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This doctoral degree was a family project, so I dedicate this study to my wife, Trena, and children, Tiana, Tivana, and Theo. Finally, I am forever grateful to my mother, Jenifer Campbell, who was my first teacher.

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Abstract

CAREER PATHWAYS IN A KNOWLEDGE-BASED ECONOMY: EARNINGS INEQUALITY AMONG SCIENCE AND ENGINEERING DOCTORATE RECIPIENTS

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This dissertation explored the intersectional effects of social factors (i.e., gender, race) and field of study on science and engineering (S&E) doctorate recipients’ labor market outcomes (i.e., career paths and salaries). These social factors represent the participants’ unique gendered and racialized experiences (Collins, 1999; James & Busia, 1993) within the labor market. The objectives of the study were achieved through a) an examination of participants’ employment sector and earning profiles; b) comparative analysis of participants’ career paths defined by the sequence of employment sectors in which workers have jobs between 2003-2010; c) modeling of participants salaries in 2010 when taking into account the intersection of gender and race, field of study, employment sector in 2010, and career path types (i.e., number of changes between employment sectors). The study employed four cycles of the Survey of Doctorate Recipients (2003, 2006, 2008, and 2010) data collected by the National Science Board (NSB, 2014).

The results revealed that differences in participants’ career paths and labor market profiles were largely accounted by social structures and field of study. In addition to these factors, doctorate recipients’ career mobility (i.e., number of employment sectors changed during 2003 and 2010) had an effect on average salaries in 2010. The study findings supported three major areas of debate: inequalities experienced by women in the S&E doctorate workforce, inequalities experienced by URM males in the doctorate S&E workforce, and differences between academic and non-academic employment sectors. This study extends the application of the intersection of gender and race/ethnicity framework to a highly educated population, and provides empirical information that may guide future research, and education policies and practices.
# Table of Contents

Acknowledgements ......................................................................................................................... iii  
Abstract............................................................................................................................................ iv  
List of Illustrations .......................................................................................................................... viii  
List of Tables ................................................................................................................................... ix  
Chapter 1: Introduction ..................................................................................................................... 1  
  Statement of the Problem............................................................................................................. .4  
  Purpose of the Study and Research Objectives .......................................................................... .5  
  Research Questions ..................................................................................................................... .6  
  Significance of the Study .............................................................................................................. .6  
  Overview of the Dissertation Chapters ......................................................................................... .8  
Chapter 2: Review of Literature ........................................................................................................ 9  
  The Importance of a Growing S&E Workforce in the United States ............................................. 9  
  The Knowledge-based Economy and its Impact on Firms and Workers .................................... 11  
    The Concept of KBE ............................................................................................................... 11  
    The Impact of the KBE on Firms and Workers ....................................................................... 12  
  Doctoral Education and Career Success .................................................................................... 13  
    Investment in Doctoral Education ........................................................................................... 13  
    Career Success ...................................................................................................................... 14  
  Employment Opportunities for S&E Doctorate Recipients .......................................................... 16  
    Academic versus Non-Academic Employment Sectors ......................................................... 16  
    Employment Sector and Career Choices .............................................................................. 17  
  Trends and Experiences of S&E Doctorate Recipients in the Labor Market .............................. 18  
    Employment Trends of S&E Doctorates in the Workforce .................................................. 18  
    Experiences of Women and Underrepresented Minorities in S&E Fields ............................. 19  
  Summary of Empirical Research ................................................................................................. 19  
  Theoretical Framework................................................................................................................. 21
List of Illustrations

Figure 2-1 Labor Market Intersectionality Model .................................................................26
Figure 4-1 Distribution of Employment Sector Sequences ....................................................47
Figure 4-2 Distribution of Employment Sector Sequences by Gender-race/ethnic Groups:
  Engineering ..........................................................................................................................50
Figure 4-3 Distribution of Employment Sector Sequences by Gender-race/ethnic Groups: Life
  Science .................................................................................................................................52
Figure 4-4 Distribution of Employment Sector Sequences by Gender-race Groups: Social
  Science .................................................................................................................................54
List of Tables

Table 2-1 Critiques of Human Capital Perspectives ............................................................... 24
Table 3-1 The 2003 Doctorate Recipients by Cohort ................................................................. 29
Table 3-2 List of Variables ........................................................................................................... 31
Table 3-3 Research Plan .............................................................................................................. 35
Table 4-1 S&E Doctorate Recipients’ Employment Sector Profiles by Social Structures .......... 39
Table 4-2 S&E Doctorate Recipients’ Employment Sector profiles by Human Capital Factors .... 41
Table 4-3 Means and Standard Deviations of S&E Doctorate Recipients’ 2010 Salaries by Social Structures ......................................................................................................................... 43
Table 4-4 Means and Standard Deviations of S&E Doctorate Recipients’ 2010 Salaries by Human Capital Factors ......................................................................................................................... 44
Table 4-5 Frequency Distribution of Employment Sector Sequences ...................................... 48
Table 4-6 Regression Model for 2010 Salary (all S&E Doctorate Recipients) ......................... 56
Table 4-7 Regression Model for 2010 Salary for Asian Social Groups .................................... 60
Table 4-8 Regression Model for 2010 Salary for White Social Groups .................................... 62
Table 4-9 Regression Model for 2010 Salary for URM Social Groups ..................................... 64
Table 4-10 Regression Model for 2010 Salary by Human Capital Factors (all S&E Doctorate Recipients) ................................................................................................................................. 68
Chapter 1

Introduction

Over the recent decades, the advancement of information and communications technology (ICT) has progressively consolidated the so-called knowledge-based economy (KBE) (Foray & Lundvall, 1995; The Organisation for Economic Co-operation and Development (OECD), 1996). Within this economic environment, which is “directly based on the production, distribution, and use of knowledge and information” (OECD, 1996, p.7), governments create policies and commit resources to increase the capacity and accessibility of education programs; individuals commit time and finances towards higher education attainment; and employers seek to hire the most innovative graduates to increase productivity and to expand and diversify their workforce talent pool (Brown & Hesketh, 2004; Lauder, Young, Daniels, Balarin, & Lowe, 2012).

This combined strategy provides competitive advantage to developed countries (Auriol, Felix, & Schaaper, 2010; Joseph & Gottlieb, 2006; Lee, Miozzo, & Laredo, 2010; Neumann & Tan, 2011). Across the OECD countries, “employment is growing in high-technology, science-based sectors ranging from computer [engineering] to pharmaceuticals” (OECD, 1996, p.10). Within the United States, the world’s largest KBE, there has been consensus on the importance of growing a highly skilled workforce, particularly in science, technology, engineering, and mathematics (STEM) that will provide the expertise to advance its economy (Auriol, Felix, & Schaaper, 2010; Florida, 2002; Mathur, 1999). In 2012, the President’s Council of Advisors on Science and Technology (PCAST) stated that U.S. future economic progress hinges on the capacity of the education system to produce more college graduates in natural sciences and engineering fields of study (Holdren & Lander, 2012).

Of specific interest to this study is the workforce that consists of doctorate recipients in science and engineering (S&E). These graduates are identified as main contributors to innovation and the creation of new knowledge in the U.S. economy (Almeida & Kogut, 1999; National Science Board, 2014; Stephan, Sumell, Black, & Adams, 2004). However, producing S&E graduates at the doctoral level requires major investment by both society and individuals. For example, in the White House 2015 financial year budget request, a total of $60.8 billion was
included for STEM education programs with $457.2 million for graduate programs, an increase of $12.3 million or approximately 3% from 2014 appropriations (The White House, 2014). At the same time, the National Science Foundation (2014) reported that students are paying higher costs to attain doctorate degrees as reflected in growing student debts. In 2011, 32% of S&E doctorate recipients reported having increased level of student debt; seven percent of S&E doctorate recipients have student debt amounts over $70,000. These growing financial commitments to education by both the U.S. federal government and by individuals point to the importance of an efficient link between the education system and the labor market as to utilize effectively graduates’ knowledge and skills in raising productivity and stimulating economic growth. Meanwhile, S&E doctorate recipients expect of high returns on their significant education investments.

The employment sector in which S&E doctorate recipients find work upon graduation is indicative of their career success within the KBE. In 2012, there were approximately 847,000 S&E doctorate recipients employed in S&E jobs. These jobs were within two traditional sectors: approximately 45% in academic and 55% in non-academic institutions (National Science Board, 2014). However, these traditional sectors have been transformed within the KBE. Academia remains an important employer of S&E doctorate recipients offering academic positions (i.e., tenure track, tenured, and non-tenure track faculty) or administrative jobs. However, within a KBE, there have been structural changes to faculty reward systems leading to less job security due to decreased chances for tenure and a corresponding increase in temporary adjunct positions (Gappa & Leslie, 1993; Umbach, 2007; Schuster & Finkelstein, 2006). On the other hand, jobs within non-academic sectors (i.e., business, government, or nonprofit organizations) are becoming more directly involved in innovation and knowledge transfer, and are requiring new skills of the doctorate recipients as they grow to be more service-oriented (i.e., information technology consulting and software development). Also, employers have a wider labor pool to choose from as some jobs are not constrained by national boundaries and can be easily outsourced (Burton-Jones, 2001; Nordenflycht, 2010). These changes in the U.S. labor market have implications on the career paths and outcomes of S&E doctorate recipients.
The structural changes brought by intensifying KBE further compound the preexisting differences in career paths and outcomes. This is reflected in labor market inequalities among various social groups, such as individuals of similar gender or race who share similar experiences in the workplace. Labor market inequality issues have been abundantly researched, and human capital and sociology theorists provided distinctive perspectives on this topic.

With regard to the human capital (HC) perspectives, researchers have put forward that individuals who obtain college degrees and job-related skills are at an advantage within the labor market. These credentials are perceived to be positively related to better employment opportunities and higher earnings (Auriol, Felix, & Schaaper, 2010; Florida, 2002), as employers are willing to hire skilled and experienced workers who are more innovative and productive (Reskin & Padavic, 1999). In general, HC scholars emphasize that individual’s job competency (skills and work experience) accounts for differences in labor market earnings.

These HC propositions have been challenged in sociological discourses. Social science research suggests that people have certain advantages or disadvantages in the labor market based on social structural factors, including race and gender (Reskin, 2000; Reskin & Padavic, 1999). Further investigations have also suggested that individual or group differences are better explained when considered at the intersection of social structures such as race and gender. For instance, this intersection is viewed as producing intertwining effects of one’s racial and gendered experiences in the labor market (Chafetz, 1997; Zinn & Dill, 1996), specifically in STEM professions. For instance, in an early longitudinal study of social scientists and engineers’ workforce, Morgan (1998) showed that in the earlier cohorts, women earned significantly less than men, but this difference decreased for the later cohorts. A more recent study on the American science workforce, although not specific to doctoral graduates, showed were less likely to achieve the same level of education and work experience in the sciences (Broyles, 2009).

While there have been less empirical studies specifically focusing on S&E doctorate populations, there are a few reports of labor market discrepancies that suggest inequality occurs at the intersection between gender and race. For instance, within academia, women of color (WOC) perceive their work as undervalued, and that they have fewer chances of being tenured if
they are married and have children (Ginther & Kahn, 2012; Kahn & Ginther, 2008). In addition, the National Science Board (2014) recently highlighted existing trends of labor market inequalities experienced by S&E doctorate recipients. First, employment distribution by race/ethnicity shows that in the year 2010 existing S&E jobs were dominated by Whites and Asians at 71% and 14% respectively. The remaining 15% of jobs were shared among non-Asian minority groups. Analysis by gender shows that males had higher employment rates within their respective fields of study at 32% and females at a lower rate of 19%. With regards to earnings, the median salary for Asians was $75,000, Whites $72,000, Hispanics $60,000, and both Native Americans and Blacks at $56,000 (NSB, 2014). A breakdown by gender shows a median salary of $80,000 for males and $53,000 for females.

The above scholarly findings and national data on employment and salaries show that inequalities in the labor market persist even at the doctorate level within S&E fields. The doctorate recipients’ similar educational attainment somewhat levels the traditional impact of human capital factors (i.e., level of education) on earnings, and allows to consider the additional effect of field of study as a human capital marker. Therefore, the study will mainly focus on the effects of social structures (i.e., race and gender) on earnings by taking an intersectionality perspective.

**Statement of the problem**

The United States has made significant investments and policy changes to meet the growing demand for a qualified S&E workforce. In addition, individuals are paying more for their higher education, as evident in the rise of student debt, in order to obtain high-level skills and attain qualifications demanded by the academia and knowledge-oriented firms. These changes highlight the importance of an efficient education system that produces highly qualified graduates ready to work in knowledge-based jobs but also capable of moving strategically between employment sectors so as to maximize individual rewards while contributing to the growth of the U.S. economy. As for S&E doctorate recipients’ labor market involvement, there has been limited empirical research to document their career mobility and subsequent outcomes (e.g., earnings) since studies focus mainly on academic professions and do not consider the changing landscape
of jobs and employment sectors that require the expertise of S&E doctorates within the knowledge-based economy.

Furthermore, national statistics show persistent trends of labor market inequalities for women and other minority groups, even for doctorate recipients who possess the highly demanded S&E expertise; this suggests that the skills and qualifications of women and minorities are either inefficiently used in the United States’ knowledge-based economy or less rewarded. Human capital research has always advocated for the importance of higher education attainment in gaining advantageous positions in the labor market without openly acknowledging the effect of social structures, while social scientists have suggested that gender and race factors might provide a better explanation of persistent differences and inequality in labor market outcomes. There is empirical evidence of persistent gender and race inequalities in the return on educational investment for S&E doctorate recipients. These inequalities affect both the individual and the knowledge-based economy. However, a career aspect that received less attention in the research literature is workers’ movements between employment sectors, the extent to which career patterns vary at the intersection of gender and race, and the effect of career mobility patterns on earnings.

**Purpose of the Study and Research Objectives**

The overarching purpose of this dissertation is to explore the intersectional effects of social factors (i.e., gender, race) and field of study on S&E doctorate recipients’ labor market outcomes (i.e., career paths and salaries). The study has three main research objectives achieved through various statistical methods. First objective is to describe the S&E doctoral recipients’ employment sector and earning profiles at the intersection of gender and race, and field of study. Second objective is achieved through comparative analysis of S&E doctoral recipients’ career paths defined by the sequence of employment sectors in which workers had jobs between 2003 and 2010, analysis conducted at the intersection of gender and race, and field of study. Third objective is achieved through modeling the 2010 salaries of doctorate recipients by taking into account the effects of gender and race, field of study, employment sector in 2010, and career path mobility (i.e., number of changes between sectors). The analysis includes four cycles.

Research questions

This study addresses the following research questions:

1. Are there differences in the S&E doctorate recipients’ employment sector profiles between 2003 and 2010 by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race)?

2. Do S&E doctorate recipients’ salary profiles vary in the year 2010 by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race)?

3. Are there differences in the S&E doctorate recipients’ career paths (i.e., sequence of employment sectors) by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race) for individuals who are employed at all times (2003, 2006, 2008, 2010)?

4. What is the relative contribution of factors predicting the S&E doctorate recipients’ salary for the year 2010, when we take into account the intersecting social structure attribute (i.e., gender, race), human capital factors (i.e., field of study), employment sector in 2010, and number of times employment sectors are changed between 2003-2010 (i.e., as a proxy for career mobility)?

Significance of the Study

Considering the huge investment that U.S. government and individuals make in education, an exploration of the labor market outcomes for graduates of U.S. higher education institutions is an important task with implications for research, practice, and policy. This study makes significant contributions to empirical research on the labor market outcomes of S&E doctorate recipients by filling several gaps in the literature. First, S&E doctorate recipients are ranked among the highest qualified individuals, yet little is known about their involvement in the labor market from a longitudinal perspective, particularly in non-academic occupations. Second, human capital theorists have highlighted the importance of higher education attainment for successful careers, and at the same time have demeaned the role of social factors such as
gender and race (Auriol, Felix, & Schaaper, 2010; Browne & Misra, 2003; Florida, 2002). On the other hand, although social scientists’ arguments for the role of these same social factors in explaining inequality of career outcomes have evolved, they never offered definitive answers to the inequality question because the human capital factor is not properly included (i.e., level of education and field of study effects). Third, scholars have outlined that theories of gender and race that ignore the intersection or simultaneous effects of both analytic categories have ignored certain unique experiences (Glenn, 1999; Kibria, 1990; Reskin & Padavic, 1999), which supports the need to address this issue from an intersectionality perspective. According to Browne and Misra’s (2003) analysis of existing propositions: “race is ‘gendered’ and gender is ‘racialized,’ so that race and gender fuse to create unique experiences and opportunities for all groups” (p.488). Considering both groups of scholars, this study goes a step further by conceptualizing the intersection of social factors (i.e., gender and race) as well as considering explicitly the influence of human capital factors (i.e., field of study) when examining the labor market outcomes of doctorate recipients. My focus on S&E doctorate recipients is appropriate, as these individuals have all achieved terminal doctoral degrees.

This study also provides insights on labor market practices in the changing U.S. knowledge-based economy. Policymakers, educators, and businesses will be informed on the career pathways of doctorate recipients from time of entry in the labor market in the early 2000s and throughout the recent decade. The differences in pathways based on analysis by field of study, and the intersecting social structures of gender and race provide information on return to educational investments that could be helpful to policies towards improving education access and lessening labor market inequalities. In addition, findings will inform prospective graduates on the marketability of their education credentials (i.e., highest level of education, field of study) in the different employment sectors of the current labor market environment.
Overview of the Dissertation Chapters

The following chapter provides a literature review focused on the context of the Knowledge-based economy, the importance of a growing S&E workforce, and the labor market experiences of S&E doctorate recipients. Chapter 2 also includes the theoretical framework that guided this research. Chapter 3 presents the methodology of this study and Chapter 4 presents in detail the results of the study. Finally, Chapter 5 includes a discussion of the main study findings, study limitations, significance of the dissertation, and implications for policy, practice, and further research.
Chapter 2
Review of Literature

This literature review draws on previous literature, policy papers, and current national statistics to provide empirical evidence for this study on the career outcomes of S&E doctorate recipients. It is organized into six main sections. The first two sections provide a general context on the importance of a growing S&E workforce in the U.S. and outline the intricacies of a knowledge-based economy: its impact on firms and on workers in science and engineering fields. The third section focuses on the individual workers, including the cost of investment in doctoral education, particularly in S&E fields, and on their expectations of a successful career after degree completion. The fourth section gives background information on employment opportunities for the participants within traditional employment sectors (academic and non-academic) along with evidence of factors that influence their employment choices. The fifth section incorporates previous findings and national statistics on the involvement of specific groups of S&E doctorate recipients (e.g., women) in the labor market in order to highlight the effect of social structures on workers’ experiences and outcomes. After summarizing main findings from empirical research, the chapter concludes with a section that presents the theoretical framework guiding this dissertation.

