DOES JOB MOBILITY ENHANCE DOCTORATE HOLDERS' RESEARCH PRODUCTIVITY?

By

Sehee Kim

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Higher, Adult, and Lifelong Education—Doctor of Philosophy

2022

ABSTRACT

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This dissertation explores the link between doctorate holders' job mobility, which is defined as a change of employers, and their knowledge production. For this, three research questions have been addressed: (1) Does job mobility affect doctorate holders' research productivity? (2) Does the effect of job mobility on research productivity differ by the sector of previous employer? (3) Does the effect of job mobility on research productivity differ by reasons for job mobility? The findings of this study reveal that mobility itself does not suffice to drive research productivity gains. Specifically, this study found no significant impact of doctorate holders' job mobility in general on their post-mobility research productivity measured by the number of presentations/publications. However, in further investigation of possible differences in the relationship depending on different contexts of changing employers in terms of their career background (i.e., which sector were they from?) and reasons for job mobility, reasons for changing employers appeared to make differences in post-mobility research performance of those who were active in research activities, although the differences were only significant for presentation productivity. These findings suggest that job mobility occurs within complex personal and professional situations of individuals and that how the career events shape the individuals' professional development and outcomes can appear differently within different contexts. In other words, the distribution and development of resources for knowledge production at the collective level cannot be disentangled from doctorate holders' career decisions and patterns at the individual level. Therefore, scholarly and practical efforts to expand knowledge production systems and improve the efficiency of human resources need to be accompanied by specific attention to individual careers.

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Chapter 1: Introduction

This dissertation explores the link between doctorate holders' job mobility, which is defined as a change of employers, and their knowledge production. This first chapter offers an overview of the research. The background of this study is described first, followed by its purpose and research questions. The next section then introduces the theoretical framework that helps explain the relationship of interest. The subsequent section presents this study's research methods. Finally, this chapter concludes with the significance of the research.

Background

Research productivity is an important component behind the career success of doctorate holders often represented by promotion, salary, and reputation (Miller et al., 2011; Runyan et al., 2013). Therefore, there are motivations for doctorate holders to strategically care about research performance in their career decisions—for example, in choosing research topics, forming co-authorship networks, and searching for jobs (Bäker, 2015; Ryazanova & McNamara, 2019). Moving to another position is one of those career strategies that has been assumed in the literature to facilitate research activities/productivity and career development (Cañibano et al., 2008; Horta et al., 2020; Jacob & Meek, 2013). Doctorate holders are exposed to new professional settings and peer communities by moving between workplaces. Through making the new connections, doctorate holders are likely to expand their networks for complementary collaboration with peers who have different experiences and perspectives (Dubois et al., 2014; Lee & Bozeman, 2005; Mahroum, 2000; Ponomariov & Boardman, 2010). Doctorate holders therefore gain access to the tacit and contextual knowledge of new peers, which is difficult to attain without proximity and personal contact (Enders & Kaulisch, 2006; Feldman & Audretsch, 1999; Gertler, 2003; Lee et al., 2010; Thune, 2009; Zucker, Darby, & Armstrong, 2002). As

such, there has been interests among scholars to research the productivity gains of job mobility among doctorate holders (e.g., Allison & Long, 1990; Aksnes et al., 2013; Bolli & Schläpfer, 2015; Cañibano et al., 2008; De Filippo et al., 2009; Dubois et al., 2014; Ejermo et al., 2020; Fernández-Zubieta et al., 2013, 2015a; Halevi et al., 2016; Hoisl, 2007, 2009; Tartari et al., 2020).

However, identifying how doctorate holders' job mobility affects research productivity is challenging because the impact of mobility can depend on the professional and personal contexts of the doctorate holders who move. Indeed, when doctorate holders decide whether to change employers, they consider their personal situations as well as their previous careers and current positions (Azoulay et al., 2017). Such contextual factors limit and shape not only the pool of position options available for them in the job market (Martin, 2004), but also the ways in which they interact with new environments and peers in the destination employer (Dietz & Bozeman, 2005; Lin & Bozeman, 2006), thereby affecting the impact of job mobility on research productivity.

The literature suggests at least two factors that may moderate how job mobility impacts research productivity. First, doctorate holders' previous professional background—particularly, experience in different sectors—can affect one's transitions between employers and their subsequent knowledge production. Sector classification is used to categorize organizations/institutions based on shared attributes (OECD, 2015). When discussing doctorate holder/researcher careers, sector classification is typically comprised of four main categories—academia (higher education), industry/business, government, and non-profit organizations, although variation does exist depending on research contexts. Many studies have focused on higher education and industry, given that the two sectors provide employment for the majority of

doctoral graduates and there are distinct differences between them. Each sector has its own working environment and reward structure (Martin, 2004; OECD, 2015; Partha & David, 1994; Shapin, 2009; Stern, 2004). Particularly, the industry sector is distinguished from academia or government due to its orientation toward generating profit. In general, research carried out in the industrial sector is product-focused applied research. Even some basic research usually plays a role in a business's broader effort to gain market advantage; this contrasts sharply to higher education institutions and governments which are oriented more toward fundamental research contributing to expanding a field's knowledge base (Auriol, 2010; Carrigan et al., 2017; Lee et al., 2010; Weimer, 2001). Such environmental distinctions lead to differences in doctorate holders' research orientation (Gulbrandsen & Thune, 2017; Lin & Bozeman, 2006; Marcson, 1960; Stuart & Ding, 2006) and their knowledge and skills (Dietz & Bozeman, 2005) depending on the employment sector in which they have worked. Accordingly, doctorate holders' prior employment experience in a particular sector can influence their job search and transition process (LaRocco & Bruns, 2006; Martin, 2004), and subsequently their post-mobility research performance.

Second, a variety of reasons motivate doctorate holders to seek a new employer within their professional and personal lives, which may also relate to variations in the impact of job mobility on research outcomes. For many doctorate holders, the desire for better and more satisfying working conditions is an important driver behind changing employers (Ababneh, 2020; Daly & Dee, 2006; Garrison, 2005; Hofaidhllaoui & Chhinzer, 2014; Johnsrud & Rosser, 2002; Kim et al., 2020; Smart, 1990; Zhou & Volkwein, 2004). Similarly, pursuing professional settings that better support their research and careers is another important motivation for doctorate holders when weighing whether to change institutions (Azoulay et al., 2017; Fritsch &

Krabel, 2012; Laudel & Bielick, 2019). However, not all job mobility is driven by seeking a better professional environment. For instance, some doctorate holders are forced to move, especially in the early phase of their careers in which temporary positions are common (Ehrenberg et al., 2010; Finkelstein et al., 2016; Morrison et al., 2011; Nerad & Cerny, 2002; Nerad et al., 2007; Okahana, 2019). Personal issues, which are often related to family needs, are also important reasons for changing employers (Azoulay et al., 2017; Chen et al., 2015; McAlpine, 2018; McAlpine & Emmioğlu, 2015). When such factors outside working contexts motivate doctorate holders to move, they may have to compromise their career-related standards by accepting a less appealing position in terms of professional advancement (Whitmarsh et al., 2007). Therefore, doctorate holders who consider professional advancement in their decision-making process are likely to attain far greater benefits from job mobility than those who do not consider it (de Rassenfosse & Hoisl, 2018).

However, even though variability among these contexts surrounding job mobility could affect research productivity, this issue has received little attention in the relevant literature. Reflecting the challenges in identifying the job mobility–research productivity relationship, the prior research presents mixed evidence regarding the effect of job mobility on research productivity. While some studies reported the positive effects of job mobility experience on doctorate holders' subsequent research performance (De Filippo et al., 2009; Dubois et al., 2014; Ejermo et al., 2020; Halevi et al., 2016; Hoisl, 2007, 2009; Tartari et al., 2020), other studies did not find the benefits of job mobility (Aksnes et al., 2013; Bolli & Schläpfer, 2015; Cañibano et al., 2008; Fernández-Zubieta et al., 2013, 2015a). In other words, empirical investigations of the association between job mobility and knowledge production remain inconclusive.

Study Purpose and Research Questions

This study explores the impact of doctorate holders' job mobility on their research productivity and whether the impact of job mobility differs according to previous employment sectors and to reasons for changing employers. To this end, research productivity has been measured in terms of conference presentation and journal publication records. These productivity measures are commonly used as indicators to evaluate the productivity level of knowledge workers (Massy & Wilger, 1995; Meho & Spurgin, 2005; Sabharwal, 2013a; van Raan, 1996; Xie & Shauman; 1998).

This study analyzed U.S.-trained doctoral graduates who stayed in the higher education sector or moved into the higher education sector from other sectors, excluding those who left higher education. This decision was made considering sector differences in research environments (Martin, 2004; OECD, 2015; Partha & David, 1994; Shapin, 2009; Stern, 2004). Unlike in academia, researchers in non-academic sectors are expected to meet their employers' specific research needs; additionally, their publication activities are less supported (Martin, 2004; Weimer, 2001). Particularly in the industry sector, employees face further impediments to publishing their work because industrial research is the corporation's intellectual property (Carrigan et al., 2017; Porter, 2019; Weimer, 2001). As such, the research productivity of those in different sectors cannot be compared equally. Therefore, this study focused on the doctorate holders who were working in the higher education sector when their productivity was measured.

The following research questions guided this study:

1. Does job mobility affect doctorate holders' research productivity?
2. Does the effect of job mobility on research productivity differ by the sector of previous employer?

3. Does the effect of job mobility on research productivity differ by reasons for job mobility?

The first question is a base question that examines whether job mobility impacts research productivity. Subsequently, the doctorate holders' previous sector (research question 2) and reasons for the employment change (research question 3) are specified to determine whether the effect of job mobility on research productivity differs by those factors.

Theoretical Framework

To understand the relationship between job mobility and research productivity, this study uses two theoretical lenses: the scientific and technical human capital theory and the job matching theory. First, the scientific and technical human capital (STHC) model suggests that knowledge workers' career history shapes their STHC, thereby affecting their productivity (Bozeman et al., 2001; Corley et al., 2019; Dietz & Bozeman, 2005; Lin & Bozeman, 2006; Ponomariov & Boardman, 2010). In this model, STHC refers to the totality of resources that enable researchers to generate knowledge and innovation (Bozeman et al., 2001; Bozeman & Corley, 2004; Corley et al., 2019; Dietz et al., 2000; Woolley & Turpin, 2009). STHC is comprised of two key intertwined components: human capital and social capital. Building on traditional concepts of human and social capital, the STHC model adopts an expanded notion of human capital that embraces both substantive and tacit forms of knowledge and emphasizes the role of social capital networks in human capital development (Bozeman et al., 2001; Corley et al., 2019; Dietz & Bozeman, 2005; Ponomariov & Boardman, 2010).

The individuals' STHC constantly evolves throughout the course of their professional lives (Bozeman et al., 2001; Cañibano & Bozeman, 2009; Corley et al., 2019; Lin & Bozeman, 2006). This life-cycle perspective embedded in the STHC model provides a useful conceptual

tool to associate changes in individuals' capital with career-related experiences and events (Bozeman et al., 2001; Corley et al., 2019; Dietz & Bozeman, 2005). From the perspective of the STHC model, mobility can be understood as a career event that stimulates STHC development through exposure to previously unacquainted professional settings and peer communities, which is in turn expected to affect productivity (Dietz & Bozeman, 2005; Lin & Bozeman, 2006; Ponomariov & Boardman, 2010). The environments and peers to which researchers are exposed throughout their careers make differences in the STHC and those differences are reflected in productivity (Dietz & Bozeman, 2005; Lin & Bozeman, 2006).

Job matching theory provides a complementary explanation of the relationship between job mobility and productivity based on job match heterogeneity. According to job matching theory, changes in job match quality through job mobility explain changes in productivity following mobility (Flinn, 1986; Liu, 1986; Jovanovic, 1979; McCall, 1990; Mortensen, 1986; Topel & Ward, 1992). For some, changing jobs can mean moving to an employer/position that offers a better fit in order to improve their career, productivity, and satisfaction. Specifically, when doctorate holders perceive that their current job does not match well with their capabilities, research areas, and professional orientation, they are indeed incentivized to seek a more satisfactory alternative to realize their full potential (Balsmeier & Pellens, 2014; Barnes, 1998; Crowder & Mouratidou, 2020; Fritsch & Krabel, 2012; Geuna, 2015; Klarner, 2016; Krabel & Mueller, 2009; Lindfelt et al., 2018; Rothblum, 1988). On the other hand, other doctorate holders may have to move due to push factors from their current positions or personal factors. It is therefore reasonable to believe that good matches would likely be more available for the former group than for the latter. Further, doctorate holders may have different degrees of understanding of the higher education job market based on previous employment sectors (Fernández-Zubieta et

al., 2015a). Hence, previous employment experience would relate to their likelihood of finding a well-fitting position, in turn affecting their productivity.

By combining the two theoretical perspectives, this study frames the impact of job mobility as a function of changes in the STHC of individuals and match quality between individuals and their employers. From the perspective of STHC, job mobility is a career event that affects individuals' research resources by means of their interactions with new work settings and peer groups. The intellectual resources are accumulated within the individual and therefore portable to the next employer. From the job matching perspective, job mobility leads to changes in job match quality, and the job match quality in the new position is reflected in post-mobility research productivity. The matching effect manifests within the specific employment relationships and is therefore not portable to another employer. From this viewpoint, this study understands job mobility not only as a career event that contributes to a reservoir of intellectual resources but also as a process of redeploying the resources both at the individual and societal levels.

Methods

This study uses data from the Survey of Doctorate Recipients (SDR), a national survey study conducted by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF). The SDR sample is extracted from doctoral graduates in science, engineering, and health aged under 76 years who have earned research-based degrees at U.S. higher education institutions (NSF, 2019). The SDR tracks doctorate recipients and collects comprehensive information on their employment and further education at two- to three-year intervals (NSF, 2019). The sample used for this study is restricted to doctoral graduates who

responded to all three waves of the 2001, 2003, and 2008 SDRs and worked in the higher education sector in 2003.

In this study, two productivity measures are examined as outcome variables: the number of conference presentations and the number of journal publications. The outcome variables have two important properties. First, they are discrete count variables that take the values of zero or a positive integer. Second, the variables have many zero observations—out of the sample, 20% have zero conference presentations and 27% have zero journal publications. To deal with both the count nature of the variables and the excess zero counts, zero-inflated negative binomial (ZINB) regression is employed. The detailed information will be provided in Chapter 3, "Methods."

Each productivity measure is regressed on the job mobility variable designed to answer each research question while controlling for individual and professional backgrounds and employment characteristics. The job mobility variable for research question 1 is a binary indicator of whether one moved between 2001 and 2003; this is used to compare the research productivity levels between doctorate holders who experienced job mobility and those who did not. The mobility variable for research question 2 is comprised of three categories, which divide those who moved by their previous employment sector: (1) those who moved within the higher education sector, (2) those who moved from the industry sector to the higher education sector, and (3) those who transitioned from non-industry sectors to the higher education sector. For research question 3, six binary variables that indicate whether the respondents considered each of the reasons (i.e., pay/promotion opportunities, working conditions, job location, changes in career or professional interests, family-related reasons, and lay-off/job termination) in their decision of changing employers were used.

Significance of the Study

The knowledge economy demands the development of human resources capable of contributing to a reservoir of knowledge (Auriol, 2010; Foray, 2006; Powell & Snellman, 2004). In this context, doctorate holders have received attention, because they are critical actors who play vital roles in creating, applying, and disseminating knowledge based on their extensive doctoral training in their field (Auriol et al., 2012; Auriol et al., 2013; Neumann & Tan, 2011; Pedersen, 2014; Stephan, 2012). While doctoral programs prepare future generations of researchers (LaPidus, 1997; Newbury, 2003), a researcher's development does not end with graduating from a doctoral program. Throughout their careers, doctoral graduates continuously interact with professional environments and peer communities and, by doing so, they develop their professional identity as well as their knowledge base and skills (Dietz & Bozeman, 2005; Lin & Bozeman, 2006). In this sense, understanding how doctorate holders' career events and patterns are linked to their roles as researchers can contribute to their long-term career planning and development (Shmatko et al., 2020).

As part of such an interest, this study examined the extent to which doctorate holders' job mobility benefits their research productivity. Particularly, this study sheds light on the contextual complexity of job mobility, primarily by investigating whether there are significant differences with regard to the effects of job mobility on research productivity depending on previous employment sector and reasons for job mobility. This distinction will generate implications not only for existing—and inconsistent—research findings regarding the impact of job mobility on research productivity, but also for future scholarly and policy discussions on doctorate holders' mobility between workplaces. In addition, given that most existing studies addressing the implications of job mobility on research productivity have been conducted outside the U.S. (with

few exceptions: Dietz & Bozeman, 2005; Ryazanova & McNamara, 2016), this study will contribute to the literature by adding empirical evidence found in the U.S. context.

In practical terms, this study's findings are relevant to stakeholders at varying levels. As agents of their own professional development, individual doctorate holders want to improve their capabilities and performance throughout their whole careers. Based on this study's findings, individuals could better understand the potential consequences of their career-related choices. For institutions and research teams that compete for capable doctorate-level talent, empirical research on the relationship between potential candidates' previous career experiences and their future performance would be useful in recruiting and selecting prospective employees. From the perspective of policymakers and higher education leaders, this study could help understand doctoral graduates' long-term career patterns and their impact on knowledge production.

Organization of Dissertation

The subsequent chapters of the dissertation are organized as follows. Chapter 2 provides a review of the relevant theoretical and empirical literature and proposes a conceptual model for this study based on prior research. In Chapter 3, there is a detailed account of the research methods used to examine the research questions. The descriptive statistics of the variables used in this study comprise Chapter 4, and Chapter 5 reports the results of the analysis models. Finally, Chapter 6 concludes this dissertation with a summary of the results and offers suggestions for future research directions.

Chapter 2: Conceptual Framework and Literature Review

This chapter reviews the theoretical and empirical literature on the relationship between doctorate holders' job mobility and their research productivity. First, the two complementary theories that provide conceptual links between job mobility and research productivity—scientific and technical human capital (STHC) theory and job matching theory—are discussed. The subsequent sections review empirical studies on the relationship between job mobility and research productivity and how the relationship is associated with the doctorate holders' previous employment sector and reasons for job mobility. Finally, a conceptual model for this study is proposed based on prior research that has addressed individual and professional factors affecting job mobility and/or research productivity.

Scientific and Technical Human Capital

The scientific and technical human capital (STHC) model was proposed to shift the focus of policy and scholarly discussions concerning scientific productivity from short-term, fragmented outputs to research capacity that develops and evolves with time and experience (Bozeman et al., 2001). STHC is defined as "the sum of the scientist's technical knowledge and skills and ties to professionally relevant networks (Bozeman et al., 2001)." That is, STHC refers to the totality of researchers' resources that enable them to create knowledge and innovation (Bozeman et al., 2001; Bozeman & Corley, 2004; Corley et al., 2019; Dietz et al., 2000; Dietz & Bozeman, 2005; Lin & Bozeman, 2006; Woolley & Turpin, 2009).

The STHC model builds on traditional human capital and social capital, integrating and expanding the original theories in a meaningful way (Bozeman et al., 2001; Corley et al., 2019; Dietz & Bozeman, 2005; Ponomariov & Boardman, 2010). In the traditional human capital theory, human capital includes an individual's stock of knowledge, skills, and values that

generate pecuniary and non-pecuniary benefits in her/his life (Becker, 1962, 2009; Schultz, 1961). The STHC model adopts the human capital concept in the more specific context of scientific knowledge production to conceptualize researchers' internal resources. While traditional human capital focuses on formal and substantive knowledge, the STHC model expands its attention to the experiential and tacit knowledge that is accumulated through direct and indirect experiences as an important aspect of human capital (Bozeman et al., 2001; Bozeman & Corley, 2004; Corley et al., 2019; Dietz et al., 2000; Lin & Bozeman, 2006).

Social capital, the actual or potential resources an individual can access through social relationships (Bourdieu, 1986; Coleman, 1988), is another key component of STHC. Social relationships of knowledge workers generate valuable resources for research. Connections and interactions with peers—through exchanging opinions and perspectives, teaching or mentoring, sharing expertise, and providing access to resources—contribute to advancing knowledge and those individuals' human capital (Bozeman & Corley, 2004; Dubois et al., 2014; Laband & Tollison, 2000; Lee & Bozeman, 2005; Nahapiet & Ghoshal, 1998; Ponomariov & Boardman, 2010; Ryazanova & McNamara, 2016). In addition, administrators and officials who help access administrative/financial support and necessary data also play an important role in conducting research activities. The STHC model thus emphasizes the role of social ties and networks in enhancing individual and collective human capital (Bozeman et al., 2001; Bozeman & Corley, 2004; Dietz et al., 2000). In short, in this model, the two key components—human capital and social capital—are closely intertwined as resources for knowledge creation, and thus, one cannot be fully understood without considering the other.

Each individual has a unique combination of STHC. Traditional human capital theory, focusing on education and training qualifications, rarely considers possible differences in the

quantity and quality of human capital among individuals with the same qualifications (Bozeman et al., 2001). By contrast, the STHC model explicitly reflects the variation in individuals' human capital. The model suggests that individual researchers' human capital consists of multiple dimensions (e.g., different facets of cognitive ability, substantive knowledge, and contextual skills) and that the range of the dimensions and the level of each dimension vary from person to person (Bozeman & Corley, 2004; Bozeman & Boardman, 2014; Bozeman et al., 2001; Corley et al., 2019; Lin & Bozeman, 2006; Woolley & Turpin, 2009). With the unique set of knowledge and skills, individuals interact in diverse ways (e.g., opinion exchanges, research collaborations) with other peers who also have their own unique capital and, by doing so, build and maintain social relationships that contribute to each other's human capital.

