center of the nation's high-tech sector, the median annual income for men with a bachelor's degree is approximately $90,000 while the median income for women with the same degree is approximately $56,000 (Silicon Valley Institute for Regional Studies, 2015). As STEM fields are eagerly searching for a more diverse pool of employees, these numbers are likely to send discouraging messages, especially to young women interested in the STEM field careers.

Since STEM occupations often require relevant college-level training (Graham & Smith, 2005), the gender gap in STEM fields is closely related to the gender gap in STEM departments in college. Therefore, the gender wage gap among STEM workers is a relevant issue that needs to be addressed in higher education. Despite the fast growth and importance of the STEM industries and the current high demand for STEM talents in the U.S today, few higher education researchers have empirically examined the gender wage inequality exclusively among STEM-trained college graduates. Moreover, what research has been conducted on the gender wage gap among this population to date has been observed and understood primarily through descriptive analyses.

The Gender Wage Gap among STEM Graduates

Among college-educated workers with STEM majors, women report lower annual earnings than men, and this pattern holds for every major within STEM (Carnevale, Strohl, & Melton, 2011). Women are out-earned by men by $17,000 among engineering majors and by $12,000 among biological sciences majors (Carnevale, Strohl, & Melton, 2011). These mere comparisons of median income by gender may be an overestimation of the gender wage gap among STEM majors, since these numbers do not account for women's and men's disparate occupational choices, such as women's greater likelihood of having a career outside STEM fields (AAUW, 2007; Graham & Smith, 2005; Rose, 2010).

When comparing women's wages to men's, one noteworthy observation is that the popular majors women tend to study within STEM (e.g., biological sciences) are associated with the lowest earnings prospect among the STEM majors. The median annual salary of each STEM major inversely corresponds to the proportion of women in the major. According to Carnevale, Strohl & Melton (2011), the highest earning major is engineering, in which women make up only 16 percent of students. On the other hand, the biological and life sciences majors have the lowest earnings and the greatest female participation (55 percent). As such, the proportion of women in a given major, which may indicate the degree of feminization of the major, appears to be closely related to the median earnings of men and women. Consequently, this inverse relationship between the proportion of women in major and earnings may partially explain why women's earnings lag behind those of men among STEM graduates.

Understanding the Gender Wage Gap in STEM

Current knowledge on the gender wage gap among STEM graduates relies on the simple comparison of median earnings between female and male STEM majors and lacks the empirical understanding of the reasons for this gender wage gap. In fact, explanations for the gender wage gap among this population are borrowed from studies on the gender wage gap among all college-educated workers, with the presumption that they operate in similar ways. Therefore, it is helpful to first take a look at the reasons for the gender wage gap among college graduates that are found in the literature. In the following section, I present some of the most common findings about the gender wage gap among college-educated workers.

Explanations for the Gender Wage Gap among the College-Educated

The gender wage gap exists at every level of education (Carnevale, Rose, and Cheah; 2011) and within the same college major (Carnevale, Strohl, & Melton, 2011). Scholars of the gender wage gap found the observed gender wage gap among college graduates to be explained by gender differences in human capital characteristics such as the choice of college major, work experience, employment status, cognitive skills, among others (Bobbitt-Zeher, 2007; Graham & Smith, 2005; Loury, 1997; Matteazzi, Pailhe & Solaz, 2013; Paglin & Rufolo, 1990). In addition, the gender-based segregation of occupations (the tendency that women and men work in different occupations from each other) is found to explain a large portion of the gender wage gap (e.g., Blau & Kahn, 2000; Hegewisch & Hartmann, 2014).

In addition to the above, the gender-based segregation of college majors also demonstrates how the influence of gender and major choice are tightly intertwined with the issue of gender wage gap (Bobbitt-Zeher, 2007; Lips, 2013; Reskin & Bielby, 2005; Rose, 2010). In other words, the lower earnings potential of college-educated women can be understood as a combination of the following three phenomena: (1) women are offered lower wages than men regardless of major choice, (2) women tend to choose a certain set of majors that men are less likely to choose, and (3) the female-dominated majors often correspond to lower wages. The third phenomenon in particular can be thought of in relation to the societal devaluation of feminine work, as defined in Jacobs & Blair-Loy (1996). It refers to the mechanism that occupations with high female representation tend to be associated with lower status and rewards. As such, this concept is a crucial element that links the gender-based segregation and the gender wage gap (e.g., Joy, 2000; National Center for Education Statistics, 1998). However, there is little empirical analysis that has gauged the contribution of the female dominance of major to the gender wage gap especially when only the STEM graduates are under consideration.

What is more concerning is the fact that the gender wage gap widens over time for college-educated workers (AAUW, 2007) and STEM workers (Carnevale, Smith & Melton, 2011). As college graduates start building their careers, women and men appear to face disparate life- and occupation-related experiences that increases the gender gap in earnings. For example, women are more likely to experience pay disadvantage associated with family formation (i.e., getting married and having children) (Daymont & Andrisani, 1984; Loury, 1997) and are less likely to be promoted at work than men (Blau & DeVaro, 2007), all of which leads to a decrease in their relative earnings. It appears that the number of explanations for the gender wage gap increases as the gender wage gap widens with time. Having examined the reasons for the gender wage gap among all college graduates, the following section considers the reasons for this gap among STEM graduates.

Explanations Specific to STEM Graduates

In most empirical work on the gender wage gap among college graduates, the science- and technology-related majors are bundled into a unitary category of STEM fields, despite the fact that the gender gap in representation widely varies by subfield within STEM (Kanny, Sax, Riggers-Piehl, 2014). Since STEM majors are considered as one unit, the gender wage gap and the factors contributing to it across different STEM majors are blurred and ignored. Consequently, it is not yet clear how the training in each STEM subfield would impact the wages of STEM graduates and the gender wage gap among them.

More specifically, few studies have paid attention to how gender composition of a given major is differently associated with the earnings of men and women. This exploration could allow for a better understanding of currently unknown aspects of the gender wage gap among STEM graduates such as how selecting a predominantly female major would differentially predict earnings of men and women. Examining the associations between the gender composition of the individual's major choice and earnings by gender is important because it can shed light on the role of gender-based discrimination on the earnings of STEM graduates. If, for example, the salience of gender composition of the major is found to be significant only for women, it means that the choice of a female-dominant major would be associated with a decrease in potential earnings for women but not for men.

Likewise, research has seldom attempted to measure how much the gender difference in gender composition of major (degree of feminization) explains the gender wage gap among STEM graduates. The closest study of this kind is by Bobbitt-Zeher (2007), who found that female representation in graduates' majors explained about 14 percent of the gender wage gap among all college graduates. Hypothetically, if gender composition of the major turns out to explain a significant portion of the gender wage gap among STEM graduates, efforts to bring men's and women's average gender composition of major to similar levels, such as recruiting more women into computer science, could narrow the gender wage gap among STEM graduates.

Purpose of the Study

Although the STEM majors play an important role in the gender wage gap among college graduates, there is a lack of research examining the gender wage gap among STEM graduates. In response, this study examined how the earnings of women and men were differently predicted by a set of variables ranging from personal background characteristics and occupational choices to the gender composition of the individual's chosen college major. Furthermore, this study estimated how these predictors of income explained the gender wage gap among STEM graduates. Lastly, to estimate the changes in the gender wage gap during the first few years of graduates' career, the gender wage gap in the first year after graduation (i.e., 2009) was analyzed and compared with the gender wage gap in the fourth year (i.e., 2012).

As mentioned earlier, research on the gender wage gap thus far has found several important factors that determine the earned income of college-educated workers and how they explain the gender wage gap. Mostly based on the human capital model, these factors include: college major, the gender composition of college major, occupational sector and job-related variables, and personal values and characteristics (e.g., Bobbit-Zeher, 2007; Graham & Smith, 2005; Rumberger & Thomas, 1993, etc.). In examining the earnings of recent STEM graduates in the US, this dissertation rests on the assumption that a similar model will hold true for STEM college graduates. Thus, this exploration is guided by the following research questions:

1) How do women and men differ in their labor market outcomes (i.e. employment status, employment industry, and wages)? Do the gender differences vary by major within STEM?
2) What are the determinants of income for women and men? To what extent are they similar or different between men and women? How much does the representation of women in the field (in the individual's college major) influence earnings?
3) How do the determinants of income explain the gender wage gap among STEM graduates?
4) How has the size of the gender wage gap (and the predictors of this gap) changed from the beginning of STEM graduates' career to the point of current analysis (the fourth year from graduation)?

In addressing these questions, the study attempts to highlight the significance of gender-based segregation of the major by estimating how much the gender composition of the major explains the gender wage gap among the STEM graduates.

To answer the above questions, this study used data from the National Center for Education Statistics (NCES), specifically the Baccalaureate and Beyond Longitudinal Study for the 2008-2012 cohort (B&B:08/12). The latest wave of this survey program, B&B:08/12 drew its initial sample from 2008 National Postsecondary Student Aid Study (NPSAS), which is a nationally representative sample of postsecondary students and institutions designed to examine how students finance their postsecondary education. The B&B:08/12 followed the individuals who earned bachelor's degrees in 2008 and surveyed them in 2009 and 2012. The Baccalaureate and Beyond Longitudinal Study (B&B) offers a wealth of information on bachelor's degree recipients' undergraduate and work experiences, demographic backgrounds, and expectations regarding post-baccalaureate study and jobs. As such, the B&B sufficiently provided information on the key independent and dependent variables such as college graduates' undergraduate major, employment status, and earnings from employment, along with relevant covariates.

Significance of the Study

There is renewed public interest in the gender earnings gap, heightened through President Obama's recent public support for the Paycheck Fairness Act and the following debates over whether the pay gap exists (e.g., Perry & Biggs, 2014). In such discussions, the importance of the STEM fields are often highlighted because a significant portion of women's pay disadvantage appears to be attributable to the fact that, due to their persistent underrepresentation in these fields, women are less likely to enjoy the high earnings potential that the STEM industries offer (Rose, 2010). However, the gender pay disparity within STEM has rarely been discussed despite the fact that it exists from the very beginning of individuals' career and widens even more rapidly than it does among non-STEM workers (Carnevale, Smith & Melton, 2011). Due to the close-knit relationship between higher education and careers in STEM fields (Graham & Smith, 2005), as well as the current public interest in the gender wage gap and economic returns to college majors, the exploration of the gender wage gap among college graduates who have earned STEM degrees is relevant and timely.

Moreover, despite the fact that STEM includes a wide range of majors and disciplines, both research and the public discourse thus far have classified them into one broad area and have seldom addressed the differences amongst the subfields that are often grouped as the STEM fields (Kanny, Sax, Riggers-Piehl, 2014). By acknowledging the individuality of the fields within STEM, this study seeks to fill a void in research. Therefore, current study intends to explain the gender wage gap that is specific to STEM college graduates, a talent pool America is eagerly seeking to foster and produce.

Findings from this study informs researchers and policy makers on how individuals' education-, life-, and occupation-related experiences differently influence the wages of women and men and how they explain the gender wage gap among STEM graduates. In particular, the results of this study highlights one aspect of college experience that has a significant impact on individuals' earnings and the gender wage gap among the STEM graduates: that is, the college major within STEM. In addition, this study's results reveal the role of college major in explaining salaries and the gender wage gap when the extent of feminization of the major (i.e., the proportion of women in the major) is held constant. An exploration of the gender pay gap among STEM graduates provides empirical evidence as to what contributes to the gaps, and estimates the consequence of women's underrepresentation in a given field on the gender pay gap among STEM graduates. In doing so, the present study also adds to the understanding of how the gender wage gap evolves as STEM graduates build their careers. Such understanding can facilitate more constructive discussions about equal pay within the STEM fields and further contribute to the discussion of the gender wage gap in general.

Outline of the Study

This chapter established the foundation and justification for the present study. Chapter 2 further expands on this foundation by comprehensively reviewing existing research related to the gender wage gap among college graduates with STEM majors. Also, Chapter 2 provides definitions of main concepts and terminologies used in the discussion of the theoretical basis for the study. Next, Chapter 3 discusses how the study was executed by thoroughly describing the hypotheses related to each research question, the variables and data used for the analysis, and the statistical analyses that were performed. Then, Chapter 4 presents the findings in detail, and Chapter 5 concludes the study by discussing the implications of the findings.

CHAPTER 2: REVIEW OF THE LITERATURE AND THEORETICAL FRAMEWORKS

Research on the gender pay gap thus far has suggested a set of perspectives at individual (micro) and societal (macro) levels and provides empirical evidence for their claims. This section presents current knowledge and understanding on the gender pay gap by defining the gender wage gap, documenting the trends in gender pay gap in the United States, and presenting the explanations of why the gender pay gap exists and persists from various perspectives. With that knowledge, I establish a framework that guided the current study, which explores the gender wage gap exclusive to college graduates with degrees in STEM fields.

The Gender Wage Gap

The gender wage gap refers to the difference between the average wages of men and women, expressed in mean or median wages. It is often expressed as the ratio of women's wages to men's, or in terms of the dollar amount of women's earnings for every dollar earned by men. The extent of the gender wage gap may vary depending on the way it is measured. For example, the gender wage gap is larger when measured over all workers than when measured over a sample of full-time workers only, and the wage gap often appears larger when it is calculated based on annual salaries than weekly earnings (Daczo, 2012). Regardless of how the wage gap is measured or calculated, the general pattern of the gender wage gap has been consistent (Daczo, 2012).

In the U.S., women's average wage has been lower than that of men ever since women started working outside the home. Women report lower earnings than men even when compared with men with the same level of education, racial identity, and occupation (AAUW, 2007). Moreover, the gender pay gap starts at the beginning of their career and typically widens over time (AAUW, 2007; Carnevale, Smith & Melton, 2011). As workers progress through their careers, the explanations for the gender wage gap become more confounded due to the life- and job-related experiences that differentially impact the wages of women and men such as starting a family (Loury, 1997). In addition, as workers age, a greater portion of the gender wage gap becomes not attributable to the differences in the observed characteristics between men and women, which may suggest increased influence of gender-based discrimination on the gender wage gap (AAUW, 2007).

The overall trend of the gender wage ratio has been upwardly-sloped since the late 1970s, meaning that women's earnings have come closer to men's earnings, with some fluctuations (IWPR, September 2010a; Bureau of Labor Statistics, 2014). For instance, the gender wage gap narrowed quite dramatically during the 1980s (O'Neill, 2003; Blau and Kahn, 2000; Blau and Kahn, 2006), as women's relative wage rose from 64.2% of men's wages in 1980 to 71.9% in 1990 (BLS, 2014). The relative wage of female (to male) workers continued to increase but at a much slower pace during the 1990s (Blau and Kahn, 2006; AAUW, 2015), and the gender pay gap has budged little since early 2000s (Fortin, 2008; IWPR, September 2010b). In fact, the latest statistics shows a drop in the wage ratio among full-time workers from 82.2% in 2011 to 80.9% in 2012 (Bureau of Labor Statistics, 2014). Even with a set of controls for personal characteristics, education levels, work experience, cognitive and non-cognitive traits, wage disadvantage against women still remains (AAUW, 2012; Fortin, 2008).

Postsecondary education is often associated with benefits in labor market opportunities such as increased earnings potential, higher lifetime wages, and access to jobs of higher quality (IWPR, April 2012; Pascarella & Terenzini, 2005). During the 1970s through the 1990s, women made marked improvements in many measures of human capital by reaching parity with men in college degree attainment, increasing labor participation rates and having more work experience (Bobbitt-Zeher, 2007; Dey and Hill, 2007; Fortin, 2007; Jacobs, 2003). In particular, the educational success of women was found to have a direct impact on the convergence of gender pay gap during the first half of 1980s (Loury, 1997).

Although convergence on many measures of human capital (i.e., college education and college major choice) between women and men did enable the gender pay gap to narrow (Blau & Kahn, 2006; Cohen, 2013; Loury, 1997), the gap still exists, even among workers with the same level of education. In 2010, AAUW (2014) found that the gender wage ratio is 77% for bachelor's degree holders, 76% for master's degree holders, and 80% among doctoral degree holders. Women with professional degrees appeared to face the greatest disadvantage among the highly educated, earning 72% of wages that their male counterparts earn. In sum, education may have hit a wall in its ability to drive gender pay equality, at least in terms of the level of education achieved.

Theoretical Frameworks

Scholars from different disciplines have attempted to explain the gender wage gap, with most work coming from three disciplines: economics, sociology, and psychology. The human capital model is the basic framework for most of the work on wage inequalities regardless of discipline or perspective. First reframed and popularized by economists (e.g., Becker, 1962; Mincer, 1974), human capital theory models wage as a function of characteristics and preferences (choices) of individual workers or employers. Following this concept, the wage differences between women and men can be understood to stem from the differences in human capital endowment between women and men (O'Neill, 2003; Graham & Smith, 2005; Reskin & Bielby, 2005).

Sociologists recognize the role of societal level differentiation and stratification by gender in how men and women differently obtain human capital. For example, gender-based segregation in occupational fields, which is a strong feature of the U.S. labor market (IWPR, September 2010b), is found to explain significant portion of the gender gap in pay (e.g., Morgan, 1998; Cohen & Huffman, 2003; Reskin & Bielby, 2005; Bobbitt-Zeher, 2007). This is because occupations with higher female representation are associated with lower average pay (England, 1992; England, Farkas, Kilbourne & Dou, 1998; Kilbourne et al., 1994).

Meanwhile, some portion of gender pay gap cannot be accounted for by gender differences in human capital, and such unexplained gender gap is likely to be a combination of bias from omitted variables and sex-based discrimination in the labor market (Reskin & Bielby, 2005). In other words, the observed gender wage gap can be sorted into three parts: (1) the portion of the gap that is explained by the gender differences in human capital measures such as education level and the length of work hours; (2) the portion that would have been explained by the gender differences in human capital characteristics but was not accounted for because the model omitted the variables that matter; and (3) the portion that stems from the presence of gender-based discrimination in the labor market. As such, research has explored the role of discrimination in the gender wage gap.