The Importance of a Growing S&E Workforce in the United States

The capacity to produce a growing technologically savvy workforce in S&E fields has been a concern for the U.S. government and other stakeholders within the economy. This is evident in policy papers, scholarly research, and national labor statistics. According to the recent 5-Year Federal STEM Education Strategic Plan (CoSTEM, 2013),

The health and longevity of our Nation’s citizenry, economy, and environmental resources depend in large part on the acceleration of scientific and technological innovations, such as those that improve health care, inspire new industries, protect the environment, and safeguard us from harm. Maintaining America’s historical preeminence in the STEM fields will require a concerted and inclusive effort to ensure that the STEM workforce is equipped with the skills and training needed to excel in these fields. (p. I)
Additionally, the strategic plan calls for the streamlining of all federally funded STEM agencies, programs, and research funding. Several initiatives were also developed to improve the American education system. These include:

- Improving K-12 STEM system by increasing amount of existing teachers by 100,000, and funding for authentic STEM exposure of students by 50% by the year 2020.
- Improving college programs by increasing the number of awarded STEM undergraduate degrees by one million in 10 years.
- Increasing women and Blacks’ graduation rates in STEM fields in 10 years.
- Designing STEM graduate curriculum to provide applied research experience.

According to scholarly research, S&E graduates are the main creators and distributors of new knowledge and innovation between universities and firms. This transfer of knowledge happens through different means: empirical publications (McMillan, Narim, & Deeds, 2000; Cohen, Nelson, & Walsh, 2002), universities and firms’ research partnerships (Kaufmann & Todtling, 2001; Meyer-Krahmer & Schmoch, 1998; Monjon & Waelbroeck, 2003), and employment of college graduates by private employers (Gubeli & Doloreux, 2005; Zucker, Darby, & Armstrong, 2002). This institutional relationship is a significant part of America’s ingenuity as it facilitates the transformation of knowledge into commercial products and services (Bercovitz & Feldman, 2006; Mueller, 2006).

National statistics on the labor market and the productivity of knowledge intensive industries (KTIs) also underscore the need for a growing S&E workforce (National Science Board, 2014). The total S&E graduates (all degree levels) employed in S&E occupations grew to approximately 5.4 million in 2010 at a rate of 1.4% since 2000. Notably, between 2008 and 2011, considering the effects of the great recession, the unemployment rate for the S&E workforce trended significantly lower than the overall workforce. For example, in October of 2010, S&E unemployment rate was 4.3% while the entire U.S. labor force was at 9.0%. The Bureau of Labor Statistics (BLS) also projects demand for S&E jobs to grow by 1.1 million by 2020.

The growth of S&E labor force also parallels the growth in KTI industries (National Science Board, 2014). These industries provided 40% of the country’s GDP in 2012. In
comparison to other developed countries, the U.S. has the highest share of commercial
knowledge-intensive service industries (i.e., communications and financial) at 32%, and high-
technology manufacturing industries (i.e., high technology and information technology) at 28%.
Nonetheless, there are some reasons for concern. While about 77% of software firms reported
innovations, the total patents granted by the U.S. Patent and Trade Office (USPTO) decreased by
5% between 2003 and 2012 (53% to 48%). In addition, in global competitors such as China, high
technology exports grew from 6% in 1995 to 22% in 2010. At the same time, the U.S. exports
decreased from 14% in 2003 to 13% in 2010. Therefore, while the U.S. maintains the highest
share and productivity of KTI industries, other countries are becoming increasingly competitive.

Overall, the above mentioned policy initiatives and economic indicators highlight the
importance of a growing S&E workforce to meet the future demands of the U.S. KBE. But how is
KBE defined, and how is it transforming the labor market structures and STEM careers? These
aspects are discussed in the next section.

The Knowledge-based Economy and its Impact on Firms and Workers

The Concept of KBE

According to the Organisation for Economic Co-operation and Development (OECD), the
notion of a KBE consists of a “fuller recognition of the role of knowledge and technology in
economic growth” (1996, p.9). However, the effect of knowledge on people’s lives is not new, as it
is the continual birthing of new ideas and discoveries that has transformed the agrarian into
industrial and currently to the knowledge-based society (Bell, 1973; Burton-Jones, 2001). The
need for and access to knowledge has increased with each new era. Knowledge is now the
primary factor of production within developed economies; these countries are fast becoming less
reliant on physical resources and more reliant on intangible and intellectual forms of capital
(Corrado, Hulten & Sichel, 2005).

These intangible and intellectual forms of capital (knowledge) are defined as “the
cumulative stock of information and skills derived from the use of information by the recipient
(Burton-Jones, 2001, p. 5). In recent times, the advancement of information and communication
technology has further enabled the availability of knowledge to individuals and organizations.
Some authors suggest that knowledge can be categorized into two main types: explicit and tacit, based on its transferability and usability (Burton-Jones, 2003; Cowan, David, & Foray, 2000). Explicit knowledge includes information that describes the “know-what” and the “know-why” of economic activities. Know-why is discovered and possessed by scholars and researchers within academic institutions. Know-what is referred to as learnt facts and is possessed by professionals such as lawyers and medical practitioners (university graduates). Both forms of explicit knowledge are transferred through the interface between universities and firms within the industry. They are distributed through scholarly publications, research collaboration between firms and universities, and the movement of professionals between universities and firms. Tacit knowledge is less transferable and includes “know-how” and “know-who.” The know-how refers to certain technical skills or capabilities, such as the operation of production systems. This type of knowledge is not necessarily confined within an organization (external sources); this necessitates collaboration among firms and/or the hiring of new professionals. The know-who includes highly regarded experts and strategic leaders within a firm (internal sources).

The Impact of the KBE on Firms and Workers

The emergence of a knowledge-based economy has increased the interdependence between higher-education programs and skills required by knowledge intensive firms (Brown & Hesketh, 2004; Burton-Jones, 2001). Firms are hiring the best talent in order to protect and broaden their knowledge-base. At the same time, individuals are focused on increasing their knowledge credentials through schooling and job-related training to improve their job prospects.

The advancement of information technology and globalization has transformed work places from a task oriented to a more process oriented, leaner (employ less staff), and unlimited by technical and geographical boundaries (Burton-Jones, 2001). This type of firm (knowledge intensive) is focused on “key knowledge assets, its ability to innovate, produce, market, and deliver” (Burton-Jones, 2001, p.151) innovative economic units. According to Burton-Jones, the scope of a firm’s operations within the KBE is dependent on its capacity to train and/or hire workers with knowledge-based expertise, such as S&E doctorate recipients. These individuals
include those that are responsible for the strategy and directions, management of main functions, and also the day-to-day activities of the firm.

A key decision of the firm’s managers is to secure the long-term employment of its knowledge-based workers. Industry competition may entice workers to migrate to other organizations, and firms attract workers by funding training programs or higher education opportunities that help guarantee their value to the company and upward employment mobility. This investment in human capital provides competitive advantage to the firm, as it is able to improve on its operations (Cohen & Levinthal, 1990; Grant, 1996). The firm is also challenged to provide the appropriate means of training. There is evidence of collaboration with universities and corporate universities (learning centers) with other firms to design industry-specific development programs (Cyert & Goodman, 1997; Nixon & Helms, 2002).

From the workers’ perspectives, their career paths and outcomes depend on employment opportunities within firms (Heinz, 2003). The advancement of the KBE and growth of knowledge-based firms suggest increased employment opportunities for S&E expertise. Upon entering the labor market, S&E graduates seek employment in firms that best fit their skills and provide stability. As firms grow and become more knowledge-based, workers may be required to seek additional skills. This has increased the amount of time and frequency of participating in further higher education or job training (lifetime learning). Workers may also be faced with the new norm of having to change jobs or professions during their careers (Burton-Jones, 2001).

There is need for further understanding of how the changes to the labor market affect the career paths of S&E doctorate holders. For instance, are recipients of doctoral degrees in different S&E fields able to have stable careers in professions related to their fields of study? Do doctorate recipients of varied social backgrounds experience differently challenges and opportunities within employment sectors?

**Doctoral Education and Career Success**

**Investment in Doctoral Education**

Undertaking doctoral studies is a major commitment. Existing research points to the riskiness due to students’ high attrition rates and the stressful challenges of completing the
degree (Golde, 2005; Lovitts, 2001). Individuals have different reasons for making the investment and different expectations on returns. The doctorate is seen as the highest grade of academic achievement that has a positive impact on lifetime earnings (Brailsford, 2010; Leonard, Becker, & Coate, 2005). Pursuing a doctorate can be also a source of leisure which provides self-actualization and answers to one’s curiosity (Brailsford, 2010; Leonard et al., 2005). Individuals also choose to pursue a doctorate because it enables a wider range of career opportunities, particularly during economic downtimes.

From a human capital standpoint, individuals choose to invest in a doctorate because the probability of future employment earnings exceeds the income loss from studying full time or part-time, plus tuition and other college expenses (Blundell, Dearden, Meghir, & Sianesi, 1999). However, further examination of the increasing student debt points to the increasing concern within the U.S. that access to doctoral studies are becoming more difficult. The National Science Board’s (2014) reports show that approximately 36% of S&E graduate students pay their education expenses out of pocket with minimal financial aid or support from their universities. In 2011, 45% of S&E doctorate recipients have college-related debt: 5% reported more than $40,000 of undergraduate debt, and 7% reported more than $70,000 of graduate debt.

The reasons for the high S&E doctorate recipient debt are not empirically researched, but national statistics point to the significant financial investment required by both the individual and society (NSB, 2014). Overall, both the financial and non-financial cost of pursuing an S&E doctorate further indicates the importance of successful careers for these highly educated workers.

**Career Success**

A successful career is defined by positive psychological and job-related outcomes an individual accomplishes throughout his/her employment history (Seibert, Crant, & Kraimer, 1999). Career success is a concern for different stakeholders: individuals who have invested time and financial resources; governments that create policies and appropriate funds to ensure an education system with the capacity to produce highly qualified graduates; and firms that strive to hire employees with the skills that fit their core competency. Considering the importance of
doctorate recipients’ careers, scholars have examined different means of measuring their success. There are two widely accepted measures, objective and subjective. Objective measures are extrinsic in nature and include identifiable rewards such as level of income and upward job mobility (Feldman & Ng, 2007; Seibert, Kraimer, & Liden, 2001). Subjective measures are more intrinsic and include personal perceptions of career accomplishments, such as career or job satisfaction and professional recognition (Arnold & Cohen, 2008; Judge, Cable, Boudreau & Bretz, 1995).

It is unclear, however, whether or not different predictors may influence either measure. John’s (1999) application of the attribution theory to understand employees’ behavior shows that workers attribute career failures to external factors and career successes to internal factors. Therefore, objective forms of success, such as salary, may provide feelings of self-accomplishment and influence job/career-satisfaction. In addition, according to the social comparison theory (Festinger, 1954), individuals tend to perceive their status in society relative to the life achievements of others. In this context, employees that perceive their income to be comparable with their colleagues may also have a high sense of job satisfaction. Furthermore, human capital theory also suggests that individuals who invest in higher education or job-related skills training will attain higher earnings and employment benefits (Becker, 1993). As a result, those who are employed in high-paying jobs based on their education achievements will likely have a sense of career satisfaction.

Research shows that historically there are differences in earnings and job satisfaction among different social groups even with similar skill levels. With regard to gender as a moderator of career success, some research studies suggest that men’s achievements are based more on personality and societal expectations, while women’s achievements are based on favorable opportunity structures and the lack of domestic responsibilities (Melamed, 1995). Recent examinations of the effect of family responsibility also show a gender-specific impact on career success (Kirchmeyer, 2006; Mayrhofer, Meyer, Schiffinger & Schmidt, 2008). This is dependent on whether the female or male takes on domestic and child-rearing tasks, which impacts time spent on the job, geographic locations, and the willingness to forgo additional job promotions.
There is also evidence that racial differences influence career advancement and success. Studies show that Blacks perceive that they have less workplace autonomy, chances for promotion, and less job satisfaction than their white counterparts (Greenhaus & Parasuraman, 1993; Greenhaus, Parasuraman & Wormald, 1990; McDonald, Lin, & Ao, 2009).

**Employment Opportunities for S&E Doctorate Recipients**

The employment choice for the doctorate recipient is normally within two broad employment sectors: academic and non-academic (business, government, or nonprofit). This section of the literature review outlines how these sectors have been changing within KBE, and what factors influence a prospective graduate to choose a particular sector.

**Academic versus Non-Academic Employment Sectors**

Research on doctorate recipients’ employment has mainly focused on academia with sparse attention to industrial occupations. This can be attributed to the fact that historically a doctoral degree was viewed as the passport to an academic career (Mangematin, 2000; Nerad, 2004; Stephan, 1996), as the majority of doctorate recipients became professors, academic researchers and administrators (NSB, 2014). In the past, academia was known to be favorable to doctorate recipients with the affinity for research, as universities provided a high level of job security and research independence (Kerr, 1994). However, academia as an employment sector has also been transformed in recent decades. Faculties in different disciplines are having varied teaching loads and funding for research, which partly accounts for disparities in salaries (Rhode, 2006; Umbach, 2007). There is also less job security due to decreased chances for tenure with a corresponding increase in temporary adjunct positions (Gappa & Leslie, 1993; NSF, 2014; Schuster & Finkelstein, 2006). In addition, as noted previously, universities continue to be reliant on private firms for research funding (Roach & Sauermann, 2010; Sauermann & Stephan, 2009; Vallas & Kleinman, 2008). This has caused academic researchers to narrow their investigations to commercial products and services. Scholarly publications are constrained as private companies want to secure the patenting and commercialization of their new innovations.

Little is empirically known about S&E doctorate recipients’ experience in U.S. businesses and government sectors. But, there is evidence that employers of private companies collaborate
with universities in research projects and internship programs as a means of attracting expecting graduates to their firms (Stern, 2004). There is also evidence that doctoral recipients now prefer to work in non-academic industries due to availability of resources for research, compensation packages, and networking opportunities (Roach & Sauermann, 2010; Sauermann & Roach, 2012; Stern, 2004; Vallas & Kleinman, 2008). Therefore, it is not surprising that empirical studies show a decrease in the interest of doctoral students in academic occupations compared to industry (Aghion, Dewatripont & Stein, 2008; Lacetera, 2009).

**Employment Sector and Career Choices**

There are two main existing studies by Sauermann and Roach on the employment choice of S&E doctorate recipients within the U.S. The first study, based on 400 participants from three universities (Roach & Sauermann, 2010), examines S&E doctoral students’ “taste for science” and if their “desire for independence, publishing, peer recognition, and interest in basic research and other individual characteristics predict preferences for research careers in industry versus academia” (p.422). The results show that participants who prefer industry occupations have less taste for science and higher desire for compensation packages, opportunities for upward job mobility, a more resourceful research environment, and networking opportunities within the scientific community. On the other hand, those with a preference for academic positions show less desire for high earnings and a greater personal drive for scientific discoveries.

The second study (Sauermann & Roach, 2012) provides additional information on the S&E doctorate recipients' career choices by examining how their preferences changed during their time as doctoral students and what role faculty advisors play in their decisions. The study involved 4,109 doctoral students at 31 U.S. universities who were at different stages in their graduate studies in the life sciences (59%), chemistry (18%), and physics (23%). Findings indicate that participants were initially attracted to faculty and research careers, particularly the life scientists and physicists. However, the further the students got in their degree programs, the less attracted they were to careers in academia. Their early attraction to academia might have been due to the influence of professors who promoted their own professions. These findings
support previous research which shows that career choices change over time (Fuhrmann, Halme, O'Sullivan, & Lindstaedt, 2011).

These preliminary findings are in need of further research. Overall, both studies inform this current study on exploring the reasons why S&E doctorate recipients choose a particular employment sector. This current study deepens our understanding and extends Sauermann and Roach’s findings on choice and preference of employment sectors.

**Trends and Experiences of S&E Doctorate Recipients in the Labor Market**

This section provides information on the S&E doctoral graduates involvement in the labor market. The review includes data on employment trends and on the career experiences of women and underrepresented minorities.

**Employment Trends and Outcomes of S&E Doctorates in the Workforce**

According to NSB statistical reports, in 2012 there were approximately 847,000 employed individuals with doctorates in S&E fields. They were evenly distributed between the academic (46%) and business (45%) employment sectors, with only 9% employed by federal and state governments. The majority (90%) of those employed in academia were within 4-year universities, including those holding postdoctoral positions.

There are notable race/ethnicity and gender distribution disparities among the employed doctorate recipients in S&E fields. In 2010, there was a high proportion of Whites at 71.5%, Asians at 13.9%, and the remaining 15% being non-Asian minority groups working in S&E jobs. Analysis by sex shows only 19% of women and 32% of men were employed in their respective fields of study, with the remaining 41% been employed outside of their specific fields. With regard to labor force non-participation, women (22%) were more likely to be out of the labor force than men (14%). The reasons identified for the non-participation included family responsibilities and retirement.

The estimated median salary for S&E doctorates recipients up to five years after receiving their degrees is $76,000 (NSB, 2014). Further breakdown by some fields of study shows a median salary of $91,000 for engineering, $64,000 for social sciences, $76,000 for physical sciences, and $65,000 for life sciences (NSB, 2014).
Finally, post-doctoral study appointments are becoming increasingly common. In 2001, 29% of new doctorate recipients in S&E fields were committed to postdoctoral positions. This grew to 42.7% in 2011. Analysis by field of study shows 69.3% for life sciences, 58.2% for physical sciences, and 41% for engineers (NSB, 2014).

**Experiences of Women and Underrepresented Minorities in S&E Fields**

Studies on workforce representation among S&E doctorate recipients have mainly focused on gender, more so on the underrepresentation and experiences of women of color (WOC) in S&E fields. Turner, Gonzalez, and Wong’s (2011) study investigates WOC faculty members’ awareness of how legal challenges to affirmative action impact their work experiences at predominantly white research institutions. The study reports that WOC faculty experienced “marginalization, subtle discrimination, racism and institutional racism, gender-bias and institutional sexism, and difficulties with students who do not expect to be taught by women of color” (p.209). Turner, Gonzalez and Wong (2008) study on WOC faculty members, reports that they felt isolated from their colleagues and their research was undervalued. Finally, Ginther and Kahn’s (2012) research points out that WOC are more likely to work at predominantly minority institutions, and married women with children have less chance of being tenured (Ginther & Kahn, 2009).