Over their careers, individuals accumulate human and social capital in planned and unplanned ways. At the same time, some parts of capital shrink or change forms (e.g., from substantive to tacit form). Accordingly, the STHC of an individual constantly evolves in composition and volume along the career path (Bozeman et al., 2001; Cañibano & Bozeman, 2009; Corley et al., 2019; Lin & Bozeman, 2006). The life-cycle perspective embedded in the model provides a useful conceptual tool to associate changes in individuals' capital with career-related experiences and events (Bozeman et al., 2001; Corley et al., 2019; Dietz & Bozeman, 2005). From the perspective of the STHC model, job mobility can be understood as a career event that affects STHC formation and development (Dietz & Bozeman, 2005; Lin & Bozeman, 2006; Ponomariov & Boardman, 2010). By moving to another employer, individuals are exposed to new, unfamiliar professional settings and peer communities that can stimulate the development of STHC (Dietz & Bozeman, 2005; Lin & Bozeman, 2006; Ponomariov & Boardman, 2010). The specific environments and peers to which researchers are exposed

throughout their career history can lead to differences in the formation of STHC and, in turn, affect research productivity (Dietz & Bozeman, 2005; Lin & Bozeman, 2006). For example, academics who migrate from non-academic sectors (e.g., the industry sector) may have distinct strengths and thus be more productive in certain areas (e.g., more productive in patents than publications) than their peers who have followed traditional academic careers (Dietz & Bozeman, 2005; Lin & Bozeman, 2006). Therefore, the STHC model suggests that the association between job mobility and research productivity might vary depending on the researcher's previous sector.

Job Matching

Job matching theory provides a complementary explanation for the relationship between job mobility and productivity based on job match heterogeneity. For individuals, changing employers can be a means to relocate themselves to an employer/position that has a better fit, allowing them to improve their career, productivity, and satisfaction (Flinn, 1986; Liu, 1986; Jovanovic, 1979; McCall, 1990; Mortensen, 1986; Topel & Ward, 1992). Job matching theory explains the increased productivity following job mobility as the result of improved job match quality through mobility. Jovanovic (1979) developed a model that depicts the relationship between job match quality, job mobility, and productivity. According to this model, employees gradually learn about their job match quality during their tenure in the position. Employees who perceive their job as a high-quality match stay in the current position where they can be productive, while those who perceive their job to be a low-quality match leave for another position. Later studies have supported the model, demonstrating that job-to-job mobility improves individuals' matching quality with their employer and, by doing so, increases their productivity in the workplace (Flinn, 1986; Liu, 1986; McCall, 1990; Topel & Ward, 1992).

However, job matching theory was originally developed from the perspective of economics, and a large part of the relevant line of research is based on the assumption that employees' wages are tied directly to their marginal productivity. Hence, the wage level was taken to represent the level of productivity, and a wage increase was interpreted as evidence of improved productivity. Questioning this approach, Jackson (2013) employed another method to find more direct empirical evidence supporting the notion that job matching increases productivity. In his analysis of the changes in teacher effectiveness resulting from switching schools, Jackson found that teachers who moved to another school were more effective in enhancing their students' performance after switching schools. With further investigation of the students' enhanced performance, he also presented empirical evidence of a separate effect of job matching—represented as the benefits of moving to a certain school that is more fitting for a particular teacher—independent from the effects of the teacher's abilities, the destination school's overall student performance, or students' self-selection.

The traditional job matching theory suggests that low productivity in the current workplace is a key driver of turnover (Flinn, 1986; Liu, 1986; McCall, 1990; Topel & Ward, 1992). On the other hand, studies conducted in academic contexts have shown that productivity increases academics' intended and actual departure (Azoulay et al., 2017; Kim et al., 2020; Matier, 1990; Ryan et al., 2012; Smart, 1990; Xu, 2008a; Zucker, Darby, & Torero, 2002). This seeming contradiction is attributable to differences in productivity definitions and contexts. While the traditional job matching studies have used wage to represent productivity from the economics perspective, studies focusing on academics have used scholarly output measures, such as publications, citations, and conference presentations, to define productivity. These research outputs are more direct productivity measures than wage, and they are not organization specific.

Higher research productivity can thus be thought of as a representation of overall research capabilities that provide more opportunities for academics to attract the interest of potential employers (Matier, 1990; Ryan et al., 2012; Zucker, Darby, & Torero, 2002).

Despite the contextual differences, job matching theory's view, which considers job mobility a mechanism for employees to redeploy themselves to a more suitable workplace, is still applicable to doctorate holders. The job matching approach suggests that if doctorate holders perceive a mismatch between their current job and their capabilities, research areas, or professional orientation, they are incentivized to seek satisfactory alternative positions to realize their potential (Geuna, 2015). For some, it may manifest as sector switching through which they relocate themselves into a working environment that better matches their intellectual orientation and preferences (Balsmeier & Pellens, 2014; Barnes, 1998; Crowder & Mouratidou, 2020; Fritsch & Krabel, 2012; Klarner, 2016; Krabel & Mueller, 2009; Lindfelt et al., 2018; Rothblum, 1988). Some others may seek positions that provide more abundant resources and support to help enhance their research (Azoulay et al., 2017; Fernández-Zubieta et al., 2015a).

The underlying mechanism of job matching theory has an additional implication for the relationship between job mobility and productivity. When changing employers does not sufficiently improve job match quality, it is less likely to positively affect productivity. In other words, the extent to which job match quality improves through job mobility, not the mobility itself, is the key. Yet, as matching is somewhat subjective, it is challenging to operationally define and measure job match quality. In this regard, the voluntary and involuntary job mobility distinction used in previous studies provides useful insight (Ackers, 2008; de Rassenfosse & Hoisl, 2018; Ferro, 2006). Not all job mobility occurs voluntarily and for career-related reasons. Personal reasons often related to family issues are important motivations for job mobility

(Azoulay et al., 2017; Chen et al., 2015; McAlpine, 2018; McAlpine & Emmioğlu, 2015). Job insecurity can also cause job changes. Researchers who are forced to move for such reasons are more likely to compromise their career-related standards to meet other needs (de Rassenfosse & Hoisl, 2018). Therefore, improved matches would be more likely for those whose job mobility is voluntary and career related (Allgood & Farrell, 2003; Carrington & Fallick, 2017; de Rassenfosse & Hoisl, 2018; Marx, 2011). Accordingly, the relationship between job mobility and productivity might depend on the motivation behind employees' mobility.

Combining the Two Frameworks

Building on the two theoretical perspectives, this study proposes two forces by which job mobility could influence research productivity. First, from the STHC perspective, changing employers is a career event that can enhance individuals' resources for research by expanding their contact with professional environments and peer communities. The degree of the effects can vary depending on the specific environments to which doctorate holders are exposed over their mobility history because different contexts affect the degree and scope of human and social capital development (Dietz & Bozeman, 2005; Lin & Bozeman, 2006). Second, from the view of job matching, job mobility can improve doctorate holders' performance by relocating them into positions where they can realize their full potential. Job mobility can bring about different consequences for each individual depending on the improvement of job match quality through mobility, which is assumed to be associated with the motivations behind the mobility. By combining the two theoretical perspectives, the effect of job mobility is framed as a function of changes in the STHC of individuals and match quality between individuals and their employers. While the two parts are conceptually separated, they are practically interrelated because

obtaining an ideal matching position can be more conducive to human and social capital development.

The Impact of Job Mobility on Research Productivity

The General Impact of Job Mobility on Research Productivity

The impact of job mobility on research productivity has been examined across diverse countries and fields, presenting mixed findings. Some studies have documented a positive association between inter-organization mobility and research productivity. A study conducted at a single institution in Spain reported that mobile researchers outperformed non-mobile peers in terms of the number and impact of publications (De Filippo et al., 2009). In the analysis of Dubois and colleagues (2014), a positive association emerged between mathematicians' moving to another department and subsequent publication productivity. Tartari et al. (2020) also found that moving to another department, particularly one with greater endowments, was related to the higher publication productivity of U.K. life scientists. Similarly, Ryazanova and McNamara (2016) found that academics at U.S. business schools who reported a greater number of previous workplaces produced more publications.

Using data from multiple fields, Ejermo et al. (2020) found that Swedish academics benefited from inter-university mobility. Overall, the movers experienced a 32% increase in publications and a 63% increase in citations. However, the reported benefits of moving to another institution were limited to the science and engineering fields, with those in the social sciences and humanities experiencing no significant benefit. On the other hand, Halevi et al.'s (2016) study on high-performing researchers found that job mobility was positively associated with the number and impact of research publications for all disciplines included in their analysis

(i.e., neuroscience, mechanical engineering, arts and humanities, oncology, environmental geology, business, and infectious diseases).

By contrast, a positive association between job mobility and research productivity was not found in other studies. In Aksnes et al.'s (2013) Norwegian case, the differences in the number of publications and citations between mobile and non-mobile researchers almost disappeared when gender, career stage, and discipline were considered. The association of job mobility with publication performance was also rejected in the analysis of economists in German-speaking countries (Bolli & Schläpfer, 2015) and of science and engineering faculty in the U.K. (Fernández-Zubieta et al., 2013, 2015a). Similarly, Cañibano et al.'s (2008) study in Spain showed that job mobility increased access to broader resources and networks but did not directly improve publication and patent productivity. Furthermore, Dietz and Bozeman (2005) found that a higher number of employers throughout one's career had negative effects on publication productivity.

The literature has reported contrasting findings on the impact of job mobility on research productivity. The diverse countries and fields in which the studies were conducted might have in part contributed to the inconsistency. The literature review also revealed that most of the empirical studies were conducted outside the U.S., indicating that our knowledge of the consequences of job mobility in the U.S. context is limited.

Previous Employment Sector and its Association with Research Productivity

Doctorate holders' movement across different sectors can affect research productivity in complicated ways. While job mobility requires time and energy to adapt professionally and psychologically to a new workplace, the adjustment burden is greater for those moving across sectors than for those moving within a sector (LaRocco & Bruns, 2006; Martin, 2004). The

greater burden can serve as both challenges and opportunities for those who change sectors. On the one hand, those who cross sector borders might face greater hurdles in the job searching and adaptation phases. It can be difficult for them to find a well-fitting position because of a likely lower understanding and narrower networks in less familiar sector contexts. On the other hand, given that doctorate holders tend to seek working environments that better match their professional orientation (Balsmeier & Pellens, 2014; Fritsch & Krabel, 2012; Krabel & Mueller, 2009), if their decision to cross the sectors allows them to realize their potential, it would positively affect their productivity. They might also benefit from their diverse experiences and networks acquired from the broader background (Abreu & Grinevich, 2013; Carrigan et al., 2017; Gulbrandsen & Thune, 2017; Powell, 2004; Weimer, 2001).

Moreover, given the differences in knowledge production structure across different sectors (Martin, 2004; OECD, 2015; Partha & David, 1994; Porter, 2019; Shapin, 2009; Stern, 2004), previous experience in a particular sector can be differently related to research activities afterward. Yet only a handful of studies have examined the effect of job mobility on research productivity depending on knowledge workers' specific previous sector experience. Studies have mainly focused on the mobility between the academic and industry sectors probably because they provide employment for a large majority of doctoral graduates and there are defined differences between them. Fernández-Zubieta and colleagues (2015a) reported that mobility from industry into academia did not significantly affect the publication performance of U.K. researchers. In the Norwegian context, Gulbrandsen and Thune (2017) found no association between academics' publication productivity and their previous work experiences outside academia. Yet, when the authors subdivided the non-academic work experiences, experience from industry appeared to be negatively associated with publication productivity. Lin and

Bozeman (2006) also found that academic scientists with industry experience had fewer publications. The authors, however, added that the effect of industry experience might vary depending on career stage and individual characteristics: female and assistant faculty members were found to benefit from previous industry experience in terms of publications. In sum, empirical evidence indicates that academics who have moved from industry are disadvantaged in research productivity compared to those who have moved within the higher education sector.

Reasons for Job Mobility and its Association with Research Productivity

Doctorate holders move to another employer for diverse reasons, and the impact of job mobility on research productivity might differ depending on the reasons. Job mobility may be positively related to research productivity only if they are conscious of their research activities and career advancement when deciding to move to another employer (Fernández-Zubieta et al., 2013). Surprisingly, however, the possible differences in research productivity caused by reasons for changing employers have barely been addressed in the literature.

In many cases, advancement in career and productivity are crucial reasons for doctorate holders' job mobility. Prior research has shown that doctorate holders move to pursue working environments conducive to their research. Laudel and Bielick (2019) found that German early-career researchers seek workplaces where they can complete their own projects, pursue their particular research interests, access specific resources, or expand their expertise. Azoulay et al. (2017) found that high-performing life scientists tend to move to employers with other high-performing peers. Similarly, doctorate holders try to find working environments with which they can be more satisfied. Prior research has indicated that academics express their intention to leave or actually leave their employer when their satisfaction with the current institution is low (Ababneh, 2020; Daly & Dee, 2006; Johnsrud & Rosser, 2002; Kim et al., 2020; Smart, 1990;

Zhou & Volkwein, 2004). Some doctorate holders move from non-academic sectors to the academic sector to obtain more flexibility and autonomy (Crowder & Mouratidou, 2020; Garrison, 2005; Volkamer & Riniker, 2018). When doctorate holders move to more favorable working environments, their productivity will possibly improve.

Conversely, some factors push or force doctorate holders to move. Doctorate holders' career-related decision-making is often closely related to personal life factors, such as issues concerning their spouse/partner and children (Azoulay et al., 2017; Chen et al., 2015; McAlpine, 2018; McAlpine & Emmioğlu, 2015; Morrison et al., 2011; Schiebinger et al., 2008). They might change jobs or even decline job offers due to family needs (Morrison et al., 2011; Schiebinger et al., 2008). Doctoral labor market conditions also influence their job mobility. Particularly for early-career scholars, frustrations over job insecurity are often indicated as a reason for leaving their current employer (Aarnikoivu et al., 2019; Dorenkamp & Weiß, 2018; Wöhrer, 2014). When such factors force doctorate holders to move, they might accept a less appealing position in terms of career advancement, which may negatively affect productivity.

de Rassenfosse and Hoisl (2018) supported this inference, demonstrating the association between the voluntariness of inventors' job mobility, measured based on their primary reason for the mobility decision, and the degree of knowledge fit with their new employer. Voluntary mobility included job mobility driven by attractive job offers, career advancements, the pursuit of better working conditions, or own business startups. Involuntary mobility included moves forced by restructuring or bankruptcy of the former employer, dismissal, or family reasons. Meanwhile, knowledge fit was measured by the extent to which participating inventors could apply their previous knowledge to their activities in the new firm. de Rassenfosse and Hoisl found that knowledge fit was higher among the voluntary mobility group than the involuntary

mobility group. Their further exploration also showed that knowledge fit was associated with increased productivity.

Major Factors Associated with Job Mobility and Research Productivity

An examination of the relationship between doctorate holders' job mobility and research productivity requires appropriate consideration of the factors affecting mobility and/or research productivity in analysis models to avoid confounding. The literature review revealed the following factors, which were grouped into three sets: individual characteristics, professional background, and employment characteristics.

Individual Characteristics

Gender. Gender has been found to influence research productivity patterns (Betsey, 2007; Fox, 2005; Hesli & Lee, 2011; Knepper et al., 2020; Maske et al., 2003; Potter et al., 2011; Sabharwal, 2013a; Sheridan et al., 2017; Stack, 2004; Toutkoushian & Bellas, 1999; Webber, 2011; Xie & Shauman, 1998) as well as career mobility (Callister, 2006; Kaminski & Geisler, 2012; Xu, 2008b). Most research has consistently observed that female doctorate holders publish fewer articles than their male counterparts (Betsey, 2007; Hesli & Lee, 2011; Knepper et al., 2020; Maske et al., 2003; Potter et al., 2011; Sheridan et al., 2017; Stack, 2004; Toutkoushian & Bellas, 1999), although some studies have found no gender differences (Webber, 2011). However, the gender effect seems to depend on other contexts. For example, in the academic context, the outperformance of males was not found among associate professors (Knepper et al., 2020) or in certain disciplines, such as computer science (Sabharwal, 2013a) or the social sciences (Stack, 2004). Gender differences also exist in mobility patterns. In previous studies focusing mainly on science and engineering faculty, female faculty showed a higher intention

(Callister, 2006) and a higher likelihood to leave their institution (Kaminski & Geisler, 2012; Xu, 2008b) than male faculty.

Race. The research findings on the effects of race on research productivity are mixed. Some studies have found negligible differences between White and non-White faculty members (Maske et al., 2003; Sax et al., 2002; Toutkoushian & Bellas, 1999; Webber, 2011). On the other hand, other researchers have reported that White faculty members publish more than their non-White counterparts, particularly Native and African Americans (Betsey, 2007; Eagan & Garvey, 2015; Potter et al., 2011). While the existing findings are inconsistent, some scholars argue that stress and tension caused by racial discrimination and stereotypes can negatively affect racial minorities' research productivity and institutional commitment (Cora-Bramble et al., 2010; Eagan & Garvey, 2015; Hopkins et al., 2013; Zambrana et al., 2021).

Age. Age and seniority are closely related to researchers' performance and mobility. The relevant literature typically reports an inverted U-shaped relationship between age and research productivity (Cole, 1979; Gonzalez-Brambila & Veloso, 2007; Kyvik, 1990a; Levin & Stephan, 1989), particularly for women (Betsey, 2007). An inverse relationship between seniority and mobility has also been observed. Faculty members' intentions to leave their college/university tend to decline with biological and career age (i.e., the number of years after receiving the highest degree) regardless of tenure status (Smart, 1990; Zhou & Volkwein, 2004). Crespi et al. (2007) confirmed this tendency among academic inventors, showing that inventors with tenure and more years of experience were less likely to move.

Marital Status and Parenthood. Marriage and parenting can affect doctorate holders' career outcomes and experiences. Studies have revealed that family needs can affect the mobility decisions of PhDs, particularly female PhDs (Martinez et al., 2017; Morrison et al., 2011a,

2011b; Schiebinger et al., 2008; Shauman & Xie, 1996), and that such a compromise can restrict professional networking and development opportunities (Shauman & Xie, 1996). Moreover, everyday family responsibilities can directly affect their productivity in professional settings. While some scholars have found no significant effect of family factors on research productivity (Eagan & Garvey, 2015; Sax et al., 2002), others have argued that the effects of marriage and having children can differ according to the doctorate holder's gender and the ages of dependent children (Fox, 2005; Kyvik, 1990b; Rothausen-Vange et al., 2005; Stack, 2004; Xie & Shauman, 1998). For example, Stack (2004) found that having young children (under age 11) was generally associated with higher research productivity, but it was not the case among female doctorate holders.

U.S. Citizenship Status. While foreign doctorate holders often experience alienation and dissatisfaction in their workplace (Collins, 2008; Mamiseishvili, 2011; Munene, 2014; Skachkova, 2007), empirical evidence has demonstrated that foreign researchers tend to be more productive than their domestic counterparts even after controlling for time spent on research (Corley & Sabharwal, 2007; Kim et al., 2011; Levin & Stephan, 1999; Mamiseishvili, 2010; Mamiseishvili & Rosser, 2010; Webber, 2012). Further, foreign doctorate holders appear to benefit from settling in the U.S. and obtaining legal status as U.S. citizens. For example, Crown and Faggian (2019) showed that, holding other things constant, obtaining U.S. citizenship (naturalization) was associated with higher levels of research productivity. Meanwhile, a previous study conducted in academic settings found no significant differences in the likelihood of moving to another higher education institution or leaving the higher education sector between foreign and domestic faculty members (Kim et al., 2020).

Professional Background

Field. The different nature of knowledge and the knowledge production process (e.g., research and data collection methods, the publication cycle, the typical format and length of manuscripts) for distinct fields leads to field differences in the quantity of research outputs produced (Becher, 1994; Betsey, 2007; Cohen et al., 2020; Dietz & Bozeman, 2005; Morgan et al., 2001; Stephan et al., 2007; Wanner et al., 1981). Researchers in the biological, medical, and physical sciences and engineering publish more than those in computer science, math, statistics, the social sciences, and the humanities (Kyvik, 1990a; Sabharwal, 2013a; Wanner et al., 1981). Moreover, mobility patterns differ across fields due to diverse job market opportunities. In certain fields like chemistry and engineering, where the non-academic demand for a doctoral-level workforce is high, collaborations between different sectors are common and encouraged (Stephan, 2012; Stephan et al., 2004; Zucker, Darby, & Armstrong, 2002). In such fields, mobility between academia and industry would occur more frequently than in fields where it is relatively more difficult for doctoral graduates to find positions outside the academic sector (i.e., the humanities).

Previous Productivity. Past productivity levels are associated not only with later productivity (Park & Gordon, 1996; Williamson & Cable, 2003; Su, 2011) but also with later mobility (Azoulay et al., 2017; Kim et al., 2020; Matier, 1990; Ryan et al., 2012; Smart, 1990; Xu, 2008a; Zucker, Darby, & Torero, 2002). High performers can have access to more and better opportunities in the academic job market (Azoulay et al., 2017; Matier, 1990; Zucker, Darby, & Torero et al., 2002). Prior research has demonstrated that such an advantage encourages high performers' subsequent mobility to another employer (Allison & Long, 1987; Azoulay et al.,

2017; Crespi et al., 2006; Kim et al., 2020; Zucker, Darby, & Torero, 2002). Therefore, past productivity records can shape the likelihood and patterns of future job mobility.

Employment Characteristics

Primary Work Activity. Doctorate holders engage in diverse work activities that compete for their limited time and attention (Anderson & Slade, 2016; Doyle, 2002; Sharobeam & Howard, 2002; Toutkoushian & Bellas, 1999). As such, the work activity in which doctorate holders are primarily involved affects their productivity types and levels. Sabharwal (2013b) found that faculty members who indicated research and development as their primary work activity produced more articles than those who engaged primarily in other work activities, such as teaching and administration. Relatedly, other studies on academics' time allocation showed a negative association between time spent on non-research activities, particularly undergraduate teaching, and research productivity (Betsey, 2007; Fox, 1992; Mamiseishvili & Rosser, 2010; Porter & Umbach, 2001; Toutkoushian & Bellas, 1999).

