

The Effects of Motherhood during Graduate School on
PhD Recipients' Paths to the Professoriate

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The Effects of Motherhood during Graduate School on
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Abstract

This study examines the effects of gender and family status on PhD recipients' likelihood of attaining tenure-track faculty jobs at U.S. higher education institutions, with a specific focus on mothers who have children during graduate school. This study compares PhD-earning mothers to other groups, including men and women without children and fathers, and it explores individual, institutional, doctoral training, and professional life course variables predicting PhD mothers' attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen years of obtaining their terminal degrees. Analyzing data from the Survey of Earned Doctorates and the Survey of Doctorate Recipients by the National Science Foundation, this study focuses on PhD recipients who are U.S. citizens and who graduated from U.S. higher education institutions between 2000 and 2005. Understanding whether and how PhD mothers "leak" out of the academic pipeline at the junction between graduate school and the professoriate is essential for higher education institutions, researchers, and policymakers, because doctoral students serve as valuable resources to higher education institutions and ensure continued research and knowledge production. The effects of gender and family status on tenure-track faculty job attainment may also inform our understanding of persistent gender gaps in academia in terms of earning potential, job status, and mobility. This study uses cumulative advantage theory to understand PhD mothers' accumulation of career-related resources in graduate school and how their accumulation influences their likelihood of attaining tenure-track faculty jobs.

This study finds that higher percentages of mothers who had children during graduate school secured tenure-track jobs within the first two years of PhD graduation compared to men and women without children in graduate school, but fewer mothers secured academic jobs at all

between 2006 and 2013 compared to other groups. Despite their early successes in attaining tenure-track jobs, mothers were more likely to secure jobs at non-research focused institutions than other groups, and they were more likely to work in non-tenure-track faculty jobs that acted as long-term positions rather than as potential stepping stones to the tenure track. A series of logistic regressions indicate that the individual, institutional, doctoral training, and professional life course factors used in this study partially explain differences in tenure-track attainment for PhD mothers, while a significant portion of the variation in tenure-track employment remains unexplained by observable characteristics. These findings suggest important implications for U.S. higher education institutions regarding female graduate students, the experiences of graduate students who are parents, and the recruitment of mothers into faculty jobs. This study also suggests important implications for future research on graduate students who are mothers.

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Chapter 1

Introduction

In this chapter, I introduce the importance of examining PhD-earning mothers' accumulation of career-related resources in graduate school and how that accumulation influences their likelihood of attaining tenure-track faculty jobs. First, I present the background of the study. Then, I discuss the purpose, research questions, and hypotheses of the study, and I briefly introduce the theories used for the study. Finally, I describe the importance of the study.

Background

Over the last two decades, doctoral education has been criticized for what Golde and Dore (2001) called a “mismatch” between doctoral students’ career aspirations and their likelihood of attaining faculty careers. In their study of over 4,100 students from 27 U.S. universities, Golde and Dore (2001) found that while over 87 percent of PhD students indicated they definitely or possibly wanted faculty careers, only half of PhD recipients actually went on to become tenure-track faculty members. This phenomenon is one result of a generally shrinking academic labor market, or the supply of potential faculty members, the higher education institutions that employ them, and the practices that allow for the allocation of faculty to jobs (Rhoades & Torres-Olave, 2015; Twombly, 2005, p. 424). While the academic labor market has been shrinking since the 1980s, the number of PhD graduates has steadily increased (Golde & Dore, 2001; Rhoades & Torres-Olave, 2015). One result is an apparent disparity between supply and demand for recent PhD graduates. Today, new PhD recipients take longer to find employment than in previous cohorts and more of them begin their careers in temporary positions, such as post-doctoral fellows or as adjunct faculty members (Rhodes, 2013; Rhodes & Torres-Olave, 2015).

The relative scarcity of tenure-track faculty jobs is particularly concerning for women who have children and pursue paths toward entry into the professoriate (e.g., Mason, 2013; Morrison, Rudd, & Nerad, 2011; Wolfinger, Mason, & Goulden, 2008; 2009). A variety of studies indicate that women with children under age six are 22 percent less likely than fathers and non-parents to attain tenure-track jobs straight out of graduate school (Mason, 2013; Wolfinger et al., 2008), and they take 29 percent longer than both fathers and non-parents to attain tenure-track jobs (Morrison et al., 2011). Furthermore, women, regardless of family status,

are overrepresented in part-time, non-tenure-track jobs, as they are 43 percent more likely than men to hold adjunct faculty positions (McMahon & Green, 2008, 2009; Perna, 2001). For PhD-earning mothers who may entertain aspirations of joining the professoriate, these factors create an even more pronounced “mismatch” between career aspirations and tenure-track position realities.

The incongruity between career aspirations and available tenure-track positions for PhD-earning mothers has implications for the academic and scientific communities as well as higher education policymakers. Doctoral education is an integral part of the academic pipeline, or the pathway through which educated workers flow into positions in academia, science, law, and medicine (van Anders, 2004). Doctoral students serve as a valuable resource to higher education institutions and current tenure-track faculty, ensuring that the U.S. can continue to engage in research and knowledge production, and serving as graduate teaching assistants providing “cheap labor” through instructing students at a relatively low institutional cost (van Anders, 2004; Wolfinger et al., 2008). A “leak” in the academic pipeline on the basis of gender and family status is particularly concerning in science and engineering fields, where females are sorely underrepresented (Gibbs, McGready, Bennett, & Griffin, 2014; Kelly & Grant, 2012). Persistent gender gaps in academia in terms of earning potential, job status, and mobility may also be linked to the fact that PhD mothers are more negatively affected by parenthood and marriage than married men with children and single women without children (Lynch, 2008; Jacobs, 2004; Jacobs & Winslow, 2004a, 2004b; Miller, 2009; Wolf-Wendel & Ward, 2006). It is important for higher education faculty, administrators, and policymakers to understand how and why PhD mothers “leak” out of the academic pipeline at the junction of graduate school and the professoriate, to understand how they face a potential “baby penalty,” and to understand graduate

school factors that influence PhD mothers' career path realities (e.g., Mason, 2013). This dissertation is an effort to identify and describe some of these issues, while looking for patterns, trends, and previously unidentified relationships between graduate school and the professoriate, focusing on recent PhD-earning mothers.

Purpose of the Study

First and foremost, this dissertation is about PhD mothers. I apply the term "PhD mothers" to women who parent children while in graduate school and who pursue faculty positions or not upon earning their terminal degrees. The purpose of this study is to examine PhD mothers' accumulation of career-related resources in graduate school and how that accumulation influences their likelihood of attaining tenure-track faculty jobs at higher education institutions within the first eight to thirteen years after PhD graduation.

While the study focuses on PhD mothers, the literature leads me to consider the larger, potential effects of gender and parenthood on PhD mothers' tenure-track employment outcomes (e.g., AAUP, 2009; Mason, 2013; Morrison et al., 2011; Wolfinger et al., 2008). Isolating the particular effects of parenthood on PhD mothers' accumulation of career-related resources and their subsequent tenure-track job attainment also requires comparing PhD mothers against relevant groups. For instance, the fact that women who are graduate students already have children during graduate school may influence their decision to aspire or not to be a faculty member. Or, women may want to be faculty members and know that being a pre-tenured faculty member is particularly demanding on one's time and energy, thus they may decide to have children before completing their doctoral degrees. In these and other ways, gender and parenthood interact for PhD mothers, influencing their decision-making during and after their graduate careers. Therefore, I include a set of comparison groups in my analysis: I compare mothers to

fathers in graduate school, men without children in graduate school, and to women without children in graduate school. Including these groups allows for an understanding of whether and how PhD mothers' accumulation of resources puts them at a cumulative disadvantage when it comes to attaining tenure-track jobs relative to the comparison groups. At the same time, it allows for a nuanced examination of the factors that may generally be at work across gender and family status.

Theoretical Framework

This study uses cumulative advantage theory as a lens to understand PhD mothers' accumulation of career-related resources (DiPrete & Eirich, 2006; Merton, 1973, 1988). Cumulative advantage theory suggests that an individual's social status affects one's ability to secure resources over time, affecting long-term outcomes like employment and advancement for the individual (Merton, 1973, 1988). In the case of this study, it is hypothesized that PhD recipients who accumulate resources early on or in greater quantities than others in graduate school tend to have a cumulative advantage in competing for tenure-track faculty jobs in the academic labor market. Those who do not accumulate career-related resources in large enough quantities, in the right combinations, or early on in graduate school tend to be at a cumulative disadvantage compared to others when competing for tenure-track jobs (DiPrete & Eirich, 2006; Merton, 1973, 1988). In this study, career-related resources are considered to be supply-side characteristics that work to explain differences between groups in tenure-track faculty job attainment. Graduating with one's terminal degree, or the point at which one changes from a graduate student to a PhD recipient, is considered to be an accumulation checkpoint, offering measurement of the supply-side characteristics that PhD recipients have accumulated in graduate school up until the point of graduation. With these constructs in mind, this study examines

whether and to what extent PhD mothers may be at a cumulative disadvantage compared to other groups, including fathers and men and women without children.

The degree to which a PhD-holder is at a cumulative advantage is evidenced through his or her individual accumulation of career-related resources in graduate school (e.g., Enders, 2002; Kennelly & Spalter-Roth, 2006). To measure this accumulation, this study uses a conceptual framework constructed from two established but related frameworks: Enders' (2002) *Doctoral Professional Success* framework and Kennelly and Spalter-Roth's (2006) *Doctoral Career-Related Resources and Strategies* framework. When they are integrated, this blended framework allows for an in-depth examination of the factors that represent the resources doctoral students attain in graduate school that assist them in competing for tenure-track faculty jobs (see Figure 1).

The conceptual framework contains four sections: individual, institutional, doctoral training, and professional life course factors. Each section includes factors that represent career-related resources students obtain or transform in graduate school which influence one's likelihood of attaining a tenure-track faculty position upon graduation. These sections contain the key supply-side variables that are analyzed in this study. The research variables and Enders' (2002) and Kennelly and Spalter-Roth's (2006) respective theoretical frameworks are discussed in depth in Chapters 2 and 3.

Research Questions

Given the importance of understanding whether and how PhD mothers' accumulation of resources puts them at a cumulative disadvantage when it comes to attaining tenure-track jobs, as well as examining PhD mothers in the context of the larger gender and family status groups to which they belong or compare, this study investigates the following research questions:

1. To what extent have PhD-earning mothers attained tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
2. How does tenure-track faculty job attainment differ between PhD-earning mothers, fathers, men without children, and women without children?
3. How do *individual, institutional, doctoral training, and professional life course factors* differ between PhD-earning mothers, fathers, men without children, and women without children?
4. What role do *individual factors* (married/partnered at time of PhD, age and number of dependents at time of PhD, time to PhD, and broad academic discipline) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
5. What role do *institutional factors* (institutional type, institutional control, and program ranking) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
6. What role do *doctoral training factors* (sources of funding, graduate teaching and research assistantships, research productivity) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
7. What role do *professional life course factors* (work outside assistantships and fellowships during graduate school, holding a post-doctoral position, and holding a non-tenure-track

faculty position) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?

To address the research questions, I use a sample of doctoral recipients who earned PhD's between 2000 and 2005. I use matched data from two National Science Foundation surveys, the Survey of Earned Doctorates (SED) and the Survey of Doctorate Recipients (SDR), to respond to the research questions (NSF, 2014a; 2014b). Data from the two surveys are matched on a unique survey respondent ID contained within the Doctorate Records File (NSF, 2014a; 2014b). Demographic variables within the Doctorate Records File, which provides a match on survey responses between the SED and SDR, allow the sample to be separated into sub-samples mothers in graduate school, fathers in graduate school, men without children in graduate school, and women without children in graduate school (NSF, 2014a; 2014b). The observation period used in this study is the first eight to thirteen consecutive years post-PhD graduation, and it is constructed so as to provide a snapshot of PhD recipients' employment outcomes up until the point SED/SDR data are currently available, which is 2013. Given that the sample includes doctorates who earned degrees between a date range of 2000 and 2005, the observation period is necessarily constructed as a date range of 2001 through 2013. The observation period on employment outcomes for PhD recipients who earned their degrees in 2005 is the shortest in the range at eight years, while the observation period for doctorates who earned their degrees in 2000 is the longest in the range at a full thirteen years.

In analyzing the data to respond to the research questions, I first employ descriptive statistics to examine employment patterns and trends of PhD mothers who earned their terminal degrees between 2000 and 2005. I also examine the employment patterns of the comparison

groups, mothers during graduate school, fathers during graduate school, men without children during graduate school, and women without children during graduate school. Descriptive statistics focused on employment trends over years, by types of institutions, and by major, and they aid in establishing a baseline understanding of the employment trends of the PhD recipients in my sample. The descriptive statistics also allowed me to compare employment outcomes over time against my key group of interest, PhD mothers.

To measure the cumulative advantage of PhD mothers relative to the other groups, I then conducted a series of logistic regression analyses to determine how the supply-side characteristics, career-related resources, influence PhD mothers' attainment of tenure-track faculty positions within the first eight to thirteen years after PhD graduation. The logistic regression analyses include the variables from my conceptual framework. The logistic regressions only examine whether PhD mothers attain tenure-track faculty jobs; the descriptive statistics provide a context on when and where PhD mothers attain those jobs. In the regressions, I first examine the influence of these variables on the likelihood that PhD mothers attain tenure-track faculty positions at U.S. higher education institutions during the observation period relative to PhD recipients at large. My focus is on determining whether PhD mothers attain tenure-track faculty jobs in comparable quantities or comparable rates and at comparable sorts of institutions to the comparison groups. Then, I examine the influence of these variables on the likelihood that PhD mothers in graduate school, fathers in graduate school, men without children in graduate school, and women without children in graduate school attain tenure-track faculty positions. My focus and methods for this dissertation arise from the research literature on PhD mothers and the academic labor market, which are discussed in depth in Chapter 2.

It is important to note that this study treats PhD graduation as an accumulation “check point,” rather than measuring the incremental accumulation of career-related resources in a time series during graduate school, which is typical of a classic approach to cumulative advantage theory (e.g., Merton, 1973). PhD graduation represents the point at which each PhD-holder’s accumulation of such resources is measured, because the data used in this study do not allow for a tracking of which resources PhD recipients gained and when during their graduate school careers. While cumulative advantage in the classic sense is measured using such timing variables (e.g., DiPrete & Eirich, 2006; Merton, 1973), limitations in the available data prevent the measurement of the incremental accumulation of such resources during PhD recipients’ graduate school years.

Despite this general limitation, an important timing variable that is tracked using the SED/SDR data is the age of one’s dependents during PhD recipients’ graduate school years. Respondents record the age of their dependent(s) upon taking the SED at the time of PhD graduation using a range (ages 0-5, 6-18, or 19 and older) (NSF, 2014a; 2014b). Time to PhD in years from graduate entry year to graduate completion year is also captured in the SED/SDR data. Using the age of the dependent(s) recorded in the SED survey response, the time to PhD, and the PhD graduation year the approximate birth year of the dependent child as constructed as a variable in this study and was transformed into the variable *Parent*. In *Parent*, a value of 1 indicates that during graduate school, the PhD recipient parented a child, and a value of 0 indicates that during graduate school, the PhD recipient did not parent a child. The children PhD recipients had after graduate school did not factor in to the variable *Parent*, because this study is primarily concerned with whether parenting children during graduate schools affects one’s likelihood of attaining a tenure-track faculty job. However, PhD recipients who waited to have

children until after graduate school are explored in the descriptive statistics in Chapter 4, and the potential impact of waiting to have a child until after a doctoral program was complete was explored.

Both the birth year of the child and the point during graduate school at which the PhD mother gained a dependent/child is important because PhD mothers who have children earlier on in graduate school may have less time and opportunity to obtain critical career-related resources in graduate school (Gardner, 2008b; Kennelly & Spalter-Roth, 2006; Kuperberg, 2009; Lynch, 2008). Furthermore, the literature indicates that the point at which a PhD-holder has a child (before starting, during the early coursework years, during the later examination and dissertation years, or at the very end of graduate school), and the birth spacing of subsequent children may matter when it comes to PhD recipients' accumulation of career-related resources and likelihood of obtaining tenure-track jobs (Gardner, 2008b; Kennelly & Spalter-Roth, 2006; Kuperberg, 2009; Lynch, 2008; Watanabe & Falci, 2014; Wolf-Wendel & Ward, 2006). Because the SED/SDR data allow for these variables to be constructed, age of dependent(s) is an important timing variable that is used in this study.

Hypotheses of the Study

This study hypothesizes that individual, doctoral training, institutional, and professional life course factors affect the likelihood that PhD mothers attain tenure-track faculty positions (Enders, 2002; Kennelly & Spalter-Roth, 2006). *Individual variables* include being married/partnered at the time of PhD degree; the number and age of dependents at the time of PhD degree; time to PhD in years; and broad academic discipline (Abedi & Benkin, 1987; Ampaw & Jaeger, 2011; Enders, 2002; Kennelly & Spalter-Roth, 2006; Morrison, et al., 2011; Wolfinger et al., 2008). *Doctoral training variables* include primary funding sourced used to

finance one's degree and includes assistantships, fellowships, scholarships, personal, family, and loan sources; attainment of a graduate teaching assistantship; attainment of a graduate research assistantship; and research productivity measured by articles published in graduate school or within the first two years after graduate school (Bair & Haworth, 2004; Bieber & Worley, 2006; Brus, 2006; Enders, 2002; Kennelly & Spalter-Roth, 2006; Ehrenberg, Jakubson, Groen, So, & Price, 2007). *Institutional variables* include doctoral institutional type as evidenced by Carnegie classification; doctoral institutional control; and doctoral program ranking as evidenced by the program's ranking by *U.S. News and World Report* at the recipients' time of PhD degree (Burriss, 2004; Caplow & McGee, 1958; Ehrenberg & Mavros, 1995; Enders, 2002; Kennelly & Spalter-Roth, 2006; Lewis, 1996; O'Meara, 2011). *Professional life course variables* include work outside a GRA position, GTA position, or fellowship during graduate school; holding a post-doctoral fellowship position; and holding a non-tenure-track faculty position after graduate school (Bair & Haworth, 2004; Bieber & Worley, 2006; Brus, 2006; Ehrenberg, Jakubson, Groen, So, & Price, 2007; Enders, 2002; Kennelly & Spalter-Roth, 2006; Kezar & Sam, 2010; Morrison, et al., 2011; Rhoades, 2013; 2015; Rhoades & Torres-Olave, 2015; Wolfinger et al., 2008).

Cumulative advantage theory suggests that doctoral recipients who accumulate higher quantities of career-related resources in graduate school increase their competitive advantage in the academic labor market and thus have an increased likelihood of attaining a tenure-track faculty position post-graduation (Merton, 1973, 1988). The theory also suggests that some career-related resources are more highly valued than others (Merton, 1973, 1988). Highly valued resources in this study include attaining graduate research assistantships, financing one's degree through a GRA position, GTA position, or fellowship, publishing articles in graduate school or

shortly thereafter, enrolling in highly ranked programs, and enrolling at research-extensive institutions (Burris, 2004; Ehrenberg & Mavros, 1995; Enders, 2002; Kennelly & Spalter-Roth, 2006; Morrison, et al., 2011; Wolfinger et al., 2008). Other highly valued resources include abstaining from outside work during graduate school and demonstrating unrestricted geographic mobility (Enders, 2002; Kennelly & Spalter-Roth, 2006; Morrison, et al., 2011; Wolfinger et al., 2008). While there are a number of other highly valued resources that relate to PhD recipients' likelihood of attaining tenure-track faculty jobs, including quality faculty mentoring and the reputation of one's faculty advisor, the data sources in this study do not provide a way to measure these variables. Ranking of doctoral granting programs is included as a proxy of institutional prestige in this study. However, the lack of other observable data on these aspects of PhD recipients' graduate experiences are one limitation of this study. These and other limitations are discussed in depth in Chapter 3.

The hypotheses in this study are based on doctoral students' accumulation of highly valued career-related resources in graduate school, which are posited to lead them to be more likely to attain tenure-track faculty positions within eight to thirteen years of PhD graduation. In this way, the hypotheses are generally based on the idea that doctoral students develop a cumulative advantage over their peers starting in graduate school, which affects their likelihood of attaining a tenure-track faculty appointment (e.g., Merton, 1973; 1988).

However, keeping this notion about cumulative advantage in mind, the hypotheses are also based on the idea that relative to their peers, PhD mothers are potentially more likely to develop a cumulative disadvantage starting in graduate school which negatively affects their likelihood of attaining a tenure-track faculty appointment (e.g., Merton, 1973; 1988). Compared to their peers, PhD mothers face a number of identity, role, work-family, and organizational

barriers in graduate school that influence their accumulation of career-related resources, thus affecting their ability to build a cumulative advantage and ultimately compete in the academic labor market for tenure-track jobs (e.g., Jean, Payne, & Thompson, 2015; Mason, 2013; Morrison, et al., 2011; Wolfinger et al., 2008). PhD mothers face higher attrition rates and times to degree (e.g., Gardner, 2008b). They are less likely to graduate from top-ranked programs, author peer-reviewed journal articles, and often are not socialized into doctoral programs in the same ways non-parenting students are (e.g., Gardner, 2008a). PhD mothers may take leaves of absence that interrupt their graduate degree funding or cause them to be passed over in favor of non-parenting students (e.g., Kennelly & Spalter-Roth, 2006). Finally, they may struggle with institutional barriers, such as a lack of health insurance, day care, transportation, and other necessary supports (e.g., Springer, Parker, & Leviten-Reid, 2008). If PhD mothers struggle to obtain important career-related resources in graduate school, they may develop a cumulative disadvantage that compounds over time, thus negatively affecting their ability to attain faculty jobs in the same proportions, at the same rate, and at the same types of institutions as compared to their peers (Merton, 1973; DiPrete & Eirich, 2006; Kennelly & Spalter-Roth, 2006). In this way, the hypotheses are influenced by the literature on PhD mothers that indicates they may develop a cumulative disadvantage which may affect their likelihood of obtaining a tenure-track faculty appointment.

Hypotheses. The main hypotheses in this study are summarized as follows:

1. Fewer PhD-earning mothers attain tenure-track faculty jobs relative to the comparison groups (responds to research question 1).

2. PhD mothers take longer to attain tenure-track faculty jobs, and fewer PhD mothers attain tenure-track faculty jobs at research institutions relative to the comparison groups (responds to research question 2).
3. *Individual, institutional, doctoral training, and professional life course* factors differ between PhD-earning mothers and the selected comparison groups. Highly valued aspects of the *individual, institutional, doctoral training, and professional life course* factors lead to a higher likelihood of attaining tenure-track faculty jobs (responds to research question 3).
4. In terms of individual factors, PhD recipients who are married/partnered at the time of PhD, who have fewer children at the time of PhD, who take fewer years to graduate, and who are in social science-related disciplines are more likely to attain tenure-track positions (responds to research question 4).
5. In terms of institutional factors, PhD recipients who come from highly ranked programs and research-extensive institutions are more likely to attain tenure-track positions (responds to research question 5).
6. In terms of doctoral factors, PhD recipients whose primary sources of funding are not personal, family or loan sources, who hold graduate research assistantships, and who publish more than one journal article in or immediately after graduate school are more likely to attain tenure-track positions (responds to research question 6).
7. In terms of professional life course factors, PhD recipients who work outside a GTA position, GRA position or fellowship during graduate school and who engage in postdoctoral study are less likely to attain tenure-track positions. PhD recipients who hold

non-tenure-track faculty positions after graduate school are less likely to attain tenure-track positions (responds to research question 7).

Importance of the Study

This study informs higher education institutions, faculty, policymakers, PhD recipients, graduate students, and the research literature at large on the characteristics of people who successfully attain tenure-track faculty jobs. This study extends current research threads on faculty careers and PhD recipients' employment patterns by offering up-to-date analyses on the employment patterns of PhD recipients and by offering specific analyses on the academic employment patterns of PhD recipients (e.g., Rhoades & Torres-Olave, 2015). This study also addresses a current hole in the higher education literature on whether and how PhD recipients with different individual and graduate school characteristics are filtered into tenure-track jobs in the primary academic labor market and into non-tenure-track jobs in the secondary academic labor market (Kezar & Sam, 2010; Rhoades, 2013; 2015; Rhoades & Torres-Olave, 2015). The study responds to a call for more research on whether PhD recipients who have initial appointments that are non-tenure-track can successfully convert over to the tenure-track or whether they become "stuck" on the non-tenure-track path (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015).

Relatively few studies in the higher education literature focus on the transition of PhD-earning mothers from graduate school to the professoriate. While a wide body of literature points to family status as a potential cause that might explain persistent gender inequalities in the professoriate (e.g., Mason, 2013), most of the literature on academic mothers focuses on women after they earn tenure-track faculty positions. Academic mothers' professional transitions through tenure and promotion and their daily life and work experiences are of particular interest

(e.g., Aenerud et al., 2007; Marschke, Laursen, McCarl Nielsen, & Rankin, 2007; Mason, 2013; Sallee, 2013; Wolf-Wendel & Ward, 2006). While understanding these aspects is important, existing research on academic mothers tends to treat graduate school and faculty members' early career pathways as discrete events, despite their linked nature. As a result, there is relatively less research on the effects of family status while in graduate school on PhD mothers' paths to the professoriate.

That being said, there are a handful of studies that have used secondary data analysis to explore how graduate school factors influence doctoral mothers' career outcomes (Kennelly & Spalter-Roth, 2006; Mason, 2013; Morrison et al., 2011; Wolfinger et al., 2008). Mason's (2013) compilation of ten years' worth of research on academic women from the 1970s through the 1990s offers the most comprehensive information to date on the effects of motherhood on women's academic career paths. However, the cohorts of women in Mason's (2013) analyses are two decades old as the last cohort graduated in 1995. Also, while Morrison et al. (2011) and Wolfinger et al. (2008) use slightly more up-to-date cohorts of graduates and focus more directly on the delay doctoral mothers experience in transitioning to the tenure-track, they aggregate the effects of marriage, spousal education and work, and children differently and thus produce incongruous findings in some areas. While Kennelly and Spalter-Roth (2006) specifically explore the possible relationships between graduate school factors and career outcomes for PhD mothers, their analyses are limited to a single cohort of doctoral students in sociology who attended graduate school in the late 1980s and early 1990s. This study focuses on recent cohorts of PhD mothers and builds on recent studies that have examined how graduate school experiences influence mothers' paths to the tenure-track.

Finally, this study contributes to the growing literature on graduate students who are parents. Much of the work on graduate student parents is policy-oriented (Brown & Nichols, 2012; Ehrenberg, Jakubson, Groen, So, & Price, 2007; Oswald & Riddock, 2007; Springer, Parker, & Leviten-Reid, 2008) or qualitative in nature (Gardner, 2008a, 2008b; Lynch, 2008). Research using national, cross-institutional data is needed to “test out” some of the findings of the existing qualitative- and policy-oriented research (Gardner, 2006, 2008a, 2008b; Lynch, 2008; Springer et al., 2008). This study extends the existing literature on graduate students who are mothers by using secondary data analysis to investigate mothers’ graduate school resources and early career outcomes.

Contributions from this study inform researchers, higher education institutions, policymakers, and current and potential graduate students by helping them understand the influences on preparation for the successful leap from graduate student to assistant professor. Examining how factors intersect to smooth the path from graduate school to the professoriate helps us understand how mothers successfully navigate their way to the tenure-track. Understanding the obstacles PhD mothers face on their journey to the professoriate helps us design policies that can improve their experiences in academia and influence their representation in fields where they are notably needed in greater numbers, such as STEM-related fields.

Organization of the Dissertation

Chapter 1 introduced the importance of examining PhD mothers’ accumulation of career-related resources and how that accumulation influences their likelihood of attaining tenure-track faculty jobs. This study investigates the individual, institutional, doctoral training, and professional life course factors that influence PhD recipients’ likelihood of attaining tenure-track faculty positions at four-year U.S. higher education institutions within the first eight to thirteen

consecutive years of PhD graduation. Though this dissertation is focused on PhD-earners who are mothers during graduate school, it examines the effects of these factors on comparison groups which align with or contrast with PhD mothers in terms of gender and family status. Chapter 2 reviews concepts, theories, and empirical research on factors that may influence how PhD mothers accumulate career-related resources to compete for tenure-track faculty jobs in the academic labor market. Chapter 3 discusses research methodology that is used to explore the research questions, including data sources, research variables, and analytic methods. Chapter 4 discusses findings from the data analysis. Chapter 5 discusses policy implications and suggestions for future research.

Chapter 2

Literature Review

In this section, I review the theoretical and empirical literature related to PhD-earning mothers, their accumulation of career-related resources in graduate school, and how this accumulation may influence their likelihood of obtaining tenure-track faculty jobs. This literature review progresses from a broad to a narrow perspective, first addressing the academic labor market and doctoral students in general and then focusing specifically on PhD-earning mothers. Major themes throughout this review include doctoral students and the academic labor market; the resources doctoral students use to compete in the academic labor market; and gender, motherhood, and the academic labor market. A conceptual framework for the study is also discussed. This review is designed to help inform the study, identify the gap in the literature, and suggest the significance of the study.