**Summary of Empirical Research**

The nature of the U.S. economy has changed to knowledge-based, which has called for increased investment by individuals and governments in higher education so as to fill the demands for knowledge-based expertise and ultimately for the continued preeminence of the U.S economy (Burton-Jones, 2001; Lee, Miozzo & Laredo, 2010). Science and engineering doctorate recipients are viewed as being at the top of the education hierarchy and are the leading producers of innovation and knowledge (NSB, 2014). This population is traditionally employed within academic sectors; however, National Science Board statistics (2014) show growing trends of employment in non-academic sectors. This is not surprising, as empirical studies point to changes in academia employment structures with fewer chances of tenured positions, higher post-doctoral opportunities and the increasing hiring of adjunct instructional staff (Kerr, 1994;
Schuster & Finkelstein, 2006; Umbach, 2007). At the same time, industry employers are providing incentives in the form of increased resources for research opportunities, scholarly and professional networks, and high financial and non-financial rewards to attract the best talents (Roach & Sauermann, 2010; Stein, 2004; Vallas & Kleinman, 2008). Research has also shown a recent transformation in the nature of jobs. These new knowledge-related jobs are mostly service oriented (i.e., information technology consulting and software development) and are not restricted by geographical boundaries (i.e., outsourcing) (Burton-Jones, 2001; Nordenflycht, 2010). More research is needed to understand how S&E doctorate recipients fare in these new labor market conditions.

Additionally, the demographic make-up of the S&E workforce is not very diverse (NSB, 2014). There is still insufficient doctorate attainment by women and underrepresented minorities, with disproportionate representation in S&E occupations and annual earnings. Considering that white male scientists and engineers have traditionally shaped and dominated the culture, norms, and practices in the S&E fields of study and the corresponding occupations, it is important to examine how social structures affect one’s ability to secure successful positions in the labor market. Prior studies have mostly been conducted on academic careers; some research shows that females, particularly women of color, perceive that their work is not as well recognized as the work of others (Ginther & Kahn, 2012). Women of color also report that they encounter obstacles toward securing tenured positions, more so if they are married and have parental responsibilities (Mason & Goulden, 2004, 2002; Wolfinger, Mason, & Goulden, 2008).

There have also been methodological limitations to previous studies; the majority of studies have taken an event-oriented approach by examining the recipients’ experience at a particular time in their careers. Lack of longitudinal focus may have overlooked the effect of situational and developmental factors influencing career success (i.e., career paths and earnings).
Theoretical Framework

Social science researchers have built on independent theories of gender and race to develop an intersectional framework to explain persistent labor market inequalities (Blea, 1992; Brewer 1993; Glenn, 1999; Kibria, 1990). The intersectionality perspective is appropriate as a primary orienting framework for this study that is examining the effect of social structures on the labor market outcomes of doctorate recipients. In addition, the study requires several notions borrowed from the human capital (HC) theory (e.g., level of education, field of study, employment sectors, career pathways, earnings) that are critical to a discussion of return to educational investments. Therefore, I am able to focus my analyses on how the intersection of social structural factors (i.e., gender, race) and human capital factors (i.e., field of study) account for differences in S&E doctorate recipients’ career paths within employment sectors and earnings.

This section is structured as follows: first, the intersectionality theory is introduced along with a summary of its three generally accepted approaches, its evidence in the labor market, and limitations. Then, the HC perspectives on return to education and credentialing are discussed. Finally, I put forward the labor market intersectionality model and its assumptions as a suitable framework for this study.

Intersection of Gender and Race

Intersection of gender and race perspectives emerged out of multicultural and multiracial feminism movements (Lorber, 1998; Mohanty, 1991; Zinn & Dill, 1996), which challenged the capacity of independent theories on gender and racial inequalities. Particularly, the notion of intersectionality proved its capacity to comprehensively analyze the social identities of women of color (WOC) (Blea, 1992; Brewer 1993; Glenn, 1999; Kibria, 1990). The intersectional framework has been used by social science researchers to investigate multiple and intertwined inequalities faced by women in areas such as politics, violence, and sexuality (Acker, 2000; Crenshaw, 1991; Hancock, 2007; Lockhart & Danis, 2010; Walby, 2009). However, a useful approach for this study is provided by Black feminist theorists who have used the intersectionality framework to examine gender and racial inequalities observed in the labor market (Collins, 1999; James & Busia, 1993). Nonetheless, the intersectional theories are not universally accepted by social feminist scholars.
and by human capital scholars. Accordingly, the generally accepted approaches are first outlined in the next subsection, followed by a critical discussion of the theory.

**Approaches to Intersectionality**

There are three generally accepted approaches of intersectionality theory as noted in McCall’s (2005) review of major studies. They are: (1) anti-categorical complexity, (2) inter-categorical complexity, and (3) intra-categorical complexity. The anti-categorical perspective calls for the elimination of social classifications, as people’s experience in our complex society should not be reduced to finite categories such as race, class, sexuality, and gender. The elimination of categories will allow a more holistic approach to understand intersectionality. On the other hand, the inter-categorical complexity approach conditionally adopts the social classifications as analytical categories which acknowledge that social inequalities exist. This enables the observation of relationships among groups of individuals and the understanding of how their perceptions of actual experiences change over time. Finally, the intra-categorical complexity approach focuses on separate social structures and overlooks the areas of intersection.

For several reasons, the inter-categorical complexity approach is appropriate for this study. First, this is a quantitative study that cannot accommodate the anti-categorical complexity perspective. Second, I argue that the intra-categorical complexity approach cannot capture the discrepancy in labor market outcomes that occurs at the intersection of social structures. Therefore, the intersection of gender and race is used as an analytical category to investigate the differences in S&E doctorate recipients’ labor market outcomes.

**Evidence of Gender and Race Intersectional Effects in the Labor Market**

Social science research on labor market inequality has found instances of gender and race intersection effects within three main areas: discrimination, domestic labor, and wages (Browne & Misra, 2003). This study focuses on the latter. There have been mixed findings in examining wage differentials. Bound and Dresser’s (1999) study on individual differences within a wage stratification system found unique patterns of racial bias for women of color and co-ethnic men, and of gender bias for white women. McCall’s (2001) analysis of the causes of wage gaps in the local labor market shows that neither gender nor race classifications, when using either
independent or in intersection, provide statistically significant evidence of wage inequalities. These mixed evidences on inequalities in labor market warrant further investigations on different worker groups, of which this study focuses on highly educated workers in S&E fields.

Limitations of Intersectionality

Walby, Armstrong, and Strid (2012) highlight a certain limitation of the intersection of gender and race theory, which is relevant to this study. There is inconclusiveness on how to focus on the status and capacity of disadvantaged groups of individuals without neglecting the influence of the dominant groups. However, this is less of a limitation for this study since it is concerned with individuals expected to be equally positioned with respect to the labor market (i.e., they all obtained doctoral degrees). Since these highly educated workers are all part of an education elite, it makes it difficult to categorize any of them as part of a dominant or dominated group. In addition, the intention of the study is not to focus on whether one group dominates the other in the labor market, but show how differences in social structures and the intersection of social structures may explain salary (an objective outcome) differences. In other words, does the intersection of social categories provide a more reliable explanation of the labor market inequalities of these highly qualified participants?

Human Capital Perspectives on Inequalities in the Labor Market

Human capital theorists view labor market inequalities from an economic perspective. First, human capital is defined as a set of innate and acquired skills that contribute to one’s economic productivity (Becker, 1993; Crook, Todd, Combs, Woehr, & Ketchen, 2011). Therefore, individuals are grouped based on their earning power, which is determined by their education attainment and work experience. The main aim of employers is to hire innovative workers to contribute the most to increasing the profitability of their firms (Altonji & Blank, 1999; Browne & Misra, 2003). Based on these HC assumptions/propositions, individuals with higher education such as S&E doctorates are at an advantage within the labor market. However, critiques of HC theory have highlighted social factors that help explain differences in earnings even for individuals who have earned similar higher education credentials. These are discussed in Table 2.1 below:
Table 2-1 Critiques of human capital perspectives

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Critiques</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HCT economic perspectives of return on education are based on a perfect labor market in which credentials and training can be directly measured in earnings.</td>
<td>Levels of education do not directly relate to job competence, and earnings are not a true measure of productivity (Ferrer &amp; Riddell, 2002; Tuijnman, 2000).</td>
</tr>
<tr>
<td>2. People make rational choices to invest in higher education.</td>
<td>Access to education varies by one’s social and cultural capitals (association with the privileged) and economic status. The lack of resources and networking may inhibit a particular social structure from investing in higher education opportunities (Bills, 2003; Collins, 1979).</td>
</tr>
<tr>
<td>3. Education is linearly related to earnings, particularly higher technical skills.</td>
<td>Technological advancement increases the chances of employment for highly skilled workers (Brown, 2001; Kivinen &amp; Ahola, 1999).</td>
</tr>
<tr>
<td>4. Education credentialing and years of education increase access to highly paid and privilege positions.</td>
<td>First, there are debates on the effects of completed education programs versus years of education on earnings (Ferrer &amp; Riddell, 2002). Second, increased attainment in higher education may inflate its value (Collins, 2002).</td>
</tr>
</tbody>
</table>

This study explores the career outcomes (i.e., pathways and salaries) of S&E doctorate recipients. These individuals acquired the highest level of educational attainment (doctoral degrees), but have varied skills according to their fields of study and varied options when entering employment sectors. Hence, they fulfill the human capital criteria of possessing educational credential and years spent in education, but additional human capital characteristics (field of study) differentiate them. They will also have different work experience based on the employment sector in which they are hired.
Labor Market Intersectionality Model

This study puts forward a conceptual model that provides a framework for examining the S&E doctorate population, a conceptual model that takes into account the propositions and limitations of the intersection of social structures (gender and race) perspective, and is also informed by the critiques of the above mentioned HC perspectives. The model incorporates the intersecting social structure of gender and race, but also suggests that characteristics of human capital (i.e., field of study) influence doctorate recipients’ labor market outcomes. The fields of study include computer/mathematics, life sciences, physical sciences, social sciences, and other S&E fields (i.e., health, S&E managerial positions). The intersecting social structure groups that will be used in this study include Asian males, Asian females, White males, White females, Underrepresented Minority (URM) males, and URM females.

The main assumptions of the model that are reflected in Figure 2.1 are:

- The use of gender and race as independent analytic categories ignores the combined influence on labor market outcomes when the two categories intersect.
- The intersection of gender and race does not represent a simple addition of factors, but it is expected to capture specific information on challenges and opportunities experienced by the gender-race social groups in the labor market, as suggested by the overlapped “A” area in the model.
- The use of the intersection of gender and race allows for a more comprehensive analysis of labor market outcomes when specific human capital factors of higher education credentialing and/or field of study are considered.
Figure 2-1 Labor Market Intersectionality Model
Chapter 3

Method

Purpose of Study

The overarching purpose of this dissertation is to explore the intersectional effects of social factors (i.e., gender, race) and field of study on S&E doctorate recipients’ labor market outcomes (i.e., career paths and salaries). The study has three main research objectives achieved through various statistical methods. The first objective is to describe the S&E doctoral recipients’ employment sector and earning profiles at the intersection of gender and race, and field of study. Second, the study provides a comparative analysis of S&E doctoral recipients’ career paths defined by the sequence of employment sectors in which workers had jobs between 2003 and 2010, analysis conducted at the intersection of gender and race, and field of study. Finally, the third objective is achieved through modeling the 2010 salaries of doctorate recipients by taking into account the effects of gender and race, field of study, employment sector in 2010, and career path mobility (i.e., number of changes between sectors). The analysis includes four cycles (2003, 2006, 2008, and 2010) of the Survey of Doctorate Recipients data collected by the National Science Foundation (NSF, 2014).

Research Questions

The study addresses the following research questions:

1. Are there differences in the S&E doctorate recipients’ employment sector profiles between 2003 and 2010 by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race)?

2. Do S&E doctorate recipients’ salary profiles vary in the year 2010 by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race)?

3. Are there differences in the S&E doctorate recipients’ career paths (i.e., sequence of employment sectors) by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race) for individuals who are employed at all times (2003, 2006, 2008, 2010)?
4. What is the relative contribution of factors predicting the S&E doctorate recipients’ salary for the year 2010, when we take into account the intersecting social structure attribute (i.e., gender, race), human capital factors (i.e., field of study), employment sector in 2010, and number of times employment sectors are changed between 2003-2010 (i.e., as a proxy for career mobility)?

Data

This empirical study utilizes four cycles of data (2003, 2006, 2008, and 2010) from the National Science Foundation Survey of Doctorate Recipients (SDR). These four cycles have similar survey questions that produce comparable data suitable for a longitudinal study. The Survey of Doctorate Recipients includes demographics and work history information on recipients of doctoral degrees in science and engineering fields who graduated from U.S. universities. The study employs public-use data files that could be downloaded from the NSF website.

Data Source

The data used in this study was collected from surveys conducted by the National Opinion Research Center (NORC) at the University of Chicago on behalf of the National Science Foundation (NSF) and the National Institutes of Health (NIH). The recent surveys administered since 2003 targeted individuals who all received their S&E doctorate degrees from institutions within the U.S. over a period of time extended to the recent decade.

Sampling Technique

The SDR uses a complex sampling design that includes a weighting system that accounts for varied sampling probabilities, non-responses, and unknown eligibility (NSF, 2011). Varied sampling rates were employed to improve reliable estimates of small populations such as underrepresented minorities. According to the SDR methodology reports, the total samples had small sampling errors, which were mostly due to the varied characteristics of the underrepresented populations.

Reliability and Validity of SDR Survey

The SDR used three modes of data collection (i.e., self-administered survey via mail or online or computer-assisted telephone interview), which likely caused measurement errors and
may have created systematic biases. For example, individuals of a particular race/ethnic group may have had less access to the electronic survey and at the same time were skeptical about the usage of the mailed (paper) format. Nevertheless, according to the methodology reports, all three modes have provided comparable information on all measures and for all respondents.

**Population and Sample**

This research, on the career paths of participants over an extended period, requires longitudinal data. The SDR follows doctorate recipients throughout their careers, from the year they earned their degree until the last survey available. The survey panel (targeted participants) is also refreshed with a new sample of doctoral graduates during each survey cycle. At the time of this study there were eight existing cohorts. The wide range of age suggests that participants have varied career lengths, and have entered the labor market in different economic times. For these reasons, the original SDR sample will be limited to those who were at a comparable age and entered the labor market within a somewhat similar economic period.

The original 2003 SDR sample (first of four cycles used in this study) has 29,030 respondents who indicated their most recent degree was at the doctoral level. This sample represents a total of 665,510 doctorate recipients who obtained their degrees at different times and are of various ages in 2003 as shown in Table 3.1.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
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<tbody>
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<td>62</td>
<td>62</td>
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<td></td>
</tr>
<tr>
<td>Race/eth</td>
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<td>White</td>
<td>URM</td>
<td>Asian</td>
<td>White</td>
<td>URM</td>
<td>Asian</td>
<td>White</td>
<td>URM</td>
<td>Asian</td>
<td>White</td>
<td>URM</td>
</tr>
<tr>
<td></td>
<td>15</td>
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<td>6</td>
<td>7</td>
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<td>9</td>
<td>8</td>
<td>9</td>
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<td>7</td>
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<td>Age '03</td>
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<td>60</td>
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<td>51</td>
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<tr>
<td>Nweighted</td>
<td>665510</td>
<td>101130</td>
<td>76650</td>
<td>70770</td>
<td>76660</td>
<td>83380</td>
<td>103260</td>
<td>117580</td>
<td>36080</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although beyond the scope of this study, it is important to note the changes over time in gender and race distributions across cohorts of doctorate recipients. Women and URMs were
less represented in the earlier cohorts. Overall women are underrepresented among S&E doctorate recipients. The representation of URMs continues to be of concern even for the recent cohorts of graduates. This study will focus on Cohort 7 of individuals who obtained their doctoral degrees between 1996-2000, and are representative of over 100,000 S&E doctorate recipients.

The longitudinal (unweighted) sample for this study (Cohort 7) is based on 3,320 respondents of whom \(N=2,996\) were employed and provided employment sector information and earnings for all four survey cycles. These respondents have on average, three years to settle in the labor market prior to the first 2003 SDR cycle used in the study. They entered the labor market at an average age of 38 and in 2010, since the average age of respondents was about 45; they are part of the active working age population. Characteristics of the research sample will be presented in Chapter 4.

**Research Design**

**Variables**

Table 3.2 provides a listing of the variables used in the study, including their descriptions, and respective categories. The demographic factors are gender (i.e., a 2-category variable: male and female) and race (i.e., a 3-category variable: Asian, White, and URM), that were used to derive the major explanatory intersecting factor, Gender_Race (i.e., a 6-category variable: Asian_Male, Asian_Female, White_Male, White_Female, URM_Male, and URM_Female). This variable was used: (1) to examine profiles based on employment sector and 2010 salary; (2) to compare career paths using sequence analysis; and (3) to help explain the differences in 2010 salary, together with other predictors, through regression analysis. Another variable of interest is the field of study of respondents’ doctoral degree reported in 2003 (i.e., a 6-category variable: computer/mathematics, life sciences, physical sciences, social sciences, engineering, and other S&E fields).

A major longitudinal variable for this study is employment sector, which is operationalized by a 4-category variable (i.e., 2-year college or other schools, 4-year college or medical institution, business/industry, government) and will be recorded at all four cycles: 2003, 2006,
2008, and 2010. This variable is a good indicator of how respondents navigated through employment sectors (and occupations) during this period of their careers.

