

# Closing the Gender Pay Gap in the US Federal Service: The Role of New Managers

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*This paper estimates the effects of managerial turnover on the unexplained gender pay gap in the US Federal civil service from 1982-2014. We exploit the appointment of new managers in an event study design. We find that changes in managerial teams reduce the unexplained gender pay gap by approximately 1.5 log points in the first year and up to 6 log points in subsequent years. Importantly, that effect is roughly 30% larger when that new manager is female. The main homophily channel operates through increases in pay grades: female employees receive almost 50% more pay grade increases following the appointment of a new female manager. We also find that female managers have the greatest effect in federal agencies, with a critical mass of women in management positions and when their appointment increases the duty station's female management share. These findings are echoed in female employees' responses to the Federal Employee Viewpoint Survey. We conclude that even highly regimented pay systems are not immune to discretionary managerial actions, which may impact the gender pay gap.*

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## I. Introduction

The US gender pay gap considerably narrowed over the last forty years, albeit at a slower pace in the 2010s. However, the share of the pay gap unexplained by traditional employee-based characteristics has been growing (Blau and Kahn, 2017), particularly at the upper end of the wage distribution (Fortin et al., 2017). Recent research has emphasized the role of firm-level factors, such as the under-representation of women in high-productivity firms (Card, Cardoso, and Kline, 2016). Women are also severely under-represented among management, lagging considerably behind their presence in the labor forces they supervise (McKinsey, 2019). Managers’ evaluation ability and leniency have considerable impacts on employees’ pay (Frederiksen, Kahn and Lange, 2020). We therefore ask: To what extent do female supervisors ameliorate gender gaps in pay?

An emerging literature documents the vital role of the identities of immediate supervisors and mid-level managers in workers’ career paths. Even in relatively more egalitarian Scandinavian firms, spending just one year under a lenient manager increases the present discounted value of earnings by roughly 10% of a year’s salary (Frederiksen, Kahn, and Lange, 2020). Employees’ social distance from their managers may also affect their career trajectories. Cullen and Perez-Truglia (2019) document the promotion advantage of employees who are socially close to their immediate supervisors in a South East Asian firm. They observed that socially close employees tend be of the same gender as their managers, highlighting the role of homophily. Promotions are a vital channel through which gender gaps in pay arise. Bronson (2022), for example, finds a sizable early career gender gap in promotions in Sweden and shows it explains nearly half the later career gender pay gap.

Using over 30 years of rich longitudinal data from the US federal civil service, we quantify the role of close supervisors in reducing the gender pay gap. We exploit the appointment of new managers at local offices, called duty stations, in an event-study design to estimate the effects of managers on the unexplained gender pay gap among US federal civilian employees from 1982 to 2014. The Federal civil service is often touted as a pay equity success story. It has highly regimented administrative pay scales with clearly defined progression criteria, which theoretically limit the scope for homophily and demographic characteristics to affect pay. The absence of a profit motive also mutes the potential effect of productivity differences between men and women, making it a neutral setting to study the effect of managerial turnover.

We find that changes in managerial teams reduce gender pay gaps, and that the effect is roughly 30% larger when that new manager is female. In the year following the appointment of a female manager, the unexplained gender pay gap closes by around 1.5 log points and by as much as 6 log points in subsequent years.<sup>1</sup> These effects are economically significant and robust.<sup>2</sup> Even in this highly structured, seemingly deterministic pay environment, we find as much as half of the reduction in the unexplained pay gap can be attributed to female managers who help female employees move up pay grades and steps faster than male managers do. Indeed, we find that female employees receive almost 50% more pay grade increases (almost half a grade) following the appointment of a new female manager.

Our main contribution sounds a cautionary note for hopes that replacing performance pay and employee negotiations with algorithmic pay systems will close the gender pay gap. While there is strong evidence that women’s relative pay decreases in settings where employees have to negotiate their pay (Roussille 2020), our results show that administrative pay systems may simply provide the illusion of a cure through gender differences in pay grades and steps. On the other hand, management diversity may improve pay equity across different pay setting regimes. Consistent with this, Biasi and Sarsons (2022) show that while moving from a seniority pay to performance pay led to a re-emergence of the gender pay gap in Wisconsin teachers’ salaries, the effect was muted in schools with female principals or supervisors. This paper also speaks to the literature on policies that seek to establish wage settings favorable to narrowing gender pay gaps: settings where employees’ prior salaries are hidden—salary history bans (e.g., Hansen and McNichols, 2020) or revealed—pay transparency laws (e.g., Baker et al., 2019).

This paper also contributes to the growing literature on the conditions under which women in leadership are more or less likely to be successful at increasing women’s relative pay. High level “diversity” initiatives, such as improving female representation on boards of directors, have been shown to have small, if any, trickle down effects on female employees’ wages (e.g., Bertrand, Black, Jensen, and Lleras-Muney, 2019; Dalvit, Patel and Tan, 2021; Maida and Weber, 2022). Nevertheless in corporate settings across several countries, studies have found a general positive

<sup>1</sup>We include traditional human capital variables as explanatory factors – age, tenure, education, and occupations. We also control for agencies, sub-agencies, duty-stations, and locality pay. Pay grades and levels are excluded as they are a key mechanism through which managers affect gender pay gaps.

<sup>2</sup>The estimates are unchanged when the estimation sample is limited to workers in the GS pay plan, the largest and least specialized federal pay scale and are robust to alternate fixed effects and controls. We observe the same pattern of results across presidential eras, although the effects of female managers are largest during President George W. Bush’s administration.

impact of female leadership on the wages and promotion rates of female employees.<sup>3</sup>

In the US federal service, women have made significant inroads but remain under represented in management relative to their employment shares.<sup>4</sup> Federal agencies with a critical mass of women in their managerial ranks drive our effects. In agencies where female managers are scarcest (agencies below the median initial female management share, 16%), the gender of new additions to the duty station’s management team has a small effect. In contrast, in agencies with a critical mass of women in management (above the median initial female management share), adding a woman to the duty station’s management team closes the pay gap by nearly 2 log points.<sup>5</sup> The importance of critical mass is consistent with recent lab and lab in the field experiments on women in leadership (see, for example, Stoddard, Karpowitz and Preece, 2020 and Born, Raneyhill, and Sandberg, 2020).

Unlike prior studies that focus on a single firm or industry, such as manufacturing, our setting allows us to estimate the effect of managers on pay gaps across a broad range of sectors, occupations, and eras.<sup>6</sup> The US federal civil service employees over 1 million people in each year. These employees are spread geographically across the United States in close to 75,000 unique duty stations (a narrowly defined work unit akin to an office or workplace) and work in over 1000 different occupations with varying levels of female representation. We focus on white-collar employees, who include everyone from equipment operators earning \$20,000 per year to aerospace engineers earning over \$120,000 per year. We observe these employees over the course of their careers.

We exploit naturally occurring managerial changes in an event-study design to estimate the impact of direct managers on the unexplained gender pay gap. The appointment of a new manager is an infrequent but sufficiently common event in our setting. We observe managerial changes every quarter, approximately 35% percent of observed employees experience the appointment of a new manager in their duty station each year.<sup>7</sup>

<sup>3</sup>See, for Portugal: Cardoso and Winter-Ebmer (2010), for Norway: Kunze and Miller (2017), for Italy: Flabbi et al. (2019), and for Germany: Bhide (2019).

<sup>4</sup>Only one third of the managers we observe are women, and on average, the female management share was 15 percentage points below the female employment share (see Figure A1). In US corporations, women comprise 38% of middle managers (McKinsey, 2019).

<sup>5</sup>This also coincides with Kanter’s (1977) 15% threshold for a critical mass of women in an organization

<sup>6</sup>For example, Flabbi et al. (2019) exploit a longitudinal matched employer-employee sample of Italian manufacturing firms from 1982 to 1997, where only 26% of workers are women, and thus focus on environments where women are vastly under-represented. Their results may not readily transfer to economy-wide settings.

<sup>7</sup>This allows to observe the appointment of female managers to 14,891 duty stations and male managers to 23,130 duty stations as we have access to all quarters of data, unlike others using the synthetic data from the Office of Personnel Management obtained through the Barrientos et al. (2018) initiative.

Because we do not directly observe the employee-manager pair, we estimate the effect of new male and female managers at the duty station. As long as the appointment of new male and female managers at a duty station is independent of the gender pay gap and its trajectory at the duty station, this approach identifies the effect of treating an office with a new female manager and the ITT effect of individual employees receiving a female manager. Our preferred estimates focus on federal duty stations with up to 5 managers (approximately 3 managers and 25 employees, on average). In those settings a single managerial change represents a substantial change in office leadership and results in a sizable share of employees experiencing a change in supervision.<sup>8</sup> The gender gap is not infinite and workers may experience more than one managerial appointment during their careers. We therefore focus our estimation on the effect of the first new manager who arrives at the duty station during the each worker’s tenure (the effects of subsequent managerial transitions are provided in the Appendix).

Finally, we match our data on the share of female managers with data from the 2008-2014 Federal Employee Viewpoint Surveys (FEVS), an annual survey of US federal employees to test whether female employees’ job satisfaction, pay satisfaction, perceptions of fairness and workplace climate are correlated with the share of female managers. Our findings are also in line with the self-reported perceptions of female employees in the US civil service. Female employees’ job and pay satisfaction are increasing in the share of female managers. These results are in keeping with recent studies finding a positive impact of female leadership on workplace climate (Tate and Yang, 2015; Lucifora and Vigani, 2022).

The remainder of the paper is organized as follows. In Section 2, we present the evolution of legislation in setting pay in the US Federal civil service and discuss the role of managerial assessments. In Section 3, we summarize the unique features of the longitudinal administrative US Federal Service data that we employ.<sup>9</sup> In Section 4, we outline our estimation and identification strategy. Section 5 reports the main event study results and their implications, as well as discusses threats to identification and robustness results. Finally, section 6 concludes.

## II. Pay Setting in the US Federal Service

Over the years, the Federal pay-setting system has been a topic of debate and controversy encapsulated in a series of legislation. Because of the large number of employees involved, around

<sup>8</sup>We find the same pattern of effects in larger offices as well (see Appendix).

<sup>9</sup>We relegate the reader to the Data Appendix for the intricate details of the extensive data cleaning process.

1.5 million, any pay increases also had considerable budgetary repercussions. As a result, from 1970 onward, pay increases have involved direct Presidential intervention. Below we provide a brief overview of Federal workers’ pay-setting process partly based on Buckley (2009).

#### *A. General Pay Schedule*

Concerns over a proper merit system for Federal employment began with the Pendleton Civil Service Act of 1883, which, however, failed to establish a link between salaries and duties. The subsequent classification Acts of 1923 and 1949 corrected this omission and classified positions according to duties and responsibilities, applying the same standards across all Federal agencies creating a “General Schedule (GS) of pay. It has been suggested (Johnson and Libecap, 1989) that this bureaucratic system reduces Congress’ cost of monitoring the federal personnel system and help guard against supervisor behavior that could be adverse to elected officials.

The Federal Salary Reform Act of 1962 established procedures for the Bureau of Labor Statistics to help set the salaries of Federal GS workers to levels comparable to private sector workers with comparable duties and responsibilities. The central core of the GS classification system establishes 15 grades, based on the difficulty, responsibility, and required qualifications of the positions, including education levels. Discretion in the assignment of initial grade can be exercised through “superior qualification actions.” OPM (2014a) reports that the percentage of new hires receiving these discretionary actions is higher among men than women. Employees in occupations with job ladders may advance (non-competitively) to higher grades by promotion at certain intervals (generally after at least a year), up to the full promotion potential. Beyond that level and in other occupations, employees compete for promotions. The basic pay rates within any GS grade are set at one of 10 fixed step rates.<sup>10</sup> Employees performing at an acceptable level of competence progress through the rate range following statutory waiting periods (one to three years depending on the step). Furthermore, employees may receive additional step increases—called Quality Step Increases (QSIs)—based on outstanding performance, subject to a limit of one QSI per year. Therefore one possible way for gender pay disparities to emerge is for men and women to be subject to different performance evaluations.<sup>11</sup>

There are several alternative pay plans to the GS schedule. They primarily cover very specialized workers (e.g. air traffic controllers). They have different salary grids, but otherwise

<sup>10</sup> Table B.1 in Appendix B displays the GS salary table for 2012 (rates frozen at 2010 levels) in the form of a matrix of 15 grades by 10 steps. It shows that increases along the steps (columns) range from 2.4% to 3.3%, while increases across the grades (rows) for step 1 range from 8.7% to 18.1%.

<sup>11</sup> Although Olson et al. (2000) found that only 3 per cent receive quality step increases.

function similarly. Around 20% of all federal employees are paid under non-GS plans (10% in our estimation sample). Our main estimates include employees under the GS schedule as well as other schedules. But we also provide some analysis focusing only on GS employees.

Beyond job classification and career progression, the overall salary grid is also adjusted for cost of living over time and across locations. The Federal Pay Comparability Act of 1970 allowed for GS pay adjustments via executive action while the Federal Employees Pay Comparability Act (FEPCA) of 1990, introduced locality-based pay to address difficulties recruiting and retaining high caliber employees in high wage markets. It set a timetable for reducing gaps between the pay of Federal and non-Federal employees doing comparable work in the same locality along with a plan for annual pay adjustments. Because some of the required locality adjustments exceeded 30-percent they were initially only partially implemented and FEPCA plans extended through the early part of the 21st century (Table 1-1 of CRS 2010).<sup>12</sup> We begin our analysis by stripping locality-year fixed effects from employees wages to absorb the yearly variation in locality pay adjustments as explained in section III.A below.

FEPCA also set up a process for yearly general increases in Federal pay: a Federal Salary Council first transmits locality pay recommendations to the President’s Pay Agent, who makes the final recommendation to the President.<sup>13</sup> The President has the authority to implement alternative pay plans when there is a “national emergency or serious economic conditions affecting the general welfare.” The pay adjustments are also reviewed annually by Congress, which may legislate a different adjustment from the one authorized by the President.

Political attitudes towards federal compensation have varied over time. During most of Clinton and Bush 43 Congress generally exceeded the President’s adjustment, but the Obama Era was marked by pay freezes and small (1%) adjustments.<sup>14</sup> We thus expect presidential cycles to influence the level of general pay increases, which themselves may influence the ability

<sup>12</sup>Initially, there were just 29 locality areas; thirteen new locality areas were added in 2016. There are now 47 locality areas – regions across the country where employees are paid more to compensate for higher costs of living. Beginning January 1994, annual salary adjustments for most GS employees would consist of a general cost-of-living adjustment equal to the BLS Employment Cost Index (ECI) minus one-half percentage point and a local-specific adjustment of no “less than one-fifth of the amount needed to reduce the pay disparity with private industry salaried in the locality involved to 5 percent.”

<sup>13</sup>The Federal Salary Council is comprised of nine pay and labor relations experts and organizations representing GS employees, some of them can be political appointees. The President’s Pay Agent normally includes the Secretary of Labor, the Directors of the Office of Management and Budget (OMB), and of the Office of Personnel Management (OPM).

<sup>14</sup>From 1994 to 2009 Congress either added to the President’s proposed adjustment or equaled the higher rate recommended for the military. Alternative plans were submitted for pay increases effective in 1995-98, 2001, 2003-05, 2007, 2008, and from 2010 to 2017. In 2008, following a failed attempt at introducing a pay-for-performance (PFP) President George W. Bush implemented a 3.5% pay increase for most federal employees via executive order. Conversely, under the “Campaign to Cut Waste,” President Barack Obama implemented a 3-year pay freeze from 2011 to January 2014, with increases limited to 1% for that year and again in 2015. GAO (2021) provides a comparison of pay locality increases proposed by the Federal Pay Council, the President’s Agent and Congress’ alternative plans for 2015 to 2019.

of individual employees to seek and obtain personal adjustments.

In summary, federal civil service employees are paid according to an administrative pay system. Salaries of federal civil service employees can increase due to grade increases, QSIs, and statutory increases in the federal pay schedule, as well as due to locality pay adjustments under the Federal Employees' Pay Comparability Act of 1990 (FEPCA). In the analyses that follow we will control for the latter and other bureaucratic determinants to isolate the potential role of managers in helping employees move along the pay grid.

### *B. The Role of Managers*

In addition to assigning tasks and providing supervision, managers evaluate their supervisees' performance and recommend them for step and grade increases. One component of this is providing performance ratings. Contrary to popular belief, the federal service does link financial rewards to performance, not just tenure. Using a random-effects model on a one percent sample of federal personnel records from 1988-2003, Oh and Lewis (2013) find that, on average, outstanding performers received annual raises one-quarter and two-thirds of a percentage point higher than fully successful performers. The ratings were also found to affect career advancement one or two years later.