Psychologists focus on the direct and indirect influence of discrimination on the determinants of gender wage gap that are often cited by economists and sociologists (i.e., Lips, 2013; Alksnis, Desmariais, & Curtis, 2008). In particular, psychological studies found that people assign lower prestige and lower wages to the work often done by women or jobs that are thought to be feminine (Alksnis, Desmariais, & Curtis, 2008; Crawley, 2014). Such findings support and explain the observation that female-dominated occupations pay less than male-dominated ones.

Following most of previous research on the gender pay gap, this study utilizes the human capital model as the base framework in conceptualizing the topic and identifying variables to analyze. On the basic frame of the human capital model, I also incorporate the roles of occupational segregation and devaluation of women's work. In the following section, I further discuss each of above perspectives and present important structural elements to consider when examining gender wage gap.

The Human Capital Approach

The human capital model is probably the most oft-cited framework when discussing any type of inequality in the labor market including the gender pay gap. Capital refers to a set of resources that are used to yield income or make other useful outputs over the long run (Becker, 2008). Activities and influences that enhance productivity and earnings, improve health, or add good habits to a person are considered human capital as they are embodied within human beings. In this model, education and training, especially, are the substantial investments that improve human capital and subsequent earnings. Also imperative in the discussion of human capital is the environmental influence on the knowledge, skills, health, values, and habits of a worker, such as family (Becker, 2008).

The human capital model is a useful tool for studying how individuals' education, work experience, personal background characteristics, preferences, and values are associated with how productive or a valuable a person is in the labor market (i.e., earnings). It is also the well-established perspective that many researchers have used to explore the worth of college education (e.g., Becker, 1975; Blau & Kahn, 2000; 2007). Using this framework, many studies explored the gender wage gap and found that women's increased endowment in human capital such as college education and work experience (Nielsen and Alderson, 1997; Fortin and Lemieux 1997; Loury 1997; O'Neill and Polachek 1993; Sicilian and Grossberg 2001) and longer work hours (Levy and Murnane, 1992) were important factors in the narrowing of gender wage gap.

Despite such impact in the research world, the model also faces some criticism. First, the model's implicit assumption of gender-neutral analysis of inputs and outcomes may not accurately reflect reality (Lips, 2013), as there are few human characteristics and choices that are truly gender-neutral in life. Human capital model is also criticized for its limited ability to isolate the influence of discrimination. Taken together, this approach is prone to making interpretations that place blame on disadvantaged (or discriminated) groups when explaining inequalities (Reskin and Bielby, 2005; Lips, 2013).

Occupational Segregation by Gender and Devaluation of Feminine Work

Occupation and related choices are important human capital. In the U.S. and many other countries, it has been frequently noted that men and women tend to work in different industries and occupations from each other (e.g., Cohen, 2013; Cohen & Huffman, 2003; Charles & Grusky, 2004; Jacobs and Blair-Loy, 1996; Shauman, 2006; Tomaskovic-Devey, et al., 2006). This sex-based division of labor is called occupational sex segregation (Reskin & Bielby, 2005).

Scholars of the gender pay gap point to the occupational sex segregation (here on termed *segregation*) as one of major elements that contribute to the differential wages between men and women (Blau & Kahn, 2006, 2007; England, Farkas, Kilbourne & Dou, 1998; IWPR, September 2010; Kunze, 2005; Shauman, 2006). Many U.S. workplaces are heavily segregated by gender, with men more likely to work in more lucrative fields while women more likely to work in least-paying occupational fields (Jacobs, 2003; Shauman, 2006). So it logically follows that the segregation is a critical source of the gender wage gap (Cohen, 2013; IWPR, 2010b). Like the gender pay gap, segregation showed a decline from 1970 to 1990 and a slower decline during the 1990s (Cotter et al., 2004; Jacobs, 2001 as cited in Tomascovic-Devey et al., 2006). Cohen (2013) finds no substantial decline in segregation during the 2000s and reports that segregation still remains high. The decline in segregation is thought to be a partial reason for gender wage gap convergence (e.g., Hsieh et al., 2013) as it happened while women actively entered formerly male-dominated occupations that offer higher pay than traditionally female-dominated jobs (Jacobs, 2003). Studies have also found that the proportion of women in the field explained a sizable portion of the gender wage gap (Bobbitt-Zeher, 2007; Marini, 1998), suggesting the important role of segregation in gender wage inequality.

Between occupational segregation and gender wage inequality lies the mechanism that occupations with high female representation tend to be associated with lower status and rewards. Numerous studies have found the inverse relationship between female representation and the earnings of a given occupation or job, net of other characteristics (e.g., England, 1992; Jacobs & Blair-Loy, 1996; Jacobs & Steinberg, 1990; Kilbourne et al., 1994; Tomaskovic-Devey, 1993; Peterson and Morgan, 1995). Moreover, a study found the average pay in occupation to have decreased once women enter that occupation (Levanon, England & Allison, 2009). Following Jacobs and Blair-Loy (1996), I label this phenomenon as the devaluation of feminine work (here on termed *devaluation*). Devaluation is another significant contributor to the gender wage gap cited in various studies (e.g., Alksnis, Desmariais, & Curtis, 2008; Booras & Rogers, 2003; Bundig, 2002; Cohen & Huffman, 2003; Jacobs & Blair-Loy, 1996)

Discrimination and Gender Roles

Although overt forms of discrimination or sexism are less commonly seen than in previous eras, researchers have found evidence of gender-based discrimination and its impact on the gender wage gap. First, the devaluation (of women's work) shows that gender-based discrimination is alive and well in our society (Alksnis, Desmariais, & Curtis, 2008; Bobbitt-Zeher, 2007). Both psychologists and sociologists define gender as a "multifaceted system of practices and beliefs that privileges men and male characteristics" and as a system "profoundly influences personal choices, social interactions, and institutions" (Alksnis, Desmariais, & Curtis, 2008, p.1418). Therefore, gender directly and indirectly impacts women's position in the labor market by impacting behaviors of both workers and employers (England, 2005; Kmec, 2005 as cited in Alksnis, Desmariais, & Curtis, 2008) such as lowering potential value of her work, creating barriers for women against choices that are likely to yield more favorable outcomes (England, 2005; Lips, 2013), and allowing gender stereotypes to influence hiring decisions (Cejka & Eagly, 1999 as cited in Alknis et al., 2008).

An offshoot of sex-based discrimination is gender-role socialization, which shapes attitudes about what is more or less appropriate for women and men to do. Gender role socialization may contribute to women's relatively lower wages by influencing women to endow themselves with human capital in a different manner than men (Lips, 2013). Gender-role socilization may also work in the form of external expectations (such as those of society or employers) that define the type of tasks or roles that are seen more suitable for women (e.g., level of authority) in professional settings (Alkadry and Tower, 2011). Discrimination may also directly impact segregation as well since gender-role socialization influences women to view traditionally male-dominated occupations as less appropriate or less suitable for themselves (Lips, 2013; Tharenou, 2013 as cited in Crawley, 2014). In addition, psychologists have found that the work typically done by women is perceived as less prestigious and is associated with lower compensation (Alksnis, Desmarais, and Curtis, 2008; Crawley, 2014; Lips, 2013; Reskin and Roos, 1990); as such, devaluation is naturally related to women's lower average wage.

The gendered ideas on appropriate behaviors and expectations hinder women in various ways in workplaces. For example, women are penalized when they try to negotiate salaries (Bowles and Babcock, 2007) and women with children face disadvantages in getting employment offers over men with the same credentials (Correll et al., 2007). In addition, successful women are more likely to be disliked or personally criticized than equally successful men (Heilman & Parks-Stamm, 2007).

Structural Changes in the Economy

The aforementioned perspectives offer a helpful lens to understand why earnings between women and men are often disparate. Using knowledge gained through these perspectives, research has identified important individual-level characteristics or variables that determine one's earnings (e.g., college education, extent of segregation in the occupational field, etc.) and hence may help explain the gender wage gap. Along with the determinants of earnings, individuals' salaries and the extent of gender wage gap are also influenced by structural changes in the economy. For example, the growth in the service sector increased the demand for female labor force (Oppenheimer, 1973) and the growing importance of the clerical sector started increasing women's employment and their wages since 1920 (Goldin, 1990). As the value of physical work declined relative to other jobs, men's average wage declined more than wonen's (Loury 1997) because men typically filled such jobs.

In fact, the narrowing of the gender wage gap from the 1970s to 1990s happened in the backdrop of several structural changes in the economy at that time. De-unionization during the

1980s negatively impacted men's average wages more than women's, bringing men's and women's wages closer together (Blau & Kahn, 1997). The latest economic recession also had the effect of narrowing the weekly gender earnings gap by lowering men's real wages more than women's. For example, Hegewisch et al. (2012) found that men's real earnings declined by 2.1% while those of women declined only by 0.9% between 2010 and 2011, and such differences in decline fully explained the decline in the gender wage gap observed during this period.

As the labor market is bound to respond to the economic cycle (i.e., boom and recession), the gender wage gap may behave differently as the economic cycle evolves. However, researchers are not in agreement on how the gender gap is affected in the backdrop of different economic landscapes. Some view that the gender wage gap tends to decrease during the time of economic downturn because firms' financial cutbacks are more likely to affect extra earnings that account for a larger share of men's earned income such as bonuses and overtime payments (Hartmann, Hegewisch, Liepmann & Williams, 2010). On the other hand, some researchers find greater wage disadvantage against women during recessions, due to changes in pure wage discrimination. For example, a study using the Current Population Survey data from 1979 to 2009 found that white women's wages relative to white men's to have fallen by 1.2 percent with one percentage-point increase in the unemployment rate (Biddle & Hamermesh, 2012).

Role of Higher Education in the Gender Wage Gap

Persistent gender wage inequality has been explored from various perspectives that have suggested many reasons and explanations as to why it still exists. Among many explanations for the gender wage gap, segregation in education and the workplace appears as a popular theme highlighted across different perspectives. In other words, the underrepresentation of women in more lucrative fields (in college major and at occupations) appears to significantly contribute to the level of the gender wage gap (Blau & Kahn, 2000; England, 1992; Huffman, 2004; Joy, 2000; Kilbourne et al., 1994; Macpherson & Hirsh, 1995).

The role of college in connection with wage inequality appears more imperative in the backdrop of the current labor market situation: 47% of U.S. workers have college degrees (including associate's degrees) (U.S. Census Bureau, 2012), and a college degree carries a greater wage premium due to the market's higher demand for technologically skilled workers (Goldin & Katz, 2007). Indeed, enhanced labor market opportunity has been considered an outcome of higher education for both women and men (Pascarella & Terenzini, 2005). The rosy promise of education as a cure for gender wage inequality seemed to fade away when the pay gap did not disappear in spite of women's educational achievements (i.e., reaching parity with and surpassing men in degree attainment). Then, researchers uncovered other important aspects of college education in understanding one's earnings potential – that is, the choice of field of study (Arcidiacono, 2004; Jacobs, 1996; Ma & Savas, 2014; Pascarella & Terenzini, 2005; Rose, 2010; Rumberger & Thomas, 1993). For example, in 2009 the median annual income of graduates with petroleum engineering majors was $120,000 while that of counseling psychology majors was $29,000 (Carnevale, Strohl & Melton, 2013). It is now quite common to find popular media articles claiming to identify the college majors that will "make you richest" (e.g., Thompson, 2014 from Atlantic).

Segregation in College Majors and the Gender Wage Gap

Like the labor market, college campuses are segregated by gender in terms of the choice of academic disciplines (Charles & Bradley, 2002; IWPR, April 2012). Women are especially underrepresented in many of the STEM majors and over-represented in education and health care fields (AAUW, 2012; Carnevale, Strohl & Melton, 2011; Charles & Bradley, 2002; Rose, 2010).

Further, segregation in higher education is reflected in the segregation within the workforce after graduation (Cohen, 2013; Rose, 2010). Assuming that individuals choose college majors and jobs based on their preferences and interests, such a pattern is not at all surprising. Moreover, given the closely-knit paths from college education to some occupational fields like STEM and medicine, sex segregation in college deserves attention when examining gender wage gap. Occupations in STEM in particular often require relevant education at the college level (Graham & Smith, 2005), and the expected increase in the demand for more STEM talent (Lewin & Zhong, 2013; Rothwell, 2015) is likely to make segregation all the more visible if current trend continues.

Sorting the list of fields of study by associated salaries (e.g., the above-mentioned median annual income of petroleum engineering majors and counseling psychology majors) and by female representation in the given college major, it becomes readily noticeable that majors with high female representation correspond to lower earnings (see Table 1). In other words, the segregated nature of academic fields appears to be closely related to the gender wage gap (AAUW, 2012; Bobbitt-Zeher, 2007; Daymont & Andrisani, 1984; Graham & Smith, 2005; Rose, 2010). College majors with higher female representation tend to be related to lower average wages for both men and women (IWPR, April 2012; Lips, 2013; NCES, 1998; Shauman, 2005). In fact, the gender composition (proportion of women) of a college major is negatively related to one's earnings and explains 13.9% of gender wage gap (Bobbit-Zeher, 2007).

Table 1-1. Median Annual Earnings of Workers with Bachelor's Degrees

	Median	Earnings by Gender		Proportion of
	Salary	Female	Male	Women in Major
Engineering	$75,000	$62,000	$79,000	16%
Computer and Mathematics	$70,000	$60,000	$73,000	31%
Physical Sciences	$59,000	$48,000	$65,000	42%
Biology and Life Sciences	$50,000	$45,000	$57,000	55%

* Table recreated with data from Carnevale, Strohl & Melton (2011).

Noting the link between the gender wage gap and underrepresentation of women in lucrative academic fields like STEM, de-segregation in the choice of college major and occupation appears to be central to resolving the issue of persistent gender gap in earnings (Rose, 2010). Increasing women's participation in the STEM fields is not the only issue of concern, however. In order for increased participation by women to bring improvements to overall gender pay equity, it is imperative that women receive fair treatment once they enter and stay in fields with higher salary potential such as STEM.

Focus on STEM and the Gender Wage Gap within STEM

Among many lucrative fields of study, it is common to find many STEM majors. The demand for STEM talents has been growing over time, including the 2007-2009 period of economic downturn, and college-educated workers with STEM degrees out-earn their non-STEM counterparts (NSF, 2014). Such high employability and income potential would make studying a STEM major a solid human capital investment for both women and men.

However, the STEM fields as a whole have been at the epicenter of segregation in college major over the years, and underrepresentation of women in STEM fields has been a persistent issue (Rose, 2010). For example, women have been earning between 18 to 20% of engineering and physics degrees and 20-28% of computer science degrees since the 1990s (AAUW, 2010). Women's lower interest in the STEM fields has been examined and explored by many, citing reasons such as biological differences (e.g., the "innate differences" between men and women mentioned by former Harvard University President Larry Summers in 2005) and stereotype threat against women's science ability (Nguyen & Ryan, 2008). In addition, women's preference to highly value social contribution (Margolis et al., 2002; Lubinski & Benbow, 2006; Eccles,

2006) may make STEM careers less appealing to women, as they often do not see such potential through most STEM careers (Eccles, 1994; Kanny, Sax, Riggers-Piehl, 2014; Sax, 1994).

While women are underrepresented in many STEM fields, women did break into a handful of STEM fields that formerly were men's territories, including the biological sciences. Perhaps due to the obvious connection that medical careers have with the nurturing and caring image, women have studied biological sciences in college in increasing numbers since the 1970s to reach nearly 60% of biological science bachelor's degree recipients in 2012 (Boulis & Jacobs, 2008; NCES, 2013). In some other STEM fields, women are not as much outnumbered as they are in engineering or computer sciences, earning close to 40% of bachelor's degrees in mathematics and physical sciences in 2012 (NCES, 2013). However, considering the small size of these fields, the female underrepresentation is still a prevalent feature in STEM fields overall.

While the gender wage gap is seen as less severe in the STEM fields than the non-STEM fields (Graham & Smith, 2005; Long, 2001), women's average pay is not at parity with men within STEM (Canevale, Smith, & Melton, 2011; DesRoches, Zinner, Rao, Iezzoni, & Campbell, 2010; Graham & Smith, 2005). For example, DesRoches et al. (2010) found all else equal, female life scientists earned $13,226 less than male counterparts. Boulis & Jacobs (2008) also found that women earn 63% of their male colleagues' salary in the field of medicine. More importantly, within STEM such a gap appears to widen with workers' age at a more rapid rate than it does among non-STEM workers (Canevale, Smith, & Melton, 2011).

What would be driving such disparity within this group of rather selective occupational fields that require specific skill sets? Do women and men enter the STEM occupations with different types of human capital or do they go into different subfields within STEM that offer varying levels of pecuniary rewards? Although studies exploring the earnings differences among college graduates often consider STEM as one large area of study (see Bobbitt-Zeher, 2007; Carnevale, Smith & Melton, 2011; Graham & Smith, 2005), the STEM field in fact consists of sub disciplines that vary in many aspects, including the level of potential earnings and the gender composition within fields (Rosser, 2012). Given the varying levels of gender composition across different STEM subfields, I suspect that discriminatory factors such as devaluation may be at work within the STEM fields as well. However, the extent to which the gender composition of a field contributes to one's wage and the gender wage gap among STEM graduates is yet to be known.

Determinants of Earnings and the Gender Wage Gap

As mentioned above, research thus far has identified various determinants of worker's earnings, which have been used to understand and explain the gender wage gap among the college-educated. These determinants can broadly be grouped into two categories at individual and societal levels. Below, I borrow the knowledge from previous research to establish a list of determinants that were used to analyze data in this study and highlight their roles in expected wage and the gender wage gap.

Individual Level Factors

As the human capital approach posits, individuals make choices in their educational investments and trainings along with other work-related choices that contribute to differences in one's earnings. Since gender differences in these determinants at least partially explain the gender wage gap, it is important to identify the determinants of income in order to study the gender gap in earnings. These individual choices that determine one's income can broadly be grouped into educational and professional choices, and personal characteristics.