Table 3-2 List of variables

<table>
<thead>
<tr>
<th>Name of Variable</th>
<th>Variable Description</th>
<th>Variable Type/Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Sex reported by respondent</td>
<td>2-category variable: 0=male; 1=female</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>Derived variable reported in the public-use data</td>
<td>3-category variable: 1=Asian; 2=White; 3=Underrepresented minorities (URM)</td>
</tr>
<tr>
<td>Field of study (FOS)</td>
<td>S&amp;E field of study as identified by the National Science Board</td>
<td>6-category variable: 1=Comp/Math; 2=LifeSc; 3=PhysSc; 4=SocialSc; 5=Engineering; 6=OtherS&amp;E</td>
</tr>
<tr>
<td>Employment Sector</td>
<td>Sector in which respondent was employed during reference week of survey</td>
<td>4-category variable: 1=2-year college or Other School System; 2=4-year college or Medical Institution; 3=Government; 4=Business/Industry</td>
</tr>
<tr>
<td>Last Employment Sector</td>
<td>Based on employment sector participants worked in during the time of the fourth and last survey cycle (2010)</td>
<td>4-category variable: 1=2-year college or Other School System; 2=4-year college or Medical Institution; 3=Government; 4=Business/Industry</td>
</tr>
<tr>
<td>Number of Sector Changes</td>
<td>Based on number of employment sectors changed during 2003-2010</td>
<td>2-category variable: 1= One sector change; 2= Two or more Sector Changes</td>
</tr>
<tr>
<td>Gender_Race</td>
<td>Based on the intersection of gender and race characteristics</td>
<td>6-category (derived variable): 1= Asian_Males; 2=Asian_Females; 3=White_Males; 4=White_Females; 5=URM_Males; 6=URM_Females</td>
</tr>
<tr>
<td>Salary in 2010</td>
<td>Basic annual salary on the job as of the survey reference week (data has been annualized as if respondent was working full time for a full year)</td>
<td>Continuous variable</td>
</tr>
</tbody>
</table>

* Derived variables

Other independent variables included number of changes between employment sectors, which was based on the number of times participants changed employment sectors during the period considered in the study (i.e., a 2-category variable: one sector change, and two or more sector changes). Some analyses will also include the last employment sector information in which the participants were employed in 2010.

These independent variables were used as explanatory variables of the 2010 salary, a continuous variable, using standard multiple regression analyses. Salary was used as a
dependent variable in the study, representing an objective measure of the S&E doctorate recipients' career outcomes.

**Data Analysis Procedures**

To answer the research questions, this study utilized categorical state sequencing, cross-tabulations and chi-square tests, descriptive statistics and One-Way Analysis of Variance (ANOVA), and multiple linear regressions as statistical methods. This section gives general descriptions of these procedures.

**Categorical State Sequencing**

Categorical state sequencing has been used in longitudinal analysis of work histories and career patterns (Pollock, 2007). The approach is non-probabilistic and does not depend on the distributional properties of variables. The focus is on "state sequences, where the position of each successive state [status or change of status] receives a meaningful interpretation in terms of age, date, or more generally of elapsed time or distance from the beginning of the sequence" (Gabadinho, Ritschard, Mueller & Studer, 2011, p.1). For instance, this type of analysis provides a holistic picture of career paths (Billari, 2001). This approach differs from other categorical data analysis such as event history analysis (Elandt-Johnson, 1999; Tabachnick & Fidell, 2013; Lawless, 2003) or event structure analysis (Griffin, 1993), which focus on the probability of an event or the status of variables at a point in time. Categorical state sequencing is essentially a descriptive statistics method.

The method was pioneered by Abbott and Forrest (1986) who used sequence alignment algorithms in optimal matching (OM) to categorize sequence trajectories. Optimal matching enables plotting of patterns, which incorporates entire sequence of events or states over time (Abbott & Forrest, 1986; MacIndoe & Abott; 2004). The optimal matching approach was improved by Massoni, Olteanu, and Rousset (2009), and can be recently conducted with "TraMineR", which is a package within the R statistical software. While this current study stops short of using the optimal matching process, it utilizes the TraMineR statistical package (Gabadinho, Ritschard, Studer & Muller, 2010) to create and display state sequence patterns (Gabadinho, Ritschard, Mueller, & Studer, 2011).
TraMineR enables the visualization (plots) of individual state sequences and frequencies (Gabadinho, Ritschard, Mueller & Studer, 2011). The individual state sequence plot depicts a "longitudinal succession of states" (p.13), and the length of each segment (colored per state) represents "the duration spent in each successive state" (p.13). The individual plots are aligned to allow comparisons at each position. The sequence frequency plot depicts the top 10 sets of most frequent sequences of states that describe a certain categorical variable (e.g., employment status). The width of the bars represents the proportion of the sequences within each set, and the complete plot provides the overall proportion of the top 10 sequence frequencies. A frequency table is also provided by the software.

The TraMineR package also produces the mean time spent in each state and transition rates between states. Mean time represents the amount of time spent in the different states. A transition rate matrix shows the probability of switching from a particular position to the other. “Transition rates provide information about the most frequent state changes observed in the data together with, on the diagonal, an assessment of the stability of each state” (p. 17). Accompanying the distribution plot is the entropy index of transversal state distribution, which represent the measure of diversity observed in the sequences (0 when all cases are in the same state and 1 when there is the same proportion of cases in each state) (Fussell, 2005).

Cross-tabulations and Chi-square tests

Two-way tables are obtained with the crosstabs command in SPSS-20 that enables the production of frequency distributions and cell percentages of two categorical variables with multiple categories. The output shows the count of occurrences and row/column percentages for different combinations of the two categorical variables. The appropriate statistical test of association between two categorical variables is a chi-square test. This procedure enables the testing of whether or not two (categorical) variables are independent of each other (Tabachnick & Fidell, 2013).

One-Way Analysis of Variance

The ANOVA procedure is used to find whether there is a statistically significant difference between means of a continuous variable compared across two or more groups (e.g., male and
female) (Tabachnick & Fidell, 2013). If more than two groups are compared, the ANOVA procedure is followed by post-hoc comparisons to determine which groups’ means are different.

**Multiple Linear Regressions**

This regression analysis approach enables the modeling of the relationship between multiple dependent variables (Tabachnick & Fidel, 2013). The model assumes that all variables are normally distributed. There are three outputs that are of interest. The first is the model summary which gives an *R Squared* (coefficient of determination), which indicates the proportion of variance in the dependent variable that can be explained by the explanatory variables. The second part of the output that is of interest is the analysis of variance (ANOVA) summary that indicates the significance of the linear regression model. The final component is the table of coefficient estimates which indicate how each explanatory variable (predictor) correlates with the outcome, and whether they have a positive or negative (significant) contribution to the dependent variable.

To conduct the analyses, normalized weights were computed based on the 2003 survey weights to reflect the proportional representation in the population for characteristics that are not time-dependent such as gender and race/ethnicity. However, sequence analysis employs the unweighted sample.

**Research Plan**

This section provides a description of how the statistical methods described in the previous section were used to address each research question. Table 3.3 provides a summary of the research plan for each research question.

**Research question 1:** Are there differences in the S&E doctorate recipients’ employment sector profiles between 2003 and 2010 by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race)?

This question focuses on exploring the employment sector profiles over time and in relation to two factors: field of study and the intersected social structures (derived variable). Because these three variables are categorical, cross-tabulations and chi-square tests are suitable statistical procedures to explore the relationships among variables.
Table 3-3 Research plan

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Variables</th>
<th>Statistical Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RQ 1</strong></td>
<td>Employment Sector Profiles</td>
<td>Cross tabulations</td>
</tr>
<tr>
<td></td>
<td>Employment sectors</td>
<td>Chi-square tests</td>
</tr>
<tr>
<td></td>
<td>Field of study</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intersected social structures</td>
<td></td>
</tr>
<tr>
<td><strong>Earning Profiles (Comparisons)</strong></td>
<td>2010 Salary</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td></td>
<td>Field of study</td>
<td>ANOVA tests</td>
</tr>
<tr>
<td></td>
<td>Intersected social structures</td>
<td></td>
</tr>
<tr>
<td><strong>Career Paths</strong></td>
<td>Employment sectors</td>
<td>Categorical Sequence Analysis</td>
</tr>
<tr>
<td></td>
<td>Field of study</td>
<td>Frequency Tables</td>
</tr>
<tr>
<td></td>
<td>Intersected social structures</td>
<td></td>
</tr>
<tr>
<td><strong>2010 Salary Model</strong></td>
<td>Intersected social structures</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td></td>
<td>Field of Study</td>
<td>Multiple Linear Regression</td>
</tr>
<tr>
<td></td>
<td>2010 employment sector</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of sector changes</td>
<td></td>
</tr>
</tbody>
</table>

**Research Question 2:** Do S&E doctorate recipients’ salary profiles in the year 2010 by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race)?

The One-Way ANOVA procedure enables the comparison of the means of the 2010 salary (continuous variable) among various groups defined by the intersected social structures (i.e., Asian_Males, Asian_Females, White_Males, White_Females, URM_Males, and URM_Females) and field of study (i.e., computer/mathematics, life sciences, physical sciences, social sciences, and other S&E fields). A post-hoc comparisons test, Tukey’s HSD, was also computed if the ANOVA test was significant to identify which groups have significantly different mean salary.

Salary was the dependent variable for this analysis. It was used as an objective measure of the S&E doctorate recipients’ career outcomes. Therefore, examining the earning differences by the intersected social structures and field of study provides additional information to the multiple regression analysis conducted in the fourth research question.
**Research question 3**: Are there differences in the S&E doctorate recipients’ career paths (i.e., sequence of employment sectors) by human capital factors (i.e., field of study) and intersecting social structures (i.e., gender, race) for individuals who are employed at all times (2003, 2006, 2008, 2010)?

Categorical Sequence Analysis was used to answer this research question. The description of the procedure is adapted from the TraMineR user guide (Gabadinho, Ritschard, Studer & Muller, 2010). The steps are listed below:

1. The employment sector categorical variables for 2003, 2006, 2008 and 2010 were first converted from string to numeric format in the SPSS file that included also gender and field of study variables. The data (SPSS format) was then imported into the TraMineR library (R statistical data package). The attached values of the variables were “converted into R factors with levels set to the value labels in the original [SPSS] files” (p.35).

2. State sequence objects were then created by TraMineR functions. The function stores the sequences along with their attributes in several formats. Two main formats were used with this data set were the “states-sequence” (STS) format and “state-permanence-sequence” (SPS) format. The states-sequence (STS) format stores the successive employment states (statuses) of an individual in consecutive columns. Each column represents a particular time or survey year. In the state-permanence-sequence (SPS) format “each successive distinct state in the sequence was given together with its duration” (p.30).

3. There are TraMineR functions for treating missing or truncated data. Normally, missing data is due to differences in participants’ job status sequence because participants may not respond to all survey cycles or unavailability of data due to survey restrictions. However, the data used in the study had no missing information.

4. Final step included describing and visualizing of employment sector or career path sequences. Sequence distribution plots and sequence frequency tables were produced.
To address the third research question, a graphical view of the participants' career path (i.e., employment sectors between 2003 and 2010) is presented, for all participants as well as separately for selected fields of study and for all gender-race groups. Observations were made about first and last sectors of employment, and number of changes between sectors during 2003 and 2010 based on plots and frequency tables. This information was useful in identifying the set of predictors for the fourth research question, which used multiple regression analysis to explain differences in the S&E doctorate recipients’ 2010 salary.

**Research Question 4:** What is the relative contribution of factors predicting the S&E doctorate recipients’ salary for the year 2010, when we take into account the intersecting social structure attribute (i.e., gender, race), human capital factors (i.e., field of study), employment sector in 2010, and number of times employment sectors are changed between 2003-2010 (i.e., as a proxy for career mobility)?

Since all predictors are categorical variables, dummy variables were computed in SPSS prior to running each model. The multiple linear regression procedure used identified the best combination of predictors for each earnings model. Ten different models were computed. First, the earnings model was run for all participants, with the intersected gender-race variable, field of study, 2010 employment sector, and number of sector changes as predictors. Then separate analysis were conducted for each gender-race group when all other predictors were included and for three selected fields of study (i.e., engineering, life sciences, and social sciences) when all other predictors were included. The reason to conduct separate analysis for gender-race and field of study sub-samples is to uncover specific differences (if any) in the prediction of earnings. This information may be useful for future research that focuses on specific sub-populations.

The regression analysis produced an $R^2$ (coefficient of determination) measure, which described the proportion of variance in salary that was explained by the linear model when including all independent variables. The contribution from each independent variable was accounted for in the $R^2$. I will report the adjusted $R^2$ that takes into account the number of predictors in the model. In addition, the unstandardized regression coefficients and their standard errors will be reported.
Chapter 4
Findings

This chapter presents analyses and findings for the study’s four research questions. Considering that the participants all earned a doctorate degree between 1996 and 2000, these individuals have fulfilled the main human capital criterion of holding highest education attainment as to gain higher earnings (Auriol, Felix, & Schaaper, 2010; Florida, 2002). Nonetheless, even though the participants are an homogeneous group with respect to level of credentials, they differ in the field of study of their highest degree (i.e., computer/mathematics, engineering, physical science, life sciences, social sciences, and other S&E related), which enables a more detailed analysis of human capital effects on career paths and outcomes. In addition, I used the analytical framework of the intersection of gender and race (McCall, 2005) to classify the participants within six social groups (i.e., Asian_Male, Asian_Female, White_Male, White_Female, URM_Male, and URM_Female). These social group labels represent the participants’ unique gendered and racialized experiences (Collins, 1999; James & Busia, 1993) within the labor market.

Hence, the research questions were examined as follows. The first two respectively sought to establish the differences in employment sector profiles and the 2010 salary by social structural and human capital factors. After examining the data and demonstrating that there are differences in profiles by these factors, the third and fourth questions explored, through comparative and correlational approaches, the relationship between these same factors and career outcomes (i.e., career path and salary). In the third question, participants’ career paths (sequences of employment sectors) were compared based on their social group and within selected fields of study. In the fourth question, the relative contribution of intersecting social structures of gender and race, field of study, 2010 employment sector, and number of sector changes within career path were examined in modeling doctorate recipients’ salary in 2010. Results in Chapter 4 are presented for each research question, and the chapter will conclude with a summary of main findings.
Research Question 1

Are there differences in the S&E doctorate recipients’ employment sector profiles between 2003 and 2010 by intersecting social structures (i.e., gender and race) and human capital factors (i.e., field of study)?

Employment Sector Profiles by Social Structures

The cross-tabulation results in Table 4.1 outline participants’ employment sector profiles for 2003, 2006, 2008, and 2010 by social structures. A computed chi-square (χ²) test shows whether there is (or not) significant association between employment sector and the social structural factor defined at the intersection of gender and race.

Table 4-1 S&E doctorate recipients’ employment sector profiles by social structures (column %)

<table>
<thead>
<tr>
<th>Employment Sector</th>
<th>Asian_Male</th>
<th>Asian_Female</th>
<th>White_Male</th>
<th>White_Female</th>
<th>URM_Male</th>
<th>URM_Female</th>
<th>Sig. p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>0.6</td>
<td>2.5</td>
<td>3.1</td>
<td>4.1</td>
<td>4.0</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Inst</td>
<td>33.0</td>
<td>43.7</td>
<td>51.1</td>
<td>54.9</td>
<td>50.6</td>
<td>56.1 ***</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>3.6</td>
<td>8.9</td>
<td>9.9</td>
<td>8.9</td>
<td>11.5</td>
<td>14.9</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>62.7</td>
<td>44.9</td>
<td>35.9</td>
<td>32.1</td>
<td>33.9</td>
<td>21.9</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>0.9</td>
<td>1.9</td>
<td>3.0</td>
<td>4.5</td>
<td>4.6</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Inst</td>
<td>29.4</td>
<td>38.2</td>
<td>49.2</td>
<td>51.4</td>
<td>50.3</td>
<td>55.2 ***</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>4.5</td>
<td>8.9</td>
<td>9.9</td>
<td>8.9</td>
<td>11.6</td>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>65.2</td>
<td>51.0</td>
<td>38.0</td>
<td>35.2</td>
<td>33.5</td>
<td>27.6</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>1.1</td>
<td>1.3</td>
<td>3.0</td>
<td>4.6</td>
<td>4.0</td>
<td>6.1</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Inst</td>
<td>27.8</td>
<td>34.2</td>
<td>48.0</td>
<td>48.4</td>
<td>51.1</td>
<td>53.9 ***</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>6.0</td>
<td>10.8</td>
<td>10.6</td>
<td>10.9</td>
<td>12.1</td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>65.1</td>
<td>53.8</td>
<td>38.5</td>
<td>36.0</td>
<td>32.8</td>
<td>26.1</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>1.1</td>
<td>1.9</td>
<td>3.4</td>
<td>5.0</td>
<td>4.6</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Inst</td>
<td>28.5</td>
<td>35.0</td>
<td>48.5</td>
<td>48.2</td>
<td>50.0</td>
<td>52.2 ***</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>5.8</td>
<td>10.2</td>
<td>9.9</td>
<td>10.7</td>
<td>11.5</td>
<td>16.5</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>64.6</td>
<td>52.9</td>
<td>38.3</td>
<td>36.1</td>
<td>33.9</td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>N=2996</td>
<td>466</td>
<td>157</td>
<td>1308</td>
<td>776</td>
<td>174</td>
<td>115</td>
<td></td>
</tr>
</tbody>
</table>

*** represents significance level p <.000

It is important to notice that consistently high proportions of S&E doctorate recipients were employed in business/industry and four-year colleges or medical institutions throughout the
entire period. Furthermore, the data highlighted that male and Asian groups had higher proportions of employment within business/industry, and females and non-Asian groups worked mostly in four-year colleges or medical institutions.

The breakdown by the intersection of gender and race (as presented in Table 4.1) revealed further details. For instance, Asian males and females had higher proportions of employment in business/industry than Whites and URMs throughout the four periods. However, dissecting the Asian doctorate recipients’ employment statistics revealed that Asian males had still higher representation (62.7% in 2003 to 64.6% in 2010) than Asian females (44.9% in 2003 to 52.9% in 2010) within the business/industry sector. The next highest employment sector for both genders of Asian workers was the four-year colleges or medical institutions.

Analysis showed a flip in results for the White and URM groups in comparison to the Asian groups. The highest proportion of white males (48% in 2010) and females (54% in 2003) were employed in four-year colleges and medical institutions throughout the period under study, and the second highest proportions of these groups were employed within the business/industry sector. Cross-tabulations also showed that both male and female URM groups had much higher proportions (over 50%) of employment within four-year colleges or medical institutions compared to business/industry.

These observations were further confirmed by Chi-square test results that underscored a significant relationship between social structures and sector of employment for each period: 2003, \( \chi^2 (15) =163.576, p < .000 \); 2006, \( \chi^2 (15) =160.400, p < .000 \); 2008, \( \chi^2 (15) =156.339, p < .000 \); and 2010, \( \chi^2 (15) =161.378, p < .000 \). Therefore, the social structures defined at the intersection of gender and race/ethnicity were likely to affect the S&E doctorate recipients’ sector of employment throughout the four periods.