While regulations do not establish a minimum time that an employee must be under a supervisor before the employee can receive a performance rating, the appraisal programs establish a minimum appraisal period.<sup>15</sup> Specifically, managers have to implement the five phases of the performance management cycle: 1) planning work and setting expectations; 2) continually monitoring performance; 3) developing the capacity to perform; 4) rating periodically to summarize performance; and 5) rewarding good performance (OPM, 2017). This rigorous and analytical appraisal process may be a reason why we see reductions in gender gaps following the appointment of new managers of any gender (see Blair-Loy et al. 2022). Additionally, OPM has long run the Federal Employment Viewpoint Survey (FEVS) to identify practices and strategies to improve performance management. We also utilize these surveys to assess gender differences in satisfaction with management.

Yet, despite relatively constrained pay setting procedures, federal supervisors seem to find ways around those rules. Federal pay has varied by race, sex, and locality more than can

<sup>15</sup>The minimum amount of time that employees must work under a specific set of elements and standards is usually a year, but it can vary by agency. Off-cycle ratings of record can be given when a within-grade increase (WGI) decision is not consistent with the employee's most recent rating of record.



be explained by observed measures of qualifications (e.g., Lewis and Oh, 2009) and in spite of bureaucratic procedures to block that variation. Pay grade levels have risen over time despite bureaucratic efforts to retain constant definitions of grade. Droганova (2018) shows that the gender gap in federal employees’ wages and promotions is correlated with the share of female managers in the office. Specifically, it favors men in offices where all the supervisors are male and favors women in offices where all the supervisors are women. Women also start at a higher initial grade and progress faster in offices with all female management teams. Instrumental variables estimates exploiting manager retirements provide suggestive evidence in the same direction; however, that analysis is limited by the instrument’s strength.

### III. Data

#### A. *Employment Data*

The primary data source for the paper is quarterly administrative payroll data obtained from the US Office of Personnel Management (OPM) through a Freedom of Information Act (FOIA) request. We focus our analysis on civilian white collar salaried permanent employees employed by the federal government between 1982 and 2014.<sup>16</sup>

The OPM data provides details of each employee’s federal employment history and pay. The data includes information on each employee’s place of employment, including the agency, sub-agency and duty station. It also includes information on their job, including their occupation and role in the office (i.e., manager, supervisor, employee) and their employment type (e.g., full, part-time, salaried, or hourly). These data enable us to follow employees over the course of their careers in the federal service including any moves across roles, offices, and agencies.<sup>17</sup> Finally, the data include information on each employee’s compensation, most notably the government pay schedule (herein called the pay plan) under which they are paid, their grade in that pay plan in each quarter, and their pay in each quarter.<sup>18</sup>

We supplement these data with human resources data collected at the time the employee was hired and when they separated from the government. These data include the individual’s age, education, and reason for separation from the federal government (e.g., retirement). These data also include information on prior federal service for employees returning to government

<sup>16</sup>White collar workers form the overwhelming majority of employees in the Federal Civil Service, only 9% were blue collar workers in 2013.

<sup>17</sup>Approximately a quarter of employees in our sample change duty stations at least once in their careers.

<sup>18</sup>The workers in our data are paid under 112 separate pay schedules, but most workers in the full data (around 80%) are paid under the GS schedule.

service after a period in the private sector. Because these data are only available beginning in 1982, we begin our sample then. Our aim is to follow workers as they progress through their career. We therefore further restrict the analysis to workers who were born in or after 1955, the post-Pill cohorts.<sup>19</sup> The data appendix provides additional details on the construction of the OPM data and each of the variables we use.

The data we obtained from OPM does not have race or gender of employees, but does include first names and last names for most. We therefore imputed gender based on employees' names. OPM redacted the names of all employees in sensitive occupations: these are primarily employees in enforcement or security roles. We were unable to impute gender for those employees and therefore exclude law enforcement and regulatory agencies and sub-agencies (e.g., the Inspector General's office). We were able to successfully impute the gender of 95 to 99% of the employees whose full names were provided by OPM.<sup>20</sup> We omit employees whose gender we could not identify, but include all managers irrespective of our ability to impute their gender. The data appendix provides extensive detail on both the gender imputation and the excluded sub-agencies.

To ensure that we have enough observations to obtain estimates of duty station gender pay gaps and fixed effects, we restrict our sample to offices with at least 15 employees. We also restrict the sample to employees who work for the government for at least 5 years to observe them for a few periods before the event.<sup>21</sup> Both restrictions remove noise from the estimation but do not otherwise meaningfully affect the estimates below.

The key variables and sample characteristics for the resulting estimation sample are summarized in Table 1 for employees working at duty stations with at most 5 managers and 6-20 managers. The full estimation sample without managerial restrictions consists of approximately 18 million quarter-year observations from approximately 250,000 unique female employees and 200,000 unique male employees who are spread across more than 10,000 duty station. Our preferred 'at most 5 manager' estimation sample consists of 1.8 million quarter-year observations from approximately 80,000 unique female and male employees who are spread across 8,000 duty

<sup>19</sup>The full sample encompassing all workers is used to calculate duty station characteristics (e.g. number of employees, gender-mix of employees and managers, the appointment of new managers, etc).

<sup>20</sup>We imputed gender based on the frequency of the first name in male and female babies born in the employee's birth cohort in the Social Security Name files. Names were coded as being indicative of a gender if at least 85% of babies born in the employee's cohort with the name had the same gender. We cross-validated our gender imputation algorithm with an extract of the EHRI-SDM data for the years 1992-2012 from Vilhuber (2018) which includes information on employee gender. In the sub-sample contained in both data sets, our gender imputation algorithm accurately classifies 95.11% of males and 99.24% for female employees.

<sup>21</sup> This last restriction implies that our data set corresponds to a continuously refreshed panel data that omits high frequency employee churning (those employed less than five years). Thus our gender gap measures will be different from the ones typically obtained from cross-sectional data.

stations (Table 1, Panel C). Like in the broader labor market, there is a roughly 15% raw gender pay gap among the workers in our sample. The average female employee earns \$50,000 per year and the average male employee earns roughly \$7,000 more (Table 1, Panel A). However, a portion of the raw gender disparity can be explained by differences in human capital, such as education. The overwhelming majority of white collar federal employees have at least some college education, but male employees are slightly more educated (Table 1, Panel B).<sup>22</sup>

Figure 1 plots the raw gender pay gap over time, alongside with the pay gap adjusted for gender differences in observed human capital (education), occupation, and age. A sizable gap, ranging from 4 to 10 log points, remains unexplained after accounting for these observed differences (the vertical distance between the two curves.) Panel A illustrates these trends for employees who work for the government for at least 5 years in the full sample, while panel B further restricts employees to duty stations with at most 5 managers and at least 15 employees. Both panels, but especially panel B, show the raw gap decreases over time, but the adjusted pay gap does not decrease proportionally. Rather the two curves evolve in parallel, as a result the unexplained gap as a share of the raw gap increases over time.

### *B. Managers*

Our data on managers is extracted from the same source, but is a distinct extract and includes managers whose gender we could not identify (about 20% of the manager sample).<sup>23</sup> Women’s presence in management positions grew alongside their employment shares over the course of our study period (Figure 1). By 2014, women were 38% of managers, up from 17% in 1987. Despite these increases, women were under-represented in management relative to their employment shares in every year and remain so. On average, in our data, women make up 40% of employees but only about 26% of managers (Table 1, Panel C). In addition to the inter-temporal variation, there is substantial variation in female management shares across agencies and across duty-stations within agencies in each period. Female management shares range from 0% to 100% across agencies and offices.

The managers we study are close supervisors. As shown in Figure 2A (solid line), the vast majority of federal offices have only 5-10 employees per manager. Unfortunately, we only observe the management team at each duty station. We do not observed direct reporting lines

<sup>22</sup>In our data, 86% of the male workers have at least some college education compared with only 76% of female workers. Male workers are also more likely to have graduate degrees.

<sup>23</sup>Appendix Tables B.2 and B.3 shows the characteristics of managers

and the divisions of management responsibilities within the duty station. We therefore focus our analysis on two samples with different managerial team sizes: those with 5 or fewer managers, and those with 6 to 20 managers. Figure 2B and 2C, respectively, show the percentage of duty stations treated with a new manager in each year for each of the sub-samples. Approximately 7% of duty stations with up to 5 managers receive a new manager each year, and commensurate with their management shares, about a third of these new managers are women (Figure 2B). The turnover rates are comparable in larger duty stations once scaled up by the number of managers (Figure 2C). Nevertheless, our preferred analyses center on the 80% of duty stations that have smaller management teams (at most 5 managers), because of the presumably more accurate employee-supervisor pairing.

To avoid the confounding effects of previous managers, the main event of interest is the first managerial change an employee experiences at the duty-station level.<sup>24</sup> We note that almost all (94%) managerial promotions are internal to the federal government and 45-50% involve promotions of employees within the duty station (Appendix Table B.4). The first new manager event is then interacted with the gender of the first new manager to create the “new female manager” variable, leaving male managers and managers with unobserved genders in the base group. For completeness, we construct a “new male manager” indicator in the same manner.<sup>25</sup> Under this definition, around 30% of female and male employees are treated with a first new manager over the course of the sample period.

#### IV. Identification strategy

In this section, we provide a more precise definition of the event that we exploit and expand on how the richness of our data allows us to estimate a very detailed specification. As explained in section II above, the federal pay setting involves several components, most of which we want to abstract from to estimate the “untainted impact” of new managers. Therefore, we begin our estimation by first constructing a log pay residual – pay received by employees not accounting for the observable characteristics of employees, duty stations, and localities. We will then use this pay residual as a dependent variable in the event study design. In this section, we also provide more details on the definition of our event of interest, in particular how the appointment of a first new manager avoids possible confounding issues with the effects of previous managers.

<sup>24</sup>A management change at a duty station will not trigger a first new manager event for all the employees at that duty station, only those who have started work since the last management change will experience their first new manager or after they begin working for the federal government.

<sup>25</sup>In the absence of managers of unobserved genders the new male manager estimates would, of course, be redundant.

### A. First stage

An important component of pay for many employees from 1994 onward comes from pay adjustment for living standards in different localities, which have become more granular over time. Thus, we begin by regressing the individuals’ annual log pay on localities of duty stations in a first step.<sup>26</sup> We run these regressions separately for each year, which allows us to fully account for the magnitude and yearly variation of the locality pay adjustments under FEPCA, as discussed in section II.A.

We then use residuals from step one to obtain the unexplained pay in the second step. Again, we regress, year by year, the residuals from the first step on the observable characteristics, some of which changed substantially over the entire period:

$$(1) \quad \hat{w}_{iqy} = X'_{iqy}\beta_y + \theta_{dy} + \omega_{iqy}, \quad y = 1987, \dots, 2014$$

where  $\hat{w}_{iqy}$  is the residual from step 1 for an individual  $i$  in quarter  $q$  and year  $y$ ,  $X_{iqy}$  are observable characteristics, including age, education, occupation, a part-time indicator, and tenure.<sup>27</sup>

The duty station/year fixed effects are denoted by  $\theta_{dy}$ ; they are thought to capture the effects of duty stations, such as female share of employees, that are shared by all employees at the duty station in a particular year. Not restricting the effects of observables to be the same across years corresponds to a model with a full set of interactions between the explanatory variables and years.<sup>28</sup> We denote the resulting log pay residual as  $\hat{\omega}_{iqy}$ .

We display yearly averages of these residuals (solid symbols) by gender in Figure 3 for sub-samples with duty stations with at most 5 and 6-20 managers, as well as residuals (hollow symbols) from a specification that controls for pay plan and pay grade fixed effects. The distance between the average male and female residuals corresponds to the average unexplained pay gap. One potential mechanism behind these unexplained disparities that we explore more below is observationally equivalent male and female workers being hired at different places on the pay

<sup>26</sup>First step regressions:  $W_{iqy} = \theta_{ly} + w_{iqy}$ ,  $y = 1987, \dots, 2014$ , where  $W_{iqy}$  is log annual pay for an individual  $i$  in quarter  $q$  and year  $y$ , and  $\theta_{ly}$  are locality fixed effects in a regression for year  $y$ .

<sup>27</sup>The part-time indicator is equal to 1 in each quarter-year in which the employee worked less than full-time. OPM defines part-time permanent workers as those working between 16 and 32 hours a week. The salaries provided by OPM are annualized full-time salaries, not pay, and do not mechanically fluctuate with hours worked. OPM notes a number of circumstances in which employees may choose to work part time including “to balance routine and/or unexpected work and family demands,” and “to recover from illness” (<https://www.opm.gov/policy-data-oversight/hiring-information/part-time-and-job-sharing/>). Approximately 8.5% of federal workers in our sample work part time at some point in their careers. 6% of full-time workers have at least one part-time spell.

<sup>28</sup>This strategy also avoids potential multicollinearity problems between duty station and their localities, when there are few duty stations at a particular locality. Localities are linked to the OPM data at the duty station level.

grid and moving through the grid at different paces. Indeed, when we include the endogenous pay grades, the male and female residuals are much closer to each other, at times with some positive (negative) average female (male) residuals. It is in this sense that the pay grid hides the underlying gender pay gap.

Thus, Figure 3 illustrates one of our most important finding: most (85%) of the unexplained pay gap over time operates through workers placement on the pay grid, a decision heavily influenced by their managers. Below we present evidence that new managers help employees move through the grid, therefore that placement in the grid has a discretionary component.

### B. Event study

Using the log pay residuals obtained in the first stage as dependent variable, we estimate the effects of managerial turnover and gender of new managers in an event study design. The following specification is estimated separately for female and male managers, because there are a certain number of managers whose gender we do not observe:

$$(2) \quad \begin{aligned} \hat{\omega}_{itq} = & \sum_{k=-L, k \neq -1}^U \delta_k \mathbf{1}\{t = k\} \cdot F_i \cdot NM_{idt} \\ & + \sum_{k=-L, k \neq -1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NM_{idt} \cdot G_d) + \gamma_{id} + \lambda_q + \varepsilon_{itq}, \quad G = f, m \end{aligned}$$

Here,  $\hat{\omega}_{itq}$  denotes the pay residual from the first stage for an individual  $i$  in event year  $t$  and calendar year-quarter  $q$ . Female employees are denoted by the indicator variable  $F_i$ . The appointment of a first new manager for an individual  $i$  is denoted by  $NM_{idt}$ , and the interaction,  $F_i \cdot NM_{idt}$ , denotes female employees getting a new manager in event year  $t$ , therefore  $\delta_k$  capture the effect of a new manager of the log gender pay gap at event time  $t = k$ . We further examine the additional effects of a new manager of gender  $G_d = f, m$  by including its interaction with  $NM_{idt}$ . In the case of a new female manager,  $G_d = f$  and the term,  $F_i \cdot (NM_{idt} \cdot f)$ , denotes female employees getting a new female manager in event year  $t$  at the duty station  $d$ . Therefore  $\delta_k^G$  capture the effect of a new manager of gender  $G_d = f, m$  on the log gender pay gap at event time  $t = k$ . Fixed effects are given by  $\gamma_{id}$  and  $\lambda_q$ , which denote individual-duty station fixed effects, and calendar year-quarter fixed effects. Because there is substantial proportion of employees (25%) who move across duty-stations, we identify individual-duty station fixed effects, which also absorb individual gender fixed effects. The event study residual is denoted by  $\varepsilon_{itq}$ .

We define treatment as the first managerial turnover the employee experiences after she begins working for the federal government. Specifically, treatment is the first time a new manager arrives at the employee’s duty station.<sup>29</sup> Event years correspond to four consecutive quarters prior to and following treatment. Depending on when treatment occurs, event years might not be equivalent to calendar years.<sup>30</sup> The year prior to treatment,  $k = -1$ , is excluded from the event study regressions. The absorbing years in our event study specification are denoted by  $-L$  and  $U$ , where  $-L$  is the earliest event year, and  $U$  is the latest event year. In our results, we report estimates for event years from  $-4$  to  $+4$ , omitting the lower and upper absorbing years in the figures.

The definition of treatment in our event studies warrants further discussion. Managers are appointed at the duty station level, thus, individuals are treated at the duty station level. We focus on the appointment of the first new manager for each individual at the duty station to avoid confounding issues driven by the effects of previous managers.<sup>31</sup> If this is the first new manager for an employee working at the duty station, we define the employee to be treated. In addition, treatment status is also restricted to employees who receive their first new manager after having worked at the federal service for at least 1 year.<sup>32</sup> Thus, when a new manager arrives at a duty station, only a subset of individuals working at the duty station are defined as treated.