Educational choices. Educational success is commonly believed to lead to positive labor market outcome. Among workers with a college education, the choice of college major in particular has a large (if not the largest) influence on the level of earned income post-graduation and on the gender wage gap (Arcidiacono, 2004; Bobbitt-Zeher, 2007; Brown & Corcoran, 1997 Daymont & Andrisani, 1984; AAUW, 2007; Ma & Savas, 2014; Rumberger & Thomas, 1993; Shauman, 2006). As mentioned earlier, women tend to major in fields that lead to jobs that are typically rewarded with lower salaries (Bradley, 2000; Gerber and Schaefer, 2004), and hence the impact of college major choice on earnings and the gender wage gap must be understood with the recognition of the role of gender-segregation in college major (e.g., Bobbit-Zeher, 2007; Brown and Corcoran, 1997; Daymont and Andrisani, 1984).

Further, one of the explanations on why some majors lead to higher salaries than others is the congruence or relatedness between one's major and job. Studies have found that majors that provide trainings for specific job skills lead to higher pay (Pascarella & Terenzini, 2005; Thomas & Zhang, 2005). This congruence between one's college major and job leads to higher salaries (Melguizo & Wolniak, 2012) and higher worker satisfaction (Wolniak & Pascarella, 2005). If women are less likely than men to select majors that offer training for specific skills (majors with low job congruence), it is likely that major-job congruence will explain the gender wage gap.

Other education-related determinants of income are institutional selectivity (Davies & Guppy, 1997; Jacobs, 1999; Ma & Savas, 2014; Pascarella and Terenzini, 2005) and cognitive skills (Farkas et al., 1997; Paglin and Rufolo, 1990) measured in standardized test scores like SAT. In addition, college GPA was found to be a significant predictor of earnings for college-educated workers at least for the year immediately following their graduation (Thomas, 2000). Although there have been declines in gender differences in the selectivity of undergraduate institution (Davies & Guppy, 1997; Jacobs, 1999) and scores of cognitive skill tests (Willingham and Cole, 1997), these variables should not be overlooked, as such small differences may still have some role in explaining persistent gender gap in earnings.

In addition, earning advanced degree (graduate degree) boosts salaries, but the magnitude of impact is different for men and women that the gender pay gap is wider among advanced degree holders (IWPR, 2015). Lastly, attendance at for-profit and less selective institutions is negatively related to earnings (Pascarella and Terenzini, 2005). If women (esp. in STEM majors) are more likely to attend for-profit and to have started at community colleges, it may explain some of the pay gap.

Professional choices. In addition to educational investments, women and men show differences in occupation-related factors. For example, work hours (typically measured in hours worked per week) and length of work experience are positively related to one's earnings and partially explain the gender wage gap (Bertrand, Goldin, and Katz, 2009; AAUW, 2012; Rumberger & Thomas, 1993). Occupational sector and job type also make differences in one's earnings potential and the gender pay gap (AAUW, 2012; Graham & Smith, 2005; Rumberger & Thomas, 1993).

Personal characteristics. While some studies found no significant association between personal backgrounds such as race and family socio-economic status and one's wages (AAUW, 2012; Rumberger & Thomas, 1993), a recent study found that parents' income level do positively impact the adult child's earnings potential (Chetty, Hendren, Kline & Saez, 2014). In addition, the average earnings of racial minority employees lag behind those of Whites and Asians. Therefore, an exploration of the gender wage gap should be aware of possible interaction effects around these variables. As pointed out earlier, gender is a multifaceted concept which is intricately connected with personal choices and social interactions at many levels (Alksnis, Desmariais, & Curtis, 2008; Lips, 2013). Therefore, it is possible that the influence of gender depends on certain demographic backgrounds and/or interacts with other determinants of income. Ma and Savas (2014) recommend to approach these demographic variables with more sensitivity as they find the field of study to be a significant determinant of earnings for all groups except male college graduates with privileged social class. More significantly, studying lucrative fields of study provided a sizeable increase in earnings to overcome the negative influences associated with having a modest family background and graduating from a non-selective institution for women but not for men from lower social class and non-selective institutions (Ma and Savas, 2014).

In addition, family formation is often found to be strongly associated with one's salary and the gender wage gap (AAUW, 2012; Correll et al., 2007; Loury, 1997). More interestingly, marriage and having dependents appear to affect women's salary differently than men's. As Korenman & Neumark (1991; 1992) found, married women earned significantly less than unmarried women, while married men earned more than their unmarried male counterparts. Moreover, having children has negative impact for women's salary while men with children enjoy pay advantage over men without children (Budig, 2014; Correll, Benard & Paik, 2007; Glauber, 2008; Killewalk, 2012; Kricheli-Katz, 2012).

Societal Level Factors

As discussed above, the literature on the gender pay gap identified segregation and devaluation as significant forces. Female-dominated occupations tend to pay less than male-dominated fields with similar educational requirements. Occupational fields with a higher representation of women typically offer lower salaries (England, 1992; Kilbourne, England &

Beron, 1994; Jacobs and Blair-Loy, 1996). Likewise, college campuses are also segregated by gender, and fields of study with high proportions of women are often related to lower earnings potential whereas predominantly male majors are often related to higher earnings potential (IWPR, April 2012; Lips, 2013; National Center for Education Statistics, 1998; Shauman, 2005).

As occupational segregation is at least partially attributable to gendered norm on women's role (e.g., Lips, 2013), gender segregation in college must be understood as societal level forces that women often encounter. In addition, devaluation of women's job also is a hindering force against the gender pay equality. Therefore, the roles of segregation of majors and devaluation of feminine majors cannot be ignored when analyzing the gender wage gap of STEM graduates. One way to quantify the degree of segregation and devaluation is to calculate the proportion of women in college major. The "gender dominance of the major" (i.e., percentage of women in the field of study) is one of the most obvious differences among college majors (Bobbitt-Zeher, 2007, p.3) and is found to explain about 14% of the total gender wage gap (Bobbitt-Zeher, 2007). Given such research, inclusion of this information in the analysis may offer interesting insights on one aspect of college majors that matters in the understanding of gender wage inequalities.

Summary of Literature

As reviewed above, the gender wage gap is a broad topic that has been explored by many researchers in the past. Women and men make different personal, educational, and occupational choices that may lead to the differences in their earnings. In addition to gender differences in these characteristics and choices, scholars have highlighted the role of gender-based segregation in field of study and work as the most visible mechanism behind the observed wage gap between women and men (e.g., Blau & Kahn, 2000; Bobbitt-Zeher, 2007; Hegewisch & Hartmann, 2014).

The choices are either voluntarily made or socially influenced, but women tend to be the majority in occupations that offer lower compensation while men are the majority in highly lucrative occupational fields. In addition, research has recognized the role of gender-based segregation of college major in explaining the gender wage gap among college graduates (AAUW, 2007; IWPR, April 2012; National Center for Education Statistics, 1998) and found gender composition of a given major explained a significant portion of the gender wage gap (Bobbitt-Zeher, 2007). However, few researchers have attempted to explore the extent to which gender composition of major or gender-based segregation of college major explains the gender wage gap among STEM graduates.

Segregation and devaluation are important concepts when discussing gender wage gap among STEM graduates as well. As mentioned above, the proportion of women in his or her college major is negatively related to one's earnings and explains a significant portion of the gender wage gap (see Bobbit-Zeher, 2007), but the extent to which the gender composition of (or women's representation in) the major contributes to the gender wage gap among STEM graduates is yet to be known. Therefore, the gender composition of major is one of the key variables in this exploration of the gender wage gap among STEM graduates. Leveraging on the findings from past research discussed above, this study aims to address the following research questions:

1. How do women and men differ in their labor market outcomes (i.e. employment status, employment industry, and wages)? Do the gender differences vary by major within STEM?

2. What are the determinants of income for women and men? To what extent are they similar or different between men and women? How much does the representation of women in the field (in the individual's college major) influence earnings?

3. How do the determinants of income explain the gender wage gap among STEM graduates?

3a. How much of the gap is due to gender differences in the characteristics of STEM graduates and how much of it is attributable to the gender differences in the salience of the determinants of income?
3b. Which variables make most significant contributions to the gender wage gap among STEM graduates? In particular, how much does the representation of women in college major contribute to the gender wage gap in STEM?

4. How has the size of the gender wage gap (and the predictors of this gap) changed from the beginning of STEM graduates' career to the point of current analysis (the fourth year from graduation)?
   4a. Has the size of the gender wage gap increased or decreased between the first year to the fourth year after graduation?
   4b. In comparison to the first year after graduation, has the portion of the gender wage gap that cannot be explained by gender differences in observed characteristics (i.e., the "unexplained portion" of the gap) increased or decreased?

In the following chapter, above research questions are discussed in depth. For each question, I present the associated hypotheses and provide the rationale for each hypothesis. After then, I detail the analysis methods governing this study, describing the variables and statistical analysis approaches that are used in this study.

CHAPTER 3: METHODOLOGY

The analyses for this study are intended to explore the determinants of wages and explanations for the gender wage gap among young college graduates with STEM degrees, while highlighting the role of college education in the pay gap. In doing so, this study utilized a national, longitudinal, and multi-institution dataset that surveyed college seniors and followed them four years after graduation. The dependent measure is the graduates' annual earned income transformed into natural log of annual salary.

The study used three types of quantitative analysis to answer the research questions. First, descriptive analysis was used to identify the differences in the labor market outcomes such as employment status and the median earnings between women and men within each STEM major. Second, two multiple regression analyses were conducted to explore the determinants of income, separately for women and men and used to identify the extent to which the determinants were similar or different between men and women. Lastly, a regression-based decomposition analysis followed to understand how the determinants contributed to the gender wage gap among the STEM graduates.

In the rest of this chapter, I detail the methods I used to conduct the analysis necessary to answer the research questions. First, I reiterate the research questions along with their accompanying hypotheses, explain the conceptual model that guides the design of analysis, and describe the dataset and the sample included in the analysis. Next, I discuss the statistical analysis methods and acknowledge limitations. Lastly, this chapter concludes with a summary of the methods.

Research Questions and Hypotheses

This section describes three research questions and the accompanying hypotheses and rationales. Unless noted otherwise, the target population for all of the following research questions and hypotheses is full-time working individuals with bachelor's degrees in STEM disciplines. The rationale and justification for limiting the target to this population are provided in the later section of this chapter.

Research Question 1. How do women and men differ in their labor market outcomes (i.e. employment status, employment industry, and wages)? Do the gender differences vary by major within STEM?

Hypothesis 1. Compared to men, women are more likely to hold part-time positions rather than full-time positions and less likely to be employed in STEM occupations. In addition, women's average wage is lower than that of men's, although the difference may not be statistically significant. Lastly, the degree of gender gap on the above three labor market outcomes (employment status, employment industry, and earnings) varies by major.

Rationale 1. National data show that women in general are disadvantaged relative to their male counterparts in various labor market indicators. Women are more likely to work part-time than men are (Bureau of Labor Statistics, 2014), and such trend also applies to young college-educated workers (Graham & Smith, 2005). According to the National Center for Education Statistics (NCES), among those who earned bachelor's degrees in 2008 and were employed in 2012, 9.7% of women had part-time appointments whereas 5.4% of men had the same employment intensity (Cataldi, Siegel, Shepherd & Cooney, 2014).

The gender pay gap tends to be smaller in STEM occupations than in non-STEM jobs, at $2,500 or 5 percent upon entry (Carnevale, Smith & Melton, 2011). However, this gap increases for older cohorts of workers, as men's median salary is almost 60 percent larger than that of women among STEM workers ages 45 to 49 (Carnevale, Smith & Melton, 2011). Since I am looking at younger workers with STEM degrees regardless of their employment industry, it is yet unclear how the gender wage gap would turn out to be for this population. However, assuming that men and women select to stay in STEM occupations at similar rates, I expected to see small differences between the wages of women and men with STEM degrees in the early years of their career.

As mentioned earlier, the degree of gender gap in earnings does vary when analyzed by major. Recognizing the variability across STEM majors, including the female representation in a given major (Kanny, Sax & Riggers-Piehl, 2014), it seems logical to expect gender differences to appear in other measures of labor market outcomes such as employment status and industry.

Research Question 2. What are the determinants of income for women and men? To what extent are they similar or different between men and women? How much does the representation of women in the field (in the individual's college major) influence earnings?

Hypothesis 2. Human capital characteristics will explain earnings of STEM graduates in similar ways as they do for all college graduates. For example, the hours worked per week will be positively associated with earnings, like it is in numerous other studies (e.g. Graham & Smith, 2005; Bobbitt-Zeher, 2007, etc.). Meanwhile, men and women will have different sets of variables that appear significant in explaining their income levels. In other words, a few determinants of income will be shared by both men and women, but there will be others that will appear significant only for women or only for men. In addition, the representation of women in the individual's college major will be negatively associated with wage for both women and men.

Rationale 2. Since college graduates with STEM degrees are a subset of the greater population of workers with a college education, it appears logical to assume that they will be influenced by a similar set of demographic, educational, and occupational variables as they contribute to one's productivity level. The human capital model (Becker, 1974) has been a widely-recognized framework to explain wages, and many studies on wages of the college-educated have found human capital variables to be significantly related to wages, such as college major and hours worked per week (e.g. Graham & Smith, 2005; Ma & Savas, 2014; Rumberger & Thomas, 1993). However, since the concept of gender may differently impact how individuals make choices and acquire resources that are related to earnings (Lips, 2013), it is logical to assume some variations exist in the determinants of earnings between women and men. For example, marital status and number of dependents may be positively related to the earnings of men while it has little or negative relationship with earnings of women as found in Daymont & Andrisani (1984) and Loury (1997).

Research Question 3. How do the determinants of income explain the gender wage gap among STEM graduates?

Research Question 3a. How much of the gap is due to gender differences in the characteristics of STEM graduates and how much of it is attributable to the gender differences in the salience of the determinants of income?

Hypothesis 3a. Among the target population (STEM graduates), a greater portion of the gap will be explained by gender differences in mean levels of the determinants of income than is attributable to the gender differences in the salience of the determinants.

Rationale 3a. The gender wage gap can be decomposed into two parts: the part attributable to the gender differences in the mean levels of the variables (e.g., the length of work hours) and the part attributable to the differences in the salience of the determinants (e.g., the predictive power of the work hours on wage) between women and men. The former is termed the "explained portion" while the latter is termed the "unexplained portion." Past research offers a range of estimations on the size of these two segments, and do not agree on which one of the two is greater than the other. The size of the explained portion tends to be greater when the estimation is calculated based on the regression coefficients of men in comparison to the estimation based on that of women (see Graham & Smith, 2005; Ma & Savas, 2014).

Despite such disagreement, I expected the gender differences in the observable characteristics to explain a greater portion of the gender wage gap, based on the findings from a study that have compared the explanations of gender wage gap among STEM workers and non-STEM workers. According to Graham & Smith (2005), the relative size of the explained portion was greater than the unexplained portion (63.1 percent versus 36.9 percent respectively) when the gender wage gap was considered among STEM workers. In other words, if there were no gender difference in observable characteristics (for example, the average length of hours worked per week is the same for men and women), 63.1 percent of the gender wage gap among STEM workers would have disappeared. Since it is logical to assume that STEM workers and STEM graduates share similar characteristics, I expect gender differences in characteristics (the "explained portion") to account for a greater portion of the gender wage gap among STEM graduates (than the "unexplained portion" does).

Research Question 3b. Which variables make significant contributions to the gender wage gap among STEM graduates? In particular, how much does the representation of women in the college major contribute to the gender wage gap in STEM?

Hypothesis 3b. The gender composition or representation of women (among degree earners) in a given major will explain a sizeable portion of the gender wage gap among STEM graduates. It will be the single most important factor among the education-related variables.

Additionally, occupation-related variables such as the length of work hours and industry of employment will also explain a large portion of the gender wage gap.

Rationale 3b. Scholars have recognized the important role of college major in explaining wage inequalities among workers with college degrees (e.g., Bobbit-Zeher, 2007; Bradley, 2000; Ma & Savas, 2014; Pascarella & Terenzini, 2005; Rumberger & Thomas, 1993). Among the characteristics of a major that lead to higher compensation than others, the gender dominance of the major (i.e., proportional representation of women in the major) is one of the most visible traits (Bobbit-Zeher, 2007; National Center for Education Statistics, 1998; Joy, 2000). Given the wide range of female representation across the STEM subfields, the gender dominance of the major was expected to explain a significant portion of the gender wage gap among workers with STEM degrees.

In addition, studies on the gender wage gap unequivocally recognize the important roles of occupation-related choices and characteristics. Studies have found approximately 50 percent of the gender wage gap to be accounted for by gender differences in occupation-related characteristics such as the employment industry and work experiences (e.g. Bobbitt-Zeher, 2007; Graham & Smith, 2005). Therefore, I expected the identical pattern to emerge among STEM graduates.

Research Question 4. How has the size of the gender wage gap (and the predictors of this gap) changed from the beginning of STEM graduates' career to the point of current analysis (the fourth year from graduation)?

Research Question 4a. Has the size of the gender wage gap increased or decreased between the first year and the fourth year after graduation?

Hypotheses 4a. The size of the gender wage gap will increase from the first year to the fourth year post graduation.

Rationale 4a. Research shows that the gender wage gap widens over time regardless of the worker's education level or industry (e.g., AAUW, 2007; Carnevale, Smith & Melton, 2011). This increase is explained by gender differences in observed characteristics that may grow with time, such as women's opting to take part-time positions or taking time off work for family responsibilities at a higher rate than men (AAUW, 2007) and men's greater likelihood of getting a promotion (Blau & DeVaro, 2006). In addition, the unexplained portion of the gender wage gap tends to increase over time (AAUW, 2007), which ultimately indicates a greater gender wage gap overall.

Rsearch Question 4b. In comparison to the first year after graduation, has the portion of the gender wage gap that cannot be explained by gender differences in observed characteristics (i.e., the "unexplained portion" of the gap) increased or decreased?

Hypothesis 4b. A greater portion of the gender wage gap will be accounted for by gender differences in the observed characteristics in the first year post graduation than in the fourth year after graduation. In other words, I expect the proportion of the gender wage gap that is unable to be accounted for by gender differences in the observed characteristics to have increased with time.