Doctoral Students and the Academic Labor Market

The academic labor market (or ALM) is a national “marketplace” containing a supply of PhD recipients seeking academic, research, and faculty positions in higher education and the institutions that recruit them for such jobs (Caplow & McGee, 1958; Ehrenberg, 2003; Finnegan, 1993; Rhoades & Torres-Olave, 2015; Twombly, 2005). The concepts of *constriction* and *segmentation* describe the nature of the ALM and influence PhD recipients’ ability to obtain tenure-track faculty jobs (Finnegan, 1993; Hudson, 2007). Constriction refers to the competition for faculty jobs, or the difficulty with which new PhD recipients obtain tenure-track faculty jobs (Hudson, 2007; Rhoades & Torres-Olave, 2015). Segmentation refers to the divisions between different types of institutions that have different sorts of missions and relates to how easily

faculty hires can cross the barriers between these divisions (Finnegan, 1993; Hudson, 2007; Twombly, 2005).

The ALM is socially organized, or actively structured and reinforced by social forces (Rhodes & Torres-Olave, 2015). As Rhodes and Torres-Olave (2015) point out, the ALM “does not simply operate by virtue of an invisible hand,” but is instead shaped by the ongoing social actions, values, and practices within academe and the faculty profession itself (p. 422). One result of the ALM being socially structured is that the various segments that divide institutions by type and organizational mission are hierarchically organized, forming a stratification of institutions with prestigious, research-centered organizations towards the top, and less prestigious, teaching-centered organizations towards the bottom (Caplow & McGee, 1958; Ehrenberg, 2003; Finnegan, 1993; Rhoades & Torres-Olave, 2015; Twombly, 2005). These stratified segments act as multiple, overlapping markets that offer variable entry, exit, and re-entry points for PhD recipients. The barriers between segments vary in terms of their permeability, or the ease with which PhD recipients with different sorts of attributes can traverse across the boundaries to obtain faculty jobs (Burris, 2004; Caplow & McGee, 1958; Lewis, 1996). Generally speaking, the boundaries are directional: it is easier for PhD recipients to obtain jobs in the lower tiers of the hierarchy than in the upper tiers (Burris, 2004; Lewis, 1996). One reason for this directionality is that tenure-track jobs are more plentiful in the upper tiers of the hierarchy (Burris, 2004).

However, it is important to note that not all doctoral graduates seek positions at research-oriented institutions or at institutions at the top of the academic hierarchy (e.g., Bair & Haworth, 2004; Gardner, 2008b; Mason, 2013; Wolf-Wendel & Ward, 2006). Doctorates who value teaching over research may seek jobs at comprehensive, liberal arts, or community colleges

where research expectations are low, but teaching opportunities are prevalent (Bair & Haworth, 2004). Similarly, not all institutions value research-oriented faculty hires and may be more interested in faculty members who are better qualified as teachers than as researchers (e.g., Burke, 1988; Clark, 1987; Finnegan, 1993; Twombly, 2005; Youn, 1988). In this way, the academic labor market is comprised of multiple, noncompeting segments of institutions seeking specific kinds of faculty qualifications and multiple, noncompeting groups of PhD recipients seeking specific kinds of institutional missions (Burke, 1988; Clark, 1987; Finnegan, 1993; Twombly, 2005; Youn, 1988).

Regardless of the ALM segment they are situated in, tenured and tenure-track faculty members are members of what is known as the primary or dominant labor market within the ALM (Rhoades & Torres-Olave, 2015). Tenure-stream faculty members tend to work at more prestigious, research-oriented institutions, and they are often referred to as the academic core as they are at the heart the faculty profession (Burriss, 2004; Rhoades & Torres-Olave, 2015). Historically speaking, the ease with which PhD recipients can obtain tenure-stream jobs in the primary labor market has fluctuated with the changing supply and demand of jobs in the ALM (Finnegan, 1993; Golde & Dore, 2001; Rhodes & Torres-Olave, 2015). Over time, the ALM has become more constricted as the supply of faculty hopefuls has increasingly exceeded the demand for new faculty jobs (Finnegan, 1993). A limited number of faculty positions in the primary market combined with a large and steady stream of faculty hopefuls means that the competition for jobs within the primary labor market is fierce, and competition is tipped in favor of PhD recipients who have the characteristics and resources that best align with the values and practices institutions desire (Golde & Dore, 2001; Rhoades & Torres-Olave, 2015).

The overflow of PhD recipients who do not obtain tenure-stream faculty positions in the primary labor market is often directed toward the growing secondary, or marginal labor market within the ALM: full-time and part-time faculty and researchers in non-tenured appointments, referred to as non-tenure-track faculty (or “NTTF”) in this study (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015). The growth of the secondary labor market that includes NTTF is a part of what has been termed a “seismic shift” in the faculty composition at American colleges and universities that has been underway since the 1970s (AAUP, 2010). Estimates of new faculty hires in non-tenure-track appointments are now approaching 75 percent of all newly hired faculty (AAUP, 2010; NCES, 2014). Because the ALM is segmented, PhD recipients with access to different types of career-related resources, such as institutional funding through assistantships and mentoring and publishing assistance from faculty members, may find themselves more or less able to cross the boundaries between the dominant but competitive primary labor market with tenure-stream faculty and the marginal but growing secondary labor market with non-tenure-stream faculty (Finnegan, 1993; Hudson, 2007; Rhoades & Torres-Olave, 2015). The secondary labor market does not strictly function by the principles set by the primary labor market, but it is influenced by them (Rhoades & Torres-Olave, 2015). For instance, a PhD-holder’s research productivity may help her get an interview at a community college, but if she lacks an appreciation for the community college’s teaching mission, her research productivity may not help her actually get hired (Twombly, 2005). The length of time faculty hopefuls experience in receiving a job offer is longer given the necessity of post-doctoral fellowships and other post-graduation training, and the competition is steeper given the rigid segmentation between prestigious and non-prestigious

institutions. As a result, the transition from graduate school to professoriate is often rockier (e.g., Ehrenberg, 2002; Mason, 2013).

Another reason the number of non-tenure stream faculty has grown is because higher education institutions have experienced declining state, government, and research support and tighter institutional budgets (e.g., Ehrenberg & Torres-Olave, 2015). In light of budget challenges, they have created or filled fewer new tenure-stream positions. Thus, institutions have used an increasing number of NTTF and contingent instructor positions to meet instructional needs at a lower cost (Kezar & Sam, 2010; McMahon & Green, 2008). With institutions generally still experiencing funding challenges, the tendency toward hiring more non-tenure stream faculty is expected to continue in all segments of the ALM (Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015). Because of the continuing trend in hiring non-tenure stream faculty jobs, this study examines various employment patterns of PhD recipients, including attaining NTTF jobs.

NTTF are a diverse group: throughout the research literature and among individual institutions, NTTF are referred to as part-timers, instructors, lecturers, adjuncts, affiliates, temporary faculty, staff faculty, and contingent faculty (AAUP, 2012). Postdoctoral scientists are considered NTTF in some contexts (AAUP, 2012). Both instructional NTTF and postdocs often work on soft-money on a contingent or temporary basis, either funded through research or laboratory grants, or contracted for instructional duties as full-time NTTF and part-time teachers (e.g., Kezar & Sam, 2010). Both are considered to exist within the secondary labor market in the ALM. In this study, however, to examine the effects employment as a postdoc or a NTTF on eventual tenure-track employment, as well as to treat postdocs and NTTF as employment outcomes in and of themselves, I separate NTTF and postdocs into separate variables. In this

study, NTTF indicates non-tenure eligible instructional staff working at higher education institutions. Postdocs are non-tenure eligible postdoctoral scientists working in research-focused positions at higher education institutions. Because holding a postdoc or an NTTF job are considered both variables and employment outcomes in various analyses in this study, each distinction is explored in depth in the following sections.

NTTF instructional faculty (NTTF). NTTF tend to share some broad demographic characteristics, and they work more frequently in some institutional sectors and disciplines. Women are overrepresented among NTTF, and are 43% more likely than men to have NTTF positions (McMahon & Green, 2008; Wolfinger et al., 2009). Faculty members of color are underrepresented among NTTF, as NTTF are more likely to be White (Wolfinger et al., 2009). Graduates with masters and/or terminal degrees from the least selective and moderately selective institutions are also more likely to become NTTF (Wolfinger et al., 2009). Taking longer than 5 years to earn a terminal degree, working as a postdoc, and leaving the academic labor force at early- or mid-career are also all positively correlated with becoming NTTF (Wolfinger et al., 2009).

Some institutional sectors such as community colleges and for-profit institutions use NTTF more often, and NTTF often represent the majority of the faculty population at these institutions (IPEDS, 2002; Jolley et al., 2014). Particular disciplines like English tend to employ higher proportions of NTTF due to greater demands for faculty to teach introductory-level courses, courses that require a certain level of disciplinary or professional specialization, courses that have a greater tendency toward enrollment variation, or courses that are closely tied to clinical, industrial, or professional environments (McMahon & Green, 2008).

In an attempt to investigate the nature, work, and impact of NTTF, researchers have assembled various functional typologies that categorize different types of NTTF (Kezar & Sam, 2011). For instance, one broadly used typology characterizes NTTF as either “voluntary” or “involuntary” (Maynard & Joseph, 2008; Kezar & Sam, 2011). Voluntary NTTF actively choose not to pursue tenure-track or full-time positions, thus voluntarily forgoing or exiting the tenure-track or full-time work (e.g., Gappa & Leslie, 1993). Involuntary NTTF aspire to acquire a tenure-track or a full-time position (Feldman & Turnley, 2004; Kezar & Sam, 2011). Involuntary NTTF often see taking a part-time or non-tenure-track position as a stepping stone to gain access to the career they ultimately desire. For instance, involuntary NTTF include “aspiring academics” and “seekers” who choose to teach as adjuncts to gain teaching experience, to acquire additional income during graduate study, or to provide financial support as they search for a full-time, tenure-track position in their field (Kezar & Sam, 2011). Involuntary NTTF may be “trailing spouses,” or members in dual-career couple relationships who wish to be at the same campus or at a nearby campus to a partner who has a tenure-track job (Wolf-Wendel, Twombly, & Rice, 2004). In almost all contexts, being an involuntary NTTF is intended to be temporary in nature, providing the NTTF member with time or financial support while waiting for an opportunity to arise (AAUP, 2010). In many cases, however, if the right opportunity does not arise to exit NTTF work, remaining a part-time NTTF can ultimately damage one’s probability of getting hired full-time or onto the tenure-track (Tuckman, Caldwell, & Vogler, 1978). Temporary positions include NTTF instructional positions, or one or a sequence of postdoctoral fellowships. However, recent surveys estimate that the vast majority of contingent faculty and postdocs eventually want permanent faculty positions: of over 10,000 respondents on a recent survey of contingent faculty, over half (52 percent) responded “definitely, yes” to a question of

whether they would accept a full-time, tenure-track faculty position, and another 21.8 percent said they probably would (CAW, 2012).

NTTF often occupy positions at less prestigious or teaching-oriented institutions, and they are locally-oriented, or focused on a particular institution and its students rather than the profession (Rhoades, 2013). Common working conditions faculty who work in the secondary labor market (in research or instruction) include lower wages, less job security, limited to no benefits, no access to tenure, and holding multiple, successive appointments that lead to limited real career advancement (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015). Compared to tenure-stream faculty, those who work in the secondary labor market are at risk for potential exploitation, where their productivity does not align with their compensation or the availability of advancement opportunities (e.g., Kezar & Sam, 2010).

A notable difference between tenure-track and NTTF is that tenure-stream faculty tend to do research and teach, while NTTF either do one or the other (Bousquet, 2008; Rhoades & Torres-Olave, 2015). This restructuring of faculty work has been especially prevalent in some fields like English composition. Bousquet (2008) refers to this restructuring as a “casualization” of the ALM, as instruction has gradually been separated from research. The prevalence of this separation is evident in the rising number of contingent faculty positions over time: in 1970, part-time positions made up less than a quarter (22.1 percent) of faculty in American higher education (NCES, 2012), but by the late 1990s, that proportion had more than doubled (Rhoades, 2013). By 2011, the percentage of part-time positions had reached 50.0 percent of the faculty (NCES, 2014; Rhoades, 2013). The prominence of part-time faculty positions varies by organizational sector, where public 4-year institutions have lower proportions of part-time staff, compared to private

not-for-profit institutions and community colleges which have higher proportions (Knapp, Kelly-Reid, & Ginder, 2010). Despite calls for change about unfair working conditions for NTTF faculty, the use of secondary labor still persists in well-resourced institutions (Rhoades & Olave-Torres, 2015).

NTTF research faculty (Postdocs). Similarly to NTTF, postdocs also occupy a position within the secondary labor market of the ALM, and their numbers have also increased dramatically over the last two decades (Nerad & Cerny, 1999; Powell, 2014). The number of postdocs has more than doubled in the last 25 years to roughly 60,000 – 100,000 postdocs as of 2014 (National Academy of Sciences, 2014). Postdocs are central to research institutions, particularly those with life science, health science, and biomedical science programs, and they support and perform key research in laboratories and academic institutions across the country (National Research Council, 2000). Most academic careers in the sciences require continuous progression from a graduate degree to a postdoc to an academic position, but the higher education literature presents mixed results with regards whether postdocs lead to tenure-track positions. Some researchers argue that postdocs are more likely to go into academic jobs and may be more likely to attain tenure-track positions in some fields (e.g., Morrison, et al., 2011; Nerad & Cerny, 1999; Reskin, 1976). Others argue that relatively few postdocs actually go on to attain tenure-track faculty jobs at research institutions (Mason, et al., 2013; Mavripilis, et al., 2010), and that the benefits of having a postdoc may vary by gender (Nerad & Cerny, 1999). Ginther and Kahn (2006a) found that women in some science fields in particular are not as likely to make it through the postdoc phase and get a tenure-track jobs. Regardless, researchers have observed that like NTTF faculty and those PhD recipients in general, a similar gap between expectations and reality exists for postdocs: roughly 56 percent of postdocs believe they will

continue on to tenure-track academic positions, but only 11-25 percent actually go on to attain tenure-track jobs (Powell, 2014; Yamamoto, 2014). The relatively few postdocs who go on to attain tenure-track jobs are influenced by a common set of values that pervades the ALM at all levels.

“Universal values” governing the ALM. Despite its being divided into hierarchical labor markets, the ALM is still governed by a common set of values by which the faculty candidates and the institutions recruiting them abide. Rhodes and Torres-Olave (2015) note that these values have been remarkably stable over time, changing little from what Caplow and McGee (1958) originally defined as the “valorized” values and practices that govern what they called the “academic marketplace,” or the ALM. These values and practices form the heart of the desired attributes PhD recipients are expected to have today to successfully compete for faculty jobs, and they are based on both merit and attractiveness (Caplow & McGee, 1958). Faculty candidates’ career-related attributes are either related to merit, or are acquired through effort, ability, knowledge and skill, or attractiveness, or acquired because of statuses already held, such as enrollment in a prestigious program (Bedeian, Cavazos, Hunt, & Jauch, 2010; Burris, 2004; Lewis, 1996; Fogarty & Saftner, 1993; Fogarty, Saftner, & Hasselback, 2012). Various researchers have classified these attributes in different ways since Caplow and McGee’s original classification; for instance, Lewis (1996) notably referred to merit-based factors as achievement and attractiveness as ascription. But while the specific terms have varied, the notion of merit-based factors and attractiveness remain true in the contemporary ALM (Burris, 2004).

Merit-based factors are the individual attributes each PhD-holder possesses based on her individual achievements (Burris, 2004; Caplow & McGee, 1958; Lewis, 1996). The strongest and most influential merit-based factors include faculty candidates’ research productivity and

research potential (Ehrenberg & Mavros, 1995). Generally speaking, the stronger merit-based factors a PhD-holder has, the better she will fare in the academic marketplace (Burriss, 2004; Caplow & McGee, 1958; Lewis, 1996). A PhD recipients' research productivity and potential are highly influential even at teaching-oriented institutions where faculty do little research, which is a testament to the universal appeal of research productivity in the ALM (Rhoades & Torres-Olave, 2015). Because of the strong relationship of research productivity and a PhD-holder's likelihood of obtaining a tenure-track job, research productivity as evidenced by journal articles published in graduate school is included as a variable in this study.

Conversely, attractiveness refers to the relational attributes that a PhD-holder possesses based on her PhD-granting institution, their originating program, its reputation and ranking, and the reputations of her faculty mentors and advisors (Bedeian, et al., 2010; Burriss, 2004; Caplow & McGee, 1958; Fogarty & Saftner, 1993; Fogarty, et al., 2012; Lewis, 1996; O'Meara, 2011). Attractiveness relates to one's likelihood of being desired or recruited by competing institutions in the market: the more likely institutions are to desire or compete for a candidate, the higher her attractiveness (Caplow & McGee, 1958; Lewis, 1996; Burriss, 2004). Because of the strong relationship of attractiveness to a PhD-holder's likelihood of obtaining a tenure-track job, attractiveness as evidenced by the institutional Carnegie classification, institutional control, and ranking of PhD recipients' graduating programs are included as variables in this study. Other aspects of attractiveness, such as the reputation of a PhD-holder's faculty advisor, however, are not included in the data sources in this study and thus represent a limitation.

Besides merit-based factors and attractiveness, the academy also highly values cosmopolitan values, or an orientation to one's discipline, rather than to one's local institution (Rhoades, Kiyama, McCormick, & Quiroz, 2008; Rhoades & Torres-Olave, 2015). While

service to an institution is important, dedication to the discipline or field is more highly valued and reinforced in the ALM (Burris, 2004; Rhoades & Torres-Olave, 2015). One way cosmopolitan values are encouraged is through embracing geographic mobility, or being willing to move across the country without geographic restraint. In this way, PhD recipients who can act as “free agent” academics benefit from being generally detached from a particular geographic location or institution, and instead are considered to be centered in the profession itself with unlimited geographic mobility (Rhoades, et al., 2008; Rhoades & Torres-Olave, 2015). One limitation of this study is the lack of ability to accurately capture PhD recipients’ geographic mobility.

Cumulative advantage and the ALM. In graduate school, well before they formally enter the ALM, PhD recipients start accumulating merit-based factors, attractiveness, and other resources to obtain a faculty job. A significant accumulation of these resources can give PhD recipients a cumulative advantage in competing against other candidates (Merton, 1973, 1988). Cumulative advantage theory is a kind of status-resource interaction model, where one’s status directly affects one’s ability to secure resources. Status acts as a cumulative exposure process, where it exposes (or fails to expose) the individual to resources over time (Merton, 1973, 1988). Merton (1973, 1988) originally developed the theory of cumulative advantage (also known as the “Matthew effect”) to explain advancement in scientific careers, and it is now widely used as a general mechanism to explain inequality between groups or individuals that grows across time. Phrases like “the rich get richer” and “the poor get poorer” are often used to describe cumulative advantage and the effects of the growing gap in advantage or disadvantage across individuals or groups (Merton, 1973, 1988; DiPrete & Eirich, 2006).

Merton's theory of cumulative advantage applies to graduate students and the ALM because the students who accumulate resources early on or in large amounts often have a cumulative advantage over other students in acquiring more resources over time, which translate to a competitive edge in the ALM (DiPrete & Eirich, 2006; Kennelly & Spalter-Roth, 2006; Merton, 1973, 1988). Through the lens of cumulative advantage, once a doctoral student gains a small advantage over other students, the advantage will compound over time into an increasingly larger advantage (DiPrete & Eirich, 2006; Merton, 1973, 1988). It is important to note that not all resources are created equal, however, and some graduate students may have limited access to, knowledge of, and ability to transform resources into career strategies.

Just as cumulative advantage works in favor of those who obtain jobs in the primary market, a cumulative disadvantage effect works against those working in the secondary labor market (DiPrete & Eirich, 2006; Merton, 1973, 1988). Cumulative disadvantage emphasizes that a lack of early successes, resources, or an accumulation of disadvantages over time directly relates to the long-term disadvantages different groups face (Merton, 1973, 1988). These disadvantages work to differentiate groups of people over time. In this case, faculty who accrue many years of contingent work are actually at an increased disadvantage when it comes to penetrating the barrier to the primary academic market, resulting in a "second-class" stigma for long-time part-time faculty (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013). Consequences include professional isolation, a sense of invisibility in departmental and university life, and being overworked and undercompensated (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010). The long-term effects secondary faculty face relate to the cumulative disadvantage they experience over time due to a lack of early success in obtaining a tenure-stream job, a lack of resources available to them early on or

throughout their career, or an accumulation of disadvantages over time. This study seeks to understand whether and how PhD recipients with different individual characteristics (gender, marital/partnered status, and family status) and graduate school characteristics (doctoral training, institutional, and professional variables) develop a cumulative disadvantage toward obtaining tenure-track faculty positions due to differentiation in the access or development of career-related resources that originates early on while they are in graduate school.

Resources PhD recipients use to compete in the Academic Labor Market

Regardless of gender and family status, to develop a cumulative advantage in the academic labor market, all PhD recipients must accumulate the necessary resources to compete for scarce tenure-track jobs. Career-related resources are the individualized stores of attributes, capabilities, and qualities doctoral recipients possess (Enders, 2002; Kennelly & Spalter-Roth, 2006). Resources can be individually-based, meaning they are a part of the PhD recipient's background characteristics, or they can be institutionally-based, meaning they act as a function of the PhD recipient's institution (Enders, 2002; Kennelly & Spalter-Roth, 2006).

Individually-based career related resources. The literature on doctoral students identifies a number of resources that are positively (or in their absence, negatively) correlated with graduates obtaining tenure-track faculty positions post-graduation. For instance, graduates whose parents attended college, whose parents have professional status through their occupations, and who achieved high grade point average at all prior levels of schooling from high school on have a better chance of obtaining tenure-track positions (Ampaw & Jaeger, 2011; Enders, 2002). Graduates who benefit from institutional funding like assistantships and fellowships, and who are younger rather than older during graduate school are more likely to obtain tenure-track jobs (Ehrenberg et al., 2007; Ehrenberg & Mavros, 1995; Kim & Otts, 2010).

Some individual resources are gendered, as well; for instance, living with a spouse and children during graduate school benefits men, but not women (Mason, 2013). Researchers describe this effect as a “caregiver bias,” or “second shift” where women are still more likely to assume with traditional gender roles related to marriage and parenting than men, and thus spend more time caring for a home, family, and related responsibilities (Hochschild, 1997; Mason, 2013).

Conversely, as compared to women with children, married men with children may be perceived as being steadier, more grounded, and more committed to their studies or jobs (Mason, 2013).

Institutionally-based career related resources. From an institutional standpoint, universities vary in the level of support they provide for scholarly productivity, funding, faculty support, and collegial network development. The more prestigious an institution or program is, the better chance its graduates have of obtaining tenure-track positions (Finnegan, 1993; Kennelly & Spalter-Roth, 2006; Zhang, 2011). One potential reason for this is that prestigious programs are more likely to possess resources and opportunities that are devoted to the support of doctoral students and their scholarly development. Prestigious programs are more likely to offer better scholarly training, opportunities to collaborate with faculty, and better career placement and advancement opportunities post-graduation. The prestige of an institution or department directly influences graduates’ level of quality research and teaching training, publication and research experience, and development of networks of peers and professional contacts (Burris, 2004; Ehrenberg et al., 2007).

Program ranking in particular has a direct relationship with PhD recipients’ ability to obtain tenure-track faculty appointments. Institutions recruit graduates into the primary labor market from the most prestigious programs (e.g., programs ranked in the top quartile of institutions), while candidates from less prestigious programs are more likely to be filtered into

the secondary labor market or less prestigious programs (e.g., programs ranked below the top quartile of institutions) (Bedeian, et al., 2010; Fogarty & Saftner, 1993; Fogarty, et al., 2012). Individuals in more prestigious programs may benefit from the quality of their faculty members' scholarly work and leadership in professional organizations (Bedeian, et al., 2010). Program ranking has a direct effect on PhD recipients' ability to develop a cumulative advantage, because obtaining graduate degrees from more prestigious programs leads to more prestigious initial academic appointments and a higher likelihood of holding more prestigious academic appointments later in the academic career (Bedeian, et al., 2010).

Transforming resources into strategies. As Kennelly and Spalter-Roth (2006) note, having a store of resources at one's disposal is worth little if doctoral students fail to transform some of those resources into career-related strategies. Career-related strategies are the purposeful ways doctoral recipients utilize their resources to develop professional skills and attributes. Career-related strategies include getting help from mentors on the job market, publishing in peer reviewed journals, participating in professional organizations, and seeking training to make professional presentations. Other career-related strategies include being mobile in the job search, avoiding full-time and non-academic work during graduate school, and avoiding temporary or part-time work immediately after graduation (Abedi & Benkin, 1987; Enders, 2002; Mason, 2013; Wolf-Wendel, et al., 2004; Wolfinger et al., 2009). For women, career-related strategies may also relate to family choices, such as choosing to delay or avoid motherhood altogether. Such strategies include spacing the birth of children farther apart, limiting the total number of births, abstaining from motherhood altogether prior to going up for tenure, and other strategies that help women avoid family-based discrimination in the job market and in their early careers

(Gardner, 2008b; Kennelly & Spalter-Roth, 2006; Kuperberg, 2009; Lynch, 2008; Watanabe & Falci, 2014; Wolf-Wendel & Ward, 2006).

Each doctoral student interacts with his or her supply of resources to develop strategies in different ways. PhD students' interactions with resources are mediated by access to resources, but are also moderated by individual choices PhD students make about their intended careers. Graduate school is a pivotal period in which students visualize what their lives and careers might be like as faculty members (Gold, 2006). Students who perceive faculty life to be conducive to their individual lifestyle and career goals tend to think more positively about becoming faculty members (Bieber & Worley, 2006). Pregnant and parenting women, or women who desire to have children either during or after graduate school, may perceive the time commitments and pressures of tenure and publishing to be a deterrent to their larger life goals (Kennelly & Spalter-Roth, 2006). Traditional wisdom in academia is that women should forgo having children in graduate school and prior to earning tenure, a sacrifice that will help them fully devote themselves to their academic pursuits (Aisenberg & Harrington, 1988; Armenti, 2004; Drago & Colbeck, 2003; Tierney & Bensimon, 1996). This "either or" approach can encourage women with children to "opt out" of pursuing academic jobs. However, when students "opt out" of pursuing academic positions due to perceived potential familial conflicts, it affects the size and heterogeneity of the pool of students from which the pipeline pulls students into academic positions.

Opting out as an avoidance strategy may be one reason why very few women who attend prestigious programs have children in graduate school (Kennelly & Spalter-Roth, 2006; Mason, 2013). Those who attend prestigious programs may be more likely to actively practice discrimination avoidance strategies, such as delaying or avoiding motherhood during graduate

school and the early career. Since women who have children are more likely to attend less prestigious programs, they may have restricted access to institutional funding, fewer opportunities to collaborate with faculty, and as a result, fewer opportunities for publishing or presenting at conferences. While as many as 63 percent of students across disciplines consider becoming a faculty member post-graduation, nearly 10 to 20 percent fewer of the same students report considering becoming a professor as a realistic outcome (Golde & Dore, 2001). Students may change their career aspirations mid-stream in graduate school, or they may decide that the pressures of the tenure-track are too difficult and thus drift away from considering faculty positions (Bair & Haworth, 2004; Gardner, 2008b). Such career decisions may influence students to develop their career-related strategies differently, or with different intensity and purpose, than those who are fully committed to the tenure-track path.

Existing frameworks of career-related resources. In the literature, there are two prominent frameworks that capture ways to analyze the career-related resources doctoral students accumulate in graduate to compete in the academic labor market: Enders' (2002) *Doctoral Professional Success Framework*, and Kennelly and Spalter-Roth's (2006) *Doctoral Career-Related Resources and Strategies Framework*. A combination of the two frameworks is used in this study, because combining them allows for a blended framework that is well-suited to the research questions and design of this study.

Enders' (2002) Doctoral Professional Success framework. In a major national study of 2,244 German doctoral graduates from 1979-1990, Enders (2002) investigated the impact of doctoral training outcomes on doctoral graduates' subsequent careers and work, comparing doctoral graduates' career outcomes and satisfaction levels with non-doctorate holders (p. 507). While Enders included tenure-track faculty positions within the examined career trajectories, he

did not isolate his analysis to those who entered the professoriate. From his analysis, Enders created the Doctoral Professional Success Framework which defined “professional success” based on PhD recipients’ levels of research engagement, income, occupation/position, and career satisfaction. Enders categorized four major areas that influenced doctoral graduates’ likelihood of professional success:

1. *Socio-biographic background*, including variables on parental education, parental professional status, gender, and living with spouse/children during graduate school;
2. *Prior education*, including grade point averages in high school and each subsequent level of higher education, engagement in vocational training, and age at first higher education degree;
3. *Doctoral training*, including grade point average during the PhD, extent of local integration in the university setting, extend of integration in the larger professional community during graduate school, and age at PhD receipt; and
4. *Professional life course*, which included engaging in a job search after graduation (as opposed to obtaining job placement prior to PhD graduation), first career destination, and presence of unemployment.

Enders (2002) found that these four dimensions of career destinations significantly influenced doctoral students’ professional success. Significant findings include that men living with spouse and children are more successful than women are in terms of obtaining professional success, as women are more likely to work part-time or not work at all during the early career. Enders also found that prestigious academic backgrounds, juvenility at all levels of higher education, and employment inside higher education and research immediately before and after graduate school helped doctoral students obtain professional success.

