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Not Equal for All: Gender and Race Differences in Salary for Doctoral Degree Recipients

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Abstract Despite a recent increase in women and racial/ethnic minorities in U.S. post-secondary education, doctoral recipients from these groups report lower salaries than male and majority peers. With a longitudinal sample of approximately 10,000 respondents from the *Survey of Doctorate Recipients*, this study adds to the limited literature examining the effects of discipline, sector of employment, personal traits (e.g., marital status and number of children), and the interaction of gender and race on annual salary over the decade after degree completion, 1999–2008. Multilevel growth models reveal greater gaps in salary for women compared to men across all race/ethnic groups. The greatest rate of return was found for Asian respondents regardless of gender, and minority males had better returns than White male peers conditional on marriage. Implications for career choice, career paths, and the need for policies that address gender and race equity are discussed.

Keywords Doctoral recipient salary · Gender and race differences in salary · Salary inequity

Introduction

Despite the increased participation of women and racial/ethnic minorities in U.S. graduate education in recent decades, these groups remain underrepresented in most STEM fields. The underrepresentation of Black/African American, Hispanic, and Native Americans in STEM can hinder progress toward equity in job conditions and compensation and limit their potential influence in program and policy development. Even when members of these groups gain access to job appointments in science fields, considerable differences in salary by gender and race have been noted (e.g., Bobbit-Zeher 2007; Easterlin 1980; Pfeffer

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1983) and continue today (Melguizo and Wolniak 2012; NSF *Report on Women and Minorities*, 2013).

Although bias based on race and occupational segregation by gender provide partial explanation for salary disparity (Boraas and Rogers 2003; Moss-Racusin et al. 2012) few studies have examined the intersection of *both* gender and race (Baker 1999; Leggon and Pearson 1997; NSF Report 13-304 2013). Moreover, to our knowledge no previous study has systematically evaluated how this intersection affects the salary opportunities of doctoral recipients in science and engineering fields while relying on longitudinal data. Our study analyzes how the effects of professional (e.g., field of formation and sector of employment) and personal traits (e.g., marital status and number of children) on salary change as a function gender, race, and their intersection. We conducted these analyses while observing the evolutions of these doctoral recipients' careers over a 10-year period. These analyses contribute to our understanding of the impact of race and gender on doctoral recipients' salary and can be useful to discussions that seek to achieve equity in pay and work responsibilities regardless of one's gender and ethnicity.

Purpose of the Study

This study extends previous findings for wage differences by gender (e.g., Bellas 1997; Toutkoushian 1999; Umbach 2007), URM[1] status (Joy 2003; Melguizo and Wolniak 2012; USDL Report 13-006 2006), and across job sectors (Webber, 2013). With a focus on science and engineering degree recipients,[2] this study provides a deeper understanding of differences in salary by examining the effect of gender and race on salary and career path, and to determine if salary differences by gender and race persist across different employment sectors. In addition, this study is unique in that it employs multilevel growth modeling (MGM), a technique that, by accounting for time-varying factors and covariates (e.g., Espy et al. 2001; Horney et al. 1995), offers robust estimates of individual growth in parameters over time.

An enhanced understanding of factors driving differences in salary after doctorate degree completion can promote more effective policies and practices in education and employment. Actions should be aimed at ensuring representation of all doctorate recipients in advanced degree programs and work sectors, ultimately promoting the contribution of all individuals in a more comprehensive and diversified scientific knowledge production process. This study also helps postsecondary education officials and employers who seek to ensure opportunities for valued and equitable careers for all doctorate degree recipients. To address these goals, this study examines the following questions:

1. What is the relationship between reported salary for doctoral degree recipients conditional on gender and race over the decade 1999 through 2008?
2. How do the influences of labor market characteristics (e.g., discipline, sector of employment) and personal traits (e.g., marital status, number of children) change as a

[1] The term URM (underrepresented minority) includes participants who identified themselves belonging to Black, Hispanic, or Native American race/ethnic groups. This definition is in accordance with recent NSF reports (NSF Report 13-204, 2013).

[2] Consistent with NSF surveys, the disciplines included in our study accounted for individuals majoring in Agriculture and Biological Sciences, Computer Sciences, Mathematics, Statistics, Physical Sciences, Psychology, Engineering, and Health Sciences.

function of gender, race, and their intersection across doctoral degree recipients over the decade 1999 through 2008?

Demand for the Doctorate, But Barriers for Women and Underrepresented Minorities

In the past few decades, the number of women doctorate earners has tripled (*Digest of Education Statistics*, 2010), science and engineering (S&E) degrees earned by Blacks and Hispanics more than doubled in number, and the number of S&E degrees earned by Native Americans increased by 61 % (*S&E Indicators*, 2008). Non-U.S. citizens also account for growth in S&E doctorates awarded in the U.S. In 2005, foreign students on temporary visas earned half or more of doctorate degrees in engineering, mathematics, computer sciences, physics, and economics. A diverse doctoral population is beneficial; foreign scholars can contribute to science by collaborating in global scientific networks, generating new knowledge, and increasing scientific capacity (NSF *Science & Engineering Indicators*, 2008c; Wagner 2007).

Recent reports from the National Academy of Science (NAS) (2010) and the Massachusetts Institute of Technology (MIT) (2011) suggest that men and women in S&E are enjoying more comparable opportunities within higher education than in previous decades. Despite some optimism, however, these reports also note concern, including underrepresentation of women in academia and ineffective institutional strategies for ensuring a diverse applicant pool (NAS 2010). Concerns from the NAS and MIT reports confirm other findings of diminished employment opportunities for doctoral recipients, especially for minority women seeking full-time and tenure-track employment in academia (Aguierre 2000; Gappa et al. 2007; Wolfinger et al. 2008). In addition, conflicting social norms that reinforce women as primary caregivers for children (and aging parents) may contribute to women's lower likelihood of obtaining a tenure-track appointment, earning tenure, and being promoted to full professor (Perna 2001a; Wolfinger et al. 2008). As women and some ethnic minorities consider career choices, some may self-select away from academia in response to perceived barriers (van Anders 2004). Some scholars argue the decision to opt out of academe is merely an illusion of choice, not a true choice (Wolf-Wendel and Ward 2006). Women and minorities may experience an unsupportive work or doctoral program climate, and cannot see a feasible way to balance work and family (Gardner 2008; Maher et al. 2004).

Along with the increase in doctorates awarded to Blacks is a doubling of Hispanic and/or Latino doctorate recipients (NSF *Science & Engineering Doctorates*, 2011). However, from 2001 to 2010 there was a decrease in the number of URMs who earned S&E bachelor's degrees (NSF Report 13-204, 2013). This lower number of S&E bachelor's degrees will likely translate to fewer minority doctorates in the next decade, and eventual reduced numbers of minorities in advanced employment positions.

The Wage Gap

There is ample literature that confirms a wage gap for doctorate recipients by gender; this literature, however, has been based mostly on examining conditions in academia (e.g., Barbezat 1988; Bellas and Toutkoushian 1999; Ehrenberg 2003; Menges and Exum 1983; Perna 2001b; Porter et al. 2008; Toutkoushian and Conley 2005; Umbach 2007). Many of these studies report that gender gaps persist within rank and institution type (AAUP Report

2012; Schuster and Finkelstein 2006; Wolfinger et al. 2008) and that average faculty salaries for females fall short of male peers by 15–22 %. While these studies have focused on faculty rank and scholarly products to explain the gap, it is still not clear how other personal factors contribute to the variation of monetary compensation between male and female doctorates, and how this influence changes over time.