Rationale 4b. While I suspect the explained portion of the gender wage gap to be greater than the unexplained portion of the gender wage gap in the first year post graduation as well, the unexplained portion of the gender wage gap tends to increase in its size with time and becomes greater than the explained portion of the gap for older college graduates (AAUW, 2007), perhaps due to the influences of job- and life-related experiences that are known to impact women's wages differentially from men's, such as family-rearing (Bobbitt-Zeher, 2007; Loury, 1997). In addition, as women build careers, their wages could be influenced by gender-based discrimination that is present in overt or subtle forms such as getting a promotion at a slower pace than men (Blau & DeVaro, 2006). Therefore, I suspected to see an increase in the size of the unexplained portion and a decrease in the size of the explained portion of the gender wage gap between the two time points.

Conceptual Model

With the above questions and hypotheses in mind, this section describes the conceptual model that guides this study. The conceptual model is primarily based on the human capital model, which relates earnings to education, work-related experiences and other personal characteristics that may improve the productivity of a worker (e.g. Becker, 1962; Mincer, 1974). In addition to above human capital characteristics, this study incorporates the gender composition of a given major (among degree earners) into the model as one way of acknowledging social forces on individuals' earnings. As a result, this study models post-baccalaureate income as a function of human capital characteristics such as demographic backgrounds, undergraduate education, and employment-related experiences (e.g. hours worked, employment status, etc.), and the gender composition of degree earners in the major measured in 2008, their final year in college.

As shown in Figure 1 below, this study posits that the dependent variable (earned income after college) is explained by the individual's human capital variables (in blue squares) and the percentage of women in major (in a blue circle). In addition, the model posits that all independent variables are influenced by discrimination. Here, discrimination includes the concept of socialization that widely impacts students' values and preferences to result in the different choices made by men and women (Lips, 2013). Although unable to be measured in this study, discrimination is incorporated into the conceptual model to acknowledge the force influencing all independent variables.

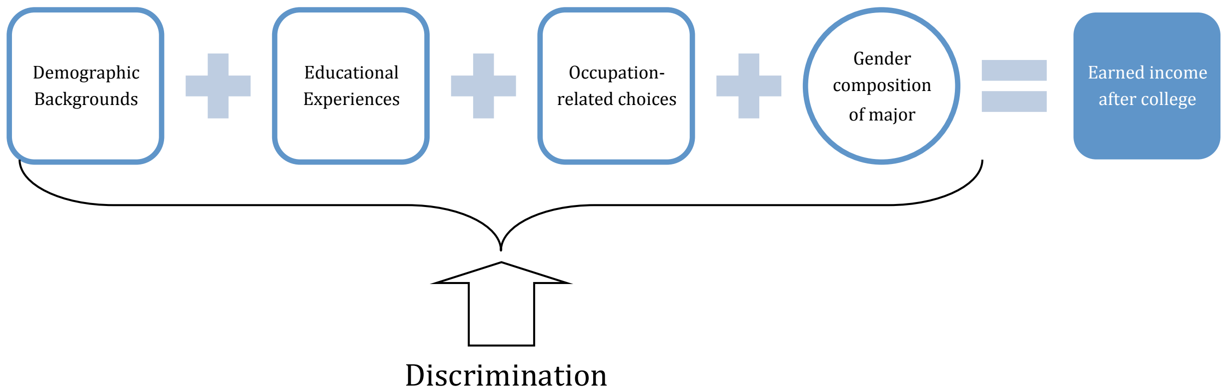

Figure 2-1. Conceptual Model of Income Among STEM Graduates

Sampling & Data

The study analyzed data from a national survey administered by the National Center for Education Statistics (NCES): 2008-12 Baccalaureate and Beyond Longitudinal Study (B&B:08/12). B&B:08/12 offers a wealth of information on various aspects of respondents' education and work experiences after they complete a bachelor's degree. This section introduces and describes the sample and data used in this study.

The B&B reports bachelor's degree recipients' information on demographic backgrounds, undergraduate education, labor market participation, income and debt repayment, and expectations regarding graduate study and work. B&B:08/12 draws its initial cohort from the 2008 National Postsecondary Student Aid Study (NPSAS), a nationally representative sample of postsecondary students and institutions. Therefore, the initial B&B cohorts are a representative sample of graduating seniors in all majors. B&B: 08/12 includes responses from approximately 15,500 students who were graduating seniors in 2008 and surveyed them in 2009 and in 2012. To allow sufficient number of observations for analysis, B&B:08 oversampled the STEM majors (Cataldi, Green, Henke, Lew, Woo, Shepherd & Siegel, 2011).

This study focused only on graduates who have earned bachelor's degrees from STEM departments, which is 4,880 respondents. Of these STEM graduates, I restricted the sample to the STEM graduates with full-time employment; approximately 55.1 percent of the STEM graduates (2,690 men and women) reported to have full-time appointments in 2012. Part-time workers were excluded from this study because they usually have different characteristics and preferences from full-time workers in regards to work and leisure (Robertson, 1989; Sadler & Aungles, 1990). For example, women are more likely than men to opt to part-time positions (rather than full-time) due to family-rearing responsibilities, a tendency that contributes to the gender wage gap (Matteazzi, Pailhe, Solaz, 2013). To avoid the confounding effects, this study examined the earnings of college graduates with bachelor's degrees in STEM disciplines who had full-time employment.

By limiting the sample to full-time workers in the fourth year from graduation, this study did not capture the individuals who were enrolled in graduate studies with part-time or no employment. While the sample of full-time working graduates included a small percentage of graduates who were working towards their graduate degrees while working full-time, this study did not include the 34.2 percent of STEM degree holders who were enrolled in school as of 2012. Therefore, this study is limited in its ability to account for the choices of these graduates to forego earnings at the time of the survey in hopes of increased wages with higher degrees.

B&B:08/12 contains the most recent information regarding the labor market experiences of college graduates that can effectively reflect the current economic landscape. Offering data on graduates' academic performances, type of institutions they attended, family background, and labor market experiences, the B&B: 08/12 is well-suited for the investigation of the roles of college major choice and other human capital characteristics in the gender wage gap of STEM graduates. Because the gender wage gap tends to grow with age and work experiences (AAUW, 2007; Carnevale, Smith & Melton, 2011), data captured in the relatively early stage of professional careers (four years at maximum) may lead to underestimation of the size of the gender gap. However, the counter argument is that this set up would in fact be a more appropriate design to gauge the impact of college experiences on the gender wage gap among the STEM graduates, possibly before other confounding forces of the gender wage gap (e.g., the gender differences in promotion rates and the effect of family formation on earnings) come into play.

Variables

This section describes the outcome measures along with the independent variables that were used to predict the outcome.

Dependent variable. To explore the relationship between college major and post-college earnings of STEM graduates, this study used respondents' self-reported annual earned income as the dependent measure. For the purpose of data analyses, the annual salary was transformed into the form of natural log of annual earnings. This is a necessary step prevalent in most studies of income since earnings distributions are always skewed to the right (which means the top few percentiles of earners account for a disproportionately large share of total earnings) (Neal &

Rosen, 1999). Taking the log of earnings transforms the highly skewed variable into one that resembles normal distribution, hence offering a way to avoid the problem of heteroskedasticity.

Independent variables. As evident from above research questions, the independent variables of primary interest are the undergraduate major and the gender composition in respondents' major. The gender composition in the major was calculated using the national data on postsecondary degree attainment (IPEDS completion component) from the National Center for Educational Statistics (NCES). To capture the gender dominance of a given major, I calculated the percentage of women for each major that share the four-digit Classification of Instructional Programs (CIP) number. To capture the impact of other aspect of college major (other than the gender dominance of major), this study also controlled for graduates' sub-major within STEM. To do so, respondents' undergraduate majors were organized into 7 categories: biological sciences, computer science, engineering, mathematics and statistics, physical sciences, technology and technician, and other STEM.

In addition, the study included covariates that were found to impact one's earnings from review of literature. All covariates can be broadly categorized into three categories of human capital: background characteristics, educational experiences, and occupational experiences. Background characteristics include information such as race and marital status. Educational experiences include both pre-college and college-level experiences such as standardized math test achievement and college GPA. Also included in this category are institution-level variables, such as institution type (categorized by institutional control) and selectivity. Lastly, the occupation-related variables include hours worked per week, employer type (i.e., for-profit company, non-profit organization), and industry of employment (i.e., STEM vs Non-STEM jobs).

Table 3.1 shows all variables that were considered in the analyses, along with the mean values for each variable by gender.

Table 3-1. Mean values for all variables by gender in 2012

Variable		Men		Women	
		Mean	Std. Dev.	Mean	Std. Dev.
DV					
Annualized Salary		60929.05	30366.36	50548.85	27429.86
IV					
Background Characteristics					
Race:	White	0.74	0.44	0.70	0.46
	Black	0.04	0.21	0.09	0.29
	Hispanic	0.09	0.28	0.08	0.27
	Asian	0.09	0.29	0.09	0.29
	Other	0.03	0.18	0.03	0.18
Number of dependent children		0.55	1.00	0.27	0.66
Married		0.48	0.50	0.36	0.48
Parent income level		2.11	1.04	2.23	1.02
US citizen		0.98	0.13	0.99	0.08
Urbanicity of 2007-08 residence		8.97	2.88	9.15	2.75
Educational Experiences					
Proportion of women in major		29.36	18.34	47.08	17.47
College Major:	Biological Sciences	0.18	0.39	0.49	0.50
	Physical Sciences	0.08	0.27	0.11	0.31
	Math/Statistics	0.06	0.23	0.09	0.28
	Computer Science	0.20	0.40	0.07	0.26
	Engineering	0.38	0.49	0.12	0.33
	Technology/Technician	0.07	0.25	0.04	0.20
	Other STEM	0.03	0.18	0.08	0.27
SAT Math score		599.38	96.06	577.18	96.58
College GPA		3.37	0.42	3.42	0.40
Institutional Selectivity (very selective)		0.34	0.47	0.34	0.48
Institution Type:	Public	0.64	0.48	0.56	0.50
	Private	0.31	0.46	0.40	0.49
	For-profit	0.05	0.22	0.04	0.19
Attended more than 1 institution		0.08	0.28	0.13	0.33
Urbanicity of bachelor's institution		7.52	3.45	7.57	3.49
Major-job relatedness:	Closely related	0.54	0.50	0.44	0.50
	Somewhat related	0.34	0.47	0.40	0.49
	Not related	0.12	0.32	0.15	0.36
Graduate degree:	No additional degree	0.73	0.44	0.56	0.50

	Below master's	0.04	0.19	0.09	0.28
	Master's	0.17	0.37	0.22	0.42
	Doctoral	0.06	0.24	0.13	0.34
Work-related experiences					
Hours Worked per week		44.57	8.78	44.08	10.07
Employer Type:	For-profit	0.68	0.47	0.55	0.50
	Non-profit	0.23	0.42	0.37	0.48
	Military	0.05	0.22	0.02	0.14
	Other	0.04	0.20	0.07	0.25
Job Industry:	STEM job	0.32	0.47	0.17	0.38
	STEM-related job	0.13	0.34	0.30	0.46
	Not STEM job	0.55	0.50	0.53	0.50
Received benefit		0.94	0.23	0.94	0.24
Received bonus		0.48	0.50	0.35	0.48
Salary important in choosing a job		0.93	0.26	0.92	0.28

Analysis Techniques

To analyze the data, this study utilized descriptive analysis, ordinary least squares (OLS) regression and regression-based decomposition analysis. To answer Research Question 1, descriptive analyses were first conducted to examine how graduates' labor market outcomes such as employment status, employment in STEM industry and salary vary by gender and major among these STEM graduates. Two-sample t-test was used to test the significant differences in the likelihood in STEM employment between men and women in each major. To consider the gender differences in earnings by major, two-way ANOVA was performed with the log-transformed salary as dependent variable (see Berry, 1987).

In regards to Research Question 2, the earnings of STEM graduates were examined as a function of the independent variables described above. Analyses involved the use of linear regressions in which the continuous dependent variable is defined as a natural log of annual earned income of STEM graduates. The linear regression model was run separately by gender, in which the independent variables were force-entered. The variables that were significant for neither gender were removed from the model, and a final model with the remaining variables was used to identify the determinants of income, making the model as parsimonious as possible.

Research Question 3 was addressed through the use of Oaxaca-Blinder decomposition (Blinder, 1973; Oaxaca, 1973), a popular technique used to identify the unique contributions of group differences to the gap in observed outcomes (Fairlie, 2005; Jann, 2008). This method effectively decomposes an outcome difference between groups (i.e., the gender wage gap) into two components: (1) the part attributable to differences in average characteristics between groups (the explained portion), and (2) the part attributable to the group differences in the salience (coefficient) of the characteristics (the unexplained portion). The explained portion of the gender wage gap, therefore, refers to the portion of the gender wage gap that would have been eliminated if the mean values of each variable in the model were identical between women and men. On the other hand, the unexplained portion of the gender wage gap is a combination of the following: (a) the portion of the gender gap that would have been eliminated if the salience (regression coefficients) of each variable in the model were identical between women and men, and (b) the portion of the gender wage gap that would have been eliminated had the model included all relevant variables to explain the gender wage gap. The Oaxaca-Blinder decomposition also offers estimates of each independent variable's contribution to the gender wage gap (Jann, 2008). Therefore, it was possible to gauge the individual contribution of each variable to the gender wage gap among STEM graduates.

Because the decomposition needs nondiscriminatory coefficients to estimate the explained and unexplained portions, there are a few ways to conduct the Oaxaca-Blinder decomposition. Simply put, the nondiscriminatory coefficients or the reference coefficients refer to the salience of variables in the absence of discrimination. When, for example, we can assume discrimination against women but no (positive) discrimination against men, the decomposition can use men's coefficients as the reference coefficients. Because this study assumes the gender-based discrimination to impact both men and women, I used a pooled regression over both groups to estimate the reference coefficients. To avoid under-estimation of the unexplained portion, I followed the recommendations of Jann (2008) and Elder, Goddeeris & Haider (2010) to include the group variable (i.e., female) in the pooled regression.

Lastly, the decomposition analysis was performed on the graduates' wages measured in the first year after graduation (i.e., 2009) to provide a comparison base for the results for the 2012 data. To use the same model for 2009 and 2012 data, the sample of STEM graduates were once again limited to individuals who had full-time jobs in 2009 *and* 2012. After the decomposition analyses for 2009 and 2012 were run, Research Question 4 was answered by comparing the decomposition analysis results between the two years.

Limitations

Before moving further, it is important to acknowledge this study's limitations. First, as mentioned earlier, there is possibility that the size of the gender wage gap among STEM graduates to be under-estimated because the wages are examined after only four years from baccalaureate graduation. Studies of the gender wage gap show that as men and women progress in their careers, the gender wage gap tends to widen (AAUW, 2007). However, I believe that exploration of the gender wage gap at an early year of career would offer useful information as well, since it allows to gauge the explanations of the gender wage gap that exist before men and women start to accumulate different traits that may lead the gender wage gap to widen. In other words, I acknowledge the cumulative advantage mechanism to be present in the salary inequity between men and women and have attempted to capture its origins in this study. Cumulative advantage is often mentioned as a mechanism of inequity in various domains of social science research, including literature on social mobility, poverty, race, crime, education, and human development (DiPrete & Eirich, 2006).

In addition, consideration of wages at this point in time suffers from a selection problem, since the analysis excludes many college graduates who were out of the workforce pursuing graduate education. In particular, since some STEM majors are more likely to choose to pursue graduate education than others (e.g., health and medical preparation programs, biology, and physics) (Carnevale, Strohl & Melton, 2011), the graduates with these majors were not well represented. Moreover, since women are more likely to be in these disciplines and graduate degrees in these disciplines appear to offer higher earnings boost than other disciplines (Carnevale, Strohl & Melton, 2011), this study may overestimate the gender wage gap among STEM graduates and the impact of gender composition of a given major on the gender wage gap by leaving these individuals out of consideration.

Next, some variables may contain inaccurate data. Since the survey is based on self-reported information, it may include some errors in the measure. Also, the employer type variables for 2012 primary job were derived from source data, and some error in the coding process might lower the accuracy of the measure. Additionally, a portion of the parent income variable includes the income of independent students, which may not accurately reflect the graduates' family background.

Lastly, the model may have omitted a few important variables. In particular, the model lacks information on the graduates' career-related values or preferences that are also important predictors of earnings and explanations for the gender wage gap (Daymont & Andrisani, 1984). Another potentially important covariate in considering pay gap is the geographic region of employment (Chetty, Hendren, Kline, & Saez, 2014), but this variable was not included in the model.

Summary

In this chapter, the methodology of this study was discussed in depth, including the conceptual model, data and sample, the dependent and independent variables, data analysis techniques and limitations of the study. Despite its limitations, this study can still make a meaningful contribution to the knowledge base for the gender wage gap among STEM graduates. The study highlights the roles of college major and the gender composition of individual's chosen major in understanding the gender wage gap along with other aspects of college experiences such as college GPA and the relatedness of the college major with respondents' current jobs. Drawing from the most recent national dataset that provides comprehensive information on college graduates, this study offers a timely examination of the link between college and careers among STEM graduates.

CHAPTER 4: RESULTS

This chapter presents the results of data analyses conducted to explore the gender wage gap among relatively recent college graduates with STEM degrees. In particular, this section reports the findings on gender differences in labor market outcomes and determinants of salary, the contributors to the gender wage gap and a comparison of the wage gap explanations between the first and fourth year after college graduation. As discussed in the previous chapter, the data analyzed here come from a national, longitudinal survey of college graduates conducted in 2009 and followed up in 2012. Among all individuals surveyed, this study analyzed information on graduates with STEM degrees who were working as full-time employees at the time of the survey in 2009 and 2012. The findings discussed in this chapter are organized by the four research questions, with a summary provided at the end of the chapter.

Gender Differences in Labor Market Outcomes

This section presents the findings that address the first research question: How do women and men STEM graduates differ in their labor market outcomes (i.e. employment status, employment industry, and wages)? Do the gender differences vary by major within STEM? Among graduates with bachelor's degrees in STEM disciplines, men and women differed in terms of their employment status, industry (STEM or non-STEM), and (mean) annual salary within (at most) four years after college graduation. Overall, men scored higher on indices that are considered advantageous (e.g., being employed full-time), while women scored higher on indices that could be considered rather disadvantageous in the labor market (e.g., to be out of the labor market in 2009 and 2012 and to be more likely to be unemployed in 2012) (see Table 4.1).