Enders’ framework (2002) is relevant to this study because it accounts for how students accumulate resources before, during, and after graduate school that relate to tenure-track faculty career outcomes for doctoral graduates. Enders’ framework is broadly generalizable because all four categories of resources apply to a variety of doctoral student circumstances, situations, and

career outcomes. However, Enders' framework is limited in the sense that it treats all doctoral students equally, despite the fact that some students (like mothers with young children) may have more restricted access to, more limited knowledge of, or generally less time to develop and use the career-related resources of which other students may be able to take advantage. Therefore, Enders' framework provides a solid framework, but is insufficient in some aspects that specifically relate to the analyses used in this study.

Kennelly and Spalter-Roth's (2006) Doctoral Career-Related Resources and Strategies framework. Using their longitudinal survey of a 1996-97 graduating cohort of 435 sociology PhD's, Kennelly and Spalter-Roth (2006) offer a more detailed framework of career-related resources and strategies that is highly relevant to the research questions in this study. The authors investigated the availability and use of three types of resources and strategies used during graduate school: institutional resources, resource-based strategies, and family-based strategies:

1. *Institutional resources* include variables such as departmental prestige, research assistantships, fellowships, and faculty help in publishing and the job search.
2. *Resource-based strategies* included ways students developed strategies related to obtaining tenure-track jobs, such as getting help from mentors on the job market, and publishing in peer reviewed journals.
3. *Family-based strategies* included birth spacing, limiting births, and the use of financial resources from spouses or parents to fund education.

The authors (2006) found that all three areas had important effects on mothers' likelihood of obtaining tenure-track faculty jobs at research or doctoral universities, but there were significant differences in terms of access and use of resources and strategies existed for mothers versus non-mothers. Mothers were less likely to obtain career-related resources in the first place, as they attended less prestigious institutions. Departmental prestige was the single most significant predictor of obtaining a tenure-track position. Mothers were also less likely to be awarded research assistantships, received less faculty help with publishing, and were more likely

to borrow funds from spouse or family to pay for school, which were negatively associated with obtaining tenure-track jobs. Mothers who were more successful at obtaining tenure-track jobs post-graduation had fewer children, had no children for four years post PhD graduation, and engaged in more part-time and temporary work (an interesting contrast with Enders' results).

While Kennelly and Spalter-Roth's framework (2006) is of significant interest to this study, it is somewhat limited in that it is tied specifically to the original survey instrument the authors used, thus evidence for each of its areas is difficult to reproduce when using different data collection methods. Kennelly and Spalter-Roth's framework is also limited in that it does not account for the accumulation of professional life course resources prior to or immediately after graduate school, such as work experience.

Despite their individual limitations with reference to this study, a synthesized framework that incorporates portions of both Enders' (2002) and Kennelly and Spalter-Roth's (2006) respective frameworks is useful for analyzing the career-related resources doctoral students accumulate in graduate to compete in the academic labor market. With this in mind, a conceptual framework that incorporates aspects of both Enders' (2002) and Kennelly and Spalter-Roth's (2006) frameworks is outlined at the end of Chapter 2.

While these frameworks offer general criteria that are applicable to all PhD recipients, the research questions in this study seek to determine whether differences exist between PhD mothers and the other groups in terms of the accumulation of career-related resources in graduate school. These differences will inform whether PhD mothers experience a cumulative disadvantage in obtaining tenure-track faculty jobs as compared to other groups across gender and family status. Therefore, the analyses used in this study require a pervasive understanding of the research literature on PhD women, mothers, and the specific challenges and obstacles they

face that may influence their specific likelihood of obtaining tenure-track faculty jobs. With this in mind, the remainder of Chapter 2 is dedicated to exploring themes in the research literature that apply directly to PhD mothers, with a specific focus on gender, motherhood, and the ALM.

Gender, Motherhood and the Academic Labor Market

In this section, I examine how gender and family status shape PhD mothers' experiences in graduate school and their likelihood of successfully obtaining tenure-track faculty jobs (e.g., Mason, 2014; Kennelly & Spalter-Roth, 2006). I explore the various obstacles PhD mothers face in the transition to the professoriate, including in the course of graduate school and in the pursuit of tenure-track positions in the ALM (e.g., Jean, Payne, & Thompson, 2015). Theories about gender identity, social roles, and work-family challenges for women in academia offer explanations for why mothers face such obstacles. A potential result of these challenges is that PhD mothers face a cumulative disadvantage in both graduate school and in their early careers as they attempt entry into the primary labor market of the ALM, which ultimately leads to lower representation in tenure-track faculty jobs (e.g., Mason, 2013; Morrison, et al., 2011; Wolfinger et al., 2008). Another result of these challenges is that PhD mothers are at greater risk of "leaking out" of the academic pipeline, to such an extent that it is questionable whether the pipeline metaphor truly captures the behavior of PhD mothers in academic employment (e.g., Gibbs, et al., 2014; Morrison et al., 2011; Wolfinger et al., 2008).

To explore these ideas in greater depth, this section is organized into three sub-sections: (1) identity, role, and work-family challenges, which refers to the nature of PhD mothers' contradictory roles and details the methods PhD mothers use to manage the conflicting intersections of academia and family life; (2) organizational barriers to PhD mothers with family demands, which refers to obstacles within the academic environment that PhD mothers face in

graduate school and the early career; and (3) gender, motherhood, and cumulative disadvantage in the ALM, which explores the relative disadvantage of mothers compared to other groups in the ALM. While these theories and concepts are a part of the broader literature on women in the academy, for the purposes of this paper, these ideas are specifically applied to PhD mothers, or women who parent children while in graduate school and who pursue faculty positions upon earning their terminal degrees.

Identity, role, and work-family challenges. While this study is limited in that it does not examine the different parenting practices of the PhD mothers included in the sample, the way women approach parenting provides an important context for how and why PhD mothers may be at a cumulative disadvantage in accumulating career-related resources in graduate school. Also, the literature supports a number of different identity, role, and work-family challenges that exist across academic women both as graduate students and as women with academic careers. Thus, in graduate school, PhD mothers tend to assume dichotomous identities that are often in conflict. Researchers describe this effect as being in a “double bind,” with students keeping one foot in parenting life, and the other in academia (Estes, 2011). As parents, mothers are subjected to normative cultural and social expectations regarding proper parenting. To engage in “good parenting,” students must emotionally and financially support their families. They must be “present” by spending “necessary” amounts of “quality” time and attention with children and partners. Popular culture tends to perpetuate the assumptions that “good moms” are financially stable, married or in a long-term relationship, educated, and are singularly focused their children (Estes, 2011, p. 199).

One powerful cultural construct that influences student-parents is the concept of intensive parenting. Traditionally, intensive parenting has been exclusively associated with mothers;

intensive mothers revolve their lives, time, attention, and well-being around their children (Lynch, 2008). Philosophies associated with intensive mothering include the idea that mothers are the most capable parents; their happiness is derived from their children; they are necessary developmental guides for their children; and they are always willing to sacrifice their own needs for those of their children (Estes, 2011; Lynch, 2008). PhD mothers tend to feel guilty when they are unable to spend intensive time with their children, or when they are unable to fully embrace their traditional maternal roles (Estes, 2011).

Unfortunately, being an intensive mother conflicts with academia's view of the "good student," and as Espinoza (2010) points out, "university environments seldom legitimate family commitments" (p. 310). Brus (2006) suggests that institutional ownership or "the unstated but closely held expectation that students who are truly committed to their fields of study will make themselves available to their professors and advisors at any time of day or night, on short notice, and without complaint," is particularly pervasive in selective graduate schools and some fields (p. 36). These expectations are closely related to Hochschild's (1995) concept of the ideal worker norm, which asserts that tenure-track academics are required to dedicate their lives to their work due to the "up or out" nature of tenure and promotion (Hochschild, 1995; Ward & Bensimon, 2002). Communicated primarily through faculty, academia expects students to be fully devoted to the pursuit of knowledge, but this is problematic for students whose identities and sense of responsibility or belonging are closely tied to a family culture or structure (Brus, 2006; Espinoza, 2010). Students often feel there are no rules or established expectations in academia that accommodate their roles as parents (Gardner, 2008a). Instead, they are an exception to the rule of the "normal graduate student." PhD mothers often feel they must prove themselves simply because they are parents and are different from the norm. Often PhD mothers make a hyper-

conscious commitment to embracing the “good student” identity, given the stigma they perceive in being outside the norm (Brus, 2006). Good students” are supposed to be “young, single, impressionable, and free from external responsibilities,” to be fully committed to academic life, and to be willing to play the role of “worker bee” in their departments (Estes, p. 199; Lynch, 2008). PhD mothers are also subjected to the institutional and cultural norms of their academic departments, which may not be supportive of students who come with families in tow. One effect of living out the commitment to being a good student is that students experience the “double bind” effect in a different way: they feel like they are missing out on both a normal family life and a normal academic life (McQuillan & Foote, 2008).

When the contexts of both parenting and academic life call for a person’s undivided time and attention, it is no wonder that PhD mothers find holding both roles to be problematic. Graduate students who are parents tend to experience high levels of emotional distress, including being overwhelmed or feeling isolated, as a result (Gardner, 2008a). The varying types of stress students experience often undermine their ability to feel like they can successfully navigate family life and the academic environment (Oswalt & Riddock, 2007). Given the multiple roles they assume, PhD mothers also use a number of strategies to manage the conflicting natures of their dual identities. These strategies are impacted by students’ gender, race/ethnicity, spousal/partner relationships, and personalities. The research suggests that there are two ways students manage the ideological differences and practical needs of each of their identities: (1) they converge their identities through integration, or (2) they separate their identities through compartmentalization (e.g., Espinoza, 2010; Estes, 2011).

When PhD mothers’ responsibilities and roles intersect, they are faced with a choice: to blend their identities in the face of the intersection, or to hide them (e.g., Estes, 2011).

Converging identities involves integration behaviors, or when mothers try to blend their divergent roles into a completely new identity (Espinoza, 2010; Estes, 2011). Integrators explicitly communicate to family members regarding school issues, explaining the demands they face and enlisting help to meet them (Espinoza, 2010). They are also more likely to be open with faculty advisors about family commitments and personal issues. Estes (2011) suggests that mothers who incorporate their identities as students and parents have clear perceptions that their parent identities are stigmatized, so they strive to be “good student-parents.” She suggests that students create this role with distinctive characteristics in its own right. PhD mothers often feel they are more committed to their degrees than other students, and that they must be more visible on campus, must work harder, and must do double the amount of work to keep up with other students and faculty expectations. Mothers put added pressure on themselves to “measure up” given that they are in a stigmatized role, and given that they perceive faculty to believe they will likely not live up to their full potentials while managing multiple responsibilities (Estes, 2011).

Some mothers choose to completely separate their roles through compartmentalization behaviors (Espinoza, 2010; Estes, 2011). Separators organize their lives to keep family and school entirely separate, though they still tend to prioritize family above school (Espinoza, 2010). In her study of 30 doctoral mothers, Lynch (2008) concluded that women practice “maternal invisibility,” or downplaying their motherhood in academic environments, and “academic invisibility,” or reducing their student identities in parenting environments as ways to cope with the pressures of maintaining the socio-cultural contexts of “good mother” and “good student.” While complete compartmentalization may not be possible for students, separators often go to a great deal of effort to divide academics and family life (Espinoza, 2010).

The choice to incorporate/integrate or to separate/compartmentalize are not mutually exclusive of each other, nor are they meant to represent an either/or mentality. Researchers suggest that students vary in their responses to different environments, and as they advance in their academic programs, they may change their approaches over time (Espinoza, 2010; Estes, 2011). Gender may also influence students' choice to integrate or compartmentalize. For instance, McQuillan (2008) found that male students often engage in compartmentalization from the beginning of their periods of academic study, but that women tend to embrace incorporation. However, as time to degree increased, women were more likely to use compartmentalization (McQuillan, 2008).

Another identity-related challenge for PhD mothers is the degree to which they are typically socialized into academic departments. Tinto's (2003) work on integration provides a foundation upon which much of the research on doctoral socialization is built. Tinto (2003) defines integration as shedding the norms, values, and practices of one's former environment, and integrating into the new environment by incorporating its particular norms, values, and practices. When environments are academically supportive of students (including providing institutional resources like funding and research support), students are more likely to persist to graduation (Ehrenberg et al., 2007; Tinto, 2003).

In examining doctoral students in a homogenous sense, Gardner (2006) found that in general, students experience a high level of ambiguity about their program guidelines and expectations, and which can create barriers to successful socialization in an academic institution. She found that students face challenges with balancing demands and priorities, which can significantly affect their ability to persist. Gardner also found that when students receive financial support as well as emotional and professional support from faculty and peers, they are

more likely to succeed. The more support students receive, the higher their likelihood of persistence (Gardner, 2006).

When adjusting the lens to examine female graduate students in particular, in their exploratory case study of women graduate students at one research institution, Clark and Corcoran (1986) found that men and women experience differential processes of socialization that can result in a differential accumulation of advantages and disadvantages affecting their academic careers. The differences in professional socialization, including different levels of “sponsorship,” or role-modeling and mentoring from faculty members that seek to advance their “protégé” students, vary significantly by field and by gender, but women in fields described as having a dominant male culture tended to face higher levels of hostility and isolation in seeking sponsorship from their advisors (Clark & Corcoran, 1986).

Similarly, in specifically examining graduate students who are mothers, Gardner (2008a) found that mothers keenly experience the effects of their misalignment with the majority of the graduate student population. In a qualitative study of 40 chemistry and history students, Gardner found that mothers often describe their graduate experiences as “out of the norm,” and they feel that they do not “fit the mold” of graduate school. Along with other women, older students, and part-time students, mothers’ feelings of “differentness” decreased their overall satisfaction with and integration into their departments and degree programs. Their feelings of being different were compounded by the practical challenges associated with balancing time, attention, and energy when one is both a student and a parent. Gardner (2008a) linked the higher rate of feeling “different” with higher levels of attrition for mothers.

Gardner (2008b) also examined how students and faculty differ in their perceptions of the relationship between family issues and student attrition. In interviews with 60 PhD mothers and

34 faculty members to learn about how they conceptualize the cultural contexts and structures that hinder student completion, she found that while students attributed personal problems, including marriage, children, and family responsibilities as a primary factor in attrition, faculty attributed student quality as the primary factor in attrition. While mothers frequently discussed the challenges of pregnancy and parenting during graduate school, only one of the 34 faculty members stated that it was an issue related to attrition. When asked about the factors that affected students the most, faculty most frequently cited that mothers were lacking in commitment, in academic preparation, or that they should not have been admitted in the first place (Gardner, 2008b).

When academic departments are more inclusive of diverse types of students, student-parents' attrition rates drop (Bieber & Worley, 2006; Golde, 2005). The socialization processes in some departments have also been found to produce gendered effects. Sallee's (2011) study of male graduates in an aerospace and mechanical engineering department suggests that in some male-dominated fields, men are socialized to adopt masculine values like competition, hierarchy, and the objectification of women in order to succeed. Women were not present in high enough numbers to be represented in the study, but Sallee (2011) expands upon the fact that if socialization is gendered, it can provide a significant barrier to the successful integration of mothers in a department or field.

Parenthood can also affect how students form educational aspirations. Graduate school is a pivotal period in which students visualize what their lives and careers might be like as faculty members (Gold, 2006). Students who perceive faculty life to be conducive to their individual lifestyle and career goals tend to think more positively about becoming faculty members (Bieber & Worley, 2006). For PhD mothers, or for women who desire to have children either during or

after graduate school, they may perceive the time commitments and pressures of tenure and publishing to be a deterrent to their larger life goals (Kennelly & Spalter-Roth, 2006). When students “opt out” of pursuing academic positions due to perceived potential familial conflicts, it affects the size and heterogeneity of the pool of students from which the pipeline pulls students into academic positions.

Another family-related challenge academic women often face is dual-career considerations (e.g., Jean, Payne, & Thompson, 2015; Wolf-Wendel, et al., 2004). While today, most married-couple families with children are classified as dual-earner status (58 percent according to the Bureau of Labor Statistics, 2010), the number of dual-career couples tends to be higher in academia (as high as 83 percent in some fields according to Schiebinger, et al., 2008). Dual-career couples are challenged to find equally satisfying, equally compensating positions in the same geographical location. This challenge is referred to as the “co-location problem” or the “two body problem” (e.g., Wolf-Wendel, et al., 2004). Dual-career couples often are faced with forming a compromise, with one partner putting his or her career on hold or settling for a less prestigious position to benefit the other’s career. Women are more likely than men to compensate to benefit their partners’ careers (e.g., Jean, Payne, & Thompson, 2015). Schiebinger and colleagues (2008) found that 40 percent of academic women refused a job offer due to their partner not receiving an adequate offer in the area, compared to 27 percent of academic men. PhD mothers may face additional limitations when it comes to co-location, due to children’s schooling, health, and childcare needs (Jean, Payne, & Thompson, 2015). The relative immobility of PhD mothers violates the largely cosmopolitan values of the academic labor market (Ehrenberg, et al., 2007), and thus immobility may prevent mothers from aligning with the universal expectations employers have for faculty in the ALM. While PhD women who are

partnered or married and those who are mothers may face limitations in their geographic mobility, and while these limitations can directly impact their ability to be employed as tenure-stream faculty, a lack information on PhD recipients' relative geographic mobility in the data sources is considered a limitation of this study.

Organizational barriers to PhD mothers with family demands. Investigation into the organizational barriers that affect PhD mothers focuses on the lack of maternity and parenting-related policies that are available for students. A lack of maternity leave policies, lack of financial support, inadequate health care, inadequate on-campus childcare, leave of absence policies, scheduling and classes, and transportation issues are all structural barriers that shape the way student-parents function within the academic environment (e.g., Brown & Nichols, 2012). Springer, Parker, and Leviten-Reid (2008) conducted a comprehensive study on the state of the policies graduate programs have implemented for student-parents. The authors' (2008) multi-institutional survey of graduate directors from the top 63 sociology departments in the country, as ranked by *U.S. News and World Report* (2007), indicated that few official policies exist to accommodate graduate student-parents, and most situations are handled on a case-by-case basis. Results also indicated that many graduate directors are unaware of university supports that may exist for parenting students. Other studies confirm that overwhelmingly, both students and program directors cite lacking or absent policies for parenting students despite the fact that students face a host of challenges related to parenting, including a lack of leave of absence policies, maternity leave policies, financial support policies, and breastfeeding facilities (Brown & Nichols, 2012; Kuperberg, 2009; Lynch, 2008; Merchant et al., 2013).

Though the general dearth of policies regarding parenting students has been fairly established, the literature indicates that the trend is shifting. In separate studies, Mason (2004)

and Kuperberg (2009) studied the rate at which schools implemented maternity related policies. In her 2007 survey of 62 top-ranked graduate schools, Mason (2004) found that 26 percent offered maternity leave to students; 10 percent offered paid maternity leave; 50 percent offered childcare subsidies; and 10 percent offered programs for emergency backup care. In a five-year follow-up study, Kuperberg (2009) found that in most areas, the accommodations top tier research universities are extending to parenting students have grown:

Table 1

Comparison of Mason (2004) and Kuperberg's (2009) Parental Policy Findings

Parental Policies	Mason, 2004 (N = 62 top-ranked graduate schools)	Kuperberg, 2009 (N = 20 top-ranked graduate schools)
Offered maternity leave to students	26%	65%
Offered paid maternity leave to students	10%	55%
Offered extended time to degree for mothers who delivered/adopted a child	n/a	45%
Institutions offering childcare subsidies	50%	30%
Institutions offering programs for emergency backup care	10%	n/a

The rate of growth elicited through comparing Mason and Kuperberg's studies indicates that schools (at least those at the uppermost rungs of selectivity) are becoming more considerate of student-parents' policy needs.

Gender, motherhood, and cumulative disadvantage. The identity, role, work-family conflicts, and organizational barriers PhD mothers face influence their ability to accumulate necessary career-related resources in graduate school and to compete in the ALM for tenure-track jobs. Because of the various challenges PhD mothers face, they tend to be at a cumulative disadvantage in graduate school and in their early careers, leading to their underrepresentation in the primary labor market of the ALM (e.g., Morrison et al., 2011; Wolfinger et al., 2008). If PhD mothers struggle to obtain important career-related resources in graduate school, they may not have the ability to develop an advantage that will compound over time, and ultimately, they may

be less able to compete for jobs in the ALM (Merton, 1973; DiPrete & Eirich, 2006; Kennelly & Spalter-Roth, 2006). PhD mothers who are unable to find a tenure-track position early on may face an increased disadvantage when it comes to penetrating the barrier to the primary academic market, resulting in a similar type of “second-class” stigma as contingent faculty (e.g., Kezar & Sam, 2010). Indeed, these limitations may directly lead PhD mothers to become disproportionately concentrated in the secondary labor market in the ALM, though their movements in and among the primary and secondary labor markets has been largely unexplored (Hudson, 2007; Rhoades, 2013).

The effects of PhD mothers being at a cumulative disadvantage may be observed in their “leaking out” of the academic pipeline, or the pathway to the professoriate (e.g., Biggs, et al., 2014; van Anders, 2004; Wolfinger et al., 2008). This “leaking out” occurs when PhD mothers (and in some cases, women in general) become effectively filtered out of the academic pipeline (e.g., Biggs, et al., 2014; van Anders, 2004; Wolfinger et al., 2008). The literature on the academic pipeline suggests that mothers specifically exit the pipeline at three distinct phases: during graduate school, after obtaining a PhD but prior to seeking a tenure-track position, and after obtaining a tenure-track position but prior to earning tenure (Morrison et al., 2011; Wolfinger et al., 2008). Women exit the pipeline at all three stages in larger numbers than men, and parenthood is related to their exiting (Mason, 2004, 2013).

At the first point in the pipeline, women are more likely to exit during graduate school or prior to seeking a tenure-track position in part because there are systemic barriers associated with parenting that discourage women from pursuing academic careers (van Anders, 2004). Women experience greater challenges with mobility, which may be required upon entering the professoriate (Wolf-Wendel, Twombly, & Rice, 2004). Women in STEM fields in particular may

perceive incompatibilities between the “greedy” cultures of science and motherhood (Etzkowitz, Kemelgor, & Uzzi, 2000; Kelly & Grant, 2012; Rosser, 2004; Grant, Kennelly & Ward, 2000). Women in science tend to strongly associate with their professional fields and thus may consider business and industry to accommodate their family lives better than academe (Monosson, 2008). Though men tend to be just as interested in having children as women, women seem to self-select away from academia in response to perceived gendered barriers related to parenthood (Ginther & Kahn, 2006b; van Anders, 2004).

At the second point in the pipeline, women tend to exit before obtaining tenure track positions in greater numbers than men (Wolfinger et al., 2008). Women face persistent gender equity issues in the academy at all levels, especially because disciplines like science, technology, and engineering fields have low proportions of female PhD graduates and faculty members. Even though there are much higher rates of female PhD’s graduating from areas like the humanities, psychology, and the fine arts, there are still proportionally lower numbers of women faculty members in those fields (Mason, 2004).

Women obtain fewer tenure track positions than men in part because of the direct effects of motherhood and timing on the female career path (Miller, 2009). In her study of more than 1,400 academic and non-academic women, Miller (2009) found that delaying motherhood leads to a substantial increase in career earnings. Women earn 9 percent more income per year of motherhood delay, as well as a 3 percent increase in wages, and a 6 percent increase in work hours (Miller, 2009). College-educated women gain the largest advantages with motherhood delay. Mothers experience fixed wage penalties and lower income returns as compared to non-mothers, which suggests a “mommy track” effect, where earlier family formation accounts for the lower rate at which women obtain tenure-track jobs (Miller, 2009; Wolfinger et al., 2008).

At the third point in the pipeline, women who have tenure-track positions exit prior to obtaining tenure at higher rates than single women or men do (Mason, 2004). An estimated 53 percent of women leave tenure-track positions before achieving tenure (Marschke, Laursen, McCarl Nielsen, & Rankin, 2007). Despite the “mommy track” observed early on in women’s academic careers, neither family formation nor marriage accounts for women’s difficulties in obtaining tenure and promotion (Wolfinger et al., 2008). Women do tend to carry heavier service and teaching loads, which may be related to their leaving tenure-track jobs prior to tenure at higher rates than men (Misra et al., 2011). Regardless of whether they were married or had children, women are more likely than men to leave tenure-track positions prior to obtaining tenure (Mason, 2004). Women with children also tend to face challenges in promotion up the academic ladder, and advancement into senior faculty ranks or administrative positions continues to be a challenge (DiFuccia, Pelton, & Sica, 2007; Kulis, Sicotte & Collins, 2002; Ginther & Kahn, 2004). Finally, women on the tenure-track also experience negative familial outcomes, such as lower rates of marriage and family formation, and higher rates of divorce. As Mason (2004) describes it, “the gap in marriage, family formation, children, and divorce is as large as the occupational gender gap” (p. 86).

Despite its prominence in the literature, it is important to note that the academic pipeline metaphor has received recent criticism, in part because of its inability to fully explain the career paths of women in the professoriate (e.g., Cannady, Greenwald, & Harris, 2014; Pawley & Hoegh, 2011). Researchers have criticized the academic pipeline as being too linear and too restrictive to accurately describe the path of women and other underrepresented groups, like ethnic minority groups, to the professoriate. The conceptualization of the pipeline as “a career trajectory with one inlet, one outlet, and one direction of flow” fails to accurately capture the

experiences of academic mothers, who often pursue part-time or temporary positions immediately after graduate school, yet sometimes go on to become full-time, tenured professors later on (Cannady et al., 2014, p. 456). Another shortcoming of the pipeline metaphor is that as a supply side model, it focuses mostly on those who fail to meet the benchmark criteria of the academic gatekeepers at each juncture of the pipeline, or those who “leak out,” without adequate attention to those who join the professoriate through different paths. The pipeline does little to illuminate those who do not take the traditional path from graduate school directly to the professoriate, and thus is conceptually ill-fitting for some groups. Researchers have suggested other less linear concepts to describe the paths of women and ethnic minority students to the professoriate, such as “ecosystem,” “lattice,” or “labyrinth,” which offer movement in a general direction with points of divergence along the way (Cannady et al., 2014; Pawley & Hoegh, 2011). This study includes analyses of employment patterns that represent the entry, exit, and re-entry movements of PhD mothers into and out of the ALM within the first eight to thirteen years post-PhD graduation. The employment pattern analyses may reveal whether PhD mothers tend to “leak out” of the academic pipeline in a linear fashion, or whether PhD mothers’ employment patterns are better described in more of a non-linear or lattice-like fashion.

A Conceptual Framework for the Study

Key concepts that inform the conceptual framework used in this study include the accumulation of PhD recipients’ career-related resources that begins in graduate school and the cumulative advantage or disadvantage toward obtaining tenure-track jobs in the ALM that PhD recipients individually develop based on this accumulation. The analyses in this study rely on a consideration of how gender and family status may intersect with PhD mothers’ access to and usage of these resources, thus affecting their ability to attain tenure-track faculty jobs in

comparable numbers, at comparable rates, and in comparable types of institutions to other groups. With these concepts and understandings in mind, this section proposes a conceptual framework used for examining what individual, institutional, doctoral training, and professional life course factors influence PhD recipients' likelihood of obtaining tenure-track faculty jobs.

As described, the framework is constructed from Enders' (2002) *Doctoral Professional Success Framework* and Kennelly and Spalter-Roth's (2006) *Doctoral Career-Related Resources and Strategies Framework*. The synthesis of these two frameworks into a single conceptual framework provides the best fit for the research questions and data sources used in this study. A synthesized framework is used because Enders' framework is too general and does not account for subtle differences between students who are parents and those who are not, and because Kennelly and Spalter-Roth's framework is tied too closely to the authors' original survey instrument and does not offer much room for generalization or broadening to other data collection methods. When combined, however, the two frameworks offer a comprehensive and appropriate analysis tool for use in this study: Conceptual Framework: Doctoral Career-Related Resources.

Figure 1. Conceptual Framework: Doctoral Career-Related Resources

		Individual	Institutional
		Resources	
	Doctoral Training		Professional Life Course
	Held a GTA position Held a GRA position Primary source of financing for graduate school attendance Research productivity during or in the first two years after graduate school as evidenced by journal articles published		Employment outside a GTA, GRA, or fellowship during graduate school Holding a postdoctoral job Holding a non-tenure-track faculty job after graduate school

This framework contains four sections: individual factors, institutional factors, doctoral training factors, and professional life course factors. Each group of factors represents career-related resources students obtain or transform in graduate school, which influence one's likelihood of obtaining a tenure-track faculty position upon graduation. These sections contain the key variables that will be analyzed in this study.

The conceptual framework offers an objective set of variables that are measurable and comparable across all PhD recipients, while providing points of comparison that allow for analyses between and among the various groups of interest in this study, including the key interest group (PhD mothers during graduate school) and the selected comparison groups (PhD fathers, men without children, and women without children, all during graduate school). The conceptual framework is relevant because the premise of this study is based on the idea that PhD mothers may be at a cumulative disadvantage in obtaining tenure-track faculty jobs, and that the origins of this disadvantage may originate in the career-related resources PhD mothers

accumulate (or not) in graduate school. Finally, the framework offers a solid foundation on which to conduct the analyses that are required to answer the research questions in this study.

Conclusion

This chapter has provided a review of the literature related to PhD-earning mothers, their accumulation of career-related resources in graduate school, and how this accumulation influences their likelihood of obtaining tenure-track faculty jobs. I also presented the conceptual framework upon which this study is based. The conceptual framework includes individual, institutional, doctoral training, and professional life course factors that relate to PhD recipients' likelihood of obtaining tenure-track faculty positions. Based on the conceptual framework, the next chapter discusses the data and variables as well as statistical methods used for this study.