Along with studies on academia, those related to other job sectors show similar findings of a wage gap. Based on Survey of Doctorate Recipient data over the past decade (1999–2008), science and engineering workers in business and industry earn approximately 20 % more than peers in education (Webber 2013). Furthermore, median weekly salaries for women doctorates were about 20 % less than those of their male peers (USDL Report 13-0060, 2006), which is similar to the 25 % differential reported by NSF (*Science & Engineering Indicators*, 2008c). The 2006 annual median salary for Black scientists and engineers was 16.2 % less than that of Whites (NSF 13-304), with similar figures for Hispanics and American Indian/Alaskan Natives showing their median salary to be 13.2 and 18.9 % less than that of their White peers, respectively.

In terms of investigating disparities by race, some scholars have identified an effect by occupational structure and/or hierarchy. Based on 1970 census data, Kaufman (1983) found that Black men face the greatest disparity in high salary positions. More recently, Grodsky and Pager (2001) also focused on structural differences as well, finding that Black men in high-earing sectors earn about 10–20 % less than White male peers, leading them to report "race remains a salient feature in the occupational hierarchy" (p. 562).

To add to the complexity, salary differentials may be a function, in part, of discipline and demand. Due to market-based demands and norms, and required level of skill, the effect of discipline on salary is also an important consideration. In general, careers in S&E offer higher salaries than those in the humanities and social sciences. By the same token, some scholars frame the faculty salary disparity as a function of market segmentation, suggesting that more women work at institutions with lower prestige, and/or may spend more time on instruction and committee work, aspects of the job that are not as highly rewarded as research (Pfeffer and Davis-Blake 1987; Smart 1991). The issues may be compounded by smaller numbers of women in S&E fields, and proportionately more women in the humanities and social sciences.

In summary, while this study builds upon previous literature concerning salary gaps based on either ethnic- or gender- based differences, our approach moves toward a more comprehensive understanding of how discipline, job sector, and personal traits affect salary variations over a 10-year period when accounting for the intersection of both gender and race/ethnicity.

Conceptual Framework

This study is guided by general concepts related to the human capital benefits of advanced education, structural theory, and the interaction of race and gender. Human capital theorists use skills and abilities gained through education and training, in part, to explore differences in rewards, while structural theorists explore elements of organizations, social structures, and labor market segmentation and/or barriers to explain the differences (Perna 2001a; Youn 1992). Individuals weigh options and make decisions (in our case, about employment and use of time) when contemplating various choices that may exist, one must consider educational costs, foregone wages while enrolled, and possible costs for day care or elderly parent care. Because of differentials in salary by gender and race, doctoral students must decide if the benefits of earning the doctoral degree outweigh the economic and emotional costs.

Postsecondary education is a critical element for increasing human capital (Becker 1962; Schultz 1961) because it advances one's personal knowledge and skills and enables one to contribute to economic production. Graduate education, in particular, enables individuals to accrue the necessary education and skills to prepare them for a complex job market. This is particularly important in the postsecondary academic employment sector due to an increase in part-time, non-tenure-track positions and a decrease in full-time and tenure-track appointments (Schuster and Finkelstein 2006; Gappa et al. 2007). Implicit in human capital theory is the idea that individuals are the primary actors who determine the outcomes of and rewards from their work. Some scholars argue that differences in work outcomes explain gender differences in salary. For example, some argue that male faculty members earn more, in part, because they out-publish female peers (Cole and Zuckerman 1987; Long 1990; Schuster and Finkelstein 2006; Wolfinger et al. 2008). Others argue that women earn less because they spend less time on research (Bellas and Toutkoushian 1999) due to the needs of school-aged children (Fox 2005) they may have. Leahy (2006) suggests the difference arises because women have a broader, less specialized research program (Leahy, 2006). It might also be because more women are employed in non-STEM fields (Characteristics of Doctoral Scientists and Engineers in US, 2006; NSF Report 09-317, 2009).

While the tenets of human capital theory help explain choice of employment and possible inequities, some scholars argue that individual attributes alone do not explain the full picture, and suggest that complexities of social structures, labor markets, and individual choice are important factors that help provide a more comprehensive explanation (Bobbit-Zeher 2007; Perna 2003; Rosenbaum 1989; Wolfinger et al. 2008; Xie and Shauman 2003). Helpful to this thinking is the inclusion of structural theory, which suggests that salary inequities are caused, in part, by the way in which positions are structured and labor markets are segmented (Youn 1992). Youn believes that academic labor markets are unique because they are segmented by academic discipline, institution type, job task (teaching, research, or administration), and job status (academic rank and time status). Current market conditions show a decrease in tenure-track faculty appointments, thereby decreasing the odds of earning a position. Women in dual career relationships face the additional challenge of limited mobility, which may lead to accepting less-preferred employment positions that offer lower salary and fewer benefits (Schiebinger et al 2008).

Factors that contribute to the pursuit of postsecondary education, employment, and wage compensation must also be examined in light of the effects of gender and race. Multiracial feminists argue that race and gender are socially constructed (Collins 1999; Glenn 1999). When presented as mutually constructed, they produce and maintain a social hierarchy that allows individuals to experience disadvantage and privilege through combined statuses of race, class, and gender (Browne and Mirsa 2003). According to Sidanius and Pratto (2001), theorists who use social constructions to explain thought and action assume that dominant groups control both resources and major social institutions, and use those institutions to declare legitimizing ideologies that make social inequalities appear natural.

Multiracial feminists also believe that the attitudes and practices associated with gender are inextricably interwoven with the attitudes and practices associated with race (Ferdman 1999). Thus, perceptions of appropriate roles and expectations for the feasibility of advanced education, employment options, and salary are affected. For example, as described by Browne and Mirsa (2003), the experiences of Latinas in the labor market reflect social constructions of gender that create a particular experience that is different from that experienced by women of other races or ethnicities. However, these authors believe that there is also a relational aspect to the experiences of Latinas in the labor market that connects them to the experiences of other women. White women, for example, are more likely to be viewed as professional workers than Latinas, and White women benefit from this privilege. Thus, Browne and Mirsa (2003) believe that the social constructions of gender and race are systematically related to labor market dynamics that, in turn, produce inequality.

Method and Data

Data

This study utilized restricted-use data from the *Survey of Doctorate Recipients* (SDR) sponsored by the National Science Foundation. Through a repeated panel design, the *SDR* has been administered every 2–3 years since 1973 to those who received a doctoral degree from a U.S. institution in a science, engineering, or health (SEH) field. The 1999 dataset used in this study has an unweighted total sample of approximately 27,750 respondents and served as the baseline to examine academic and professional trajectories at four more points in time when the survey was administered (2001, 2003, 2006, and 2008). Respondents were included in this study if data existed for the individual at all five time points. Valid data on 10,100 respondents who were followed over this 10-year period was available and were included. Missing data in some of the predictor variables led to a final analytic sample size of approximately 9980. We conducted bivariate analyses comparing our final sample with the 120 cases dropped from our models; the cases that had missing information showed no significant differences in non-missing variables when compared to the non-missing information cases.[3] The total number of observations upon which the models were fitted was 49,880 cases.

Growth Models

This study relies on multilevel growth modeling (MGM) to examine variations of wage[4] (dependent variable) trajectories over time. MGM presents important conceptual variations from HLM approaches. In traditional multilevel analysis, individuals or units are nested within structures (i.e., students within classrooms, classrooms within schools). In growth modeling, the individual becomes the nesting structure and time is nested within the individual. In other words, repeated observations from an individual represent the level-1 state, and the attributes of the individual account for the level-2 variables (Bliese and Ployhart 2002). Each individual has characteristics that can change over time (time variant) and characteristics that are time invariant. Among the time invariant characteristics we

[3] Missing data accounted for 1.18 % of the total cases. In addition to the bivariate analyses, models excluding the variables with missing cases were fitted and the magnitude of the coefficients associated with variables with no missing cases remained unchanged. As such, we are confident that missing cases do not affect inferences made from these models, as that missing data appear to have happened at random (Gelman, Carlin, Stern, & Rubin, 2003). To comply with NSF standards, all numbers reported herein are rounded.