The above findings show that the intersectional gender and race model proposed in the literature (Chafetz, 1997; Collins, 1999; James & Busia, 1993; Zinn & Dill 1996) does not only apply to the labor market experiences of WOC, but also to other social groups. Therefore, the intersectionality approach is useful in examining the effect of social structures on labor market
outcomes. The findings noted in research question 2 on salary distribution bolster this argument even more.

### Employment Sector Profiles by Human Capital Factors

The cross-tabulation results in Table 4.2 outline participants’ employment sector profiles for 2003, 2006, 2008, and 2010 by human capital factors. A computed chi-square (χ²) test shows whether there is (or not) significant association between employment sector and field of study, which is a crucial dimension of doctorate recipients’ human capital.

#### Table 4-2 S&E doctorate recipients’ employment sector profiles by human capital factors (column %)

<table>
<thead>
<tr>
<th>Field of Study</th>
<th>Comp /Math.</th>
<th>Life Sciences</th>
<th>Phys. Sciences</th>
<th>Social Sciences</th>
<th>Eng.</th>
<th>Other S&amp;E</th>
<th>Sig. p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Sector</td>
<td>2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>1.8</td>
<td>2.8</td>
<td>3.3</td>
<td>5.2</td>
<td>1.2</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Insti.</td>
<td>57.5</td>
<td>59.5</td>
<td>41.6</td>
<td>54.6</td>
<td>27.2</td>
<td>65.0</td>
<td>***</td>
</tr>
<tr>
<td>Government</td>
<td>7.2</td>
<td>9.4</td>
<td>7.3</td>
<td>10.8</td>
<td>7.9</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>33.5</td>
<td>28.3</td>
<td>47.8</td>
<td>29.4</td>
<td>63.6</td>
<td>26.1</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>2.3</td>
<td>2.8</td>
<td>3.5</td>
<td>5.7</td>
<td>0.7</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Insti.</td>
<td>57.7</td>
<td>53.8</td>
<td>40.4</td>
<td>52.6</td>
<td>25.6</td>
<td>60.5</td>
<td>***</td>
</tr>
<tr>
<td>Government</td>
<td>5.9</td>
<td>10.0</td>
<td>5.1</td>
<td>11.1</td>
<td>8.1</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>34.2</td>
<td>33.4</td>
<td>51.0</td>
<td>30.6</td>
<td>65.6</td>
<td>26.8</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>3.2</td>
<td>3.3</td>
<td>3.5</td>
<td>4.6</td>
<td>0.7</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Insti.</td>
<td>55.4</td>
<td>51.1</td>
<td>39.1</td>
<td>51.0</td>
<td>24.8</td>
<td>57.3</td>
<td>***</td>
</tr>
<tr>
<td>Government</td>
<td>7.7</td>
<td>11.2</td>
<td>6.7</td>
<td>12.6</td>
<td>9.1</td>
<td>10.2</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>33.8</td>
<td>34.3</td>
<td>50.7</td>
<td>31.8</td>
<td>65.4</td>
<td>28.7</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Year Coll. and Other Sch.</td>
<td>3.1</td>
<td>3.0</td>
<td>3.9</td>
<td>5.8</td>
<td>1.0</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>4-Year Coll. and Medical Insti.</td>
<td>54.3</td>
<td>51.9</td>
<td>39.3</td>
<td>50.7</td>
<td>25.5</td>
<td>56.7</td>
<td>***</td>
</tr>
<tr>
<td>Government</td>
<td>6.7</td>
<td>11.1</td>
<td>6.5</td>
<td>11.6</td>
<td>9.5</td>
<td>10.2</td>
<td></td>
</tr>
<tr>
<td>Business/Industry</td>
<td>35.9</td>
<td>33.9</td>
<td>50.3</td>
<td>31.9</td>
<td>64.0</td>
<td>28.0</td>
<td></td>
</tr>
</tbody>
</table>

**N=2996**

*** represents significance level p < .000

First, it is noticeable that the distributions of S&E doctorate recipients’ employment across sectors remain relatively unchanged throughout the four periods considered within each field of study. Second, the highest proportions of the participants were employed in four-year college and medical institutions and business/industry sectors. Further analysis by field of study shows varied proportions of employment by the same two employment sectors. While the higher
percentages of those who specialized in computer/mathematics, life sciences, social sciences, and the other S&E category worked in four-year college and medical institutions, those who majored in physical sciences and engineering mostly worked in the business/industry across the four periods. It is noticeable that over 60% the engineering participants were employed in business/industry throughout the four periods.

These observations suggest a relationship between field of study and employment sector. These patterns were further confirmed by Chi-square test results that highlighted a significant relationship between human capital structures and sector of employment for each period: 2003, ($\chi^2 (15) = 270.964, p < .000$); 2006, ($\chi^2 (15) = 267.785, p < .000$); 2008, ($\chi^2 (15) = 235.920, p < .000$); and 2010, ($\chi^2 (15) = 226.308, p < .000$). Therefore, the field of study (as a human capital factor) is likely to affect the S&E doctorate recipients’ sector of employment throughout the four periods. When considered with the results noted in Table 4.1, which shows varied proportions of employment in different employment sectors by the intersected social characteristics, we can certainly question whether social factors or field of study influence more the labor market experiences and outcomes of the S&E doctorate recipients.

**Research Question 2**

Do S&E doctorate recipients’ salary profiles vary in the year 2010 by intersecting social structures and human capital factors?

**Salary Profiles by Social Structures**

This section provides a comparison of the 2010 salary by social structures. The results from the descriptive statistics (i.e., means and standard deviations) as displayed in Table 4.3 compare the 2010 salary of S&E doctorate recipients who belong to specific social groups. I first noticed that males earned more than females within each race/ethnicity group. Among both males and females, Asian doctorate recipients earned the highest mean salary in 2010. Asian males are at the top of the earning list while URM females are at the bottom.
Table 4-3  Means and standard deviations of S&E doctorate recipients’ 2010 salaries by social structures

<table>
<thead>
<tr>
<th>Social Structures</th>
<th>N</th>
<th>Mean/Average ($)</th>
<th>Std. Deviation ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian_Male</td>
<td>466</td>
<td>112,000</td>
<td>30,800</td>
</tr>
<tr>
<td>Asian_Female</td>
<td>157</td>
<td>99,100</td>
<td>31,600</td>
</tr>
<tr>
<td>White_Male</td>
<td>1308</td>
<td>99,400</td>
<td>35,200</td>
</tr>
<tr>
<td>White_Female</td>
<td>776</td>
<td>85,900</td>
<td>34,200</td>
</tr>
<tr>
<td>URM_Male</td>
<td>174</td>
<td>95,300</td>
<td>33,500</td>
</tr>
<tr>
<td>URM_Female</td>
<td>115</td>
<td>78,800</td>
<td>32,200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,996</td>
<td>96,800</td>
<td>35,100</td>
</tr>
</tbody>
</table>

Note: Salaries were rounded to the nearest $100

The ANOVA test shows a statistically significant difference among the mean salary by social structures (F (5, 2990) = 43.248, p < .000). Tukey’s HSD pairwise comparisons were then applied to assess differences between groups, and results are presented below.

- Asian_Male group earned significantly higher salary (m = 112,000, sd = 30,800) than all the other five groups: Asian_Female, White_Male, White_Female, URM_Male, and URM_Female.
- Asian_Female group earned significantly higher salary (m = 99,100, sd = 31,600) than other female groups: White_Female and URM_Female. They earned significantly less than Asian_Male, but there is no significant difference in salary when compared to White_Male and URM_Male groups.
- White_Male group earned significantly higher salary (m = 99,400, sd = 35,200) than White_Female, and URM_Female, but significantly less than the Asian_Male group. There was no significant difference when compared to Asian_Female and URM_Male groups.
- White_Female group earned significantly lower salary (m = 85,900, sd = 34,200) than Asian_Female, Asian_Male, and White_Male groups, but there was no significant difference when compared to the URM_Female.
- URM_Male group earned significantly higher salary (m = 95,300, sd = 33,500) than White_Female and URM_Female groups, but significantly lower salary than Asian_Male.
There were no significant differences in salary when compared to Asian_Female, and White_Female groups.

- URM_Female group earned significantly lower salary ($m = 78,800, sd = 32,200) when compared to all groups, although there was no significant difference when compared to White_Female group.

These identified differences in salary by social structures for doctorate recipients are comparable to findings of previous social science research. Separate investigations by Bound and Dresser (1999) and later by Brown and Misra (2003), though focused on individuals at varied education levels, also use the intersection of gender and race framework to identify discrepancies in wages.

**Salary Profiles by Human Capital Factors**

Table 4.4 provides the means and standard deviations of the participants’ 2010 salary by field of study. It is first noticeable that the doctorate recipients who worked in engineering professions earned more than those who worked in other fields followed by doctorate recipients in computer/mathematics, physical sciences, Other S&E and life sciences. Those who obtained degrees in social science earned the lowest salary in 2010.

<table>
<thead>
<tr>
<th>Fields of Study</th>
<th>N</th>
<th>Mean/Average ($)</th>
<th>Std. Deviation ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>580</td>
<td>115,700</td>
<td>30,100</td>
</tr>
<tr>
<td>Computer/Mathematics</td>
<td>222</td>
<td>102,600</td>
<td>35,200</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>491</td>
<td>98,700</td>
<td>33,300</td>
</tr>
<tr>
<td>Other S&amp;E</td>
<td>157</td>
<td>96,700</td>
<td>33,600</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>722</td>
<td>90,300</td>
<td>34,500</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>824</td>
<td>86,600</td>
<td>34,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2,996</td>
<td><strong>96,800</strong></td>
<td><strong>35,100</strong></td>
</tr>
</tbody>
</table>

*Note: Salaries were rounded to the nearest $100*
The ANOVA test shows a statistically significant difference among the mean salary by fields of study ($F(5, 2990) = 59.125, p < .000$). Tukey’s HSD pairwise comparisons were then applied to assess differences between fields of study, and results are presented below.

- Engineering degree recipients earned significantly higher salaries ($m = 115,700$, $sd = 30,100$) than those in all the other five fields: computer/mathematics, life sciences, physical sciences, social sciences, and other S&E (that likely include medicine and science-related management).

- Social science degree recipients ($m = 86,600$, $sd = 34,500$) earned significantly lower salaries compared to those in all fields of study, except the life sciences, which shows no significant difference in salary.

- Life science degree recipients earned significantly lower salaries ($m = 90,300$, $sd = 34,500$) than those who worked in engineering, computer/mathematics, and physical sciences, but no significant difference compared to those in social sciences, and other S&E fields.

- Physical science degree recipients earned significantly higher salaries ($m = 98,700$, $sd = 33,300$) than life sciences and social sciences, but significantly less than those who obtained degrees in engineering. There were no significant difference compared to those in computer/mathematics and other S&E fields.

- Other S&E degree recipients earned significantly higher salaries ($m = 96,700$, $sd = 33,600$) than those in social sciences, but significantly less than those in engineering. There were no significant difference in salary compared to those in life sciences, computer/mathematics, and physical sciences.

The differences in the 2010 salaries by field of study for the S&E doctorate recipients suggest that although the positive relationship between earnings and higher education attainment predicted by human capital theory is valid (doctorate recipients obtain high salaries), there is however variability in earnings which is caused by field of study, even at the same degree level.
Research Question 3

Are there differences in the S&E doctorate recipients’ career paths (i.e., sequence of employment sectors) by intersecting social structures (i.e., gender and race) and human capital factors (i.e., field of study) for those who are employed at all times (2003, 2006, 2008, 2010)?

Having established the differences in employment sector and salary profiles by social structures and human capital factors above, this section provides comparative analyses of participants’ career paths (i.e., sequence of employment sectors) based on the same factors. The main question that will be answered is: Does the stability of one’s career path differ by social structure and field of study? I define career stability as same employment sector over multiple survey cycles.

First, an overall distribution plot of the participants’ career paths is shown, followed by selected plots for engineering, life sciences and social sciences. These three fields were chosen based on the dissimilarity in employment sector profiles between those who specialized in engineering and those in the social sciences. At the same time, the employment sector distributions were more evenly distributed for the life science participants as illustrated in Table 4.2. These fields of study are also very different in terms of knowledge and skills, as well as domains in the labor market and society where doctorate recipients’ expertise would be useful and valued. It is important to note that the sequence analyses incorporate both social structures and human capital factors. This is somewhat different from the first two sections, where the effect of social structures and human capital factors on employment sector and salary were considered separately.

Each plot shows the sequence of employment sectors from 2003 through 2010. In each survey cycle respondents indicated their sector of employment which corresponds to a state in the sequence. These states were plotted together to form individual sequences corresponding to each individual record. The states are highlighted with different colors as noted in the plot key. The employment sector frequency tables correspond with the plots and provide a count (and percentage) of the sequences for the top ten most popular types. Each sequence is in some
order a combination of the four possible employment sectors: 2-year college or other schools, 4-year college or medical institution, business/industry, government. I should note that sequence analysis is based on the unweighted sample which means results provide mainly general information on the types of trajectories, and comparisons among groups should be made cautiously.

**Career Paths for all Doctorate Recipients**

The sequence plot in Figure 4.1 displays the 2,996 sequences of employment sectors for all the participants. Sequences are ordered in 2003 by the four employment sectors. Each sequence then displays various sectors on the subsequent years. Some sequences indicate steady employment sectors (no changing colors) while others combine different sectors (colors).

![Figure 4.1 Distribution of career paths sequences](image)

Table 4.5 provides additional information about Figure 4.1 by presenting the most frequent sequences in decreasing order. Results show that 40% of the participants worked within four-year colleges and medical institutions through the entire period, 2003 to 2010. Also, 31.6% of the participants were within business/industry, 6.17% in government, and 1.97% in two-year colleges and other education systems’ sectors at all 4 times between 2003 and 2010. Therefore,
80.24% of the doctorate recipients show stable career paths within respective employment sectors. The remaining 19.76% of participants transitioned between sectors in different combinations. However, it is important to note that in terms of the sample population of 2,996 participants, the remaining 19.76% corresponds to a significant amount of 592 doctorate recipients. Whether changing employment sectors or maintaining work in the same sector is a positive or negative outcome is certainly debatable within KBE. It is also important to note that employment sector information is available at quite a large interval of time (2-3 years) which means that doctorate recipients could have been involved in sector changes that are not captured by this study.

Table 4-5 Frequency distribution of employment sector sequences

<table>
<thead>
<tr>
<th>Sector(s)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Year College and Medical Institution (4)</td>
<td>1213</td>
<td>40.00%</td>
</tr>
<tr>
<td>Business/Industry (4)</td>
<td>948</td>
<td>31.64%</td>
</tr>
<tr>
<td>Government (4)</td>
<td>185</td>
<td>6.17%</td>
</tr>
<tr>
<td>4-Year College and Medical Institution/(1) -Business/(3)</td>
<td>79</td>
<td>2.64%</td>
</tr>
<tr>
<td>4-Year College and Medical Institution/(2) -Business/(2)</td>
<td>59</td>
<td>1.97%</td>
</tr>
<tr>
<td>2-Year College and Other School System/ (4)</td>
<td>58</td>
<td>1.94%</td>
</tr>
<tr>
<td>Business/Industry/Industry/(1) -4-Year College and Medical Institution/ (3)</td>
<td>30</td>
<td>1.00%</td>
</tr>
<tr>
<td>Business/Industry/(2) -4-Year (2)</td>
<td>27</td>
<td>0.90%</td>
</tr>
<tr>
<td>Business/Industry/(2) -Government/ (2)</td>
<td>23</td>
<td>0.77%</td>
</tr>
<tr>
<td>4-Year College and Medical Institution/ (3) -Business/(1)</td>
<td>22</td>
<td>0.73%</td>
</tr>
</tbody>
</table>

Note: The numbers in brackets () represent number of consecutive periods in particular sector.

Career Paths: Selected Fields of Study

This section includes sequence analyses on three selected fields of study: engineering, life science, and social science. These were selected for further analyses based on their high rate of participation by the doctorate recipients as noted above in the frequency analyses. The employment sector sequences plots within this section are presented for each field of study, at the intersection of social structures (gender and race).
Employment sector sequences: Engineering. Figure 4.2 displays sequences of employment sector for the doctorate recipients specialized in engineering by the intersecting social structural factors. There were 152 unique employment sector sequences for Asian males and 33 unique sequences for Asian females. It was evident that the higher proportion of Asian males and females were employed in the business/industry for the four survey years (2003, 2006, 2008, and 2010), and the second highest proportion were employed in four-year colleges and medical institutions. A higher proportion of Asian females worked in the government sector with some transition from four-year colleges or medical institutions and government sectors to the business/industry, particularly in 2010. There were no sequences that included the two-year colleges or other school systems sector for these groups.

In comparison to the Asians, White male and female groups had more varied employment sector sequences. It was also noticeable that a higher proportion of Whites worked in four-year colleges or medical institutions than in business/industry in comparison to Asians. Of the 267 unique sequences for White males, the highest proportion is in business/industry throughout the period. The 52 sequences corresponding to White females were more evenly distributed between four-year colleges or medical institutions, and business/industry than for their male counterparts, but they showed more movements between four-year colleges or medical institutions, business/industry, and government. There was a very minute proportion of Whites involved in two-year colleges or other college systems.

As expected, the URM population had less employment sector sequences: males totaled 51 and females totaled 18. The URMs’ employment sector sequences were less stable than for Asians and Whites. The URM females had the highest proportion of employment within the government and two-year colleges or other college system sectors.

In general, the males of all three race/ethnic groups had higher employments in the business/industry sector in comparison to the female groups. The Asian females also had a higher proportion of employment in the business/industry compared to White and URM females. The URMs clearly had the least stable career paths.
Figure 4-2 Distribution of employment sector sequences by gender-race/ethnic groups:

Career path sequences: Life sciences. Figure 4.3 displays sequences of employment sector for the doctorate recipients specialized in life sciences by the intersecting social structural factors. There were 80 unique sequences for Asian males and 60 unique sequences for Asian females. Both groups showed a higher proportion of transitions to the business/industry sector between 2006 and 2010.
The White females’ (182) employment sector sequences were less stable than those (278) of white males. The White females also had higher transition into the business/industry sector in comparison to the White males.

The URM groups had a higher proportion of employment in four-year colleges or medical institutions. The URM males (totaled 70 unique sequences) had some changes into the business/industry sector for the latter years. The URM females (totaled 49 unique sequences) had a significantly smaller proportion of employment in the business/industry sectors than the other groups, and a larger proportion of employment in government and two-year colleges or other school systems sectors.