Chapter 3

Research Methodology

In this chapter, I present research methodology that was conducted to examine the factors influencing PhD mothers' accumulation of career-related resources and how that accumulation affected their likelihood of obtaining tenure-track faculty positions within the first eight to thirteen consecutive years of graduating with their terminal degrees. First, I present the data sources and the study sample. Then, I discuss the dependent and independent variables that were used to explore the research questions. The independent variables include individual, institutional, doctoral training, and professional life course variables. Finally, I present the analytic methods, data analysis process, and limitations of this study.

Data Sources and Sample

I used data from the Survey of Earned Doctorates (SED) and the Survey of Doctorate Recipients (SDR), administered by the National Center for Science and Engineering Statistics (NCSES) to respond to the research questions (NSF, 2014a; 2014b). The SED is an annual census since 1975 of all PhD recipients from accredited U.S. institutions, and it collects information on each doctoral recipient's educational history, demographics, and post-graduation plans (NSF, 2014a). The SDR is a longitudinal biennial survey conducted since 1973 that provides demographic and career history information about individuals with a research doctoral degree in a science, engineering, health, or social science field from accredited U.S. institutions. The survey follows a sample of individuals through their careers from the year of the award of their terminal degree until age 76. The panel is refreshed each survey cycle with a sample of new doctoral degree earners (NSF, 2014b).

The sampling frame for the SDR is constructed from the SED, so data between the two surveys is matched using a unique identification number for each PhD recipient held in the Doctorate Records File, providing a mechanism through which the datasets are merged (NSF, 2014a; 2014b). It was necessary to use data from both the SED and SDR because the SED offers cross-sectional data that provides detail on PhD recipients' doctoral training factors in graduate school, and the SDR offers longitudinal data that provides a more complete picture of the actual career outcomes of a set of the same doctoral recipients.

The study sample used restricted individual data made available through a license with the NCSES, NSF. The sample was limited to respondents who graduated with a PhD and responded to the SED between 2000 and 2005, who self-reported they were U.S. citizens, and who responded to at least one iteration of the SDR in 2001, 2003, 2006, 2008, 2010, and 2013. A total of 4,993 PhD recipients were U.S. citizens, graduated during the requisite years, and responded to at least one iteration of the SDR. Of these 4,993 doctorates, about 60 percent or 2,994 were included in the final sample. The final sample was narrowed to only those PhD recipients who ended up working at U.S. higher education institutions during the observation period 2006 through 2013, because the analyses are concerned with people who seek and attain academic jobs. Those PhD recipients who did not work at a higher education institutions between 2006 and 2013 were excluded from the analyses.

Narrowing the sample helped control for the various employment intentions of PhD recipients; some PhD recipients never intend to seek jobs in higher education contexts. Self-selection into business and industry instead of higher education is particularly common in STEM fields (Etzkowitz, et al., 2000; Grant, Kennelly & Ward, 2000; Kelly & Grant, 2012; Rosser, 2004), and STEM fields formed a significant portion of the sample used in this study. If

graduate students do not envision themselves working in academia or do not aspire to become teaching or research faculty, they may not accumulate the kinds of career-related resources during graduate school that will help them attain academic jobs in the same ways that those who are academically-bound do (e.g., Bieber & Worley, 2006; Kennelly & Spalter-Roth, 2006). Focusing on PhD recipients who worked at higher education institutions provides a clearer understanding of those who likely envisioned themselves working in academic contexts or who aspired into higher education-related jobs.

Of those who worked in higher education institutions, this study focused on doctorate recipients from natural science, social science, life science, and engineering fields. Humanities doctorates were originally included in the sample but were omitted from the final analysis because they comprised only one percent of the sample, which was too small for any meaningful statistical analysis.

This study used an additional dataset to construct an institutional variable, *Program Ranking*. The more highly ranked or prestigious an institution or program is, the better chance its graduates have of obtaining tenure-track positions (Bedeian, et al., 2010; Finnegan, 1993; Fogarty, et al., 2012; Fogarty & Saftner, 1993; Kennelly & Spalter-Roth, 2006; Zhang, 2011). The prestige of an institution or department directly influences graduates' level of quality research and teaching training, publication and research experience, and development of networks of peers and professional contacts (Bedeian, et al., 2010; Burris, 2004; Ehrenberg et al., 2007). With this in mind, program rankings published in *America's Best Graduate Schools* by the *U.S. News and World Report (USNWR)* from 1999 to 2005 were used to construct the variable *Program Ranking*. *Program Ranking* was a dichotomous variable where 1 indicated the PhD recipient's doctoral program was ranked in the top quartile by *USNWR* during or

overlapping with the doctorate's graduation calendar year, and where 0 indicated the PhD recipient's doctoral program was not ranked in the top quartile by *USNWR* during or overlapping with the doctorate's graduation calendar year. I linked the *USNWR* program ranking to each PhD recipient's doctoral institution using the Integrated Postsecondary Education Data System (IPEDS from the National Center of Education Statistics, NCES) institutional code in the merged SED/SDR data. I matched the *USNWR* program ranking year to the PhD graduation year for each doctoral recipient. For instance, engineering programs were ranked annually from 2000 to 2005, so the appropriate ranking for each doctoral program was linked with the PhD recipients' particular graduation calendar years. However, because the *USNWR* did not rank all programs annually between 2000 and 2005, in most cases, the PhD graduation year was matched with the most recent *USNWR* program ranking available. For example, psychology programs were ranked in 1999, 2002, and 2005 (U.S. News and World Report, 1999, 2002, 2005). Thus, I used the 1999 values for 2000 and 2001 program rankings; the 2002 values for 2002, 2003, and 2004 rankings; and the 2005 values for 2005 rankings for the psychology PhD recipients.

I matched the large category of major representing the PhD recipients' doctoral major program area as described in the *USNWR* to the PhD recipients' academic specialty as described in the SED variable PHDDISS, which included code fields for PhD recipients' major field specialties. For instance, doctorates whose academic field was described in the SED variable PHDDISS as "geology" were matched to the appropriate *USNWR* rankings for geology programs per the PhD recipient's PhD graduation year.

I used doctoral program rankings from *USNWR* instead of other published program rankings, like the 1993 National Research Council study of doctoral program quality because *USNWR* provided program rankings data that best aligned with PhD recipients' graduation years

(2000-2005). Using yearly ranking data from the *USNWR* allowed for a more exact match of program ranking based on doctoral program quality to the years PhD recipients graduated from their particular programs. However, there are limitations to using *USNWR* program rankings (e.g., Ehrenberg, 2003). While *USNWR* program rankings are intended to indicate the quality of a program's students and faculty, they are essentially statistical measures that rely on peer assessment scores. Among others, Ehrenberg (2003) has raised questions about the motivations of higher education administrators who participate in ranking peer schools, either because they opt out due to questioning the value of the survey, or because they rate peer schools lower than their reputations deserve. However, despite these criticisms, program ranking and institutional prestige affect how program quality is defined and how PhD recipients are perceived in the academic labor market, and *USNWR* rankings have persisted in quantifying program prestige (Burris, 2004; Morpew & Swanson, 2011; O'Meara, 2011; Sweitzer & Volkwein, 2009).

I used an ordinal construction for the variable *Program Ranking* because the literature suggests that institutions ranked in the top quartile have been shown to be relatively invariable over time (Morpew & Swanson, 2011). Morpew and Swanson (2011) found that the same 29 institutions appeared in the top 25 lists for *USNWR* between 1988 and 1998, and the same 20 institutions appeared in the top 25 lists for *USNWR* between 1998 and 2008. Morpew and Swanson (2011) suggest that the top 25 indicate an elite group of programs that is difficult for less-highly ranked programs to enter. Using Morpew and Swanson's (2011) top-quartile approach, I classified program rankings into the top quartile of institutions and then the remainder of institutions.

Research Variables

Dependent variable. The dependent variable was measured by whether or not a PhD recipient attained a tenure-track faculty job at a U.S. higher education institution between 2006 and 2013. The dependent variable *Tenure-Track Faculty Appointment* was constructed as a dichotomous variable with a value of 1 indicating the PhD recipient attained a tenure-track job at a U.S. higher education institution between 2006 and 2013, and with a value of 0 indicating the PhD recipient did not attain a tenure-track faculty job at a U.S. higher education institution between 2006 and 2013.

The dependent variable was constructed from the SDR variable TENSTA, which was based on a survey question displayed for SDR respondents who indicated they worked at a U.S. higher education institution during the survey reference period. The question linked to TENSTA asked, “What was your tenure status [during the reference period]?” Respondents who indicated they were either “On tenure-track but not tenured” or “Tenured” were coded as 1 indicating they attained a tenure-track faculty appointment. Respondents who indicated “Not applicable: no tenure system at this institution”; “Not applicable: no tenure system for my position”; “Not on tenure-track”; or [Logical skip] were coded as 0 as they did not attain a tenure-track faculty appointment. Respondents who were coded as 1 in any of the SDR iteration years between 2006 and 2013 were considered to have attained a tenure-track appointment at all, even if they subsequently left such appointment.

Independent variables. This study used a comprehensive set of independent variables that might explain how the career-related resources that PhD mothers accumulated in graduate school influenced their likelihood of obtaining tenure-track jobs. Appendix I contains a full list of the independent variables, the original variables in the SED/SDR dataset from which they

were drawn, and descriptions of the coding. The independent variables originated from the synthesized career-related resources framework drawn from Enders' (2002) and Kennelly and Spalter-Roth's (2006) respective frameworks (see Figure 1).

Individual variables. The individual variables were drawn from the SED/SDR dataset. All individual variables were captured at the time of PhD graduation so as to approximate the accumulation checkpoint described in Chapter 1. They included *Gender, Age, Married/Partnered, Number of Children, Age of Children, Time to PhD*, and *Academic Discipline*. The research literature offers mixed results on the effects of age and marital status on mothers' likelihood of obtaining tenure-track positions (e.g., Morrison et al., 2011; Wolfinger et al., 2008), however, it suggests fewer children and the presence of older-aged children leads to higher likelihoods of obtaining tenure-track faculty positions (Mason, 2013; Morrison et al., 2011; Wolfinger et al., 2008). Quicker time to degree and being in a social science-related discipline are positively related to obtaining tenure-track positions (Abedi & Benkin, 1987; Ehrenberg, et al., 2007).

Gender was derived from the SED variable SEX. The values for SEX included "male" and "female." Males were set up as the reference group and were coded with value of 0, and females were coded with a value of 1. The values for *Age* were calculated using two SED variables: Birth Year (BIRTHYR), representing the reported year of birth of the PhD recipient, and PhD Calendar Year (PHDCALYR), representing the calendar year the respondents reported earning their terminal degrees. I subtracted Birth Year from PhD Calendar Year to construct the continuous variable *Age in Years*. *Age in Years* was used in the descriptive analyses to compare the median age at graduation for PhD mothers and the comparison groups. However, for the logistic regressions *Age in Years* was constructed into a categorical variable, *Age*. Following

other studies on PhD recipients (e.g., Morrison et al., 2011), this study did not presume a linear effect of age on career outcomes; rather, this study presumed two groups: “younger” scholars who completed their degrees before they turned age 35 and “older” scholars who completed their degrees after they turned age 35. Using the categorical form of *Age* also helped normalize the distribution and subsequent effect of *Age in Years* in the regression models.

Similar to *Age*, *Time to PhD* was constructed using the SED variable YRSGRAD, representing the total number of years rounded to the nearest whole number from the doctoral recipients’ entry into any program in graduate school to the calendar year of graduation. The continuous *Time to PhD in Years* was used in the descriptive analyses to compare a median number of years approximating the total time to PhD for mothers and the comparison groups. Because time to degree can differ significantly across program type, I constructed the categorical variable *Time to PhD* to normalize the distribution of time to degree across program types and to use in the logistic regression models (e.g., Kim & Otts, 2010; Morrison et al., 2011). This study presumed two groups: PhD recipients with a “shorter” time to degree which was less than 10 years from graduate entry to graduation, and PhD recipients with a “longer” time to degree which was 10 years or more from graduate entry to graduation. The construction of the categorical variable *Time to PhD* mirrors how variations in time to degree has been handled in other studies (e.g., Morrison et al., 2011).

I constructed the variable *Married/partnered* using the variable MARSTA in the SED dataset. The original variable was recoded to group the responses marked “Married” or “Living in a marriage-like relationship” into the variable *Married/Partnered*, where 1 indicated the PhD recipient reported being married or partnered at time of PhD. Survey responses marked “Widowed,” “Separated,” “Divorced” and “Never Married” were recoded as 0 indicating the

PhD recipient reported being unmarried or not partnered at the time of PhD. *Married/partnered* was constructed independently of a PhD recipient's status as a parent. For instance, single mothers were coded with a 0 on *Married/partnered*, but with a 1 on *Parent*.

The variables *Number of Children* and *Age of Children* were constructed using the SED variables DEPEND5, indicating the presence of a dependent aged 0-5 at the time of PhD, and DEPEND18, indicating the presence of a dependent aged 6-18 at the time of PhD. It is important to note that the SED asks survey respondents to indicate whether they lived with or were responsible for dependents, which could indicate the presence of biological children, adopted children, or simply children living in their homes for which they were responsible in some way. In this way, the PhD mothers and fathers in this study may be the parents of biological children, adoptive children, or they may have been simply be living with a child for which they were in some way responsible. I used the term *children* rather than dependents because I grouped all minors aged 18 and under together. I also used the terms *mother* and *father* because I grouped all adults reporting responsibilities of dependents together, regardless of their specific status in relation to the child. My grouping of dependents and caregivers into *children* and *parents* follows the models of other studies using SDR data (e.g., Morrison et al., 2011).

Number of Children was constructed first as a continuous variable indicating the numeric value for the total number of children at the time of PhD reported by the survey respondents. This continuous variable was then transformed into an ordinal variable where 0 indicated the PhD recipient had no children, 1 indicated the PhD recipient had one child, and 2 indicated the PhD recipient had two or more children. Because the number of PhD recipients with more than two children was less than one percent of the sample, this categorical construction of *Number of Children* was used in all analyses including the logistic regressions.

Two variables were constructed to represent the age of children. *Children aged 0-5* was constructed as a categorical variable where 0 indicated the PhD recipient had no children aged 0-5 years, and any other value indicated the number of children aged 0-5 each PhD recipient had. *Children aged 6-18* was constructed as a categorical variable where 0 indicated the PhD recipient had no children aged 6-18 years, and any other value indicated the number of children aged 6-18 the PhD recipient had. If the PhD recipients had children in both age categories, they were coded with values above 0 in each variable.

Finally, *Academic Discipline* was derived from the SED variable PHDFIELD indicating the reported field of the PhD recipients' doctorate. Because this study only included doctorates who earned PhDs, the values for *Academic Discipline* were narrowed to exclude medicine, law, and other fields which do not issue a PhD as the terminal degree. The values for *Academic Discipline* were constructed using SDR's disciplinary coding scheme. "Natural sciences" included the fields of mathematics and physical sciences. "Social sciences" included sociology, psychology, communication, economics, political science, and education (only PhDs, not EdDs, were included for education). "Engineering" included the fields of engineering and computer and information sciences. Finally, "life sciences" included the fields of life sciences and biomedical sciences.

I controlled for academic discipline because some fields are more closely tied to faculty job attainment than others (e.g., Wolf-Wendel & Ward, 2015). For instance, for PhD recipients in communications and education fields, jobs in professional labor markets may be tied more closely to the discipline than faculty jobs in the ALM. Other fields have achieved gender parity in faculty hiring to a greater degree than others (Aanerud, et al., 2007; Ginther & Kahn, 2004; Kulis, et al., 2002). Gender parity has been achieved with recent cohorts of social scientists

(Aanerud et al., 2007; Kulis et al., 2002), but not with economists (Ginther & Kahn, 2004). Finally, graduate gender ratios may vary substantially across fields, such as in psychology compared to engineering (Etzkowitz, et al., 2000; Grant, et al., 2000; Kelly & Grant, 2012; Rosser, 2004). It is for these reasons that broad academic discipline was embedded in the analyses.

Institutional variables. The institutional variables were drawn from the merged SED/SDR data and from incorporated *USNWR* data. Institutional variables included *Institutional Type* evidenced by the 2010 Carnegie classification of the PhD recipients' doctorate institutions, *Institutional Control* (public/private) of the PhD recipients' doctorate institutions, and *Program Ranking* derived from the top-quartile ranked *USNWR* programs, as described. The more selective a particular program is and the more research-extensive an institution is, the more likely doctoral students are to get faculty jobs (Burris, 2004; Ehrenberg & Mavros, 1995). Program ranking has a direct effect on PhD recipients' ability to attain tenure-track jobs because institutions recruit graduates into the primary labor market from the most prestigious programs, while candidates from less prestigious programs are more likely to be filtered into the secondary labor market or less prestigious programs (Bedeian, et al., 2010; Fogarty, et al., 2012; Fogarty & Saftner, 1993; Morphew & Swanson, 2011).

The variable *Institutional Type* was constructed using the SED variable CARNEG10, representing the 2010 Carnegie Classification of U.S. higher education institutions. The values on *Institutional Type* included "Research university (very high)" indicating an extensive research focus; "Research university (high)" indicating a high research focus; and "Special focus/other" indicating institutions with a special focus such as an engineering or life sciences.

The variable *Institutional Control* was constructed using the value on the SED variable CONTROL that corresponded with the PhD graduating year of the doctorate recipient. For instance, if the PhD recipient graduated in 2003, then the value on CONTROL for the year 2003 was used. In cases where the PhD recipient's calendar year did not align exactly with the value on CONTROL, the last known CONTROL value was used. For example, the CONTROL value for the year 2003 was used for PhD recipients graduating in calendar years 2003, 2004, and 2005, as the next SDR iteration was not reported until 2006. Initial testing revealed there was no variance on institutional control for institutions in the sample between 2000 and 2005.

Doctoral training variables. The doctoral training variables were drawn from the merged SED/SDR data and included PhD recipients' primary funding sources for financing their PhDs (*Primary Funding*), the presence of graduate teaching assistantships (*GTA*), the presence of graduate research assistantships (*GRA*), and research productivity in graduate school as evidenced by journal articles published in or within the first two years following PhD graduation (*Research Productivity*). Using higher proportions of institutional-based funding such as assistantships, fellowships, and scholarships to finance one's degree is positively associated with obtaining a faculty position, while using higher proportions of personal funding, such as loans, savings, and family funds to finance one's degree is negatively associated with obtaining a faculty position (Ehrenberg & Mavros, 1995; Kim & Ottis, 2010). The literature indicates that while graduate research assistantships positively contribute to doctoral students' likelihood of obtaining faculty jobs (e.g., Kennelly & Spalter-Roth, 2006), graduate teaching assistantships are associated with a longer times-to-degree and attrition (Ampaw & Jaeger, 2011; Kim & Ottis, 2010). Because research and teaching assistantships may have different effects, variables for graduate teaching assistantships and graduate research assistantships were constructed

separately. Additionally, publishing journal articles in or shortly after graduate school is one of the most significant positive predictors of obtaining a faculty position (e.g., Burris, 2004).

GRA and *GTA* were constructed using the SED variables SRCEC and SRCED. Survey respondents were asked, “Which of the following were sources of financial support in graduate school?” and reported “graduate teaching assistantship” or “graduate research assistantship.” If survey respondents indicated they held a graduate teaching assistantship, the value of SRCEC was 1, and if respondents indicated they held a graduate research assistantship, the value of SRCED was 1. In this way, the question on funding sources was used to approximate which PhD recipients held assistantships since they usually offer financial awards including stipends, wages, tuition remission, or some combination of financial awards (Ehrenberg & Mavros, 1995; Kim & Otts, 2010).

Primary Funding was constructed using the SED variable SRCEPRIM indicating the primary source of financial support reported by the PhD recipients. *Primary Funding* was constructed by grouping the SRCEPRIM values for “Fellowships,” “Scholarships,” and “Grants” together into the value “Fellowships, Scholarships, and Grants.” The SRCEPRIM values for “Graduate Teaching Assistantship” and “Graduate Research Assistantship” were left as is. Finally, I grouped the SRCEPRIM values for “Loans (from any source),” “Personal Savings, Personal Earnings during graduate school other than GTA, GRA, or fellowships,” and “Spouse’s, partner’s, or family’s earnings or savings” together into the value “Self, Family, or Loan Sources.”

Research Productivity in graduate school as evidenced by journal articles published was constructed from the SDR variable ARTICLE. Cases with entries for ARTICLE were limited to those PhD recipients who responded to the SDR iteration immediately following their PhD

calendar year, thus providing a reference point that occurred during the time they were in graduate school or had graduated less than two years earlier. Depending on the distance between the PhD graduation year and the first eligible SDR iteration, respondents reported the number of articles they had published in graduate school, the number of articles they had published during the first year after graduate school, and/or the number of articles they had published during the second year after graduate school. For instance, 2000 graduates who responded to the 2001 iteration of the SDR with the reference point of the previous year may have reported the number of articles published while they were still in graduate school. However, a PhD recipient who graduated in calendar year 2003 and responded to the 2006 SDR with the reference point of the previous year, 2005, may have reported the number of articles published at the point that she had been out of graduate school for two years. In this way, ARTICLE provided a proxy for research productivity in graduate school and the immediate period after graduation. This proxy was variable based on the PhD calendar year of the recipient, but the data were limited due to the biennial nature of the SDR. Following the model used in other studies on PhD recipients (e.g., Morrison et al., 2011), allowing for variation in publishing across disciplines, and with a goal of normalizing the distribution of the continuous values in the total number of articles published, I constructed *Research Productivity* into an ordinal variable, where 0 indicated the PhD recipient published no articles during the reference period, 1 indicated the PhD recipient published only one article during the reference period, and 2 indicated the PhD recipient published two or more articles total during the reference period. Each reference period represented a two-year timeframe based on the timing of the next SDR release.

Professional life course variables. The professional life course variables were drawn from the merged SED/SDR data, and they included working in a job outside a GTA position,

GRA position, or fellowship during graduate school (*Outside Job*), holding a postdoc (*Postdoc*), and holding a non-tenure-track faculty job after PhD graduation (*NTTF*). The research indicates that working in industry or non-academic settings during graduate school is negatively associated with obtaining a faculty job (Enders, 2002). The findings are mixed on the benefits of engaging in post-doctoral study (Ehrenberg & Mavros, 1995; Wolf-Wendel, et al., 2004). Some studies suggest postdocs have a higher probability of attaining tenure-track jobs (Ehrenberg & Mavros, 1995; Morrison, et al., 2011; Nerad & Cerny, 1999; Reskin, 1976), while others suggest that increasingly, postdocs are leading scientists away from the tenure track (Powell, 2014; Mason, et al., 2013; Mavripilis, et al., 2010; Nerad & Cerny, 1999). Finally, holding a NTTF faculty position after graduate school is negatively associated with obtaining a tenure-track faculty job (Kezar & Sam, 2010; Rhoades, 2013; 2015; Rhoades & Torres-Olave, 2015).

The variable *Outside Job* was constructed using the SED variable SRCEPRIM, where survey respondents responded to the question, “Which two sources [listed amongst the total financial sources reported] provided the most financial support?” and the values were either “Personal earnings during graduate school other than [Fellowship, Scholarship, Grant, GTA, GRA, other assistantship, internship, traineeship, loans from any source, personal savings, spouse’s, family, or partner’s earnings or savings, employer reimbursement/assistance, or foreign support].” If the survey respondent indicated that personal earnings during graduate school were a primary or secondary form of support, it was an indication that the survey respondent may have held an outside job with which she earned wages to pay for school costs. No assumptions were made as to part-time or full-time work; rather, this variable served as a proxy for assumed ongoing wages earned outside institutional-based or family-based funding sources. SRCEPRIM

provided the closest available approximation in the dataset of outside work performed during graduate school.

Postdoc was constructed using the SDR variable ACADPDOC indicating that during the survey reference date, the type of academic position the PhD recipient reported holding was a postdoctoral fellow or associate. PhD recipients were coded with a 1 if they indicated holding a postdoc at any time during the observation period, meaning that they may have indicated holding multiple postdoc appointments or multiple years in one postdoc.

NTTF was constructed by cross-tabulating the values for the following SDR variables: TENSTA indicating tenure status and the academic employment variables indicating a teaching or research faculty member (ACADADJF for adjunct faculty; ACADTCHF for teaching faculty; and ACADRCHF for research faculty). When the value on TENSTA was 0 indicating that the PhD recipient was not in a tenured or tenure-track position and when the value on ACADADJF, ACADTCHF, or ACADRCHF was 1, indicating the PhD recipient was in a faculty position, the respondent was coded as being in a NTTF position. PhD recipients were coded with a 1 if they indicated holding a NTTF at any time during the observation period, meaning that they may have indicated holding multiple NTTF appointments or multiple years in one NTTF job, but the value was 1 regardless.

Statistical Method

First, I employed descriptive statistics to examine the employment patterns and trends of PhD recipients who earned their terminal degrees between 2000 and 2005. I compared mothers' employment patterns with the employment patterns of the comparison groups including mothers during graduate school, fathers during graduate school, men without children during graduate school, and women without children during graduate school. Typical employment patterns of

PhD recipients included jobs in academia and research including tenure-track faculty jobs, NTTF faculty jobs, post-doctoral work, and higher education administration and managerial jobs. Other employment patterns included jobs outside of academia, including in business, industry, and government. Special attention was paid to the tenure-track outcomes of mothers and the comparison groups, including assessing whether mothers attained tenure-track jobs at comparable rates of time and at comparable institutions to others.

To measure the degree to which PhD mothers were at a potential cumulative disadvantage compared to other groups, I then conducted a series of logistic regression analyses through sequential logistic regression to understand how mothers' attainment of tenure-track faculty jobs was influenced by the factors in the conceptual framework relative to the comparison groups. Logistic regression was the most appropriate method with which to respond to the research questions because it allowed for a modeling of the odds of a set categorical outcome (Agresti, 2007). This study used logistic regression analysis because the outcome variable (Y) was binary ($Y = 1$ if the PhD recipient attained a faculty appointment during the observation period; $Y = 0$ if the PhD recipient did not attain a faculty appointment during the observation period). Logistic regression accounted for the fact that the binary variable uses a Bernoulli distribution; thus, it is not normally distributed and has a necessarily restricted range (Agresti, 2007).

Further, this study uses sequential logistic regression to specify the order with which the predictor variables enter the models, which offers a method that most closely aligns with the conceptual framework. Sequential logistic regression provided a mechanism through which I compared each variable's coefficients in the model and calculated the effect size of each (Agresti, 2007). In this way, sequential logistic regression allowed me to interpret the subtleties

in how individual, institutional, doctoral training, and professional life course factors worked to predict PhD recipients' attainment of tenure-track faculty jobs.

The logistic regression analyses included the variables from my conceptual framework. First, I examined the influence of the variables on the likelihood that PhD recipients in general attained tenure-track faculty positions at U.S. higher education institutions within the first eight to thirteen consecutive years of graduation, where gender and family status are included as variables (Model 1). Then, I examined the influence of the variables on PhD mothers who had children during graduate school specifically (Model 2). In the final model (Model 3), I compared the same set of predictors across comparison groups, including mothers during graduate school, fathers during graduation school, men without children during graduation school, and women without children during graduate school. My focus was on whether and how predictors of tenure-track job attainment varied across gender and family status.

The logistic regression models were formally specified using the logit link and the following equation:

$$\log \left(\frac{p(Y = 1)}{1 - p(Y = 0)} \right) = \alpha + \beta_1 IND + \beta_2 INST + \beta_3 DOCT + \beta_4 PROF$$

The equation represents the log odds that $Y = 1$ as a function of the predictor values. Within the equation, the intercept α indicates the value of the criterion when the predictor values are equal to zero after controlling for all the covariates (Agresti, 2007). $\beta_1 IND$ indicates individual predictors associated with doctoral mothers' likelihood of obtaining tenure-track faculty positions, such as marital status at time of PhD, dependents and their ages at time of PhD, time to degree, and dummy coded academic discipline variables. $\beta_2 INST$ indicates institutional predictors such as Carnegie classification, institutional control, and program ranking. $\beta_3 DOCT$

indicates doctoral training predictors such as sources of funding, research or teaching assistantships and research productivity. Finally, β_4 *PROF* indicates professional life course predictors such as outside work during graduate school, postdoctoral work, and NTTF work post-graduate school.

Table 2 outlines how each set of analyses aligns with the research questions posed in this study.