[4] The annual wage was captured in constant dollars. Models with current dollars rendered the same inferences.

have gender, ethnicity, type of doctoral granting institution, discipline of doctoral degree. Examples of time variant characteristics are sector of employment after doctoral degree attainment, marital status, and years since graduation.

Given the longitudinal structure of data required in growth modeling, techniques that address non-independence in the responses for individuals at two or more time points are required to obtain estimations that go beyond the simple reporting of individual trends. Another key challenge in growth modeling is the likelihood that responses will tend to become either more variable or less variable over time (Bliese and Ployhart 2002). These two challenges, autocorrelation and heteroskedasticity, were accounted for in our models (see Appendix). Evidence of autocorrelation was found and addressed, however, heteroskedasticity was not present. These findings mean that while salary at time 2 is correlated to the salary received at time 1, given the relative small number of points in time (five), the variance of salary remained constant during the time period our of study.

Disaggregating Analyses by Gender and Race

As discussed in the literature review above, female participants tend to have lower salaries than their male counterparts. Consequently, if we fit models and merely include a dummy variable for gender, we would still be using the information of males to compute mean salaries of females and vice versa. To obtain estimates for males' attributes that do not take any information from their female counterparts (and the other way around), the models fitted were completely disaggregated by gender (see Table 4). Using the same rationale, we also fitted models that accounted for the intersection between gender and race such as computing models only for White males, White females, Asian males, Asian females, URM males and URM females[5] (see Tables 4, 5). There is another important feature associated with the complete disaggregation of analyses by gender and the interactions by gender and race. Since we are not using any information from one group to obtain the coefficients of the other group, we tested whether the coefficients associated with the variables included in our models presented statistically significant differences. For example, we tested if the average salary of males and females when all other predictors in the models are zero (see intercepts in Table 4) were statistically significant different—and we repeated these test with all the other predictors. To achieve these comparisons we relied on an individual linear coefficient contrast presented in Eq. (1) as proposed by DeMaris (2004, pp. 97–99)

[5] As Table 3 indicates (congruent with previous studies on doctorate recipients), Hispanic, African American, and Native American participants are the least represented groups in the analytic sample. This sample size limitation greatly affected the standard errors of the coefficients corresponding to models disaggregated by Hispanic males, Hispanic females, African American males, African American females, Native American males and Native American females. Based on the widely accepted definition of URMs provided by NSF, we proceeded to estimate models for URM males and URM females in order to capture potential differences in compensation across underrepresented groups. Although the aggregation of Hispanic, African American, and Native American participants could potentially be a source of bias, models where the disaggregation across those groups took place were also conducted and the magnitude of the coefficients were similar across them. As mentioned, the main differences found were the standard errors (due to sample size differences) of the coefficients across models. Table 4 shows that Native American males have the highest difference in magnitude when compared to White males. To test whether this difference would have changed the results shown in the URM male model shown in Table 5, we omitted Native Americans from that estimation. The magnitude of the coefficients was not affected, which justified the inclusion of Native American males in the final set of analyses.

$$t^* = \frac{\hat{\beta}_i{}^1 - \hat{\beta}_i{}^2 - \delta^0}{\mathrm{Se}\left\{\hat{\beta}_i{}^1 \mp \hat{\beta}_i{}^2\right\} - 0} \tag{1}$$

where $\widehat{\beta}_i{}^1$ is the coefficient of interest in model 1, and $\widehat{\beta}_i{}^2$ is the corresponding coefficient in model 2. The value of δ^0 shown in Eq. (1) accounts for the covariance or the shared information used to estimate the coefficients being compared. Given that the samples are mutually exclusive and exhaustive, there is no shared information, consequently, δ^0 is zero, and it has a standard error of zero shown in the denominator of the equation. Finally, note that the remaining difference is distributed as a *t* random variable with $n - (p + q) - 1$ degrees of freedom (DeMaris 2004), with a cut-off value of 1.96 for $a < .05$.

Results

Table 1 shows the time-invariant demographic characteristics of the 9980 doctorate recipients tracked from 1999 to 2008. Special emphasis was placed on participant attributes, including gender, race, type and level of institution for doctorate degree, sector of employment, field of study, and time to degree. Years since graduation and years since graduation squared were included to control for the effect of experience in the job market after doctoral degree attainment. The inclusion of its quadratic form is in line with the Mincerian wage equation (Lemieux 2006; Mincer 1974), indicating that years of experience reach a maximum and start to decline as knowledge and skills associated with a given profession are being constantly updated.

As shown, the majority of doctorates were earned from public institutions (68 %) and from Research I institutions (75 %). Twenty-eight percent of the sample was female and 18 % of the sample was foreign born. Regarding the demographics by gender and race, we see that 30 % of the Asian doctorates were female, the highest female percentage in the sample. Native American doctorates had the lowest proportion of graduates coming from the public sector (61.5 %). Black participants had the highest presence in the postdoctoral appointment, above the average at 6.4 %. Also shown in Table 1, about 23 % of the participants reported to have no remaining debt from their education after graduation and a fourth had some level of reported debt.

Table 2 shows sector of employment and marital status for each survey year. Some changes in employment sector and marital status are observed at each time point, but there is generally little change over time. The largest percentage change occurred in movement out of the education sector. In 1999, 50 % of the respondents were employed in education, but the percentage declined slightly in each subsequent year, down to 46.1 % in 2008. The business/industry sector absorbed the greatest movement, increasing its share from 40.1 % in 1999 to 43.6 % in 2008.

Table 3 shows salary variation, disaggregated by respondents' ethnicity and gender. In 1999, Native American doctorate holders reported the lowest mean salary. Black doctorates reported the highest mean, but also showed the highest within-group variation. Although we observed an increase among groups, the pattern described in 1999 was maintained in 2001–2006. In 2008, however, Hispanic doctorates reached parity with Black participants, surpassing the mean salary for Asian and Whites. The unconditional gender salary parity was never reached in this 10-year period; female salaries remained significantly below male peers throughout the decade. We acknowledge caution interpreting these findings as factors

Table 1 Doctoral recipients' demographic and institution characteristics by gender and race/ethnicity

Variable	Hispanic *N*	Hispanic %	White *N*	White %	Black *N*	Black %	Asian *N*	Asian %	Native Am *N*	Native Am %	Total *N* *N*	Total %
Gender												
Male	330	78.1	5600	71.6	270	72.3	890	69.7	50	80.0	7150	71.7
Female	90	21.9	2220	28.4	100	27.7	390	30.3	10	20.0	2820	28.3
Birth status												
Foreign-born	80	19.8	1420	18.2	80	20.0	230	18.1	10	20.0	1830	18.3
US-born	340	80.2	6410	81.8	300	80.0	1050	82.0	50	80.0	8150	81.7
PhD institution type												
Private	130	31.6	2520	32.2	130	35.3	410	32.1	20	38.5	3220	32.4
Public	290	68.4	5300	67.8	240	64.7	870	67.9	40	61.5	6740	67.7
Level Institution												
Research I	330	78.3	5900	75.4	300	80.0	970	75.6	40	63.1	7550	75.7
Research II	40	9.9	860	11.0	40	9.9	140	10.6	10	20.0	1090	10.9
Doctorate-Granting	40	8.9	800	10.3	30	6.9	120	9.3	10	16.9	1000	10.0
Comprehen-special	10	2.6	250	3.2	10	2.9	60	4.4	NA	0.0	330	3.3
Discipline												
Biology or agricultue	110	25.6	1980	25.3	100	25.3	340	26.5	10	23.1	2540	25.5
Computer science	20	4.0	180	2.2	NA	1.1	20	1.6	NA	3.1	220	2.2
Math/stats	20	4.5	330	4.2	20	4.5	60	4.3	NA	1.5	420	4.2
Physical sciences	80	19.5	1500	19.2	90	23.5	240	19.0	20	33.9	1940	19.4
Psychology	40	9.4	1190	15.2	50	12.8	180	14.4	NA	7.7	1470	14.7
Social sciences	80	19.3	1070	13.7	40	10.9	140	11.0	10	15.4	1350	13.5
Engineering	60	15.3	1240	15.9	70	18.9	230	18.1	10	15.4	1620	16.3
Health	10	2.4	330	4.2	10	2.9	70	5.2	NA	0.0	420	4.2