We estimate event studies separately for new female and male managers. Usually, the event study results estimated using specification (2) for new female managers would imply mirrored results for the effects of new male managers when genders of all managers are known. Because we interpolate gender using an algorithm, as discussed in Section III.A, and include new managers of unknown gender, the effects of new female managers are identified relative to all non-female managers. Since the effects of new female managers and new male managers in this setting are not

<sup>29</sup>Our preferred estimates require treated employees to have been working at the duty station for at least one year prior to their first managerial turnover. This insures that each treated person in the event study has a pre-treatment period. However, estimates are robust to including those with even shorter tenures prior to the first new manager’s appointment. They are also robust to defining the event as the first managerial turnover after at least a year of service. Estimates using these alternate treatment definitions are included in the Appendix.

<sup>30</sup>For example, if a duty station receives a new manager in the second quarter of the year 2000, the event year 0 is defined as 4 quarters prior to and including the event quarter, thus including the last two quarters of 1999 and the first two quarters of 2000. The first event year following treatment is then captured by the last two quarters of the year 2000, and the first two quarters of the year 2001, and so on.

<sup>31</sup>We have however estimated event studies using appointment of the second manager as treatment. The effects associated with the second manager, regardless of gender, are not substantial. The results can be found in Appendix Figures A.1 and A.2, Tables A.1 and A.2.

<sup>32</sup>If an employee has received new managers prior to the appointment of the current new manager at the duty station, the employee is defined to not be treated even if she receives a new manager at the same time as treated employees at the same duty station. We limit the treated group to those who worked for the federal government for at least a year before experiencing their first management change. Those whose workplaces experience management changes in their first year are not ever coded as treated. An alternate approach would define treatment as the first new managerial appointment after at least one year of service. These estimates (available upon request) are virtually indistinguishable from our main specification.

reciprocal of each other, their estimates need not be symmetrical. Therefore, for completeness, we estimate event studies for both new female and male managers.<sup>33</sup>

## V. Event-study Results

In this section, we begin by presenting our main event-study results for duty stations with at most 5 managers and duty stations with 6-20 managers. We follow with estimations on specific sub-samples: first, by the agency’s initial rank of the female managerial share; second, by the level of education of employees which may limit their access to grade increases. Third, we distinguish presidential cycles which influence the level of general pay increases, as discussed in section II.A. Fourth, we explore the type of managerial changes and circumstances under which female managers have the largest impacts. These allow us to discuss the conditions under which new female managers are found to have the largest impact. This is followed by a thorough discussion of potential threats to identification. These include the balance of the observed characteristics of workers and duty stations by new manager gender, analyses of the sensitivity of the estimates to key specification and sample choices.

We complement the event-study analysis with two-way fixed-effects difference-in-differences estimates of the overall effect of the appointment of same-sex managers on promotions and the adjusted pay gap to probe the primary mechanism, namely homophily, that we argue might be at play. The robustness of these estimates is put to the test using newly proposed estimators for staggered treatment effects (Borusyak et al., 2021). Finally, we extend the analysis to employee retention (exit) following the appointment of a new female or male manager, both at the duty station level and in the federal service.

### A. Main Results

Figure 4 provides a graphical representation of our main event study results. The solid orange line is the total effect of the addition of a female manager on the gender gap. It is the combined effect of receiving a new manager (regardless of manager gender) and the effect of that new manager being female ( $\delta_k + \delta_k^f$ ). The dotted orange line isolates the female manager effect ( $\delta_k^f$ ) and the vertical distance between the two curves is the new manager effect ( $\delta_k$ ). Because we were unable to observe the genders of all new managers, the excluded group in the interaction is male new managers and managers of unknown genders. For completeness, the blue lines depict

<sup>33</sup>Additionally, since the control group includes managers of unknown gender, our estimates of the effects of new female and new male managers are likely lower bounds of the true effects.



the analogous estimates for new male managers. A positive estimate corresponds to a reduction in the gender pay gap (the female pay penalty becoming less negative). Table 2 reports the corresponding point estimates with standard errors (clustered at the duty station level).

Our first finding is that managerial turnover has a positive effect on the negative gender gap: thus it reduces the gap. For our preferred sample, duty stations with at most 5 managers, the gender gap is stable prior to the event (there is no pre-trend) and then improves following the appointment of a new manager at the duty station. The gender pay gap improves by 3.5 log points over the four years following the appointment of a new male manager and by almost 5 log points following the appointment of a new female manager. The pattern of estimates is similar, albeit slightly larger and noisier, in the larger (6-20 manager) offices.

Our second finding isolates the effect of the manager’s gender. As anticipated, the differential effect of female managers, illustrated by the dotted line (orange), is positive ranging from 1 to 1.8 log points and very precisely estimated in offices with up to 5 managers, as shown in Table 2. Conversely, the differential effect of male managers, illustrated with the dotted line (blue), is negative ranging from  $-0.2$  to  $-0.6$  log points. Estimates are similar for employees at duty stations with 6-20 managers, although the female manager effect is smaller and less precisely estimated.

As discussed earlier, female managers are in the minority. This propels us to look at circumstances under which female managers are more or less effective at reducing the pay gap and the types of workers who benefit most. We begin by categorizing agencies according to their initial female management shares, that is the female management share at the agency in the first 3 years we observe it.<sup>34</sup> The initial female management share of the agency may differ from both the initial and current female management share of each of its duty stations, or even the sub-agencies in which they are housed. Nonetheless, we believe it captures women’s wider presence in the agency’s power structures overall and relative to the rest of the federal government. The first row of Figure 5, presents our event study estimates for sub-samples of agencies: those with initial female managerial shares below the median (16%) and those initially above the median.<sup>35</sup> The new manager effects are significantly larger in agencies with above median initial female

<sup>34</sup>For the agencies created before our first observation year (e.g.the Departments of Agriculture, Commerce, Energy, Education, Health and Human Services, Labor, Housing and Urban Development, Transportation, etc.), this corresponds to the years 1982-1985. For agencies created during our sample period (such as the Department of Veteran Affairs created in 1989), the initial female management share is calculated based on the first 3 years we observe the agency in the data.

<sup>35</sup>Table C.1 reports the corresponding estimates with standard errors clustered at the duty station level. The corresponding graphs and tables for larger offices are available in Figure D.1 and Table D.2.

management shares. The effects are comparable in the first two event years (year 0 and year 1), but then appear to hit a ceiling in the low initial female management share agencies. In contrast, in the above median agencies, the effects are substantially larger in the following years. The total new male and new female manager effects top out at 4.95 and 6.13 log points (Table C.1, columns 7 and 8), respectively in above median agencies compared with only 3 and 3.6 log points in the below median agencies (Table C.1, columns 7 and 8). Our results suggest women benefit more from management turnover in agencies where their inclusion is more common. They are also consistent with the “decisive minority” literature arguing that a critical mass of female managers is required for female managers to have preferential, possibly remedial, impact on women’s wages.

Educational attainment is a key factor in employees’ initial GS grades and promotion ceilings. Individuals with a high school diploma and no additional experience typically qualify for GS-2 positions, those with a Bachelor’s degree for GS-5 positions; and those with a Master’s degree for GS-9 positions. In the second row of Figure 5, we report the event-study estimates for employees with less than a Bachelors degree and those with at least a bachelor’s degree. Overall, more educated female workers experience more relative wage growth after managerial turnover, possibly reflecting their eligibility for a larger range of pay grades and greater career advancement. However, the differential impact of a new female manager is larger for less educated workers (Table C.2, columns 2 and 6).

Next we ask if the effect of managers varies over time and across political eras. In Figure 6, we divide our data by presidential cycles: Reagan and Bush 41 (1987–1992), Clinton (1993–2000), Bush 43 (2001–2008), and the first six years of Obama (2008–2014). We present our event-study results for our preferred sample, offices with at most 5 managers (estimates for the up to 20 manager sample are provided in the appendix). First, the overall pattern of estimates we documented in the full sample is present across the Presidential Eras, with the exception of the first era (Reagan-Bush 41) where it is a bit noisier and dampened, likely due to it running into the initial seam of our sample. Fewer duty stations also had a critical mass of female managers in that era.<sup>36</sup> When women are a critical mass in the managerial team (as discussed above) and when the pay environment is more favorable to increases, new female managers become relatively more effective than new male managers at reducing the pay gap. Consistent with this, the largest total effects occurred in the Bush 43 Era a time of federal government reorganization

<sup>36</sup>Only a quarter of duty-stations had management teams with at least half female managers during the Reagan and Bush 41 presidencies compared to more than half of all duty stations during Bush 43 presidency.

and expansion, in which newly appointed female managers were more likely to be assuming their roles in workplaces with a critical mass of women. In that period, female managers closed the gender gap by as much as 6 log points compared with 4 log points for male managers (Figure 6, panel C). Despite unprecedented 3-year general pay freeze (2011-2014) during the Obama years, the ability of managers to get pay increases for their female employees were only modestly dampened (compared to the preceding presidency). We find sizable total effects of new managers on the gender pay gap, but smaller differences between female and male managers' effectiveness at reducing the gap.

Finally, in order to gain more insight into the mechanisms underlying our results we ask: does the female manager effect vary with the type of managerial change (Figure 8).<sup>37</sup> We begin by comparing the effect of new female managers who are new to both the role and the duty station (external appointments) with the effect of those who worked at the duty station prior to their appointment (internal appointments). Roughly half of the new managers we observe are external appointments. As panel A shows, external female manager appointments are driving the new female manager (NFM) effect. While the gap in the overall turnover effect (NM) is narrower across the groups, the overall effect of external appointees' is still larger. In contrast, appointments that grow the size of the managerial team result in larger total decreases (NM+NFM) in the gender gap, but no difference in the female manager effects (panel B). Given our earlier finding that new female managers more effective at improving the pay gap in agencies with a critical mass of other female managers we ask whether new female managers are also more able to close the gender gap when their addition increases the female manager share at the duty station (panel C). Consistent with our earlier findings, new female managers reduce the gender gap more when their presence increases the presence of women on the managerial team.

Lastly, one might wonder whether generational change is playing a role in our effects. Gender norms, particularly around women's role in the workplace have shifted across the cohorts we study. While we did not find substantial differences in our effects across eras above, we nonetheless reproduce our estimates for new managers who are at least 10 years younger and at least 10 years older than the managers they replace (panel D). The effects across both groups are indistinguishable, suggesting that generational change is not driving the new manager effect (NM) and will not eliminate the gender wage gaps.

<sup>37</sup>To make the comparisons across managerial changes visually tractable, we omit the new male manager effects (NMM and NM+NMM) from the figures.

### *B. Threats to Identification and Sensitivity of Estimates*

Our estimation strategy uses management turnover as a natural experiment. It is natural to ask whether the duty stations where male and female managers are appointed are comparable before their appointment. If, for example, women were more likely to be appointed as managers as part of a remediation scheme in duty stations with worsening gender gaps, our estimates would conflate the effect of female managers with the circumstances of their appointment. Fortunately, that does not appear to be the case. The gender pay gaps are stable before a new manager is appointed. While one can never prove the absence of relevant unobserved variables, both employees and duty stations that receive new male and new female managers appear comparable in the preceding year (Table 4). Female employees who receive new female managers have the same salaries, unexplained pay gaps, education levels, and federal job tenure as female employees who receive new male managers (Table 4, columns 1 and 2 and columns 5 and 6). The only notable exception is the share of female employees at the duty station. Female managers are appointed at duty stations that have more female employees. This is, however, a fixed and stable difference that should be absorbed and not affect the event-study estimates. Additionally, while the stock of existing male and female managers differ modestly on observables, most notably education and birth cohort, the newly appointed male and female managers we observe have indistinguishable observable characteristics (Appendix table B.5).

Consistent with the appointment of new male and female managers being independent of trends in their duty stations, our estimates are robust to various combinations of controls and fixed effects. The top row of Figure 7 displays our main estimates of the new female manager effects ( $\delta_k + \delta_k^f$  and  $\delta_k^f$ ) from Figure 4 alongside estimates from specifications that include individual fixed effects in lieu of individual/duty station fixed effects and estimates that exclude duty station fixed effects in estimation of the first stage residuals that we use as a dependent variable in event studies. The new manager effect is somewhat smaller in the individual fixed effect specification, but the overall pattern of results is unchanged across the specifications and  $\delta_k^f$  is virtually indistinguishable across them.

Roughly a quarter of employees in our sample change duty stations at some point in their government service. While managers may be a motivation for changing jobs our results are not driven by duty station moves. If anything, the effects are slightly larger when the sample is restricted to employees who only work at one duty station during their careers (Figure 7). A notable difference in male and female employees is the incidence of spells of part time work: 8%

of employees have at least one spell of part time work during their federal careers. The estimates are virtually identical when the sample is restricted to employees who only work full-time during their federal careers (Figure 7). Finally, the estimates are also robust to limiting the sample to workers paid under the same GS pay scale (Figure B.4).

### *C. Mechanisms: Grade Increases and Retention*

The highly structured nature of federal employment and compensation implies that merit increases in pay steps and expedited grade increases (our proxy for promotions) are the mechanisms through which managers could impact worker pay. Managers could expand effort to directly obtain pay step or grade increases for their subordinates. They could also indirectly increase pay by initiating performance evaluations (e.g., Oh and Lewis (2013)) which could make workers eligible for or more successful in their pursuit of higher pay grades in their current role or in moving to roles with higher pay grades. We next test whether female employees receive more pay grade increases following the appointment of a new female manager at their office.

Because each of the different government pay scales has a different number and spacing of pay grades, we focus this analysis on the 90% of employees in our sample under the GS pay scale. While step increases can occur in consecutive years, pay grade increases are less frequent and lumpier. The average GS-pay-plan employee in our sample experiences just over 3 pay grade increases during the entire period in which we observe them (Table 1, Panel A). We therefore estimate the cumulative effect of female managers on promotions using a two-way fixed effects difference-in-differences (TWFE-DiD) approach. For ease of interpretation, we limit the sample to those receiving a new manager of observed gender during the observation period. The thought experiment asks whether 1) do those whose first new manager is the same gender experience more pay grade increases than those whose first new manager's gender differs from theirs? and 2) Does the effect of a new same gendered manager differ for male and female employees?

Specifically, our promotion,  $P_{igt}$ , regressions take the form:

$$(3) \quad P_{igt} = \delta^S(NM_{idt} \cdot S_{idt}) + \delta_f^S F_i \cdot (NM_{idt} \cdot S_{idt}) + \gamma_i + \lambda_t + \epsilon_{igt},$$

where  $F_i$  is an indicator that equals 1 if the employee is female and  $NM_{idt} \cdot S_{idt}$  is an indicator that equals 1 in the years after a new manager arrives if the employee's first new manager is the same gender as them and 0 otherwise.<sup>38</sup> Our primary interest,  $\delta_f^S$ , isolates the differential effect of homophily, that is, of a manager of the new same gendered manager on female employees.

Table 5 presents the resulting estimates for employees at duty stations with up to 5 managers.<sup>39</sup> For reference and comparability with our earlier estimates, we begin by providing, estimates for the GS pay scale employee subsample using the pay residual variable used in the earlier event study analysis (panel B).<sup>40</sup> Female employees' pay increases 30% more than men's (3.86 log points vs. 2.92 log points) in the years following the appointment of a new manager of the same gender. These estimates are comparable to our event study estimates for the full sample of employees (including those outside the GS pay plan) that showed that new female managers closed the gender pay gap by about 30% more than new male managers.

Next in Panel A of Table 5, we turn to the effect of new female managers on pay grade increases. All employees, male and female, have more pay grade increases in the years following the appointment of a new same gendered manager. Employees that receive a manager of the same gender see their GS grade increase by 0.3 grades more than those who receive an opposite gender manager (Panel A, column 2). Given the over-representation of men in management, homophily could create a gender gap in pay even if the impact of these preferences were symmetric. However, it is not. Female employees benefit almost 50% more than male employees from the appointment of a same gender manager.

Finally, we estimate the effect of homophily on employee retention (panel C). Given the preceding estimates, it is unsurprising that workers are significantly less likely to switch duty stations following the appointment of a manager with the same gender. The size of this effect does not measurably differ across male and female employees.

<sup>38</sup>We have written the new same sex manager indicator as  $NM_{idt} \cdot S_{idt}$  to serve as a reminder that  $\delta^S$  is the combined effect of receiving a new manager and that manager being the same gender as the employee.

<sup>39</sup>Analogous estimates for those in duty stations with 6 to 20 managers are in the appendix.

<sup>40</sup>This mirrors what we saw above where the full and GS subsamples provided virtually identical estimates in the main event study estimation (Figure B.4 and Table B.7).