Female STEM graduates were also less likely than their male counterparts to be employed within the STEM fields. As shown in Table 4.2, men were more likely to have full-time STEM jobs than women in both 2009 and 2012, although the gender difference in having a STEM job was smaller in 2012 than in 2009. Interestingly, gender differences in having a full-time STEM occupation were different by major. In 2009, there were statistically significant gender gaps favoring men in the proportion of graduates with STEM jobs among graduates with biological sciences, computer sciences, engineering, and physical science degrees; the biggest difference appeared among the computer science and physical sciences majors. By 2012, the overall gender gap in the proportion of STEM workers became much smaller, with field-level gender differences observed only among biological sciences majors. These trends are not unique to STEM graduates. Among non-STEM graduates, men were also more likely than women to have full-time STEM jobs in 2009 and 2012, the gender gap was smaller in 2012 than 2009, and the likelihood of having a STEM job decreased for both men and women from 2009 to 2012.

A majority of the graduates who reported to have STEM jobs in 2009 but no longer have STEM jobs in 2012 have switched to non-STEM occupations while the rest have switched to STEM-related jobs or are enrolled in graduate programs: In 2012, 82.5% of the STEM job leavers have non-STEM jobs, 14.2% have STEM-related jobs, and 3.2% are enrolled in graduate programs. This trend holds true for graduates with STEM and non-STEM degrees. Given the high average salary that typical STEM jobs offer, STEM workers' departure from STEM workforce may impact the earning levels of men and women. The implication of this phenomenon to mean salary levels and the gender wage gap will be further discussed in the next chapter.

Before reporting the descriptive analysis results regarding the gender gap in salary by major, I would like to present more detailed information about the salary of recent college graduates with STEM degrees, as salary is the primary dependent variable for the regression analyses conducted in this study. Among STEM graduates with full-time employment in 2012, men's median salary was higher than women's ($60,000 for men and $46,000 for women), and this trend held true among graduates with non-STEM majors as well ($45,760 for men and $40,800 for women). The gender wage gap in fact appeared larger among graduates with majors in the STEM fields than those with non-STEM majors. Further analyses of salary of STEM graduates with full-time jobs revealed that those whose majors tend to have larger female representation had lower median salary. As shown in Table 4.3, the median salary of graduates with 50% or less female in his or her major was $60,000 while that of graduates with more than 50% female in his or her major was $43,590. Women's median salary was lower than men's regardless of the gender composition of major, and the gender gap appeared larger among graduates whose majors had more men than women than vice versa (-$12,562.40 vs -$2,000.00).

The gender wage gap also varied by major. Table 4.4 reports the mean salaries of men and women by major for 2009 and 2012. The mean salary here is not log-transformed, and hence may exaggerate the gender differences in wages. To adjust for skewness, a two-way ANOVA on log-transformed salary with gender and major was performed on a sample of 2,650 STEM graduates with full-time jobs in 2012. There was a significant interaction between gender and major, $F(6, 2630) = 5.43$, $p< .000$. This confirms that there were salary differences by gender and that they varied by major in 2012 (see Appendix B for more full ANOVA results). Simple main effects analysis showed that men's salaries were significantly higher than women's salaries among computer science, technology/technician, and other STEM majors ($p<.05$). There were no statistically significant gender wage gaps among the rest of majors.

Table 4-1. Comparison of employment status by gender among STEM graduates, 2009 & 2012

	2009			2012		
Employment Status	Men (N=2,620)	Women (N=2,010)	Gender Gap (W-M)	Men (N=2,520)	Women (N=1,940)	Gender Gap (W-M)
One Full-time job	58.5%	41.9%	**-16.6%**	66.7%	52.2%	**-14.4%**
One Part-time job	12.5%	19.2%	**6.7%**	5.4%	9.7%	**4.3%**
Multiple jobs	8.1%	10.6%	**2.5%**	4.1%	4.6%	0.5%
Unemployed	8.1%	8.6%	0.5%	7.6%	10.1%	**2.4%**
Out of labor force	12.7%	19.7%	**7.0%**	16.2%	23.4%	**7.2%**

Note: Bold denotes statistically significant difference ($p < 0.05$)

Table 4-2. Percentage of STEM graduates in STEM workforce by gender and major in 2009 & 2012

	2009			2012		
Major	Men (N=1,540)	Women (N=840)	Difference (W-M)	Men (N=1,650)	Women (N=1,000)	Difference (W-M)
Biological Sciences	24.6%	17.2%	**-7.4%**	14.0%	9.0%	**-5.0%**
Computer Sciences	61.8%	47.3%	**-14.5%**	5.1%	0.0%	-5.1%
Engineering	75.1%	64.7%	**-10.5%**	58.0%	54.1%	-3.9%
Math/Statistics	15.2%	13.0%	-2.2%	15.1%	9.1%	-6.0%
Physical Sciences	49.1%	34.7%	**-14.4%**	43.7%	33.3%	-10.3%
Tech/Technicians	41.8%	27.5%	-14.3%	24.3%	12.2%	-12.2%
Other STEM	19.6%	16.1%	-3.6%	14.3%	14.8%	0.5%
All STEM	54.9%	29.0%	**-25.8%**	32.2%	17.1%	**-15.1%**

Note: Bold denotes statistically significant gender difference ($p <.05$).

Table 4-3. Median salary of STEM graduates by percentage of women in the respondent's major

Percentage of female in major	0% to 50%		50% to 100%	
	Salary ($)	N	Salary ($)	N
All	60,000.00	1,790	43,590.00	900
Men	62,662.40	1340	45,000.00	340
Women	50,100.00	450	43,000.00	560
Difference	-12,562.40		-2,000.00	

Table 4-4. Comparison of mean salary by gender and major in 2009 & 2012

	2009			2012		
Major	Men ($)	Women ($)	Difference	Men ($)	Women ($)	Difference
Biological Sciences	32,512.48	30,333.80	**-2,178.68**	46,333.57	48,278.97	1,945.40
Computer Sciences	49,988.63	42,795.01	**-7,193.62**	63,251.85	55,691.33	**-7,560.52**
Engineering	53,341.13	51,191.54	-2,149.59	70,997.60	67,860.21	-3,137.39
Math/Statistics	41,696.92	38,252.55	-3,444.37	53,949.03	50,418.99	-3,530.04
Physical Sciences	38,409.07	31,812.67	**-6,596.40**	46,573.52	47,787.34	1,213.82
Tech/Technicians	46,433.86	41,381.17	-5,052.69	60,526.55	43,307.28	**-17,219.27**
Other STEM	34,320.01	31,908.18	-2,411.83	57,736.53	41,469.15	**-16,267.38**
All STEM	46,471.49	36,081.44	**-10,390.05**	60,929.05	50,548.85	**-10,380.20**

Note: Bold denotes statistically significant gender difference (p <.05).

Gender Differences in the Determinants of Earnings

Next, I analyzed the determinants of salary earned in 2012 for female and male STEM graduates. All independent variables were force-entered into the OLS regression model, and the model was run for each gender on the log-transformed annual salary of STEM college graduates. The variables that appeared not to be significant at $p<.05$ for both men and women were considered unrelated and removed from the model, except for the racial background and the variables that I expect to be closely related to women's behavior in job selection: proportion of women in major, number of dependent children, and marital status. As a result, the following five variables were removed from the model: SAT Math scores, the institutional control variables (private and for-profit), and urbanicity of institution (a scale of twelve, from rural remote to large city). The final model without these five variables was run again, and the results are presented in Table 4.5 below.

The final models explained 28% of the variance for men (N=1,500) and 31% for women (N=920) (adjusted r-squared). Of note, the variable of primary interest in this study, representation of women in the major, was not a statistically significant determinant of salary. In fact, the female representation in the major (a continuous variable ranging from 5.2 to 85.4 percent) becomes no longer significant once the college major dummies enter the model. Given the importance of this variable in this study, the relationship among female representation in the major, the undergraduate major, and salary will be further discussed in the next chapter.

Among the independent variables, many turned out to be statistically significant for both men and women: race, urbanicity of residence in 2007-08, college major, institutional selectivity, having a job related to his or her major, graduate degrees, work hours, employer type (for-profit, non-profit, military or other), employment sector (STEM, STEM-related, non-STEM), having a job that offers benefit, and importance of salary in choosing a job. All work-related experiences were significantly related to salary for both women and men.

Interestingly, some of these determinants worked in slightly different ways between men and women. Among women, those who identified as Asian earned approximately 12% more than the white group while earnings for women from the remaining racial/ethnic groups did not differ from those of white women. For men, racial identity did not make statistical difference in salary except for the "other" group (includes American Indian or Alaska Native, Native Hawaiian/other Pacific Islander, other, and more than one race) who earned 11% less than the white group.

In terms of college major, mathematics and statistics, computer science, and engineering majors out-earned graduates with biological science degrees. In addition, among men, technology/technician majors also earned more than biological sciences majors. The regression results also show that salary is higher when the respondent reports that his or her major is related to his or her job. For men, salary was higher when college major and job were closely and somewhat related than when the two are not related at all. For women, however, salary was higher only among those who reported that their job and major were somewhat related. In fact, among women, the mean salary of those whose major and job are somewhat related was greater than that of women whose major and job are closely related ($p<.05$). But there was no differences in mean salaries between men whose major and job are closely related and those whose major and job are somewhat related.

Further exploration of the occupations of graduates by the degree to which job and major are related offers an explanation for this slight discrepancy in the salience of major-job relationship between men and women. Given that the majority (58.1%) of full-time working male STEM graduates are engineering or computer sciences majors, it is not surprising that, if their major and job are closely or somewhat related, the most popular occupations are engineering and computer or information system occupations (median salary of $70,000 and $65,000, respectively). These jobs tend to offer higher salaries than jobs in fields only partially related to STEM. By contrast, the top occupation of female STEM graduates whose major and job are closely related was PK-12 educators, who reported median salary of $42,000. (Presumably many of these women were STEM educators[1], hence their reporting of a close alignment between their major and their job.) These teaching salaries are lower than that of the occupation most common among women whose major and job are somewhat related, healthcare professionals, who reported a median salary of $53,750. Thus, due to gender segregation in the labor force (even among STEM graduates), having a job closely related to one's major may be indicative of higher salaries for men, but not for women.

Not surprisingly, graduate degrees also boost salary for both women and men. However, there is a slight difference in the type or level of degree that makes a difference. For women, having any post-graduate degree or certificate was significantly (and positively) related to salary. But for men, only the master's level degrees showed up as significant (11.5% more in salary). This finding may be related to the industry of employment of the advanced degree holders, as it is commonly understood that STEM or STEM-related occupations offer higher salaries than non-STEM occupations. On average, the advanced degree holders in the sample were more likely to work in STEM-related occupations—and less likely to work in non-STEM occupations—than those without advanced degrees. In particular, master's degree holders were also more likely to

[1] It is uncertain whether they are teaching STEM subject in 2012, but 82.4% of these PK-12 educators (who have reported their jobs to be closely related to major) indicated to have taught science, math or computer science since college graduation. Although these individuals considered their job to be closely related to their major fields, STEM teachers at the secondary school levels are not included as STEM job workers in current data set.

work in STEM occupations than those without advanced degrees, and this trend was more pronounced among men.

All work-related variables were significant for both men and women. However, the impact of employer type slightly varied by gender. Although rather obvious, those who work for non-profit firms reported lower salaries than those working in for-profit firms for both women and men. For men only, working at another type of employer (including employers other than schools, government, military, non-profit, for-profit, and self-employed) was negatively related to salary.

Some factors were related to salary for only one gender. The following were statistically significant for men's salary only: number of dependent children, US citizenship status for 2012, and college GPA. Only among men, earnings were higher among those with children (3.3% higher per each additional child), US citizens earned 18% less than non-citizens, and men earned 6.7% more in salary for each one point increase in GPA. On the other hand, one variable was statistically significant for women's salary only: parent income in 2007: Female graduates' salary increased by 3.8% when her parents' income level moved up one quartile.

Table 4-5. Determinants of log-transformed 2012 salary among STEM college graduates by gender

	Men (N=1,500)			Women (N=920)		
	Coef.	Exp(b)		Coef.	Exp(b)	
Background Characteristics						
Race (Reference: White)						
Black	-0.023	0.978		0.036	1.037	
Hispanic	-0.034	0.967		0.026	1.027	
Asian	0.038	1.038		0.112	1.119	*
Other	-0.116	0.890	*	0.001	1.001	
Number of Dependent Children	0.032	1.033	*	0.020	1.021	
Married	0.004	1.004		0.031	1.031	
Parent Income Level	0.000	1.000		0.037	1.038	**
US Citizens	-0.195	0.823	*	-0.024	0.976	
Urbanicity of Residence 07-08	0.009	1.009	**	0.011	1.011	**

Education-related Experience						
Proportion of Women in Major	0.000	1.000		-0.001	0.999	
College Major (Reference: Biological Sciences)						
Physical Sciences	-0.007	0.993		-0.008	0.992	
Math/Statistics	0.148	1.159	*	0.137	1.146	*
Computer Science	0.256	1.291	***	0.249	1.283	**
Engineering	0.314	1.369	***	0.265	1.303	***
Technology/Technician	0.211	1.235	*	0.016	1.016	
Other STEM	0.210	1.234	**	-0.060	0.942	
College GPA	0.069	1.072	*	0.007	1.007	
Institutional Selectivity	0.068	1.071	**	0.092	1.096	**
Major-job relatedness (Reference: Not related)						
Closely related	0.169	1.184	***	0.070	1.072	
Somewhat related	0.153	1.166	***	0.110	1.117	**
Graduate Degrees (Reference: No additional degree)						
Lower than Master's degree	0.049	1.050		0.164	1.178	**
Master's degree	0.109	1.115	***	0.161	1.174	***
Doctoral degree	0.061	1.063		0.258	1.294	***
Work-related Experiences						
Hours Worked per Week	0.009	1.009	***	0.005	1.005	**
Employer Type (Reference: For-profit employer)						
Non-profit	-0.199	0.819	***	-0.090	0.914	**
Military	0.023	1.023		0.155	1.167	
Other	-0.149	0.861	*	-0.099	0.905	
Job-sector (Reference: Non-STEM job)						
STEM job	0.100	1.105	**	0.166	1.181	***
STEM-related job	0.080	1.083	*	0.156	1.169	***
Job Offers Benefits	0.320	1.377	***	0.348	1.416	***
Job Offers Bonus	0.132	1.141	***	0.159	1.172	***
Salary Important in Choosing Job	0.153	1.166	**	0.253	1.288	***
Adjusted R^2	0.279			0.306		

Note: * p <.05; ** p < .01; *** p < .001

Explanation of the Gender Wage Gap Among STEM Graduates

The same set of independent variables used to predict the 2012 salary were again employed to perform the regression-based decomposition analysis (Oaxaca-Blinder decomposition). This technique takes the difference in predicted wages of men and women and identifies the portions of the gender wage gap that can be explained by gender differences in observable characteristics (the mean levels of independent variables) and salience of these characteristics. The former is often called the explained component of the gender wage gap. The latter includes the portion explained by gender differences in the salience of the characteristics (coefficients of the independent variables) along with the error terms (bias due to omitted variables in the model). Also labeled as "discrimination" (e.g. Neumark, 1988; Oaxaca & Ransom, 1994), this portion of the wage gap is often called the unexplained component or the unexplained gap.

Before delving into the results from the Oaxaca-Blinder decomposition analysis, I would like to remind the reader of the issue of reference coefficient (or base coefficient) associated with this technique. As mentioned in Chapter Three, the decomposition results vary depending on which group's regression coefficients are used as reference. To avoid such ambiguity, researchers recommend using the coefficients from pooled regression that includes the group indicator in the model (Jann, 2008; Elder, Goddeeris & Haider, 2010). Following this advice, I performed and now report the decomposition results based on pooled regression results with the group indicator (female) in the pooled regression model.

The Oaxaca-Blinder decomposition results (Table 4.6) indicate the counter-factual difference in log-transformed annual salary between female and male STEM graduates to be .1856 ($p<.001$), which translates to approximately 20% in wage difference. Based on the decomposition result (based on the pooled regression), the explained portion was .152 or 81.9% of the total gender wage gap while the unexplained gap was .0336 or 18.1% of the total wage gap. The unexplained gap of .0336 was not statistically significant. In other words, most (81.9%) of the gender wage gap among these recent college graduates with STEM degrees could be explained by the gender differences in observable characteristics. The variable of primary interest in this study, proportion of women in the major, did not appear significant in the decomposition analysis.

Most of the 81.9% were related to gender differences in experiences related to education and employment. The detailed decomposition results (Table 4.7) show that education-related experiences explained 46.8% and occupation-related experiences explained 30.4% of the gender wage gap among STEM graduates. Only 4.7% of the wage gap was attributable to gender differences in background characteristics.

Of the education-related variables, gender differences in college major, major-job relatedness, and graduate education accounted for 50.8%, 2.9%, and -12.6% of the wage gap, respectively. (These numbers are sum of the coefficients of the variables that make up the information for college major, major-job relatedness and graduate education.) The negative number in decomposition means the amount of gap that would have (additionally) appeared, had there was no gender difference in that variable. Therefore, the -12.6% associated with graduate education means that 12.6% of the gender wage gap has been narrowed because women were more likely than men to obtain the master's and doctoral degrees.

Quite understandably, the occupation-related experiences explained a significant portion of the gender wage gap as well. The employer type explained 15.4% of the gender wage gap, which is the largest portion explained by occupation-related variables in the model. Although relatively small in size, the job's industry also deserves attention when understanding the gender wage gap. As the disaggregated detailed decomposition shows in Appendix D, 3.5% of the wage gap can be attributed to the fact that women are less likely than men to have a STEM job. Since secondary school STEM teaching is not considered as a STEM job in the present study, however, this finding may partly be explained by the fact that female STEM graduates were more likely to be PK-12 teachers than their male counterparts.