Table 1 continued

Variable	Hispanic *N*	Hispanic %	White *N*	White %	Black *N*	Black %	Asian *N*	Asian %	Native Am *N*	Native Am %	Total *N* *N*	Total %
Educational debt												
No debt	100	22.8	1820	23.2	80	20.3	300	22.8	20	29.2	2300	23.1
Debt $1–10 K	60	13.9	1170	14.9	50	12.3	200	15.4	NA	7.7	1480	14.8
Debt $10.1–20 K	30	6.3	550	7.0	20	6.4	88	6.6	NA	6.2	690	6.9
Debt $20.1–30 K	20	4.5	430	5.5	20	4.5	60	4.4	NA	0.0	520	5.2
Unknown debt	220	51.3	3770	48.2	200	54.7	620	48.7	40	55.4	4850	48.6
Total *N*	420	100	7830	100	380	100	1280	100	60	100	9980	100

Table 2 Doctoral recipients' demographic characteristics and sector of employment, 1999–2008

Variable	1999 *N*	1999 %	2001 *N*	2001 %	2003 *N*	2003 %	2006 *N*	2006 %	2008 *N*	2008 %	Total *N*	Total %
Sector												
Education	4980	50.0	4920	49.3	4890	49.0	4740	47.5	4600	46.1	24,130	48.4
Government	990	9.9	1000	10.0	1020	10.3	970	9.7	1020	10.3	5000	10.0
Business and industry	4000	40.1	4060	40.7	4060	40.7	4260	42.8	4350	43.6	20,740	41.6
Marital status												
Not married	2080	20.9	1980	19.8	2040	20.4	1890	19.0	2060	20.7	10,050	20.1
Married	7890	79.1	8000	80.2	7940	79.6	8080	81.0	7920	79.3	39,820	79.8

Ns are rounded

Table 3 Time variant salary by gender and race/ethnicity

Variable	*N*	1999		2001		2003		2006		2008	
		Mean $	SD	Mean $	SD	Mean $	SD	Mean $	SD	Mean $	SD
Race											
Hispanic	420	74,398	47,659.2	84,502	41,524.5	92,748	51,718.1	101,015	52,339.1	119,272	74,295.6
White	7830	72,127	43,980.2	83,176	50,350.2	91,303	57,142.7	101,136	64,450.3	114,839	70,640.8
Black	380	78,504	61,394.1	91,563	71,998.5	102,225	79,777.2	108,057	71,980.0	119,273	90,970.9
Asian	1280	70,895	43,371.6	82,003	47,497.7	93,641	68,270.4	102,633	68,674.1	116,400	72,747.3
Native American	60	68,578	38,484.6	77,739	40,637.8	83,612	54,692.7	93,053	61,555.1	106,409	69,536.4
Gender											
Female	2620	71,938	45,830.3	82,786	49,861.4	91,611	58,395.1	101,055	63,292.7	114,627	69,833.1
Male	7360	73,251	41,842.0	84,981	52,606.6	93,188	62,415.6	102,869	68,961.4	117,346	77,501.0

Values are in US dollars, rounded to nearest dollar

Ns are rounded

and covariates not included in these analyses may influence salary variations among participants, thus suggesting the need for additional investigation.

Multilevel Growth Modeling

Table 4 shows the Multilevel Growth Model fitted by gender. The models in Table 4 contain both the logged version of salary amounts and the real US dollar (USD) of those amounts. Note that both sets of models (logged and real dollars) yielded consistent results in terms of inferences and coefficient magnitudes. While explaining the results from log models is not inherently complex as it merely requires using percentages, we believe that real amounts rather than log values provides a more natural understanding of salary differences. Thus since both models rendered the same inferences, our presentation of the findings are based on real dollar values. Table 4 also shows a test for change in individual coefficients under the column *t value*. The computations for this statistic are based on Eq. (1), using actual USD amounts. Given that this statistic relies on the t-distribution and the sample sizes analyzed are above 1400 observations, a value greater than 1.96 is associated with a probability of .05, which by convention is associated with statistically significant differences. In this case, these differences would reflect salary differences between male and female doctorate recipients in a specific indicator.

The first set of growth models (Table 4) were fitted by gender. These models show that after controlling for autocorrelation and individual variations and holding all other variables constant, male doctorates had an average salary of $66,302 in 1999, about $10,000 dollars greater than the average salary of women doctorate holders ($p < .05$). The average growth in salary associated with years since Ph.D. completion was also significantly higher for male doctorates than for female recipients ($t = 5.15$; $p < .001$). The decline of salary associated with years since graduation squared also had a higher magnitude for male participants.

Table 4 also shows that being married was associated with a decrease in the average salary for female doctorates (the logged model), whereas being a married male represented a significant increase in salary variations. The difference between these two coefficients ($5300) was highly significant. This means that the payoff associated with being married is greater for male recipients. A longer time to degree had a negative impact for both men and women, but more so for men. Each year of increase in time to degree was associated with a decrease of almost $1000 for male participants. In addition, the postdoctoral appointment was a negative contributor to the wage trajectory for both men (about $11,000) and women (about $14,000). Since there were few members of underrepresented groups in postdoctoral appointments, further disaggregation of the factor by gender and race was not possible. Consequently, this variable was not included in the models presented in Table 5. As expected, years since degree completion had a significant impact on the growth trend in salary, and affected men more than women. The inclusion of race/ethnicity in Table 4 was used as a possible source of confounding. A discussion on the importance of race is discussed further in Tables 5 and 6.

Results in Table 4 also show that type of institution and discipline made a difference in future salary. Doctorate holders who obtained their degrees from Research I universities earned $4,000 and almost $6000 more than female and male doctorate holders, respectively, who graduated from Research II institutions. Compared to respondents who earned their degree in the social sciences, computer scientists earned about $13,700 (female) and $19,300 (male) more on average. Similarly, doctorate holders from engineering earned more than peers in social sciences, with a higher differential for women engineers. Both males and females with a doctorate in psychology earned less than their counterparts in social sciences, with males earning about $3000/year less than female peers in psychology.