We confirm the robustness of our estimates to the recently identified issues with parallel trend assumptions in staggered TWFE-DiDs (see, for example, Callaway and Sant’Anna (2021) and Borusyak (2021)). Both the pay residual estimates and the GS grade increase estimates are virtually unchanged when re-estimated using the new estimator proposed in Borusyak (2021) and, if anything, the retention estimates are slightly larger in magnitude (Table 5, columns 2 and 3).<sup>41</sup> This provides further evidence that the potential pitfalls of two-way fixed effect estimation are not driving our earlier results on employee pay disparities.

#### *D. Employee Sentiment*

Managers’ roles in workplaces extend beyond the formal employee performance reviews. In addition to maintaining centralized longitudinal compensation data, the federal government regularly surveys its employees about their experiences. We link data on women’s presence in management teams to these employee surveys data in order to examine the relationship between women’s presence on management teams and employees job satisfaction, experiences in the workplace, and their perceptions of it’s climate.

The Federal Employee Viewpoint Surveys (FEVS), administered by OPM, are drawn as an annual probability sample from the population of permanent federal employees to assess the work attitudes and work experiences of federal employees.<sup>42</sup> It is designed to provide a representative snapshot of employees’ attitudes, experiences and perceptions about how effectively agencies are managing their workforce (OPM, 2014).<sup>43</sup>

Each iteration of the survey contains demographic information on the respondents along with their answers to questions about their workplaces and their experiences in them. The 98-item survey covers eight topic areas: personal work experiences, work unit, agency, supervisor, leadership, satisfaction, work/life, and demographics. It includes questions such as “How satisfied are you with the recognition you receive for doing a good job?” Employees are then asked to provide answers on a 5 point scale with 5 indicating the most satisfaction. These data are

<sup>41</sup>Borusyak (2021) proposes a new DiD estimator that is unbiased and efficient in staggered DiD settings in which two-way fixed effects may be biased, particularly those in which the already treated observations serve as problematic controls in two-way fixed effect estimation. Borusyak’s (2021) method uses only the never and not yet treated observations to construct counterfactual controls for the treated observations.

<sup>42</sup>Originally administered as the Federal Human Capital Survey (FHCS) in 2002, the survey was substantially modified between 2002 and 2004. It has been administered bi-annually until 2010, when it became an annual survey. The FEVS Public Release Data Files begin in 2006, we use that year and all subsequent surveys through 2014 in the analysis that follows.

<sup>43</sup>The exact FEVS sampling strategy varies from year to year. It is generally a stratified sample based on a census in one strata and a probability sample in the other strata. Each year’s sampling frame is designed to produce results that are representative of the federal workforce overall, and at the agency and sub-agency levels. Additional information on the FEVS is available at: <https://www.opm.gov/fevs/about/>

regularly used by the government to evaluate human resource policies and programs (e.g. assessments of the Human Capital Framework, Diversity, Equity, Inclusion and Accessibility, Veterans’ programs, and Work-Life programs).

Because the FEVS is an anonymous survey, we are not able to link individual responses to the respondent’s payroll data. Instead, we link each employee’s survey responses to the characteristics of the management teams at their agencies. For comparability with the pay gap analysis above, we further restrict the sample to the 29 agencies that appear in both the pay gap analysis and in the OPM survey.<sup>44</sup>

We present some analysis of FEVS in Table 6. The dependent variables are employees’ self-declared view on job satisfaction, pay satisfaction, recognition, diversity, discrimination, and trust in supervisor, rated on a scale of 1 to 5. We seek to verify that subjective views align with our objective results that increase in female management team is favorable to relative women’s pay. We note that this is tall order given the self-selection of respondents to the survey. The explanatory variables of interest are indicators for female employees and agencies with low and high female management shares, and their interactions.<sup>45</sup> The regression estimates show a significant female disadvantage in the above categories, except pay satisfaction, which speaks to the mechanisms we have highlighted to reduce the gender pay gap. But they reveal that female viewpoints on job satisfaction, pay satisfaction, diversity, and discrimination are relatively higher in agencies with a high female management share by comparison with those with a mediocre female management share. This is consistent with our event-study results showing greater reduction of the gender pay with the higher female management share at the agency level (Figure 5).

## VI. Discussion and Conclusions

The US federal civil service provides a unique environment to study the potentially gendered impact of new managers on the pay of white-collar subordinates. The US Government is a large employer with over 1 million civilian employees spread throughout the country, covering a wide range of occupations and service sectors whose levels of pay and pay differentials echo those found in the broader economy.<sup>46</sup> In addition, a wide-ranging and well-documented set of rules and Federal legislation constrains the pay of federal civil service employees to pay plans and

<sup>44</sup>We use the survey weights provided by OPM. They are designed to weight each respondent based on the probability of the employee’s selection into survey participation and nonresponse, as well as demographics and characteristics of the sampling frame (OPM, 2014).

<sup>45</sup>Omitted category is agencies in quintile 2-4.

<sup>46</sup>The 1990 FEPCA has a stated goal of making Federal and private sector workers doing the “same level of work” more comparable (Buckley, 2009).



grids within plans and compliance is closely monitored by a strong union and large bureaucracy. Yet, in spite of these pay-setting constraints, federal pay varies more with gender and race than can be explained by observed qualifications and managers can find ways to assign employees to higher grade levels than formally warranted (Olson et al, 2000; Lewis and Oh, 2009; Oh and Lewis, 2013).

We bring thirty-three years of rich longitudinal data from this setting to the task of identifying the causal effect of managerial turnover and manager gender on pay disparities. We exploit more than 20,000 new manager appointments in an event-study design to estimate the impact of managers on the gender pay gap. These estimates are robust to alternate samples, specifications, controls, fixed effects, and treatment definitions. We find that the appointment of a first new manager, irrespective of gender, reduces the gap by approximately 3 log points on average in the following 2 to 3 years. When that new manager is a woman, this reduction is even larger (by 1 to 1.5 log points). Taken together, a new female manager reduces the gender gap by up to 5 log points (compared to the status quo) in the five years following her appointment. The magnitude of these effects is in keeping with the scale of movements along the federal pay grid. The immediate effect is roughly equivalent to a step increase within a pay grade, while the medium-run effect is comparable to the increase in pay associated with an increase in a worker's pay grade.

These findings sound a cautionary note for studies that estimate pay disparities conditional on pay grade or algorithmic score or job title. When the inputs into algorithmic or deterministic wage setting are the product of discretionary decisions by human actors, the adoption of algorithmic or deterministic wage setting will formally incorporate these biased disparities. Then the adoption of these schemes will mask and deceptively rationalize disparities instead of eliminating them. That is indeed the case here. Figure 3 plots the unexplained pay gap with and without accounting for workers' potentially endogenous pay grades. It shows that most (almost 90%) of the unexplained pay gap over time operates through workers' placement on the pay grid, a decision heavily influenced by their managers and their gender.

We confirm the differential promotion (pay grade) mechanism behind these effects by directly estimating the effect of managerial turnover and gender on gender disparities in pay grade increases (promotions). In the years following the appointment of a new manager, female employees receive significantly more pay grade increases if that new manager is female. While one

can only speculate on how female managers increase women’s promotion, performance reviews and personal effort are the two natural channels. Female managers may assess female employees’ work more favorably, making them more likely to be eligible for performance-related pay increases and more successful in their pursuit of them. The actions through which female managers speed the promotion of female employees are beyond the scope of this paper and are a fruitful topic for future research.

Our findings also provide insights into the effects of policy innovations aimed at reducing the gender gap. Policies such as bans on asking about salary history at hiring and pay transparency initiatives (Baker et al., 2019), have focused on giving employees the knowledge to improve their salary position. Such policies enable women to compare their salaries to those of employees in similar positions and roles. This could close gender gaps among men and women in the same roles, but will not address gender gaps that arise due to similarly situated men and women rising through the ranks at different rates and ending up in different boxes. Similarly, salary history bans may prevent past pay disparities at previous employers from propagating to new positions, but they will not prevent disparities in promotions and roles from being carried forward and influencing future pay. This is consistent with the initial research on the effects of these initiatives, which finds modest (1%) reductions in the gender gap, primarily among new hires, following the adoption of these policies (Hansen and McNichols, 2020; Davis et al., 2021).

This paper estimates the effect of female managers on the gender gap in the federal civil service. While the federal service encompasses a wide range of occupations and industries, we can only speculate as to the effects of female managers in the private sector. The civil service’s pay system is, on average, more highly regulated and deterministic than many of those found in the private sector. Gender gaps in managers’ assessments of subordinates are larger on more subjective measures (e.g. potential) than on more concrete measures such as past productivity (Benson, Li and Shue, 2022). It is therefore likely that, if anything, direct supervisors play an even larger role in gender pay gaps in the private sector.

## References

- BAKER, M., HALBERSTAM, Y., KROFT, K., MAS, A., AND MESSACAR, D. 2019. “Pay transparency and the gender gap” NBER Working Paper No. w25834). National Bureau of Economic Research.
- BARRIENTOS, ANDRÉS F., ALEXANDER BOLTON, TOM BALMAT, JEROME P. REITER, JOHN M. DE FIGUEIREDO, ASHWIN MACHANAVAJJHALA, YAN CHEN, CHARLEY KNEIFEL, AND MARK DELONG. 2018. “Providing access to confidential research data through synthesis and verification: An application to data on employees of the US federal government.” *The Annals of Applied Statistics* 12(2): 1124–1156.
- BERTRAND, MARIANNE, SANDRA E. BLACK, SISSEL JENSEN, AND ADRIANA LLERAS-MUNEY. 2019. “Breaking the glass ceiling? The effect of board quotas on female labour market outcomes in Norway.” *The Review of Economic Studies*, 86(1): 191-239.
- BENSON, ALAN, DANIELLE LI, AND KELLY SHUE. 2022. “‘Potential’ and the gender promotion gap.” Discussion Paper.
- BHIDE, ANITA 2019. “Do Female Executives Reduce Gender Gaps?” JMP Stanford University.
- BIASI, BARBARA, AND HEATHER SARSONS. 2022 “Flexible Wages, Bargaining, and the Gender Gap.” *Quarterly Journal of Economics*, 137(1): 215-266.
- BLAIR-LOY, MARY, OLGA V. MAYOROVA, PAMELA C. COSMAN, AND STEPHANIE I. FRALEY. 2022 “Can rubrics combat gender bias in faculty hiring?.” *Science* 377 ( 6601): 35-37.
- BLAU, FRANCINE D., AND LAWRENCE M. KAHN. 2017. “The gender wage gap: Extent, trends, and explanations.” *Journal of Economic Literature*, 55 (3): 789-865.
- BORUSYAK, KIRILL, XAVIER JARAVEL, AND JANN SPIESS. 2021 “Revisiting event study designs: Robust and efficient estimation.” arXiv preprint arXiv:2108.12419 (2021).
- BUCKLEY, JOHN E. 2009. “Fifty years of BLS surveys on Federal employees’ pay.” *Monthly Labor Review* 132: 36.
- CARD, DAVID, ANA RUTE CARDOSO, AND PATRICK KLINE. 2016 “Bargaining, sorting, and the gender wage gap: Quantifying the impact of firms on the relative pay of women,” *Quarterly journal of economics* 131(2): 633–686.

- CARDOSO, ANA RUTE, AND RUDOLF WINTER-EBMER. 2010. "Female-led firms and gender wage policies." *Industrial & Labor Relations Review*, 64 (1): 143-163.
- CHOI, SUNGJOO 2018. "Pay equity in government: Analyzing determinants of gender pay disparity in the US federal government" *Administration & Society* 50(3): 346-371.
- CONGRESSIONAL RESEARCH SERVICE (CRS) 2010. "Federal White-Collar Pay: FY2009 and FY2010 Salary Adjustments "CRS Report for Congress RL34463.
- DALVIT, NICOLAS, ASEEM PATEL, AND JOANNE TAN. 2021. "Intra-firm hierarchies and gender gaps." *Labour Economics* : 102029.
- DAVIS, JESSE, PAIGE OUMET, AND XINXIN WANG. 2021. "Hidden Performance: Salary History Bans and Gender Pay Gap." Available at SSRN 3915609.
- DROGANOVA, MARIA 2018. "Women Working for Women: Career Advancement and the Gender Wage Gap in the U. S. Federal Government". Available at SSRN: <https://ssrn.com/abstract=3074466> or <http://dx.doi.org/10.2139/ssrn.3074466>
- FLABBI, LUCA, MARIO MACIS, ANDREA MORO, AND FABIANO SCHIVARDI 2019. "Do female executives make a difference? The impact of female leadership on gender gaps and firm performance." *The Economic Journal* 129 (622): 2390-2423.
- FORTIN, NICOLE M., BRIAN BELL, AND MICHAEL BÖHM 2017. "Top earnings inequality and the gender pay gap: Canada, Sweden, and the United Kingdom." *Labour Economics* 47: 107–123.
- FOSTER, LUCIA, JULIA MANZELLA, ERIKA MCENTARFER, AND DANIELLE H. SANDLER. 2020. "Employment and earnings for federal government economists: Empirical evidence by gender and race." *AEA Papers and Proceedings*, 110: 210–14.
- HANSEN, BENJAMIN, AND DREW MCNICHOLS. 2020 "Information and the Persistence of the Gender Wage Gap: Early Evidence from California's Salary History Ban.". No. w27054. National Bureau of Economic Research.
- JOHNSON, RONALD N. AND GARY D. LIBECAP 1989. "Bureaucratic Rules, Supervisor Behavior, and the Effect on Salaries in the Federal Government," *Journal of Law, Economics, & Organization*, 5 (1): 53–82.

- KUNZE, ASTRID, AND AMALIA R. MILLER 2017 “Women helping women? Evidence from private sector data on workplace hierarchies.” *Review of Economics and Statistics*, 99(5): 769-775
- LEWIS, G. B. AND OH, S. S. 2009. “A Major Difference?: Fields of Study and Male-Female Pay Differences in Federal Employment.” *American Review of Public Administration*, 39(2):107–24.
- LUCIFORA, CLAUDIO, AND DARIA VIGANI. 2022. “What if your boss is a woman? Evidence on gender discrimination at the workplace.” *Review of Economics of the Household*, 20(2): 389–417.
- MAIDA, A. AND WEBER, A. 2022. “Female leadership and gender gap within firms: Evidence from an Italian board reform,” *Industrial & Labor Relations Review*, 75(2): 488–515.
- OLSON, CRAIG A., DONALD P. SCHWAB, AND BARBARA L. RAU. 2000. “The effects of local market conditions on two pay-setting systems in the federal sector.” *Industrial & Labor Relations Review*, 53(2): 272–289.
- OH, SEONG SOO, AND GREGORY B. LEWIS. 2013. “Performance ratings and career advancement in the US Federal Civil Service.” *Public Management Review* 15(5): 740–761.
- ROUSSILLE, NINA. 2020 “The central role of the ask gap in gender pay inequality.” URL: [https://ninaroussille.github.io/files/Roussille\\_askgap.pdf](https://ninaroussille.github.io/files/Roussille_askgap.pdf) 34.
- TATE, GEOFFREY, AND LIU YANG. 2015 “Female leadership and gender equity: Evidence from plant closure.” *Journal of Financial Economics*, 117(1): 77–97.
- TREIMAN, DONALD J., AND HEIDI I. HARTMANN 1981. *Women, Work, and Wages: Equal Pay for Jobs of Equal Value*. National Research Council. National Academies Press,
- U.S. GOVERNMENT ACCOUNTABILITY OFFICE (GAO) 2009. “Womens Pay - Gender Pay Gap in the Federal Workforce Narrows as Differences in Occupation, Education, and Experience Diminish,” Report GAO-09-279.
- U.S. GOVERNMENT ACCOUNTABILITY OFFICE (GAO) 2021. “Human Capital –Administration and Implementation of the General Schedule Locality Pay Program,” Report GAO-22-104580.

U.S. OFFICE OF PERSONNEL MANAGEMENT(OPM) 2014a. “Government-wide Strategy on Advancing Pay Equality in the Federal Government.”