Table 2
Summary of Data Analyses

Research Question	Data Analysis
1. To what extent have PhD-earning mothers attained tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?	Descriptive statistics: Distribution of frequency, percentage, mean, standard deviation
2. How does tenure-track faculty job attainment differ between PhD-earning mothers, fathers, men without children, and women without children?	Descriptive statistics: Distribution of frequency, percentage, mean, standard deviation Statistical tests: Chi-square tests of association
3. How do individual, institutional, doctoral training, and professional life course factors differ between PhD-earning mothers and fathers; and between PhD-earning mothers and women without children?	Descriptive statistics: Distribution of frequency, percentage, mean, standard deviation Statistical tests: Chi-square tests of association
4. What role do <i>individual factors</i> (married/partnered at time of PhD, age and number of dependents at time of PhD, time to PhD, and broad academic discipline) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?	Model 1: Sequential logistic regression on all PhD recipients Model 2: Sequential logistic regression on PhD mothers only

Research Question	Data Analysis
5. What role do <i>institutional factors</i> (institutional type, institutional control, and program ranking) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?	Descriptive statistics: Distribution of frequency, percentage, mean, standard deviation Statistical tests: Chi-square tests of association
6. What role do <i>doctoral training factors</i> (sources of funding, graduate teaching and research assistantships, research productivity) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?	Model 1: Sequential logistic regression on all PhD recipients Model 2: Sequential logistic regression on PhD mothers only
7. What role do <i>professional life course factors</i> (work outside assistantships and fellowships during graduate school, holding a post-doctoral position, and holding a non-tenure-track faculty position) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?	
Comparing predictors of tenure-track job attainment across gender and family status	Model 3: Logistic regression (full model) comparing predictors for mothers in graduate school, fathers in graduate school, men without children in graduate school, and women without children in graduate school

Limitations

This study has a number of limitations. First, the observation period is limited by the available SDR data. Due to the rolling timeline of PhD graduation years, the observation period varies across participants. Only eight years of SDR data are available for 2005 graduates, but thirteen years of data are available for 2000 graduates. Second, measurement of the dependent

variable may be limited by examining only the first eight to thirteen consecutive years after PhD graduation. The observation period may not be long enough to fully understand PhD recipients' early career employment patterns. The observation period may be too short to identify whether PhD recipients were effectively "stuck" in jobs in the secondary labor market working involuntarily in NTTF faculty appointments or postdocs (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015). Thus, the observation period has the potential to underestimate the amount of time it takes for PhD recipients to settle into a tenure-track, NTTF, or other position from a long-term career perspective.

Despite these limitations, the observation period provides a snapshot of what PhD recipients did in terms of employment in the immediate period after graduation. These analyses are meaningful to the research literature and address some of the holes identified in the existing literature about employment patterns in PhD recipients' early careers (e.g., Kezar & Sam, 2010; Rhoades & Torres-Olave, 2015) and about PhD mothers' transitions from graduate school to the professoriate (Gardner, 2006, 2008a, 2008b; Kennelly & Spalter-Roth, 2006; Lynch, 2008; Mason, 2013; Morrison et al., 2011; Springer et al., 2008; Wolfinger et al., 2008).

The other limitations in this study relate to a lack of variables provided in the data sources. For instance, one limitation of this study is a lack of information on PhD mothers' geographic mobility. The SED/SDR dataset offers no variables that account for PhD recipients' *perceptions* of their mobility including their willingness to move geographic distances for tenure-track faculty jobs. While it is possible to measure PhD recipients' actual mobility represented by the geographic distance in miles from their doctoral granting institution to their first job post-PhD graduation, the simple calculation in geographic miles neglects an important aspect of

geographic mobility: it is unclear whether PhD recipients were partnered or married to other PhD recipients and whether a job offer to one partner affected job offers to the other partner (e.g., Jean, et al., 2015; Wolf-Wendel, et al., 2004). From the SDR data, it is impossible to know whether the PhD recipients moved for their own job opportunities, for their partner's job opportunities, or for some other reason entirely. Since there are high proportions of dual-career couples in academia (as high as 83 percent in some fields) (Bureau of Labor Statistics, 2010; Schiebinger, et al., 2008), and since women are more likely than men to compromise their own career ambitions and employment options to benefit their partners' careers (e.g., Jean, et al., 2015), including PhD recipients' actual geographic mobility without knowing the reasons why they exercised mobility or not would cloud the regression results. The simple calculation of geographic miles between PhD recipients' doctoral granting institution and their employer institutions did not provide adequate insight into the weighing of dual-career couple goals and priorities that often comes in academic relationships, thus I chose not to include the calculation of geographic miles in my analyses.

Another limitation of this study is that the analyses only provide proxies for some aspects of PhD recipients' graduate school experiences such as outside work and research productivity. The data also do not include some aspects of PhD recipients' graduate school characteristics, such as the reputation of a PhD-holder's faculty advisor, which directly relates to the attractiveness of the PhD-holder to institutions in the academic labor market (e.g., Burris, 2004; Caplow & McGee, 1958; Lewis, 1996). Social and personal connections between faculty members already established in the field can directly affect the recruitment of particular PhD recipients into tenure-track faculty positions (Bedeian, et al., 2010; Burris, 2004; Caplow & McGee, 1958; Fogarty, et al., 2012; Fogarty & Saftner, 1993; Lewis, 1996; O'Meara, 2011).

Because of the strong relationship of attractiveness in the sense of one's likelihood of being desired or recruited by competing institutions in the market to a PhD-holder's likelihood of obtaining a tenure-track job, attractiveness as evidenced by the Carnegie classification, control, and ranking of PhD recipients' graduating programs are included as variables in this study. Some aspects of attractiveness, such as the reputation of a PhD-holder's faculty advisor, are not included in the data sources in this study and thus represent a limitation. Despite this limitation, other aspects of attractiveness that affect PhD recipients' likelihood of obtaining tenure-track faculty jobs are included in this study, including institutional type, institutional control, and program ranking. Program ranking in particular may compensate for a lack of information on the reputation of PhD recipients' faculty advisors or the role of their social connections with other institutions and faculty members in the field, because program rankings have been relatively stable over time (Morphew & Swanson, 2011; O'Meara, 2011). Faculty members at programs within the top quartile of the *USNWR* rankings may have established strong social, personal, and professional bonds that leads to a higher rate of recruitment of their graduates into other top-ranked programs (e.g., Morphew & Swanson, 2011; Sweitzer & Volkwein, 2009). In this way, the inclusion of program ranking as a variable may partially compensate or act as a proxy for the lack of information on the specific roles PhD recipients' faculty advisors may play in their recruitment into tenure-track faculty positions. Despite criticisms that *USNWR* program rankings are merely peer assessment scores that may be socially influenced by the survey participants, *USNWR* rankings may provide a better fit for this study than other rankings systems because they are subjective and they represent program reputations and institutional prestige from a socially constructed, peer perspective (Burris, 2004; Ehrenberg, 2003; Morphew & Swanson, 2011; O'Meara, 2011; Sweitzer & Volkwein, 2009).

Conclusion

This chapter presented research methodology to examine the factors influencing PhD mothers' accumulation of career-related resources and strategies and how that accumulation affects their likelihood of obtaining tenure-track faculty positions within the first eight to thirteen consecutive years of PhD graduation. The study used individual data from the SED and the SDR by the NSF. The dependent variable is PhD recipients' attainment or non-attainment of a tenure-track faculty appointment at a U.S. higher education institution between 2006 and 2013, representing the first eight to thirteen years (depending on the graduation year) post-PhD graduation. Independent variables include individual, doctoral training, institutional, and professional life course variables that relate to PhD recipients' characteristics and experiences while in graduate school. These variables comprise the career-related resources PhD recipients accumulate while in graduate school, which influences their development of either a cumulative advantage or disadvantage in terms of their likelihood of obtaining a tenure-track faculty job. The analytic methods used in this study include descriptive statistics to examine the employment patterns and trends of PhD mothers who earned their terminal degrees between 2000 and 2005, as well as the employment patterns of the comparison groups, including mothers, fathers, men without children, and women without children during graduate school. Additionally, logistic regression analyses was conducted to explore the factors that influence PhD mothers' attainment of tenure-track faculty positions within the first eight to thirteen years after PhD graduation, relative to the comparison groups. Chapter 4 presents results from these descriptive statistics and logistic regression analyses.

Chapter 4

Results

In this chapter, I present the results of the analyses. First, I report descriptive statistics of the study sample to investigate the characteristics of PhD recipients who graduated from U.S. higher education institutions between 2000 and 2005 and how those characteristics differed across gender and family status. The descriptive analyses include individual, institutional, doctoral training, and professional life course variables, and I also report on how employment outcomes differed between PhD-earning mothers in graduate school, fathers in graduate school, men without children in graduate school, and women without children in graduate school. Finally, I report the results from a series of logistic regression analyses on the factors that influenced PhD mothers' and others' attainment of tenure-track faculty jobs between 2006 and 2013. All statistically significant differences are reported using an alpha level of $p < .05$.

Definitions

Throughout the discussion, I use a variety of gender-, family-, and employment-related terms that are nuanced and can vary in meaning. For sake of clarity, I outline the handful of terms I use repeatedly throughout Chapters 4 and 5 which have distinct and specific meanings to the analyses in this study:

- *PhD Mothers*, or simply *Mothers*, refers to female PhD recipients who gave birth to, adopted, or parented at least one dependent aged (0-18 years) child during the same time they attended graduate school. *Mother* assumes female gender identity: the SDR allowed for male or female gender identification. Mothers may have given birth to, adopted, or acquired children through marriage or some other means *before or during* graduate school. Predictably, many women in the sample went on to have children after they

graduated with their doctorates: while these women are considered mothers in actuality, women who waited to have children until after they graduated with their terminal degrees are not labelled *Mothers* in the analyses in this study. Unless otherwise noted, this study is solely concerned with *PhD Mothers* who parented children at the same time they attended graduate school.

- *PhD Fathers*, or simply *Fathers*, refers to male PhD recipients who parented at least one dependent aged child during the same time they attended graduate school. *Fathers* are defined by the same criteria as *Mothers*, except their gender is male.
- *Men without children in graduate school/ Women without children in graduate school* refers to male or female PhD recipients who did not give birth to, adopt, or otherwise parent a child during the same time they attended graduate school. *Men and women without children in graduate school* may have gone on to give birth to, adopt, or acquire children after they graduated with their doctorates.
- *Family Status* refers to a PhD recipient's status as a parent of a dependent child, indicating simply whether one is a parent or not. *Family Status* does not refer to the PhD recipients' married/partnered status, a combination of parental and marital status (e.g., single mother), nor does it refer to the educational status of the PhD recipients' own parents. In this way, *Family Status* is used simply to refer to whether one is a parent or not, a naming convention that is consistent with other studies on PhD mothers (e.g., Morrison et al., 2011).
- *Employment Outcomes* refer to the career jobs PhD recipients are hired into by employers upon completion of their doctorate degrees. This study is primarily focused on academic employment outcomes, or employment at U.S. higher education institutions.

Research Findings

First, I describe the demographic characteristics of the study sample, PhD graduates who are U.S. citizens, who graduated with their terminal degrees from U.S. higher education institutions between 2000 and 2005, and who worked at U.S. higher education institutions at any point between 2006 and 2013 ($N = 2,994$). All 2,994 PhD recipients responded to the SED and reported their graduate school experiences between 2000 and 2005, thus the descriptive statistics on the independent variables which describe graduate school characteristics use the full N of 2,994. Around half of the 2,994 PhD recipients consistently reported their employment outcomes by responding to all four iterations of the SDR (2006, 2008, 2010, and 2013) (see Appendix II for statistics on response patterns). To control for missing data where descriptive statistics track employment patterns over time, I used a modified N for some of the descriptive statistics on employment outcomes (which is clearly marked on the relevant tables) so as to include only the respondents who responded to the SDR each time it was administered during the observation period. The regression models used different N s based on the different populations included in each model. The PhD recipients full model included all 2,994 PhD recipients (Table 12). The model with PhD mothers in graduate school included 214 PhD mothers (Table 13; Table 14). The model with PhD fathers in graduate school model included 248 PhD fathers (Table 14). The model with PhD men who did not have children during graduate school included 1,187 men who did not have children during graduate school (Table 14). The model with PhD women who did not have children during graduate school model included 1,345 women who did not have children during graduate school (Table 14).

While only the PhD recipients who worked at higher education institutions during the observation period ($N = 2,994$) are included in the following analyses, it is important to note that

many individuals who graduated with their terminal degrees between 2000 and 2005 ended up working at higher education institutions over other labor market sectors including business/industry and government. Of the 4,993 total PhD recipients who graduated from U.S. institutions between 2000 and 2005, about 60 percent worked at higher education institutions during the observation period, with 54 percent reporting a college or university as their first employer (see Appendix III). Notably, mothers were most likely to work at higher education institutions for their first reported job (see Appendix III). Over 62 percent of mothers worked at higher education institutions for their first reported job compared to 55 percent of fathers and women without children and 52 percent of men without children. The relative distribution of employment outcomes by labor market sector was stable across SDR cohorts (see Appendix IV) and across PhD graduation years (see Appendix V).

Descriptive statistics of the study sample. Tables 3, 4, and 5 display the descriptive statistics of the 2,994 PhD recipients who worked at U.S. colleges and universities during the observation period, 2006-2013. Because the sample includes doctorates who graduated over a five-year period, I ran initial tests to ensure that there were no significant differences in graduate school characteristics or employment outcomes amongst the PhD recipients within the sample (Table 3). I divided the sample ($N = 2,994$) into two cohorts according to the first year during respondents were eligible to respond to the SDR based on their PhD graduation calendar year (2000, 2001, 2002, 2003, 2004, or 2005). Because the SDR is administered every two to three years, there were two major cohorts of respondents. The SDR 2003 cohort included PhD recipients who graduated from their doctoral institutions in the calendar years 2000, 2001, and 2002 and were first eligible to respond to the SDR in 2003 ($n = 1,388$). The SDR 2006 cohort included PhD recipients who graduated from their doctoral institutions in the calendar years

2003, 2004, and 2005 and were first eligible to respond to the SDR in 2006 ($n = 1,606$). These initial analyses assisted with gauging whether shifts in tenure-track job attainment and other ALM conditions occurred between 2003 and 2006.

SDR 2003 was slightly underrepresented in the sample at 46.3 percent compared to SDR 2006, which comprised 53.7 percent of the sample. The representation of PhD graduates by individual graduation calendar years (2000, 2001, 2002, 2003, 2004, or 2005) was fairly stable from year to year, though there were fewer graduates from the year 2000 ($n = 293$, 9.8%) compared to graduates from other years. Because there were no significant changes in tenure-track job attainment rates (the dependent variable) between SDR 2003 and SDR 2006, I chose to start the observation period in 2006 when both cohorts provided employment data. The analyses also revealed there were no significant differences in graduate school experiences (the independent variables) amongst the PhD recipients by cohort or graduation year within the sample. Because the analyses showed that there was no significant differences by graduation year, I decided not to include the graduation year variable in further analyses.

Table 3

Descriptive statistics: Study sample and survey cohorts (N = 2,994)

	Perc. (%)	Freq. (N)
SDR 2003 Cohort	46.3	1,386
2000 graduates		293
2001 graduates		532
2002 graduates		563
SDR 2006 Cohort	53.7	1,608
2003 graduates		508
2004 graduates		573
2005 graduates		525
Total	100.0	2,994

Tables 4 describes the characteristics of the study sample. The sample was roughly divided between men at 47.9 percent and women at 52.1 percent. A majority of respondents in

the sample, 84.6 percent, did not have children during graduate school. The underrepresentation of parents in the sample filtered into the comparison groups, causing the number of both PhD mothers and fathers to be relatively small. Only 214 female respondents (7.1 percent) and 248 male respondents (8.3 percent) had children during graduate school, graduated during the requisite years, and responded to the SDR during the observation period. Because of their small numbers, in many cases throughout the descriptive analyses percentages rather than raw numeric values are presented.

Because of the observation period used in this study, the sample contains both PhD recipients who had children *during* graduate school and PhD recipients who waited to have children until *after* graduate school. While the majority of respondents did not have children during graduate school, many PhD recipients did go on to have children after graduating with their degrees (see Table 4). Between 2006 and 2013, 43.6 percent of the sample went on to have children.

To investigate whether waiting to have a child until after graduate school had a bearing on tenure-track job attainment, I ran a variety of statistical tests and regressions with a variable called “had a child later on,” indicating that the PhD recipient did not have a child during graduate school, but went on to have a child(ren) after graduate school was complete. The analyses did not reveal any significant differences in tenure-track job attainment between PhD recipients who had children in graduate school versus those who waited to have children until after graduate school.

Table 4 describes the percentages of PhD graduates by gender, family status, and academic field as well as the chi-square statistics representing significant associations between gender, family status, tenure-track attainment and academic field. Expectedly, there was some

variation in gender, family status, and tenure-track job attainment across the academic disciplines represented in the sample. Women comprised around two-thirds of the PhD recipients in social and life science fields, and a third to nearly half of the PhD recipients in engineering and natural science fields, respectively. The differences in graduates by gender and academic field are well-documented in the research literature (Etzkowitz, et al., 2000; Grant, et al., 2000; Kelly & Grant, 2012; Rosser, 2004). Also, social science fields in particular have become more feminized in recent years in the sense that faculty hiring opportunities for women have vastly improved in recent decades (Kalleberg & Reskin, 1995; Morrison et al., 2011; Spalter-Roth & Merola, 2001). These gender differences are reflected in the data.

Notably, the proportions of PhD recipients who were parents in graduate school were fairly stable across academic disciplines. Even though the differences in family status during graduate school were statistically significant $\chi^2(3, N = 2,994) = 134.598, p < .05$, the statistical associations are relatively weak. The proportions of mothers who had children during graduate school across academic disciplines was small in every field, always less than 10 percent. The smaller proportions of mothers aligns with smaller proportions of females in general in each discipline, with less feminized fields like natural sciences (5.3% mothers) and engineering (3.8% mothers) featuring fewer overall mothers than more feminized fields like social sciences (9.7% mothers). The differences in family status across academic disciplines seem to be more of a carry-over from the larger effect of gender, rather than a distinct difference in family status between disciplines.

In terms of tenure-track employment, fewer graduates in the natural sciences attained tenure-track jobs than in any other field. This was also expected, as natural science fields tend to be more closely tied to professional labor markets than to the ALM (e.g., Etzkowitz, et al., 2000;

Grant, et al., 2000; Kelly & Grant, 2012; Rosser, 2004). The data do not offer a clear explanation on why natural science graduates in the sample attained fewer tenure-track jobs between 2006 and 2013 compared to other fields. It is important to note, however, that other STEM fields such as life sciences and engineering had higher rates of tenure-track job attainment than natural science and social science fields, so the distinction between STEM and non-STEM fields does not offer a clear explanation for why some fields featured higher tenure-track job attainment rates by gender than others.

Table 4

Descriptive statistics: Gender and family status during and after graduate school by academic field (N = 2,994)

	Natural sciences (%)	Social sciences (%)	Life sciences (%)	Engineering (%)	χ^2
Gender, regardless of family status					
Male	53.5	39.2	32.8	67.1	119.713***
Female	46.5	60.8	67.2	32.9	
Family status during graduate school					
Mothers who had children during graduate school	5.3	9.7	9.5	3.8	134.598*
Fathers who had children during graduate school	7.8	8.5	5.9	11.8	
Women without children during graduate school	41.1	51.1	57.7	29.1	
Men without children during graduate school	45.8	30.7	26.9	55.3	
Family status after graduate school					
PhDs who had children during graduate school	13.1	18.2	15.4	15.7	19.373**
PhDs who had children after graduate school	46.4	41.5	36.8	44.1	
PhDs who did not have children after graduate school	40.5	40.3	47.8	40.3	
Attained a tenure-track job between 2006 and 2013					
Mothers who had children in graduate school who attained TT jobs	31.0	54.2	50.0	75.0	13.394*

Fathers who had children in graduate school who attained TT jobs	48.5	59.1	86.7	56.8	8.432*
Men without children in graduate school who attained TT jobs	46.1	67.5	69.1	55.5	46.306***
Women without children in graduate school who attained TT jobs	40.5	53.7	67.8	58.2	43.923***

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Table 5 describes the characteristics of the sample in terms of the independent variables used in this study. Considering the PhD recipients who worked in higher education (N=2,994), natural science graduates comprised 44.4 percent of the sample compared to social science doctorates at 36.7 percent, life science doctorates at 8.5 percent, and engineering doctorates at 10.5 percent.

The median age when graduates in the sample received their doctorates was 35 years old and most took less than 10 years to earn their PhDs from graduate entry year to graduation year. Among graduates in the sample, 37.3 percent were married when they earned their PhDs. Of the parents in the sample, many had only one child and most had children between the ages of 0 and 5 (62.1% of parents).

With regards to their PhD institutions, the majority of the sample earned doctorates from research institutions classified by the 2010 Carnegie classification as “very high research” (84.5%) or “high research,” (10.4%) and most attended public institutions (69.7%). Approximately 36 percent of PhD recipients earned their doctoral degrees from prestigious PhD programs in their academic fields, defined as the top 25 ranked PhD programs according to *USNWR* per the years the PhD recipients graduated from their institutions.

During their PhD studies, nearly 60 percent of the sample reported holding a GTA position and 58 percent reported holding a GRA position. Graduates reported that the primary sources they used to finance their degrees were scholarships, fellowships or grants (37.8%), self,

family or personal loans (26.3%), research assistantships (20.3%), or teaching assistantships (15.6%). Most PhD recipients demonstrated research productivity by publishing journal articles during or immediately after graduate school. About ten percent published only one article and 54.5 percent published more than one article.

Only about 12 percent of PhD recipients worked in an outside job aside from a GTA, GRA, or fellowship during their graduate studies. About a quarter of the sample (23.7%) held postdocs after graduating with their terminal degrees. Finally, close to 40 percent of the sample held an NTTF job at any point during the observation period with 38.3 percent holding such jobs.

Table 5
Descriptive statistics: Independent variables (N = 2,994)

Variable		Perc. (%)	Freq. (N)
<i>Individual Characteristics at the time of PhD</i>			
Gender	Female	52.1	1,559
	Male	47.9	1,435
Age	Younger scholars aged 0-34 years	59.9	1,794
	Older scholars aged 35+ years old	40.1	1,200
Married/Partnered during graduate school	Married/partnered	37.3	1,116
	Not married/partnered	62.7	1,878
Number of Children during graduate school	No children	84.6	2,532
	1 child	13.0	388
	More than 1 child	2.5	74
Age of Children during graduate school	At least one child aged 0-5	10.5	315
	At least one child aged 6-18	6.4	192
Time to PhD	10 years or less	84.8	2,539
	More than 10 years	15.2	455
Academic Discipline	Natural sciences	44.4	1,328
	Social sciences	36.7	1,100
	Life sciences	8.5	253
	Engineering	10.5	313

<i>Institutional Characteristics</i>			
Institutional Type	Research university (very high)	84.5	2,529
	Research university (high)	10.4	312
	Special focus/other institution	5.1	153
Institutional Control	Public	69.7	2,086
	Private	30.3	908
Program Ranking	Top-quartile ranked program	36.1	1,082
	Not top-quartile ranked program	63.9	1,912

<i>Doctoral Training Characteristics</i>			
GTA, GRA	Held a GTA position	59.4	1,779
	Held a GRA position	57.6	1,725
Primary Funding during graduate school	GRA position	20.3	607
	GTA position	15.6	468
	Fellowships, scholarships, grants	37.8	1,133
	Self, family, or loans	26.3	786
Research Productivity	Did not publish a journal article	35.8	1,073
	Published one journal article	9.7	289
	Published more than one journal article	54.5	1,632

<i>Professional Life Course Characteristics</i>			
Outside Job	Outside employment	12.4	370
	No outside employment	87.6	2,624
Postdoc	Held a postdoc	23.7	710
NTTF	Held an NTTF position	38.3	1,147

Statistical tests of group differences. This section presents the results of chi-square tests designed to identify significant differences between individual, institutional, doctoral training, and professional life course variables. I examine differences in the individual variables first, followed by differences in employment outcomes across groups. The tests were conducted in response to the following research questions:

- How do *individual, institutional, doctoral training, and professional life course factors* differ between PhD-earning mothers, fathers, men without children, and women without children?

- To what extent have PhD-earning mothers attained tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
- How does tenure-track faculty job attainment differ between PhD-earning mothers, fathers, men without children, and women without children?

First, I present significant differences between the comparison groups on the independent variables. Then, I present significant differences between the comparison groups on the dependent variable.

Differences between comparison groups on independent variables. Chi-square tests revealed statistically significant differences between the observed and expected frequencies for PhD recipients by gender and family status on a number of the control variables.

Individual variables. Table 6 displays the results of chi-square tests indicating that mothers and fathers in graduate school were significantly more likely to be “older scholars” or at least 35 years old at the time of their PhD, $\chi^2(3, N = 2,994) = 172.105, p < .001$). Mothers in graduate school were more likely to take 10 years or more to complete their PhD degrees, $\chi^2(3, N = 2,994) = 84.523, p < .001$). Finally, there was a significant difference between groups on academic discipline, $\chi^2(5, N = 2,994) = 134.598, p < .001$). Men without children in graduate school and fathers in graduate school were more likely to be in the natural sciences and engineering, while women without children in graduate school and mothers in graduate school were more likely to be in the social sciences.

Table 6

Chi-square results of individual variables across gender and family status (N = 2,994)

	Mothers N (%)	Women without children N (%)	Fathers N (%)	Men without children N (%)	χ^2 or t
35+ years old	150 (70.1)	521 (38.7)	156 (62.9)	373 (31.4)	172.105***
10+ years to PhD	71 (33.2)	190 (14.1)	60 (24.2)	134 (11.3)	84.523***

Natural sciences	71 (33.2)	546 (40.6)	103 (41.5)	608 (51.2)	134.598***
Social sciences	107 (50.0)	562 (41.8)	93 (37.5)	338 (28.5)	
Life sciences	24 (11.2)	146 (10.9)	15 (6.0)	68 (5.7)	
Engineering	12 (5.6)	91 (6.8)	37 (14.9)	173 (14.6)	

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Institutional variables. Table 7 displays the results of chi-square tests indicating statistically significant associations between gender and family status on doctoral program institutional type, $\chi^2 (5, N = 2,994) = 16.307, p < .001$. Mothers in graduate school and men without children in graduate school were more likely than fathers in graduate school and women without children in graduate school to attend research universities classified “very high”. Men and women without children in graduate school were more likely to come from *USNWR* top 25 ranked programs, $\chi^2 (3, N = 2,994) = 42.831, p < .001$.

Table 7

Chi-square results of institutional variables across gender and family status (N = 2,994)

	Mothers N (%)	Women without children N (%)	Fathers N (%)	Men without children N (%)	χ^2
Research university (very high)	187 (87.4)	1,104 (82.1)	207 (83.5)	1,031 (86.9)	16.307***
Research university (high)	16 (7.5)	170 (12.6)	24 (9.7)	102 (8.6)	
Special focus/other institution	11 (5.1)	71 (5.3)	17 (6.9)	54 (4.5)	
Top-quartile ranked program	62 (29.0)	438 (32.6)	71 (28.6)	511 (43.0)	42.831***

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Doctoral training variables. Table 8 displays the results of chi-square tests indicating statistically significant associations between gender and family status on holding a GTA position, $\chi^2 (3, N = 2,994) = 13.262, p < .001$) and a GRA position $\chi^2 (3, N = 2,994) = 9.961, p$

<.05), though the associations were relatively weak on GRA in particular. Mothers in graduate school and men without children in graduate school were slightly more likely to hold GTA positions, and men without children in graduate school were more likely to hold GRA positions. There was a significant difference between groups on the primary source used to finance graduate school, $\chi^2(9, N = 2,994) = 84.769, p < .001$. Mothers and fathers in graduate school were more likely to finance their degrees through self, family, and loan sources, while men and women without children in graduate school were most likely to finance their degrees through scholarships, fellowships, and grants. Finally, fathers in graduate school were more likely to publish more than one article, $\chi^2(4, N = 2,994) = 39.218, p < .001$

Table 8

Chi-square results of doctoral training variables across gender and family status (N = 2,994)

	Mothers N (%)	Women without children N (%)	Fathers N (%)	Men without children N (%)	χ^2
Held a GTA position	125 (58.4)	766 (57.0)	136 (54.8)	752 (63.4)	13.262***
Held a GRA position	121 (56.5)	745 (55.4)	134 (54.0)	725 (61.1)	9.961*
Funding					
GRA	31 (14.5)	231 (17.2)	41 (16.5)	304 (25.6)	84.769***
GTA	29 (13.6)	202 (15.0)	38 (15.3)	199 (16.8)	
Schol., fellow. grant	69 (32.2)	534 (39.7)	77 (31.0)	453 (38.2)	
Self, family, loan	85 (39.7)	378 (28.1)	92 (37.1)	231 (19.5)	
Published one article	30 (14.0)	141 (10.5)	28 (11.3)	90 (7.6)	39.218***
Published more than one article	115 (53.7)	679 (50.5)	164 (66.1)	674 (56.8)	

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Professional life course variables. Table 9 displays the results of chi-square tests indicating statistically significant associations between gender and family status on holding a job outside a GTA position, GRA position, or fellowship during graduate school, $\chi^2(3, N = 2,994) =$

55.864, $p < .001$). Mothers and fathers in graduate school were more likely to hold outside jobs. Men without children in graduate school were more likely to hold postdocs, $\chi^2(3, N = 2,994) = 22.782$, $p < .001$). Finally, mothers and women without children in graduate school were significantly more likely to hold NTTF jobs, $\chi^2(3, N = 2,994) = 20.035$, $p < .001$).

Table 9

Chi-square results of professional life course variables across gender and family status (N = 2,994)

	Mothers N (%)	Women without children N (%)	Fathers N (%)	Men without children N (%)	χ^2
Outside job	42 (19.6)	167 (12.4)	51 (20.6)	110 (9.3)	55.864***
Postdoc	37 (17.3)	295 (21.9)	46 (18.5)	332 (28.0)	22.782***
NTTF	102 (47.7)	548 (40.7)	91 (36.7)	406 (34.2)	20.035***

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Descriptive statistics on academic employment outcomes. There was considerable movement in and out of different types of academic jobs and employer institutional types for the PhD recipients between 2006 and 2013. As discussed, the descriptive statistics on employment outcomes over time only include PhD recipients who responded to all four iterations of the SDR between 2006 and 2013 ($n = 1,543$). The descriptive statistics on job transitions are included in the first following sub-section, and they are intended to provide context for the analyses in this study.