Table 4 Growth trend analysis for salary variation by gender

	Female ln	Female USD	Male ln	Male USD	*t* value
(Intercept)	10.73*** (0.06)	56,285.11*** (2960.13)	10.94*** (0.04)	66,301.94*** (3062.61)	**2.35**
Time	0.08*** (0.01)	6611.65*** (362.01)	0.07*** (0.00)	7074.92*** (291.18)	1.00
US-born	−0.03 (0.03)	−456.18 (1616.67)	−0.03 (0.02)	−1431.94 (1612.42)	−0.43
Married	−0.04* (0.02)	−1445.38 (860.82)	0.08*** (0.01)	3909.59*** (926.40)	**4.23**
Dependents	0.01 (0.01)	699.05 (613.75)	0.00 (0.00)	−164.15 (421.03)	−1.16
Time to degree	−0.01*** (0.00)	−383.86** (126.59)	−0.02*** (0.00)	−987.30*** (158.07)	**−2.98**
Unknown debt	0.03 (0.04)	1861.02 (2077.75)	−0.04* (0.02)	−1475.43 (1967.65)	−1.17
Debt $1–10 K	0.00 (0.03)	−1323.05 (1579.61)	−0.02 (0.02)	−705.37 (1706.47)	0.27
Debt $10.1–20 K	0.03 (0.04)	1225.50 (2013.19)	−0.05 (0.02)	−2950.94 (2262.78)	−1.38
Debt $20.1–30 K	0.01 (0.01)	184.19 (740.75)	0.00 (0.01)	115.07 (862.84)	−0.06
Research II	−0.08* (0.03)	−3987.36* (1734.54)	−0.10*** (0.02)	−5917.92*** (1571.31)	−0.82
Doc-granting	−0.06 (0.03)	−2363.44 (1704.55)	−0.08*** (0.02)	−5954.24*** (1702.97)	−1.49
Spec/comp	0.02 (0.05)	3273.21 (2509.44)	0.03 (0.03)	9753.80** (2993.92)	1.66
Biol or Agricul	0.02 (0.03)	−331.58 (1660.63)	0.01 (0.02)	−1334.33 (1748.06)	−0.42
Computer Sci	0.25** (0.08)	13,673.83*** (3969.46)	0.19*** (0.04)	19,292.49*** (3544.53)	1.06
Math/Stats	0.07 (0.06)	4464.93 (3156.38)	−0.03 (0.03)	−4195.32 (2535.71)	**−2.14**
Physical Sci	0.08* (0.04)	2907.53 (1997.18)	−0.01 (0.02)	−4192.03* (1786.59)	**−2.65**
Psychology	−0.12*** (0.03)	−7500.37*** (1705.54)	−0.09*** (0.02)	−10,494.06*** (2063.43)	−1.12
Engineering	0.25*** (0.05)	11,116.83*** (2502.56)	0.15*** (0.02)	7502.46*** (1832.14)	−1.17
Health	0.14*** (0.04)	6726.80** (2150.81)	0.10** (0.04)	6751.44 (3545.28)	0.01
Hispanic	−0.02 (0.04)	−2148.85 (2225.10)	−0.03 (0.03)	275.22 (2428.91)	0.74
Black	0.00 (0.04)	2499.47 (2259.37)	−0.02 (0.03)	1077.18 (2713.72)	−0.40
Asian	0.03 (0.03)	237.92 (1797.41)	−0.03 (0.02)	−2634.78 (1828.63)	−1.12
Native Am	0.02 (0.11)	−2585.83 (5527.55)	−0.14 (0.09)	−8061.24 (8442.38)	−0.54
PostDoctoaral	−0.16*** (0.04)	−13,892.70*** (2209.68)	−0.22*** (0.03)	−11,384.77*** (2686.54)	0.72
Education	−0.12*** (0.02)	−14,287.08*** (898.36)	−0.22*** (0.01)	−23,291.16*** (865.76)	**−7.22**

Table 4 continued

	Female ln	Female USD	Male ln	Male USD	*t* value
Government	−0.09** (0.03)	−2471.69 (1424.65)	−0.06*** (0.02)	−11,779.36*** (1259.38)	**−4.89**
Years Since Grad	0.04*** (0.00)	1746.75*** (202.54)	0.05*** (0.00)	3148.86*** (182.09)	**5.15**
Years Sinc Grad^2	0.00*** (0.00)	−18.85*** (4.86)	0.00*** (0.00)	−44.18*** (3.67)	**−4.16**
AIC	29,844.7	332,302.58	67,642.58	867,864.52	
BIC	30,124.14	332,582.02	67,956.49	868,178.42	
Log Likelihood	−14,885.35	−166,114.29	−33,784.29	−433,895.26	
Num. obs.	14,110	14,110	35,765	35,765	

Omitted or comparison groups are Research I institutions, White race, social sciences discipline, and business/industry sector

*** $p < 0.01$; ** $p < 0.01$; * $p < 0.05$, values in bold text are significant at 5 % or below

Table 5 Growth trend analysis for salary variation by gender and race/ethnicity

	Fem White	Male White	Fem Asian	Male Asian	Fem URM	Male URM
(Intercept)	51,643.42*** (3655.21)	65,005.85*** (3642.22)	54,126.38*** (6716.89)	64,570.35*** (6830.02)	60,816.42*** (5740.22)	66,367.49*** (8589.04)
Time	5868.60*** (420.93)	6937.50*** (325.28)	7468.57*** (942.38)	6990.83*** (789.16)	5309.49*** (807.90)	6563.86*** (1066.13)
US-born	−926.90 (2237.52)	−3678.86 (2118.40)	3131.19 (3076.07)	−379.65 (2781.09)	−1680.21 (3075.35)	9189.66* (4337.41)
Married	−1257.00 (1037.04)	2773.69** (1057.56)	−2846.36 (2329.00)	4125.51 (2607.71)	−1241.66 (1789.24)	10,737.33*** (2690.52)
Dependents	834.41 (763.36)	−46.33 (490.47)	181.06 (1934.85)	−436.15 (1060.98)	1007.57 (1037.85)	−370.36 (1278.41)
Time to degree	−275.42 (151.31)	−967.11*** (188.05)	−420.65 (421.08)	−1238.91*** (374.29)	−298.02 (244.77)	−672.48 (445.91)
Unknown debt	1548.99 (2473.56)	−848.88 (2338.32)	128.19 (5485.78)	−9644.19* (4095.48)	−3033.74 (4737.80)	−1812.01 (7148.45)
Debt $1–10 K	−1587.89 (1940.67)	−783.57 (2095.29)	269.95 (3903.37)	3102.54 (3250.02)	−1555.60 (3329.88)	−8788.14 (5322.07)
Debt $10.1–20 K	2204.37 (2416.15)	−3365.19 (2682.07)	964.44 (5959.96)	−2131.48 (5621.85)	−602.61 (4127.02)	−1566.25 (6568.21)
Debt $20.1–30 K	1244.24 (938.37)	181.32 (1005.16)	−1582.10 (1883.50)	2138.89 (2513.59)	−798.28 (1347.79)	−40.38 (2511.88)
Research II	−4552.00* (2096.80)	−7468.63*** (1858.03)	5045.79 (4423.13)	−2531.94 (3376.32)	−8119.22* (3706.67)	−677.97 (5009.14)
Doctoral-granting	−2466.84 (2025.17)	−6323.69** (1977.93)	−3961.25 (4934.95)	−1178.56 (3906.99)	200.46 (3630.59)	−5298.98 (5830.54)
Spec/Comp	5419.63 (3054.65)	11,884.35*** (3454.27)	−4100.84 (6698.76)	−7773.15 (6988.59)	−8294.19 (4950.87)	8337.31 (10,471.94)
Biol or Agricul	−2669.23 (1948.54)	−1293.91 (1995.93)	−2215.03 (4197.55)	1125.22 (4743.74)	−2944.54 (3526.74)	−8222.48 (5378.33)
Computer Sci	11,474.72* (5730.57)	21,814.76*** (4383.73)	18,792.80** (7239.76)	16,821.29* (6653.10)	13,948.41* (6894.50)	14,760.50 (12,321.14)
Math/Stats	7093.05 (3958.81)	−4444.08 (2976.10)	−6630.12 (7662.12)	697.72 (5823.28)	10.03 (5829.93)	−10,413.38 (8474.05)
Physcal Sci	3057.60 (2450.15)	−4319.35* (2051.92)	2606.29 (4653.83)	−485.92 (4784.61)	−5572.86 (4531.00)	−8754.45 (5708.83)
Psychology	−7881.09*** (1992.22)	−9865.51*** (2322.79)	−7100.13 (6095.53)	−7729.63 (7980.97)	−9894.27** (3591.26)	−16,605.09** (6384.24)
Engineering	11,430.23*** (3180.05)	8096.52*** (2154.68)	9843.70 (5466.59)	7317.44 (4610.80)	11,644.02* (5204.50)	8451.60 (5839.78)