U.S. OFFICE OF PERSONNEL MANAGEMENT(OPM) 2014b. “Technical Report: Results From The 2014 Federal Employee Viewpoint Survey. ”

U.S. OFFICE OF PERSONNEL MANAGEMENT(OPM) 2017. “A Handbook for Measuring Employee Performance. . ”

VILHUBER, LARS. 2018, “Office of Personnel Management (OPM) extract of EHRI - FOIA Request 2013-06654, doi:10.7910/DVN/27927, Harvard Dataverse

## Figures and Tables

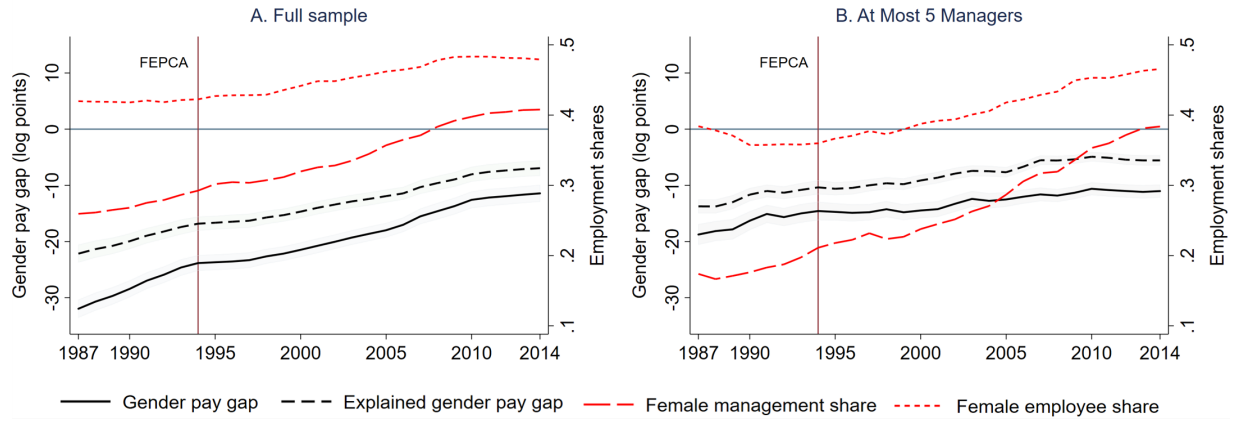


FIGURE 1. GENDER PAY GAP AND FEMALE EMPLOYMENT

Note: The full sample in the Figure is restricted to workers who were employed by the U.S. Federal Service for at least 5 years. The “Explained” pay gap is the gender pay gap that can be explained by locality FE, education, occupation, age, and age<sup>2</sup>.

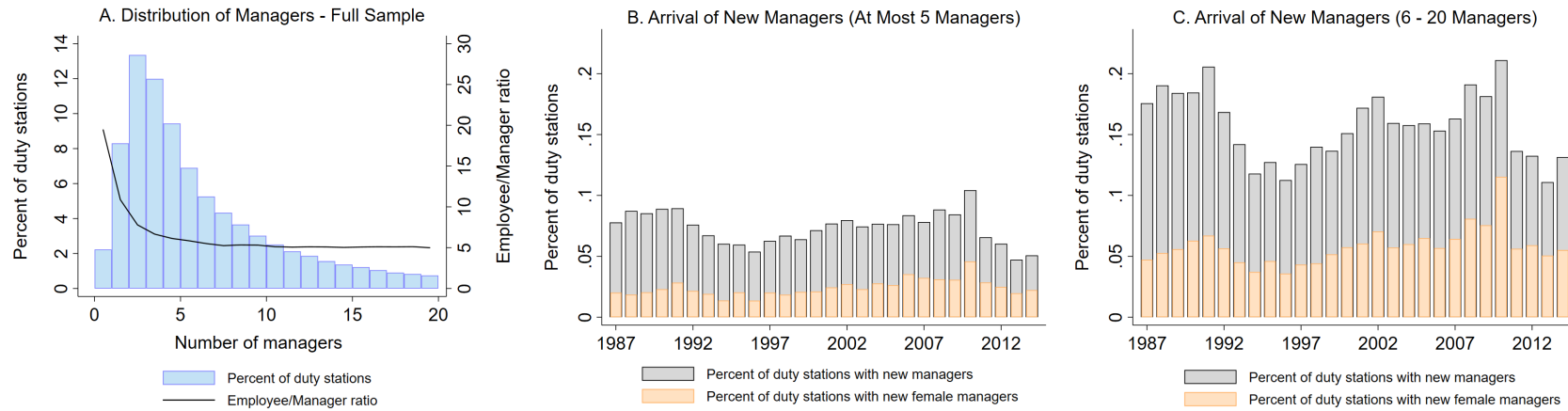


FIGURE 2. MANAGERS ACROSS DUTY STATIONS

Note: In panel A, 20 managers does not include duty stations with more than 20 managers. In the full sample, 82.8% of duty stations have at most 20 managers in all years. There are 10,798 duty stations in the full sample: 1,952 duty stations have more than 20 managers in at least one year while 9,876 duty stations have 20 managers or less in at least one year.



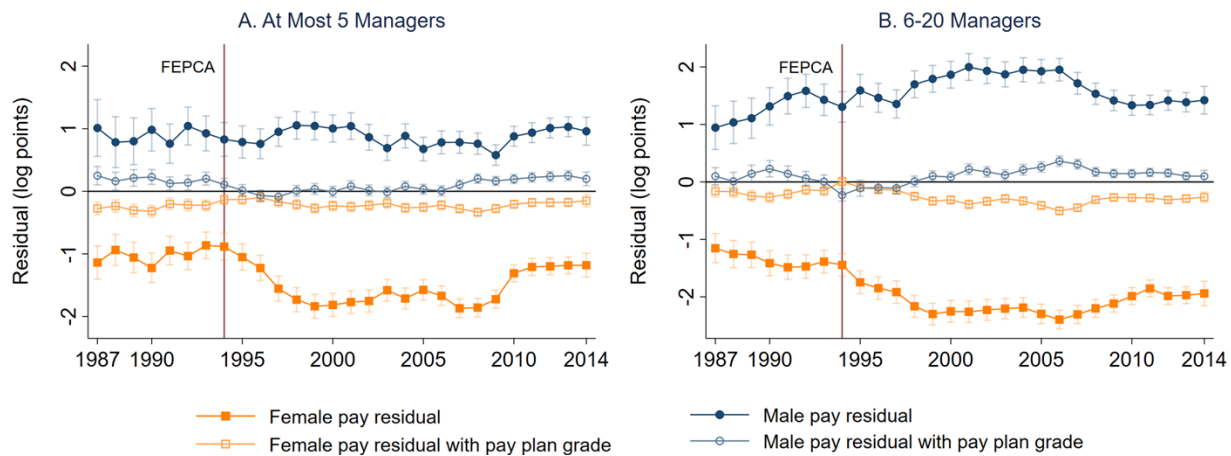


FIGURE 3. PAY RESIDUALS BY GENDER

Note: Female and male pay residuals are from yearly regressions of individuals' log pay on birth year bins, education, tenure, occupation, share of female workers at the duty station, and duty station FEs. Vertical bars represent 95% confidence intervals with standard errors clustered at the duty station.

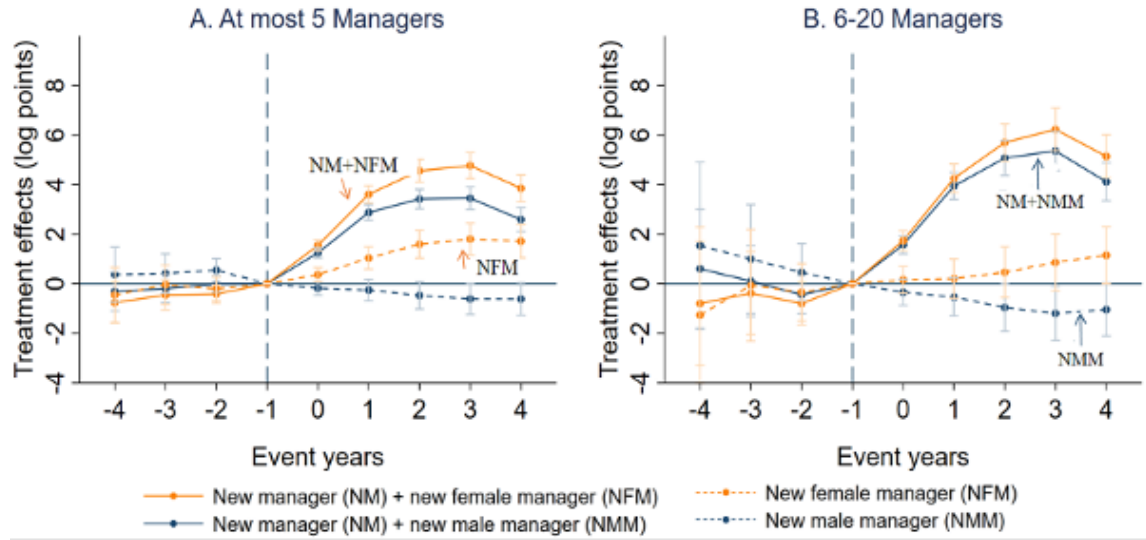


FIGURE 4. EVENT STUDY ESTIMATES: EFFECTS OF FIRST NEW MANAGERS ON THE GENDER PAY GAP

Note: Estimates and standard errors are reported in Table 2. Treatments effects are the difference between log female and log male pay residual pay. New manager (NM) + new female manager (NFM) curves are the combined effects of managerial turnover and new manager being a woman. Analogous curves for new male manager are displayed for completeness because the sample includes managers with missing gender (see text). Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

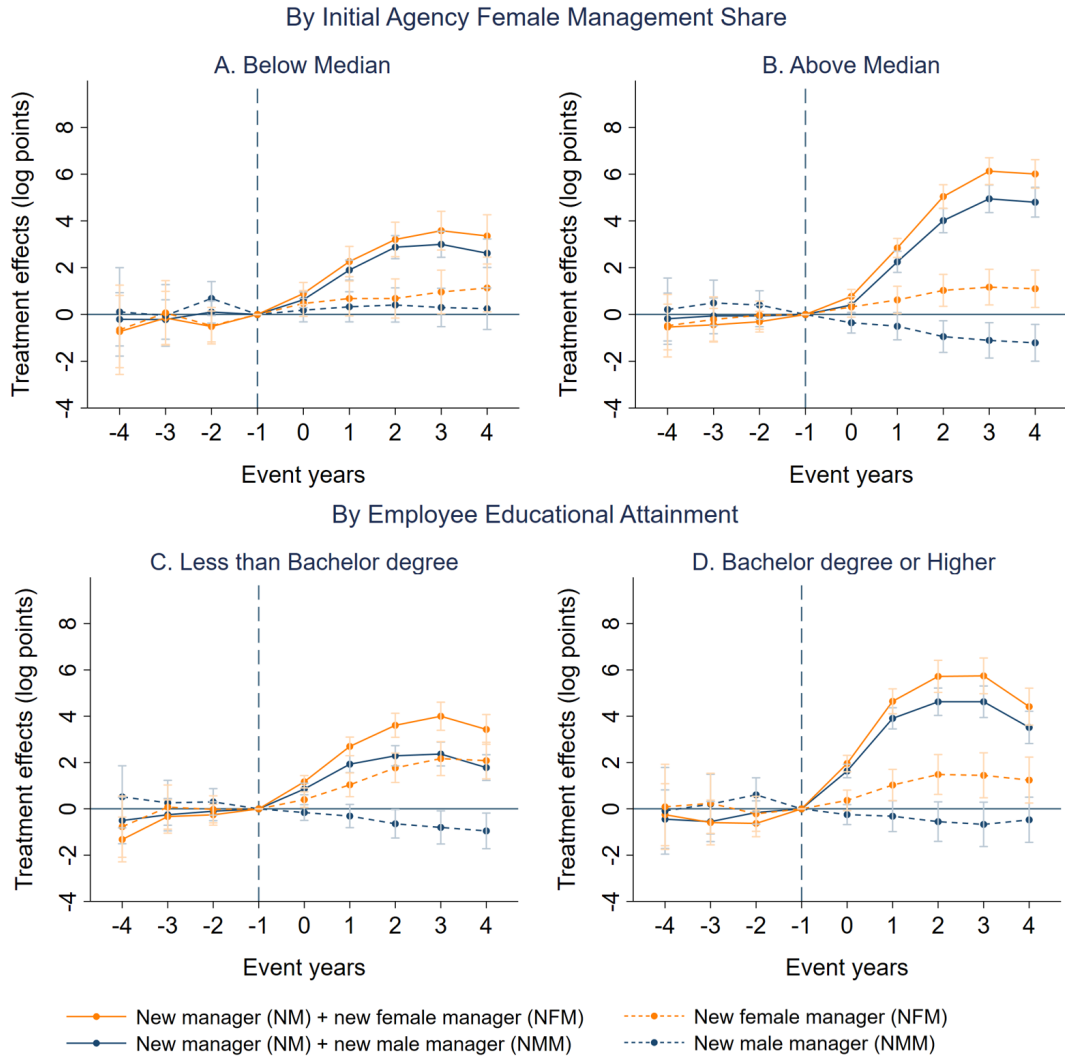


FIGURE 5. HETEROGENEITY OF EVENT STUDY ESTIMATES (AT MOST 5 MANAGERS)

Note: Estimates and standard errors are reported in Table 3. In panels A and B, the initial female management share is calculated in the first three years of the agency's existence. To be included agencies must exist for at least 5 years. The median is 16%. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

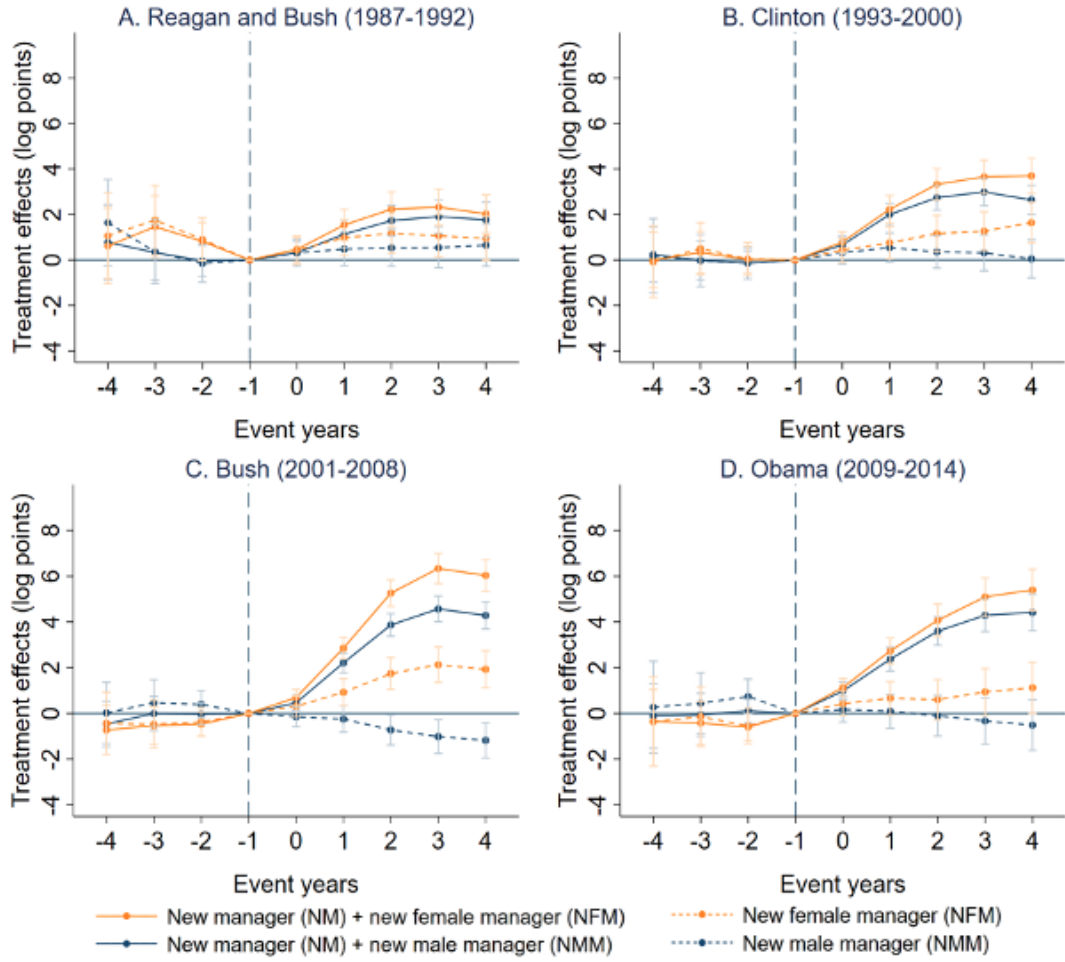


FIGURE 6. EVENT STUDY ESTIMATES BY PRESIDENTIAL ERA (AT MOST 5 MANAGERS)

Note: Estimates and standard errors are reported in Table C.3. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