Overall, the highest proportions of employment for all groups were in four-year colleges and medical institutions. Sequences also showed movements between government and business/industry sectors.
Figure 4-3 Distribution of employment sector sequences by gender-race/ethnic groups:

Life Science

**Career path sequences: Social sciences.** Figure 4.4 displays sequences of employment sector for the doctorate recipients specialized in social sciences by the intersecting social structural factors. The Asian males (totaled 35 sequences) had stable employment sequences in the four-year colleges or medical institutions sector, while the Asian females (totaled 33 sequences) had a high proportion of employment in the four-year colleges or medical
Institutions sector in 2003 with a decreasing trend for 2006, 2008, and 2010. The plots also show that most of the participants who started in 2003 within a particular sector stayed with these sectors for the four years.

The White male and female groups had the highest occurrence of employment within the social sciences: males had 250 sequences and females had 317 sequences. The higher proportions worked in four-year colleges or medical institutions, which were mostly stable within employment sector sequences. The White females had a slightly higher proportion of changes in the latter years in comparison to their male counterparts.

Among the URM groups, males (74 sequences) and females (113 sequences) also had somewhat stable employment sector sequences throughout the period under study, but mostly in our-year colleges or medical institutions. The small changes between sectors were between government and business/industry.

Overall, the highest concentration of employment for all groups within the social science field of study was within four-year colleges or medical institutions. The social science doctorate recipients also seemed to have stable careers within sectors.
A comparison of the three fields of study, engineering, life sciences, and social sciences, shows that Asians were mostly employed in the business/industry sector, and White and URM S&E doctorate recipients were mostly employed in four-year colleges or medical institutions and government sectors. The females of all racial groups also had a higher proportion of employment in four-year colleges or medical institutions and government compared to business/industry sectors.
sectors. The majority of participants from all gender/race groups maintained stable careers. The changes between employment sectors mostly occurred between 2008 and 2010.

**Research Question 4**

What is the relative contribution of factors predicting the S&E doctorate recipients' salary for the year 2010, when we take into account the intersecting social structure attribute (i.e., gender and race), human capital factors (i.e., field of study), employment sector in 2010, and number of times employment sectors were changed between 2003-2010 (i.e., as a proxy for career mobility)?

Each of the analyses conducted to address the first three research questions showed differences in employment sector profiles, career paths, and 2010 earnings by social structures and fields of study. Since these bivariate analyses could not capture the relative importance of social structures and human capital factors on career outcomes, I further employed multivariate statistics techniques to predict earnings. This section presents results of regression analyses, which identify a combination of factors that best predict the S&E doctorate recipients’ 2010 salaries. Ten separate regression models were computed. First, the main model included a combination of all hypothesized explanatory variables: social and human capital factors, the 2010 employment sector and the number of sector changes experienced by participants during the period. Second, I also conducted separate regression analyses for each of the gender-race social groups (i.e., Asian_Male, Asian_Female, White_Male, White_Female, URM_Male, URM_Female) when taking into account all fields of study and for the three selected fields of study (i.e., social sciences, engineering, life science), because I assumed that the corresponding models could provide different results. It is important to note that for all 10 linear regression models, there was no violation of the assumption of normality, linearity, and multicollinearity.

**Earnings Model for all S&E Doctorate Recipients**

Table 4.6 comprises results from regression analysis of the entire S&E doctorate recipient sample (N=2,996), including all predictors mentioned above. Table 4.7 presents the unstandardized regression coefficients and their standard errors, as well as the corresponding p
values that indicate the statistical significance of t-tests for each regression coefficient. The table also includes the ANOVA test for the model and the adjusted R squared.

### Table 4-6 Regression model for 2010 salary (all S&E doctorate recipients)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>B</th>
<th>Std. error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>12433</td>
<td>1528</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Social Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian_Male</td>
<td>3830</td>
<td>1687</td>
<td>.023</td>
</tr>
<tr>
<td>Asian_Female</td>
<td>-3833</td>
<td>2586</td>
<td>.138</td>
</tr>
<tr>
<td>White_Female</td>
<td>-2468</td>
<td>2452</td>
<td>.314</td>
</tr>
<tr>
<td>URM_Male</td>
<td>-13559</td>
<td>3023</td>
<td>.000</td>
</tr>
<tr>
<td>URM_Female</td>
<td>-10209</td>
<td>1450</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Human Capital Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer/Mathematics</td>
<td>-4361</td>
<td>2426</td>
<td>.072</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>-13159</td>
<td>1781</td>
<td>.000</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>-10227</td>
<td>1889</td>
<td>.000</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>-14276</td>
<td>1807</td>
<td>.000</td>
</tr>
<tr>
<td>Other S&amp;E</td>
<td>-18820</td>
<td>2862</td>
<td>.511</td>
</tr>
<tr>
<td><strong>Employment Sector in 2010</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Yr College and Other School. Sys.</td>
<td>-32298</td>
<td>3094</td>
<td>.000</td>
</tr>
<tr>
<td>4-Yr College or Medical Institutions.</td>
<td>-26320</td>
<td>1260</td>
<td>.000</td>
</tr>
<tr>
<td>Government</td>
<td>-1695</td>
<td>2013</td>
<td>.400</td>
</tr>
<tr>
<td><strong>Number of Sectors Changed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One Sector Change</td>
<td>-13379</td>
<td>1636</td>
<td>.000</td>
</tr>
<tr>
<td>Two or more Sector Changes</td>
<td>-5978</td>
<td>2577</td>
<td>.002</td>
</tr>
<tr>
<td><strong>Test Statistics</strong></td>
<td></td>
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</tr>
<tr>
<td>Adjusted R Squared</td>
<td>.251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANOVA F Value</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANOVA Sig (p-value)</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A significant regression model was found which predicted 25% (adjusted R Squared of .251) of the variance in the S&E doctorate recipients’ 2010 salaries ($F (15, 2980) = 68.003, p<.001$). Asian males had a significantly higher salary of about $3,800 more than the average of about $124,300. The other significant result is that the two URM groups obtained lower salaries than average. For instance, an URM male was likely to earn about $13,500 less and an URM female was likely to earn approximately $10,200 less than the average salary. Therefore, being Asian male has a positive effect on salary, while being URM male or female has a negative effect
on salary. These results also confirm findings of previous research, even though not specific to highly educated workers, which identify income discrepancies for specific gender and/or race groups, particularly for women of color (WOC) and White females (Browne & Misra, 2003; McCall, 2001).

The effect of human capital factors on salary showed varied effects of field of study on earnings. Statistically significant differences were notable for life sciences (about $13,000 less than average), physical sciences (about $10,200 less than average), and social sciences (about $14,200 less than average). However, doctorate recipients with degrees in computer/math and other S&E fields show no significant difference when compared to the average salary.

With respect to employment sectors, when all other factors were held constant, differences in salary were significant for the academic sectors. S&E doctorate recipients who worked in two-year colleges and other school systems had salaries that were likely to be lower than the average salary by $32,300 and those in four-year colleges or medical institutions had salaries that were likely to be lower than the average by $26,300.

Finally, changing employment sectors mostly led to a negative effect on the 2010 salary, although the effect of the number of sector changes between 2003 and 2010 was not clear. Recipients with the more ‘stable’ path of one sector change likely had their salaries decreased significantly by $13,400 compared to average salary. However, being in a less ‘stable’ path characterized by two or more sector changes likely led to salaries decreased by only $6,000 compared to average.

The results in previous sections show that those participants within the academic sectors earned lower salaries; therefore, more stable careers within these sectors may not account for the increase in annual salaries. This assumption on the relationship of career stability and earnings is further substantiated by Turner, Gonzalez and Wong (2008) analyses of national data sets on labor market outcomes that show WOC encounter obstacles in being tenured, and at the same time perceive their work as undervalued (and less rewarded) within academic institutions.
Earnings Models and Social Structures

Tables 4.7 to 4.9 provide results from six regression analyses of S&E doctorate recipients that belong to each of the six social structures. The independent variables used in these models include fields of study, 2010 employment sectors, and number of sector changes. The tables present the unstandardized regression coefficients and their standard errors, as well as the corresponding p values that indicate the statistical significance of t-tests for each coefficient. In addition, the tables include the ANOVA test for each model and the adjusted R squared.

**Asian males.** A significant regression model was found which predicted 20.4% (adjusted \( R^2 \) of .204) of the 2010 salary variance for the Asian male S&E doctorate recipients \((F (10, 455) = 12.948, p<.000)\) as noted in Table 4.7 below. The breakdown by human capital factors showed statistically significant but mixed (positive and negative) relationships for different fields of study when compared with engineering ($125,100). Those who specialized in the life and social sciences likely earned about $5,300 and $13,600 respectively less. However, those who majored in computer/mathematics, social sciences, and the other S&E fields did not earned a significant difference in salary.

Regarding the effect of employment sectors, when all other factors were held constant, each Asian male that worked in the four-year colleges and medical institutions sector likely earned $24,300 less than the average salary. However, there were no statistical differences in amount of earnings for those who worked in the two-year college and other school systems, and the government sectors. Finally, Asian males that changed employment sectors twice or more during the period likely earned less than the average salary.

Overall, this regression model affirms that Asian males earned their highest incomes as engineers within the business/industry. Also, the decrease in income for multiple sector changes suggests that these individuals may do better if they stay within the current employment position (engineering and business/industry) in which they are successful.

**Asian females.** A significant regression model was found which predicted 24.3% (adjusted \( R^2 \) of .243) of the 2010 salary variance for the Asian female S&E doctorate recipients \((F (10, 146) = 6.002, p<.000)\) as noted in Table 4.7.
None of the participants within this group showed any significant difference in their earnings by field of study when compared to the average salary. Only for the Life sciences degree recipients, earnings were about $12,700 much lower than the average. Regarding employment sectors, when all other factors were held constant, each Asian female that worked in non-business/industry employment sectors, except government, likely earned significantly less than the average salary: two-year college and other school systems ($42,000 less) and four-year colleges or medical institutions ($31,000 less). Those working in the government sector showed no significant salary difference compared to the average salary. However, none of the regression coefficients indicating changes between sectors is statistically significant which suggests career mobility did not play a major role in Asian females’ earnings.

The results of this regression model illustrate that Asian females, similar to their male counterparts, prosper in engineering professions and the business/industry sector. This is a unique result as it shows that females of the Asian race are able to obtain rewarding employment similar to their male counterparts.

**White males.** A significant regression model was found which predicted 28.6% (adjusted R Squared of .286) of the 2010 salary for White male S&E doctorate recipients (F (10, 1297) = 53.441, p<.000) as noted in Table 4.8 below. When all other factors were fixed, significant but negative coefficients to the earnings model were noticeable for those who majored in the life sciences ($10,400 less than the average salary of about $127,800), physical sciences ($11,600 less), and social sciences ($12,400 less). There were no significant differences for computer/mathematics and the other S&E fields.

The sector of employment also had significant but negative relationship with earnings. Individuals who worked in two-year colleges and other school systems, four-year colleges and medical institutions, and government sectors likely earned $47,300, $34,000, and $5,900 less than average, respectively. Also, those who changed employment sectors once earned $13,400 less than the average, but surprisingly those who changed sectors more than twice showed no significant difference in earnings.
Table 4-7 Regression models of 2010 salary for the Asian doctorate recipients

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<th></th>
<th>Asian_Female</th>
<th></th>
<th>p</th>
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<td></td>
<td></td>
<td>B</td>
<td>Std. error</td>
<td></td>
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<td>.000</td>
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<td>.546</td>
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<td>.737</td>
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<td></td>
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<td></td>
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<td></td>
<td>.000</td>
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</table>
Overall, as with Asian males, White males earned higher in engineering fields and the business/industry sector. The significant negative coefficients corresponding to academic sectors also help explain the growing preference for business/industry sectors by prospective doctoral graduates.

**White females.** A significant regression model was found which predicted 10.0% (adjusted $R^2$ of .100) of the salary variance for White female S&E doctorate recipients ($F_{(10, 765)} = 8.492, p<.000$) (Table 4.8). The breakdown by fields of study showed significantly negative coefficients in the earnings model for two fields of study. Those who majored in both the life and social sciences earned approximately $17,000 less than average salary of about $111,000. Those who worked in the other fields showed no significant difference in earnings.

Regarding employment sectors, when all other factors were held constant, each White female that worked in a non-business/industry employment sector except government likely earned significantly less than the average salary: two-year college and other school systems ($15,700 less), and four-year colleges or medical institutions ($15,000 less). Those who worked in the government sector likely earned $5,900 more than the average. Finally, White females that changed employment sectors during the period likely earned less than the average: one sector change ($15,000 less), and two or more sector changes ($17,800 less).
Table 4-8 Regression models of 2010 salary for the White doctorate recipients

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<td>2-Yr College and Other School Systems</td>
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<td>4-Yr College or Medical Institutions</td>
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</tr>
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Overall, the results show that white females earn less in life and social sciences in comparison to those who specialized in the other fields. At the same time, they also earn less in the academic sectors when compared to the other sectors.

**URM males.** A significant regression model was found which predicted 16.6% (adjusted R Squared of .166) of the 2010 salary for URM male S&E doctorate recipients (F (10, 163) = 4.447, p<.000) as noted in Table 4.9 below. When all other factors were held constant, significant but negative coefficients to the earnings model were noticeable for those who specialized in the life and social sciences, both of which likely earned about $15,000 less than the average salary. Regarding employment sectors, only those who worked in the four-year college or medical institutions sector likely earned below the average salary at about $26,200 less. There was no significant difference in salary based on the number sector changes made by the participants.

It is noticeable that the earnings of URM males who majored in computer/mathematics, physical sciences, and other S&E fields were not significantly different than the average salary. This is comparable to the earnings of the other two male groups (Asian males and White males). At the same time, the significantly lower earnings by URM males who worked in four-year colleges or other medical institutions, helps explain the growing preference by males across race groups to work in the higher paying business/industry sector (Sauermann & Roach, 2012).

**URM females.** A significant regression model was found which predicted 25.7% (adjusted R Squared of .257) of the 2010 salary for URM female S&E doctorate recipients (F (10, 104) = 4.938, p<.000) as noted in Table 4.9 below. When all other factors were held constant, significant but negative coefficients to the earnings model were noticeable for all fields of study except computer/mathematics and the other S&E fields’ category when compared to the average salary at about $124,600. Those who specialized in the life sciences likely earned about $28,300 less; physical sciences, $33,800 less; social sciences, $37,200 less; and other S&E $6,900 less.
Table 4-9 Regression models of 2010 salary for the URM doctorate recipients

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<tr>
<th>Independent Variables</th>
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<th>p</th>
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</table>
With regards to employment sectors, when all other factors were held constant, each URM female that worked academic sectors likely earned significantly less than the average salary: two-year college and other school systems ($29,900 less) and four-year colleges or medical institutions ($17,400 less). Finally, URM females that changed employment sectors during the period likely earned less than the average: one sector change ($17,300 less), and two or more sector changes ($22,900 less).

This regression model on URM females affirms previous studies which suggest that women of color are at a disadvantage in academia (Ginther & Kahn, 2012; Turner, González, & Wong, 2011). However, overall in this study the disadvantage in earnings are not limited to academia but business/industry sector.

**Earnings Models and Human Capital Factors (Selected Fields of Study)**

Table 4.10 provides results from regression analyses for S&E doctorate recipients in engineering, life science, and social science fields. The independent variables used in these models included the social structures, 2010 employment sectors, and number of sector changes. Each table presents the unstandardized regression coefficients and their standard errors, as well as the corresponding p values of t-tests for each regression coefficient. The table also includes the ANOVA test for the model and the adjusted R squared.

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**Engineering field of study.** A significant regression model was found which explained 15.35% of 2010 salary for engineering doctorate recipients (F (10, 579) = 11.482, p<.000) as noted in Table 4.10 below. However, there is no statistically significant effect of social structures on earnings with one exception: being an URM female will significantly lower the average salary of about $124,400 by $9,600.

With regards to employment sectors, when all other factors were held constant, each individual that held an engineering doctorate that worked in a non-business/industry employment sector, with the exception of the government sector, likely earned significantly less than the average salary: two-year college and other school systems ($58,800 less), and four-year colleges
or medical institutions ($20,900 less). There was no significant difference in earnings for those who worked in the government sector.

The regression model also showed that for each engineer that changed employment sectors once during the period, there was a significant and negative effect of lowering salary by about $16,200. This is unexpected, as within the same regression model the participants that have less stable paths (two or more changes in employment sectors) did not earn significantly different salary than those with stable careers.

The model suggests an earning advantage for the engineering field regardless of social structures. However, employment sector matters because individuals who worked in academic sectors earned significantly less than the average salary even with the same engineering degree. Noticeably, among the female engineers, only the URMs earned significantly less than the average salary, although all female groups in engineering are more likely to have below average salaries. Therefore, the intersectionality framework uncovers the unique disadvantage of URM females in the S&E doctorate labor market.

Life science field of study. A significant regression model was found which explained 15.4% of the 2010 salary for life science doctorate recipients ($F (10, 711) = 14.150, p<.000$) as noted in Table 4.10 below. However, as with those in the engineering field of study, there is no statistically significant effect of social structures on earnings with one exception: being an URM female will significantly lower the average salary of about $103,700 by $9,300. In general, female groups in the life sciences and the URM males are more likely to earn less than average salaries.

With regard to employment sectors, results were similar to engineering. The regression model shows that when all other factors were held constant, each individual that held a life science doctorate and worked in a non-business/industry employment sector, with the exception of the government sector, likely earned significantly less than the average salary: two-year college and other school systems ($38,100 less), and four-year colleges or medical institutions ($25,200 less). There was no significant difference in earnings for those who worked in the government sector.
The regression model also showed that career stability had significant effects on earnings; where, those who changed employment sectors once during the period, likely earned less than the average salary by about $11,200, and those with two or more sector changes likely earned less than the average by about $11,900.

As in engineering, it is noticeable that URM females were the only social group to have earned less than the average salary. This also points to the dual influence of these individuals’ gender and race on their experiences in the labor market.

**Social science field of study.** A significant regression model was found which explained 10.1% of 2020 salary for life science doctorate participants (F (10, 813) = 10.132, p<.000) as noted in Table 4.10. However, there were varied effects by the different social structures on earnings. First, members of the Asian_Male group were the only participants to have earned significantly higher ($11,600 more) than the average ($103,700). Second, only the URM groups earned significantly less than the average salary. It is important to highlight that the URM males had the largest earnings gap by about $18,000 when compared to the others. Finally, both Asian and White females’ salaries were not significantly different from the average.