Current Position. A job position reflects work experiences and environment, reward systems, job security status, etc. In the higher education sector, holding a ladder faculty position can offer a comparative advantage in terms of research-related productivity through the availability of human, financial, and administrative resources supporting research activities (Betsey, 2007). Faculty rank is also an important factor affecting productivity. Prior research that explored differences in research productivity by academic rank found that faculty at higher rank tended to have higher research productivity (Betsey, 2007; Sax et al., 2002; Tien & Blackburn, 1996; Toutkoushian & Bellas, 1999). Similarly, tenure status appeared to be associated with research productivity, but the findings of previous studies were mixed. While Bess (1998) and

Holley (1997) reported that the research productivity of academics decreased after tenure, McNurlen and West (2000) found that it increased.

Institutional Characteristics. Higher education institutions vary according to their prestige/reputation and research focus (Clark, 1987, 1989; Rhode, 2006), and these variations lead to a hierarchy in the research production system in the academic sector (Altbach, 2015; Weakliem et al., 2012; Kosar & Scott, 2018, van Vught, 2008). Institutions with a high reputation and extensive research focus provide research environments with high-quality facilities, administrative and financial support, and a strong peer community (Long, 1978; Long & McGinnis, 1981; Martin-Rovet, 2003). In fact, placement in prestigious research institutions appears to be positively associated with productivity (Fox & Mohapatra, 2007; Long, 1978; Long & McGinnis, 1981; Su, 2011). The Carnegie Classification of the employer institution has been widely used in prior research as a representation of institutional characteristics, reflecting institutional prestige and research/teaching orientation (Altbach, 2015; Kosar & Scott, 2018).

Job Satisfaction. Prior research has revealed a close relationship among doctorate holders' job satisfaction, mobility, and research productivity in academic settings. Satisfaction with their job and employer is a significant predictor of whether doctorate holders leave or intend to leave their institution (Ababneh, 2020; Daly & Dee, 2006; Johnsrud & Rosser, 2002; Kim et al., 2020; Rosser, 2004; Smart, 1990; Zhou & Volkwein, 2004). Satisfaction with different aspects of jobs can have different effects on their intentional and actual job changes (Kim et al., 2020; Smart, 1990; Volkwein et al., 1998; Volkwein & Parmley, 2000; Zhou & Volkwein, 2004). Smart (1990) showed that satisfaction with their institution and career reduced faculty members' intention to leave. Kim et al. (2020) found that, while satisfaction with working conditions decreased faculty members' likelihood of leaving their institution, satisfaction with

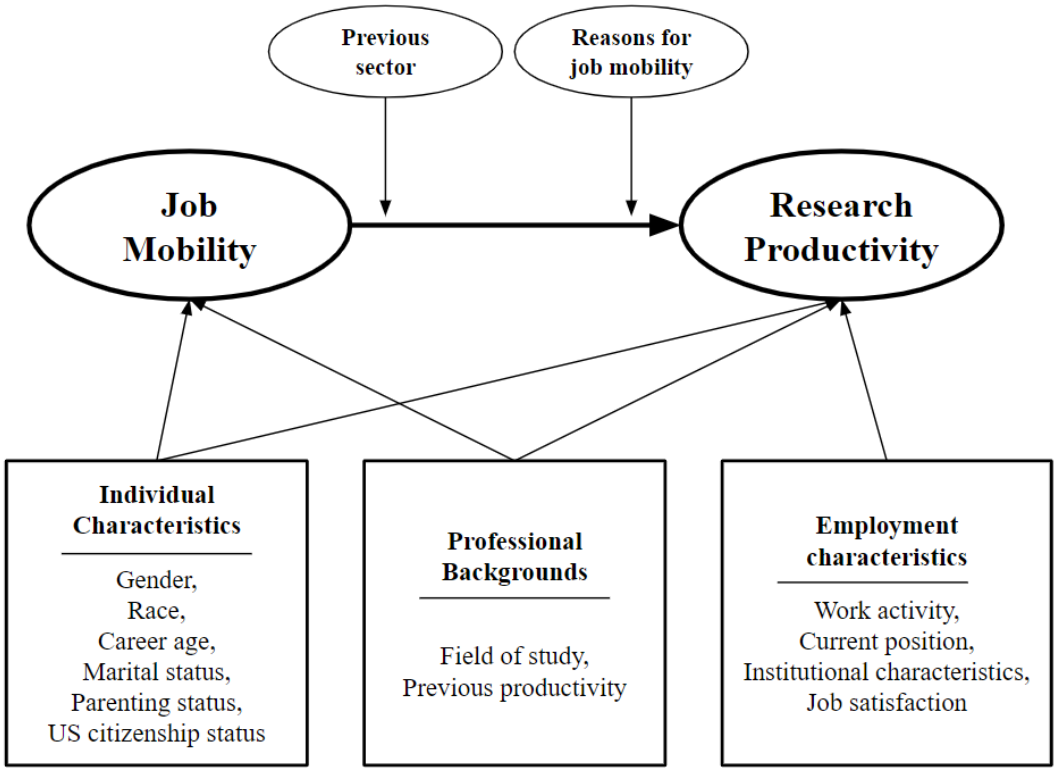
compensation had no significant effect on their possibility of leaving. Further, the level of satisfaction, particularly intrinsic satisfaction, was reported to have a positive association with their research productivity (Kim et al., 2011; Sabharwal & Corley, 2009).

Conceptual Model for this Study

Based on the aforementioned theories and prior research, the conceptual model for this study shown in Figure 1 is proposed.

Figure 1

Conceptual Model for Relationship between Doctorate Holders' Job Mobility and Research Productivity



According to this conceptual model, doctorate holders' job mobility is associated with their research productivity, but the association can differ depending on their previous

employment sector and reasons for job mobility. The individual characteristics and professional background of doctorate holders directly affect their job mobility and research productivity. The employment characteristics only affect research productivity because, in this study, employment characteristics in a new position after job mobility (or in the original position, if they did not move) are considered in order to examine research productivity after changing employers. The details of the variables are presented in the following chapter.

Chapter 3: Methods

This chapter describes the research methods used to examine the relationship between job mobility and research productivity and whether this relationship differs by previous employment sector and reasons for changing employers. The data source and sample are presented first, followed by the variables considered in this study. Then, the analytical approach and analysis process are discussed. Finally, this chapter closes with a discussion of the limitations of the data and methods used.

Data Source

To explore the relationship between job mobility and productivity of doctorate holders, this study used data from the Survey of Doctorate Recipients (SDR), a national survey study conducted by the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF). The SDR provides comprehensive national data on post-doctorate career trajectories of U.S.-trained PhDs. The sample of the SDR comprises doctoral graduates in the fields of science, engineering, and health aged 76 years and under who have received research-based degrees from U.S. higher education institutions (NSF, 2019). The SDR tracks the sample at two- to three-year intervals, collecting longitudinal information on their employment and further education (NSF, 2019).

Sample

This study focused on doctorate holders who responded to all three waves of the SDR in 2001, 2003, and 2008. The sample was selected based on the availability of variables critical to this study. First, the SDR did not collect productivity-related information in every survey wave, although this was an important variable in this study. The 2003 and 2008 surveys were the most recent to contain productivity data in the form of the total number of conference presentations

and journal publications. In each wave, the respondents were asked to report their productivity during the past five years—that is, productivity between 1998 and 2003 was reported in the 2003 SDR, and productivity between 2003 and 2008 was reported in the 2008 SDR. Considering the limitations of this data, 2003 was used as a reference point to identify the respondents' job mobility status. Each SDR wave required respondents to report any employment changes made between the current and previous surveys; specifically, the 2003 survey provided information about whether they changed employers between the 2001 and 2003 surveys. Utilizing this information, this study defined job mobility as a change of employers between 2001 and 2003 and examined whether productivity in the following five years—as reported in the 2008 SDR—differed by job mobility status, previous sector, and reasons for job mobility. Previous productivity between 1998 and 2003—as reported in the 2003 SDR—was also included in the models to consider research activities that were conducted prior to the period in which the outcome variables were measured (i.e., 2003–2008).

Since job mobility is measured between 2001 and 2003, employment-related information (e.g., position, employer characteristics) reported in the 2001 SDR indicates respondents' status before and the 2003 SDR indicates it after their job mobility. Therefore, their previous employment sector was identified using the 2001 survey; personal characteristics and current employment characteristics were extracted from the 2003 survey. Table 1 summarizes the SDR survey waves used in this study and the information extracted from each.

This study additionally limited the sample to those in the higher education sector (i.e., two- and four-year colleges/universities, medical schools, or university-affiliated research institutes) in 2003 by excluding those who left this sector. The motivation for this decision was in consideration of the incomparable nature of the research productivity of those in different

sectors under the same conditions. As previously discussed, working environments, knowledge production, and reward structures differ by sector (Dasgupta & David, 1994; Martin, 2004; OECD, 2015; Shapin, 2009; Stern, 2004). Furthermore, in non-higher education sectors, research activities are often limited by employers (Martin, 2004; Weimer, 2001). As such, this study focused on doctorate holders working for higher education institutions in 2003 (i.e., after job mobility was recorded).

Table 1

Use of Each Survey Wave

SDR survey wave	**Information extracted**
2001	Previous sector
2003	Mobility status (2001–2003), Individual characteristics, Employment characteristics, Previous productivity (1998–2003)
2008	Productivity outcomes (2003–2008)

A total of 18,928 doctorate holders responded to all three survey waves. However, 2,860 respondents reported that they were not working for pay in 2001 and/or 2003. These respondents did not answer the questions related to job mobility; thus, they were removed from the sample. Of the remaining respondents, 8,515 were working outside the higher education sector in 2003. They were also excluded to focus on those who remained in the higher education sector or who moved into the higher education sector from another sector. As a result, 7,553 respondents were included in this study.

Variables

Dependent Variables

Two productivity variables measured in 2008—the total number of conference presentations and journal publications produced during the preceding five years—served as dependent variables, regardless of whether the presentations/publications had been co-authored. Each SDR variable contained integer numbers starting from zero, and any output greater than a total count of 95 was combined and coded as 96. Although using self-reported measures may not be ideal, prior research has demonstrated a high correlation between such data and the actual records, which supports the use of self-reported productivity data (Clark & Centra, 1982). The distribution of the dependent variables is presented in Table *11*.

Independent Variables

This study examined the relationship between job mobility and research productivity, and whether this relationship differs by previous employment sector or by reasons for changing employers. Therefore, three types of job mobility variables were created for each research question using the 2001 and 2003 data.

Research Question 1: Does job mobility affect doctorate holders' research productivity? To answer this question, I created a binary job mobility indicator of whether the individual changed employers between 2001 and 2003 set to 1 if they had and 0 if they had not. Of the 7,553 samples included in this study, 87.95% (*N*=6,643) had remained with the same employer and 12.05% (*N*=910) had moved to another employer.

Research Question 2: Does the Effect of Job Mobility on Research Productivity Differ by the Sector of Previous Employer? To answer this question, I focused on the 910 doctorate holders who had changed employers between 2001 and 2003. Their employer before

the employment change—defined as those recorded in the 2001 survey—were grouped into three sector categories: (1) *higher education* (e.g., two- and four-year colleges and universities, medical schools, or university-affiliated research institutes); (2) *industry* (e.g., private-for-profit companies/organizations or self-employment); and (3) *non-industry* (e.g., local/state/federal governments, K-12 schools/systems, or private, not-for-profit organizations). As the sample of this study was limited to those in higher education institutions as of the 2003 survey (i.e., after job mobility was recorded), this variable represents the sector from which the respondents moved to higher education. Of the 910 doctorate holders who changed employers between 2001 and 2003, 72% (*N*=658) switched employers within the higher education sector, 16% (*N*=146) moved from industry to the higher education sector, and 12% (*N*=106) moved from non-industry sectors to the higher education sector.

Research Question 3: Does the Association between Job Mobility and Research Productivity Differ by Reason for Job Mobility? The SDR data provided additional information about the reasons for respondents' job mobility. Six binary indicators denoted whether the respondents considered the following in their decision to change employers: (1) pay, promotion opportunities, (2) working conditions, (3) job location, (4) changes in career or professional interests, (5) family-related reasons, and (6) lay-off/job termination. Multiple choices allowed the participants to reflect the complexity of reasons that motivate doctorate holders to move.

Of the 910 respondents who switched employers between 2001 and 2003, more than half (56.2%; *N*=511) indicated that better pay and promotion prospects were an important consideration, followed by working conditions (40.8%; *N*=371) and job location (39.7%; *N*=361). Approximately a quarter of the respondents (*N*=239) indicated that their job mobility

was driven by changes in their career or professional interests, about one-fifth (*N*=194) indicated that they switched jobs for family-related reasons, and 18% (*N*=159) indicated that their choice was driven by a previous job termination. As the original survey allowed for multiple choices, the six variables were not exclusive of each other.

Control Variables

Based on the conceptual framework suggested in the previous chapter (see Figure 1), three groups of variables were included in the statistical models to examine whether there is a unique relationship between job mobility and research productivity and whether this relationship differs by previous employment sector and by reasons for job mobility: (1) individual background (i.e., gender, race, career age, marital status, parenting status, and U.S. citizenship status), (2) professional background (i.e., field and previous productivity), and (3) employment characteristics (i.e., primary work activity, position, tenure status, Carnegie classification, and job satisfaction). These variables were extracted from the 2003 SDR to reflect respondents' status after their job mobility.

Individual Characteristics. Six variables were included in the model to measure individual characteristics: gender, race, career age, marital status, parenting status, and U.S. citizenship status.

***Gender*.** Gender was coded as 0 for male and 1 for female.

***Race*.** Seven race/ethnicity categories were simplified into five groups: (1) Asian, (2) Black, (3) Hispanic, (4) White, and (5) other. The category of 'other' included American Indian/Alaskan Native, Native Hawaiian/other Pacific islander, and multiple-race individuals. White served as the reference category.

***Career Age*.** Career age—defined as the number of years since the highest degree was received—was calculated by subtracting the year in which the respondent's PhD was awarded from 2003.

Marital Status. Respondents' marital status is a binary indicator coded as 1 if the individual was married or living in a marriage-like relationship and 0 if the respondent was widowed, separated, divorced, or never married.

***Parenting Status*.** To identify parenting status, I utilized four SDR variables that provide information on whether the respondents lived with dependent children aged younger than six years, between 6 and 11 years, between 12 and 18 years, and 19 years or older, respectively. The information in the four variables were combined into a newly created composite variable that consists of four categories: (1) no dependent children, (2) having dependent children younger than six years, (3) having dependent children between the ages of 6 and 18 years, and (4) having dependent children aged 19 years or older. Respondents who reported having no dependent children in all the four SDR variables were recoded into the no dependent children category; those who reported having children in more than one age group were coded into the category of their youngest children. The no dependent children category served as the reference category.

***Citizenship Status*.** U.S. citizenship status was divided into three categories: (1) native U.S. citizen, (2) naturalized U.S. citizen, and (3) non-U.S. citizen. Non-U.S. citizens included both permanent and temporary residents. Native U.S. citizens served as the reference group.

Professional Background. Respondents' field of study and previous productivity were included in the models to consider their professional background.

Field. Seven broad fields were considered: (1) biological, agricultural, and environmental sciences, (2) computer sciences, mathematics, and statistics, (3) physical sciences, (4)

psychology, (5) social sciences, (6) engineering, and (7) health. The biological, agricultural, and environmental sciences category was chosen arbitrarily as the reference category.

Previous Productivity. Two productivity variables (i.e., the total number of conference presentations and journal publications) measured in 2003 were used to assess respondents' productivity during the preceding five years (since 1998).

Employment Characteristics. Five variables relating to respondents' employment were included in the model: (1) primary work activity, (2) position, (3) tenure status, (4) Carnegie classification, and (5) job satisfaction. Position and tenure status were included to represent their current position, and the Carnegie classification was included as a proxy for their employer's characteristics.

Primary Work Activity. Respondents' primary work activities were summarized into four categories: (1) research and development, (2) teaching, (3) management and administration, and (4) other. The research and development category served as the reference category.

Position. Two SDR variables—faculty rank and postdoc—were combined into a composite categorical variable. First, the following categories of faculty rank were considered: (1) professor, (2) associate professor, (3) assistant professor, (4) instructor/lecturer, and (5) other. The category of 'other' included positions for which the rank system was not applicable. Then, if the respondents indicated that their position was postdoc, they were, regardless of their rank, recoded into a new category of (6) postdoc. Professor was used as the reference category.

Tenure Status. Tenure status was divided into three categories: (1) tenured, (2) on the tenure track but not tenured, and (3) not on the tenure track. Tenured was used as the reference category.

***Carnegie Classification*.** The Carnegie classification of respondents' employers was summarized into the following categories: (1) very high research institutions (R1), (2) high research institutions (R2), (3) doctorate granting institutions, (4) comprehensive institutions, (5) liberal arts colleges, and (6) other. R1 institutions was the reference category.

***Job Satisfaction*.** Respondents were asked to rate their satisfaction with each aspect of their job—salary, benefits, job security, opportunities for advancement, intellectual challenge, level of responsibility, degree of independence, and contribution to society—on a Likert scale of one ("very satisfied") to four ("very dissatisfied"). As the original scale code is counterintuitive, I recoded them in reverse so that a score of one represented "very dissatisfied" and four represented "very satisfied" for ease of interpretation. The eight items were then combined using the mean of the rated scores to create a composite variable for job satisfaction. The Cronbach's α for the composite measure was 0.79.

Table 2 presents the summary of the variables and the original SDR variable(s) used to create them.

Table 2

Variables

Variable	**Description/Category**	**Original variable(s) used**	**Data source**
Dependent Variables			
Presentations	Number of conference presentations (2003–2008)	PAPERS	2008
Publications	Number of journal publications (2003–2008)	ARTICLE	2008
Independent Variables			
Job mobility	Not moved*	EMSMI	2003
	Moved		
Previous sector	Moved within higher education*	EMSMI	2003
	Moved from industry	EMTP	2001
	Moved from non-industry		

Table 2 (cont'd)

Pay/promotion	No*	CHPAY	2003
	Yes		
Working conditions	No*	CHCON	2003
	Yes		
Job location	No*	CHLOC	2003
	Yes		
Change in interests	No*	CHCHG	2003
	Yes		
Family-related reasons	No*	CHFAM	2003
	Yes		
Lay-off	No*	CHLAY	2003
	Yes		
Control Variables - Individual characteristics			
Female	Male*	GENDER	2003
	Female		
Race	Asian	RACETHM	2003
	Black		
	Hispanic		
	White*		
	Other		
Career age	Number of years since the highest degree was received	SDRYR	2003
Marital status	Not married*	MARSTA	2003
	Married		
Parenting	No dependent children*	CH6IN	2003
	Dependent children (<6)	CH611IN	2003
	Dependent children (6–18)	CH1218IN	2003
	Dependent children (≥19)	CH19IN	2003
U.S. citizenship	Native U.S. citizen*	CTZN	2003
	Naturalized U.S. citizen		
	Non-U.S. citizen		
Control Variables - Professional background			
Field	Biological/agricultural/environmental sciences*	NSDRMEM	2003
	Computer/math		
	Physical sciences		
	Psychology		
	Social sciences		
	Engineering		
	Health		
Previous presentations	Number of conference presentations (1998–2003)	PAPERS	2003
Previous publications	Number of journal publications (1998–2003)	ARTICLE	2003

Table 2 (cont'd)

Control Variables – Employment characteristics			
Primary work activity	Research and development*	WAPRSM	2003
	Teaching		
	Management and administration		
	Other		
Position	Full professor*	PDIX	2003
	Associate professor	FACRANK	2003
	Assistant professor		
	Instructor/Lecturer		
	Postdoc		
	Other		
Tenure status	Tenured*	TENSTA	2003
	On tenure track but not tenured		
	Not on tenure track		
Carnegie classification	Very high research institutions*	CARNEG	2003
	High research institutions		
	Doctorate granting institutions		
	Comprehensive institutions		
	Liberal arts college		
	Other institutions		
Satisfaction	Job satisfaction	SATSAL	2003
		SATBEN	2003
		SATSEC	2003
		SATADV	2003
		SATCHAL	2003
		SATRESP	2003
		SATIND	2003
		SATSOC	2003

*Reference category

Analytical Strategy: Zero-Inflated Negative Binomial Regression

When the outcome variable is a discrete count variable that takes zero or positive integer values, it is not appropriate to use a traditional regression model designed for continuous prediction (Cameron & Trivedi, 1986; Coxe et al., 2009; Gardner et al., 1995). Moreover, the distribution of a count variable is typically positively skewed with a high concentration of zero and small values, which violates the residual normality assumption of traditional linear

regression (Beaujean & Grant, 2016; Coxe et al., 2009). The dependent variables used in this study—the number of conference presentations and journal publications—were count variables. The histograms of the dependent variables presented in Figure 2 demonstrate the positive skewness of their distributions. Hence, it was necessary to employ an appropriate analytical approach to consider the nature of these variables.

Poisson and negative binomial regressions provide more generalized forms of regression for count outcome variables. The Poisson regression model relies on the Poisson distribution, defined by a single parameter equal to both the mean and variance. The mean-variance equality assumption of the Poisson regression model does not hold when the prevalence of extreme values in the outcome variable (i.e., zero/close to zero or very large values) is greater than expected. In this case, the variable's variance is larger than its mean, introducing the so-called overdispersion problem. The negative binomial regression model releases the mean-variance equality assumption and addresses this overdispersion (Beaujean & Grant, 2016; Greene, 2008; Hilbe, 2011; Lindén & Mäntyniemi, 2011). To detect if overdispersion exists in the data, I examined the mean and variance of the two dependent variables (see Table 3). In both variables, the variance was much greater than the mean, giving a clear sign of overdispersion. Therefore, negative binomial regression is more appropriate for this study.