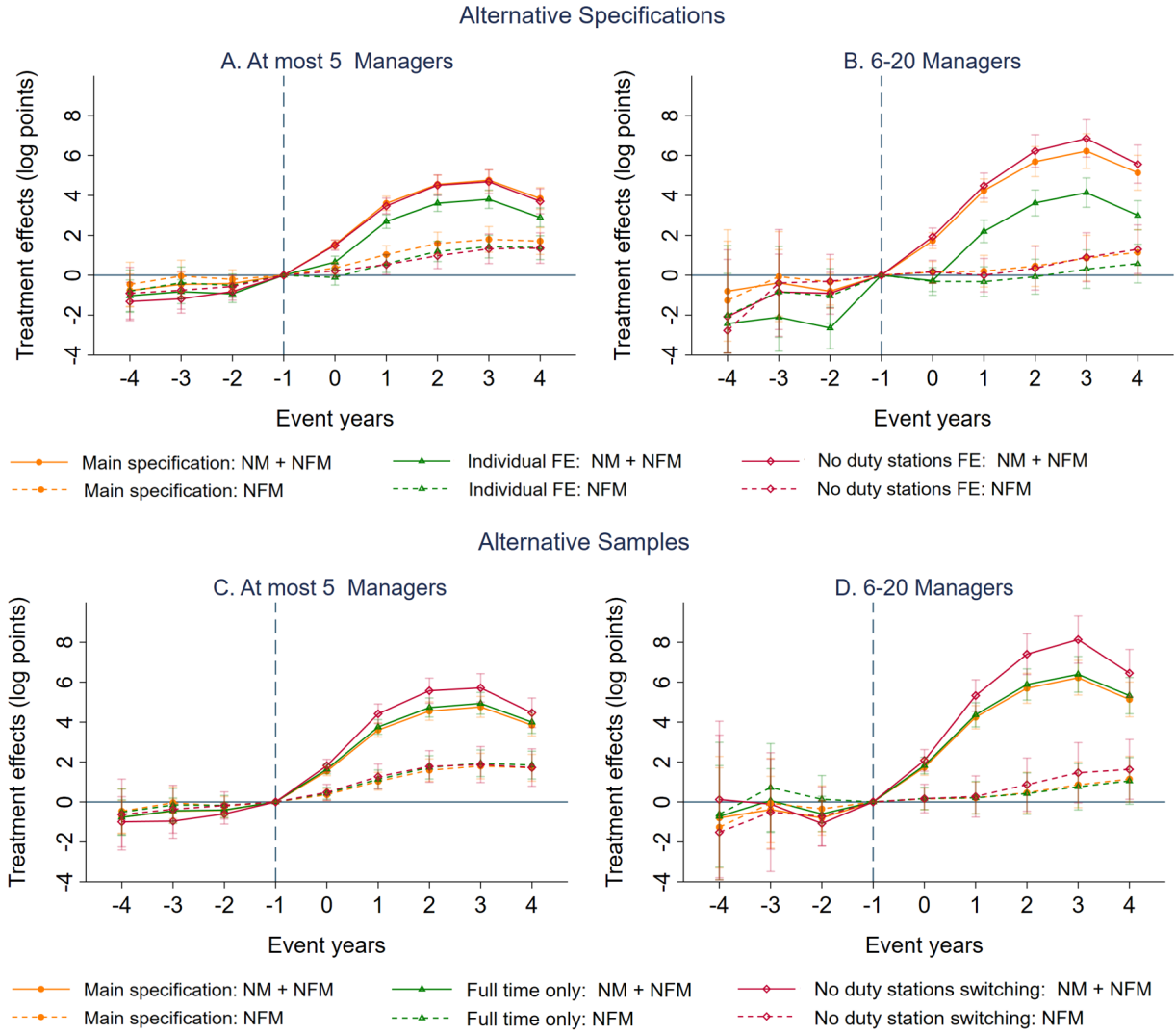


FIGURE 7. SENSITIVITY ANALYSIS: FIRST NEW FEMALE MANAGER EFFECTS

Note: Estimates and standard errors are reported in Tables C.4 and C.5. Main specification refers to the specification estimated in equation (2) in section IV. The main specification reproduces the estimates from Figure 4. In Panels A and B, the "individual FE" estimates replace individual-duty station FEs with individual effects that do not vary with duty station changes. "No duty stations FE" estimates exclude duty station FEs in the first stage, but contain individual-duty station FEs in the second stage. In Panels C and D, "full time only" excludes the 8% of employees who have a part-time spell during their federal service. "No duty station switching" excludes the 25% of employees that switch duty stations at any point in the sample. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

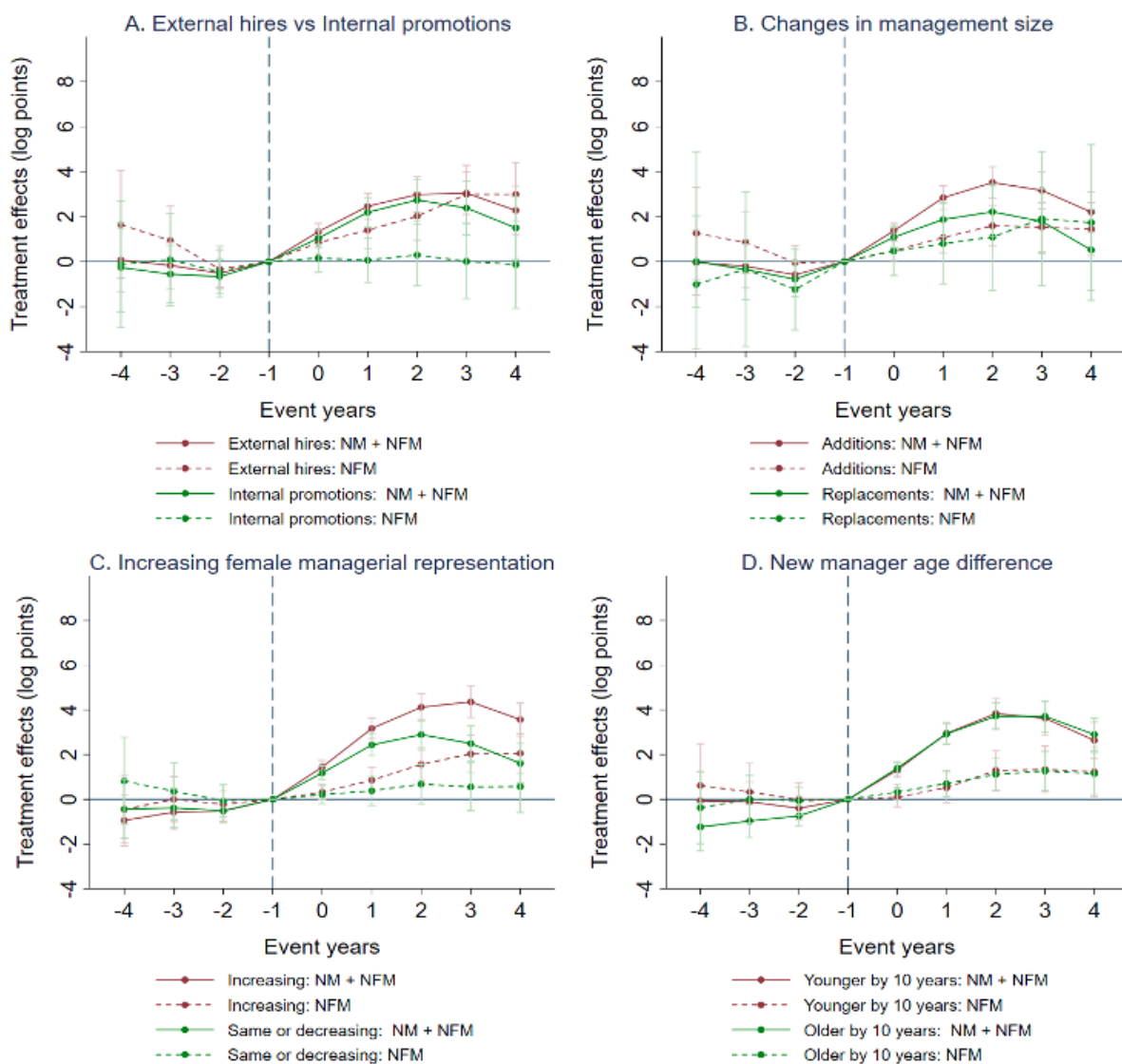


FIGURE 8. EVENT STUDY ESTIMATES BY SOURCE AND TYPE OF MANAGERIAL CHANGE

Note: Estimates and standard errors are reported in Table C.6. The estimated specification is given by equation (2) in section IV. Estimates are obtained for the sample with at most 5 managers at the duty station level. Panel A restricts estimation sample to individuals whose new manager was hired either externally or promoted within duty stations. Panel B splits the sample depending on whether the new manager increases the size of the management team at the duty station or not. Panel C splits the sample depending on whether the new female manager increases female managerial representation at the duty station. Panel D restricts the sample to individuals who either received a new manager that was 10 years older or 10 years younger than the average managerial age at the duty station.

TABLE 1—DESCRIPTIVE STATISTICS

	Female employees		Male employees	
	At most 5 managers (1)	6-20 managers (2)	At most 5 managers (3)	6-20 managers (4)
<i>Panel A: Outcomes</i>				
Salary	49,466.69 (22,768.86)	49,758.00 (25,051.62)	56,798.28 (25,556.67)	57,518.81 (27,325.57)
Log salary	10.70 (0.47)	10.69 (0.51)	10.84 (0.46)	10.85 (0.49)
Unexplained log salary (x100)*	-1.48 (17.31)	-2.00 (19.97)	0.86 (18.35)	1.58 (21.11)
N pay plan changes	0.02 (0.33)	0.03 (0.30)	0.03 (0.23)	0.03 (0.27)
N grade changes (GS sample)	3.26 (2.03)	3.31 (2.10)	3.07 (1.88)	2.90 (1.93)
<i>Panel B: Individual characteristics</i>				
Birth year	0.29	0.30	0.27	0.31
1955-1960	(0.45)	(0.46)	(0.44)	(0.46)
Birth year	0.24	0.25	0.24	0.25
1960-1965	(0.43)	(0.43)	(0.43)	(0.43)
Birth year	0.18	0.19	0.20	0.18
1965-1970	(0.39)	(0.39)	(0.40)	(0.39)
Birth year	0.13	0.12	0.14	0.12
1970-1975	(0.33)	(0.32)	(0.34)	(0.33)
Birth year	0.09	0.08	0.09	0.08
1975-1980	(0.28)	(0.27)	(0.28)	(0.27)
Birth year	0.07	0.06	0.07	0.06
1980+	(0.26)	(0.24)	(0.25)	(0.24)
Education:	0.24	0.23	0.14	0.14
High school or less	(0.43)	(0.42)	(0.35)	(0.34)
Education:	0.32	0.33	0.22	0.23
Some college	(0.46)	(0.47)	(0.41)	(0.42)
Education:	0.33	0.30	0.47	0.42
Bachelor's degree	(0.47)	(0.46)	(0.50)	(0.49)
Education:	0.11	0.14	0.17	0.22
Graduate degree	(0.31)	(0.35)	(0.38)	(0.41)
Tenure (years)	9.92 (7.67)	9.99 (7.67)	9.63 (7.27)	9.73 (7.39)
<i>Panel C: Workplace characteristics</i>				
Female employee share at duty station	0.43 (0.22)	0.38 (0.18)	0.37 (0.22)	0.36 (0.18)
Female management share at duty station	0.27 (0.31)	0.25 (0.21)	0.25 (0.30)	0.24 (0.21)
N duty stations	7,918	4,975	7,245	4,598
N unique individuals	44,411	56,068	38,185	46,653
N individuals with part time spell	5,251	6,463	1,672	2,417
N treated individuals	13,564	7,001	11,289	5,497
N person quarters	1,012,027	1,292,349	805,865	951,830

Note: Standard deviations are in parentheses. Unexplained log pay is residual log pay after controlling for location, age, education, tenure, occupation, agency-subagency-duty station, and share of female employees and managers. Workplace characteristics are at the duty station - quarter level.

TABLE 2—EVENT STUDY ESTIMATES: EFFECTS OF FIRST NEW MANAGERS ON THE GENDER PAY GAP

Event year	At most 5 managers				6-20 Managers			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.37 (0.56)	-0.46 (0.56)	-0.31 (0.40)	-0.76* (0.07)	1.54 (1.72)	-1.27 (1.81)	0.60 (1.22)	-0.80 (1.28)
-3	0.41 (0.41)	-0.04 (0.41)	-0.20 (0.29)	-0.46 (0.31)	0.99 (1.12)	-0.07 (1.15)	0.10 (0.73)	-0.38 (0.85)
-2	0.54** (0.24)	-0.21 (0.24)	-0.01 (0.17)	-0.41* (0.19)	0.46 (0.59)	-0.34 (0.59)	-0.45 (0.39)	-0.80* (0.44)
0	-0.18 (0.14)	0.36** (0.15)	1.24*** (0.10)	1.55*** (0.12)	-0.34 (0.27)	0.16 (0.27)	1.57*** (0.18)	1.74*** (0.20)
1	-0.26 (0.22)	1.04*** (0.23)	2.88*** (0.16)	3.61*** (0.18)	-0.54 (0.39)	0.20 (0.41)	3.94*** (0.28)	4.25*** (0.30)
2	-0.47* (0.28)	1.59*** (0.29)	3.42*** (0.20)	4.55*** (0.24)	-0.96* (0.49)	0.46 (0.52)	5.07*** (0.36)	5.70*** (0.38)
3	-0.61* (0.32)	1.80*** (0.33)	3.45*** (0.23)	4.76*** (0.27)	-1.20** (0.56)	0.86 (0.58)	5.35*** (0.40)	6.23*** (0.44)
4	-0.62* (0.33)	1.71*** (0.34)	2.59*** (0.25)	3.85*** (0.28)	-1.05* (0.55)	1.15** (0.58)	4.11*** (0.39)	5.14*** (0.45)
N duty stations	8,532	8,532	8,532	8,532	5,310	5,310	5,310	5,310
N unique individuals	82,596	82,596	82,596	82,596	102,721	102,721	102,721	102,721
N person years	1,772,395	1,750,461	1,772,395	1,750,461	2,208,968	2,191,958	2,208,968	2,191,958

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered at the duty station are in parentheses. Event year treatment effects are reported in log points. All event study specifications include quarter-year and individual-duty station fixed effects, see event study equation 2. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.



TABLE 3—HETEROGENEITY OF EVENT STUDY ESTIMATES (AT MOST 5 MANAGERS)

Event year	By initial agency female management share				By employee educational attainment			
	Below median		Above median		Less than Bachelor's degree		Bachelor's degree or higher	
	New male manager (1)	New female manager (2)	New male manager (3)	New female manager (4)	New male manager (5)	New female manager (6)	New male manager (7)	New female manager (8)
-4	0.11 (0.96)	-0.66 (0.97)	0.21 (0.69)	-0.48 (0.68)	0.52 (0.68)	-0.77 (0.67)	-0.09 (0.95)	0.09 (0.94)
-3	-0.04 (0.67)	0.07 (0.70)	0.49 (0.50)	-0.21 (0.49)	0.26 (0.49)	0.08 (0.49)	0.20 (0.66)	0.24 (0.66)
-2	0.68* (0.37)	-0.48 (0.40)	0.40 (0.31)	-0.03 (0.31)	0.30 (0.29)	-0.02 (0.30)	0.61 (0.38)	-0.22 (0.39)
0	0.19 (0.26)	0.47* (0.28)	-0.35 (0.23)	0.32 (0.22)	-0.16 (0.17)	0.40** (0.17)	-0.25 (0.22)	0.37 (0.23)
1	0.33 (0.33)	0.68* (0.38)	-0.50* (0.30)	0.62** (0.30)	-0.31 (0.26)	1.04*** (0.26)	-0.32 (0.34)	1.03*** (0.34)
2	0.41 (0.37)	0.68 (0.43)	-0.95*** (0.35)	1.03*** (0.35)	-0.64** (0.31)	1.77*** (0.32)	-0.55 (0.44)	1.48*** (0.44)
3	0.30 (0.42)	0.96** (0.48)	-1.11*** (0.39)	1.17*** (0.39)	-0.80** (0.37)	2.17*** (0.37)	-0.67 (0.49)	1.45*** (0.50)
4	0.25 (0.45)	1.14** (0.52)	-1.21*** (0.40)	1.10*** (0.41)	-0.95** (0.39)	2.08*** (0.40)	-0.47 (0.50)	1.24** (0.51)
N duty stations	5,086	5,086	3,642	3,642	7,845	7,845	7,305	7,305
N unique individuals	46,385	46,385	36,526	36,526	39,155	39,155	45,732	45,732
N person years	1,012,801	1,012,801	804,755	804,755	879,048	870,181	961,149	946,933