Those who worked in academic sectors were also likely to have earned less than the average salary: two-year colleges and other systems at about $30,900 less, and four-year colleges or medical institutions at about $16,700 less. However, those who worked in the government sector likely earned about $3,400 more than the average. Regarding transition between employment sectors, those who changed sectors once likely earned $13,600 less and those with two or more changes likely earned $5,800 less than the average salary.

There were two noticeable contrasts in the results of this regression. While Asian males had significantly higher earnings, URM males earned very significantly less. Also, only the URM females of the three female groups earned significantly lower salary. It is also worth emphasizing that only members of the URM groups, along with those who worked in the academic sectors earned less than the average salary.
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<td>p</td>
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<td>Std.</td>
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Summary of Major Findings

Employment Sector Profiles by Social Structures

- Since a higher proportion of males than females were doctorate recipients, male groups were overrepresented in all employment sectors; meanwhile, the female groups were mostly employed in four-year colleges or medical institutions.

- Asian groups, both male and female, were overrepresented in the business/industry sector. White males were also mostly employed in business/industry, but to a lesser extent than the Asian groups. White females and both the URM male and female groups were mostly employed in four-year colleges or medical institutions.

- It is noticeable that over the four survey cycles (2003, 2006, 2008, and 2010) about 4% of the total participants within Asian and White groups transitioned to the business/industry employment sector. At the same time, individuals within the two URM groups more or less maintained their employment sector with the highest proportion of employment occurrences in four-year college and medical institutions.

Employment Sector Profiles by Fields of Study

- Engineering doctorate recipients had the highest proportion of employment within the business/industry sector.

- Life science doctorate recipients had a fairly even distribution of employment across all sectors.

- Social science doctorate recipients were somewhat evenly distributed between four-year colleges or medical institutions, two-year colleges and other school systems, and government, but were less present in the business/industry sector.

Career Paths

- The sequence analysis plot of employment sectors for all doctorate recipients shows that 80.24% of the participants had stable career paths throughout the period. Also, 40% of participants worked only in four-year colleges and medical institutions, and 31.6% worked only in business/industry.
• Sequence analyses for the engineering field of study show the following effects of social structures: (1) all male groups, regardless of race, had a higher proportion of stable career paths, mostly within business/industry, followed by four-year colleges or medical institutions; (2) Asian males had the highest proportion of stable career paths, mostly in business/industry; (3) Asian females had a higher proportion of stable career paths within business/industry compared to White and URM females; and (4) the URM groups’ stable career paths were mostly in the academic sectors.

• Sequence analyses for the life sciences field of study show the following effects of social structures: (1) Asian males and females had a high proportion of stable career paths within the business/industry sector; (2) Asian male and female groups who started within the four-year college or medical institutions sector showed some transition to business/industry; (3) URM groups were mostly employed in four-year colleges or medical institutions and exhibited somewhat stable career paths in comparison to other groups.

• Those who obtained doctorate degrees in the social sciences field of study had the highest proportion of career paths within four-year colleges or medical institutions for all social groups. These were mainly stable career paths with low proportions of movements into other employment sectors. However, it is noticeable that the Asian females who experienced a higher proportion of sector changes moved mostly from four-year colleges or medical institutions to business/industry.

**2010 Salaries and Social Structures**

Overall, the regression analysis for each social group defined at the intersection of gender and race shows mostly significant predictors but with negative correlation with salary. Results of the regression analysis confirm observations based on the descriptive statistics of 2010 salaries.

• **Asian males** earned significantly higher salary than all the other five groups. Asian males who obtained doctorates in engineering earned higher than the average salary compared to those who specialized in the life and physical sciences. Those who specialized in
computer/mathematics, social sciences, and other S&E fields (that likely include medicine and science-related management) showed no significant difference compared to engineering. With respect to employment sector, those who worked in the business/industry likely earned significantly higher salaries than those who worked in four-year college and medical institutions, but no significant difference when compared to those who worked in two-year colleges and other school systems, and the government sectors. At the same time, individuals who changed employment sectors more than twice during the period likely earned less than the average salary.

- **Asian females** earned significantly higher salary than other female groups, less than Asian males, but somehow comparable with the other two male groups. Asian females who held engineering doctorates earned significantly higher salary than all those who specialized in other fields. Those in other fields showed no significant difference. Those who worked in the academic sectors likely earned significantly less than the average salary. Their transition between employment sectors did not significantly affect their earnings.

- **White males** earned significantly higher than White and URM females, less than Asian males, but comparable with Asian females and URM males. White males with engineering doctorates earned significantly higher salary than those who specialized in the life, physical, and social sciences, but no significant difference with those who specialized in computer/mathematics and other fields. Participants who worked in the non-business/industry employment sector likely earned significantly less than the average salary. The individuals who changed employment sector only once likely earned higher than the average salary.

- **White females** earned comparable salary with URM females, but significantly less than all other groups. White females who held engineering doctorates earned significantly higher salary than those in the life and social sciences, but no significant difference when compared to the other fields of study. White females that worked in the academic sectors
likely earned significantly less than the average salary. Those who worked in the government sector likely earned more than the average salary. At the same time, those who changed employment sectors during the period likely earned less than the average salary.

- **URM males** earned significantly higher salary than White and URM females, less than Asian males, but comparable with Asian females and White males. URM males who held engineering doctorates earned significantly higher than the average salary than those who majored in the life and physical sciences, but no significant difference with those in computer/mathematics and the other S&E fields. Those who worked in four-year colleges or medical institutions, along with those who changed employment sectors, likely earned significantly less than the average salary. There was no significant difference when compared with those who worked in the government sector.

- **URM females** earned comparable salary with White females, but significantly less than all other groups. URM females showed somewhat similar trends to URM males. Those who held engineering doctorates earned significantly higher than the average salary for those in all fields of study except in computer/mathematics and the other S&E fields, both of which showed no significant difference. Those who worked in academic sectors or those who changed employment sectors likely earned significantly less than the average salary. There was no significant difference when compared with those who worked in the government sector.

**2010 Salaries and Human Capital Factors (Field of Study)**

Overall, the regression analysis models for engineering, life sciences, and social sciences show mostly significant predictors negatively correlated with the outcome. Results of the regression analysis confirm observations based on the descriptive statistics of 2010 salaries.
• **Engineering** doctorate recipients earned significantly higher salaries than those in all other fields. However, with respect to their sector of employment, those who worked in a non-business/industry employment sector, with the exception of the government sector, likely earned significantly less than the average salary.

• **Life Science** doctorate recipients earned significantly lower salaries than those who worked in engineering, computer/mathematics, and physical sciences, but comparable with those in social science and other S&E fields. However, with respect to their sector of employment, each individual that held a life science doctorate and worked in non-business/industry employment sectors, except for the government sector, likely earned significantly less than the average salary. Finally, those who changed employment sectors likely earned less than the average salary.

• **Social Science** doctorate recipients earned comparable salaries with those in life sciences, but significantly lower salaries compared to those in all other S&E specializations. However, with respect to their sector of employment, URM males and females earned significantly less than the average salary, while Asian and White females did not show any significant difference in salary. Those who worked in academic sectors were also likely to have earned less than the average salary. However, those who worked in the government sector earned salaries comparable to the average. Finally, those who transitioned twice or more between employment sectors likely earned less than the average salary.
Chapter 5
Discussion

This chapter provides an interpretation of selected major findings as it relates to research literature in the context of the intersection of gender and race theoretical framework adopted in this dissertation. The chapter also addresses the implications of the findings to theory, policy, and practice, and includes a discussion of the limitations of the study and future directions of research. The final section includes closing remarks on the importance of a substantial and meaningful return to investment in higher education.

Contributions to Research Literature

This section addresses the meaning of the major findings of this study in three main areas: inequalities experienced by women in the S&E doctorate workforce, inequalities experienced by URM males in the doctorate S&E workforce, and differences between academic and non-academic employment sectors. I take into consideration whether the study findings agree with or contradict previous research, and to what extent they contribute to previous research. However, it is important to note up front that a part of the rationale for this dissertation is the scant empirical attention which has been given to the S&E doctorate recipients. Therefore, most of my findings can be perceived as pioneering the literature on this topic.

Women in the S&E Doctorate Workforce

This research has unfolded differences in career paths and earnings of S&E doctorate recipients in relation to the intersected influence of their race/ethnicity and gender. There are several dissimilarities in their labor market outcomes as noted in chapter 4, but particularly striking are contrasts between female and male social groups, and gaps among the female social groups, particularly that of Asian and URM females.

With regards to the differences between the female and male social groups, first, the participants’ employment sector profiles show that, since higher proportion of males than females were doctorate recipients, male groups were as expected overrepresented in all employment sectors; meanwhile, the female groups were mostly employed in four-year colleges or medical
institutions. Second, all male groups, regardless of race, had a higher proportion of stable career paths, mostly within business/industry, followed by four-year colleges or medical institutions. These findings on difference in sector of employment by gender-race social groups are relevant to the general understanding of individuals’ career path success in terms of earnings, as place of employment is indicative of earning potential. This research has highlighted that significant differences are still evident between women and men with S&E doctorates when they are classified by their intersected social structures. The average earnings for the year 2010 vary from approximately $112,000 for Asian males, $99,400 for White males, $95,300 for URM males, compared to $99,100 for Asian females, $85,900 for White females, and $78,800 for URM females which show significant gender-race earning gaps in the S&E doctorate recipients’ workforce.

The differences in earnings between the female and male groups are even evident when comparing results within the academic employment sectors (Tables 4.7, 4.8, and 4.9). All female groups showed significantly lower earnings within four-year colleges or medical institutions, and two-year colleges and other school systems when compared to the average salaries, while the three male groups showed significantly higher earnings within the same employment sectors. These findings affirm previous research on academic careers, and extend findings specific to WOC. For example, Turner, González, and Wong (2011) reported in their qualitative analysis of WOC faculty members that the women felt socially isolated from their coworkers and that their scholarly works were not perceived as the same value as of their male colleagues. This current study suggests that Asian and White females may be also facing obstacles in academic institutions, at least with regards to their earnings. It is also interesting, according to sequence analyses results, that the women within the three social groups generally had stable careers throughout the period within academic sectors, with the exception of Asian females, which showed some movements towards business/industry. It is possible that even receiving lower earnings than men, members of the women groups are willing to persist within academic sectors. This is an area for further investigation, as there may be additional reasons for staying in
academic sectors, such as personal and family preferences. There is also research which suggests that married women with children have less chance of being tenured in four-year colleges (Ginther & Kahn, 2009) which perhaps contribute to making other career choices or advancing slower in academic positions.

In addition to the findings on the difference between the female and male groups in academic sectors, the case of the URM females is worth further discussion. Previous research has shown that WOC have certain disadvantages in the workforce. Ginther and Kahn (2012) report on their quantitative research that WOC are more likely to work at minority colleges and universities with high URM student enrollment. Therefore, these women prefer an environment where individuals of the same race are likely the majority. This is further supported by NSB’s (2014) employment reports, which indicate that minority colleges hire majority URM faculty members and researchers. Clearly, there is also a need for further research on understanding how institutional characteristics play a role in the gender-race representation of highly educated workers; however, this current study only posits that the social structures dynamic is different within employment sectors. In addition, this current study points out that the impact of the intersection of gender and race/ethnicity on differences (and often inequalities) in the labor market outcomes is not limited to WOC, but should be discussed for other social groups, particularly other female groups.

This research also shows significant differences in employment outcomes among the female groups. An obvious contrast is the differences of URM females’ per field of study in comparison to Asian and White females. This study shows that both Asian and White females in engineering, life sciences, and social sciences (Table 4.10) showed no significant difference in earnings when compared to the average salary, but URM females do. The participants’ salary profiles show that on average for the year 2010 Asian and white females earned about $21,100 and $7,900 respectively more than URM females. The high earnings of the Asian females are noticeable, which is explained by their high participation in the engineering field and especially high employment occurrences in the business/industry sector that offer more competitive salaries.
This finding on Asian females is worth emphasizing, as further analyses shows that the male
groups have the highest rate of employment and earn the most as engineers within the
business/industry sector; therefore, this area is evidently male dominated at the doctoral level.
This is clearly an achievement by Asian females who break into male-dominated fields and
employment sectors, although previous studies which focused on gender only have pointed to the
challenges females as a whole face in their careers. In an early study, though not specific to the
doctoral level, Rossi (1965) posited that women who have “entered top professional [science]
fields have had to have extraordinary motivation… exceptional ability, and some unusual pattern
of socialization in order to reach their occupational destinations” (p. 1196). Rossi’s early findings
on women in non-academic careers are informative to this current study as it indicates that Asian
females are overcoming certain obstacles. However, the specific obstacles they experience are in
need of further investigations as it may lead to empirical information on Asian female success and
on the career hindrances faced by non-Asian females. Overall, these differences within female
S&E doctorate recipients’ racial groups, point to the importance of adopting an intersectionality
framework when examining labor market outcomes (Lorber, 1998; Mohanty, 1991; Zinn & Dill,
1996).

**URM Males in the Doctorate S&E Workforce**

The usage of the intersection of gender and race theoretical framework has also provided
empirical information on the career paths and earnings of URM males in S&E fields. The NSB’
(2014) reports historically show that men in general are at an advantage in the labor market.
However, little attention has been given to this URM male group in literature; there is no
information available on their involvement in the S&E or doctorate-level work force, probably
because of their small numbers, which may have prevented quantitative analysis. This current
research has shown inequalities in career paths and earnings that provide the background for
future empirical investigations.

While males in general were overrepresented the business/industry sector, analysis
shows that the URM males were mostly employed in four-year colleges or medical institutions
throughout the four periods. This is a noticeable difference, as this research clearly indicates that those who work in academic sectors consistently earn less than those in other sectors. It is therefore not surprising that while URM males’ average salary ($95,300) for the year 2010 was higher than that of White females and URM females, by about $9,400 and $16,500 respectively, and they earned substantially less than Asian females by about $3,800, White males by $4,100 and Asian males by $16,700. Of course, their low employment in the business/industry sector is also a result of the low proportion among the engineering graduates who are more likely to find jobs in industry.

It is evident that the URM males, as with URM females, are at certain disadvantages in the labor market, which are possibly determined by discrimination but also choice of field of study. These findings also further extend the application of the intersection of gender and race/ethnicity framework, which has been mainly applied to the context of WOC in academia.

**Careers in Academia and Business/Industry Employment Sectors**

Historically, a doctoral degree has been considered the passport for a career in academia (Mangematin, 2000; Nerad, 2004; Stephan, 1996). However, data on S&E doctorate recipients’ career choice shows two traditional paths: academia and business/industry (NSB, 2014). The results of sequence analyses of this study also show that approximately 40% of the participants had stable careers for the four periods in four-year colleges and medical institutions, 2% in two-year college and other school systems, and about 32% in business/industry (see Table 4.5). The study also takes a closer look at these traditional employment sectors and provides information on career paths over the four cycles and on earnings for the year 2010 by intersected social structures.

Within the academic sectors:

- The proportion of participants employed by field of study was of the following descending order: first social sciences, followed by life sciences, and the lowest for engineering.
Individuals from the male groups within this sector were in higher proportions from social sciences and less from engineering and life sciences. The URM males had the highest proportions in academia in comparison to the other groups.

Female doctorate recipients within this sector were mostly from the White and URM groups.

There was evidence of transitioning from the academic sectors to business/industry for male groups, Asian groups and White groups between 2003 and 2010.

Within the business/industry sector:

- The proportion of participants employed by field of study was of the following descending order: first engineering, followed by life sciences, and the lowest for social sciences.
- There was a higher proportion of individuals from male groups than from female groups in this sector.
- Asian females had the highest representation from the female groups in this sector.
- The engineers earned higher average salaries than those who specialized in different fields of study. Asians earned the highest salaries in this sector.

These findings do not indicate preference by the participants for a particular sector over the other, but they give details on the actual career paths and earnings within the period considered. However, the higher earnings by Asian males, White males, and Asian females who specialized in engineering and worked in the business/industry sector; and the lower earnings for those for White females, URM males, and URM females who specialized in the social sciences and worked in the academic employment sectors add to the earnings gap discourse. More important, there is a growing preference for jobs in the business/industry employment sector for doctorate recipients. This trend can be explained by structural changes to faculty work load and research funding (Umbach, 2007), decreased tenured opportunities in academia (Schuster & Finkelstein, 2006); and higher compensation packages, availability of resources for research, and networking with
industry leaders within the business/industry sector (Roach & Sauermann, 2010; Sauermann & Roach, 2012; Stern, 2004; Vallas & Kleinman, 2008).

Reasons for the predominance of White and URM groups who specialized in life and social sciences within academic sectors are not explored. The discussion above on the lower earnings of the female groups in academia points to the need for further research that investigates the subjective perspectives of members from different social groups who navigate their career paths within or between academic and non-academic sectors. Other factors such as the type of higher education institution which awarded the doctoral degree, prior work experience, and personal preference could help explain one’s career pattern.

**Implications for Theory**

The intersection of gender and race as a theoretical approach emerged from multicultural and feminist scholars (Lorber, 1998; Mohanty, 1991; Zinn & Dill, 1996) who claim that the independent basis of gender and race theories does not enable comprehensive analysis of the life course experiences of WOC. Subsequently, the framework has been used to highlight inequalities in areas such as politics and the labor market (Acker, 2000; Collins, 1999; Crenshaw, 1991; Hancook, 2007; James & Busia, 1993; Lockhart & Danis, 2010; Walby, 2009). Yet, critics have argued that the framework has been underused and as a result, some question its validity. There are three generally accepted approaches of the intersectionality theory (McCall, 2005) that are used in major studies: (1) anti-categorical complexity, (2) inter-categorical complexity, and (3) intra-categorical complexity.

This research has used the inter-categorical complexity perspective as it integrates social classifications (gender and race/ethnicity) to analyze individuals’ outcomes in the labor market and makes several contributions to advancing this theory. First, this study extends the application of the intersectionality theory and its inter-categorical complexity perspective to a highly educated population. The homogeneity in educational level of the S&E doctorate recipients provides a somewhat equal basis for analyzing differences in career outcomes for social groups defined at the intersection of gender and race (i.e., Asian males, Asian females, White females, etc.).
Second, the study applies the intersectionality model to examine labor market outcomes and to discuss issues related to the much debated earning gaps; therefore it addresses important aspects of equity in the labor market and return to educational investment by different social groups.