Table 3

Mean and Variance of the Outcome Variables

Dependent Variables	Mean	Variance
Number of conference presentations (2003–2008)	11.12	255.83
Number of journal publications (2003–2008)	8.45	189.29

Figure 2

Histograms of the Dependent Variables

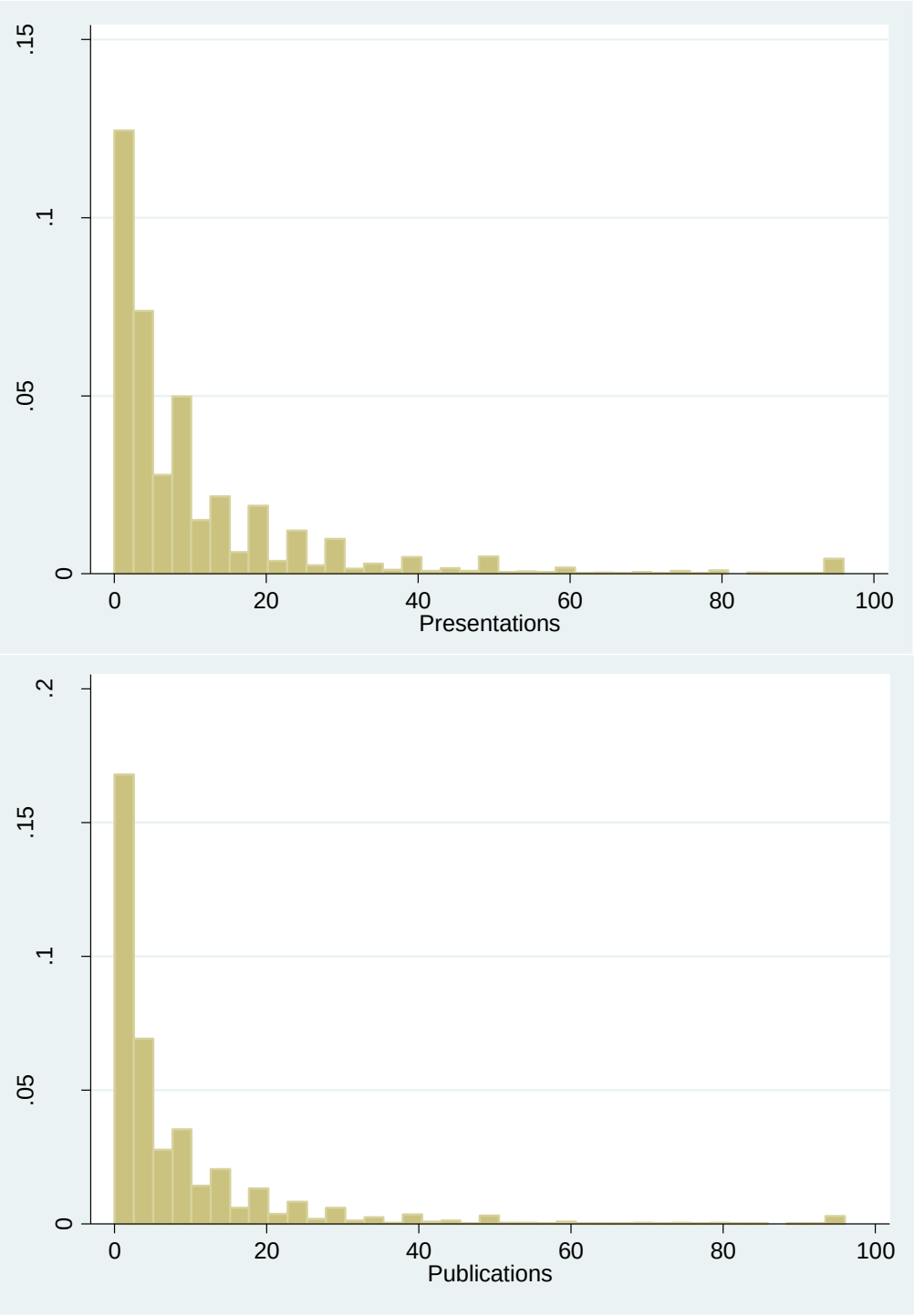


Figure 2 shows that there are many zero values in the dependent variables. Specifically, the proportion of zero responses was 20.12% for conference presentations and 26.55% for publications, which may indicate that a substantial portion of respondents was not involved in research activities at all. These doctorate holders would not produce research output corresponding to the outcome variables regardless of their job mobility status and the individual and professional characteristics considered in the models. Therefore, without considering the zero values, the estimates would not appropriately capture the actual relationship between the variables of interest. In such cases, the zero-inflated negative binomial (ZINB) regression model, which addresses both the excess zero counts and overdispersion, can be a better modeling option. ZINB handles excess zero values by combining the logistic and negative binomial regression models. The former model estimates the probability of zero counts, and the latter predicts the counts for the respondents with nonzero outcome variables.

The Vuong test of ZINB versus standard negative binomial model is used to select the model that fits the data better. If the Vuong test statistic exceeds the critical value of 1.96, the ZINB regression model is favored over the standard negative binomial model; if it does not, the ZINB regression model is rejected and the standard negative binomial model is selected. In this study, the Vuong test was rejected for all regression models. Hence, the ZINB models were adopted.

Analyses

Multiple zero-inflated negative binomial regression models were implemented to determine the associations between doctorate holders' job mobility and research productivity. As an extension of the negative binomial (NB) regression, the zero-inflated negative binomial regression was specified in the following form:

$$Y_i \sim \begin{cases} 0, with\ probability\ p_i \\ NB, with\ probability\ 1 - p_i \end{cases}$$

The base model equation of the NB regression model, which uses a log transformation as a link function to relate the predictor variables to the outcome, takes the following form (Chin & Quddus, 2003; Sheu et al., 2004):

$$E(Y_i) = \exp(\beta_0 + \beta_1 M_i + \boldsymbol{\beta_2 I_i} + \boldsymbol{\beta_3 P_i} + \boldsymbol{\beta_4 E_i} + \boldsymbol{\varepsilon_i})$$

where Y_i refers to the productivity measure (i.e., the number of conference presentations or journal publications between 2003 and 2008) in observation *i*; M_i indicates a job mobility variable; the vector $\boldsymbol{I_i}$ represents the doctorate holders' individual characteristics (i.e., gender, race, career age, marital status, parenting status, and U.S. citizenship status); the vector $\boldsymbol{P_i}$ denotes their professional background (i.e., field and previous productivity measures); and the vector $\boldsymbol{E_i}$ includes their employment characteristics (i.e., primary work activity, position, tenure status, Carnegie classification, and job satisfaction). $\boldsymbol{\varepsilon_i}$ is an error term.

p_i is the probability of having a zero count estimated using the logistic regression model.

$$p_i = \frac{\exp(\gamma_0 + \gamma_1 M_i + \boldsymbol{\gamma_2 I_i} + \boldsymbol{\gamma_3 P_i} + \boldsymbol{\gamma_4 E_i})}{1 + \exp(\gamma_0 + \gamma_1 M_i + \boldsymbol{\gamma_2 I_i} + \boldsymbol{\gamma_3 P_i} + \boldsymbol{\gamma_4 E_i})}$$

Based on the base model, three types of models, each of which included a different type of job mobility variable for each research question as the key independent variable, were estimated for each outcome variable. Model 1 answered research question 1 (i.e., *Does job mobility affect doctorate holders' research productivity?*) by regressing each research productivity variable on job mobility variable 1 (i.e., whether the doctorate holder moved to another employer) and the three sets of control variables (i.e., individual characteristics, professional background, and employment characteristics). To answer research question 2 (i.e.,

Does the effect of job mobility on research productivity differ by the sector of previous employer?), each productivity variable was regressed on job mobility variable 2 (i.e., previous employment sector) and other control variables (Model 2). Finally, Model 3 addressed research question 3 (i.e., *Does the effect of job mobility on research productivity differ by reasons for job mobility?*) by including the six indicators of respondents' reasons for changing employers (i.e., pay/promotion opportunities, working conditions, job location, changes in career/professional interests, family-related reasons, and lay-off or job termination) as mobility variables. Table 4 presents a summary of the models.

Table 4

Summary of the Models

Research question	**Model**	**Sample**	**Dependent variable**	**Job mobility variable(s)**
1. Does job mobility affect doctorate holders' research productivity?	Model 1-1 Model 1-2	Total sample	Presentations Publications	Whether the doctorate holder moved to another employer
2. Does the effect of job mobility on research productivity differ by the sector of previous employer?	Model 2-1 Model 2-2	Those who moved	Presentations Publications	Previous employment sector
3. Does the effect of job mobility on research productivity differ by reasons for job mobility?	Model 3-1 Model 3-2	Those who moved	Presentations Publications	Job mobility reason indicators

The result of a zero-inflated negative binomial model consists of two parts: a logistic and a negative binomial regression model. First, the logistic regression component of the ZINB model predicts the probability of whether the doctorate holder had zero research output. Specifically, the coefficients (γ) in the logistic regression model indicate the log odds of the

productivity variable being zero. Since the meaning of these coefficients is not intuitive, I additionally present exp(γ) (or, the odds ratio) to assist with the interpretation of each estimate. The odds ratio represents the change in the probability of the productivity outcome variable being zero associated with a one-unit increase in the corresponding predictor variable.

Then, for the doctorate holders with nonzero outcome variables, the negative binomial regression part of the ZINB model estimates the number of the research outputs. The estimated coefficients (β) in the negative binomial model represent the expected change in the log count of the productivity outcome variable associated with a unit increase in the corresponding predictor variable. As is the case for the logistic regression model coefficients, I also present exp(β) (or, the incidence rate ratio) for convenience of interpretation. The incidence rate ratio represents a factor change in the expected number of research outputs (presentations or publications) associated with the change in the corresponding independent variable.

Consideration of Reverse Causality

It is tricky to examine the relationship between job mobility and research productivity since this relationship can be both simultaneous and bidirectional. This study, based on the STHC model and job matching theory, assumes that job mobility affects research productivity. However, at the same time, research productivity can also facilitate doctorate holders' future job mobility by increasing their visibility. Empirical evidence has demonstrated that researchers who actively publish and are frequently cited have more opportunities in the academic job market (Azoulay et al., 2017; Matier, 1990; Zucker, Darby, & Torero, 2002). In fact, productive academic researchers appeared to be more likely to intend to leave their current position (Ryan et al., 2012; Smart, 1990; Xu, 2008a) and actually move to another academic institution (Allison &

Long, 1987; Kim et al., 2020; Azoulay et al., 2017) or sector (Crespi et al., 2006; Zucker, Darby, & Torero, 2002).

Therefore, the effects of research productivity on mobility need to be considered in the analysis. In the current study, job mobility was defined as having changed employers between 2001 and 2003, and research productivity was measured by the number of presentations and publications produced between 2003 and 2008. In other words, research production after job mobility was considered in this study. This time lag between the time when the job mobility occurred and when the research outputs were produced mitigates the reverse causality concern in interpreting the results. In addition, research productivity between 1998 and 2003 (before the period of 2003–2008 during which the outcome variables were measured) was also included in the models to control for previous research experience and productivity.

Limitations

Although the SDR provides the most comprehensive information on U.S.-trained doctorate holders' career trajectories and outcomes, the data still have limitations. This study could not use more recent data because research productivity information has not been collected since 2008. In addition, research productivity variables from the SDR data lump research outputs produced for five years together—the variables from the 2003 SDR contain productivity during 1998–2003; the variables from the 2008 SDR contain productivity during 2003–2008. Because of this, this study could not explore more detailed changes in research productivity after job mobility. Also, some respondents possibly experienced additional job mobility between 2003 and 2008, during which period research productivity was measured.

Research productivity was measured using two research outcome variables (i.e., the number of conference presentations and journal publications during the five years between 2003

and 2008). The variables, however, represent the simple counts of the research outputs, only measuring research productivity in terms of quantity. While previous studies have often used the number of citations and/or the quality of the journals in which the articles are published in order to reflect the quality of research outputs (e.g., Allison & Long, 1990; Aksnes et al., 2013; De Filippo et al., 2009; Ejermo et al., 2020; Halevi et al., 2016; Sandström, 2009), this study could not consider the quality aspect due to limited data availability. In addition, research output was counted without consideration of the number of co-authors and the authorship order; thus, the degree to which the respondents contributed to each research project was not considered. The models might have yielded somewhat different results if fractional counts were used as outcome variables instead of normal counts (Burrell & Rousseau, 1995; Lee & Bozeman, 2005; Sandström, 2009).

Chapter 4: Descriptive Statistics

This chapter provides findings from the descriptive statistics. First, the descriptive statistics for the sample are presented. Then, job mobility patterns by individual characteristics, professional background, and employment characteristics are displayed. Finally, the descriptive statistics of the outcome variables (i.e., research productivity) are presented by job mobility variables.

Descriptive Statistics for the Sample

Table 5 presents the descriptive statistics for the study sample—doctorate holders who worked in the higher education sector in 2003.

Table 5

Descriptive Statistics of the Sample

Variables	**Category**	***N***	**%**
Total		7,553	100.00%
Gender	Male	5,121	67.80%
	Female	2,432	32.20%
Race	White	5,709	75.59%
	Asian	796	10.54%
	Black	409	5.42%
	Hispanic	466	6.17%
	Other	173	2.29%
Career Age		M = 17.35 / S.D. = 10.09	
Marital Status	Not married	1,364	18.06%
	Married	6,189	81.94%
Parenting Status	No children	3,786	50.13%
	Children<6	1,295	17.15%
	Children6-18	2,073	27.45%
	Children≥19	399	5.28%
U.S. Citizenship	Native citizen	6,183	81.86%
	Naturalized citizen	878	11.62%
	Non-citizen	492	6.52%
Field	Biological sciences	2,209	29.25%
	Computer/Math	648	8.58%
	Physical sciences	1,197	15.85%

Table 5 (cont'd)

	Psychology	849	11.24%
	Social sciences	1,463	19.37%
	Engineering	783	10.37%
	Health	404	5.35%
Previous Presentations		M = 10.06 / S.D. = 12.91	
Previous Publications		M = 7.25 / S.D. = 10.69	
Primary Work Activity	R&D	2,822	37.36%
	Teaching	3,227	42.72%
	Management	984	13.03%
	Other	520	6.88%
Position	Full professor	2,828	37.44%
	Associate professor	1,892	25.05%
	Assistant professor	1,383	18.31%
	Instructor/Lecturer	342	4.53%
	Postdoc	192	2.54%
	Other	916	12.13%
Tenure Status	Tenured	4,117	54.51%
	On tenure track	1,164	15.41%
	Not on tenure track	2,272	30.08%
Carnegie Classification	R1	3,068	40.62%
	R2	538	7.12%
	Doctorate granting	821	10.87%
	Comprehensive	1,413	18.71%
	Liberal arts	596	7.89%
	Other	1,117	14.79%
Satisfaction		M = 3.35 / S.D. = .47	

Out of the total of 7,553 doctorate holders, two-thirds were men. White doctorate holders accounted for three-quarters, the largest majority of the sample, followed by Asians (10.54%), Hispanics (6.17%), and Blacks (5.42%). The average career age (the number of years after the receipt of a doctorate) at the time when the mobility status was identified (i.e., 2003) was 17.35 years (S.D. = 10.09). 81.94% of the sample were married and 50.87% were parents—17.15% had preschool children under six years old, 27.45% had school-age children aged 6–18 years, and 5.28% had adult dependent(s) aged 19 years or older. Regarding the U.S. citizenship status,

native citizens dominated the respondents (81.86%), 11.62% were naturalized citizens, and 6.52% were non-U.S. citizens.

Doctorate holders in biological sciences made up the largest proportion of the study sample (29.25%), followed by social sciences (19.37%) and physical sciences (15.85%). Computer sciences/math, psychology, and engineering each accounted for about 10%. Health majors took up the smallest share at only 5.35%. For the five years between 1998 and 2003, the doctorate holders included in the sample had 10.06 conference presentations (S.D. = 12.91) and 7.25 journal publications (S.D. = 10.69) on average.

Most doctorate holders who were working at a higher education institution in 2003 were primarily involved in research and development (37.36%) or teaching (42.72%). Regarding position, 62.49% were senior-level faculty members who had a full professorship (37.44%) or associate professorship (25.05%), followed by assistant professors (18.31%). 70% held a tenure-track position with 54.51% already being tenured and 15.41% on the tenure track but not yet tenured. In terms of the Carnegie classification of employers, 58.61% were employed in doctoral universities including very high research institutions (R1), high research institutions (R2), and doctorate-granting institutions. Particularly, R1 institutions employed the largest proportion of the sample (40.62%). Comprehensive institutions also played an important role as a key employer type, providing employment to 18.71% of the sample. The perceived satisfaction with job position using a 5-point Likert scale was 3.35 (S.D. = .47).

Table 6 presents the descriptive statistics by whether the doctorate holder produced research outputs or not. It shows significantly different distributions between the group who

produced research outputs and those who did not, justifying the use of ZINB regression models in which the two groups are analyzed separately.

Table 6

Descriptive Statistics of the Sample by Whether the Respondent Produced Research Outputs

Variables	**Category**	**Presentations**		**Publications**	
		Produced one or more	**Zero**	**Produced one or more**	**Zero**
Total		6,033	1,520	5,548	2,005
Gender	Male	68.01%	66.97%	68.58%	65.64%
	Female	31.99%	33.03%	31.42%	34.36%
	χ^2	0.59		5.86*	
Race	White	75.25%	76.91%	75.27%	76.46%
	Asian	10.92%	9.01%	11.30%	8.43%
	Black	5.11%	6.64%	4.67%	7.48%
	Hispanic	6.40%	5.26%	6.45%	5.39%
	Other	2.32%	2.17%	2.31%	2.24%
	χ^2	12.61*		36.07***	
Career Age		16.56	20.54	16.45	19.86
	t	-13.95***		-13.12***	
Marital Status	Not married	17.34%	20.92%	16.82%	21.50%
	Married	82.66%	79.08%	83.18%	78.50%
	χ^2	10.53**		21.79***	
Parenting Status	No children	47.87%	59.08%	47.26%	58.05%
	Children<6	18.66%	11.12%	19.48%	10.67%
	Children6-18	28.78%	22.17%	28.71%	23.94%
	Children≥19	4.69%	7.63%	4.54%	7.33%
	χ^2	109.92***		134.84***	
U.S. Citizenship	Native citizen	80.81%	86.05%	80.77%	84.89%
	Naturalized citizen	12.02%	10.07%	11.66%	11.52%
	Non-citizen	7.18%	3.88%	7.57%	3.59%
	χ^2	28.30***		38.88***	
Field	Biological sciences	29.65%	27.63%	31.31%	23.54%
	Computer/Math	7.86%	11.45%	7.89%	10.47%
	Physical sciences	15.22%	18.36%	15.19%	17.66%
	Psychology	10.97%	12.30%	10.45%	13.42%
	Social sciences	19.64%	18.29%	18.62%	21.45%
	Engineering	11.06%	7.63%	10.74%	9.33%
	Health	5.60%	4.34%	5.79%	4.14%
	χ^2	47.88***		75.31***	

Table 6 (cont'd)

Previous Presentations		12.10	2.07	12.69	2.88
	t	28.49***		30.96***	
Previous Publications		8.60	1.88	9.44	1.19
	t	22.62***		31.51***	
Primary Work Activity	R&D	43.06%	14.74%	46.74%	11.42%
	Teaching	39.30%	56.32%	36.54%	59.85%
	Management	11.95%	17.30%	11.21%	18.05%
	Other	5.69%	11.64%	5.52%	10.67%
	χ^2	432.33***		788.86***	
Position	Full professor	38.06%	35.00%	38.03%	35.81%
	Associate professor	26.07%	20.99%	26.05%	22.29%
	Assistant professor	20.04%	11.45%	20.48%	12.32%
	Instructor/Lecturer	2.85%	11.18%	2.63%	9.78%
	Postdoc	2.83%	1.38%	3.14%	0.90%
	Other	10.14%	20.00%	9.68%	18.90%
	χ^2	358.05***		362.07***	
Tenure Status	Tenured	55.68%	49.87%	55.30%	52.32%
	On tenure track	17.40%	7.50%	18.04%	8.13%
	Not on tenure track	26.92%	42.63%	26.66%	39.55%
	χ^2	184.45***		177.69***	
Carnegie Classification	R1	43.86%	27.76%	46.90%	23.24%
	R2	7.76%	4.61%	7.95%	4.84%
	Doctorate granting	11.49%	8.42%	11.34%	9.58%
	Comprehensive	17.62%	23.03%	15.97%	26.28%
	Liberal arts	6.88%	11.91%	5.86%	13.52%
	Other	12.40%	24.28%	11.99%	22.54%
	χ^2	278.58***		531.36***	
Satisfaction		3.37	3.27	3.38	3.27
	t	8.16***		9.66***	

* = p < .05, ** = p < .01, *** = p < .001

The proportion of males was slightly higher among doctorate holders who produced research outputs than among those who did not, though the gender difference was significant only for publication productivity. Asians and Hispanics were represented in slightly higher proportions, and Whites and Blacks were represented in smaller proportions among those who were active in research activities than among those who were not. 83% of the respondents with at least one presentation/publication were married, while the corresponding proportion was 79% for

those with zero presentations/publications. There were notable differences in the distribution of parenting status between the two groups: while 47–48% of those who had at least one presentation/publication indicated that they had no children, 58–59% of those who had zero presentations/publications did so. Regarding the U.S. citizenship status, native citizens made up a smaller proportion among research producers than among non-research producers: 81% of research producers were native citizens, while 85–86% of non-research producers were native citizens.