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure 5. All event study specifications include quarter-year and individual-duty station fixed effects. The median initial female management share is 16%. The initial female management share of each agency is calculated based on the female management share at the agency level in the first three years of the agency's existence. Agencies must exist for at least 5 years to be included in the sample. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE 4—BALANCE: EMPLOYEE AND DUTY STATION CHARACTERISTICS IN THE YEAR PRIOR TO A NEW MANAGER

	At most 5 managers				6-20 managers			
	Female employees		Male employees		Female employees		Male employees	
	New female manager	New male manager	New female manager	New male manager	New female manager	New male manager	New female manager	New male manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel A: Outcomes</i>								
Salary	43,841.79 (21,195.88)	42,204.12 (20,648.28)	50,988.12 (24,872.30)	50,121.09 (23,357.83)	40,528.46 (22,085.20)	39,334.25 (21,118.75)	47,849.58 (25,101.14)	46,042.73 (23,201.70)
Log salary	10.58 (0.46)	10.54 (0.46)	10.73 (0.46)	10.72 (0.47)	10.48 (0.51)	10.45 (0.50)	10.65 (0.51)	10.62 (0.49)
Unexplained log salary (x100)*	-4.61 (18.13)	-4.91 (18.75)	-4.26 (20.11)	-2.73 (19.96)	-6.42 (21.75)	-7.36 (21.43)	-3.92 (23.68)	-3.99 (24.14)
GS grade† (GS sample)	8.08 (2.82)	8.05 (2.87)	9.04 (2.90)	9.31 (2.86)	7.85 (3.18)	7.81 (3.14)	8.89 (3.18)	8.83 (3.10)
<i>Panel B: Individual characteristics</i>								
Birth year	0.23 (0.42)	0.26 (0.44)	0.20 (0.40)	0.22 (0.41)	0.23 (0.42)	0.24 (0.43)	0.22 (0.41)	0.24 (0.42)
1955-1960								
Birth year	0.21 (0.40)	0.23 (0.42)	0.20 (0.40)	0.21 (0.41)	0.22 (0.42)	0.22 (0.41)	0.24 (0.43)	0.22 (0.41)
1960-1965								
Birth year	0.19 (0.39)	0.19 (0.39)	0.19 (0.39)	0.19 (0.39)	0.20 (0.40)	0.20 (0.40)	0.19 (0.39)	0.20 (0.40)
1965-1970								
Birth year	0.15 (0.36)	0.14 (0.35)	0.17 (0.37)	0.16 (0.37)	0.15 (0.36)	0.16 (0.36)	0.15 (0.36)	0.15 (0.36)
1970-1975								
Birth year	0.12 (0.32)	0.11 (0.31)	0.13 (0.33)	0.12 (0.32)	0.10 (0.30)	0.11 (0.31)	0.11 (0.32)	0.11 (0.31)
1975-1980								
Birth year	0.10 (0.30)	0.08 (0.28)	0.11 (0.31)	0.09 (0.29)	0.09 (0.28)	0.09 (0.28)	0.10 (0.29)	0.09 (0.28)
1980+								
Education:	0.21 (0.41)	0.23 (0.42)	0.12 (0.33)	0.14 (0.35)	0.21 (0.41)	0.20 (0.40)	0.13 (0.34)	0.12 (0.32)
High school or less								
Education:	0.32 (0.47)	0.30 (0.46)	0.23 (0.42)	0.22 (0.41)	0.29 (0.45)	0.27 (0.45)	0.21 (0.41)	0.22 (0.41)
Some college								
Education:	0.34 (0.47)	0.35 (0.48)	0.45 (0.50)	0.46 (0.50)	0.32 (0.47)	0.34 (0.47)	0.39 (0.49)	0.4 (0.49)
Bachelor's degree								
Education:	0.12 (0.33)	0.13 (0.34)	0.20 (0.40)	0.18 (0.38)	0.17 (0.38)	0.19 (0.39)	0.26 (0.44)	0.26 (0.44)
Graduate degree								
Tenure (years)	6.23 (6.78)	6.48 (6.63)	6.13 (6.32)	6.46 (6.36)	4.69 (5.89)	4.63 (5.73)	4.78 (5.67)	4.73 (5.47)
N unique individuals	5,913	6,887	3,489	6,907	2,851	4,005	1,876	3,426
N person quarters	18,982	22,518	11,115	22,719	7,588	11,076	4,967	9,147

Continued on next page

TABLE 4 CONTINUED

	At most 5 managers				6-20 managers			
	New female manager		New male manager		New female manager		New male manager	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel C: Workplace characteristics</i>								
Female employee	0.52		0.37		0.46		0.37	
share at duty station	(0.21)		(0.22)		(0.17)		(0.17)	
Female management	0.34		0.23		0.31		0.23	
share at duty station	(0.34)		(0.30)		(0.22)		(0.20)	
N duty stations	2,201		3,120		1195		1,733	

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. \* Unexplained log pay is the residual of log pay after controlling for location, age, education, tenure, occupation, agency-subagency-duty station, and share of female employees and managers obtained using equation (1) in section IV. † GS grade is summarized at the time of arrival of the first new manager. Workplace characteristics are at the duty station - quarter level.

TABLE 5—DID ESTIMATES OF HOMOPHILY EFFECTS ON PAY AND GRADE (GS SAMPLE AT MOST 5 MANAGERS)

	DiD (1)	DiD (2)	Borusyak DiD (3)	DiD (4)	DiD (5)
Panel A: Dependent variable – GS Grade					
New same sex manager	0.419*** (0.019)	0.308*** (0.016)	0.311*** (0.022)	0.266*** (0.025)	0.251*** (0.022)
New same sex manager * Female emp.				0.327*** (0.041)	0.122*** (0.033)
Panel B: Dependent variable – Log pay residual (X100)					
New same sex manager		3.359*** (0.137)	3.454*** (0.197)		2.917*** (0.186)
New same sex manager * Female emp.					0.940*** (0.273)
Panel C: Dependent variable –Switching duty station					
New same sex manager	-0.032*** (0.002)	-0.034*** (0.002)	-0.044*** (0.003)	-0.029*** (0.004)	-0.033*** (0.004)
New same sex manager* Male emp.				-0.005 (0.004)	-0.002 (0.004)
N unique individuals	19,718	19,718	19,718	19,718	19,718
N person years	646,268	646,268	646,268	646,268	646,268
Fixed effects	Yes	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	No	Yes

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered at the duty station level in parentheses. Estimates reported are for the duty stations with at most 5 managers sample. The log pay residual is the remainder after controlling for location, age, education, tenure, occupation, agency-subagency-duty station, and share of female employees and managers obtained using equation (1) in section IV. “New same sex manager” is an indicator that equals 1 when the worker’s first new manager is the same sex as the worker. Fixed effects include year-quarter, locality, and individual fixed effects. Individual controls include education, age, age<sup>2</sup>, and occupation. Average values with standard deviations in parentheses for dependent variables are: GS grade – 9.36 (2.72); Log pay residual – -0.55 (17.2); Switching duty station – 0.33 (0.47).

TABLE 6—FEDERAL EMPLOYEE VIEWPOINT SURVEY: FEMALE MANAGEMENT SHARES AND EMPLOYEE ATTITUDES

Dependent variable: answers to questions on the scale 1-5	(1)	(2)	(3)	(4)	(5)	(6)
	Job satisfaction	Pay satisfaction	Recognition	Diversity	Discrimination	Trust in supervisor
Average answer	3.74	3.58	3.34	3.59	3.75	3.80
Female	-0.0350*** (0.0098)	0.0214 (0.0204)	-0.0644** (0.0232)	-0.2080*** (0.0161)	-0.1421*** (0.0129)	-0.1287*** (0.0182)
Agencies with low share of female management	-0.0301** (0.0133)	-0.0486 (0.0346)	-0.0290 (0.0194)	-0.0324* (0.0160)	0.0016 (0.0127)	-0.0232 (0.0153)
Agencies with high share of female management	0.0077 (0.0192)	0.0465* (0.0251)	-0.0336 (0.0205)	-0.0167 (0.0212)	0.0058 (0.0111)	0.0298* (0.0164)
Female*Agencies with low share of female management	-0.0022 (0.0177)	-0.0436 (0.0621)	0.0062 (0.0297)	0.0322 (0.0199)	-0.0002 (0.0169)	0.0450** (0.0183)
Female*Agencies with high share of female management	0.0596** (0.0207)	0.0494** (0.0232)	0.0235 (0.0211)	0.0609** (0.0216)	0.0335* (0.0179)	-0.0116 (0.0173)
N	448,424	448,937	448,437	422,019	409,931	449,042

Note: All specifications include year and agency fixed effects. Standard errors clustered by agency are in parentheses. \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . “High Share” is an indicator that the agency’s female management share is in the top quintile in a given year. “Low Share” is an indicator that the agency’s female management share is in the bottom quintile in a given year. The middle quintiles (2-4) are the base category. The sample is restricted to the subset of agencies whose female respondent shares in FEVS are within 15 percentage points of their shares in OPM.

The “job satisfaction,” “pay satisfaction” and “recognition” questions each ask the worker to rate how satisfied they are with that aspect of their employment. Workers respond on a scale of 1-5, with 5 being the most satisfied.

The “diversity,” “discrimination” and “trust” questions ask the respondent to use a 1-5 scale to indicate how much she agrees with the statement with 5 indicating strong agreement. The test of the statements are: Diversity: “Policies and programs promote diversity in the workplace (e.g. recruiting minorities and women, training in awareness of diversity issues, mentoring.” Discrimination: “Prohibited personnel practices (e.g. illegally discriminating for or against any employee/applicant, obstructing a person’s right to complete for employment, knowingly violating veterans’ preference requirements) are not tolerated.” Trust in supervisor: “I have trust and confidence in my supervisor.”

## **Appendices**

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- Appendix A: Extensions
- Appendix B: Supplementary Tables and Figures
  - Managers
  - Additional Robustness
- Appendix C: Tables Underling Figures
- Appendix D: Tables and Figures – At Most 20 Managers Sample

## APPENDIX A Extensions

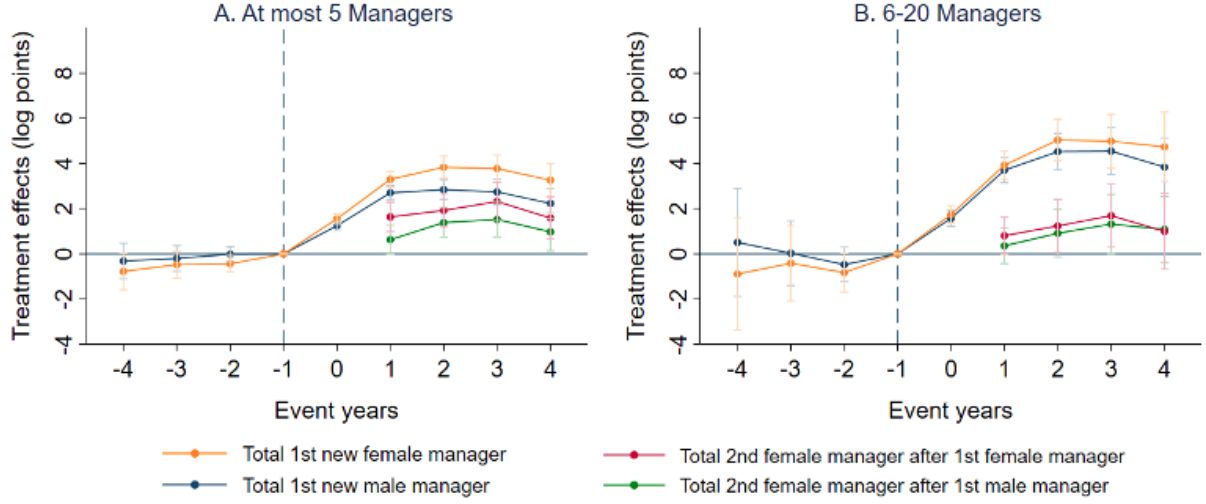


FIGURE A.1. EVENT STUDY ESTIMATES FOR SECOND FEMALE MANAGER

Note: Estimates and standard errors are reported in Table A.1 in Appendix A. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station. The estimated equations are given by:

$$\hat{\omega}_{itq} = \sum_{k=-L, k \neq -1}^U \delta_k \mathbf{1}\{t = k\} \cdot F_i \cdot NM_{idt} + \sum_{k=-L, k \neq -1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NM_{idt} \cdot G_d) + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot NSM_{idt} + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NSM_{idt} \cdot G_d) + \gamma_{id} + \lambda_q + \varepsilon_{itq}, \quad G = f, m$$

where  $NSM_{idt}$  denotes arrival of the second manager. The remaining notation is the same as in event study equation 2.

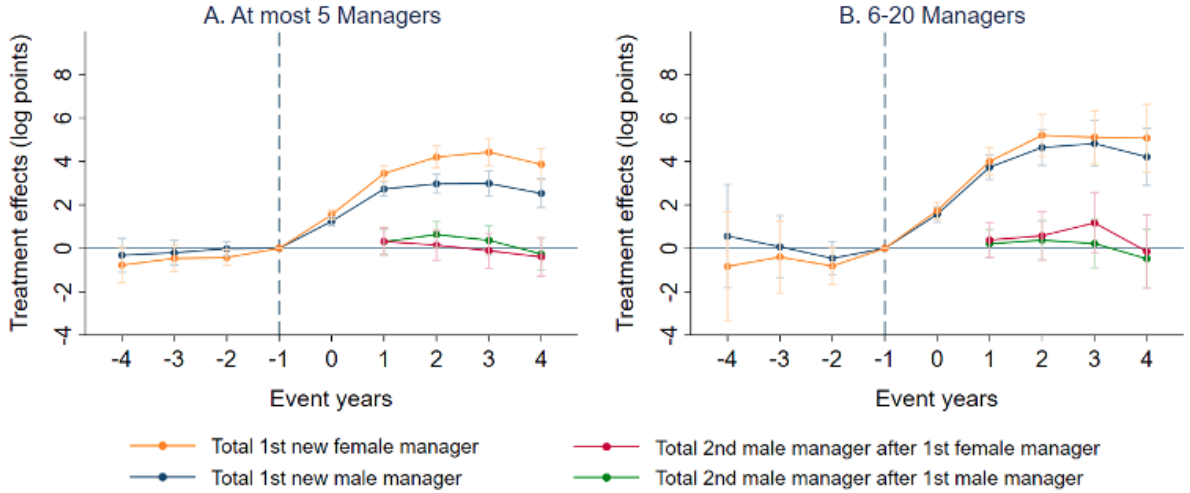


FIGURE A.2. EVENT STUDY ESTIMATES FOR SECOND MALE MANAGER

Note: Estimates and standard errors are reported in Table A.2 in Appendix A. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station. The estimated equations are given by:

$$\hat{\omega}_{itq} = \sum_{k=-L, k \neq -1}^U \delta_k \mathbf{1}\{t = k\} \cdot F_i \cdot NM_{idt} + \sum_{k=-L, k \neq -1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NM_{idt} \cdot G_d) + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot NSM_{idt} + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NSM_{idt} \cdot G_d) + \gamma_{id} + \lambda_q + \varepsilon_{itq}, \quad G = f, m$$

where  $NSM_{idt}$  denotes arrival of the second manager. The remaining notation is the same as in event study equation 2.

TABLE A.1—EVENT STUDY ESTIMATES FOR SECOND FEMALE MANAGER

Event year	At most 5 managers				6-20 Managers			
	New second female manager after male (1)	New second female manager after female (2)	New manager + New male manager (3)	New manager + New female manager (4)	New second female manager after male (5)	New second female manager after female (6)	New manager + New male manager (7)	New manager + New female manager (8)
-4			-0.31 (0.40)	-0.78* (0.42)			0.51 (1.22)	-0.89 (1.27)
-3			-0.20 (0.29)	-0.47 (0.31)			0.03 (0.73)	-0.41 (0.85)
-2			-0.02 (0.17)	-0.44** (0.19)			-0.47 (0.39)	-0.83* (0.44)
0			1.25*** (0.10)	1.55*** (0.12)			1.58*** (0.18)	1.74*** (0.20)
1	0.63* (0.32)	1.64*** (0.33)	2.70*** (0.16)	3.30*** (0.18)	0.36 (0.40)	0.81* (0.42)	3.71*** (0.28)	3.93*** (0.31)
2	1.39*** (0.34)	1.92*** (0.37)	2.84*** (0.22)	3.84*** (0.25)	0.91* (0.54)	1.24** (0.60)	4.53*** (0.41)	5.04*** (0.47)
3	1.52*** (0.40)	2.32*** (0.43)	2.75*** (0.29)	3.78*** (0.31)	1.32** (0.67)	1.69** (0.72)	4.55*** (0.53)	4.99*** (0.61)
4	0.98*** (0.43)	1.59*** (0.47)	2.24*** (0.33)	3.26*** (0.37)	1.08 (0.75)	1.00 (0.86)	3.84*** (0.66)	4.74*** (0.78)
N duty stations	8,532	8,532	8,532	8,532	5,310	5,310	5,310	5,310
N unique individuals	82,596	82,596	82,596	82,596	102,721	9102,721	102,721	102,721
N person years	1,772,395	1,750,461	1,772,395	1,750,461	2,208,968	2,191,958	2,208,968	2,191,958

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered at the duty station are in parentheses. Event year treatment effects are reported in log points. Estimates in this Table are graphed in Figure A.1 in Appendix A. All event study specifications include quarter-year and individual-duty station fixed effects. The estimated equations are given by:

$$\hat{\omega}_{itq} = \sum_{k=-L, k \neq -1}^U \delta_k \mathbf{1}\{t = k\} \cdot F_i \cdot NM_{idt} + \sum_{k=-L, k \neq -1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NM_{idt} \cdot G_d) + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot NSM_{idt} + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NSM_{idt} \cdot G_d) + \gamma_{id} + \lambda_q + \varepsilon_{itq}, \quad G = f, m$$

where  $NSM_{idt}$  denotes arrival of the second manager. The remaining notation is the same as in event study equation 2. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.