As mentioned above, most of the gender wage gap in 2012 among the STEM graduates could be attributed to gender differences in observable characteristics, and the overall differences in coefficients or salience of those characteristics do not appear statistically significant. The detailed decomposition results are consistent with that story line, revealing only a few variables to be statistically significant in the unexplained portion. Before delving into reporting results for the unexplained portion, it should be noted that interpretation of the detailed decomposition results for the unexplained must be conducted with caution. According to Jann (2008), the interpretation of detailed decomposition for the unexplained part is only meaningful "for variables for which scale shifts are not allowed, that is, for variables that have a natural zero point" (Jann, 2008, p. 461). Among the variables that appeared to be statistically significant in contributing to the unexplained portion of the gender wage gap, only one met the above criterion of having a natural zero point: the parent income level. The gender wage gap explained by the parent income level was -43.9% .

This negative coefficient means the gap that would have been added had the two groups (here, men and women) had the same regression coefficients for that variable. Applied to the case of parent income level here, the gender wage gap would have been larger by 43.9% if parent income played the same role in men and women's salary. As shown in Table 4.5, parent income level is a significant determinant of salary for women but not for men. More specifically, a per unit increase (1 quartile) in parent income for women is associated with a 3.8% wage increase in salary, but there is no relationship between parent income and salary for men. Without such differences in coefficients, the entire gender wage gap would have been greater by 0.081 or 43.9%.

Table 4.6. Decomposition of gender wage gap among STEM graduates in 2012

	2012 (N=2,420)		
Predicted Means	Coefficient		Exp(b)
Men's Wage	10.926	***	55,611.76
Women's Wage	10.741	***	46,191.45
Gender Wage Gap	0.186	***	1.20
Decomposition	Coefficient		% of Gap
Explained	0.152	***	81.9%
Unexplained	0.034		18.1%
Total	0.186		100.0%

Note: *** denotes statistical significance at p <.001

Table 4-7. Detailed decomposition of gender wage gap among STEM graduates in 2012 (N=2,420)

	Explained		Unexplained	
Variables	Coefficient	% of gap	Coefficient	% of gap
Background Characteristics				
Race				
White	0.000	0.0%	0.045	24.4%
Black	-0.001	-0.3%	0.001	0.4%
Hispanic	0.000	-0.1%	0.000	0.1%
Asian	0.000	0.2%	-0.001	-0.6%
Other	0.000	-0.1%	-0.002	-1.0%
Number of Dependent Children	**0.008**	**4.3%**	0.005	2.5%
Married	0.002	0.9%	-0.011	-6.0%
Parent Income Level	-0.002	-0.9%	**-0.081**	**-43.9%**
US Citizen	0.001	0.7%	-0.169	-91.2%
Urbanicity of Residence 07-08	0.000	0.1%	-0.017	-9.4%
Education-related Experiences				
Proportion of Women in Major	0.013	7.2%	0.025	13.3%
College Major				
Biological Sciences	**0.033**	**17.7%**	-0.020	-10.8%
Physical Sciences	**0.004**	**2.0%**	-0.007	-3.6%
Math/Statistics	-0.001	-0.3%	-0.005	-2.7%
Computer Science	**0.015**	**8.3%**	-0.007	-3.6%
Engineering	**0.040**	**21.5%**	-0.004	-1.9%
Technology/Technician	0.000	0.2%	0.006	3.2%
Other STEM	0.003	1.5%	**0.011**	**5.8%**
College GPA	-0.002	-1.2%	0.211	113.9%

Institutional Selectivity	0.000	-0.2%	-0.008	-4.3%
Major-Job Relatedness				
Not Related	**0.003**	**1.9%**	-0.006	-3.4%
Closely Related	**0.005**	**2.7%**	0.025	13.3%
Somewhat Related	**-0.003**	**-1.7%**	-0.002	-1.1%
Graduate Education				
No additional beyond bachelor's	**-0.017**	**-9.2%**	**0.058**	**31.5%**
Lower than Master's	0.000	-0.2%	-0.002	-0.8%
Master's	-0.001	-0.8%	0.007	3.9%
Doctoral	-0.005	-2.4%	-0.009	-4.9%
Occupation-related Experiences				
Hours Worked per Week	0.004	2.4%	0.170	91.6%
Employer Type				
For-profit	**0.009**	**4.7%**	0.043	23.0%
Non-profit	**0.014**	**7.7%**	-0.011	-6.0%
Military	**0.003**	**1.8%**	-0.001	-0.6%
Other	0.002	1.2%	0.002	0.9%
Industry: STEM				
No STEM job	-0.002	-1.0%	0.024	13.0%
STEM-related job	-0.007	-3.5%	-0.006	-3.3%
STEM job	**0.007**	**3.5%**	-0.004	-2.0%
Job offers benefit	0.003	1.5%	-0.026	-14.0%
Job offers bonus	0.020	10.6%	-0.012	-6.3%
Salary important in choosing job	0.003	1.5%	-0.092	-49.6%
Constant			-0.096	-51.5%
Total	**0.152**	**81.9%**	0.034	18.1%

Note: Bold denotes statistical significance (p>0.05).

Comparison of Decomposition Results: First vs. Fourth Year since Graduation

Thus far the decomposition results for 2012 showed that the vast majority of gender differences in salary are explained by mean-level differences in the educational and employment experiences of women and men. Now, by comparing the decomposition of salary in 2012 with the one for 2009, I attempt to document how the wage gap and the explanations of the gap evolve over time. For fair comparison between 2012 and 2009, I limited the analyses to the respondents who reported to have full-time jobs in both 2009 and 2012. In addition, because some variables were available for only one of the years, the regression model used for this set of analyses appear slightly different from the model used to answer research question 3 above. The resulting decomposition model for the 2009-2012 comparison (research question 4) does not include the following variables: graduate degrees, whether the job offers a bonus, and the importance of salary in choosing a job.

As shown in Table 4.8, the gender wage gap among STEM graduates (who were working full-time in 2009 and in 2012) slightly decreased from .234 to .215 log points or approximately 26 % to 24% of women's projected mean salary in given year. Turning to the decomposition of the wage gap, the unexplained portion of the gender wage gap also decreased from 2009 to 2012, accounting for 17.3% and 13.9% of the gender wage gap in the given year. This means that the portion explained by the gender differences in salience or coefficients has decreased while the gap that could be explained with gender differences in the observable characteristics became larger over the course of three years. The detailed decomposition results for this group of sample for 2009 and 2012 (Table 4.9) show that most of increase in the explained portion appears to come from the increase in the role of education-related experiences (from 42.8% to 57.6%). In particular, it appears to be the increase in the portion of the gap explained by college major (for full detail on the decomposition comparison, see Appendix E). Since there is no change in the (mean levels for) choice of college major between the two years, the increase in the decomposition coefficient must have come from the increase in the regression coefficient for college majors between 2009 and 2012, which can be confirmed in the pooled regression results for the two years (see Appendix F).

Consequently, the size of the unexplained portion of the gender wage gap decreased from 2009 to 2012, and the unexplained gaps are not statistically significant in 2009 and in 2012. However, the detailed decomposition results of the unexplained portion reveal an interesting finding about the parent income level. In 2009, the gender difference in the salience of parent income level was not significant in explaining the wage gap, but in 2012, it explained about -57.5% of the gender wage gap (see Appendix E). In other words, there would have been 57.5% of additional wage gap in 2012 had the parent income level worked in the same way for men and women. It is interesting that the parent income level becomes significant in explaining the gender wage gap in the fourth year after graduation when it did not do so in the first year. Chapter five will further probe the salience of parent income level on women's salary and its role in explaining the gender wage gap.

Table 4-8. Decomposition of gender wage gap among STEM graduates, 2009 & 2012

	2009 (N=1,590)			2012 (N=1,480)		
Predicted Means	Coefficient		Exp(b)	Coefficient		Exp(b)
Men's Wage	10.714	***	44,983.00	10.987	***	59,114.41
Women's Wage	10.480	***	35,593.20	10.773	***	47,693.48
Gender Wage Gap	0.234	***	1.26	0.215	***	1.24
Decomposition	Coefficient		% of Gap	Coefficient		% of Gap
Explained	0.194	***	82.7%	0.185	***	86.1%
Unexplained	0.041		17.3%	0.030		13.9%
Total	0.234		100.0%	0.215		100.0%

Note: *** denotes statistical significance at $p < 0.001$

Table 4-9. Detailed decomposition result for 2009 & 2012, aggregated

	2009 (N=1,590)		2012 (N=1,480)	
Decomposition	Coefficient	% of Gap	Coefficient	% of Gap
Explained				
Background Characteristics		4.3%		4.0%
Education-related Experiences		42.8%		57.6%
Occupation-related Experiences		35.6%		24.4%
Explained Total	0.194	82.7%	0.185	86.1%
Unexplained				
Background Characteristics		-56.0%		-41.1%
Education-related Experiences		3.2%		23.8%
Occupation-related Experiences		36.8%		-26.9%
Constant	0.078	33.3%	0.125	58.2%
Unexplained Total[a]	0.041	17.3%	0.030	13.9%

Note: Statistical significance for each of the human capital area is not indicated.
[a] The unexplained gaps are not statistically significant (p=0.088 in 2009; p=0.204 in 2012).

Summary

Overall, the results demonstrate that female STEM graduates are less likely to secure a full-time job and stay in STEM occupations, and report lower average salaries than their male counterparts. Of many determinants of salary, variables that mattered for both women and men include race, college major, relatedness of job and college major, employer type, and job industry. Interestingly, a few determinants were associated with the salary of only one gender: Parents' income level was a positive predictor of salary only for women, while for men salary was positively predicted by the number of dependent children and negatively predicted by having US citizenship.

The decomposition analyses on salary of STEM graduates in 2012 revealed that the bulk of the gender wage gap could be explained by gender differences in observable characteristics. For example, the fact that men and women differ in the choice of college major and employer type explained a significant portion of the gender wage gap. On the other hand, gender difference in the salience of parent income on salary also (negatively) explained a significant portion of the gender wage gap. This means that the gender wage gap would have been greater than currently predicted if it weren't for the fact that parent income is positively related with salary for women but not so for men.

The comparison of decomposition analyses for 2009 and 2012 salary shows that the gender wage gap slightly decreased. The gender gap can mostly be explained by gender difference in observable characteristics (the explained gap) in both 2009 and 2012, and the size of the explained gap slightly increased from being 82.7% to 86.1%. On the other hand, the gap explained by gender difference in the salience of characteristics (sometimes called discrimination) appears to have decreased (from 17.3% to 13.9%). Since the unexplained gap is not statistically significant, however, it appears rather insufficient to conclude that the unexplained gap has decreased between the two years.

CHAPTER 5: DISCUSSION AND CONCLUSION

This final chapter presents a brief overview of the study's objectives and the four research questions, summarizes the theoretical frameworks that guided the design of the study, and reviews the methodological analyses used. Then, it discusses the study's findings in relation to the existing research and offers implications for educators and policy makers. Finally, the chapter concludes with a review of this study's limitations and suggestions for future research.

Overview of the Study

Science- and technology-based industries are big employers that offer lucrative wages and are searching for a more diverse pool of employees (Muro, Rothwell, Andes, Fikri, & Kulkarni, 2015). However, like in other industries, a pay gap exists between male and female employees in STEM industries (Carnevale, Smith & Melton, 2011). For example, in the Silicon Valley region[2], where the majority of residents are employed in the health and technology industries, the median salary of men with a bachelor's degree was approximately $90,000 while that of women with the same degree was approximately $56,000 (Silicon Valley Institute for Regional Studies, 2015). Such observations are likely to discourage many young women interested in the STEM field careers.

This gender wage gap among STEM workers then poses an important question to scholars in higher education: how does the pay gap appear among college-educated workers who studied a STEM discipline? Since many STEM occupations require college education in a related STEM field (Graham & Smith, 2005), the majority of STEM workers have at least a bachelor's degree in a STEM discipline. The gender wage gap in STEM, therefore, is relevant to the college students studying a STEM major. And also (if not more) relevant and intriguing to

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[2] The geographical boundaries of Silicon Valley include all cities in the Santa Clara County and San Mateo County.

higher education scholars is the question of how the pay gap would appear between women and men who studied STEM majors. However, few higher education researchers have empirically examined the gender wage inequality exclusive to STEM-trained college graduates.

This study examined the gender wage gap that is specific to STEM college graduates, a talent pool America is eagerly seeking to foster and produce. More specifically, this study examined how individuals' background characteristics, education-related experiences and occupation-related experiences significantly predicted salaries of men and women with STEM degrees. In addition, the study assessed the degree to which these predictors of salary also served to explain why women earn less than men in STEM fields. To do so, this study addressed the following four research questions:

1) How do women and men differ in their labor market outcomes (i.e. employment status, employment industry, and wages)? Do the gender differences vary by major within STEM?
2) What are the determinants of income for women and men? To what extent are they similar or different between men and women? How much does the representation of women in the field (in the individual's college major) influence earnings?
3) How do the determinants of income explain the gender wage gap among STEM graduates?
4) How has the size of the gender wage gap (and the predictors of this gap) changed from the beginning of STEM graduates' career to the point of current analysis (the fourth year from graduation)?

The design of this study was guided by human capital theory supplemented by two sociological lenses (i.e., occupational segregation and devaluation of women's work). Like many studies on earnings and pay gap between groups, this study's design was mainly based on human capital theory, in which wages are modeled as a function of family background, education, and work experiences (Becker, 2008). In addition, this study also acknowledged the forces exerted by occupational segregation (e.g., Morgan, 1998; Cohen & Huffman, 2003; Reskin & Bielby, 2005; Bobbitt-Zeher, 2007) and devaluation of women's work (e.g., Alksnis, Desmariais, & Curtis, 2008; Booras & Rogers, 2003; Bundig, 2002; Cohen & Huffman, 2003; Jacobs & Blair-Loy, 1996).

The study utilized data from two sources, both from national surveys administered by the National Center for Education Statistics (NCES): (1) 2008-12 Baccalaureate and Beyond Longitudinal Study (B&B:08/12) and (2) the degree completion data from the Integrated Postsecondary Data System (IPEDS). B&B:08/12 was administered to students who completed requirements for a bachelor's degree in 2007- 08 academic year and followed them up with a second survey in 2012. Information on respondents' education and work experiences from B&B:08/12 was supplemented by degree completion data from IPEDS which were used to calculate the proportion of women in each disaggregated STEM major. The sample was limited to approximately 1,500 male and 920 female graduates with bachelor's degrees in STEM disciplines with full-time employments in 2012. Thus, the STEM trained workers included in this study were in their early career (at most in their fourth year of post-college employment).

For this study, three sets of quantitative analysis were conducted. First, descriptive statistics were used to examine gender differences in employment patterns and mean salary levels of these young college graduates. Additionally, the analysis examined whether the gender differences in these labor market outcomes varied by major within STEM. The results of these descriptive statistics informed the first research question.

For the second research question, multivariate regression analysis identified significant determinants of salary for women and men. The ordinary least square regression model assessed the relationships between the independent variables and STEM graduates' salary separately by gender. The results enabled the comparison of determinants of salary between men and women.

For the third research question, the Oaxaca-Blinder decomposition analysis examined how the determinants of income explained the gender wage gap between male and female STEM graduates who were full-time employees in 2012. Then, to answer the fourth research question, another set of decomposition analyses were conducted to examine how the gender wage gap and its determinants evolved from 2009 to 2012. For this set of analysis, the sample was limited to the graduates who had full-time employment in both 2009 and 2012, which decreased the sample size to 1,610.

Discussion of the Findings

The analyses in chapter 4 described gender differences in the three labor market outcomes (i.e., employment intensity, industry of employment, and salary), identified significant determinants of salary, and examined how these determinants explained the gender wage gap among STEM graduates. The following section discusses the findings from the previous chapter in relation to the extant research on the gender wage gap. Consistent with chapter 4, this section is organized by each of the four research questions.

Gender Differences in Labor Market Outcomes

Research Question 1. How do women and men differ in their labor market outcomes (i.e. wages, employment sector, employment status, etc.)? Do the gender differences vary by major within STEM?

I hypothesized that, compared to men, women would be more likely to hold part-time positions and less likely to be employed in STEM occupations. The t-test results by gender support these hypotheses. In comparison to men, women were more likely to have part-time jobs and less likely to have full-time jobs. These findings are in line with prior research regarding the general population of employees; the proportion of part-time workers is higher among women than men, and the proportion of STEM workers is higher among men than women (Bureau of Labor Statistics, 2014; Graham & Smith, 2005). This study confirms that such gender differences also extend to the subset of STEM-educated employees. However, it is perplexing that even women with STEM degrees are less likely than their male counterparts to be employed within STEM occupations after graduation.

Next, I expected to find women's average wage to be lower than that of men's, and the t-test result of salary by gender supported this hypothesis. This is consistent with the extant research that finds women's median salary to be lower than that of men among STEM workers (Carnevale, Smith & Melton, 2011). This study demonstrates that this same pattern of the gender wage gap also applies to men and women with STEM degrees.

Lastly, I hypothesized that the degree of the gender gap in the full-time employment, STEM employment and average salary levels would vary by major. Such is also supported by the comparison of the t-test results in full-time employment and STEM employment for each STEM major along with the two-way ANOVA result on salary by gender and major. Again, this finding parallels the findings of prior research on the gender wage gap among college graduates, which finds the gender differences in average salary and STEM employment to vary by major (AAUW, 2012; Graham & Smith, 2005). However, this study offers the evidence that gender differences in labor market outcomes vary by subfield within STEM

Research Question 2. What are the determinants of income for women and men? To what extent are they similar or different between men and women? How much does the representation of women in the field (in the individual's college major) influence earnings?

Since the graduates in my sample are a subset of population of college-educated workers, I expected the human capital characteristics that explained the earnings of college graduates to be also applicable to STEM graduates. I also hypothesized that a few determinants of income would appear significant only for women or only for men. The multivariate regression results supported these hypotheses; all education- and occupation-related variables appeared significant in predicting salaries for both men and women. In addition, some of the background characteristics (e.g., number of dependent children, parent income level) were significant for only gender.