Not surprisingly, there were remarkable differences in the distribution of primary work activity between doctorate holders who produced research outputs and those who did not. Among those who had at least one presentation (publication), 43.06% (46.74%) were involved in research and development; 39.30% (36.54%) were involved in teaching; and 11.95% (11.21%) were involved in management/administration. Among those who had zero presentations (publications), the corresponding proportions were 14.74% (11.42%), 56.32% (59.85%), and 17.30% (18.05%), respectively. The proportion of those in faculty positions (full, associate, or assistant professors) was higher among the group who produced research outputs compared to the group who did not. Specifically, faculty members accounted for 85% of those who produced at least one presentation/publication and accounted for 67–70% of those who produced no research outputs. Similarly, those on the tenure track (those who were already tenured or on the tenure track but not yet tenured) accounted for three-quarters of research producers, while they made up about 60% of non-research producers. In terms of the Carnegie classification of employers, the proportions of those employed in very high research institutions (R1), high research institutions (R2), and doctorate-granting institutions were higher among research

producers than among non-research producers. Finally, doctorate holders who produced research outputs reported higher satisfaction than those who did not.

Job Mobility Patterns

Job Mobility Patterns for the Total Sample

Table 7 presents the job mobility patterns in this study. From the total of 7,553 doctorate holders in the data, about 12% (*N*=910) had changed their employers while 88% had stayed with the same employer during the study period. Of the 910 doctorate holders who changed employers, 72.3% (*N*=658) had moved within the higher education sector, 16.04% (*N*=146) had moved from the industry sector to the higher education sector, and 11.65% (*N*=106) had moved from non-industry sectors to the higher education sector.

Table 7

Distribution of Job Mobility

Total 7,553 (100%)						
Not moved 6,643 (87.95%)	Moved 910 (12.05%)					
	Within higher education 658 (72.31%)		From industry to HE 146 (16.04%)		From non-industry to HE 106 (11.65%)	
	Pay/ promotion	Working conditions	Job location	Change in interests	Family reasons	Lay-off
	511 (56.2%)	371 (40.8%)	361 (39.7%)	239 (26.3%)	194 (21.3%)	159 (17.5%)

Note. The survey questionnaire allowed respondents to choose all reasons that applied to them. Hence, the sum of the numbers of respondents who indicated each reason exceeds the total number of doctorate holders who changed their employers.

Table 7 also presents the distribution of survey respondents by reasons for changing employers. Pay/promotion was the most frequently chosen reason for changing employers. Specifically, out of the 910 doctorate holders who had changed employers, 56.2% (*N*=511) indicated that better pay and promotion prospects were important considerations in their job mobility. Working conditions and job location followed, accounting for 40.8% (*N*=371) and 39.7% (*N*=361), respectively. Approximately a quarter (*N*=239) indicated that their job mobility was driven by changes in their career/professional interests. About a fifth changed employers for family-related reasons (*N*=194) and 18% (*N*=159) reported that their previous appointments were affected by lay-off/job termination.

Job Mobility Patterns by Subgroup

Table 8 through Table 10 explore the distributions of job mobility patterns for each category of control variables.

Table 8

Distribution of Job Mobility by Subgroup

Variables	**Total**	**Not moved**	**Moved**
	N	**(% or Mean)**	
Total	7,553	87.95%	12.05%
Gender			
Male	5,121	88.97%	11.03%
Female	2,432	85.81%	14.19%
χ^2		15.46***	
Race			
White	5,709	88.91%	11.09%
Asian	796	83.92%	16.08%
Black	409	84.60%	15.40%
Hispanic	466	86.48%	13.52%
Other	173	86.71%	13.29%
χ^2		22.73***	
Career Age	7,553	M=18.22	M=11.10
t		20.50***	

Table 8 (cont'd)

Marital Status			
Not married	1,364	86.14%	13.86%
Married	6,189	88.35%	11.65%
χ^2		5.14*	
Parenting Status			
No children	3,786	87.90%	12.10%
Children<6	1,295	80.15%	19.85%
Children6-18	2,073	91.70%	8.30%
Children≥19	399	94.24%	5.76%
χ^2		116.70***	
U.S. Citizenship			
Native citizen	6,183	88.36%	11.64%
Naturalized citizen	878	89.29%	10.71%
Non-citizen	492	80.49%	19.51%
χ^2		28.31***	
Field			
Biological sciences	2,209	86.92%	13.08%
Computer/Math	648	87.96%	12.04%
Physical sciences	1,197	88.30%	11.70%
Psychology	849	87.40%	12.60%
Social sciences	1,463	88.93%	11.07%
Engineering	783	88.63%	11.37%
Health	404	88.86%	11.14%
χ^2		4.59	
Presentations (98–03)	7,553	M=10.27	M=8.71
t		3.42***	
Publications (98–03)	7,553	M=7.34	M=6.57
t		2.05*	
Primary work activity			
R&D	2,822	87.17%	12.83%
Teaching	3,227	88.81%	11.19%
Management	984	88.62%	11.38%
Other	520	85.58%	14.42%
χ^2		7.05	
Position			
Full professor	2,828	94.59%	5.41%
Associate professor	1,892	94.45%	5.55%
Assistant professor	1,383	72.96%	27.04%
Instructor/Lecturer	342	78.36%	21.64%
Postdoc	192	72.92%	27.08%
Other	916	83.41%	16.59%
χ^2		574.93***	

Table 8 (cont'd)

Tenure status			
Tenured	4,117	96.60%	3.40%
On tenure track	1,164	68.90%	31.10%
Not on tenure track	2,272	82.04%	17.96%
χ^2		764.12***	
Carnegie Classification			
R1	3,068	87.65%	12.35%
R2	538	89.22%	10.78%
Doctorate granting	821	89.89%	10.11%
Comprehensive	1,413	89.95%	10.05%
Liberal arts	596	86.74%	13.26%
Other	1117	84.87%	15.13%
χ^2		20.15**	
Satisfaction	7,553	M=3.36	M=3.32
t		2.24*	

* = p < .05, ** = p < .01, *** = p < .001

Table 8 shows the job mobility distribution by subgroup. Men were significantly less likely to change employers than women (11.03% and 14.19%, respectively; $\chi^2 = 15.46$; $p<.001$). There were significant racial differences in job mobility patterns ($\chi^2 = 22.73$; $p<.001$); mobility between employers occurred less frequently among Whites (11.09%) than among the other racial groups, particularly among Asians and Blacks (16.08% and 15.40%, respectively). The career age of doctorate holders who changed employers (11.10) was much lower than that of those who stayed with their employer (18.22) ($t = 20.50$; $p<.001$). Job mobility was less common among married doctorate holders than among their unmarried counterparts ($\chi^2 = 5.14$; $p<.05$).

There were significant differences in job mobility patterns depending on doctorate holders' parental status and the age of their youngest child ($\chi^2 = 116.70$; $p<.001$). The proportion of employer changers was 12.10% among doctorate holders who had no dependent children. This proportion was higher among those with children younger than six (19.85%) and lower among those with children aged 6–18 years (8.30%) or aged 19 years or older (5.76%).

Differences were also observed depending on U.S. citizenship status. Non-U.S. citizens were more likely to change employers: 19.51% of those without citizenship moved to another employer while 11.64% of native U.S. citizens and 10.71% of naturalized U.S. citizens moved to another employer ($\chi^2 = 28.31$; $p<.001$). There was no significant field difference in job mobility patterns ($\chi^2 = 4.59$; $p>.05$).

Doctorate holders who remained with the same employer had significantly more presentations and publications between 1998 and 2003 than those who changed employers. 5–6% of doctorate holders who held full or associate professorships in 2003 indicated that they had changed employers between 2001 and 2003, whereas 22–27% of assistant professors, instructors/lecturers, and postdocs reported job mobility during the same period. Among full/assistant professors and postdocs who changed employers, nearly 80% were from another higher education institution; this proportion was higher than the 70% for associate professors and instructors/lecturers.

Mobility patterns significantly varied by tenure status. Only 3% of those tenured in 2003 reported employer changes between 2001 and 2003. By contrast, 31% of those on the tenure track but not yet tenured experienced job mobility during the study period ($\chi^2 = 764.12$; $p<.001$). The proportion of doctorate holders who changed employers was lower at high research (R2), doctorate granting, and comprehensive institutions than at very high research (R1), liberal arts, and the other types of institutions ($\chi^2 = 20.15$; $p<.01$). Doctorate holders who had remained with the same employers expressed slightly but significantly higher levels of satisfaction than those who had changed employers ($t=2.24$; $p<.05$).

Table 9

Distribution of Previous Employment Sectors by Subgroup

Variables	**Total**	**Moved within HE**	**Moved from industry to HE**	**Moved from non-industry to HE**
	N		**(% or Mean)**	
Total	910	72.31%	16.04%	11.65%
Gender				
Male	565	70.62%	17.70%	11.68%
Female	345	75.07%	13.33%	11.59%
χ^2			3.13	
Race				
White	633	72.51%	15.80%	11.69%
Asian	128	70.31%	20.31%	9.38%
Black	63	68.25%	20.63%	11.11%
Hispanic	63	77.78%	9.52%	12.70%
Other	23	73.91%	4.35%	21.74%
χ^2			9.08	
Career Age	910	M=10.33	M=13.62	M=12.41
F			10.93***	
Marital Status				
Not married	189	73.54%	14.29%	12.17%
Married	721	71.98%	16.50%	11.51%
χ^2			0.57	
Parenting Status				
No children	458	71.83%	13.97%	14.19%
Children<6	257	76.65%	13.62%	9.73%
Children6-18	172	70.35%	20.93%	8.72%
Children≥19	23	47.83%	47.83%	4.35%
χ^2			27.56*	
U.S. Citizenship				
Native citizen	720	72.78%	15.42%	11.81%
Naturalized citizen	94	61.70%	24.47%	13.83%
Non-citizen	96	79.17%	12.50%	8.33%
χ^2			8.50	
Field				
Biological sciences	289	77.16%	10.73%	12.11%
Computer/Math	78	66.67%	28.21%	5.13%
Physical sciences	140	67.14%	20.00%	12.86%
Psychology	107	71.96%	11.21%	16.82%
Social sciences	162	81.48%	5.56%	12.96%
Engineering	89	50.56%	42.70%	6.74%
Health	45	77.78%	13.33%	8.89%
χ^2			83.53***	

Table 9 (cont'd)

Presentations (98–03)	910	M=9.43	M=4.77	M=9.73
F			12.10***	
Publications (98–03)	910	M=7.37	M=2.81	M=6.80
F			14.90***	
Primary work activity				
R&D	362	74.03%	14.64%	11.33%
Teaching	361	72.58%	17.17%	10.25%
Management	112	70.54%	15.18%	14.29%
Other	75	65.33%	18.67%	16.00%
χ^2			4.34	
Position				
Full professor	153	79.74%	11.11%	9.15%
Associate professor	105	71.43%	20.00%	8.57%
Assistant professor	374	78.07%	10.43%	11.50%
Instructor/Lecturer	74	70.27%	18.92%	10.81%
Postdoc	52	78.85%	7.69%	13.46%
Other	152	57.35%	33.55%	16.45%
χ^2			60.97***	
Tenure status				
Tenured	140	84.29%	8.57%	7.14%
On tenure track	362	79.01%	10.50%	10.50%
Not on tenure track	408	62.25%	23.53%	14.22%
χ^2			41.95***	
Carnegie Classification				
R1	379	73.88%	13.72%	12.40%
R2	58	60.34%	22.41%	17.24%
Doctorate granting	83	77.11%	14.46%	8.43%
Comprehensive	142	73.24%	16.90%	9.86%
Liberal arts	79	81.01%	11.39%	7.59%
Other	169	65.68%	21.30%	13.02%
χ^2			14.58	
Satisfaction	910	M=3.34	M=3.18	M=3.36
F			6.80**	

* = p < .05, ** = p < .01, *** = p < .001

Table 9 presents the distribution of previous employment sectors of doctorate holders who changed employers by subgroup. While three-quarters of females moved between higher education institutions, a slightly smaller proportion of males did so (70.62%). However, the difference was not statistically significant ($\chi^2 = 3.13$; $p>.05$). Likewise, there were no significant

differences in the distribution of previous employment sectors by race ($\chi^2 = 9.08$; $p>.05$), marital status ($\chi^2 = 0.57$; $p>.05$), or U.S. citizenship status ($\chi^2 = 8.50$; $p>.05$).

Doctorate holders who moved between higher education institutions were the youngest, revealing that job mobility from non-higher education sectors to the higher education sector tended to occur in the later stages of their careers ($F = 10.93$; $p<.001$). In a similar vein, job mobility from industry to higher education occurred more frequently among those who had children aged six years or older ($\chi^2 = 27.56$; $p<.05$). This tendency was particularly notable among PhDs who had children aged 19 years or older, nearly half of whom were from the industry sector.

The influx from the industry sector to the higher education sector was particularly common among engineering PhDs (42.70%), followed by computer/math PhDs (28.21%). Job mobility from non-industry jobs to higher education jobs was relatively more common among those in psychology than among those in other fields (16.82%). In addition, doctorate holders who moved from the industry sector had fewer presentations and publications during the period 1998 through 2003 than those from other higher education institutions or non-industry sectors.

No significant differences in the distribution of previous employment sectors were observed by primary work activity older ($\chi^2 = 4.34$; $p>.05$) and institutions' Carnegie classification ($\chi^2 = 14.58$; $p>.05$). Meanwhile, those not on the tenure track showed different patterns from those tenured or on the tenure track. While 9–11% of those tenured or on the tenure track were from industry, this proportion reached 24% of doctorate holders not on the tenure track ($\chi^2 = 41.95$; $p<.001$). Doctorate holders who moved from other higher education institutions or non-industry sectors showed higher satisfaction levels than those from the industry sector.

Table 10

Distribution of Reasons for Job Mobility by Subgroup

Variables	**Total**	**Pay/ promotion**	**Working conditions**	**Job location**	**Change in interests**	**Family reasons**	**Lay-off**
	N			**(% or Mean)**			
Total	910	56.2%	40.8%	39.7%	26.3%	21.3%	17.5%
Gender							
Male	565	58.05%	38.94%	38.76%	25.13%	19.29%	17.70%
Female	345	53.04%	43.77%	41.16%	28.12%	24.64%	17.10%
χ^2		2.18	2.07	0.51	0.98	3.65	0.05
Race							
White	633	55.45%	40.60%	39.02%	25.43%	22.91%	15.80%
Asian	128	58.59%	35.94%	32.81%	27.34%	14.84%	24.22%
Black	63	52.38%	42.86%	47.62%	33.33%	15.87%	26.98%
Hispanic	63	57.14%	47.62%	42.86%	25.40%	23.81%	11.11%
Other	23	69.57%	47.83%	65.22%	26.09%	21.74%	17.39%
χ^2		2.51	3.06	10.83*	1.95	5.50	10.99*
Career Age	910	(N) 12.26	(N) 11.01	(N) 11.43	(N) 10.80	(N) 11.22	(N) 11.16
		(Y) 10.20	(Y) 11.22	(Y) 10.59	(Y) 11.93	(Y) 10.64	(Y) 10.80
t		3.71***	-0.37	1.49	-1.78	0.85	0.49
Marital Status							
Not married	189	49.21%	42.33%	39.15%	24.87%	13.23%	23.81%
Married	721	57.98%	40.36%	39.81%	26.63%	23.44%	15.81%
χ^2		4.68*	0.24	0.03	0.24	9.31**	6.64*
Parenting Status							
No children	458	54.80%	38.21%	37.55%	26.64%	15.72%	18.56%
Children<6	257	59.92%	38.52%	42.41%	26.46%	27.63%	14.40%
Children6-18	172	55.23%	48.84%	43.60%	25.58%	26.74%	20.35%
Children≥19	23	47.83%	56.52%	21.74%	21.74%	21.74%	8.70%
χ^2		2.53	8.78*	5.86	0.32	17.67**	4.27

Table 10 (cont'd)

U.S. Citizenship							
Native citizen	720	56.53%	41.81%	41.25%	26.11%	23.19%	15.83%
Naturalized citizen	94	48.94%	36.17%	35.11%	18.09%	13.83%	27.66%
Non-citizen	96	60.42%	37.50%	32.29%	35.42%	14.58%	19.79%
χ^2		2.73	1.57	3.75	7.41*	7.25*	8.46*
Field							
Biological sciences	2,209	61.59%	41.18%	36.33%	24.22%	21.45%	15.22%
Computer/Math	648	48.72%	26.92%	38.46%	26.92%	19.23%	26.92%
Physical sciences	1,197	57.86%	41.43%	32.14%	27.86%	19.29%	25.71%
Psychology	849	55.14%	39.25%	48.60%	20.56%	25.23%	10.28%
Social sciences	1,463	58.02%	48.15%	47.53%	27.16%	21.60%	16.67%
Engineering	783	39.33%	34.83%	33.71%	37.08%	20.22%	16.85%
Health	404	57.78%	48.89%	48.89%	22.22%	22.22%	11.11%
χ^2		15.95*	12.52	15.37*	8.44	1.62	17.64**
Presentations (98–03)	910	(N) 7.90	(N) 7.96	(N) 8.37	(N) 8.93	(N) 8.64	(N) 9.38
		(Y) 9.35	(Y) 9.80	(Y) 9.23	(Y) 8.10	(Y) 8.98	(Y) 5.55
t		-2.03*	-2.55*	-1.19	1.03	-0.40	4.13***
Publications (98–03)	910	(N) 5.10	(N) 5.97	(N) 6.28	(N) 6.80	(N) 6.54	(N) 7.08
		(Y) 7.72	(Y) 7.44	(Y) 7.02	(Y) 5.92	(Y) 6.66	(Y) 4.15
t		-4.27***	-2.36	-1.18	1.26	-0.15	3.64**
Primary work activity							
R&D	362	59.39%	42.82%	41.44%	24.59%	22.38%	17.40%
Teaching	361	51.80%	40.72%	36.84%	24.10%	19.67%	19.67%
Management	112	66.96%	35.71%	40.18%	40.18%	16.96%	11.61%
Other	75	45.33%	38.67%	44.00%	24.00%	30.67%	16.00%
χ^2		13.20**	1.95	2.28	12.80**	6.00	3.99
Position							
Full professor	153	58.17%	47.71%	41.83%	32.03%	23.53%	5.88%
Associate professor	105	52.38%	43.81%	43.81%	21.90%	28.57%	20.95%
Assistant professor	374	70.05%	43.05%	40.91%	24.06%	16.84%	17.11%
Instructor/Lecturer	74	28.38%	37.84%	36.49%	18.92%	25.68%	20.27%

Table 10 (cont'd)

Postdoc	52	34.62%	25.00%	34.62%	36.54%	26.92%	30.77%
Other	152	43.42%	32.89%	34.87%	28.95%	21.05%	21.71%
χ^2		73.20***	13.78*	3.62	10.05	10.02	23.84***
Tenure status							
Tenured	140	65.00%	48.57%	47.86%	30.71%	22.14%	2.86%
On tenure track	362	71.55%	41.99%	41.99%	23.76%	18.23%	15.75%
Not on tenure track	408	39.46%	37.01%	34.80%	26.96%	23.77%	24.02%
χ^2		85.46***	6.14*	8.77*	2.71	3.58	33.62***
Carnegie Classification							
R1	379	59.37%	43.80%	44.06%	25.59%	24.80%	15.04%
R2	58	53.45%	39.66%	39.66%	29.31%	18.97%	20.69%
Doctorate granting	83	51.81%	42.17%	37.35%	26.51%	20.48%	12.05%
Comprehensive	142	55.63%	39.44%	42.96%	30.99%	15.49%	19.01%
Liberal arts	79	54.43%	43.04%	31.65%	17.72%	17.72%	25.32%
Other	169	53.25%	33.73%	31.95%	26.63%	21.30%	19.53%
χ^2		3.09	5.28	10.22	4.99	6.45	7.77
Satisfaction	910	(N) 3.19	(N) 3.29	(N) 3.29	(N) 3.29	(N) 3.33	(N) 3.37
		(Y) 3.42	(Y) 3.37	(Y) 3.36	(Y) 3.40	(Y) 3.30	(Y) 3.09
t		-7.03***	-2.50*	-1.99*	-2.76**	0.77	6.62***

* = p < .05, ** = p < .01, *** = p < .001

Table 10 presents the distribution of reasons for changing employers by subgroup. When focused on those who changed employers, there were no statistically significant differences in reasons for changing employers between the two gender groups. Meanwhile, significant race differences were found in the reasons for their mobility. The share of doctorate holders who reported job location as a reason for changing employers was particularly higher among Asians (32.81%) than among the other groups (39.02–65.22%) ($\chi^2 = 10.83$; $p<.05$). The proportion of doctorate holders who left their previous employer due to lay-off/job termination was higher among Asians and Blacks: 26.98% of Blacks and 24.22% of Asians indicated lay-off/job termination as one of the reasons for their job mobility while this was 15.80% and 11.11% among Whites and Hispanics, respectively ($\chi^2 = 10.99$; $p<.05$).

Doctorate holders who changed employers for pay/promotion opportunities were younger on average than those who changed employers for other reasons ($t = 3.71$; $p<.001$). Regarding marital status, married doctorate holders more often indicated that they had considered pay and promotion prospects ($\chi^2 = 4.68$; $p<.05$) and family-related reasons ($\chi^2 = 9.31$; $p<.01$) in their decision to change employers than unmarried ones. By contrast, the proportion of those who left their previous employer due to lay-off/job termination was significantly greater among unmarried doctorate holders than among married ones (23.81% vs. 15.81%, $\chi^2 = 6.64$; $p<.05$). In addition, doctorate holders who had pre-school or school-age children more often indicated that they moved for family-related reasons than those who had adult dependents or no dependents ($\chi^2 = 17.67$; $p<.01$).

35.42% of non-U.S. citizens and 26.11% of native U.S. citizens left their previous employer because of changes in career or professional interests, whereas this proportion was only 18.09% among naturalized citizens ($\chi^2 = 7.41$; $p<.05$). Meanwhile, the proportion of those

who left their previous employer due to lay-off/job termination was particularly greater among naturalized citizens ($\chi^2 = 8.46$; $p<.05$). Native citizens (23.19%) more often indicated that they considered family-related reasons in their decision to change employers than naturalized citizens (13.83%) or non-U.S. citizens (14.58%) ($\chi^2 = 7.25$; $p<.05$).