Within this context of overall employment trends, the dependent variable is specifically concerned with whether PhD recipients attained tenure-track faculty jobs between 2006 and 2013. For these statistics, the full sample of 2,994 PhD recipients is used. The descriptive statistics on overall tenure-track job attainment are presented in Figures 2-5.

Tenure-track outcomes for PhD recipients across gender and family status. Tables 11 and 12 demonstrate the results of the statistical tests for tenure-track employment outcomes. Chi-

square tests revealed gender and family status had an effect on attaining a tenure-track job within the first two years after graduating with a terminal degree, $\chi^2(3, N = 2,994) = 63.258, p < .001$. Fathers and mothers were more likely to attain tenure-track jobs early on compared to men and women without children. This result represents a significant departure from previous literature (e.g., Wolfinger & Mason, 2008) which suggests mothers take 29 percent longer than other groups to attain tenure-track jobs.

One might assume that some of the differences in early tenure-track job attainment between groups may be attributed to differences in academic discipline (Kim & Otts, 2010; Powell, 2014). For instance, men and women without children in graduate school were more likely to take postdocs (see Table 9). However, the differences in the proportions of PhDs who took postdocs does not fully account for the differences in early tenure-track job attainment for fathers and mothers. The higher, earlier rates of tenure-track job attainment for fathers and mothers in graduate school are more likely related to other individual factors, including the fact that higher proportions of mothers in graduate school graduated from research “very high” institutions, higher proportions of fathers came from top-ranked programs, and fathers’ and mothers’ high levels of research productivity through publishing journal articles (Burriss, 2004).

Gender and family status did not have an effect on overall tenure-track job attainment, $\chi^2(3, N = 2,994) = 9.121, p = .28$. There was not a statistically significant difference between mothers’ overall attainment of tenure-track jobs compared to other groups. This finding also represents a significant departure from previous literature (e.g., Mason, 2013; Wolfinger & Mason, 2008; Morrison et al., 2011), which suggests that fewer mothers in graduate school attain tenure-track jobs compared to men and women without children in graduate school.

Chi-square tests revealed gender and family status did have an effect when considering employer institutional type, $\chi^2(3, N = 2,994) = 90.611, p < .001$. Of mothers and fathers in graduate school who attained faculty jobs, about equal percentages attained jobs at research and non-research institutions. In this way, mothers and fathers in graduate school were more evenly distributed across institutional types than men and women who did not have children during graduate school. This finding corresponds with previous literature that suggests mothers in graduate school are more likely to work at non-research institutions than other groups (e.g., Mason, 2013; Wolfinger & Mason, 2008).

Table 10
Chi-square results for tenure-track employment in the first two years post-PhD across gender and family status (N = 2,994)

	Mothers N (%)	Women without children N (%)	Fathers N (%)	Men without children N (%)	χ^2
Attained a TT job within first two years post-PhD	71 (33.2)	276 (20.5)	101 (40.7)	249 (21.0)	63.258***
Attained a TT job at all during the observation period	101 (47.2)	675 (50.2)	139 (56.0)	651 (54.8)	9.121

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Table 11
Chi-square results of first academic employer institutional type by gender and family status (N = 2,994)

	Mothers (%)	Women without children (%)	Fathers (%)	Men without children (%)	χ^2
Research	43.0	38.0	35.5	43.1	90.611***
Doctoral	8.9	6.1	8.1	6.0	
Comprehensive	16.8	11.5	20.6	10.4	
Liberal arts	7.0	5.7	6.9	4.5	
2-year institution	3.3	2.9	6.9	1.9	
Special focus	5.1	5.2	6.9	3.6	

Note. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

Transitions into and out of academic jobs between 2006 and 2013. Figure 2 displays the distribution of PhD recipients' academic jobs from 2006 through 2013. The number of NTTF teaching and research faculty climbed sharply between 2006 and 2008, capping off with around 525 PhD recipients employed in NTTF faculty jobs in 2013. This sharp climb in the number of NTTF jobs corresponded with a general decline in the number of tenure-track jobs at the start of the economic recession in 2008 that has been observed in other studies and is likely related to a tightening in available federal, state, and institutional funds dedicating to sponsored research and faculty hiring during that period (e.g., Rhoades & Torres-Olave, 2015; Powell, 2014). As a result, since 2008 more PhD recipients in the sample worked in NTTF teaching and research faculty jobs than tenure-track faculty jobs. The number of PhD recipients working in tenure-track teaching and research faculty jobs declined each year between 2008 and 2013.

Predictably, the number of PhD recipients working as postdocs declined with each survey iteration with only a small number of working postdocs in 2013. One might assume that a decline in postdocs might lead to an increase in tenure-track teaching and research faculty jobs, as postdocs transfer out of temporary research positions onto the tenure-track. Indeed, the research literature suggests that many postdocs seem to expect this transition from their temporary research positions to the tenure-track to occur (Yamamoto, 2014; Powell, 2014). However, most postdocs seemed to have transitioned into business and industry or other non-academic employment (represented by no academic job in Figure 2) or NTTF positions. Finally, the number of PhD recipients working in other, NTTF academic jobs including staff-level, managerial, and administrative jobs, remained small and fairly stable over time.

Figure 2

Distribution of PhD recipients into academic jobs, 2006-2013 (N = 1,543)

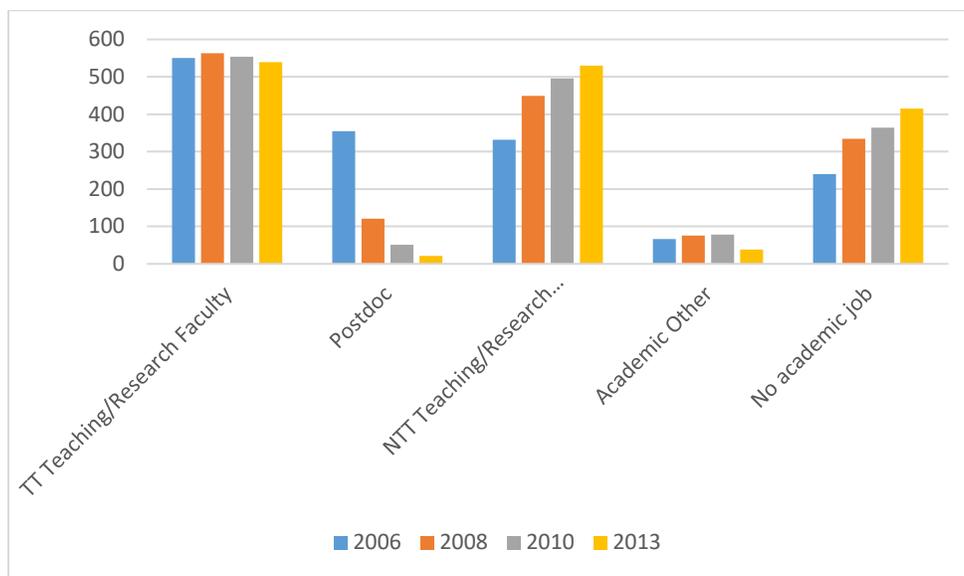
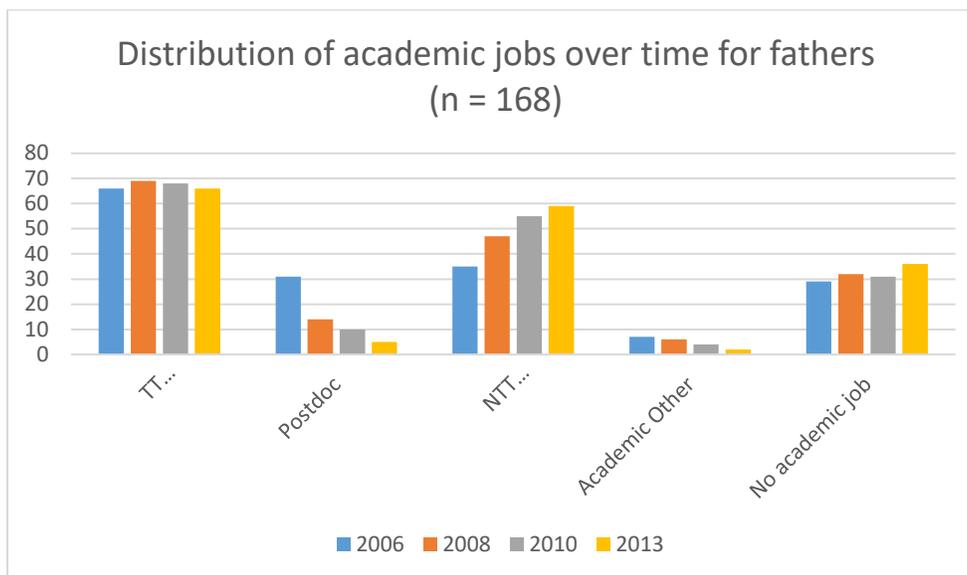
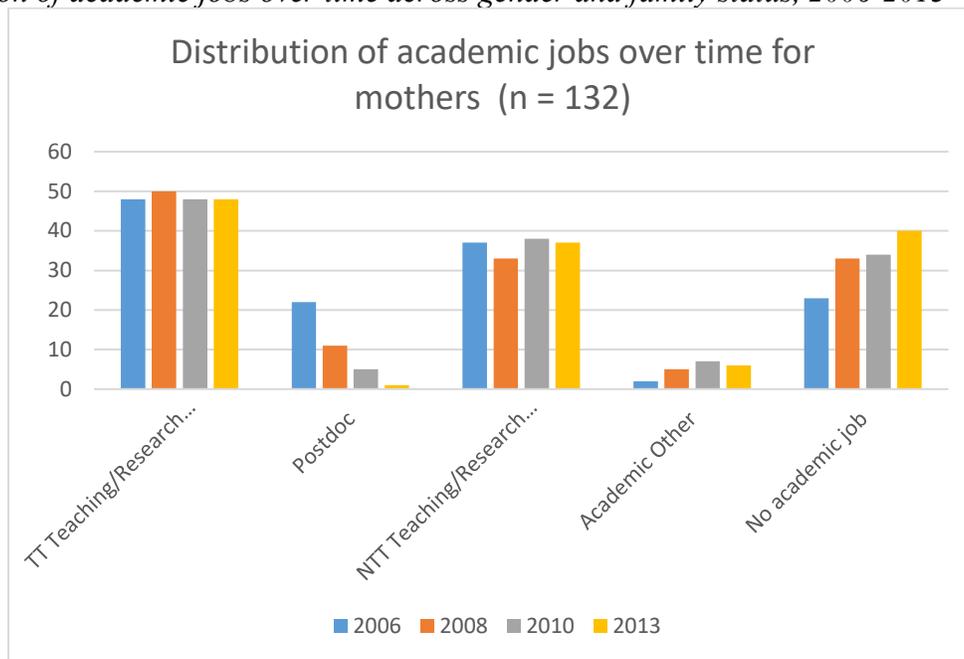
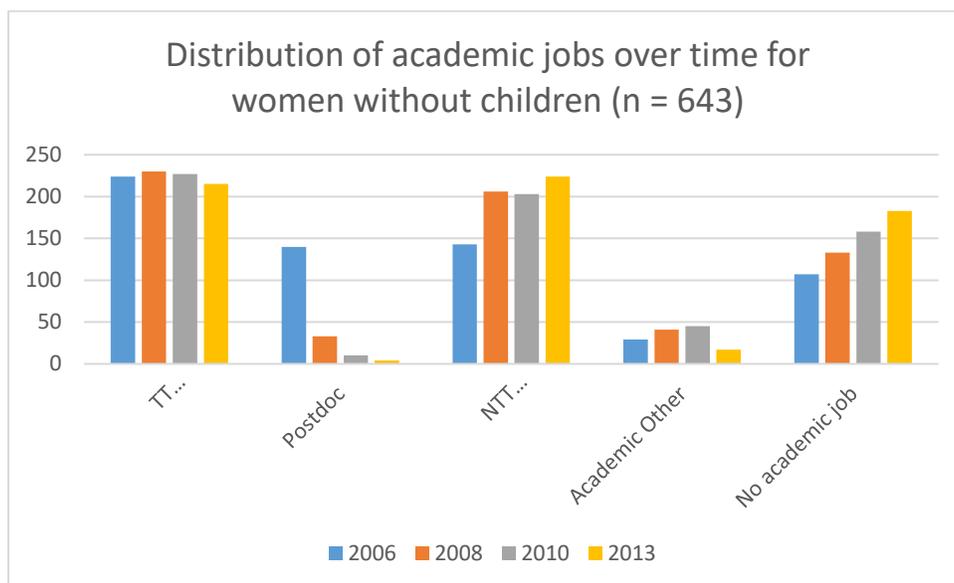
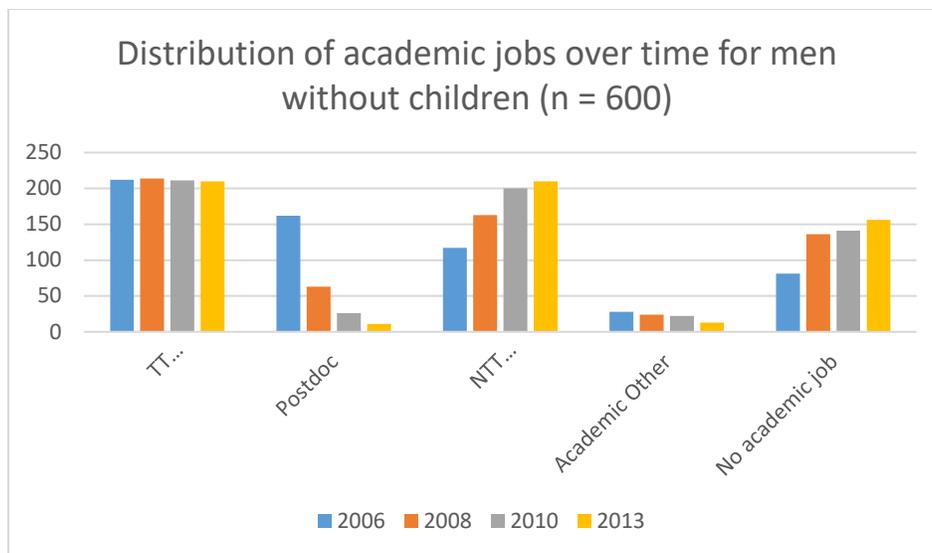


Figure 3 graphically demonstrates the distribution of PhD recipients' academic employment outcomes across gender and family status. The distribution of PhD recipients into academic jobs over time tended to be similar across the comparison groups, with some exceptions. Mothers in graduate school in particular started out early and in higher proportions in NTTF jobs, and higher proportions of them remained in such jobs over the course of time as compared to other groups. Other groups experienced the opposite effect, with smaller numbers of PhD recipients holding NTTF jobs at the beginning of the time range and growing numbers of NTTF jobs toward the end of the time range. The number of tenure-track faculty jobs and postdocs declined over time for all comparison groups at similar rates. Finally, the small number of PhD recipients working in other, NTTF academic jobs including staff-level, managerial, and administrative jobs, remained small and fairly stable over time for all comparison groups.

Figure 3

Distribution of academic jobs over time across gender and family status, 2006-2013





When examining employment outcomes for PhD recipients, it is important to not only examine *what kinds* of jobs doctorates attained but at *what types of institutions* they worked. With that in mind, Figure 4 demonstrates the distribution of PhD recipients into academic jobs by institutional type. Most PhD recipients worked at research institutions, though the number of them continuing to do so over time dropped from year to year. Employment at other institutional types, including doctoral granting, comprehensive, liberal arts, 2-year institutions, and special

focus institutions, while relatively small compared to research universities, remained fairly stable over time.

Figure 5 demonstrates the distribution of PhD recipients across gender and family status in academic jobs by institutional type. Most men and women without children in graduate school tended to work at research institutions with small proportions of PhD recipients working at doctoral granting, comprehensive, and liberal arts institutions. Minimal numbers of men and women without children in graduate school worked at 2-year institutions and special focus institutions. Conversely, employer institutional type is more evenly distributed for mothers and fathers in graduate school. Mothers and fathers in graduate school were both most likely to work at research institutions, but larger proportions of them also worked at comprehensive institutions.

Figure 4

Distribution of academic jobs over time for PhD recipients by employer institutional type, 2006-2013 (N = 1,242)

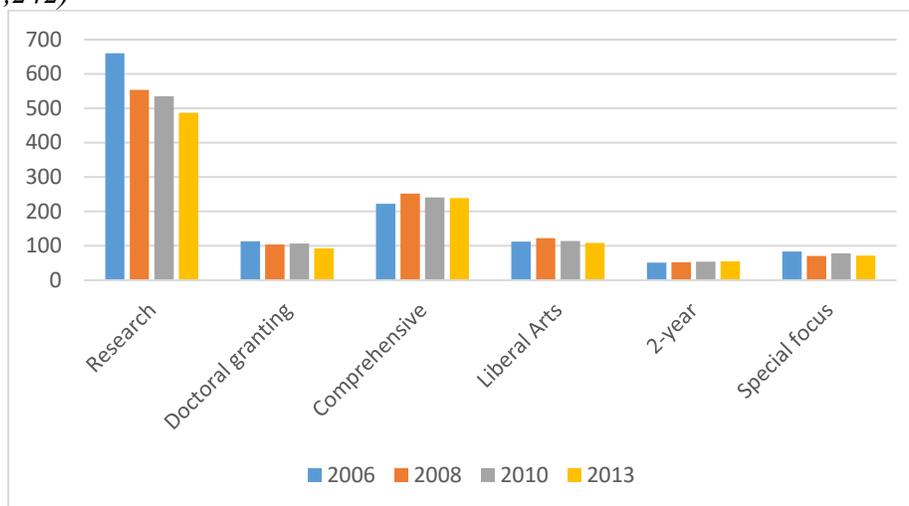
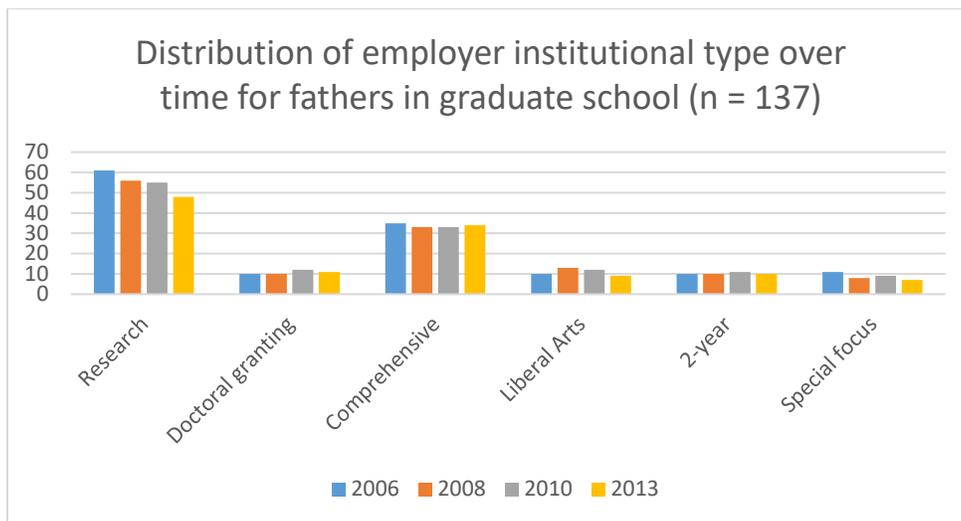
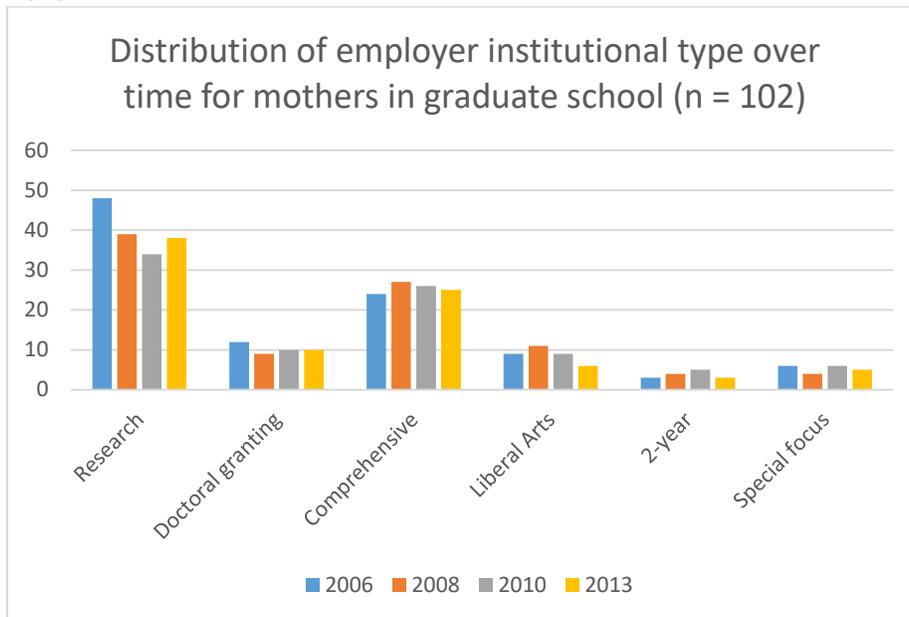
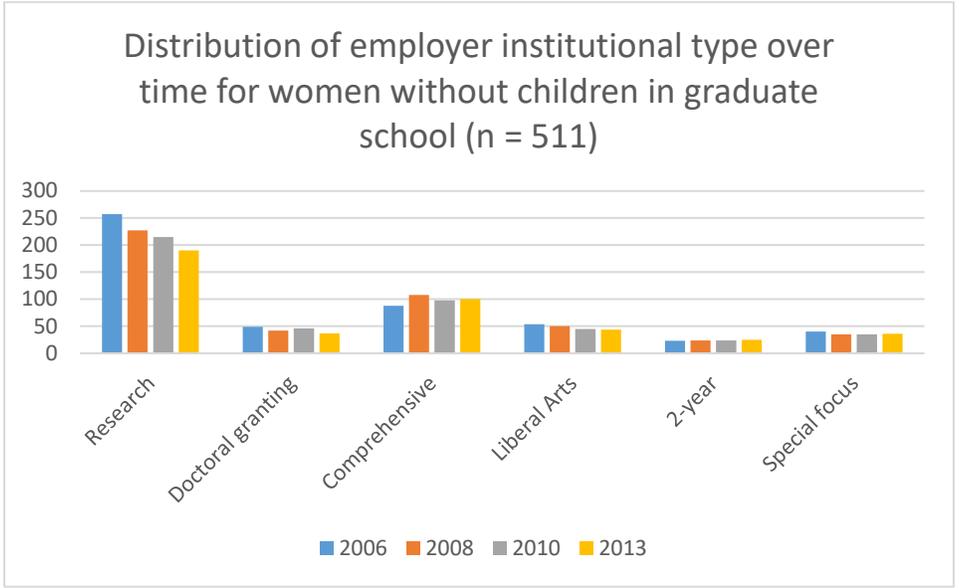
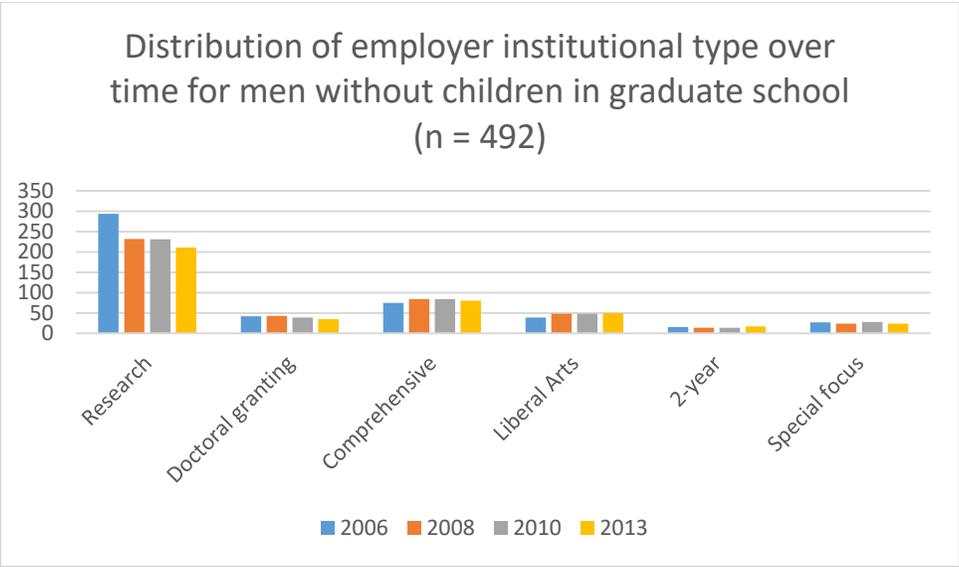


Figure 5

Distribution of academic jobs over time by employer institutional type across gender and family status, 2006-2013





Regression Results

PhD recipients’ attainment of tenure-track faculty positions. This section presents the results of logistic regression analyses to examine PhD mothers’ attainment of tenure-track faculty jobs within the first eight to thirteen years of graduating with their terminal degrees.

These analyses were conducted in response to the following research questions:

- What role do *individual factors* (married/partnered at time of PhD, age and number of dependents at time of PhD, time to PhD, and broad academic discipline) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
- What role do *institutional factors* (institutional type, institutional control, and program ranking) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
- What role do *doctoral training factors* (sources of funding, graduate teaching and research assistantships, research productivity) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
- What role do *professional life course factors* (work outside assistantships and fellowships during graduate school, holding a post-doctoral position, and holding a non-tenure-track faculty position) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?

The analyses use factors within the conceptual framework as predictors of tenure-track job attainment. Model 1 and Model 2 are sequential logistic regression models that introduce blocks of predictor variables in sequence to examine the effects of the four areas of the conceptual framework on the outcome variable, attainment of tenure-track faculty jobs. Model 1 includes all PhD recipients, and Model 2 includes PhD mothers only. Model 3 is a set of four full logistic regression models that compares the same predictors across groups: mothers, fathers, men without children, and women without children. With this set of models, I was able to (1) identify the effects of the predictors on the odds of PhD recipients in general attaining tenure-track faculty jobs, (2) identify the effects of predictors on the odds of mothers specifically attaining tenure-track faculty jobs, and (3) compare the effects of predictors across groups.

I converted logits from the logistic regression models into odds ratios because odds ratios are more easily interpretable (Agresti, 2007). An odds ratio greater than one indicates that the

odds of PhD recipients attaining a tenure-track job was greater for the given category of the independent variable (e.g., graduating from a top-ranked program) than for the reference category (e.g., not graduating from a top-ranked program). When logits were negative and the independent variable was dichotomous, I present the inverse odds ratio to make the interpretation of the results more intuitive (Agresti, 2007).

Because tenure-track job attainment varies across academic disciplines, I chose to control for academic field as a part of my individual variables. In initial testing, I split the sample by academic field and ran logistic regression models on each discipline. However, the number of sample respondents in some fields was too small for the models to be valid, and the number of mothers in particular was divided too finely into the field-specific models. I also tested interaction variables on academic discipline, gender, and family status. However, no interaction variables produced significant effects above the main effects of gender and family status. Therefore, interaction variables were also not included in the final models.

Model 1: Factors that influence PhD recipients' attainment of tenure-track faculty positions. Table 12 presents the results of sequential logistic regression analysis in Model 1, which used the variables in the conceptual framework to predict the likelihood of attaining tenure-track faculty jobs for all PhD recipients.

Goodness of fit measures. The overall regression estimation of Model 1 was significant ($p < .001$ on the chi-square test). The overall percentage from Model 1 was 76.9. This means that on the basis of the final model, 76.9 of PhD recipients were accurately classified as attaining tenure-track jobs or not. The Nagelkerke R^2 of Model 1 was .409, indicating that the model explained 41 percent of the variance in tenure-track jobs attainment for PhD recipients. The

Nagelkerke R^2 improved significantly Model 1 with the inclusion of the last set of predictors, professional life course factors.

Individual variables. Gender and family status were important predictors of tenure-track faculty job attainment. Mothers and fathers in graduate school were less likely to attain tenure-track jobs overall, compared to men without children in graduate school. Men without children in graduate school were three times more likely than mothers (reverse odds ratio = .659, $p < .05$) and fathers (reverse odds ratio = .771, $p < .01$) to attain tenure-track faculty jobs. Descriptively, we know that mothers and fathers attained tenure-track jobs in higher percentages than men and women without children, yet over the course of the entire observation period of 2006-2013, mothers and fathers were less likely to attain tenure-track jobs than the reference group, men without children in graduate school.

Academic discipline was also an important predictor of tenure-track job attainment. PhD recipients in social science fields had two times greater odds (odds ratio = 1.930, $p < .001$) and PhD recipients in life science fields had 3.5 times greater odds (odds ratio = 3.686, $p < .001$) of attaining tenure-track faculty jobs than PhD recipients in natural science fields. PhD recipients in engineering fields had 1.5 times greater odds (odds ratio = 1.424, $p < .01$) of attaining tenure-track faculty jobs as natural sciences Ph.Ds. While taking 10 or more years to graduate with a PhD was a significant predictor of tenure-track job attainment in early partial models (blocks 1, 2, and 3), the variable was not a significant predictor of tenure-track job attainment in the full model. No other individual variables related to family status were significant predictors of tenure-track faculty attainment for PhD recipients.