The study's results were mostly consistent with the extant research, but some added new layers to the findings established by past research. For example, this study identified a positive relationship between the number of children and salary among men. This finding is consistent with research that finds labor market advantages for fathers (e.g., Correll, Benard & Paik, 2007; Budig, 2014). Budig (2014) demonstrates that fathers out-earn childless men when controlling for selection bias and other external changes such as wife's decreased work hours due to childbirth. Correll, Benard & Paik (2007) found that fathers were more likely to receive call-backs and higher wage offers than childless men with comparable résumé. Perhaps fatherhood signals a worker's "greater maturity, commitment, or stability" to potential employers (Budig, 2014).

On the other hand, women's salaries showed no association with the number of children. This finding challenges the existing literature which observed the wage penalty for mothers (e.g., Budig, 2014; Budig & England, 2001). According to Budig (2014), the motherhood wage penalty is larger among low-wage workers but not applicable for top 10% of female workers. Thus, perhaps this study did not observe a wage penalty for mothers due to the fact that female STEM graduates tend to be higher wage-earners than women working in other fields. Or, it could be that the timing of this study was too early for the wage penalty for mothers to have set in. The sample of women in this study was younger than the samples in Budig's study and only 18.5% of the female graduates in the sample reported to have one or more children.

Among the education-related variables, I expected that the proportion of women in the graduate's college major would be negatively associated with wage for both women and men. This hypothesis was not supported by the regression results, which may seem to challenge the notion of devaluation (of feminine work). In the present study, however, the proportion of women in the major was strongly related to salary until college major is controlled. The fact that college major was still a significant determinant of salary net of gender dominance in the major suggests that there is more about college major that (directly and/or indirectly) impacts salary than just the underrepresentation of women in more lucrative majors.

Research Question 3a. How much of the wage gap is due to gender differences in the characteristics of STEM graduates and how much of it is attributable to the gender differences in the salience of the determinants of income?

Regarding this question, I hypothesized that gender differences in the observable (human capital) characteristics would explain more than half of the entire gender wage gap; this was supported by the Oaxaca-Blinder decomposition results of this study. This is also consistent with prior work on the gender wage gap among college-educated workers (e.g., Bobbitt-Zeher, 2007; Graham & Smith, 2005), but confirms the validity of such finding for the subpopulation of STEM graduates.

Research Question 3b. Which variables make significant contributions to the gender wage gap among STEM graduates? In particular, how much does the representation of women in the college major contribute to the gender wage gap in STEM?

I expected the gender composition in a given major to explain a sizeable portion of the gender wage gap among STEM graduates. However, the decomposition analysis results showed that this variable did not explain the gender wage gap among these STEM graduates. This finding counters the findings of Bobbitt-Zeher (2007) and observations made by other researchers (e.g., NCES, 1998; Joy, 2000). Of note, Bobbitt-Zeher (2007) was slightly different from present study as it did not account for the differences associated with the specific choice of college major. It appears that college major had stronger explanatory power than the gender-dominance of major in relation to the gender wage gap.

Next, I hypothesized that the occupation-related variables such as length of work hours and employment in the STEM industry would explain a large portion of the gender wage gap. However, the decomposition results demonstrated that the education-related variables (i.e., college major, major-job relatedness, and graduate education) explained a greater portion of the gap than the occupation-related variables. This finding seems to challenge previous literature suggesting the greater role of occupation-related experiences in explaining the gender wage gap (e.g., Bobbitt-Zeher, 2007; Graham & Smith, 2005). However, the findings from this study may appear different from those of prior research because this study captured salary information of workers of the same age group, which practically controlled for the length of work experience. This study therefore suggests that college major explains most of gender wage gap among workers in the same cohort.

Research Question 4a. Has the size of the gender wage gap increased or decreased between the first year and the fourth year after graduation?

Research on the gender wage gap established that the wage gap between men and women widens over time regardless of education level and occupational fields (e.g., AAUW, 2007;

Carnevale, Smith & Melton, 2011). Therefore, the size of the gender wage gap was hypothesized to have increased from the first year to the fourth year post graduation. However, the decomposition results did not support this hypothesis. The gender wage difference in the absolute dollar amount has increased, but proportionally, the gender wage gap slightly decreased between 2009 and 2012. While this finding challenges prior research, it should be noted that the timing of this study may have been too early in people's careers to accurately capture the gender wage gap trend. In later years, the gender wage gap among STEM graduates may grow larger, something that future research will need to consider.

It should be noted that the subjects in this study were among the cohort of college graduates whose post-college employment situations corresponded with the economic recession that started in 2007. However, STEM industries suffered less than non-STEM industries from the latest recession; the unemployment rate for STEM workers with bachelor's degree or above was less than 2% in 2008, while that of non-STEM counterparts was approximately 2.5%. (Langdon, McKittrick, Beede, Kahn & Doms, 2012). In addition, healthcare and education sectors (sectors in which female STEM majors were most likely to work in 2009 and 2012) were also hit less severely by the latest recession (Sahin, Song & Hobjin, 2010). In sum, the recession may not have impacted the employment situations of STEM men and women in 2009 to make it greatly vary from their employment situations in 2012.

Rsearch Question 4b. In comparison to the first year after graduation, has the portion of the gender wage gap that cannot be explained by gender differences in observed characteristics (i.e., the "unexplained portion" of the gap) increased or decreased?

Research suggests that the unexplained portion of the gender wage gap would rise with time (e.g., AAUW, 2007; Bobbitt-Zeher, 2007; Loury, 1997) due to the roles of several job- and life-related experiences that impact women's wages differentially from men's, such as family-rearing (Loury, 1997) and promotional rates (Blau & DeVaro, 2006). Thus, I hypothesized that the unexplained portion of the gender gap would increase from 2009 to 2012. However, the decomposition results in this study did not support the hypothesis. Again, this may be due to this study's focus on STEM graduates very early in their careers.

Summary

Based on above findings, several conclusions about the gender wage gap among STEM graduates can be inferred. First, on average, female graduates appeared to lag behind their male counterparts on several measures of labor market outcomes including salaries, even among STEM graduates. This is a pool of individuals who acquired the knowledge in some of the most desired fields in the American labor market (Rothwell, 2014). Thus, findings suggest that women may still face wage disadvantages (in comparison to men) even when they do select to study and receive a degree in a STEM field.

Second, some salary determinants impact salaries of men and women in different ways for young college-educated workers with STEM degrees. These were mostly background characteristics such as having more children and parents' income levels. Specifically, having more children meant higher salaries for men (earning 3.3% more per additional child) but not for women. On the other hand, parents' income level was positively related to salary among women (3.8% increase in salary per one quartile increase in parents' income), but it had no significant relationship to salary among men. These findings suggest that the personal background or situation of workers may differently impact the value of labor for men and women.

The education-related experiences (i.e., college major, the extent to which college major and job were related, and the level of graduate degree earned) explained the majority of the gender wage gap among these STEM graduates. Of these variables, the gender difference in college major (i.e., gendered segregation in college major) alone explained nearly half of the observed wage gap. Specifically, it appears that the high concentration of women in the biological sciences major (relative to the high concentration of men in engineering and computer sciences majors) explained why women's average salary was lower than men's.

Lastly, this study did not observe an increase in the gender wage gap between the first and fourth year after college graduation. The extant literature suggests, however, that the gap may increase as more of these students start building families and go through promotions at work. Given the timing of this study (during at most the fourth year of employment), this finding warrants another examination in a few more years.

Implications

Based on the study's findings, de-segregating STEM majors (i.e., reducing gender differences in college major choice) appears to be the most straightforward yet difficult solution to achieving pay equality between men and women with STEM degrees (Rose, 2010). For the de-segregation across STEM majors to happen, we need to create an environment that can encourage young women to pursue traditionally male-dominated STEM fields such as computer sciences and engineering. In fact, this message has been prevalent in outreach efforts in STEM fields for many years (e.g., code.org, MentorNet), but women are still severely underrepresented among first-year college students intending to major in the computer sciences and engineering (Sax et al., 2015a; Sax et al., 2015b) and among bachelor's degree recipients from those majors (NCES, 2014).

Nevertheless, de-segregating STEM majors alone would not be enough to help female STEM graduates reach pay equity with their male peers. First, women earn less than men whether they are working in STEM or non-STEM occupations (AAUW, 2016; Carnevale, Smith & Melton, 2011). Thus, even if we reach gender equity in the receipt of bachelor's degrees in presently male-dominated STEM fields, history tells us that women would likely not receive the same salaries as men. Secondly, this study found that roughly 18% of the gender pay gap is "unexplained" based on variables used in this study (i.e., a discrimination effect). As such, the findings of this study support the notion that achieving pay equity in STEM is not just a function of students' individual college major choices, but also a result of society and policy.

Thus, the findings of this study suggest several implications for how families, educators, and policy makers can help the next generation of workers to move a step closer towards gender pay equality. The first section below discusses the implications for families and educators in their interactions with young women, while the second section describes how this study can inform the work of policy makers.

Implications for Families and Educators

Although de-segregating STEM majors alone would not eliminate the gender pay gap among STEM graduates, it certainly is one way to approach the issue of the gender wage gap. Most female STEM graduates in the sample were biological sciences majors, the field of study associated with lower salaries than most other STEM majors. Had some of these biological science majors studied computer science or engineering, the gender wage gap would have been smaller. On that note, there are some implications for parents and teachers of young female students.

Parents and K-12 educators play important roles in shaping the interests and motivations of young students (Kanny, Sax, & Riggers-Piehl, 2014), and there are several ways they can help girls to be interested or stay engaged in the STEM fields. First, parents and adults in the family can spark their daughters' interest in computing and other technology fields around the home by creating and fostering an environment that makes the topic of science and engineering readily accessible (NCWIT, n.d.). This includes encouraging girls to take opportunities to have hands-on experience to create technology (e.g., making mobile applications or games) and discussing future career options in a STEM field.

K-12 educators can help girls become and stay interested in the STEM fields in school as well. The National Center for Women & Information Technology (NCWIT) suggests that K-12 educators can encourage girls to be engaged in STEM subjects by assuming all students (including women and minority students) can succeed in the classroom and personalizing the learning experience by linking "knowledge and learning to students' strengths, interests, and prior experiences" (NCWIT, 2015). In addition, high school educators can (rather directly) impact the decision of young female students when advising them on college options and potential fields of study by presenting the college majors and related occupations in a way that does not associate them with a certain gender. These efforts will help young women assess all possible options with equal weight and make more informed decisions about their college major.

Lastly, administrators and faculty in higher education have roles in recruiting more women into male-dominant STEM classrooms. Through re-branding of these majors (i.e., computer science and engineering), they can help women to see the immediate contributions to society that they can make with their STEM degrees (Sax et al., 2015a; Sax et al., 2015b).

Implications for Policy Makers

This study also has important implications for policy, as policy makers may be able to more directly address the gender wage gap issue. Federal and many state governments in the U.S. do have legal protections against discrimination in salary and employment based on gender, but they appear insufficient as they stand (AAUW, 2014). The federal and state governments can shorten the path to the gender pay equity by establishing laws and regulations that ensure that women (and others) do not receive unfair wages (AAUW, 2016). One of such efforts was the executive order signed by President Obama in 2014, which banned employers from retaliating against employees who talk or ask about salaries. However, this mandate is applicable only to federal contractors. By expanding it to all employers, the federal government will provide the legal ground on which all employees can ask for fair treatment for their work. Concurrently, state governments can also help by implementing a set of pay transparency policies. These include requiring employers to list the minimum base salary in the job ads while prohibiting employers from asking about salary history (AAUW, 2016).

Limitations and Directions for Future Research

This study provides new insights to research on pay equity by focusing on the issue of the gender wage gap among STEM graduates, a highly desired talent pool in the American labor market (Rothwell, 2014). However, it is important to acknowledge the limitations of this study that may inform future research on the topic of the gender wage gap.

The current study used one of the most up-to-date postsecondary data that provided information on students who received bachelor's degrees in 2007-08. This study measured the gender wage gap as of 2012, which is only four years after college graduation. Therefore, most of the graduates in this study had at most four years of post-college work experience, and these four years may have not been enough time to illuminate the dynamics of the many variables that contribute to the gender wage gap over the course of one's entire career. However, by focusing on the early years of employment, this study was able to gauge the impact of college major choice on the gender wage gap that emerges immediately following college graduation.

Further, the timing of this study presents a challenge to the effort to provide a complete picture of the gender wage gap among STEM graduates. This study does not include respondents who were enrolled in graduate programs in 2012 and not working full-time. Among those excluded were the many biological science majors pursuing graduate degrees in the healthcare profession. When these students graduate and start working in the healthcare field, the gender wage gap stemming from the differences in college major choice may decrease.

Another limitation of this study lies in the theoretical framework. This study heavily relies on the human capital theory in its foundation, a theory often criticized for its susceptibility of making interpretations that place blame on disadvantaged (or discriminated) groups when explaining inequalities (Reskin and Bielby, 2005; Lips, 2013). The human capital theory assumes that all inputs and outputs (independent and dependent variables) are gender-neutral (Lips, 2013), but in reality few human characteristics and choices are truly gender-neutral because gender "profoundly influences personal choices, social interactions, and institutions" (Alksnis, Desmariais, & Curtis, 2008, p.1418). Therefore, this study's finding about the role of college major in the gender wage gap should not be interpreted as a message that blames women for not choosing to study engineering or computer science, for example. Instead, the findings of this study inform researchers of the variables with notable gender differences that have significant implications for the gender wage gap.

In addition to the variables used in this study, greater detail on employees' occupations would also benefit future analysis of the gender wage gap. While this study accounted for the industry of occupations, it did not control for graduates' individual occupations. Research on the gender wage gap shows that occupations and occupational segregation play a major role in the wage gap between men and women (Blau & Kahn, 2006, 2007; England, Farkas, Kilbourne &

Dou, 1998; IWPR, September 2010; Kunze, 2005; Shauman, 2006). However, for this study, it was deemed inefficient to include more than thirty occupational categories in the regression models.

Nevertheless, to explore this in a bit more detail, I utilized a supplementary analysis of gender wage differences in individual (more detailed) occupational categories. The mean salaries of men and women in each of the 33 occupational categories were compared via t-test and the results revealed that the salaries of men and women were significantly different in two of the 33 occupational groups: business managers (mean difference=$17,916; p=.0112) and computer/information systems occupations (mean difference=$7,161.05; p=.0486). Using more disaggregated information on employees' occupation and job titles, future research will contribute to a more solid understanding of how each human capital variable explains the gender wage gap.

Conclusion

Prior research on the gender wage gap identified many factors that contribute to the wage gap between men and women. Among them, studies that looked at salaries of college-educated workers found that college major and the proportion of women in the major explain a significant portion of the gender wage gap among this group of individuals. However, few studies have focused exclusively on the STEM talent pool: workers with STEM degrees from college.

This study contributes to the research on the gender wage gap among workers with college degrees and adds to the understanding of salary as an outcome of college education. More specifically, this study informs the literature on the human capital factors that differently impact salaries of men and women and how these factors explain the current gender wage gap among workers with bachelor's degrees in a STEM discipline. Future research should explore the pay gap at more disaggregated occupational levels.

In summary, this study also provides a counterargument to the "gender wage gap is a myth" argument (e.g., Perry & Biggs, 2014), which claims that the pay gap no longer exists between men and women once the differences in human capital factors such as education, marital status, and occupation are taken into consideration. Indeed, this study found gender differences in some human capital variables (e.g., number of dependent children, college major, and employer type, etc.) to have explained most of the gender wage gap among STEM graduates, but approximately 18% of the wage gap could not be explained. Moreover, through a supplementary analysis of occupations, this study suggests that men and women with similar academic degrees and jobs may not be receiving the same level of compensation in some occupations (i.e., business managers and computer/information system occupations). Thus, there appears to be an additional barrier faced by women even after they break into more lucrative and traditionally male-dominated fields of study and occupations.