Better pay and promotion prospects were most common among biological sciences PhDs (61.59%) and least common among engineering majors (39.33%) ($\chi^2 = 15.95$; $p<.05$). 48–49% of doctorate holders in psychology, social sciences, and health indicated that they had considered job location in their decision to change employers; the proportion was noticeably higher than in the other fields where around 35% of doctorate holders did the same ($\chi^2 = 15.37$; $p<.05$). PhDs in computer sciences/math or physical sciences were more often influenced by lay-off/job termination ($\chi^2 = 17.64$; $p<.05$). Also, the PhDs who left their previous employer for better pay and promotion opportunities had significantly more previous presentations and publications than those who moved for other reasons. By contrast, those who changed employers due to lay-off/job termination had significantly fewer presentations and publications between 1998 and 2003.

Doctorate holders in management/administration positions were more likely to have changed employers for better pay and promotion opportunities ($\chi^2 = 13.20$; $p<.01$) or changed career/professional interests ($\chi^2 = 12.80$; $p<.01$) than those in other types of positions. In addition, the proportion of doctorate holders who indicated better pay/promotion opportunities and/or working conditions as their reasons for changing employers was particularly higher among those in ladder faculty positions. The proportion of respondents who indicated that better pay/promotion opportunities, working conditions, and/or job location were their reasons for leaving their previous employer was lower among those not on the tenure track than among those tenured or on the tenure track.

There were no significant differences in the distributions of reasons for changing employers across institutions' Carnegie classifications. The level of job satisfaction was higher when doctorate holders changed employers for better pay and promotion opportunities (t=-7.03; p<.001), working conditions (t=-2.50; p<.05), job location (t=-1.99; p<.05), and/or changed professional interests (t=-2.76; p<.01) and lower when they moved due to being laid-off (t=6.62; p<.001).

Research Productivity of Doctorate Holders

Of the doctorate holders included in this study, 20.12% did not present at professional conferences and 26.55% did not publish any academic research in refereed journals between 2003 and 2008. Of those who had presentation/publication records, the average number of conference presentations was 11.12 (S.D. 15.99; range 0–96); the average number of journal publications was 8.45 (S.D. 13.76; range 0–96) (Table 11).

Table 11

Summary Statistics of the Productivity Outcomes

Dependent Variables	% Zero	For non-zero observations		
		Mean	S.D.	Median
Conference presentations	20.12%	13.92	16.77	8
Journal publications	26.55%	11.51	14.92	6

Table 12 presents the research productivity of doctorate holders by whether they changed employers, their previous employment sector, and reasons for changing employers. To test whether the productivity level varied by job mobility status, the Mann–Whitney z tests and the Kruskal–Wallis chi-square tests were conducted.

Table 12

Summary Statistics of the Productivity Outcome by Mobility Variables

Dependent Variables	% Zero	χ^2	For non-zero observations			
			Mean	S.D.	Median	χ^2 / z
Conference presentations						
Not moved	19.83%	3.07	13.94	16.96	8	-1.11
Moved	22.31%		13.71	15.27	9	
Within higher education	18.69%		13.82	15.41	9	
From industry to HE	35.62%	20.91***	11.45	12.23	6.5	3.29
From non-industry to HE	26.42%		15.63	17.35	10	
Pay/promotion (No)	30.08%	24.74***	11.65	14.10	6	-4.17***
Pay/promotion (Yes)	16.24%		15.05	15.86	10	
Working conditions (No)	24.86%	4.97*	12.98	14.10	9	-1.68
Working conditions (Yes)	18.60%		14.68	16.69	10	
Job location (No)	25.68%	9.10**	13.41	14.59	9.5	-0.13
Job location (Yes)	17.17%		14.11	16.18	9	
Change in interests (No)	21.46%	1.06	13.76	15.56	9	-0.44
Change in interests (Yes)	24.69%		13.56	14.43	9	
Family-related reasons (No)	22.63%	0.20	14.00	15.58	9	0.70
Family-related reasons (Yes)	21.13%		12.66	14.10	9	
Lay-off (No)	20.91%	4.88*	14.74	16.01	10	4.97***
Lay-off (Yes)	28.93%		8.29	8.81	5	
Journal publications						
Not moved	26.67%	0.47	11.67	15.22	6	0.62
Moved	25.60%		10.33	12.52	6	
Within higher education	21.43%		10.79	13.20	6	
From industry to HE	41.10%	25.59***	7.40	8.23	4	12.71**
From non-industry to HE	30.19%		10.51	11.41	7	
Pay/promotion (No)	35.34%	35.34***	9.32	12.45	5	-3.19**
Pay/promotion (Yes)	18.00%		10.95	12.54	7	
Working conditions (No)	28.94%	7.73**	9.42	10.40	6	-1.40
Working conditions (Yes)	20.75%		11.51	14.77	6	
Job location (No)	26.96%	1.33	9.61	10.92	6	-1.27
Job location (Yes)	23.55%		11.37	14.50	6	
Change in interests (No)	25.63%	0.00	10.54	12.74	6	0.78
Change in interests (Yes)	25.52%		9.74	11.89	6	
Family-related reasons (No)	25.00%	0.64	10.11	12.00	6	-0.75
Family-related reasons (Yes)	27.84%		11.16	14.37	7	
Lay-off (No)	23.70%	8.17**	11.04	13.16	6	4.33***
Lay-off (Yes)	34.59%		6.38	6.93	4	

* = p < .05, ** = p < .01, *** = p < .001

No statistically significant differences in research productivity measures—conference presentations and journal publications—were found between doctorate holders who stayed with their employer and those who changed employers. However, comparing the research productivity measures of doctorate holders who changed employers according to the sector of previous employment revealed hidden differences. First, the proportion of doctorate holders who were not involved in research activities during the study period (2003–2008) differed significantly by previous sector, with those who moved from the industry sector having the highest (35.62% for conference presentations; 41.10% for journal publications) and those who moved within the higher education sector having the lowest (18.69% for conference presentations; 21.43% for journal publications). Moreover, when those with presentation activities between 2003 and 2008 were considered, doctorate holders from the industry sector had significantly fewer publications than the other two groups ($\chi^2 = 12.71$; $p<.01$).

Among the group who changed employers, there were also differences in research productivity depending on the reason for changing employers. The PhDs who left their previous employer for better pay and promotion opportunities were less likely to be inactive in research activities measured as presentations and publications and, when they produced research outputs, had significantly more presentations and publications than those who moved for other reasons. By contrast, those who changed employers due to lay-off/job termination were significantly more likely to have no presentations and publications and, even though they produced those research outputs, had significantly fewer presentations and publications than those who changed employers for other reasons not related to such job security issues.

Chapter 5: Regression Analysis

This chapter reports the results of regression analysis. To determine (1) whether job mobility affects doctorate holders' research productivity and whether the effect of job mobility on research productivity differs (2) by previous employment sector and (3) by reasons for job mobility, six zero-inflated negative binomial (ZINB) regression models designed to answer the three research questions with two outcome measures for each were conducted.

Does Job Mobility Affect Doctorate Holders' Research Productivity?

In this section, I present the results of Models 1-1 and 1-2, which explore the relationship between job mobility (i.e., whether the doctorate holder changed employers or not) and research productivity. The findings of Model 1-1, which includes the number of conference presentations as the research outcome variable, are presented in Table 13. The results of Model 1-2, whose outcome variable is the number of journal publications, are displayed in Table 14. In each table, the left side displays the logistic regression component of the ZINB model, which estimates the probability of the variable having a zero outcome; the right side presents the negative binomial regression component, which predicts the number of presentations/publications for those respondents who had at least one presentation/publication.

Table 13

Zero-inflated Negative Binomial Regression Model to Estimate the Impact of Job Mobility on Presentation Productivity

Variables	**Logistic**		**Negative binomial**	
	γ	**Exp(*γ*)**	***β***	**Exp(*β*)**
Moved (vs. Not moved)	0.63	1.89 ***	0.02	1.02
Female (vs. Male)	0.04	1.04	-0.07	0.93 **
Race (ref. = White)				
Asian	0.31	1.36	0.00	1.00

Table 13 (cont'd)

Black	0.23	1.26	-0.04	0.96
Hispanic	0.11	1.11	-0.08	0.92
Other	-0.18	0.84	0.11	1.12
Career age	0.04	1.04 ***	-0.01	0.99 ***
Married (vs. Not married)	0.10	1.11	0.07	1.08 *
Parenting status (ref. = No children)				
Children<6	-0.27	0.77	0.05	1.05
Children6-18	-0.24	0.79	-0.01	0.99
Children≥19	0.00	1.00	0.04	1.05
U.S. citizenship (ref. = Native)				
Naturalized citizen	-0.43	0.65 *	0.03	1.03
Non-citizen	-0.22	0.80	0.05	1.05
Field (ref. = Biological sciences)				
Computer/Math	-0.12	0.88	-0.19	0.82 ***
Physical sciences	0.16	1.17	0.16	1.17 ***
Psychology	0.08	1.09	0.09	1.10 *
Social sciences	-0.15	0.86	-0.03	0.97
Engineering	0.10	1.11	0.20	1.22 ***
Health	-0.11	0.90	-0.01	0.99
Previous publications	-0.73	0.48 ***	0.04	1.04 ***
Primary work activity (ref. = R&D)				
Teaching	0.95	2.59 ***	-0.27	0.76 ***
Management	0.96	2.60 ***	-0.14	0.87 ***
Other	1.05	2.86 ***	-0.21	0.81 ***
Position (ref. = Full professor)				
Associate professor	0.12	1.12	-0.12	0.89 ***
Assistant professor	0.08	1.08	-0.17	0.85 **
Instructor/Lecturer	0.50	1.66 *	-0.58	0.56 ***
Postdoc	-0.72	0.49	-0.58	0.56 ***
Other	0.36	1.43	-0.23	0.79 ***
Tenure status (ref. = Tenured)				
On tenure track but not tenured	-0.56	0.57 *	0.17	1.19 **
Not on tenure track	0.12	1.13	-0.02	0.98
Carnegie classification (ref. = R1)				
R2	-0.35	0.70	0.01	1.01
Doctorate granting	-0.34	0.72	-0.05	0.95
Comprehensive	-0.16	0.85	-0.29	0.75 ***
Liberal arts	-0.04	0.96	-0.41	0.67 ***
Other	0.29	1.34	-0.11	0.90 **
Satisfaction	-0.06	0.94	0.10	1.11 ***
LR Chi-square		2975.03***		
Vuong test		21.34***		

* = p < .05, ** = p < .01, *** = p < .001

The Impact of Job Mobility on Presentation Productivity

When controlling for individual and professional background and employment characteristics, the group which moved to another employer and that which stayed with the same employer differed in terms of their likelihood of having no conference presentations (Table 13): the individuals who changed employers were 89% more likely to not have made any presentations during the study period (i.e., 2003–2008) than those who did not switch employers ($\exp(\gamma) = 1.89$; $p<.001$). Interestingly, this finding differs from the previous descriptive findings, which indicated that no significant difference exists between the two groups in terms of presentation activities. Meanwhile, among those who had at least one presentation during the study period, the observed difference in the number of conference presentations between the two groups was not statistically significant ($\exp(\beta) = 1.02$; $p>.05$).

Other Predictors of Presentation Productivity

According to the logistic regression results, doctorate holders were more likely to have no conference presentations with increasing career age ($\exp(\gamma) = 1.04$; $p<.001$). Naturalized citizens were less likely to have not given any presentations than native U.S. citizens ($\exp(\gamma) = 0.65$; $p<.05$). Regarding employment characteristics, doctorate holders whose primary role was in research and development (R&D) were less likely to have not given any presentations than those in any other type of work activity. Differences between tenured professors and those on the tenure track but not yet tenured were also significant: the latter group was 43% less likely to have not given any presentations ($\exp(\gamma) = 0.57$; $p<.05$).

Negative binomial regression results show that, female doctorate holders who had given at least one presentation gave 7% fewer presentations than their male counterparts ($\exp(\beta) = 0.93$; $p<.01$). With increasing career age, the expected number of presentations significantly

decreased (exp(β) = 0.99; p<.001). Additionally, married doctorate holders had 8% more presentations than did single doctorate holders even after controlling for other relevant factors, such as age and parental status (exp(β) = 1.08; p<.05). Meanwhile, race, parenting status, and U.S. citizenship did not significantly affect the number of presentations.

Field of study was associated with the total number of presentations among respondents who gave at least one conference presentation. Compared to doctorate holders in biological sciences, those in computer sciences/math gave 18% fewer conference presentations (exp(β) = 0.82; p<.001), and those in physical sciences, psychology, and engineering had 17% (p<.001), 10% (p<.05), and 22% (p<.001) more presentations, respectively. No difference was observed between doctorate holders in biological sciences and those in social sciences or health. Not surprisingly, previous presentation productivity was significantly and positively associated with presentation productivity (exp(β) = 1.04; p<.001).

PhDs holding a teaching position gave 24% fewer conference presentations than those holding an R&D position (exp(β) = 0.76; p<.001); those who indicated management as their primary work activity gave 13% fewer presentations (exp(β) = 0.87; p<.001). Position was also associated with presentation productivity. Full professors gave a significantly greater number of presentations than other employees of higher education institutions at all levels and of all types. Those on the tenure track but not yet tenured gave 19% more presentations than those tenured.

Employer characteristics were shown to affect presentation productivity. While the doctorate holders in very high research (R1) institutions did not differ in terms of presentation productivity compared to those in high research (R2) institutions or in doctorate granting institutions, they gave significantly more presentations than those in comprehensive institutions (exp(β) = 0.75; p<.001), liberal arts colleges (exp(β) = 0.67; p<.001), or other types of

institutions (exp(β) = 0.90; p<.01). Finally, perceived satisfaction significantly increased the expected number of conference presentations (exp(β) = 1.11; p<.001).

Table 14

Zero-inflated Negative Binomial Regression Model to Estimate the Impact of Job Mobility on Publication Productivity

Variables	**Logistic**		**Negative binomial**	
	γ	**Exp(γ)**	β	**Exp(β)**
Moved (vs. Not moved)	0.31	1.36	-0.06	0.94
Female (vs. Male)	0.03	1.04	-0.13	0.88 ***
Race (ref. = White)				
Asian	-0.19	0.83	-0.01	0.99
Black	0.02	1.02	-0.16	0.85 **
Hispanic	-0.04	0.96	-0.04	0.96
Other	0.06	1.06	0.08	1.08
Career age	0.03	1.03 ***	-0.01	0.99 ***
Married (vs. Not married)	-0.01	1.00	0.06	1.06
Parenting status (ref. = No children)				
Children<6	-0.21	0.82	0.03	1.03
Children6-18	-0.13	0.88	-0.01	0.99
Children≥19	-0.16	0.86	0.04	1.04
U.S. citizenship (ref. = Native)				
Naturalized citizen	0.43	1.54 *	0.06	1.07
Non-citizen	-0.19	0.83	0.03	1.03
Field (ref. = Biological sciences)				
Computer/Math	-0.02	0.98	-0.15	0.86 **
Physical sciences	0.01	1.01	0.06	1.06
Psychology	0.23	1.26	0.07	1.07
Social sciences	-0.33	0.72 *	-0.21	0.81 ***
Engineering	-0.10	0.90	0.06	1.06
Health	-0.33	0.72	0.08	1.08
Previous publications	-1.02	0.36 ***	0.05	1.05 ***
Primary work activity (ref. = R&D)				
Teaching	1.14	3.12 ***	-0.33	0.72 ***
Management	1.12	3.07 ***	-0.20	0.82 ***
Other	1.02	2.79 ***	-0.31	0.73 ***
Position (ref. = Full professor)				
Associate professor	-0.13	0.88	-0.13	0.88 ***
Assistant professor	-0.11	0.90	-0.25	0.78 ***
Instructor/Lecturer	0.60	1.83 *	-0.40	0.67 ***

Table 14 (cont'd)

Postdoc	-1.09	0.34	-0.59	0.55 ***
Other	0.53	1.70 *	-0.27	0.76 ***
Tenure status (ref. = Tenured)				
On tenure track but not tenured	-0.46	0.63 *	0.28	1.33 ***
Not on tenure track	0.13	1.14	0.01	1.01
Carnegie classification (ref. = R1)				
R2	-0.14	0.87	-0.06	0.94
Doctorate granting	0.16	1.17	-0.16	0.85 ***
Comprehensive	0.06	1.06	-0.51	0.60 ***
Liberal arts	0.30	1.34	-0.57	0.56 ***
Other	0.76	2.14 ***	-0.09	0.92 *
Satisfaction	-0.13	0.87	0.14	1.15 ***
LR Chi-square		3370.13***		
Vuong test		22.64***		

* = p < .05, ** = p < .01, *** = p < .001

The Impact of Job Mobility on Publication Productivity

When controlling for personal and professional background and employment characteristics, those who stayed with their employer and those who changed employers did not differ significantly in their likelihood of not having publications (exp(γ) = 1.36; p>.05). Of those who published, the number of publications did not differ significantly by job mobility status (exp(β) = 0.94; p>.05) (see Table 14).

Other Predictors of Publication Productivity

Logistic regression results show that, among the individual background factors included in the model, career age and U.S. citizenship status were significantly associated with the likelihood of having no publications. Higher career age was associated with a higher likelihood of not having publications (exp(γ) = 1.03; p<.001). Naturalized citizens were more likely to not have published than native U.S. citizens (exp(γ) = 1.54; p<.05). Regarding field of study, doctorate holders in social sciences were less likely to have zero publications compared to those

in biological sciences (exp(γ) = 0.72; p<.05). Not surprisingly, doctorate holders whose primary role was in research and development were less likely to have zero publications. Significant differences were also found between those tenured and those on the tenure track but not yet tenured: the latter group was 37% less likely to produce no journal articles (exp(γ) = 0.63; p<.05).

Negative binomial regression results show that, among respondents who had at least one publication, female doctorate holders had 12% fewer journal publications than their male counterparts (exp(β) = 0.88; p<.001). There was also a significant difference between Whites and Blacks: Blacks had 15% fewer publications than Whites (exp(β) = 0.85; p<.01). Higher career age was associated with a higher likelihood of having fewer publications. PhDs in computer sciences/math (exp(β) = 0.86; p<.01) and in social sciences (exp(β) = 0.81; p<.001) had fewer journal publications than those in biological sciences. Previous publication productivity was significantly and positively associated with subsequent publication productivity (exp(β) = 1.05; p<.001).

Significantly more publications were observed among doctorate holders whose primary role was in research and development than among those involved primarily in other types of work activity. Specifically, relative to doctorate holders holding an R&D position, those who indicated teaching as their primary work activity had 28% fewer publications (exp(β) = 0.72; p<.001); those who held a management/administration position had 18% fewer publications (exp(β) = 0.82; p<.001). In addition, doctorate holders with a full professorship published significantly more articles in refereed journals than did others. Those on the tenure track but not yet tenured published 33% more articles than those tenured (exp(β) = 1.33; p<.001).

Publication productivity varied by the Carnegie classification of the employing institution. While the doctorate holders in very high research (R1) institutions did not differ in publication productivity from those in high research (R2) institutions, they published significantly more articles in refereed journals than those in doctorate granting institutions (exp(β) = 0.85; p<.001), comprehensive institutions (exp(β) = 0.60; p<.001), liberal arts colleges (exp(β) = 0.56; p<.001), or other types of higher education institutions (exp(β) = 0.92; p<.05). Finally, the level of perceived satisfaction had a positive influence on publication productivity (exp(β) = 1.15; p<.001), not only on presentation productivity.

Does the Effect of Job Mobility on Research Productivity Differ by the Sector of Previous Employer?

To answer the second research question, Model 2-1 with conference presentation productivity and Model 2-2 with journal publication productivity as their respective outcome variables were tested on doctorate holders who had changed employers. In this section, the results of Model 2-1 are displayed in Table 15 and those of Model 2-2 are displayed in Table 16.

Table 15

Zero-inflated Negative Binomial Regression Model to Examine Whether the Impact of Job Mobility Differs by the Sector of Previous Employer

Variables	**Logistic**		**Negative binomial**	
	γ	**Exp(γ)**	β	**Exp(β)**
Previous sector (ref. = Within HE)				
From industry	-0.14	0.89	0.09	1.09
From non-industry	0.81	2.24	0.06	1.06
Female (vs. Male)	-0.11	0.90	-0.05	0.95
Race (ref. = White)				
Asian	0.35	1.41	0.00	1.00
Black	-0.79	0.46	0.10	1.10
Hispanic	0.27	1.31	-0.06	0.94

Table 15 (cont'd)

Other	-1.94	0.14	-0.29	0.75
Career age	0.02	1.02	-0.01	0.99
Married (vs. Not married)	0.07	1.07	0.25	1.28 **
Parenting status (ref. = No children)				
Children<6	-0.30	0.74	0.07	1.07
Children6-18	0.15	1.17	-0.16	0.85
Children≥19	0.63	1.87	0.14	1.15
U.S. citizenship (ref. = Native)				
Naturalized citizen	-0.54	0.58	0.04	1.04
Non-citizen	0.14	1.16	0.20	1.22
Field (ref. = Biological sciences)				
Computer/Math	0.39	1.47	-0.22	0.80
Physical sciences	0.65	1.91	0.26	1.29 *
Psychology	1.30	3.66 *	0.30	1.35 *
Social sciences	0.27	1.32	0.00	1.00
Engineering	0.43	1.53	0.14	1.15
Health	0.63	1.89	0.09	1.10
Previous publications	-0.68	0.51 ***	0.04	1.04 ***
Primary work activity (ref. = R&D)				
Teaching	1.00	2.71 *	-0.21	0.81 *
Management	1.13	3.09 *	-0.26	0.77 *
Other	0.40	1.50	-0.47	0.62 **
Position (ref. = Full professor)				
Associate professor	0.76	2.13	-0.32	0.72 *
Assistant professor	-0.03	0.97	-0.18	0.84
Instructor/Lecturer	0.69	1.99	-0.64	0.53 **
Postdoc	-0.12	0.89	-0.50	0.61 *
Other	0.34	1.40	-0.45	0.64 **
Tenure status (ref. = Tenured)				
On tenure track but not tenured	-0.71	0.49	0.12	1.13
Not on tenure track	0.35	1.42	-0.06	0.94
Carnegie classification (ref. = R1)				
R2	-1.05	0.35	-0.14	0.87
Doctorate granting	-0.84	0.43	-0.11	0.90
Comprehensive	-0.60	0.55	-0.16	0.85
Liberal arts	-0.45	0.64	-0.60	0.55 ***
Other	0.13	1.14	-0.16	0.85
Satisfaction	-0.45	0.64	0.10	1.11
LR Chi-square		364.31***		
Vuong test		8.29***		

* = p < .05, ** = p < .01, *** = p < .001

The Differences in the Impact of Job Mobility on Presentation Productivity by the Sector of Previous Employer

There was no significant difference by previous employment sector in presentation productivity among doctorate holders who changed their employers (Table 15). While the differences between the groups were not significant, the coefficients showed different patterns from those in the previous descriptive finding. In the regression model, doctorate holders who moved from the industry sector to the higher education sector had a lower likelihood of having not given conference presentations compared to those who moved within the higher education sector ($\exp(\gamma) = 0.89$; $p>.05$). By contrast, in the descriptive finding (see Table 12), the proportion of doctorate holders who were not involved in research activities during the five years following their job mobility was nearly twice that of those who moved from the industry sector as compared to those who moved within the higher education sector.