Institutional variables. The type of doctoral institutions PhD recipients graduated from also mattered when it came to tenure-track job attainment. PhD recipients who graduated from

institutions with a Carnegie 2010 classification of “special focus/other” were significantly less likely to attain a tenure-track faculty job than PhD recipients who graduated from “research (very high)” institutions (inverse odds ratio of .505, $p < .01$). In other words, the odds of a PhD recipient from a “research (very high)” institution attaining a tenure-track job was nearly 2.5 times higher odds than PhD recipients who graduated “special focus” institutions. Graduating from an institution classified as “research university (high)” and graduating from a public institution were significant predictors in the partial models (block 1), but the variables were not significant predictors in the full model. No other institutional variables were significant predictors of tenure-track faculty attainment for PhD recipients in general.

Doctoral training variables. PhD recipients who published more than one article in graduate school or shortly thereafter had over 1.5 times greater odds than those who published no articles to attain tenure-track faculty jobs (odds ratio = 1.660, $p < .001$). In the earlier partial models, holding a GTA position was a significant predictor (block 3), but the variable was not significant in the full model.

Professional life course variables. Once the professional life course factors were added into the model, the Naglekerke R^2 values improved significantly, indicating that professional life course factors are a particularly strong set of predictors of tenure-track faculty job attainment. PhD recipients who held postdoc positions were significantly less likely to attain tenure-track faculty jobs than PhD recipients who did not hold postdocs (inverse odds ratio of .162, $p < .001$). The odds of attaining tenure-track faculty jobs for PhD recipients who did not take postdocs were over 6 times higher odds than for PhD recipients who did take postdocs. Holding a NTTF position was also a significant predictor of tenure-track job attainment: PhD recipients who held NTTF positions were significantly less likely to attain tenure-track jobs than those who did not

hold NTTF positions (inverse odds ratio of .095, $p < .001$). In other words, PhD recipients who did not hold NTTF positions had over 10.5 times higher odds than PhD recipients who did hold NTTF positions of attaining a tenure-track job.

Table 12

Results of Model 1, factors influencing the tenure-track job attainment for all PhD recipients (N = 2,994)

	Block 1	Block 2	Block 3	Full Model
Men, no children in grad school (ref)	---	---	---	---
Mothers in grad school	.666 *	.670 *	.691 *	.659 *
Fathers in grad school	.745 ***	.764 **	.793 **	.771 **
Women, no children in grad school	1.024	1.051	1.073	.907
Married/partnered	1.084	1.084	1.011	1.051
35+ years old	.833 *	.861	.969	1.068
10+ years to PhD	.748 *	.731 *	.771 *	.918
Natural sciences (ref)	---	---	---	---
Social sciences	2.123 ***	2.081 ***	2.193 ***	1.930 ***
Life sciences	3.317 ***	3.449 ***	4.010 ***	3.686 ***
Engineering	1.753 ***	1.702 ***	1.837 ***	1.424 *
Res. university (very high) (ref)		---		---
Research university (high)		.742 *	.821	.858
Special focus/other institution		.390 ***	.494 ***	.505 **
Public institution		1.191 *	1.088	1.077
Top 25 ranked program		1.144	1.082	1.157
Held GRA position			1.202 *	1.217
Held GTA position			1.301 **	1.230
Primary Funding				
GRA (ref)			---	---
GTA			1.513 **	1.553 **
Scholarship, fellowship, grant			1.116	1.197
Self, family, loan			.913	.922
Published no articles (ref)				
Published one article			.882	.864
Published more than one article			1.491 ***	1.660 ***
Outside job				1.020
Held a postdoc				.162 ***
Held a NTTF job				.095 ***
-2 Log Likelihood	4019.35	3976.14	3900.73	3049.12
Chi-square (df = 20)	124.853 ***	168.066 ***	243.472 ***	851.611 ***

	Block 1	Block 2	Block 3	Full Model
Overall percentage	58.2%	59.9%	61.9%	76.9%
Nagelkerke R ²	.054	.073	.104	0.409
N	2,994	2,994	2,994	2,994

Note. ***p < 0.001, **p < 0.01, *p < 0.05. Values reported are odds ratios [Exp(B)].

Model 2: Factors that influence PhD mothers' attainment of tenure-track faculty positions. Table 13 presents the results of sequential logistic regression analysis in Model 2, which used the variables in the conceptual framework to predict the likelihood of attaining tenure-track faculty jobs for PhD mothers who had children in graduate school only. While each partial model with the corresponding regression coefficients is provided in Table 13, I focus primarily on the full model, with all variables entered in.

Goodness of fit measures. The overall regression estimation of Model 2 was significant ($p < .001$ on the chi-square tests on both models). The overall percentage from Model 2 was 79.0 percent. This means that on the basis of the final model, 79.0 percent of PhD mothers have been accurately classified as attaining tenure-track jobs or not. The Nagelkerke R² of Model 2 (full model) was .456, indicating that the model explains 45.6 percent of the variance in tenure-track jobs attainment for PhD mothers. The Nagelkerke R² improved significantly on both models with the inclusion of the last set of predictors, professional life course factors (a difference of 0.242). Importantly, the chi-square test on the mothers only model $\chi^2(20, N = 214) = 51.187, p < .001$) became significant when the professional life course factors were included, indicating that professional experiences are a key set of predictors for mothers in particular.

Predictors of tenure-track job attainment for mothers. Significant predictors include academic discipline and primary funding source. The results suggest that being in the social sciences positively predicts mothers' odds of attaining tenure-track faculty jobs, but funding

one's degree primarily through self, family, or loan sources, taking a NTTF job, and holding postdocs negatively predict mothers' odds of attaining tenure-track faculty jobs. The findings suggest that PhD mothers in the social sciences had nearly 5 times greater odds (odds ratio = 4.897, $p < .01$) than PhD mothers in the natural sciences of attaining a tenure-track faculty job.

Conversely, mothers who funded their degrees through research assistantships rather than primarily through self, family, or loan sources had almost 6 times greater odds (inverse odds of .173, $p < .01$) of attaining a tenure-track faculty job ($p < .01$). PhD mothers who did not hold postdocs had nearly 3.5 times greater odds than those who did hold postdocs of attaining a tenure-track job (inverse odds ratio of .303, $p < .05$). PhD mothers who did not hold NTTF jobs had 10.5 times greater odds than those who did hold NTTF jobs of attaining a tenure-track job (inverse odds of .094, $p < .001$).

Table 13

Results of Model 2, factors influencing the tenure-track job attainment for PhD mothers during graduate school (N = 214)

	Block 1	Block 2	Block 3	Full Model
Married/partnered	1.442	1.449	1.367	1.139
35+ years old	0.944	1.103	1.281	1.331
Children aged 0-5	0.722	0.828	0.798	1.354
Children aged 6-18	0.588	0.624	0.625	0.914
One child (ref)	---	---	---	---
More than one child	1.669	1.597	1.891	0.994
10+ years to PhD	0.733	0.723	0.746	1.249
Natural sciences (ref)				
Social sciences	2.752 **	2.734 **	4.643 ***	4.897 **
Life sciences	2.398	2.140	3.404 **	2.838
Engineering	7.055 **	6.926	8.777	6.546
Res. univ. (very hi) (ref)		---	---	---
Research university (high)		0.345	0.318	0.349
Special focus/other institution		0.470	0.472	0.506
Public institution		1.436	1.316	1.146
Top 25 ranked program		0.606	0.552	0.516

	Block 1	Block 2	Block 3	Block 4
Held GRA position			1.626	1.311
Held GTA position			0.531	0.610
Primary Funding				
GRA (ref)			---	---
GTA			0.641	0.473
Scholarship, fellowship, grant			0.554	0.392
Self, family, loan			0.312 *	0.192 **
Published no articles (ref)			---	---
Published one article			1.833	0955
Published more than one article			1.404	1.492
Outside job				0.888
Held a postdoc				0.303 *
Held a NTTF				0.091 ***
-2 Log Likelihood	279.49	272.522	258.661	206.474
Chi-square (df = 20)	16.495	6.976	13.861	52.187 ***
Overall Percentage	60.7%	63.6%	67.3%	79.0%
Nagelkerke R ²	0.099	0.139	.214	.456
N	214	214	214	214

Note. ***p < 0.001, **p < 0.01, *p < 0.05. Values reported are odds ratios [Exp(B)].

Model 3: Factors across comparison groups. Table 14 presents the results of sequential logistic regression analysis in Model 3, which used the variables in the conceptual framework to predict the likelihood of attaining tenure-track faculty jobs the comparison groups: PhD mothers who had children in graduate school; PhD fathers who had children in graduate school; PhD men who did not have children in graduate school; and PhD women who did not have children in graduate school. I focus on the full models with all variables entered in for each comparison group, and compare coefficients in these final, full models across the groups.

Goodness of fit measures. For Model 3, the regression models conducted for the comparison groups of PhD mothers, PhD men without children, PhD women without children, and PhD fathers showed that the overall estimations of the models were significant (p < .001 on

all models on the chi-square tests). The overall percentages from the mothers, fathers, men without children, and women without children regression models were 79.0%, 79.4%, 77.7%, and 77.0%, respectively. The Nagelkerke R^2 were .456, .496, and .420, and .407, respectively, indicating that the models explained 45.6% of the variance in mothers' tenure-track attainment; 49.6% of the variance in father's tenure-track attainment; 42.0% of the variance in men without children's tenure-track attainment; and 40.7% of the variance in women without children's tenure-track attainment.

Predictors of tenure-track job attainment for PhD mothers. Significant predictors include academic discipline and primary funding source. The results suggest that being in the social sciences positively predicts mothers' odds of attaining tenure-track faculty jobs, but funding one's degree primarily through self, family, or loan sources, taking a NTTF job, and holding postdocs negatively predict mothers' odds of attaining tenure-track faculty jobs. The findings suggest that PhD mothers in the social sciences had over 5 times greater odds (odds ratio = 5.142, $p < .01$) than PhD mothers in the natural sciences of attaining a tenure-track faculty job.

Conversely, mothers who funded their degrees through research assistantships rather than primarily through self, family, or loan sources had 5 times greater odds (inverse odds of .198, $p < .01$) of attaining a tenure-track faculty job ($p < .01$). PhD mothers who did not hold postdocs had nearly 3.5 times greater odds than those who did hold postdocs of attaining a tenure-track job (inverse odds ratio of .303, $p < .05$). PhD mothers who did not hold NTTF jobs had 11 times greater odds than those who did hold NTTF jobs of attaining a tenure-track job (inverse odds of .091, $p < .001$).

Predictors of tenure-track job attainment for PhD fathers, men without children, and women without children. In terms of academic discipline, social science men without children in graduate school and fathers in graduate school each had about 2.5 times greater odds (odds ratio for men without children = 2.450, $p < .001$; odds ratio for fathers = 2.893, $p < .05$) than their natural science counterparts of attaining tenure-track faculty jobs. Women who did not have children during graduate school in social science disciplines had about 1.5 times greater odds (odds ratio = 1.732, $p < .01$) than their natural sciences counterparts to attain tenure-track faculty jobs. Life sciences men without children in graduate school had about 3 times greater odds (odds ratio = 2.782, $p < .01$) and fathers in graduate school had 16 times greater odds (odds ratio = 16.761, $p < .01$) of attaining tenure-track jobs than their natural science counterparts. Engineering women without children in graduate school had nearly 4 times greater odds (odds ratio = 3.935, $p < .05$) of attaining tenure-track jobs than their natural sciences counterparts, but no other comparison groups saw this effect.

Institutional variables varied across models. Men and women without children in graduate school who graduated from institutions with a Carnegie 2010 classification of “research university (very high)” had 2 times greater odds (inverse odds of .436, $p < .05$ for men without children, and inverse odds of .368, $p < .01$) as PhD recipients who graduated from institutions classified as “special focus” to attain tenure-track faculty jobs. Fathers who graduated from “special focus/other” institutions saw no significant differences in tenure-track job attainment compared to their “research university (very high)” counterparts. Fathers in graduate school were the only group for whom being in a top 25 ranked program according to *USNWR* rankings was significant, and fathers who graduated from such programs had over 2.5 greater odds (odds ratio

= 2.620, $p < .05$) than fathers who did not graduate from top-ranked programs of attaining tenure-track jobs.

Doctoral training predictors also varied across comparison groups. Women without children in graduate school who financed their degrees primarily through a teaching assistantship had nearly 2 times greater odds (odds ratio = 1.887, $p < .01$) than those who financed their degrees through a research assistantship to attain a tenure-track job. Primary funding source was not a significant predictor for male groups. Additionally, publishing more than one article in graduate school or shortly thereafter was significant for both men and women without children in graduate school, as men and women without children who published more than one article had over 1.5 times greater odds (odds ratio = 1.687, $p < .01$ for men without children; odds ratio = 1.656, $p < .01$ for women without children) than those who published no articles to attain tenure-track faculty jobs. Publishing more than one article was not a significant predictor for fathers in graduate school.

In terms of professional life course variables, across all models, holding a NTTF faculty job and holding a post-doctoral fellowship significantly reduced one's chances of attaining a tenure-track job. Men without children in graduate school and fathers who did not take postdocs had 7 times greater odds than those who did take postdocs of attaining tenure-track jobs (inverse odds ratio of .140, $p < .001$ for men without children; inverse odds ratio of .142, $p < .001$ for fathers). Women without children in graduate school who did not take postdocs had 5 times greater odds of attaining tenure-track jobs than those who did take postdocs (inverse odds ratio of .175, $p < .001$).

Men without children in graduate school who did not hold NTTF faculty jobs had nearly 10 times greater odds of attaining a tenure-track faculty job (inverse odds ratio of .101, $p < .001$)

than those who held NTTF positions. Fathers in graduate school who did not hold NTTF jobs had 21 times greater odds of attaining a tenure-track job than those who took such jobs (inverse odds ratio of .047, $p < .001$). Women without children in graduate school who did not take NTTF jobs had 10 times greater odds of attaining a tenure-track job than those who took NTTF jobs (inverse odds ratio of .094, $p < .001$).

Table 14
Results of Model 3, factors influencing the tenure-track job attainment for PhD recipients by comparison group (N = 2,994)

	<i>Had children during graduate school</i>		<i>Did not have children during graduate school</i>	
	<i>Mothers</i>	<i>Fathers</i>	<i>Men</i>	<i>Women</i>
Married/partnered	1.326	1.482	1.112	.970
35+ years old	1.096	1.246	.855	1.267
Time to PhD 10+ years	1.319	1.453	.793	.809
Natural sciences (ref)	--	--	--	--
Social sciences	5.142 **	2.563 *	2.319 ***	4.121 **
Life sciences	2.574	18.737 **	2.793 **	1.959 ***
Engineering	7.541	1.655	1.150	.809 *
Res. univ. (very hi) (ref)	--	--	--	--
Research univ. (high)	.287	2.162	.866	.789
Special focus/other	.400	2.379	.493	.383 **
Public institution	1.143	1.335	1.015	1.128
Top 25 ranked program	.583	2.824 *	1.143	1.122
Held a GRA position	1.364	2.002	1.442 *	.982
Held a GTA position	.612	1.424	1.215	1.358 *
Primary Funding				
GRA (ref)	--	--	--	--
GTA	.511	1.430	1.634	1.696
Scholarship, fellowship, grant	.400	1.753	1.184	1.302
Self, family, loan	.198 *	.948	.952	1.057
Pub. 0 articles (ref)	--	--	--	--
Published 1 article	.968	.674	.690	.962
Published > 1 article	1.492	1.547	1.732 **	1.647
Outside job	.909	.858	1.008	1.038
Postdoc	.303 *	.131 ***	.141 ***	.179 ***

	<i>Mothers</i>	<i>Fathers</i>	<i>Men</i>	<i>Women</i>
NTTF	.091 ***	.053 ***	.098 ***	.095 ***
-2 Log Likelihood	202.135	225.645	1184.037	1375.286
Chi-square (df = 20)	88.858 ***	114.519 ***	447.335 ***	489.261 ***
Overall percentage	79.4%	79.4%	77.7%	77.0%
Nagelkerke R ²	.454	.496	.420	.407
N	214	248	1,187	1,345

Note. ***p < 0.001, **p < 0.01, *p < 0.05. Values reported are odds ratios [Exp(B)].

Conclusion

This chapter discussed the results from data analyses. The descriptive analyses revealed that the study sample, PhD recipients who were U.S. citizens, who graduated from U.S. institutions between 2000 and 2005, and who worked at higher education institutions, was evenly split between men and women. However, very few PhD recipients had children in graduate school, causing the numbers in the PhD mothers and PhD fathers comparison groups to be relatively small. PhD mothers tended to have different graduate school characteristics than their peers in the sample, often statistically significant. Notably, mothers often came from the social sciences, were older, and graduated around age 38, five to six years older than their peers. Mothers took on average one year longer to graduate with their PhDs compared to the average PhD recipient. Mothers were more likely to graduate from research institutions, but fewer mothers graduated from top-ranked programs. Most mothers financed their degrees through personal funding and loans. Mothers were about as productive as other groups in terms of publishing journal articles and most published articles during or immediately after graduate school. Slightly fewer mothers held postdocs, but mothers were significantly overrepresented in NTTF jobs.

In terms of employment outcomes, between 2006 and 2008, there was a sharp decline in the number of PhD recipients attaining tenure-track jobs perhaps as a result of the limited state,

federal, and institutional funding for hiring as well as the economic recession. After 2008, fewer PhD recipients attained tenure-track jobs, while more took NTTF jobs. Mothers were overrepresented in NTTF jobs at all points in time. Family status had an early effect on tenure-track employment. Fathers secured tenure-track jobs in the highest percentages within the first two years post-PhD, followed by mothers. The effects of family status on tenure-track job attainment dissipated over time, as mothers secured tenure-track jobs in relatively equal proportions to other groups. Despite higher proportions of mothers attaining tenure-track jobs, fewer mothers attained jobs at research institutions: mothers took academic jobs in higher proportions across employer institutional types with roughly even proportions working at research and non-research institutions.

Analyzing the variables that influenced PhD recipients' attainment of tenure-track faculty jobs indicated that mothers and fathers were less likely than men without children in graduate school to obtain tenure-track faculty jobs and being in the social sciences improved one's likelihood of obtaining such jobs. The institutional type and control of PhD recipients' graduate institutions influenced their job attainment and publishing more than one article in or right after graduate school improved one's likelihood of getting on the tenure-track. Across the board, taking a postdoc or a NTTF faculty job at any point decreased one's likelihood of obtaining a tenure-track job.

While all of the regression models in this study were statistically significant, the predictors varied across gender and family status and thus failed to control for a large portion of the variance at play in the specific comparison groups. For instance, being in a top ranked program improved the likelihood that men would attain tenure-track jobs, but had no discernible effect on women. Publishing more than one journal article improved the likelihood that childless

men would attain jobs, but had no discernable effect on others. Finally, the primary funding source for one's graduate studies had an influence on women's likelihood of attaining tenure-track jobs, but not men's. The strongest and most consistent predictors across all models and comparison groups were academic discipline, holding a postdoc, and holding a NTTF faculty job. In the next chapter, I discuss these findings and their implications for policy and future research.

Chapter 5

Conclusions

In this chapter, I discuss the results of the research conducted and its implications for policy and future research. First, I interpret the findings from the data analyses that were relevant to the research questions. By analyzing data from PhD recipients who were U.S. citizens, who earned their terminal degrees between 2000 and 2005, who responded to at least one iteration of the SDR from 2006 through 2013, and who worked at higher education institutions, this study found that gender and family status influenced the career-related resources PhD recipients accumulated in graduate school and their subsequent employment outcomes. The analyses focused on PhD mothers, but the findings are nuanced in that they track differences across gender and family status.

This study investigated the following research questions:

1. To what extent have PhD-earning mothers attained tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
2. How does tenure-track faculty job attainment differ between PhD-earning mothers, fathers, men without children, and women without children?
3. How do *individual, institutional, doctoral training, and professional life course factors* differ between PhD-earning mothers, fathers, men without children, and women without children?
4. What role do *individual factors* (married/partnered at time of PhD, age and number of dependents at time of PhD, time to PhD, and broad academic discipline) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher

education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?

5. What role do *institutional factors* (institutional type, institutional control, and program ranking) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
6. What role do *doctoral training factors* (sources of funding, graduate teaching and research assistantships, research productivity) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?
7. What role do *professional life course factors* (work outside assistantships and fellowships during graduate school, holding a post-doctoral position, and holding a non-tenure-track faculty position) play in PhD mothers' attainment or non-attainment of tenure-track faculty jobs at U.S. higher education institutions within the first eight to thirteen consecutive years of earning their terminal degrees?

Major Findings

The “conventional wisdom” in academia advises faculty-bound women against having children in graduate school, recommending they delay family formation even until the point of achieving tenure (Aisenberg & Harrington, 1988; Armenti, 2004; Drago & Colbeck, 2003; Kennelly & Spalter-Roth, 2006; Lynch, 2008; Mason, 2013; Morrison et al., 2011; Sallee, 2011; Springer et al., 2008; Tierney & Bensimon, 1996; van Anders, 2004; Wolfinger et al., 2008; 2009). However, the findings from this study suggest that this conventional wisdom may not always be true.

Descriptive findings. Descriptively, fathers and mothers who had children during graduate school attained tenure-track jobs in higher percentages at earlier rates than their peers who did not have children during graduate school. These findings complicate the existing literature on PhD mothers, which suggests that mothers experience up to a 22 percent delay in attaining tenure-track faculty jobs (Morrison et al., 2011; Wolfinger et al., 2008). However, when compared with men without children in graduate school in the regressions and considering the entire observation period of 2006 to 2013, mothers fell short of attaining tenure-track jobs in comparable percentages to other groups. This finding aligns with the existing literature, which suggests that mothers experience a gender penalty and a baby penalty and have lower overall rates of tenure-track job attainment compared to other groups (e.g., Mason, 2013).

Mothers who had children in graduate school were more evenly distributed across employer institutional type and often worked at non-research institutions including comprehensive, liberal arts, two-year, and special focus institutions than at research universities. In this way, the descriptive findings suggest that gender and family status affect the types of institutions where PhD recipients attain jobs. These findings correspond with previous literature suggesting mothers may choose to work at more teaching-oriented institutions, self-selecting away from jobs at research-focused institutions because they perceive incompatibilities between keeping up with research productivity expectations for tenure and the demands of faculty life (e.g., Bair & Haworth, 2004; Gardner, 2008b; Ginther & Kahn, 2006b; Mason, 2013; Wolf-Wendel & Ward, 2006). The descriptive findings may also suggest that because mothers accumulate different sorts of graduate school resources than other groups, they are at a cumulative disadvantage when it comes to competing for highly-valued jobs at research

institutions (e.g., DiFuccia, et al., 2007; Hollenshead, et al., 2005; Kulis, et al., 2002; Mason & Goulden, 2009).

Regression findings. This study found that professional experiences such as holding a postdoc or an NTTF job are the most consistent predictors of tenure-track faculty job attainment across groups defined by gender and parental status. Taking a postdoc or working in a NTTF position negatively influenced all PhD recipients' odds of attaining a tenure-track faculty job. This finding supports recent studies that suggest despite the expectations many postdocs seem to have of moving on to the tenure-track (e.g., Powell, 2014; Yamamoto, 2014), taking a postdoc lowers the odds of attaining tenure-track jobs. The finding on NTTF positions also corresponds with studies suggesting NTTF jobs provide poor stepping stones for those hoping to move on to the tenure-track (CAW, 2012; Kezar & Sam, 2011).

The regression findings in this study indicate that academic discipline matters when it comes to securing tenure-track jobs. PhD recipients in social science, life science, and engineering fields have greater odds of attaining tenure-track jobs than PhD recipients in natural science fields. The institutional type of one's doctoral program also matters: graduates from special focus institutions have lower odds of attaining tenure-track faculty jobs than graduates from research institutions.

Research productivity makes a difference in tenure-track job attainment, as publishing more than one article in or immediately after graduate school positively predicts attaining tenure-track jobs. Finally, funding sources in graduate school matter: funding one's graduate school primarily through GTA positions helps most PhD recipients. Mothers' funding situations are somewhat different: PhD mothers are most likely to use personal, family, and loan sources to

primarily fund their degrees, but these funding sources negatively influence their odds of attaining tenure-track jobs.

Contributions to the research literature. The results of this study expand the findings of previous studies on how PhD mothers' accumulation of career-related resources in graduate school influence their tenure-track faculty job attainment (Kennelly & Spalter-Roth, 2006; Mason, 2013; Morrison et al., 2011; Wolfinger et al., 2008). This study extends existing research threads on faculty careers and PhD recipients' employment patterns (e.g., Rhoades & Torres-Olave, 2015). This study addresses a hole in the higher education literature on how PhD recipients with different individual and graduate school characteristics are filtered jobs into jobs in the primary and secondary labor markets in the ALM (Kezar & Sam, 2010; Rhoades, 2013; 2015; Rhoades & Torres-Olave, 2015). Finally, this study focuses on the effects of PhD recipients' family status during graduate school and on PhD mothers' paths to the professoriate. Few studies have focused on these particular areas, and even fewer have used secondary data analysis techniques to do so (Kennelly & Spalter-Roth, 2006; Mason, 2013; Morrison et al., 2011; Wolfinger et al., 2008).

This study found a number of new findings on tenure-track employment outcomes for PhD mothers. I discuss the potential reasons for these findings and relate them to the existing literature. Finally, I suggest the implications of my findings for policy and future research and reach a conclusion for this study.

Up-to-date data. There are a number of potential reasons why PhD mothers fared somewhat better in this study than in previous studies. For one, this study presents up-to-date data on recent cohorts of PhD recipients. Kennelly and Spalter-Roth's (2006) sample included graduates from 1996 and 1997; Morrison et al.'s (2011) included graduates from 1995; and

Mason's (2013) comprehensive analyses included graduates from 1978 through 1995. A span of five to 10 years separates the graduation years of the PhD recipients in this study and the graduation years of the PhD recipients in previous studies, and in the last decade, employment outcomes may have shifted for these newer cohorts of PhD mothers. The fact that the tenure-track employment outcomes for the PhD mothers in this study are improved as compared to those in previous studies is a positive sign that tenure-track jobs may be more equitably distributed across gender and family status than in previous years and with previous cohorts of PhD graduates.

At the point of this dissertation, no other empirical studies on PhD mothers have been published in the higher education literature using data as recent as the SDR 2013 iteration. However, while this dissertation was being completed, a research brief from the Association of Institutional Research analyzing SDR 2013 data was published (Tanenbaum & Upton, 2014). While the research brief was primarily focused on STEM employment outcomes, the authors' findings corroborate the findings in this dissertation in areas in which the analyses overlap (Tanenbaum & Upton, 2014). The findings in this study suggest that the PhD mothers seemed to find ways to accommodate combining academic work and family responsibilities, which aligns with previous research that suggests academic women can succeed in faculty and family roles (Ward & Wolf-Wendel, 2012).

Changing attitudes towards balancing academic work and life. Another potential reason the findings in this study differ from previous studies is that the mothers in this sample may have been influenced by broadly changing attitudes towards balancing academic work and family life for newer generations of faculty members, which a variety of researchers have observed (e.g., Helms, 2010; Trower, 2010; Wolf-Wendel & Ward, 2015). The PhD mothers in this study may

be among the recent generations of academic women who seek to “have it all” with family and work and consider having a meaningful career and family life to be both attainable and desirable (Helms, 2010; Trower, 2010; Wolf-Wendel & Ward, 2015, p. 28). Academic women who employ strategies and take advantage of institutional supports to manage academic and family responsibilities can and do experience productive academic lives and fulfilling family lives (e.g., Wolf-Wendel & Ward, 2012).

Disciplinary differences. Disciplinary differences may have also played a role. Mothers in this study may have attained tenure-track jobs at higher rates because they were concentrated in the social sciences, which have become feminized in the sense that faculty hiring opportunities for women have vastly improved in recent decades (Kalleberg & Reskin, 1995; Morrison et al., 2011; Spalter-Roth & Merola, 2001). That being said, some fields have experienced more gender parity in faculty hiring than others (Ginther & Kahn, 2004; Van Vooren & Spalter-Roth, 2008). Also, women in STEM fields often strongly identify with their professional fields and may seek career options beyond academia (Mason, et al., 2013; Monosson, 2008). Whereas natural science graduates may have greater job opportunities outside academia, social science graduates may have more opportunities within academia (Kalleberg & Reskin, 1995; Spalter-Roth & Merola, 2001; Van Vooren & Spalter-Roth, 2008). A larger number of job opportunities and a relatively weaker pull from the professional realm may have allowed mothers in the social sciences to match to faculty jobs more easily.

Mothers in graduate school are relatively rare. Another important finding in this study was the discovery that very few women have children in graduate school at all, despite the fact that those that are doing so are going on to attain tenure-track jobs at higher rates than some groups. This study did not address *why* the number of PhD mothers continues to be quite small.