APPENDICES

Appendix A: Summary Statistics of All Variables, 2009

	Male					Female				
Variable	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
DV										
Annualized Salary	1,540	46471.49	18994.61	1074	234000	840	36081.44	15784.67	45	156000
Log transformed salary	1,540	10.65	0.47	6.98	12.36	840	10.39	0.51	3.81	11.96
IV										
Primary interest variable										
Proportion of women in major	1,540	27.99	17.59	5.2	83.7	840	44.14	18.32	5.2	85.4
Background Characteristics										
Race:										
White	1,540	0.74	0.44	0	1	840	0.68	0.46	0	1
Black	1,540	0.05	0.21	0	1	840	0.10	0.30	0	1
Hispanic	1,540	0.08	0.27	0	1	840	0.10	0.30	0	1
Asian	1,540	0.10	0.29	0	1	840	0.09	0.28	0	1
Other	1,540	0.04	0.19	0	1	840	0.03	0.18	0	1
Parent income level	1,540	2.12	1.04	1	4	840	2.18	1.02	1	4
Number of dependent children	1,540	0.23	0.66	0	6	840	0.15	0.50	0	4
Married	1,540	0.36	0.48	0	1	840	0.28	0.45	0	1
US Citizen	1,540	0.98	0.15	0	1	840	0.98	0.13	0	1
Educational Experiences										
College Major:										
Biological Sciences	1,540	0.15	0.36	0	1	840	0.44	0.50	0	1
Physical Sciences	1,540	0.08	0.26	0	1	840	0.11	0.32	0	1
Math/Statistics	1,540	0.05	0.22	0	1	840	0.09	0.29	0	1
Computer Science	1,540	0.21	0.41	0	1	840	0.11	0.31	0	1
Engineering	1,540	0.40	0.49	0	1	840	0.14	0.35	0	1

Technology/Technician	1,540	0.08	0.27	0	1	840	0.05	0.21	0	1
Other STEM	1,540	0.04	0.19	0	1	840	0.07	0.25	0	1
SAT Math score	1,320	598.14	100.74	220	800	740	571.74	101.59	280	800
College GPA	1,540	3.35	0.42	1	4	840	3.41	0.37	2	4
Institution Very Selective	1,520	0.35	0.48	0	1	840	0.34	0.47	0	1
Institution Type:										
Public	1,540	0.62	0.49	0	1	840	0.52	0.50	0	1
Private	1,540	0.32	0.47	0	1	840	0.43	0.50	0	1
For-profit	1,540	0.06	0.24	0	1	840	0.05	0.22	0	1
Attended more than 1 institution	1,540	0.07	0.25	0	1	840	0.12	0.32	0	1
Urbanicity of 2007-08 residence	1,540	7.49	3.49	1	12	840	7.62	3.52	1	12
Urbanicity of bachelor's institution	1,540	9.04	2.85	1	12	840	9.07	2.82	1	12
Job-major relatedness:										
Closely related	1,540	0.60	0.49	0	1	840	0.52	0.50	0	1
Somewhat related	1,540	0.27	0.45	0	1	840	0.30	0.46	0	1
Not related	1,540	0.13	0.33	0	1	840	0.18	0.39	0	1
Work-related experiences										
Hours Worked per week	1,540	43.54	6.36	35	80	840	42.27	5.67	35	75
Employer Type:										
For-profit	1,540	0.70	0.46	0	1	840	0.54	0.50	0	1
Non-profit	1,540	0.21	0.41	0	1	840	0.37	0.48	0	1
Military	1,540	0.05	0.22	0	1	840	0.02	0.15	0	1
Other	1,540	0.04	0.19	0	1	840	0.07	0.25	0	1
Job Industry:										
STEM job	1,540	0.55	0.50	0	1	840	0.29	0.45	0	1
STEM-related job	1,540	0.16	0.36	0	1	840	0.28	0.45	0	1
Not STEM job	1,540	0.29	0.46	0	1	840	0.43	0.50	0	1
Received benefit	1,520	0.93	0.26	0	1	830	0.86	0.35	0	1

Appendix B: Summary Statistics of All Variables, 2012

	Male					Female				
Variable	N	Mean	Std. Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max
DV										
Annualized Salary	1,680	60929.05	30366.36	0	470000	1,010	50548.85	27429.86	0	440000
Log transformed salary										
IV										
Primary Interest Variable										
Proportion of women in major	1,680	29.36	18.34	5.20	85.40	1,010	47.08	17.47	5.20	85.40
Background Characteristics										
Race:										
White	1,680	0.74	0.44	0	1	1,010	0.70	0.46	0	1
Black	1,680	0.04	0.21	0	1	1,010	0.09	0.29	0	1
Hispanic	1,680	0.09	0.28	0	1	1,010	0.08	0.27	0	1
Asian	1,680	0.09	0.29	0	1	1,010	0.09	0.29	0	1
Other	1,680	0.03	0.18	0	1	1,010	0.03	0.18	0	1
Number of dependent children	1,680	0.55	1.00	0	7	1,010	0.27	0.66	0	4
Married	1,680	0.48	0.50	0	1	1,010	0.36	0.48	0	1
Parent income level	1,680	2.11	1.04	1	4	1,010	2.23	1.02	1	4
US citizen	1,680	0.98	0.13	0	1	1,010	0.99	0.08	0	1
Educational Experiences										
College Major:										
Biological Sciences	1,680	0.18	0.39	0	1	1,010	0.49	0.50	0	1
Physical Sciences	1,680	0.08	0.27	0	1	1,010	0.11	0.31	0	1
Math/Statistics	1,680	0.06	0.23	0	1	1,010	0.09	0.28	0	1
Computer Science	1,680	0.20	0.40	0	1	1,010	0.07	0.26	0	1
Engineering	1,680	0.38	0.49	0	1	1,010	0.12	0.33	0	1
Technology/Technician	1,680	0.07	0.25	0	1	1,010	0.04	0.20	0	1
Other STEM	1,680	0.03	0.18	0	1	1,010	0.08	0.27	0	1
SAT Math score	1,460	599.38	96.06	270	800	900	577.18	96.58	200	800
College GPA	1,680	3.37	0.42	1	4	1,010	3.42	0.40	1	4
Institution Very Selective	1,660	0.34	0.47	0	1	1,000	0.34	0.48	0	1

Institution Type:										
Public	1,680	0.64	0.48	0	1	1,010	0.56	0.50	0	1
Private	1,680	0.31	0.46	0	1	1,010	0.40	0.49	0	1
For-profit	1,680	0.05	0.22	0	1	1,010	0.04	0.19	0	1
Attended more than 1 institution	1,680	0.08	0.28	0	1	1,010	0.13	0.33	0	1
Urbanicity of 2007-08 residence	1,680	8.97	2.88	1	12	1,010	9.15	2.75	1	12
Urbanicity of bachelor's institution	1,680	7.52	3.45	1	12	1,010	7.57	3.49	1	12
Job-major relatedness:										
Closely related	1,650	0.54	0.50	0	1	1,000	0.44	0.50	0	1
Somewhat related	1,650	0.34	0.47	0	1	1,000	0.40	0.49	0	1
Not related	1,650	0.12	0.32	0	1	1,000	0.15	0.36	0	1
Graduate Degrees:										
No additional degree	1,680	0.73	0.44	0	1	1,010	0.56	0.50	0	1
Below master's	1,680	0.04	0.19	0	1	1,010	0.09	0.28	0	1
Master's	1,680	0.17	0.37	0	1	1,010	0.22	0.42	0	1
Doctoral	1,680	0.06	0.24	0	1	1,010	0.13	0.34	0	1
Work-related experiences										
Hours Worked per week	1,650	44.57	8.78	2	80	1,000	44.08	10.07	8	80
Employer Type:										
For-profit	1,560	0.68	0.47	0	1	940	0.55	0.50	0	1
Non-profit	1,560	0.23	0.42	0	1	940	0.37	0.48	0	1
Military	1,560	0.05	0.22	0	1	940	0.02	0.14	0	1
Other	1,560	0.04	0.20	0	1	940	0.07	0.25	0	1
Job Industry										
STEM	1,650	0.32	0.47	0	1	1,000	0.17	0.38	0	1
STEM-related	1,650	0.13	0.34	0	1	1,000	0.30	0.46	0	1
Non-STEM	1,650	0.55	0.50	0	1	1,000	0.53	0.50	0	1
Received benefit	1,610	0.94	0.23	0	1	990	0.94	0.24	0	1
Received bonus	1,680	0.48	0.50	0	1	1,010	0.35	0.48	0	1
Salary important in choosing a job	1,680	0.93	0.26	0	1	1,010	0.92	0.28	0	1

Appendix C: ANOVA Results, 2012

Two-way Analysis of Variance of 2012 Salary by Gender and College Major (N=2,650)

Source	Partial SS	df	MS	F	p
Model	93.487	13	7.191	33.090	0.000
female	**4.502**	1	4.502	20.720	0.000
Major_STEM	**51.339**	6	8.557	39.380	0.000
female#Major_STEM	**7.078**	6	1.180	5.430	0.000
Residual	572.156	2630	0.217		
Total	665.643	2650	0.252		

Note: Bold denotes statistical significance ($p<.001$).

Appendix D: Disaggregated Decomposition Results, 2012 (N=2,420)

Mean Predicted Wage_Male	10.926					
Mean Predicted Wage_Female	10.741					
Predicted Gender Wage Gap	0.186					
Decomposition	Explained			Unexplained		
	Coefficient		% of gap	Coefficient		% of gap
Total	0.152	***	81.9%	0.034		18.1%
Detailed Decomposition						
Background Characteristics						
Race						
White	0.000		0.0%	0.045		24.4%
Black	-0.001		-0.3%	0.001		0.4%
Hispanic	0.000		-0.1%	0.000		0.1%
Asian	0.000		0.2%	-0.001		-0.6%
Other	0.000		-0.1%	-0.002		-1.0%
Number of Dependent Children	0.008	**	4.3%	0.005		2.5%
Married	0.002		0.9%	-0.011		-6.0%
Parent Income Level	-0.002		-0.9%	-0.081	*	-43.9%
US Citizen	0.001		0.7%	-0.169		-91.2%
Urbanicity of Residence 07-08	0.000		0.1%	-0.017		-9.4%
Education-related Experiences						
Proportion of Women in Major	0.013		7.2%	0.025		13.3%
College Major						
Biological Sciences	0.033	**	17.7%	-0.020		-10.8%
Physical Sciences	0.004	*	2.0%	-0.007		-3.6%
Math/Statistics	-0.001		-0.3%	-0.005		-2.7%
Computer Science	0.015	***	8.3%	-0.007		-3.6%
Engineering	0.040	***	21.5%	-0.004		-1.9%
Technology/Technician	0.000		0.2%	0.006		3.2%
Other STEM	0.003		1.5%	0.011	*	5.8%
College GPA	-0.002		-1.2%	0.211		113.9%
Institutional Selectivity	0.000		-0.2%	-0.008		-4.3%
Major-Job Relatedness						
Major-Job Not Related	0.003	*	1.9%	-0.006		-3.4%
Major-Job Closely Related	0.005	*	2.7%	0.025		13.3%
Major-Job Somewhat Related	-0.003	*	-1.7%	-0.002		-1.1%
Graduate Education						
No additional beyond bachelor's	-0.017	***	-9.2%	0.058	*	31.5%
Post-baccalaureate	0.000		-0.2%	-0.002		-0.8%
Master's	-0.001		-0.8%	0.007		3.9%
Doctoral	-0.005		-2.4%	-0.009		-4.9%

Occupation-related Experiences					
Hours Worked per Week	0.004		2.4%	0.170	91.6%
Employer Type					
For Profit	0.009	**	4.7%	0.043	23.0%
Non Profit	0.014	***	7.7%	-0.011	-6.0%
Military	0.003	**	1.8%	-0.001	-0.6%
Other	0.002		1.2%	0.002	0.9%
Job Sector: STEM					
Non-STEM	-0.002		-1.0%	0.024	13.0%
STEM-related	-0.007		-3.5%	-0.006	-3.3%
STEM	0.007	**	3.5%	-0.004	-2.0%
Job offers benefit	0.003		1.5%	-0.026	-14.0%
Job offers bonus	0.020	***	10.6%	-0.012	-6.3%
Salary important in choosing job	0.003		1.5%	-0.092	-49.6%
Constant				-0.096	-51.5%
Total	0.152	***	81.9%	0.034	18.1%

Note: * p <.05; ** p < .01; *** p < .001

Appendix E: Comparison of Detailed Decomposition Results, 2009 & 2012

Predicted Means	2009 (N=1,590)			2012 (N=1,480)		
Men's Wage	10.714	***		10.987	***	
Women's Wage	10.480	***		10.773	***	
Gender Wage Gap	0.234	***		0.215	***	
Decomposition	**Coefficient**		**% of Gap**	**Coefficient**		**% of Gap**
Explained	0.194	***	82.7%	0.185	***	86.1%
Unexplained	0.041		17.3%	0.030		13.9%
Total	0.234		100.0%	0.215		100.0%
Explained Portion	**Coefficient**		**% of Gap**	**Coefficient**		**% of Gap**
Background Characteristics						
Race						
White	0.001		0.3%	0.000		0.1%
Black	0.000		0.0%	-0.001		-0.5%
Hispanic	0.000		0.0%	0.000		0.0%
Asian	0.001		0.3%	0.001		0.6%
Other	0.000		-0.2%	0.000		-0.2%
Number of Dependent Children	0.007	**	2.9%	0.008	*	3.6%
Married	0.005	*	2.0%	0.000		0.0%
Parent Income Level	-0.002		-0.7%	-0.002		-0.7%
US Citizen	0.000		0.0%	0.002		0.7%
Urbanicity of Residence 07-08	0.000		-0.2%	0.001		0.5%
Education-related Experineces						
Proportion of Women in Major	-0.002		-0.8%	0.012		5.6%
College Major						
Biological Sciences	0.040	***	17.1%	0.039	***	18.3%
Physical Sciences	0.007	**	3.0%	0.006	*	2.9%
Math/Statistics	-0.002		-0.7%	-0.001		-0.5%
Computer Science	0.009	**	3.9%	0.014	**	6.6%
Engineering	0.038	***	16.3%	0.044	***	20.3%
Technology/Technician	0.001		0.5%	0.000		0.2%
Other STEM	0.001		0.5%	0.002		1.1%
College GPA	-0.005		-2.0%	-0.004		-1.7%
Institutional Selectivity	0.001		0.5%	0.002		1.0%
Major-Job Relatedness						
Not Related	0.005	*	2.3%	0.005		2.3%
Closely Related	0.005	*	2.3%	0.005		2.2%
Somewhat Related	-0.001		-0.2%	-0.001		-0.7%
Occupation-related Experiences						
Hours Worked per Week	**0.010**	**	**4.2%**	0.009		4.3%
Employer Type						
For-profit	0.016	***	6.9%	0.011	**	5.1%

Non-profit	0.009	*	3.8%	0.014	**	6.4%
Military	0.002		0.7%	0.003	*	1.4%
Other	0.003		1.2%	0.003		1.5%
Job Sector: STEM						
No STEM job	0.015	***	6.4%	0.001		0.6%
STEM-related job	-0.001		-0.6%	-0.001		-0.5%
STEM job	0.023	***	9.7%	0.005		2.4%
Job offers benefit	0.008		3.3%	0.007		3.2%
Explained Total	0.194	***	82.7%	0.185	***	86.1%
Unexplained Portion	Coefficient		% of Gap	Coefficient		% of Gap
Race						
White	0.050		21.4%	0.060		27.8%
Black	0.005		2.2%	-0.001		-0.4%
Hispanic	-0.001		-0.4%	0.002		0.7%
Asian	-0.002		-0.7%	-0.001		-0.3%
Other	-0.003		-1.4%	-0.002		-1.1%
Number of Dependent Children	0.003		1.3%	0.003		1.3%
Married	0.007		3.0%	0.001		0.6%
Parent Income Level	-0.051		-21.6%	-0.123	**	-57.5%
US Citizen	-0.161		-68.6%	0.010		4.5%
Urbanicity of Residence 07-08	0.020		8.8%	-0.036		-16.8%
Education-related Experineces						
Proportion of Women in Major	-0.106		-45.4%	0.004		1.8%
College Major						
Biological Sciences	0.005		2.3%	0.003		1.4%
Physical Sciences	0.006		2.4%	-0.002		-1.1%
Math/Statistics	0.002		0.7%	-0.004		-2.0%
Computer Science	-0.007		-3.2%	-0.005		-2.3%
Engineering	-0.022		-9.5%	-0.015		-6.9%
Technology/Technician	-0.001		-0.3%	0.005		2.1%
Other STEM	0.004		1.8%	0.007		3.1%
College GPA	0.120		51.1%	0.043		20.2%
Institutional Selectivity	-0.001		-0.2%	-0.003		-1.2%
Major-Job Relatedness						
Not Related	-0.003		-1.3%	-0.008		-3.6%
Closely Related	0.011		4.6%	0.017		8.0%
Somewhat Related	0.000		0.1%	0.009		4.3%
Occupation-related Experiences						
Hours Worked per Week	0.052		22.1%	-0.178		-83.1%
Employer Type						
For-profit	0.073	*	31.2%	0.057		26.5%
Non-profit	0.000		0.1%	-0.003		-1.4%

Military	0.000	-0.1%	-0.001	-0.6%
Other	-0.003	-1.3%	0.001	0.2%
Job Sector: STEM				
No STEM job	0.002	1.0%	0.028	13.1%
STEM-related job	0.001	0.4%	-0.009	-4.2%
STEM job	-0.004	-1.6%	0.002	0.7%
Job offers benefit	-0.035	-15.0%	0.047	21.9%
_cons	0.078	33.3%	0.125	58.2%
Unexplained Total	0.041	17.3%	0.030	13.9%

Note: * p <.05; ** p < .01; *** p < .001

Appendix F: Pooled Regression Results, 2009 & 2012

Pooled Regression on Log-transformed Salary among STEM Graduates, 2009 & 2012

	2009 (N=1,590)			2012 (N=1,480)		
	Coef.	Exp(b)		Coef.	Exp(b)	
Background Characteristics						
Race (Reference group: White)						
Black	-0.026	0.975		0.014	1.014	
Hispanic	-0.014	0.986		-0.027	0.974	
Asian	0.011	1.011		0.052	1.054	
Other	-0.112	0.894	*	-0.083	0.921	
Number of Dependent Children	0.066	1.068	***	0.025	1.026	*
Married	0.044	1.045	*	-0.001	0.999	
Parent Income Level	0.022	1.022	*	0.017	1.017	
US Citizens	0.010	1.010		-0.198	0.820	*
Urbanicity of Residence 07-08	0.012	1.012	***	0.013	1.013	***
Education-related Experience						
Proportion of Women in Major	0.000	1.000		-0.001	0.999	
College Major (Reference group: Biological Sciences)						
Physical Sciences	0.039	1.040		0.051	1.053	
Math/Statistics	0.191	1.210	***	0.175	1.191	**
Computer Science	0.238	1.268	***	0.270	1.311	***
Engineering	0.300	1.350	***	0.322	1.380	***
Technology/Technician	0.205	1.228	**	0.177	1.194	*
Other STEM	0.127	1.135	**	0.096	1.101	
College GPA	0.114	1.121	***	0.080	1.083	**
Institutional Selectivity	0.093	1.098	***	0.106	1.112	***
Major-job relatedness (Reference group: Not related)						
Closely related	0.172	1.188	***	0.146	1.157	***
Somewhat related	0.126	1.134	***	0.131	1.141	***
Work-related Experiences						
Hours Worked per Week	0.010	1.010	***	0.008	1.008	***
Employer Type (Reference group: For-profit employer)						
Non-profit	-0.167	0.846	***	-0.173	0.841	***
Military	-0.019	0.981		0.031	1.032	
Other	-0.243	0.785	***	-0.153	0.858	*
Job-sector (Reference group: Non-STEM job)						
STEM job	0.166	1.181	***	0.073	1.075	*
STEM-related job	0.100	1.106	***	0.049	1.050	
Job Offers Benefits	0.189	1.208	***	0.437	1.548	***
Female	-0.041	0.960		-0.030	0.971	

Note: * $p <.05$; ** $p < .01$; *** $p < .001$

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