Other Predictors of Presentation Productivity Among Doctorate Holders Who Changed Employers

Logistic regression results indicate field and primary work activity as significant predictors of zero presentations. Compared to the doctorate holders in biological sciences, those in psychology were 3.7 times more likely to have no presentations ($\exp(\gamma) = 3.66$; $p<.05$). In addition, doctorate holders whose primary role was in research and development were less likely to have no presentations. To be specific, PhDs in teaching-focused positions were 2.7 times ($\exp(\gamma) = 2.71$; $p<.05$) and those in management/administrative positions were 3.1 times ($\exp(\gamma) = 3.09$; $p<.05$) more likely to have no presentations than those whose primary role was in research and development.

Negative binomial regression results show that no individual background variables except marital status were significant factors in the presentation productivity of doctorate holders who changed employers. Among this group, married doctorate holders had 28% more conference presentations than those who were unmarried ($\exp(\beta) = 1.28$; $p<.01$). In addition, significant differences in presentation productivity emerged by field of study: among those who had at least one conference presentation, those in psychology had 35% more presentations than those in biological sciences ($\exp(\beta) = 1.35$; $p<.05$). PhDs in physical sciences also had 29% more presentations than those in biological sciences ($\exp(\beta) = 1.29$; $p<.05$). Previous presentation productivity was positively associated with post-mobility presentation productivity ($\exp(\beta) = 1.04$; $p<.001$).

Doctorate holders whose primary role was in research and development had more total presentations than those primarily involved in other types of work activity. Of doctorate holders who had at least one presentation, those in teaching-focused positions had 19% fewer presentations ($\exp(\beta) = 0.81$; $p<.05$) and those in management/administrative positions had 23% fewer presentations ($\exp(\beta) = 0.77$; $p<.05$) than those in R&D-focused positions. Full professors significantly outperformed all doctorate holders in other positions except assistant professors. Associate professors had 28% fewer presentations than full professors ($\exp(\beta) = 0.72$; $p<.05$). Also, those in non-professor positions had 36–47% fewer publications than full professors. When position was considered in the model, tenure status did not significantly affect presentation productivity. Finally, there was a significant difference in presentation productivity between those who moved to liberal arts schools and those who moved to very high research institutions (R1) ($\exp(\beta) = 0.55$; $p<.001$).

Table 16

Zero-inflated Negative Binomial Regression Model to Examine the Differences in the Impact of Job Mobility on Presentation Productivity by the Sector of Previous Employer

Variables	**Logistic**		**Negative binomial**	
	γ	**Exp(*γ*)**	***β***	**Exp(*β*)**
Previous sector (ref. = Within HE)				
From industry	-1.04	0.35 *	-0.16	0.85
From non-industry	0.02	1.02	0.04	1.05
Female (vs. Male)	0.01	1.01	-0.02	0.98
Race (ref. = White)				
Asian	-1.28	0.28 *	-0.17	0.85
Black	0.39	1.48	-0.05	0.95
Hispanic	0.06	1.07	-0.27	0.76 *
Other	-0.56	0.57	-0.26	0.77
Career age	0.00	1.00	-0.01	0.99 *
Married (vs. Not married)	1.37	3.93 **	0.26	1.30 **
Parenting status (ref. = No children)				
Children<6	-0.46	0.63	-0.10	0.91
Children6-18	0.36	1.44	-0.10	0.90
Children≥19	0.71	2.03	0.35	1.42
U.S. citizenship (ref. = Native)				
Naturalized citizen	0.37	1.44	0.05	1.05
Non-citizen	-0.13	0.88	0.12	1.13
Field (ref. = Biological sciences)				
Computer/Math	0.01	0.01	-0.12	0.88
Physical sciences	0.88	2.41	0.14	1.15
Psychology	0.65	1.91	0.09	1.09
Social sciences	-0.27	0.76	-0.01	0.99
Engineering	0.46	1.59	0.26	1.30 *
Health	-0.08	0.92	0.29	1.34 *
Previous publications	-0.89	0.41 ***	0.05	1.05 ***
Primary work activity (ref. = R&D)				
Teaching	1.47	4.35 *	-0.44	0.65 ***
Management	1.70	5.49 **	-0.44	0.64 ***
Other	1.61	4.99 **	-0.05	0.95
Position (ref. = Full professor)				
Associate professor	-0.14	0.87	-0.29	0.75 *
Assistant professor	-0.30	0.74	-0.11	0.89
Instructor/Lecturer	0.08	1.09	-0.70	0.49 **
Postdoc	-13.37	0.00	-0.62	0.54 **
Other	0.81	2.25	-0.39	0.68 *

Table 16 (cont'd)

Tenure status (ref. = Tenured)				
On tenure track but not tenured	-1.07	0.34	-0.08	0.92
Not on tenure track	-0.50	0.61	-0.29	0.75 *
Carnegie classification (ref. = R1)				
R2	0.62	1.87	-0.16	0.85
Doctorate granting	0.00	1.00	-0.14	0.86
Comprehensive	-0.16	0.85	-0.23	0.80 *
Liberal arts	0.56	1.76	-0.50	0.61 ***
Other	1.20	3.33 **	-0.15	0.86
Satisfaction	-1.06	0.35 **	-0.03	0.97
LR Chi-square		466.43***		
Vuong test		8.92***		

* = p < .05, ** = p < .01, *** = p < .001

The Differences in the Impact of Job Mobility on Publication Productivity by the Sector of Previous Employer

Table 16 presents the results of the models that predict publication productivity. Doctorate holders who moved from the industry sector to the higher education sector were 65% less likely to have no publications than those who moved within the higher education sector ($\exp(\gamma) = 0.35$; $p<.05$), which contrasts with the previous descriptive finding in which the proportion of doctorate holders with zero publications was notably higher among those moving from the industry sector (see Table 12). When focused on those with publication records, the sector of previous employer was not associated with research productivity as measured by the number of journal publications.

Other Predictors of Publication Productivity Among Doctorate Holders Who Changed Employers

According to the logistic regression results, being Asian significantly decreased the likelihood of having zero publications ($\exp(\gamma) = 0.28$; $p<.05$); being married increased the odds

of having zero publications (exp(γ) = 3.93; p<.01). Regarding employment characteristics, doctorate holders whose primary role was in research and development were less likely to have not published. Also, those who had higher satisfaction with their job were less likely to have zero publications (exp(γ) = 0.35; p<.05).

Negative binomial regression results show that, among the individual background factors included in the model, race, career age, and marital status were significantly associated with the number of journal publications. Among those who published, Hispanics had 24% fewer publications than their White counterparts (exp(β) = 0.76; p<.05). While career age was not associated with doctorate holders' likelihood of having zero publications, when they had at least one journal publication, an increase in career age was significantly associated with a lower number of publications (exp(β) = 0.99; p<.05). Those who were married had 30% more publications than those who were not (exp(β) = 1.30; p<.01).

While doctorate holders in physical sciences and psychology significantly differed from those in biological sciences in terms of their presentation productivity, the differences were not significant in the model for publication productivity. On the other hand, doctorate holders in engineering or health sciences published 30–34% more articles than those in biological sciences. Meanwhile, previous publication productivity was a strong predictor of post-job mobility publication productivity (exp(β) = 1.05; p<.001).

Doctorate holders whose primary role was in research and development were more likely to have published more articles than those whose primary role was in non-R&D activities. As was the case in the model with presentation productivity, full professors showed significantly higher productivity than those in other positions except assistant professors: associate professors published 25% fewer articles (exp(β) = 0.75; p<.05) and those in non-professor positions

published 32–51% fewer journal articles than full professors. In addition, doctorate holders not on the tenure track had 25% fewer publications than those who were tenured (exp(β) = 0.75; p<.05). Regarding the employer's Carnegie classification, working in comprehensive or liberal arts institutions that focus on teaching rather than research was negatively associated with publication productivity.

Does the Effect of Job Mobility on Research Productivity Differ by Reasons for Job Mobility?

To examine whether the impact of job mobility on research productivity differs by reasons for changing employers (research question 3), Models 3-1 and 3-2 were estimated for doctorate holders who changed employers. The findings of Model 3-1 with presentation productivity as the outcome variable are presented in Table 17, and the results of Model 3-2 with journal publications as the outcome variable are displayed in Table 18.

Table 17

Zero-inflated Negative Binomial Regression Model to Examine the Differences in the Impact of Job Mobility on Presentation Productivity by Reasons for Job Mobility

Variables	**Logistic**		**Negative binomial**	
	γ	**Exp(γ)**	β	**Exp(β)**
Reason for changing employers				
Pay/promotion (vs. No)	-0.44	0.65	0.17	1.19 *
Working conditions (vs. No)	0.01	1.01	0.00	1.00
Job location (vs. No)	-0.69	0.50 *	-0.01	0.99
Change in interests (vs. No)	0.05	1.05	0.03	1.03
Family-related reasons (vs. No)	-0.08	0.92	-0.13	0.88
Lay-off (vs. No)	-0.88	0.41	-0.26	0.77 **
Female (vs. Male)	-0.02	0.98	-0.02	0.98
Race (ref. = White)				
Asian	0.44	1.55	-0.04	0.96
Black	-0.68	0.51	0.09	1.09
Hispanic	0.28	1.33	-0.07	0.94

Table 17 (cont'd)

Other	-1.44	0.24	-0.39	0.68
Career age	0.02	1.02	-0.01	0.99
Married (vs. Not married)	0.13	1.14	0.21	1.24 *
Parenting status (ref. = No children)				
Children<6	-0.45	0.64	0.08	1.09
Children6-18	-0.02	0.98	-0.16	0.86
Children≥19	0.27	1.31	0.09	1.09
U.S. citizenship (ref. = Native)				
Naturalized citizen	-0.42	0.66	0.10	1.11
Non-citizen	0.05	1.05	0.22	1.24
Field (ref. = Biological sciences)				
Computer/Math	0.37	1.44	-0.13	0.87
Physical sciences	0.61	1.84	0.29	1.34 **
Psychology	1.31	3.72 *	0.33	1.39 **
Social sciences	0.45	1.57	0.01	1.01
Engineering	0.13	1.14	0.22	1.25
Health	0.45	1.56	0.09	1.09
Previous publications	-0.62	0.54 ***	0.04	1.04 ***
Primary work activity (ref. = R&D)				
Teaching	0.78	2.18 *	-0.20	0.81 *
Management	1.07	2.91 *	-0.35	0.71 **
Other	0.68	1.97	-0.46	0.63 ***
Position (ref. = Full professor)				
Associate professor	0.69	1.99	-0.32	0.73 *
Assistant professor	0.02	1.02	-0.19	0.82
Instructor/Lecturer	0.54	1.72	-0.61	0.54 **
Postdoc	-0.04	0.96	-0.51	0.60 **
Other	0.22	1.24	-0.45	0.64 **
Tenure status (ref. = Tenured)				
On tenure track but not tenured	-0.52	0.60	0.13	1.14
Not on tenure track	0.32	1.38	0.02	1.02
Carnegie classification (ref. = R1)				
R2	-0.50	0.61	-0.11	0.90
Doctorate granting	-1.09	0.34	-0.09	0.92
Comprehensive	-0.60	0.55	-0.17	0.85
Liberal arts	-0.50	0.61	-0.59	0.55 ***
Other	0.26	1.29	-0.14	0.87
Satisfaction	-0.53	0.59	0.03	1.03
LR Chi-square		378.90***		
Vuong test		8.48***		

* = p < .05, ** = p < .01, *** = p < .001

The Differences in the Impact of Job Mobility on Presentation Productivity by Reasons for Job Mobility

Holding other control variables constant, changing employers for a better job location was associated with a 50% lower likelihood of having no presentations ($\exp(\gamma) = 0.50$; $p<.05$). Of those with presentation activities, doctorate holders who indicated that they changed employers for better pay and promotion opportunities gave 19% more conference presentations than those who did not ($\exp(\beta) = 1.19$; $p<.05$). On the other hand, those whose previous job was terminated gave 23% fewer presentations compared to those who were not affected by the job security issue ($\exp(\beta) = 0.77$; $p<.01$).

Other Predictors of Presentation Productivity Among Doctorate Holders who Changed Employers

The logistic regression results of Model 3-1 (Table 17) indicate field and primary work activity as significant predictors of zero presentations. Compared to the PhDs in biological sciences, those in psychology were 3.7 times more likely to have zero presentations ($\exp(\gamma) = 3.72$; $p<.05$). In addition, doctorate holders in research and development positions were less likely to have no presentations: the doctorate holders whose primary responsibility was teaching were 2.2 times ($\exp(\gamma) = 2.18$; $p<.05$) and those whose primary responsibility was management were 2.9 times ($\exp(\gamma) = 2.91$; $p<.05$) more likely to have zero presentations.

In the negative binomial regression results, marital status was the only significant factor among individual background variables predicting the presentation productivity of doctorate holders who changed employers. Of those who changed employers, married doctorate holders had 24% more conference presentations than did those who were unmarried ($\exp(\beta) = 1.24$; $p<.05$). In addition, there were differences by field of study: PhDs in psychology produced 39%

more presentations (exp(β) = 1.39; p<.01) and those in physical sciences produced 34% more presentations (exp(β) = 1.34; p<.01) than their counterparts in the biological sciences. Meanwhile, presentation productivity between 1998 and 2003 was a strong predictor of presentation productivity between 2003 and 2008 (exp(β) = 1.04; p<.001).

Doctorate holders in research and development positions gave more presentations than those in other types of positions. Specifically, those whose primary responsibility was teaching had 19% fewer presentations and those whose primary responsibility was management had 29% fewer presentations relative to those whose primary responsibility was research and development. Also, full professors had more conference presentations than those in other positions except assistant professors. Associate professors had 27% fewer presentations than full professors. Those in non-professor positions had 36–46% fewer presentations than full professors. Finally, there was a significant difference in presentation productivity between those who worked for liberal arts and very high research institutions (R1) (exp(β) = 0.55; p<.001).

Table 18

Zero-inflated Negative Binomial Regression Model to Examine the Differences in the Impact of Job Mobility on Publication Productivity by Reasons for Job Mobility

Variables	**Logistic**		**Negative binomial**	
	γ	**Exp(*γ*)**	***β***	**Exp(*β*)**
Reason for changing employers				
Pay/promotion (vs. No)	0.01	1.01	0.03	1.03
Working conditions (vs. No)	-0.25	0.78	0.01	1.01
Job location (vs. No)	-0.33	0.72	-0.02	0.98
Change in interests (vs. No)	0.11	1.11	0.00	1.00
Family-related reasons (vs. No)	0.63	1.88	0.07	1.07
Lay-off (vs. No)	-0.03	0.97	-0.18	0.84
Female (vs. Male)	0.01	1.01	-0.03	0.97
Race (ref. = White)				
Asian	-1.14	0.32	-0.17	0.85

Table 18 (cont'd)

Black	0.45	1.56	-0.03	0.97
Hispanic	0.05	1.05	-0.26	0.77 *
Other	-0.33	0.72	-0.26	0.77
Career age	0.00	1.00	-0.01	0.99
Married (vs. Not married)	1.50	4.47 **	0.26	1.29 **
Parenting status (ref. = No children)				
Children<6	-0.69	0.50	-0.11	0.90
Children6-18	0.16	1.18	-0.10	0.90
Children≥19	0.10	1.11	0.28	1.32
U.S. citizenship (ref. = Native)				
Naturalized citizen	0.58	1.79	0.09	1.09
Non-citizen	0.06	1.07	0.12	1.13
Field (ref. = Biological sciences)				
Computer/Math	-0.49	0.61	-0.13	0.88
Physical sciences	0.74	2.11	0.13	1.14
Psychology	0.76	2.15	0.09	1.09
Social sciences	-0.17	0.85	0.00	1.00
Engineering	-0.01	0.99	0.22	1.25 *
Health	-0.45	0.64	0.28	1.33 *
Previous publications	-0.86	0.42 ***	0.05	1.05 ***
Primary work activity (ref. = R&D)				
Teaching	1.38	3.97 *	-0.44	0.64 ***
Management	1.89	6.64 **	-0.41	0.66 ***
Other	1.58	4.85 **	-0.08	0.92
Position (ref. = Full professor)				
Associate professor	-0.33	0.72	-0.27	0.76 *
Assistant professor	-0.35	0.70	-0.08	0.92
Instructor/Lecturer	-0.02	0.98	-0.69	0.50 **
Postdoc	-1.90	0.15	-0.51	0.60 **
Other	0.48	1.62	-0.34	0.71 *
Tenure status (ref. = Tenured)				
On tenure track but not tenured	-1.20	0.30	-0.08	0.93
Not on tenure track	-0.62	0.54	-0.28	0.76 *
Carnegie classification (ref. = R1)				
R2	0.47	1.61	-0.14	0.87
Doctorate granting	0.05	1.05	-0.14	0.87
Comprehensive	-0.25	0.87	-0.23	0.80 *
Liberal arts	0.60	1.82	-0.48	0.62 ***
Other	1.18	3.25 **	-0.15	0.86
Satisfaction	-1.02	0.36 **	-0.05	0.95
LR Chi-square		469.93***		
Vuong test		8.91***		

* = p < .05, ** = p < .01, *** = p < .001

The Differences in the Impact of Job Mobility on Publication Productivity by Reasons for Job Mobility

The effect of job mobility on publication productivity did not differ by reasons for job mobility (Table 18). This finding is in contrast to the descriptive findings presented in Table 12, in which three reasons (e.g., pay or promotion opportunities, working conditions, and lay-off/job termination) were strongly related to publication productivity. In other words, once all other factors were considered in the regression model, the differences in the association between job mobility and productivity by reasons for job mobility disappeared.

Other Predictors of Publication Productivity Among Doctorate Holders Who Changed Employers

In the logistic regression results of Model 3-2 (Table 18), married doctorate holders were more likely to have zero journal publications than unmarried doctorate holders ($\exp(\gamma) = 4.47$; $p<.01$). In addition, doctorate holders in non-R&D positions were 4–6.6 times more likely to not be involved in publication activities compared to those in R&D positions. Those who had higher satisfaction with their job were less likely to have zero publications ($\exp(\gamma) = 0.36$; $p<.01$).

Negative binomial regression results show that race and marital status were significantly associated with the number of journal publications. Of those who published articles, Hispanics had 23% fewer publications than Whites ($\exp(\beta) = 0.77$; $p<.05$). Married doctorate holders had 29% more publications than unmarried doctorate holders ($\exp(\beta) = 1.29$; $p<.01$). Regarding professional background variables, doctorate holders in engineering or health sciences published 25–33% more articles, compared to those in biological sciences. Previous publication records were also significantly associated with publication productivity after changing employers ($\exp(\beta) = 1.05$; $p<.001$).

Doctorate holders holding teaching or management positions had 35% fewer publications than those holding R&D positions. Full professors demonstrated significantly higher publication productivity than those in the other positions except assistant professors. Associate professors had 24% fewer publications than full professors ($\exp(\beta) = 0.76$; $p<.05$); those in non-professor positions had 29–50% fewer publications than full professors. In addition, doctorate holders not on the tenure track had 24% fewer publications than those who were tenured ($\exp(\beta) = 0.76$; $p<.05$). With regard to Carnegie classification, working in comprehensive or liberal arts institutions was negatively associated with publication productivity.

Summary of the Findings

The findings of this study are summarized in Table 19. The findings of this study showed that doctorate holders who moved were more likely to have no presentations during the study period (i.e., 2003–2008) than those who did not. Doctorate holders who moved from industry to higher education were less likely to have no publications than those who moved within the higher education sector. Changing employers for a better job location was associated with a lower likelihood of having zero presentations. Of those who had at least one conference presentation, doctorate holders who indicated that they changed employers for better pay and opportunities for career advancement produced more presentations in their new position than those who did not. On the other hand, those who left their previous employer due to job termination gave fewer presentations compared to those who had not been affected by job insecurity.

Table 19

Summary of the Findings

Research Question	**Independent Variable**	**Conference presentations**		**Journal publications**	
		Logistic	***NB***	***Logistic***	***NB***
1. Does job mobility affect doctorate holders' research productivity?	Moved (vs. Not moved)	+	*NS*	*NS*	*NS*
2. Does the effect of job mobility on research productivity differ by the sector of previous employer?	From industry (vs. Within HE)	*NS*	*NS*	-	*NS*
	From non-industry (vs. Within HE)	*NS*	*NS*	*NS*	*NS*
3. Does the effect of job mobility on research productivity differ by reasons for job mobility?	Pay/promotion	*NS*	+	*NS*	*NS*
	Working conditions	*NS*	*NS*	*NS*	*NS*
	Job location	-	*NS*	*NS*	*NS*
	Change in interests	*NS*	*NS*	*NS*	*NS*
	Family-related reasons	*NS*	*NS*	*NS*	*NS*
	Lay-off	*NS*	-	*NS*	*NS*

Note. *NS* = Not Significant.