Graduate women may be “leaning in” to academic work by dedicating themselves to their academic pursuits above other life priorities (Sandberg, 2013). Mothers who plan to seek academic positions may be developing strategies to handle real and perceived potential familial conflicts in ways that allow them to successfully accommodate the simultaneously demanding roles of mother and student (e.g., Biggs, et al., 2014; van Anders, 2004; Wolfinger et al., 2008). Finally, we know that in recent years, institutions have been increasing the policies and supports available to graduate students who are parents (e.g., Kuperberg, 2009). It is possible that recent cohorts of PhD mothers are benefiting from the efforts of these institutions in ways that are helping them graduate and attain tenure-track jobs.

Mothers take jobs at different types of institutions. This study discovered that gender and family status affected employer institutional type. Women were generally less likely than men to attain jobs at research intensive institutions, and PhD mothers were less likely than women without children to attain jobs at research institutions. The split between research and non-research institution jobs was more evenly proportioned for mothers than for any other group. In this way, the gendered effect on the institutional type of one’s employer was compounded for mothers, as both gender and family status negatively influenced their likelihood of securing jobs at research institutions. The gender and family status differences in employer institutional type align with findings from previous studies that indicate mothers are less likely to secure or seek jobs at research-focused institutions (Wolf-Wendel & Ward, 2006).

The data in this study do not indicate whether mothers failed to secure jobs at research-focused institutions or self-selected away from jobs at research-focused institutions, but previous literature suggests that both activities may be at play (e.g., Bair & Haworth, 2004; Gardner, 2008b; Ginther & Kahn, 2006b; Mason, 2013; Wolf-Wendel & Ward, 2006). Departmental

norms in more male-dominated fields may shape hiring committees' perceptions in considering mothers to be good candidates for tenure-track positions (DiFuccia, et al., 2007; Kulis, et al., 2002; Ginther & Kahn, 2004). Also, the organizational policies and cultural perspectives of particular campuses and departments may fail to consider the needs of pre-tenure women with children, thus making it more difficult for mothers to attain tenure-track jobs (Hollenshead, et al., 2005; Mason & Goulden, 2009).

Women with children may self-select away from jobs at research-oriented institutions because they perceive incompatibilities between keeping up with research productivity expectations for tenure and the demands of family life (Bair & Haworth, 2004; Gardner, 2008b; Ginther & Kahn, 2006b; Mason, 2013). Unfortunately, women who self-select away from research institutions due to perceived incompatibilities between work and life may not realize that research universities offer a number of built-in supports to help them maintain active scholarship records, including graduate students, postdocs, colleagues, research offices, and abbreviated teaching loads (Wolf-Wendel & Ward, 2012). Teaching-oriented institutions such as a comprehensive universities typically do not offer this level of research support, even though faculty may be expected to increase research productivity to expand the research mission of the institution (e.g., Wolf-Wendel & Ward, 2012).

On a positive note, however, perhaps greater frequencies of mothers seek jobs at more teaching-oriented institutions simply because they enjoy teaching (e.g., Bair & Haworth, 2004; Gardner, 2008b; Mason, 2013; Wolf-Wendel & Ward, 2006). Mothers who value teaching over research may seek jobs at comprehensive, liberal arts, or community colleges where research expectations are lower, but teaching opportunities are prevalent (Bair & Haworth, 2004). In this way, greater frequencies of mothers may be seeking jobs at institutions in noncompeting

segments of the ALM (Burke, 1988; Clark, 1987; Finnegan, 1993; Twombly, 2005; Youn, 1988).

Professional experiences are important. Another important finding in this study about mothers' employment outcomes centered on the influence of NTTF jobs and postdocs on eventual tenure-track faculty employment. The descriptive results indicated that women were significantly more likely to hold NTTF jobs. The effect of family status compounded the gender effect on likelihood of holding a NTTF job for mothers, however, as mothers started out early in higher proportions in NTTF teaching and research faculty jobs and remained in such jobs over the course of time. Other groups including women without children in graduate school experienced the opposite effect, with smaller numbers of PhD recipients holding NTTF faculty jobs at the beginning of the time range, and growing numbers of NTTF faculty jobs toward the end of the time range. In this way, mothers were overrepresented as NTTF at the beginning of the observation period, and the negative effects of gender and family status on NTTF employment carried through for mothers to the end of the observation period.

The findings on women being overrepresented in NTTF jobs aligns with previous literature (e.g., McMahon & Green, 2008; Wolfinger et al., 2009). This study does not address whether the women and mothers in the sample were voluntary or involuntary NTTF, but understanding the differences between voluntary and involuntary NTTF helps provide context to the findings. Women and mothers who voluntary NTTF may have sought such positions because they perceived them to better allow them to accommodate their family responsibilities (Kezar & Sam, 2011), gain teaching experience (Kezar & Sam, 2011), or earn wages as a trailing spouse in dual-career couple relationships (Wolf-Wendel et al., 2004). Women and mothers who were involuntary NTTF, however, may have been aspiring academics who ultimately wished to

be hired full-time or onto the tenure-track (AAUP, 2010; CAW, 2012; Tuckman et al., 1978). In either case, because women and PhD mothers specifically are overrepresented in NTTF jobs, they may face potential exploitation in the ALM, leading to lower wages, less job security, limited benefits, and holding multiple, successive appointments that lead to limited real career advancement (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015).

This study supports previous literature suggesting that the academic pipeline metaphor is too linear and too restrictive to accurately describe the path of PhD mothers (Cannady et al., 2014; Pawley & Hoegh, 2011). The metaphor of a continuous pipeline from graduate school to the professoriate assumes that NTTF faculty jobs or postdocs may eventually lead to tenure-track jobs as PhD mothers move from one stage to the next in a linear path. However, the pipeline metaphor does not account for the fact that postdocs are leading PhD mothers away, rather than toward the tenure-track. The findings from this study do not support findings in other studies that suggest that postdocs and NTTF jobs may be “on-ramps” through which PhD mothers gain access to the tenure-track (Cannady et al., 2014; Pawley & Hoegh, 2011), because most postdocs and NTTF positions were found to lead away, rather than toward, the tenure-track.

Limitations of the conceptual framework. This study found that the conceptual framework was insufficient to explain the supply-side factors that predict PhD mothers’ attainment of tenure-track jobs. The conceptual framework included four areas of career-related resources doctoral students accumulate in graduate school: individual, institutional, doctoral training, and professional life course resources. All four areas of career-related resources have been found to influence doctoral recipients’ likelihood of attaining tenure-track faculty jobs in previous studies (Enders, 2002; Kennelly & Spalter-Roth, 2006). This study found that the only

shared significant predictors across all groups were academic discipline, holding a NTTF faculty job, and holding a postdoc. Institutional type, being in a top-ranked program, financing one's degree through a teaching assistantship, and publishing articles in or shortly after graduate school all mattered, variably, for members of other groups, but not for PhD mothers. Financing one's degree through personal, self, or loan sources was the only significant covariate that specifically influenced PhD mothers' likelihood of attaining tenure-track jobs, and it negatively influenced their odds of tenure-track job attainment.

Because the factors chosen for this study failed to fully explain the variance in PhD mothers' attainment of tenure-track jobs, we cannot fully determine whether differences in accumulation of these supply-side factors put PhD mothers at a cumulative disadvantage compared to other groups. In fact, the tenure-track employment outcomes for PhD mothers suggest the opposite. This study was primarily concerned with whether PhD mothers attained tenure-track jobs in comparable quantities to others, and despite their small numbers and differences in types of employers, PhD mothers were successful in attaining these jobs. While there were differences in the accumulation of supply-side resources between PhD mothers and others, these differences did not come to bear on the equations modeling tenure-track job attainment.

Other limitations to consider. Because the findings on PhD mothers in this study differ from previous studies, it is important to consider the strength of the regression models in a holistic sense. It is difficult to say with statistical confidence that the regressions as a whole are useful for predicting the tenure-track attainment of PhD mothers, men without children, fathers, or women without children, although the regressions were significant for all groups. The lack of a variety of significant covariates indicates that PhD mothers' attainment of tenure-track jobs is

largely explained by variables not examined in this study. The inability of this study to use SDR data to pin down the observable variables that explain PhD mothers' attainment of tenure-track jobs, especially given their recent successes in gaining tenure-track jobs in higher percentages than other groups, is a challenge that other studies have also observed (e.g., Ginther & Kahn, 2004). The regression findings in this study should be considered with this limitation in mind.

Implications for Policy

The findings in this study suggest several important policy implications for U.S. higher education institutions as well as for PhD mothers and female graduate students. First, I discuss the implications for higher education institutions. Then, I discuss the implications for PhD mothers and female graduate students who may be considering having children during graduate school and also pursuing tenure-track employment.

Policy implications for higher education institutions. The findings in this study indicate that PhD mothers have been successful in attaining tenure-track faculty jobs. Institutions should not discourage PhD mothers from entering graduate school because they can be successful. Institutions must find ways to accommodate female and male graduate students who want to balance work and family life, and they should enact policies to support these students rather than leaving them to manage individual choices and pressures on their own. For instance, many of the policies outlined in the American Association of University Professors (2001) *Statement of Principles on Family Responsibilities and Academic Work* apply to graduate students as well as to pre-tenured faculty members and could be modified to support graduate students with children. Policies that assist with family demands including leaves of absence, deferred funding, health insurance coverage, lactation support, access to affordable day care, and family leave, would provide needed support to graduate students who have children (AAUP,

2010; Brown & Nichols, 2012; College and University Work and Family Association, 2011; Hollenshead, et al., 2005; Kuperberg, 2009; Lynch, 2008; Merchant et al., 2013). If higher education institutions do not find ways to support graduate students with children, they may lose out on students who could be promising members of their faculties.

At the same time, faculty and administrators need to be aware that mothers are still a vastly underrepresented group compared to those without children in graduate school, due in part to increased pressures (Espinoza, 2010; Estes, 2011), emotional and financial stresses (Gardner, 2008a; Oswald & Riddock, 2007), and higher attrition rates (Bieber & Worley, 2006; Gardner, 2008b; Golde, 2005). Faculty and administrators should be cognizant of how departmental cultures and faculty attitudes may affect the resources and supports that are extended to mothers, being alert to potential caregiver bias (Hochschild, 1997; Mason, 2013), unequal distribution of resources (Kennelly & Spalter-Roth, 2006), and a lack of socialization (Sallee, 2011). Faculty should mentor mothers and should assist them in publishing journal articles (Ehrenberg & Mavros, 1995; Rhoades & Torres-Olave, 2015). Faculty and administrators should recommend wider access to resources such as research and teaching assistantships for graduate students who are mothers, so that GTAs, GRAs, fellowships, scholarships, and grants can also be primary funding sources for mothers along with their peers (Ehrenberg et al., 2007; Ehrenberg & Mavros, 1995; Kim & Otts, 2010). Faculty and administrators should encourage mothers to consider working at all types of institutions, as they do for PhD students with no children (Bair & Haworth, 2004; Gardner, 2008b; van Anders, 2004). Finally, institutions should educate graduate students that taking a postdoc or a NTTF job may not ultimately lead them to the tenure-track (Barker & Christensen, 1998; Bousquet, 2008; Kezar & Sam, 2010; Mason, et al, 2013; Mavripilis, et al, 2010; Rhoades, 2013; Rhoades & Torres-Olave, 2015).

Higher education institutions need to ensure that once mothers are hired in to tenure-track faculty jobs, they have the supports they need to continue their progression through promotion and tenure. Clear guidelines for promotion and tenure are needed (Fox & Colatrella, 2006; Gardner & Blackstone, 2013; Wolf-Wendel & Ward, 2014). Policy considerations such as stopping the tenure clock as modeled by the AAUP statement on family and work balance (AAUP, 2010) or delaying or suspending grants to fulfill family obligations as modeled by the NSF Career-Life Balance Initiative (NSF, 2014) should be enacted to support women with children through tenure and promotion up the academic ladder. Research-focused institutions in particular need to consider potential biases against gender and family status in their hiring decisions (Etzkowitz et al., 2000; Grant et al., 2000; Kelly & Grant, 2012; Rosser, 2004), and they should adopt hiring practices that accommodate mothers with children.

Policy implications for female graduate students and PhD mothers. Female graduate students considering having children during graduate school and graduate students who are mothers themselves should be aware that the decision to have a child in graduate school brings forth a number of simultaneous pressures, risks, and rewards with regards to tenure-track employment. Decades of prior data and conventional academic wisdom indicate that having a child delays women on the path to the tenure track, if they get there at all (e.g., Aisenberg & Harrington, 1988; Armenti, 2004; Drago & Colbeck, 2003; Mason, 2013; Morrison et al., 2011; Tierney & Bensimon, 1996; Wolfinger et al., 2008). Faculty today are encouraged to opt out of pursuing family and academia (Belkin, 2003) or lean in to either family life or academia, but not both (Sandburg, 2003).

However, data from this study suggest other alternatives. Recent data on newer cohorts of PhD recipients suggest an either-or approach may not always be required. A number of studies

point to the positive aspects of balancing work and family life (e.g., Wolf-Wendel & Ward, 2004), and generationally, PhD recipients today may be more driven to “have it all” by enjoying the balance of both worlds (Helms, 2010; Trower, 2010; Wolf-Wendel & Ward, 2015, p. 28). Though the SDR data do not explain the reasons for this shift in employment outcomes for PhD mothers, it seems to have subtly occurred. With this in mind, women in graduate school considering having a child should be aware that being a mother does not necessarily negatively influence their likelihood of attaining a tenure-track job. However, it may affect their likelihood of attaining job at a research institution. It also may increase their likelihood of taking a NTTF job. Finally, PhD recipients, especially women, should be aware that taking a NTTF job or postdoc does not seem to function as an effective stepping stone to the tenure track.

Implications for Future Research

The findings in this study suggest several important implications for future research on topics related to PhD recipients generally and PhD mothers particularly. Little empirical research has been conducted yet to explore this the shift in employment outcomes for recent cohorts of PhD mothers. Future research should address questions of why this shift occurred, what initiated it, and what facilitated it. For instance, why and how did the select few PhD mothers in this sample secure faculty positions at research institutions? Why and how did other PhD mothers secure faculty positions at non-research institutions? Are there observable group differences between these mothers? Many of these questions may be better approached through qualitative investigation or would benefit from a larger sample size and more long-term data than were available in this study.

Given that the characteristics of the PhD mothers in this study seemed to be similar to mothers in previous studies, yet the outcomes for PhD mothers in this study were different from

previous studies, further research needs to address whether the characteristics of PhD mothers have changed in ways the SDR data do not observe. For instance, have the characteristics of PhD mothers changed in recent cohorts, and could these different sorts of characteristics lead them to higher probabilities of attaining tenure-track jobs? Are variables that were unobserved in this study, including geographic mobility, related to this change? An observable way PhD mothers in this sample differed from PhD mothers in previous studies was their comparable productivity levels to other groups in publishing journal articles during or shortly after graduate school. Future research should investigate how these and other key supply-side characteristics are related to tenure-track job attainment.

Another area for future research is related to the conceptual framework used in this study. Kennelly and Spalter-Roth's (2006) framework offered a nuanced investigation of differences across gender and family status. However, many of the variables Kennelly and Spalter-Roth (2006) found to be significant for PhD mothers were not significant for the PhD mothers in this study. For instance, Kennelly and Spalter-Roth (2006) found that departmental prestige was the single most significant predictor of obtaining a tenure-track position, but department prestige only affected the men in this study. Kennelly and Spalter-Roth's (2006) framework may have set the foundation for work on PhD mothers, but the findings in this study suggests the framework needs further refinement to apply to other contexts. Better defining a set of observable supply-side characteristics that influence tenure-track attainment for PhD mothers is an important step in understanding why mothers are attaining such jobs in higher percentages and at earlier points than their peers without children in graduate school. Further research is needed on the variables that influence mothers' paths to the tenure-track.

Future research on PhD mothers should also consider both quantitative and qualitative approaches. Future quantitative research should continue to accommodate separate analyses for various groups across gender and family status, given the nuance of different variables across different groups. In this way, further research can lead to a new conceptualization of the frameworks of career-related resources that account for such nuances.

Qualitative research could help identify whether institutional or departmental behaviors of the PhD mothers' doctoral institutions helped contribute to their recent successes above other groups in attaining tenure-track jobs. For instance, do mothers seem to be forming stronger bonds with faculty mentors, which could contribute to their higher publication records, and are these bonds translating to a greater likelihood of securing jobs in the academic marketplace? Are there family strategies in motion, such as favoring the woman as the primary job-holder in a dual-career couple hiring situation? We know that recently, policies for graduate students who are parents have increased at institutions across the country (Kuperberg, 2009). How have these policies had an impact on increasing the hiring of mothers into academic roles?

With recent successes in attaining tenure-track jobs, questions about PhD mothers' attrition and retention come to bear. Future research should investigate the attrition levels of recent cohorts of PhD mothers. Have recent cohorts of mothers experienced changes in attrition, socialization, and perceptions of work-family conflict? Do the select few mothers who attained tenure-track jobs represent a cohort of mothers who are "leaning in" to academic careers, and how do they compare to others who might "opt out" of academic careers, self-selecting away from academia during graduate school? Or, like newer generations of faculty seem to express, do they feel as if they "have it all" and enjoy the best of both family and academic life?

Finally, the findings on the influence of NTTF employment and postdocs on PhD mothers' likelihood of attaining a tenure-track job is a key finding in this study and serves as a jumping off point for future research. From this study and others, we understand that holding a NTTF job detracts from one's likelihood of attaining a tenure-track job. With this in mind, more research needs to be conducted on whether PhD recipients are aware of this gap between expectations and reality. Are the PhD recipients who take NTTF positions considered to be voluntary or involuntary NTTF? Why are women, and specifically mothers, overrepresented as NTTF? Are the PhD recipients taking postdocs aware of their own expectation-reality gap? Why are postdocs being led away from higher education institutions? This study suggests that neither NTTF nor postdoc positions are "on ramps" that lead to the tenure-track, but this study is limited by an observation period of only eight to thirteen years post-PhD. Longitudinal research indicates that over greater spans of time, NTTF positions can be "on ramps" in the academic pipeline to the tenure-track (Wolfinger et al., 2009), so further research on this contradiction is merited.

Finally, while this study used PhD graduation as an accumulation checkpoint for PhD recipients, the statistically significant differences on a number of independent variables across gender and family status did not lead to statistically significant differences in the weights of those variables on the dependent variable, attainment of tenure-track jobs. The findings in this study indicate that if a cumulative disadvantage for mothers exists, it likely begins at an even earlier point than graduate school or with a different set of resources than were hypothesized in this study. Also, there are likely other variables beyond SDR data that could explain a greater amount of the variance in tenure-track employment between groups across gender and family

status. Future research should be conducted to investigate and define variables that can better describe this variance.

Conclusion

This study examined the effects of gender and family status on PhD recipients' likelihood of attaining tenure-track faculty jobs at U.S. higher education institutions, with a specific focus on PhD mothers who have children during graduate school. This study compared PhD mothers to other groups defined by gender and family status, including men and women without children and fathers, and it explored individual, institutional, doctoral training, and professional life course variables predicting whether PhD mothers and others attained tenure-track faculty jobs within the first eight to thirteen years of obtaining their terminal degrees. As the ALM has become constricted since the 1980s, the relative scarcity of tenure-track faculty jobs has been particularly concerning for mothers who pursue paths toward entry into the professoriate (e.g., Mason, 2013; Morrison, Rudd, & Nerad, 2011; Wolfinger et al., 2008; 2009). Where previous studies have found that mothers are delayed in attaining tenure-track jobs and are less likely to attain tenure-track jobs compared to other groups, this study found that recent cohorts of PhD mothers attain tenure-track jobs in higher percentages and at earlier points than men and women without children. However, only a very small number of PhD mothers graduated from 2000 to 2005 at all, thus this study examines the outcomes of only a small number of PhD mothers. Higher than average numbers of mothers pursue academic jobs, so the graduate school factors that help them shape their career aspirations and secure tenure-track positions are key to understanding the recent trends in job outcomes for mothers.

PhD mothers are an important part of academia, and they are valuable resources to higher education institutions and current tenure-track faculty in research and knowledge production.

Persistent gender gaps in academia in terms of earning potential, promotion potential, job status, and mobility affect PhD mothers' job attainment. It is important for higher education faculty, administrators, and policy makers to understand the graduate school factors that influence PhD mothers' career path realities. By focusing on recent PhD mothers and considering differences across gender and family status, this dissertation identified patterns, trends, and previously unidentified relationships between graduate school and the professoriate for PhD mothers. These relationships prompt higher education researchers to continue to study PhD mothers and their early career pathways to and away from the tenure-track.

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Appendix I: A list of independent variables

Category	Original Variable	Data Source	Recoded Variable	Description of Coding
Individual variables	SEX	SED 2000-2005	GENDER	1 if female
	DEPEND5, DEPEND18	SED 2000-2005	PARENT	1 if parent of a dependent-aged child (0-18 years) at time of PhD graduation
	BIRTHYR, PHDCALYR	SED 2000-2005	AGE	1 if “older” scholar who completed degree at 35 years of age or older
	MARSTA	SED 2000-2005	MARRPART	1 if married or partnered at the time of PhD
	DEPEND5, DEPEND18	SED 2000-2005	ONECHILD	1 if PhD recipient had one child
	DEPEND5, DEPEND18	SED 2000-2005	TWOCHILD	1 if PhD recipient had two or more children
	DEPEND5	SED 2000-2005	CHILD0-5	1 if PhD recipient had at least one child aged 0-5 years at time of PhD graduation
	DEPEND18	SED 2000-2005	CHILD6-18	1 if PhD recipient had at least one child aged 6-18 years at time of PhD graduation
	YRSGRAD	SED 2000-2005	TIMETOPHD	1 if “longer” time to PhD degree, which 10 years or more from graduate entry to graduation
	PHDFIELD	SED 2000-2005	ACDIS1	1 if PhD field is natural sciences (reference category)
	PHDFIELD	SED 2000-2005	ACDIS 2	1 if PhD field is social sciences
	PHDFIELD	SED 2000-2005	ACDIS 3	1 if PhD field is engineering
PHDFIELD	SED 2000-2005	ACDIS 4	1 if PhD field is life sciences	
Institutional variables	CARNEG10	SED 2000-2005	INSTRI	1 if PhD recipient’s doctoral institution is very high research active institution

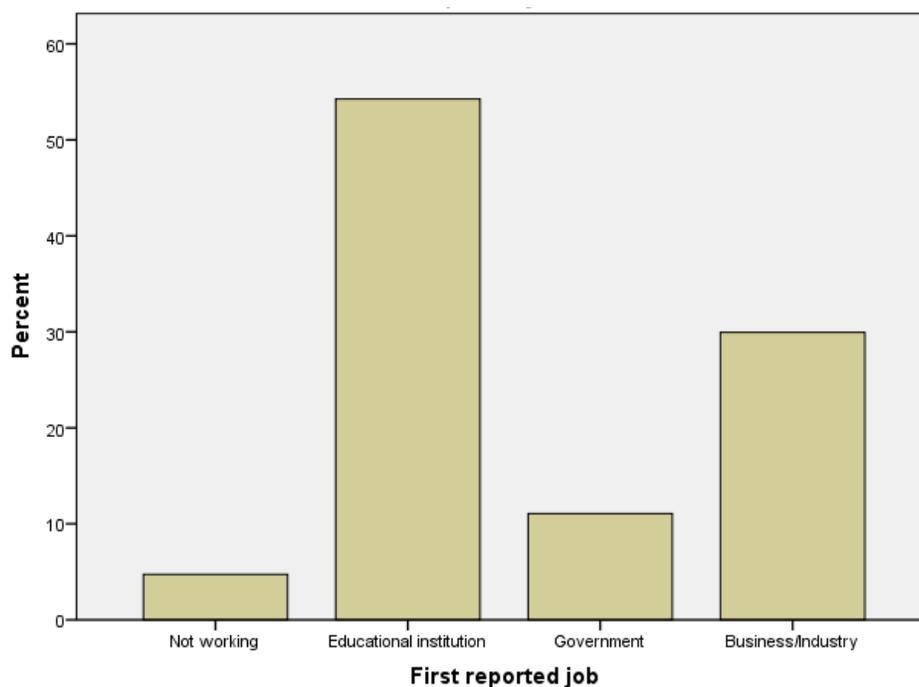
	CARNEG10	SED 2000-2005	INSTRII	1 if PhD recipient's doctoral institution is high research active institution
	CARNEG10	SED 2000-2005	INSTDOC	1 if PhD recipient's doctoral institution is doctoral granting institution
	CARNEG10	SED 2000-2005	INSTSPECFOC	1 if PhD recipient's doctoral institution is special focus institution
	CONTROL	SED 2000-2005	PUBLIC	1 if public institution
		USNWR 1999-2005	TOP25	1 if PhD program ranked top 25 0 if PhD program ranked outside top 25
Doctoral Training	SRCEC	SED 2000-2005	GRA	1 if reported graduate research assistantship as source of financial support in graduate school
	SRCED	SED 2000-2005	GTA	1 if reporting graduate teaching assistantship as source of financial support in graduate school
	SRCEPRIM	SED 2000-2005	PRIMFGRA	1 if primary source for funding is GRA
	SRCEPRIM	SED 2000-2005	PRIMFGTA	1 if primary source for funding is GTA
	SRCEPRIM	SED 2000-2005	PRIMFGRA	1 if primary source for funding is GRA
	SRCEPRIM	SED 2000-2005	PRIMFFSG	1 if primary source for funding is fellowship, scholarship, or grant
	SRCEPRIM	SED 2000-2005	PRIMFSELF	1 if primary source for funding is loans (from any source), personal savings, personal earnings during graduate school other than GTA, GRA, or fellowships, or spouse's, partner's, or family's earnings or savings
	ARTICLE	SDR 2006-2013	ARTICLE1	1 if published only one article during or

				immediately after graduate school
	ARTICLE2	SDR 2006-2013	ARTICLE2	1 if published more than one article during or immediately after graduate school
Professional Life Course	SRCEPRIM	SED 2000-2005	OUTSIDE	1 if personal earnings during graduate school other than fellowship, scholarship, grant, GTA, GRA, other assistantship, internship, loans from any source, personal savings, spouse's, family, or partner's earnings or savings, employer reimbursement/assistance, or foreign support
	ACADPDOC	SDR 2006-2013	POSTDOC	1 if held a postdoctoral position
	ACADADJF, ACADTCHF, ACADRCHF, TENSTA	SDR 2006-2013	NTTF	1 if held a non-tenure-track faculty position

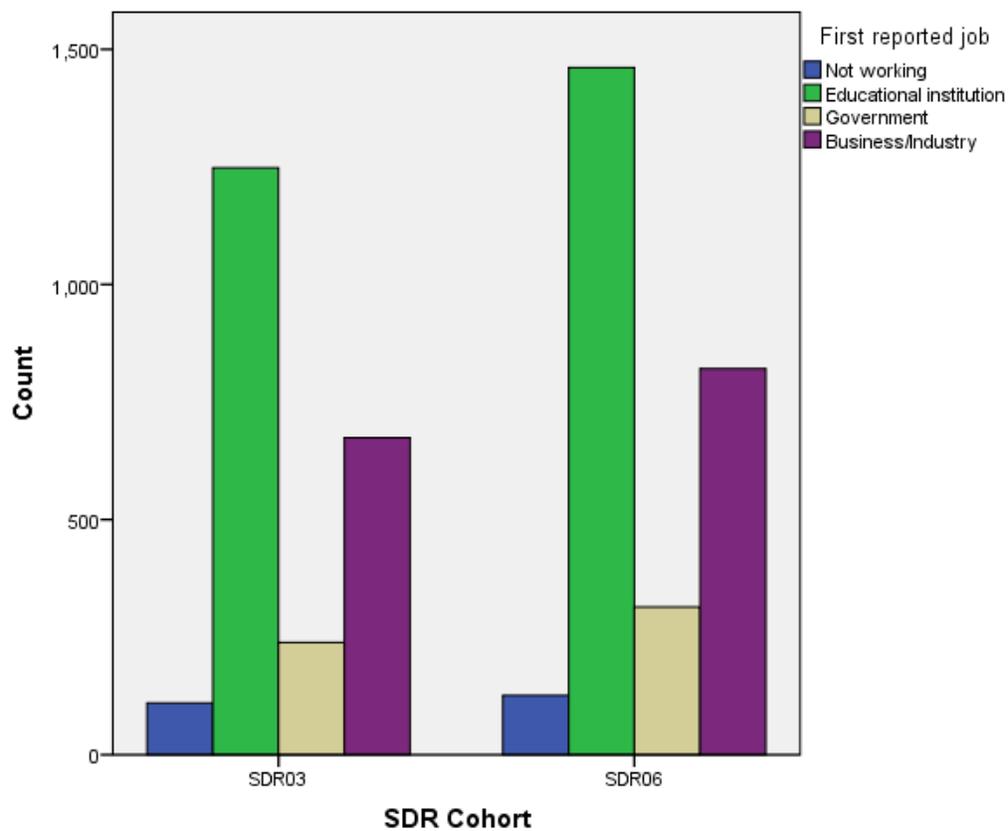
Appendix II: Total responses over SDR iterations (2006, 2008, 2010, 2013) (N = 2,994)

Total Responses	Frequency	Percent
Responded once	394	13.2
Responded twice	355	11.9
Responded thrice	702	23.4
Responded quare	1,543	51.5
Total	2,994	100.0

Appendix III: Employment outcomes based on first reported job (N = 1,242)



Appendix IV: Employment outcomes by SDR cohort based on first reported job (N = 1,242)



Appendix V: Distribution of first reported job by PhD graduation year (N = 1,242)