Table 5 continued

	Fem White	Male White	Fem Asian	Male Asian	Fem URM	Male URM
Health	5358.57* (2612.17)	9218.06* (4449.81)	8069.94 (6261.45)	4537.32 (7886.62)	10,615.61** (4067.18)	−941.57 (8332.64)
Education	−13,037.08*** (1079.68)	−22,053.55*** (984.68)	−19,031.28*** (2229.06)	−27,488.07*** (2172.04)	−17,956.51*** (2117.21)	−28,751.40*** (2964.80)
Government	−115.90 (1757.01)	−11,385.66*** (1406.54)	−11,419.70*** (3335.10)	−17,415.43*** (3393.11)	−5186.25 (3057.21)	−2743.31 (4780.57)
Years Since Grad	2024.25*** (233.35)	3427.50*** (205.16)	2761.08*** (506.65)	3130.98*** (458.92)	1664.93*** (442.49)	2002.50*** (593.33)
Years Since $Grad^2$	−20.05*** (5.65)	−49.71*** (4.10)	−54.97*** (13.67)	−30.58*** (11.10)	−4.63 (11.78)	−17.36 (13.09)
AIC	246,902.49	677,959.64	43,725.29	119,115.88	40,811.13	69,719.78
BIC	247,127.29	678,215.00	43,896.77	119,317.20	40,980.64	69,904.72
Log Likelihood	−123,420.25	−338,948.82	−21,831.65	−59,526.94	−20,374.57	−34,828.89
Num. obs.	10,445	27,950	1890	4910	1775	2905

Omitted or comparison groups are Research I institutions, social sciences discipline, and business/industry sector

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 6 Test for change in individual coefficients

	Between gender			Within gender female			Within gender male		
	WF & WM	AF & AM	MF & MM	WF & AF	AF & MF	MF & WF	WM & AM	AM & MM	MM & WM
(Intercept)	**−4.65**	−1.95	−0.49	−0.69	−0.21	1.03	0.06	1.06	−1.29
Time	**−3.84**	−1.54	−1.46	**−2.83**	**2.72**	−0.57	**−2.83**	**2.74**	−0.80
US-born	0.94	0.30	**−2.18**	−0.74	1.08	−0.51	−1.28	−1.57	**2.62**
Married	**−3.53**	**−2.16**	**−3.83**	0.30	−0.38	0.17	−0.57	−1.56	**2.58**
Dependents	0.06	−0.15	0.78	0.29	−0.44	0.28	0.20	0.38	−0.63
Time to degree	**3.82**	**2.00**	0.85	0.41	−0.60	0.39	1.03	−1.77	1.24
Unknown debt	**−2.68**	−0.60	−0.58	0.93	0.07	−1.05	**2.43**	−0.07	−1.43
Debt $1–10 K	−0.20	−0.32	0.89	−0.53	0.55	−0.13	−0.90	1.64	−1.17
Debt $10.1–20 K	1.64	0.51	0.06	0.01	0.34	−0.55	−0.24	−0.14	0.39
Debt $20.1–30 K	0.55	−1.13	−0.60	1.32	−0.25	−1.36	−0.56	0.38	0.07
Research II	0.90	0.93	−1.39	−1.87	**2.29**	−0.96	−1.73	−0.06	1.33
Doctoral-Grnt	1.66	−0.44	0.73	0.34	−0.63	0.50	−1.29	0.56	0.29
Spec/Comp	−1.15	0.26	−1.59	1.38	0.39	**−2.36**	**2.34**	−1.39	−0.09
Biol Agricul	−0.29	−0.24	0.88	0.14	−0.08	−0.06	−0.02	0.95	−1.18
Computer Sci	−1.28	0.33	−0.16	−0.72	0.52	0.15	0.72	−0.01	−0.44
Math/Stats	**2.22**	−0.62	1.03	1.66	−0.92	−0.80	−0.35	0.74	−0.60
Physical Sci	**2.30**	0.43	0.42	0.32	0.79	−1.35	−0.52	0.73	−0.45
Psychology	0.44	0.37	0.68	−0.02	0.39	−0.67	0.28	0.40	−0.96
Engineering	0.65	0.43	−0.08	0.31	−0.13	−0.17	0.51	−0.64	0.35
Health	−1.00	0.48	1.14	−0.22	−0.33	0.82	0.94	0.26	−1.24
Education	**5.93**	**2.68**	**2.90**	**2.07**	−0.33	−1.75	2.07	0.30	−1.94
Government	**4.83**	1.58	−0.45	**2.46**	−0.99	−1.36	1.62	**−2.50**	1.75

Table 6 continued

	Between gender			Within gender female			Within gender male		
	WF & WM	AF & AM	MF & MM	WF & AF	AF & MF	MF & WF	WM & AM	AM & MM	MM & WM
Years Since Grad	**4.52**	0.54	0.46	−1.32	−1.63	−0.72	0.59	−1.50	**−2.27**
Years Sinc Grad^2	**−4.25**	1.39	−0.72	**2.36**	**2.79**	1.18	−1.62	0.77	**2.36**

Omitted or comparison groups are Research I institutions, social sciences discipline, and business/industry sector

t* values above 1.96 represent statistically significant differences

WF white female, *WM* white male, *AF* Asian female, *AM* Asian Male, *MF* minority female, *MM* minority male

With regard to sector of employment in Table 4, we see that compared to those employed in business/industry, individuals employed in the education sector had lower salaries, a decrease of $14,000 for female and $23,300 for male respondents. Employment in the government sector compared to business/industry was associated with a decrease of almost $2500 for females, and almost $12,000 for male doctorates. As shown in Table 4, the gender disparity for both comparisons by sector was statistically significant.

Table 5 accounts for the interaction between gender and race/ethnicity. These models use real salary as the dependent variable and all corresponding models using logarithmic values were fitted to corroborate that all the inferences we present are congruent. Given the ease of interpreting real USD amounts, we focus on these models; the models with logged transformations are available upon request. As shown, males in all three race groups reported higher adjusted mean salaries than female counterparts, with the greatest disparity between White men and women. White female doctorates had the lowest mean salaries, followed by those for Asian female respondents. Salaries of Asian women increased the most at each time point (about $7500), followed by Asian and White male doctorate holders (close to $7000). Female URM participants received the lowest increase in salary over the 10-year window covered in the study ($5309). Surprisingly, URM male respondents had the highest increase in salary associated with being married compared to those not married. Married women consistently had lower salaries compared to single women. The group with the highest returns associated with years of experience since doctoral degree attainment is White males, followed by Asian males and Asian females.

Also shown in Table 5, delay in degree completion was most costly for Asian males, however, this delay also affected White participants (both genders) and URM males. The payoff in getting the doctoral degree from a Research I institution was higher for White male and female participants, and for URM women. White males graduating from a Research II institution earned on average almost $7500 less than White male peers from a Research I institution, and the corresponding magnitude associated with this coefficient was about $8000 for URM women. Computer scientists had higher average salaries than doctorates in the reference group, social sciences, and White women who majored in math and statistics were the only group with higher salaries than other women counterparts in the social sciences. White males with a degree in psychology had an average reported salary of almost $10,000 less compared to their White male counterparts in social sciences. White females from psychology reported an average salary $7800 less than White females in the reference group. However, the group with the largest difference was male URM participants with a doctorate degree in psychology who reported a salary of over $16,500 less than White males in the reference group.