Chapter 6: Discussion and Conclusion

Job mobility has received scholarly attention as a type of career event that can facilitate doctorate holders' research activities/productivity and career development. However, we still do not have sufficient empirical knowledge about how doctorate holders' job mobility affects their research productivity. Previous relevant studies were mostly conducted outside the U.S., leaving the link between job mobility and research productivity in the U.S. context understudied. Furthermore, prior research has reported mixed findings with respect to the effect of job mobility on research performance. As such, this dissertation has sought to make a contribution by exploring whether doctorate holders' job mobility is associated with their research productivity in the U.S. and examining whether the effect of job mobility on research productivity differs by the professional and personal contexts of the doctorate holders who move, particularly by their previous employment sector and reasons for job mobility. For this, three research questions were addressed: (1) Does job mobility affect doctorate holders' research productivity? (2) Does the effect of job mobility on research productivity differ by the sector of previous employer? (3) Does the effect of job mobility on research productivity differ by reasons for job mobility? The rest of this chapter provides the interpretation of the findings from the analysis for each research question and then discusses the theoretical and practical implications of the findings and future research directions.

The Impact of Job Mobility on Research Productivity

The first research question was, "Does job mobility affect doctorate holders' research productivity?" According to the results, those who changed employers were significantly more likely not to be involved in presentation activities after moving to a different employer, even after controlling for individual characteristics, previous presentation records, and employment

characteristics (Table 13). When focused on those who had at least one presentation/publication, the job mobility indicator of whether the doctorate holders changed employers between 2001 and 2003 was not significantly associated with their research performance, measured as the number of presentations/publications produced between 2003 and 2008. In other words, job mobility, in general, was found not to affect the research productivity of doctorate holders who are active in presentation/publication activities. This finding is different from previous studies in which the effect of job mobility on research productivity appeared significant, though the direction of the effect was not consistent across studies, with some studies found a positive association (De Filippo et al., 2009; Dubois et al., 2014; Ejermo et al., 2020; Halevi et al., 2016; Hoisl, 2007, 2009; Tartari et al., 2020) while others found a negative association (Aksnes et al., 2013; Bolli & Schläpfer, 2015; Cañibano et al., 2008; Fernández-Zubieta et al., 2013, 2015a) between job mobility and research productivity. This distinct finding shows that job mobility of doctorate holders working in the higher education sector in the U.S. does not significantly affect their research productivity in general, unlike in the European context where previous studies have been carried out. Given that it is common for doctoral graduates in many European countries to remain at the same institution where they received their degree during their academic careers (Cruz-Castro & Sanz-Menéndez, 2010; Ejermo et al., 2020; Horta et al., 2010), changing employers can have different meanings and effects on research productivity in the U.S and many European countries.

The Differences in the Impact of Job Mobility on Research Productivity by the Sector of Previous Employer

The second research question asks, “Does the effect of job mobility on research productivity differ by the sector of previous employer?” The results show that job mobility from

industry decreased the likelihood of having zero publications compared with job mobility within higher education (Table 16). Among doctorate holders with at least one presentation/publication, no significant difference was observed in productivity (2003–2008). It might be because those who move to the higher education sector share similar qualifications and orientations. Doctorate holders tend to move towards working environments that match better with their professional orientation. For instance, while doctorate holders who are oriented toward basic research are more likely to pursue academic positions, those who are inclined toward applied and commercialized research are more likely to pursue industrial positions (Agarwal & Ohyama, 2013; Balsmeier & Pellens, 2014; Fritsch & Krabel, 2012; Krabel & Mueller, 2009; Roach & Sauermann, 2010). Furthermore, on the demand side, institutions hire employees who they believe fit well to the organization and position (Bruff, 2007; Fuerstman & Lavertu, 2005; Meizlish & Kaplan, 2008; Singh & Agrawal, 2011). Moving to the higher education sector, therefore, indicates that the movers have the qualifications, aptitude, and potential that are expected to contribute to their success in the destination sector. The finding may also mean that the current working environment has a stronger influence on performance than previous experience. Lin and Bozeman (2006) support this possibility, finding that there were significant differences between faculty with and without industry experience in total career publications, but the differences were not significant anymore when focused on publications for the recent five years during which the faculty were in higher education.

Comparing the regression findings with the descriptive findings provides additional insights into the differences in the relationship between job mobility and research productivity by previous sector. The simple descriptive comparison of productivity measures showed that the share of doctorate holders who produced no research outputs (either conference presentations or

journal publications) after changing employers (2003–2008) was higher among those who moved from the industry sector than among those who moved within the higher education sector or from non-industry sectors. In particular, the share of doctorate holders not involved in presentation/publication activities was nearly twice as high among those moving from industry to higher education compared to those moving within higher education (Table 12). Moreover, when comparing productivity for 2003–2008 among doctorate holders who had at least one presentation/publication from different sectors, those moving from the industry sector were the least productive (Table 12). As described in the previous paragraph, the low productivity of those from industry disappeared when all other things were considered in the regression models, indicating that their low productivity was attributable to other characteristics included in the model rather than to their industry background.

Of the variables considered in the regression analyses, employment characteristics seem to be important factors that explain the different patterns between descriptive findings and regression findings. The descriptive findings in Chapter 4 show that those who moved from the industry sector were concentrated in positions associated with zero or lower levels of research productivity—such as non-faculty/non-tenure track positions, or associate professors although they held faculty appointments (Table 9). The differences in the distribution of positions by previous sector might be related to the transition costs of crossing sector boundaries. The adaptation burden when crossing sectoral boundaries is greater than that when changing employers within a sector due to sector differences in working environments, knowledge production, and reward structures; particularly, moving between industry and academia requires greater adaptation efforts because of stark differences between the two (Anderson, 2009; LaRocco & Bruns, 2006; Martin, 2004; Porter, 2019; Wilson et al., 2014). For this reason, some

doctorate holders from the industry sector who would like to move to and settle in the higher education sector go through a transition period. For example, they have to accept less secure positions such as postdocs or lecturers/instructors (Carrigan et al., 2017) or take positions at a lower level from their previous careers (Garrison, 2005).

To secure the same type/level of position, those from industry would need to show evidence of their capability and aptitude when applying for a position in higher education, with a comparable track record to that of other candidates from another higher education institution, to prove their research performance (e.g., publication records) (Crowder & Mouratidou, 2020; Martin, 2004; Weimer, 2001). It might be the reason why those moving from industry to higher education were less likely to have no publications than those moving within higher education when controlling for other factors, including employment characteristics, in the model. The findings show that, though experience from non-academic sectors does not directly affect their research performance after mobility, they can indirectly affect performance by limiting available positions in the transition process.

The Differences in the Impact of Job Mobility on Research Productivity by Reasons for Job Mobility

The third research question asks, "Does the effect of job mobility on research productivity differ by reasons for job mobility?" According to the results, doctorate holders who changed employers for better pay/promotion opportunities had significantly higher research productivity than those who did so for other reasons, though the association was limited to presentation productivity. This result demonstrates the benefits of relocating to a position that better recognizes and supports their work on productivity gains. Admittedly, however, the direction of this effect can still be unclear. Doctorate holders who could find job opportunities

offering better compensation and recognition might be more competitive in the job market in the first place. In fact, prior research has shown that high performers have access to better job opportunities in the academic job market (Matier, 1990; Zucker, Darby, & Torero, 2002) and are more likely to move to another employer (Allison & Long, 1987; Azoulay et al., 2017; Crespi et al., 2006; Kim et al., 2020; Zucker, Darby, & Torero, 2002). To avoid reverse causality, in this study there is time lag between when job mobility occurred and when research performance was measured. In addition, previous productivity levels before changing employers were also included in the regression models to consider the doctorate holders' previous research experience and capabilities. Nonetheless, those who changed employers for better pay/promotion opportunities might still have unobservable attributes related to their capability and aptitude. It is possible that the benefits of job mobility for better pay/promotion opportunities might have been somewhat overestimated due to those unobservable attributes.

Changing employers because of working conditions or changes in professional interests was not related to the doctorate holders' research productivity represented by the number of presentations or publications. This finding may indicate that job mobility driven by a desire to find a position that better matches one's professional preferences does not make a difference in post-mobility research productivity, which does not correspond with what the scientific and technical human capital theory and the job matching theory suggest. The results may have been affected by the ambiguous nature of the survey items. Each of the both items (i.e., working conditions and changes in professional interests) embraces a range of specific reasons under an umbrella term. For example, in light of the literature, working conditions may include department climate (Sheridan et al., 2017), peer quality (Azoulay et al., 2017; Laudel & Bielick, 2019), and work-life balance (Crowder & Mouratidou, 2020; Garrison, 2005; Volkamer &

Riniker, 2018). Job mobility to pursue quality peer communities and job mobility for better work-life balance, for instance, can be associated differently with research activities in their new position. However, the data used in this study could not identify such details, leaving room for future research.

While doctorate holders who indicated that they changed employers for a more preferable job location were less likely to have no conference presentations, there was no difference in the number of research outputs among those who had at least one presentation. Family-related reasons had no association with the number of presentations and publications. It is possible that, even though doctorate holders consider changing jobs for reasons not directly related to their jobs and careers, they make the ultimate decision to move only when positions that meet their minimum career-related standards are available. If such minimum standards exist, the simple dichotomous distinction between voluntary and involuntary mobility proposed in previous studies (e.g., Ackers, 2008; de Rassenfosse & Hoisl, 2018; Ferro, 2006) would not work appropriately as an analytical frame. There probably exists a third type of mobility, which can be called bounded voluntary mobility, where doctorate holders find an acceptable alternative position to move to within their own standards.

Doctorate holders who changed employers because of lay-off/job termination were less productive than those who changed employers for other reasons, though the association was significant only for presentation productivity, not publication productivity. Those who are forced to find another position due to lay-off/job termination might have limited time and options available; therefore, they might have to accept a less appealing job in terms of professional advancement (Allgood & Farrell, 2003; de Rassenfosse & Hoisl, 2018). In fact, the descriptive findings of this study showed that those who changed employers due to lay-offs had significantly

lower satisfaction with their new position than those who moved for other reasons (Table 10). Accepting a less suitable position might have adversely affected their human and social capital development, job match quality, and subsequent research performance in the new position.

Other Determinants of Research Productivity

There are other factors that are related to research productivity. Of the individual characteristics, gender played an important role in research productivity even after adjusting for family factors, such as marital and parenting status, and their position characteristics. This finding confirms previous literature showing that male researchers will likely outperform their female counterparts (Betsey, 2007; Hesli & Lee, 2011; Knepper et al., 2020; Maske et al., 2003; Potter et al., 2011; Sheridan et al., 2017; Stack, 2004; Toutkoushian & Bellas, 1999). Such a gender disparity in research productivity can further deepen the gender gap in career advancement because female doctorate holders may have to meet higher standards for promotion and advancement (Long et al., 1993; Park & Gordon, 1996). This finding again urges continuous academic and administrative attention to systemic gender disparities.

Employment characteristics were particularly important in predicting research productivity. As expected, doctorate holders produced significantly more research output when they were primarily involved in research and development. In addition, productivity increased as academic rank increased with full professors producing the largest number of research outputs, consistent with prior research findings (Betsey, 2007; Sax et al., 2002; Tien & Blackburn, 1996; Toutkoushian & Bellas, 1999). This increase in research productivity with increasing academic rank can be explained by the human and cultural capital the faculty members had accumulated throughout their careers (McNurlen & West, 2000). Moreover, senior faculty can contribute to research projects through diverse roles, such as by serving as mentors or data contributors (Jones

& McCullough, 2015; Syed et al., 2015). These broader roles might have affected the results, increasing the normal counts of research outputs among senior-level faculty members, which were measured in this study without considering the number of authors or authorship orders. Meanwhile, it is interesting that the differences in research productivity between full professors and assistant professors disappeared when focused only on doctorate holders who changed employers. This result may be related to assistant professors' active efforts to settle into and develop their early careers by searching for more suitable jobs and accelerating their research performance.

In addition, significant differences were observed by tenure status: doctorate holders on the tenure track but not yet tenured showed higher productivity than those who were already tenured. However, the difference disappeared when focused on those who changed employers. This finding is intuitive given the general research expectations for obtaining tenure, particularly at research-focused institutions (Coggburn & Neely, 2015; Corbett, 1992; Dennis et al., 2006; Marshall & Rothgeb, 2011; Rothgeb & Burger, 2009). Meanwhile, doctorate holders working at very high research institutions (R1) produced significantly more conference presentations and journal articles than their peers at comprehensive or liberal arts institutions. Doctorate holders working at high research institutions (R2) were not significantly different from those at R1 institutions in terms of research productivity. In other words, those at research-oriented institutions were unsurprisingly more productive in research than those at teaching-oriented institutions. While the significance of employment characteristics highlights the importance of working environments and incentive systems in facilitating research performance, the direction of this association has not been established. Prior research has indicated that doctorate holders self-select their specific type of position and employer according to their job attribute preference

(Agarwal & Ohyama, 2013; Balsmeier & Pellens, 2014; Krabel & Mueller, 2009; Roach & Sauermann, 2010). Those with a strong research orientation are more likely to choose research-focused positions and institutions. In addition, doctorate holders with greater research capability are more likely to secure ladder faculty positions and be tenured (Coggburn & Neely, 2015; Corbett, 1992; Dennis et al., 2006; Mangematin, 2000; Mangematin et al., 2000; Marshall & Rothgeb, 2011; Rothgeb & Burger, 2009; Sheridan et al., 2017; Tregellas et al., 2018). Although the analysis models included previous productivity to consider this effect, the estimated relationship should still be interpreted cautiously.

Following prior research, perceived satisfaction was a strong predictor of research productivity (Kim et al., 2011; Sabharwal & Corley, 2009). It should be mentioned that the relationship between job mobility and research productivity cannot be separated from satisfaction. High satisfaction could be achieved if one's job mobility was voluntary and contributed to the match quality between individuals and their employers. The opposite case would also be possible. In fact, the job satisfaction level varied depending on why the doctorate holder had changed employers (Table 10). Therefore, satisfaction may to some extent mediate the impact of job mobility on research productivity.

Implications for Theory and Literature

This study adds empirical research conducted in the U.S. context to the literature. Most previous studies that address how doctorate holders' job mobility is related to their role as knowledge producers have been conducted in European contexts such as Germany (Hoisl, 2007, 2009), Norway (Aksnes et al., 2013), Spain (Cañibano et al., 2008; De Filippo et al., 2009), Sweden (Ejermo et al., 2020), and the U.K. (Fernández-Zubieta et al., 2013, 2015a; Tartari et al., 2020). Even some studies conducted in the U.S. targeted a narrower group of doctorate

holders—for example, Lin and Bozeman (2006) focused on faculty affiliated with National Science Foundation (NSF) and Department of Energy (DOE) research centers; Ryazanova and McNamara (2016) focused on academics at business schools. This study contributes to the literature by exploring a broader sample of doctorate holders who work in higher education in the U.S.

In addition, this dissertation contributes to our understanding of the conditions under which we can expect the impact of job mobility on research productivity to be positive or negative. In prior relevant research, the effects of moving between employers on doctorate holders' research performance were assumed based on the potential contribution of job mobility to expanding networks for the exchange of intellectual resources and/or finding environments where they can make the best use of their resources. The assumption is relevant to STHC model and job matching theory. The STHC model suggests that job mobility can affect research productivity through changes in human and social capital (Dietz & Bozeman, 2005; Lin & Bozeman, 2006; Ponomariov & Boardman, 2010). Job matching theory explains that job mobility's effects on productivity are attributable to changes in job match quality after job mobility. This study's findings showed that, when doctorate holders were motivated by favorable compensation and recognition from another employer, their job mobility was positively associated with their performance in the new position; when doctorate holders were forced to move due to job insecurity, their research performance was negatively affected. While this study does not provide empirical explanations of the specific mechanisms behind this relationship, from the standpoint of STHC model and job matching theory, the findings suggest that professional and personal contexts that drive doctorate holders to consider changing jobs influence job opportunities and constraints, in turn affecting the degree and direction of changes

in human and social capital/job match quality as a result of moving to another employer. It encourages future research to investigate how the contexts of job mobility shape doctorate holders' job search and decision-making process and how they are linked to the possibilities of finding a well-fitting position that is beneficial in accumulating and utilizing the doctorate holders' human and social capital.

Implications for Policy and Practice

This study has implications for hiring practices at higher education institutions. Theoretically, moving to another sector can positively and negatively affect research productivity. On the one hand, sector switchers might have to experience a more challenging transition (LaRocco & Bruns, 2006; Martin, 2004). On the other hand, they can benefit from their human and social capital accumulated from the broader background (Abreu & Grinevich, 2013; Carrigan et al., 2017; Gulbrandsen & Thune, 2017; Powell, 2004; Weimer, 2001). Despite this complex transition process involved in sector switching, this study's results showed that doctorate holders who moved to the higher education sector did not differ in their post-mobility research productivity by the sector of previous employment. Recruiters at higher education institutions could utilize this information in establishing their recruitment and hiring strategies. In light of this study, recruiters can hire candidates from diverse sectors to enrich their campus/department/team with a greater diversity of scientific and technical human capital without worrying about performance.

The findings also urge policymakers and higher education leaders to take the job security issues of doctorate holders more seriously. The prevalence of contingent positions in higher education has been well documented. For example, higher education institutions motivated by the needs for cost reduction and flexible employment have increasingly hired contingent faculty

(Curtis & Thornton, 2014; Finkelstein et al., 2016; Schuster & Finkelstein, 2006). Along with this trend, the number and share of contingent faculty positions have increased greatly at all types of higher education institutions, not only at public two-year institutions and for-profit institutions that were traditional employers of the contingent academic workforce (Kezar & Maxey, 2013; McNaughtan et al., 2017). In the literature, there have been concerns about how the increasing job insecurity affects their effectiveness (Baldwin & Wawrzynski, 2011; Goldenberg & Cross, 2011) and job satisfaction (Howell & Hoyt, 2007). Adding to the existing concerns, this study's findings show that the lack of job security and forced job mobility caused by it can be adversely related to their subsequent research activities. The lack of job security in this regard impedes the optimal use of doctoral-level human resources. Further, given that research records often play a role in achieving career advancement in higher education (Meizlish & Kaplan, 2008; Wright & Vanderford, 2017), the failure to obtain a secure job at an earlier stage in their careers can have cumulative effects on doctorate holders' entire careers (Kindsiko & Baruch, 2019). Thus, there need to be policy and practice efforts to increase job security to better deploy doctorate-level human resources to places where they can be better utilized.

Future Research

There are several possibilities for future related research. First, future research could explore how job mobility affects a broader range of outcomes. This study captured only partial aspects of research productivity by focusing only on two types of research outcomes—conference presentations and journal publications. Furthermore, while this study focused on research productivity, changing employers might also have a beneficial association with other types of career-related outcomes such as job satisfaction, salary level, and/or promotions. Especially, given that this study concomitantly showed that a not inconsiderable proportion of

doctorate holders were not involved in research activities represented as conference presentations and journal publications regardless of their background, future research exploring the relationship between job mobility and other career outcomes will help reveal the comprehensive influence of job mobility.

Second, future research could address the mechanism behind the relationship between the drivers of job mobility and research productivity. By exploring the association between the two factors, this study demonstrated that doctorate holders' post-mobility research productivity differed by reasons for job mobility. However, it still leaves open the question of 'how' this happens. Further investigation using qualitative approaches would deepen our understanding of how different motivations of changing employers shape doctorate holders' transition experiences and how those experiences influence their research activities in their new position.

Third, in the data used for this study, doctorate holders who moved to a new position were asked to choose all the reasons they considered when making their job mobility decision among the listed items. Thus, this study could not identify the key reason for their job mobility and the relative importance of each reason, regarding all reasons considered in their decision to change employers as equally important. However, there may be a key primary reason for them to change employers that might be more strongly tied to the transition process and later research productivity, which could be addressed in future studies.

Finally, due to data availability, this study used the data collected during 2001–2008; hence, the sources are admittedly somewhat outdated. Using more recent data could provide useful information on the current association between doctorate holders' job mobility and their research performance. In addition, research productivity outcome measures from the data lump research outputs produced for five years together. Given that doctorate holders who changed

employers might suffer from adaptation costs in the short term (Fernández-Zubieta et al., 2015a), there can be systemic increase and decrease patterns in research activities during the period immediately after mobility. By exploring longitudinal data, future research could contribute to understanding the changes in research performance in a new position.

Conclusion

This dissertation connects the inextricably intertwined aspects of job mobility as individuals' career-related decisions and as the transfer of intellectual resources embedded in the individuals. The findings of this study reveal that mobility itself does not suffice to drive research productivity gains. Specifically, this study found no significant impact of doctorate holders' job mobility in general on their post-mobility research productivity measured by the number of presentations/publications. However, in further investigation of possible differences in the relationship depending on different contexts of changing employers in terms of their career background (i.e., which sector were they from?) and reasons for job mobility, reasons for changing employers appeared to make differences in post-mobility research performance of those who were active in research activities, although the differences were only significant for presentation productivity. These findings suggest that job mobility occurs within complex personal and professional situations of individuals and that how the career events shape the individuals' professional development and outcomes can appear differently within different contexts. In other words, the distribution and development of resources for knowledge production at the collective level cannot be disentangled from doctorate holders' career decisions and patterns at the individual level. Therefore, scholarly and practical efforts to expand knowledge production systems and improve the efficiency of human resources need to be accompanied by specific attention to individual careers.

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