In addition, the study used the human capital proposition that suggests that higher levels of education are positively related to higher incomes and provide advantageous positions in the labor market (Allen, Harris, & Butlin, 2003; Auriol, Felix, & Schaaper, 2010; Florida, 2002; Heisz, 2003). However, in this study I put forward that higher education credentials as a form of human capital can be differentiated by individuals’ field of study, which will also impact their earnings. This allowed me to incorporate the intersectional perspective of gender and race with the human capital perspective on differentiated higher education attainments. In other words, the S&E doctorate recipients’ labor market outcomes were examined by the intersected gender and race/ethnicity classification and within specific fields of study.

Overall, the application and/or extension of the intersectionality theory in this research helps make the analysis more inclusive of other groups. Previous research focused on WOC (somehow identified in this research as URM females), while my research extends to groups such as Asian males, Asian females, White males, White females, and URM males. It helps to prove that even at the highest education level there are unique manifestations of labor market inequalities. Nevertheless, there are still areas where further research is needed to strengthen the gender and race intersectional framework.

**Implications for Practice and Policy**

Considering the importance of preparing a growing and diverse S&E workforce that is highly trained to meet the demands of an intensifying knowledge-based economy (KBE), the U.S. government continues to make substantial investment in STEM education programs. The goal has been to increase participation of students in STEM areas at all education levels: pre-kindergarten through 12th grade, undergraduate, and graduate education (American Association for the Advancement of Science, 1993; National Research Council, 1994; PCAST, 2012).
Nonetheless, even with decades of changes in higher education policies and practices, along with increasing investment of money and human resources in school educational programs, recent investigations show that there are leakages (attrition) throughout the STEM pipeline. The National Science Board reports that of the total number of students within six years of entering college in 2003–04, enrollment in STEM programs were only approximately 20% at the associate level and 28% at the bachelor level (Chen & Soldner, 2013). Furthermore, of the total number of enrollments, 69% attrition at the associate level and 48% at the bachelor level further reduced the STEM pipeline. Chen and Soldner’s (2013) analysis reveals that factors affecting the high attrition include students’ social characteristics, type of college entered, and precollege preparation.

While this dissertation has focused on doctorate recipients that have successfully negotiated their pathways through the STEM educational pipeline and have entered the labor market, it provides relevant information on individuals of different social groups who have succeeded within specific fields of study and within different employment sectors. This information can help educators and policy makers to develop policies with regard to increasing diversity in access to STEM education. Also considering the findings on the participants’ workforce involvement, I discuss implications for policies on collaboration between educators and employers on education program development. Finally, considering the economic perspective on the findings that relate to earnings, I discuss the policy implications of pay equity.

**STEM Education Policies**

The implications can be viewed in two main areas: (1) how to improve access to STEM programs by targeting specific populations based on individuals’ social groups and examining the success stories of individuals of certain social groups; (2) how to improve STEM pipeline efforts by examining successful populations.

- Access to STEM programs has been a persistent problem. The findings of this study reinforce this issue as it shows that the proportions of S&E doctorate recipients do not match the corresponding demographics of the U.S. population. Second, the demographic distribution by S&E fields of study is also uneven
which affects the employment sectors, career paths, and earnings. The persistence of these social issues from school to the workplace should be recognized and better understood. It is critical for policy makers to research the challenges that individuals of certain social groups (i.e., URM males and URM females) encounter in relation to access to STEM and implement suitable programs. Appropriate programs at specific age groups are also important, as studies have shown that children’s interest in academics and science-related fields peaks at the middle-school level (Sadler, Coyle, & Schwartz, 2000). Different programs can also be designed and be geared towards increasing youth STEM literacy. These include engineering and mathematics outreach programs through after-school sessions and summer camps and teacher training seminars through universities and science organizations (Adams, Turns, & Atman, 2003; Hunter, 2006; Jeffers, Safferman, & Safferman, 2004). Policy makers should also work to improve existing classroom-based initiatives towards improving literacy and interest in STEM areas, such as establishing national standards for teaching and literacy in science and technology and standards for technology literacy for elementary schools (National Academy of Engineering, 2005; National Research Council, 1994).

- Examination of successful populations can help improve STEM pipeline efforts. In an earlier discussion, I suggested that Asian doctorate recipients seem to have built a social and professional network that may attract their fellow ethnic members to engineering fields and/or business/industry employment sectors. An extension to this point is that Asians who have successfully navigated the education pipeline are able to facilitate their children’s matriculation and progress in STEM fields. There are possible forms of social capital, such as parental guidance, role models, exposure to STEM careers, and other factors that encourage generations of Asian students to succeed in engineering and science
areas. Policy makers should invest in research that examines the factors that contribute to populations such as Asians, who are also a minority group, successfully navigate the STEM pipeline. This information can be used to inform other social groups and improve educational programs.

**Policies on Collaboration between Educators and Employers**

Involvement of employers in curriculum development or program design and career services will help to improve the job readiness of degree recipients, which may aid the distribution of individuals from different social groups between employment sectors. Involving employers in designing practical research projects will help ensure students are trained in the skill types and knowledge-base required by employers. The involvement of students in internship programs will improve transition from school to work and job readiness. This is particularly relevant to the population in this study, doctorate recipients, who are considered to be leading contributors of knowledge and innovation to business/industry (NSB, 2014).

**Policies on Pay Equity**

Policies that govern pay equity in the S&E doctorate workforce may encourage participation of URM and women groups. I suggest that prospective STEM students’ perceptions of existing labor market inequalities may have a counterproductive effect on efforts toward increasing the country’s STEM workforce. For example, if students within URM groups perceive that their chances of succeeding in the labor market are lessened by gender and/or racial factors, they might be less inclined to pursue such careers.

**Limitations and Delimitations of the Study**

This study has several limitations. First, the dependent variable, salary in 2010, was defined as the basic annual salary on the job as of the survey reference week (data has been annualized as if respondent was working full time for a full year) (NSB, 2014). Therefore, the amount does not necessarily represent the actual annual earnings of the participant, but the expected earnings, based on agreement with employer. In addition, salary is defined in literature as an objective means of career success and is viewed as an external indicator of career
advancement (Ng, Eby, Sorensen, & Feldman, 2005; Seibert, Kraimer, & Liden, 2001). This, therefore, is a limitation on how the participants feel about their career achievements, since other forms of objective success may include professional honors in the workplace and movement up the organizational ladder (Seibert, Kraimer, & Liden, 2001). There are also subjective measures of career success, which are defined as internal feelings of career accomplishment (Judge, Cable, Boudreau, & Bretz, 1995); examples include job satisfaction, personal preference, and organizational commitment. Although I recognized the importance of including both objective and subjective measures of career success, this study is limited to an examination of earnings.

The second limitation is related to measurement aspects of one of the independent variables, employment sector, which was defined as the sector in which the respondent was employed during the reference week of survey. This may not represent the sector of employment that the individual was in prior to the reference week of the biannual survey. While this study focuses only on respondents who were employed for the four survey periods, it is possible that there are brief periods (two to three years between survey cycles) of unemployment in between surveys. A further possible limitation is that individuals may also change jobs and/or employers among employment sectors more often than recorded by the four SDR cycles. This suggests that the examination of career mobility is over-simplified in this study due to data limitations.

There were also certain boundaries or delimitations set in this dissertation so as to provide focus on the listed research questions. First, I choose to focus on S&E doctorate recipients from the 1996-2000 SDR cohort (i.e., obtained their highest degrees between 1996 and 2000), who were employed and who provided employment sector information and earnings for all four survey cycles. The cohort delimitation was necessary as the SDR follows a wide range of respondents from as early as 1973. This suggests that the participants are of different ages, had varied lengths of careers, and entered the labor market at different economic times. Hence the choice of the 1996-2000 cohort provides a group of participants who have comparable experiences. These respondents have, on average, three years of experience in the labor market prior to their first survey and were the average age of 38 at the time.
Another delimitation was the choice of using respondents who indicated that they were employed for the four survey cycles. This was a necessary step for the sequence analyses used in this study. While the statistical software, R, enables the plotting of sequences of employment sectors which includes gaps between periods, because this study is limited to only four periods of employment the decision was made to include only those who were employed to give actual representations of career paths.

There was also the theoretical decision of using the intersection of gender and race/ethnicity framework that led to methodological delimitations. As noted in the previous sections of the dissertation, this enables a focus on the dual gendered and racialized experiences of the participants. However, the data used in the analyses may also provide certain information based on independent frameworks of gender and race, and these direct effects that are not considered in the study.

**Future Research**

This dissertation provides background information for further investigations on the career paths of S&E doctorate recipients. Quantitative analyses can use data from the Survey of Earned Doctorates (SED) and the Survey of Doctorate Recipients (SDR). Both surveys are conducted for the National Science Foundation. These surveys provide rich sources of data on the careers of S&E doctorate recipients from US universities since 1920. They include data on participants’ fields of study, professional training, work experiences, and demographics. Other studies may consider an extended period of time (longitudinal) and may include more details on job-related factors. For example, this dissertation has focused on the doctorate recipients’ employment sector mobility; however, further examinations of job type and movements within and/or between organizations within specific employment sectors could be important to address. Individual factors may also include reason for job change and family-related influences.

Qualitative investigations can also produce useful details on S&E doctorate recipients’ perspective of their experiences within the labor market. Phenomenological research and case studies on individuals who specialized in certain fields, graduated from a certain ranked
institution, and worked in different employment sectors (academic and non-academic) may identify differences in career paths. Based on the findings of this dissertation, it will be informative to explore factors that contribute to the Asian doctorate recipients’ (and other groups) employment dynamics.

Another labor market indicator that is worth further empirical attention is the match between education credential and workplace requirements. While the S&E doctorate recipients have completed the highest level of education within their fields, the applicability of their knowledge to specific jobs can be further researched. Do these professionals require further training in order to compete within the fast changing knowledge and technology-based economy? What collaboration is required between educators and employers to enhance the job readiness of new degree recipients? Current higher education efforts toward increasing graduates’ employability can be improved through further involvement of members of the business/industry and government sector.

There is also need for scholarly work on the STEM education pipeline. The findings of this research are focused on doctorate recipients who have successfully navigated the STEM education pipeline; however, the demographic breakdowns are biased towards Asians and Whites. Therefore, future studies may explore what policies and resources are needed to increase the participation of URM students at the K-12, bachelor, and master’s levels that will increase their matriculation in and completion of S&E doctoral programs.

**Closing Remarks**

My journey to being a doctoral student emerged from personal circumstances during the time when the U.S. labor market underwent huge job losses as an effect of the great recession (actual dates of recession according the U.S. Department of Labor were December 2007 to June 2009). At the time, as a new graduate with my master’s degree in business, I endured the predicament of losing my temporary job, and like many Americans, was faced with the difficult choice of finding a new job or returning to university to further my education with the hope of obtaining new skills which would improve my job prospects. My eventual decision to pursue a
doctoral degree brought feelings of self-worth and hope for the future; however, I continue to question if it is worth the investment. This I believe will be answered in the near future as I reenter the labor market. As an URM male, I will be likely faced with the challenges and opportunities discussed in this study. Hence, using the intersection of gender and race/ethnicity theory to frame the design, analyses, and discussions of this study was a research decision close to my personal situation as I wanted to learn how other doctorate recipients with specific social characteristics succeed in the labor market. However, in this section, I reflect on two main areas that motivated me to research the earning inequality of S&E doctorate recipients. These include the importance of return on investment in education as it relates to S&E doctorate recipients, and also the perspective of STEM education as a potential socioeconomic equalizer. It is important to note that my doctoral degree is not in a STEM field (although education and social sciences are related), but the findings have implications for the larger doctoral population.

The increasing financial commitment required by individuals to pursue an S&E doctoral degree (NSB, 2014) has raised the stakes of return on investment in S&E doctoral programs. Individuals invest in higher education to acquire new skills that will improve their job prospects in the KBE. This is implied in the findings of this study as it relates to differences in the doctorate recipients’ career paths and earnings by their fields of study and social characteristics. For instance, the capacity to market oneself, or the usage of education credentials to obtain desirable employment could be affected by individual’s social characteristics. For example, Asians seem to have more social capital (networking/contacts) which likely improves the employability of engineering doctorate recipients. In general, job seekers could use their social characteristics in addition to their educational credentials so as to impress employers.

In addition, individuals’ field of study affects career outcomes because their utility within different employment sectors is perceived differently by employers. Field of study as a differentiating human capital dimension is not researched enough; however, at the doctoral level, particularly in this current study, it speaks to the transferability of one’s skills from one employment sector to the other. The majority of participants within this research (80%) remain
within a particular employment sector, and those who changed sectors had limited movements. At the same time, analyses on earnings show that field of study within certain employment sectors made a significant difference. Engineers within the business/industry sector yield higher incomes than doctorate recipients from the life science and social science fields within academic sectors.

The high earnings that result from pursuing a particular field of study speaks to the broader socioeconomic issue of earnings disparities within the U.S. economy. A part of the rationale for this dissertation is to situate employment within the advancement of information and communications technology that has given rise to knowledge and technology intensive (KTI) industries (i.e., commercial knowledge-intensive services, high-technology manufacturing) (Burton-Jones, 2001; Lee, Miozzo & Laredo, 2010). The findings indicate that these industries, particularly those in the business/industry sectors, provide employment opportunities with attractive salaries and benefits. According to the Department of Commerce, these science-related jobs pay 33% higher income than other jobs (Beede et al., 2011). Furthermore, the Bureau of Labor Statistics projects increasing demand for science and engineering (S&E) expertise through the year 2020 (NSB, 2014). However, the historical under-representation of minority groups in STEM fields has resulted in their scarce employment in high paying knowledge-based jobs (Broyles & Fenner, 2010; NSB, 2014) which will be perpetuated if these groups to do enter the STEM pipeline during K-12 education. Therefore, I suggest that increasing the involvement of underrepresented minority groups in STEM programs will not only expand America’s talent pool, but also increase earnings for social groups that are currently perceived as being disadvantaged. These groups may not be disadvantaged primarily because of their socio-demographic characteristics but because not enough of them are present in fields of study and employment sectors that are nationally recognized for their economic power. In other words, embracing careers in STEM will help to equalize current socioeconomic inequalities within American society.
Appendix A

IRB Approval
Institutional Review Board
Notification of Exemption

May 7, 2014

Throy Campbell
Dr. Maria Trache
Educational Leadership & Policy Studies

Protocol Number: 2014-0603

Protocol Title: Career Mobility in a Knowledge-based Economy: Pathways of Science and Engineering Doctorate Recipients

EXEMPTION DETERMINATION

The UT Arlington Institutional Review Board (IRB) Chair, or designee, has reviewed the above referenced study and found that it qualified for exemption under the federal guidelines for the protection of human subjects as referenced at Title 45CFR Part 46.101(b)(4).

· (4). Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

You are therefore authorized to begin the research as of May 7, 2014.

Pursuant to Title 45 CFR 46.103(b)(4)(iii), investigators are required to, “promptly report to the IRB any proposed changes in the research activity, and to ensure that such changes in approved research, during the period for which IRB approval has already been given, are not initiated without prior IRB review and approval except when necessary to eliminate apparent immediate hazards to the subject.” Please be advised that as the principal investigator, you are required to report local adverse (unanticipated) events to the Office of Research Administration; Regulatory Services within 24 hours of the occurrence or upon acknowledgement of the occurrence. All investigators and key personnel identified in the protocol must have documented Human Subject Protection (HSP) Training on file with this office. Completion certificates are valid for 2 years from completion date.
The UT Arlington Office of Research Administration; Regulatory Services appreciates your continuing commitment to the protection of human subjects in research. Should you have questions, or need to report completion of study procedures, please contact Robin Dickey at 817-272-9329 or robind@uta.edu. You may also contact Regulatory Services at 817-272-3723 or regulatoryservices@uta.edu.
Appendix B

Excerpts from the Survey of Doctorate Recipients’ Instrument
The questions noted below were taken from the 2010 Survey of Doctorate Recipients’ instrument. These questions were similar to those of the previous three instruments (2003, 2006, and 2008 survey cycles) used in this study. The SDR used the National Science Foundation’s Survey of Earned Doctorates (an annual census conducted of all individuals receiving a research doctorate from an accredited U.S. institution in a given academic year) as its primary sample frame, from which data on the respondents’ field of study were obtained. In addition, according to the NSB, some of the respondents’ demographic data were obtained from external sources. It is also important to note that the data used in this study was derived from multiple questions.


Part A - Employment Situation

A13. Which one of the following best describes your principal employer during the week of October 1, 2010? Were you…

SELF-EMPLOYED or a BUSINESS OWNER

1. in a non-incorporated business, professional practice, or farm
2. in an incorporated business, professional practice, or farm

PRIVATE SECTOR employee

3. in a for-profit company or organization
4. in a non-profit organization (including tax-exempt and charitable organizations)

GOVERNMENT employee

5. in a local government (e.g., city, county, school district) 6 in a state government (including state colleges/universities)

6. in the U.S. military service, active duty or Commissioned Corps (e.g., USPHS, NOAA)

7. in the U.S. government (e.g., civilian employee)

8. OTHER type of employee – Specify type of employer
A14. Was your principal employer an educational institution?
   1. Yes
   2. No

A15. (If Yes) Was the educational institution where you worked a…

   Mark one answer.
   1. Preschool, elementary, middle, or secondary school or system
   2. Two-year college, community college, or technical institute
   3. Four-year college or university, other than a medical school
   4. Medical school (including university-affiliated hospital or medical center)
   5. University-affiliated research institute
   6. Other – Specify

A36. As of the week of October 1, 2010, what was your basic annual salary on your principal job, before deductions?

**Part D - Recent Educational Experiences**

D1. Between October 2008 and October 2010, did you complete another degree such as a master's or another doctorate?
   1. Yes
   2. No

D2. (If Yes) What type of degree did you earn?

   If you completed more than one degree, mark the level for the highest degree awarded.

   Mark one answer.
   1. Bachelor’s degree (e.g., BS, BA, AB)
   2. Master’s degree (e.g., MS, MA, MBA)
   3. Doctorate (e.g., PhD, DSc, EdD)
   4. Other professional degree (e.g., JD, LLB, MD, DDS, DVM) – Specify
   5. Other – Specify

D3. What was the primary field of study for this degree?
Part E – Demographic Information

E11. What is your birthdate?

The following demographic data was derived from external sources by the NSB:

Gender

1. Gender

2. Race/Ethnicity


Hancock, A. M. (2007). When multiplication doesn’t equal quick addition. *Perspectives on Politics, 5*(1), 63–79.


Biographical Information

Throy A. Campbell earned his doctorate in K-16 Educational Leadership and Policy Studies Department at the University of Texas at Arlington. He received his master's degree in business administration and finance. His research interests include labor market outcomes of college graduates, education leadership, finance, and international students' experiences.