Over the decade 1999 to 2008, respondents working in the education sector consistently had lower salaries that peers working in business and the private sector. The highest wage gap was found for URM male doctorates with an almost $29,000 difference. A gap was also observed for White and Asian male doctorates, with a difference of $22,000 and $27,000, respectively.

To provide more detail about the interaction between race and gender, Table 6 shows the tests for change in individual coefficients. Based on Eq. (1) and conducted using actual USD, Table 6 shows that compared to White males, White females had lower mean salary, and lower salary increases over time. Compared to peers in industry, the average mean salary decrease for White women in education was $13,037, and the reduction associated with a White man was $22,054 (values in Table 5).

The analysis of male participants by ethnicity shows that the difference in salaries for married URM males was higher than the average salary of married White males. Married women had statistically lower average salaries than married men, regardless of ethnicity. This finding is shown by the test for change in individual coefficients shown in Table 6.

URM males in governmental appointments had higher salaries than their Asian counterparts in government. The decline associated with the quadratic version of years of experience since graduation was significantly more pronounced for White males than it was for their female counterparts. In the within gender comparison, we see that Asians experienced the highest decline in salary associated with this coefficient, reaching statistically significant differences when compared to White and minority women.

Limitations

Findings herein are based on self-reported data; it is possible that respondents may have misreported their salary or other information. Although a substantial percentage of respondents did not answer the question on education debt, we included this variable because of its importance. The *SDR* non-response option for this item was coded as *unknown*, thus allowing us to capture some of the variation associated with debt information. We decided to keep the variable in the models due to its effect on time to degree (Bowen and Rudenstine 1992; Ehrenberg and Mavros 1992), the ability to study full-time study without outside employment, and future career path and employment choice (Ehrenberg 1991).

We were also unable to capture detailed nuances of individuals' job duties. While SDR data include questions related to productivity, our models include faculty and non-faculty members, which translates into different responsibilities and duties that could affect male/female salary disparity. For example, for non-faculty members, questions about teaching, publication (books, articles, reports, monographs), tenure, faculty rank, and service would be constants values with either NA or missing selections. These systematic answers would create collinearity problems with the sector of employment that doctorate recipients selected. In addition, while SDR asks for reasons for changing employers, or reasons for not being employed, these responses do not apply to the great majority of our respondents.

Although the *SDR* focuses on measures that relate to human capital, we acknowledge that the benefits of continued education extend beyond this construct to others such as social capital, which includes the important, albeit intangible, benefits that contribute to one's productivity through social relationships (Coleman 1988). *SDR* data are limited in their ability to capture social structures and norms that can potentially enhance an individual's chances to be successful during doctoral study and beyond. In a similar vein, we acknowledge that our analyses of gender and race do not address class or cultural issues that may also affect opportunities for doctoral education, mentoring, salary, and work experiences such as supervision of others. We also acknowledge that our sample size for some subgroups (Native Americans) is small, but overall analyses shown are within acceptable ranges.[6] In light of recent decreases in the number of STEM majors, we believe it especially important to examine each group individually where possible, remaining mindful of important cultural characteristics that can affect educational goals and objectives.

Discussion and Implications

Results from this study underscore the complex dynamics that contribute to the salary of recent doctoral recipients. Findings show that salary differs by gender, race/ethnicity, time to degree, some disciplines, and characteristics of the doctorate-granting institution. In almost every category, women consistently earned lower salaries than male peers, regardless of

[6] Analyses with sample weights were conducted, results were congruent and are available upon request.

employment sector. White women earned less that URM men and less than their Asian and URM female counterparts. URM participants (both male and female) reported the lowest salary increases over time, and this increase was commensurate with the increases reported by White female doctorates. In general, marriage penalizes salary for women doctorates, but provides a benefit to men. We found that those who earned their doctoral degree from a Research I institution and those who worked in business/industry earned the highest salaries. The delay in time to degree completion is costly due to lost wages, but results herein found delay in degree most costly for Asian males. Having held at least one postdoctoral appointment was associated with a decrease in salary for both male and female doctorates. In this case, the between-gender differences were non-significant, meaning that men and women were equally affected by the postdoctoral experience. Although salary trajectories declined over time, we note the possibility that the relatively low salary typically offered to postdoctoral researchers may account for this. Furthermore, this finding does not include the long-term economic and career benefits that result from this advanced training. In addition, where one starts employment (sector, discipline, and initial compensation) affects subsequent gains and other benefits over time. For groups who begin with lower salaries, it is not surprising to find a larger gap that grows over time. Further study of differences by race, gender and sector may provide additional insight. For example, disciplines of doctoral degree that typically pay well and employ outside academia may contribute to notable salaries for minority recipients.

Regarding educational debt, respondents with unknown amounts of debt reported higher salaries than those with no debt. Caution is advised, however, as this finding may be a statistical artifact of the response patterns with a large number of responses coded as unknown. Due to the categorical nature of the question on debt, we recommend additional study of this important issue combined with other data that details the level of educational debt during and after degree completion.

We also acknowledge the body of literature on the intersection of race and gender. Scholars on this topic (e.g., Bowleg 2008; Bowleg et al. 2008; Hancock 2007) note that individual identities and social inequality based on ethnicity, sexual orientation, and gender are intersectional rather than additive. As such, they pose a variety of methodological challenges. Furthermore, Hancock (2007) purports that quantitative analyses do not explicitly capture the qualitative within-group diversity posited by intersectional theorists, and thus argue that quantitative analyses are not ideal to illuminate the nuances that exist. Acknowledging this perspective, we characterize our analyses not as intersections but as interactions. Nevertheless, we believe our quantitative analyses herein provide additional insight into salary differences experienced by doctoral recipients with regards to race and gender, and confirm that differences still do exist in our society today.

Some Positive Changes, Yet Some Issues Remain

We acknowledge the positive changes that have occurred in the past few decades for women and minorities in degree access, completion, and employment. Indeed, there has been progress in the number of women who earn doctorate degrees as well as the growth of URMs in some STEM fields (NSF Report 13-304). We also note similar findings in the National Academies report for key measures such as grant funding, nominations for international and national honors and awards, and offers of employment in other institutions (NAS 2010). However, these and other reports show that discrepancies remain. For example, women doctorates in psychology earn less than male peers despite comprising the larger percentage of doctorate holders (USDL Report 13-0060 2006). Some minority groups in STEM fields earn less than Asian and White peers (Melguizo and Wolniak

2012). Minority workers continue to report experiences of hostility and discrimination (Turner et al. 2011). And in most science fields women are underrepresented among candidates for tenure relative to the number of female assistant professors (NAS 2010). While it cannot be viewed as a panacea (Etzkowicz et al. 2000), obtaining a critical mass of women and underrepresented minorities (URM)[7] in the professional work setting will contribute to greater equity in pay and work responsibilities.

The findings presented herein contribute to our understanding of salary differences by race and gender for recent doctorate recipients. Salary differences by gender and/or race may occur from continued occupational segregation and/or perceived value held for minority and female doctorate recipients and employees. Some scholars believe that the control exerted by dominant groups can create legitimizing ideologies that make social inequalities appear natural (e.g., Sidanius and Pratto 2001). If inequalities are perceived as natural, there is little impetus for change.

Women, Work, and Family

Wolfinger et al. (2008) believe that the inflexible structure of the American workplace and the male career model force women to choose between work and family. Perhaps the imbalance of women and minorities in select STEM fields occur because of social inequalities that are not consciously perceived as such. Women who choose not to enter (Arnold 1995), or those who report hesitancy to consider certain career fields due to the challenges of work and family balance, may be unaware of potential inequities. Future studies may wish to include qualitative discussions, such as those done by Ward and Wolf-Wendel (2012) beyond academic settings, to determine women and minorities' rationale for their choices and whether those are perceived to be attributed to structural dimensions, such as lack of employment positions (which might signal occupational segregation, glass ceilings, or glass walls) as well as more detailed understandings of why and how one manages the work-family balance. The possibility of extended complications that come from the combination of race and gender challenge us even further.

Influence of the Doctoral Institution

Our findings also note the importance of time to degree, educational debt, and discipline of degree for doctorate recipients. The loss of foregone wages is paramount for advanced degree completion, but the longer time to degree completion may also affect the doctoral student's job prospects, family relationships, and ability to participate in civic and other social activities. Institutional and federal agency resources for graduate assistantships and fellowships are critical in helping students focus on their degree program, uninterrupted from unrelated employment. Increased assistantships that enable shorter time to degree also help an institution's rating, since many degree applicants and rankings agencies include time to degree as an important factor.

As state appropriations to postsecondary institutions have declined, tuition and fees account for a greater share of revenues (Kirschstein and Hurlbert 2012). Recent changes in graduate student loans have removed federal subsidies, adding further burden and loan costs to students (Belasco et al. 2013). It is possible that heightened debt loads at degree completion will influence one's choice of future employment, especially since average

[7] The term URM includes participants who identified themselves belonging to Black, Hispanic, or Native American race/ethnic groups.

annual salaries in the private sector are higher than those in education. Additional study to provide clarity on degree recipients' choice of employment sector is warranted, as well as possible interactions between gender, race, and educational debt.

Our findings of significant differences in salary by gender, race, discipline of study, and institutional characteristics may also be used by individuals as they consider whether or not to pursue doctoral education. Like other individuals who make rational decisions (Manski 1977), potential doctoral students must attempt to determine if future salary and other benefits will outweigh the costs of deferred earnings and possible detriments to quality of life that occur during doctorate study as well as labor market returns that can be expected over one's career.

Implications for Institution Officials

Institution officials may want to continue monitoring degree seekers and completers by gender and race and implement policies and programs that seek to reinforce welcoming messages that value all workers regardless of gender or race. Employers may want to ensure that programs such as "stop-the-clock" (the option to take a leave of absence of reduce the number of working hours for a limited period of time without penalty to future work promotions) are available in many locations, and employees should be encouraged to take advantage of these activities without fear of reprisal. Supervisors should serve as positive role models to employees to ensure against unspoken bias against the worker who desires to participate in policies or programs that can help balance work and family needs. Future researchers may wish to look for evidence of marginalization in duties assigned to workers or uneven patterns of attrition. Examining fissures in the pipeline of women in science, Etzkowicz and Ranga (2011) discuss the "Vanish Box phenomenon" found among female scientists who move from academia to new occupations emerging between science and business. Often, the non-linear trajectories that women follow are not like the traditional, linear paths that male scientists follow, but provide women scientists with more favorable work conditions than those in academic science and industrial research.

Future Studies

Along with salary and salary gains, future studies may wish to examine other labor market outcomes that may contribute to potential inequities among doctoral recipients. For example, career outcomes such as working conditions and perceived climate are also important to one's work and life satisfaction. Perceived collegiality, autonomy, and flexibility in how one completes their work tasks are important dimensions of satisfaction, and for some individuals, may be equally if not more important than salary. These factors may resist simple measure, but are no less important in our full understanding of the benefits of doctoral degree completion and how it affects economic and knowledge production. Future studies may also wish to more deeply examine the effects of educational debt or postdoctoral experience on salary, perhaps as mediated by choice of employment position and sector. Degree recipients who accumulate debt from education may choose a higher paying position, simply to help in paying down the debt. Because such decisions may affect career paths and long-term work satisfaction, greater information can contribute to decisions about the pursuit of doctoral education.

Appendix

See Table 7.

Table 7 Models used for analyses

Step	HLM	GLMM	Implementation
Unconditional means model	$Y_{ij} = \beta_{0j} + \varepsilon_{ij}$ $\beta_{0j} = \gamma_{00} + \eta_{0j}$	γ_{00} η_{0j} ε_{ij}	$\ln Y_{ij} = \gamma_{00} + \eta_{0j} + \varepsilon_{ij}$
Model time as a linear function	$Y_{ij} = \beta_{0j} + \beta_1(T)_{ij} + \varepsilon_{ij}$ $\beta_{0j} = \gamma_{00} + \eta_{0j}$	$\gamma_{00} + \beta_1(T)_{ij}$ η_{0j} ε_{ij}	$\ln Y_{ij} = \gamma_{00} + \beta_1(T)_{ij} + \eta_{0j} + \varepsilon_{ij}$
Model time as a quadratic function	$Y_{ij} = \beta_{0j} + \beta_1(T)_{ij} + \beta_2(T^2)_{ij} + \varepsilon_{ij}\beta_{0j}$ $= \gamma_{00} + \eta_{0j}$	$\gamma_{00} + \beta_1(T)_{ij} + \beta_2(T^2)_{ij}$ η_{0j} ε_{ij}	$\ln Y_{ij} = \gamma_{00} + \beta_1(T)_{ij} + \beta_2(T^2)_{ij}$ $+ \eta_{0j} + \varepsilon_{ij}$
Model slope time variability	$Y_{ij} = \beta_{0j} + \beta_1(T)_{ij} + \beta_2(T^2)_{ij} + \varepsilon_{ij}$ $\beta_{0j} = \gamma_{00} + \eta_{0j}$ $\beta_{ij} = \gamma_{10} + \eta_{1j}$	$\gamma_{00} + \gamma_{10}(T)ij + \beta_2(T^2)_{ij}$ $\eta_{0j} + \eta_{1j}(T)_{ij}$ ε_{ij}	$\ln Y_{ij} = \gamma_{00} + \gamma_{10}(T)ij + \beta_2(T^2)_{ij}$ $+ \eta_{0j} + \eta(T)_{1j} + \varepsilon_{ij}$
Autocorrelation error structure	$Y_{ij} = \beta_{0j} + \beta_1(T)_{ij} + \beta_2(T^2)_{ij} + \varepsilon_{ij}\rho_1$ $\beta_{0j} = \gamma_{00} + \eta_{0j}$ $\beta_{ij} = \gamma_{10} + \eta_{1j}$	$\gamma_{00} + \gamma_{10}(T)ij + \beta_2(T^2)_{ij}$ $\eta_{0j} + \eta_{1j}(T)_{ij}$ $\varepsilon_{ij}\rho_1$	$\ln Y_{ij} = \gamma_{00} + \gamma_{10}(T)ij + \beta_2(T^2)_{ij}$ $+ \eta_{0j} + \eta(T)_{1j} + \varepsilon_{ij}\rho_1$
Heteroskedastic error structure	$Y_{ij} = \beta_{0j} + \beta_1(T)_{ij} + \beta_2(T^2)_{ij} + \varepsilon^*_{ij}\rho_1$ $\beta_{0j} = \gamma_{00} + \eta_{0j}$ $\beta_{ij} = \gamma_{10} + \eta_{1j}$ $where\ Var\left(\varepsilon^*_{ij} \mid x_{ij}\right) \neq \sigma^2\ for\ all\ i$	$\gamma_{00} + \gamma_{10}(T)ij + \beta_2(T^2)_{ij}$ $\eta_{0j} + \eta_{1j}(T)_{ij}$ $\varepsilon^*_{ij}\rho_1$ $where\ Var\left(\varepsilon^*_{ij} \mid x_{ij}\right) \neq \sigma^2\ for\ all\ i$	$\ln Y_{ij} = \gamma_{00} + \gamma_{10}(T)ij + \beta_2(T^2)_{ij}$ $+ \eta_{0j} + \eta(T)_{1j} + \varepsilon^*_{ij}\rho_1$ $where\ Var\left(\varepsilon^*_{ij} \mid x_{ij}\right) \neq \sigma^2\ for\ all\ i$

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