TABLE A.2—EVENT STUDY ESTIMATES FOR SECOND MALE MANAGER

Event year	At most 5 managers				6-20 Managers			
	New second male manager after male	New second male manager after female	New manager + New male manager	New manager + New female manager	New second male manager after male	New second male manager after female	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4			-0.32 (0.40)	-0.77* (0.42)			0.56 (1.22)	-0.83 (1.28)
-3			-0.20 (0.29)	-0.47 (0.31)			0.07 (0.73)	-0.40 (0.85)
-2			-0.02 (0.17)	-0.43** (0.19)			-0.46 (0.39)	-0.82 (0.44)
0			1.25*** (0.10)	1.55*** (0.12)			1.57*** (0.18)	1.74*** (0.20)
1	0.30 (0.29)	0.32 (0.32)	2.73*** (0.16)	3.45*** (0.19)	0.21 (0.33)	0.38 (0.41)	3.74*** (0.29)	4.01*** (0.32)
2	0.64** (0.30)	0.15 (0.35)	2.97*** (0.22)	4.20*** (0.26)	0.38 (0.46)	0.58 (0.57)	4.65*** (0.42)	5.21*** (0.49)
3	0.37 (0.35)	-0.11 (0.41)	2.99*** (0.29)	4.43*** (0.32)	0.22 (0.57)	1.17 (0.71)	4.83*** (0.54)	5.11*** (0.62)
4	-0.26 (0.38)	-0.40 (0.45)	2.53*** (0.34)	3.87*** (0.37)	-0.48 (0.67)	-0.15 (0.86)	4.21*** (0.67)	5.08*** (0.80)
N duty stations	8,532	8,532	78,532	8,532	5,310	5,310	5,310	5,310
N unique individuals	82,596	82,596	82,596	82,596	102,721	102,721	102,721	102,721
N person years	1,772,395	1,750,461	1,772,395	1,750,461	2,208,968	2,191,958	2,208,968	2,191,958

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered at the duty station are in parentheses. Event year treatment effects are reported in log points. Estimates in this Table are graphed in Figure A.2 in Appendix A. All event study specifications include quarter-year and individual-duty station fixed effects. The estimated equations are given by:

$$\hat{\omega}_{itq} = \sum_{k=-L, k \neq -1}^U \delta_k \mathbf{1}\{t = k\} \cdot F_i \cdot NM_{idt} + \sum_{k=-L, k \neq -1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NM_{idt} \cdot G_d) + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot NSM_{idt} + \sum_{k=1}^U \delta_k^G \mathbf{1}\{t = k\} \cdot F_i \cdot (NSM_{idt} \cdot G_d) + \gamma_{id} + \lambda_q + \varepsilon_{itq}, \quad G = f, m$$

where  $NSM_{idt}$  denotes arrival of the second manager. The remaining notation is the same as in event study equation 2. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

## APPENDIX B Supplementary Tables and Figures

TABLE B.1—SALARY TABLE 2012 GENERAL SCHEDULE (GS)

A. Annual Rates by Grade and Step										
Grade	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10
1	17,803	18,398	18,990	19,579	20,171	20,519	21,104	21,694	21,717	22,269
2	20,017	20,493	21,155	21,717	21,961	22,607	23,253	23,899	24,545	25,191
3	21,840	22,568	23,296	24,024	24,752	25,480	26,208	26,936	27,664	28,392
4	24,518	25,335	26,152	26,969	27,786	28,603	29,420	30,237	31,054	31,871
5	27,431	28,345	29,259	30,173	31,087	32,001	32,915	33,829	34,743	35,657
6	30,577	31,596	32,615	33,634	34,653	35,672	36,691	37,710	38,729	39,748
7	33,979	35,112	36,245	37,378	38,511	39,644	40,777	41,910	43,043	44,176
8	37,631	38,885	40,139	41,393	42,647	43,901	45,155	46,409	47,663	48,917
9	41,563	42,948	44,333	45,718	47,103	48,488	49,873	51,258	52,643	54,028
10	45,771	47,297	48,823	50,349	51,875	53,401	54,927	56,453	57,979	59,505
11	50,287	51,963	53,639	55,315	56,991	58,667	60,343	62,019	63,695	65,371
12	60,274	62,283	64,292	66,301	68,310	70,319	72,328	74,337	76,346	78,355
13	71,674	74,063	76,452	78,841	81,230	83,619	86,008	88,397	90,786	93,175
14	84,697	87,520	90,343	93,166	95,989	98,812	101,635	104,458	107,281	110,104
15	99,628	102,949	106,270	109,591	112,912	116,233	119,554	122,875	126,196	129,517

B. Percentage increases from previous step/grade										
Grade	Grade Increase	Step 2 Increase	Step 3 Increase	Step 4 Increase	Step 5 Increase	Step 6 Increase	Step 7 Increase	Step 8 Increase	Step 9 Increase	Step 10 Increase
1	9.787	0.033	0.032	0.031	0.030	0.017	0.028	0.028	0.001	0.025
2	0.117	0.024	0.032	0.026	0.011	0.029	0.028	0.027	0.027	0.026
3	0.087	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
4	0.116	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
5	0.112	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
6	0.109	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
7	0.105	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
8	0.102	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
9	0.099	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
10	0.096	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
11	0.094	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
12	0.181	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
13	0.173	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
14	0.167	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026
15	0.162	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.027	0.026

Note: Amounts are in USD. The usual progression is 52 weeks (one year) between steps 1-2, 2-3, and 3-4, then 104 weeks (two years) between steps 4-5, 5-6, and 6-7, and finally 156 weeks (three years) between steps 7-8, 8-9, and 9-10. It normally takes 18 years to advance from step 1 to step 10 within a single GS grade if an employee remains in that single grade. See <https://www.opm.gov/policy-data-oversight/pay-leave/pay-administration/fact-sheets/within-grade-increases/>



FIGURE B.1. FEMALE MANAGEMENT AND EMPLOYEE SHARES FOR SELECT AGENCIES

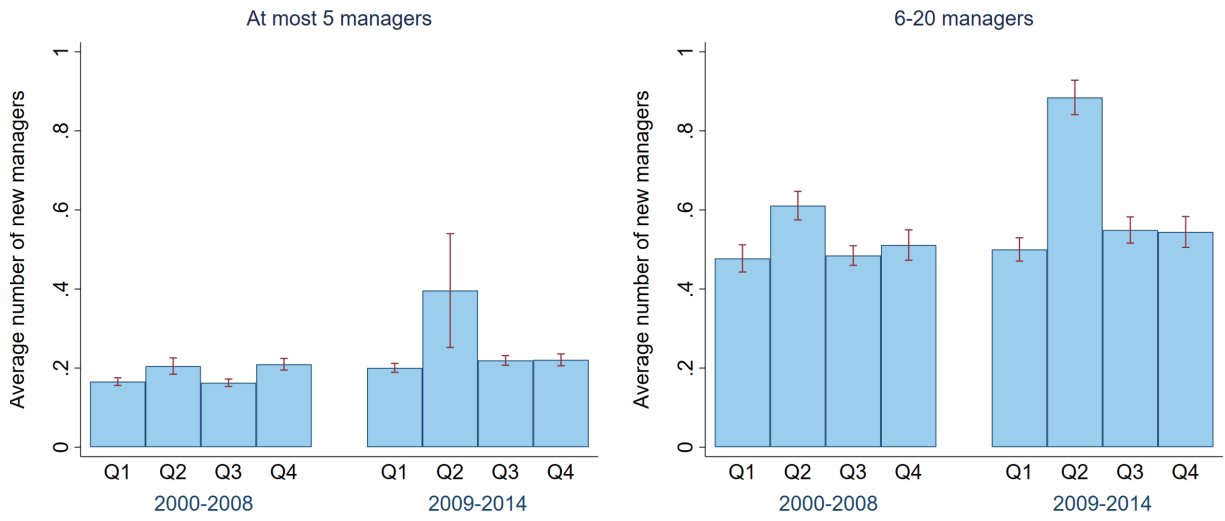


FIGURE B.2. AVERAGE QUARTERLY MANAGEMENT INCREASES

Note: Vertical bars represent 95% confidence intervals.

TABLE B.2—MANAGERIAL DESCRIPTIVE STATISTICS (AT MOST 5 MANAGERS)

	All Managers				New managers			
	All managers	Female managers	Male managers	Unidentified managers	All Managers	Female managers	Male managers	Unidentified managers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Salary	78,950.46 (35,534.34)	79,235.97 (34,431.34)	81,275.75 (36,659.53)	71,938.40 (32,924.23)	69,731.12 (33,556.62)	70,198.31 (31,576.97)	71,213.03 (34,728.15)	63,567.36 (33,130.45)
Log salary	11.18 (0.45)	11.18 (0.46)	11.21 (0.45)	11.09 (0.45)	11.04 (0.48)	11.06 (0.47)	11.06 (0.48)	10.93 (0.51)
GS grade (GS sample)	12.11 (2.11)	11.96 (2.11)	12.27 (2.06)	11.87 (2.23)	11.61 (2.43)	11.63 (2.25)	11.67 (2.45)	11.36 (2.74)
Age	49.37 (9.15)	48.45 (9.21)	49.40 (9.15)	50.74 (8.91)	44.92 (9.75)	44.48 (9.55)	45.02 (9.72)	45.73 (10.23)
Birth year 1955-	0.54 (0.50)	0.45 (0.50)	0.53 (0.50)	0.70 (0.46)	0.40 (0.49)	0.35 (0.48)	0.39 (0.49)	0.55 (0.50)
Birth year 1955-1960	0.13 (0.34)	0.16 (0.37)	0.13 (0.34)	0.08 (0.27)	0.14 (0.35)	0.16 (0.36)	0.14 (0.35)	0.10 (0.30)
Birth year 1960-1965	0.10 (0.30)	0.12 (0.33)	0.10 (0.30)	0.05 (0.21)	0.12 (0.33)	0.14 (0.35)	0.12 (0.33)	0.08 (0.27)
Birth year 1965-1970	0.07 (0.25)	0.09 (0.28)	0.07 (0.26)	0.03 (0.18)	0.10 (0.31)	0.11 (0.31)	0.11 (0.31)	0.07 (0.25)
Birth year 1970-1975	0.04 (0.20)	0.05 (0.22)	0.04 (0.20)	0.02 (0.14)	0.08 (0.27)	0.08 (0.27)	0.08 (0.28)	0.05 (0.21)
Birth year 1975-1980	0.02 (0.15)	0.03 (0.18)	0.02 (0.15)	0.01 (0.10)	0.05 (0.23)	0.07 (0.25)	0.05 (0.23)	0.03 (0.16)
Birth year 1980+	0.10 (0.30)	0.09 (0.29)	0.10 (0.30)	0.10 (0.31)	0.10 (0.30)	0.09 (0.29)	0.09 (0.29)	0.13 (0.33)
Education: High school or less	0.12 (0.32)	0.15 (0.36)	0.10 (0.30)	0.11 (0.31)	0.13 (0.34)	0.15 (0.36)	0.12 (0.32)	0.14 (0.34)
Education: Some college	0.18 (0.39)	0.24 (0.43)	0.16 (0.37)	0.15 (0.36)	0.20 (0.40)	0.24 (0.43)	0.19 (0.39)	0.18 (0.38)

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TABLE B.2 CONTINUED

	All managers (1)	All Managers Female managers (2)	Male managers (3)	Unidentified managers (4)	All Managers (5)	New managers Female managers (6)	Male managers (7)	Unidentified managers (8)
Education:	0.39	0.35	0.41	0.39	0.37	0.35	0.39	0.34
Bachelor's degree	(0.49)	(0.48)	(0.49)	(0.49)	(0.48)	(0.48)	(0.49)	(0.47)
Education:	0.30	0.25	0.32	0.33	0.27	0.24	0.28	0.30
Graduate degree	(0.46)	(0.43)	(0.46)	(0.47)	(0.44)	(0.43)	(0.45)	(0.46)
Total tenure (years)	19.38 (9.81)	18.71 (9.76)	19.36 (9.72)	20.41 (10.05)	13.40 (9.65)	13.82 (9.64)	13.31 (9.45)	12.76 (10.45)
Managerial tenure (years)	6.56 (6.20)	6.04 (6.04)	6.89 (6.40)	6.43 (5.78)	1.16 (3.48)	1.10 (3.41)	1.25 (3.62)	0.98 (3.11)
N unique individuals	153,205	49,218	76,361	27,626	51,400	16,448	26,057	8,895
N unique individuals (GS sample)	92,898	34,044	44,522	14,332	37,978	13,299	18,997	5,682
N duty stations	8,160	6,144	7,456	5,091	6,680	4,729	5,806	3,414

Note: Descriptives statistics are provided for the sample with at most 5 managers at the duty station level. Standard deviations are in parentheses. Unexplained log pay is residual log pay after controlling for location, age, education, tenure, occupation, agency-subagency-duty station, and share of female employees and managers. Workplace characteristics are at the duty station - quarter level.

TABLE B.3—MANAGERIAL DESCRIPTIVE STATISTICS (6-20 MANAGERS)

	All Managers				New managers			
	All managers (1)	Female managers (2)	Male managers (3)	Unidentified managers (4)	All Managers (5)	Female managers (6)	Male managers (7)	Unidentified managers (8)
Salary	77,586.95 (36,652.58)	79,495.76 (36,988.84)	80,021.03 (36,970.98)	68,610.78 (33,877.47)	67,455.45 (35,094.85)	68,991.24 (34,352.08)	69,148.54 (35,311.30)	58,872.52 (34,689.14)
Log salary	11.15 (0.49)	11.17 (0.50)	11.18 (0.47)	11.02 (0.50)	10.98 (0.53)	11.01 (0.52)	11.02 (0.51)	10.82 (0.59)
GS grade (GS sample)	11.85 (2.54)	11.86 (2.48)	12.03 (2.50)	11.33 (2.70)	11.26 (2.91)	11.41 (2.70)	11.35 (2.91)	10.68 (3.23)
Age	49.20 (9.07)	48.31 (9.23)	49.33 (9.11)	50.01 (8.63)	44.65 (9.74)	44.31 (9.66)	44.77 (9.73)	45.00 (9.93)
Birth year 1955-	0.56 (0.50)	0.46 (0.50)	0.56 (0.50)	0.71 (0.45)	0.43 (0.49)	0.37 (0.48)	0.42 (0.49)	0.56 (0.50)
Birth year 1955-1960 (0.30)	0.13 (0.33)	0.16 (0.37)	0.13 (0.33)	0.08 (0.27)	0.14 (0.35)	0.16 (0.37)	0.14 (0.35)	0.10 (0.30)
Birth year 1960-1965	0.09 (0.28)	0.12 (0.32)	0.09 (0.29)	0.04 (0.19)	0.11 (0.32)	0.14 (0.34)	0.12 (0.32)	0.07 (0.25)
Birth year 1965-1970	0.06 (0.24)	0.08 (0.27)	0.06 (0.24)	0.03 (0.17)	0.10 (0.29)	0.11 (0.31)	0.10 (0.30)	0.06 (0.24)
Birth year 1970-1975	0.04 (0.19)	0.05 (0.21)	0.04 (0.19)	0.02 (0.13)	0.07 (0.25)	0.07 (0.26)	0.07 (0.26)	0.04 (0.19)
Birth year 1975-1980	0.02 (0.14)	0.02 (0.16)	0.02 (0.15)	0.01 (0.09)	0.05 (0.22)	0.05 (0.22)	0.05 (0.23)	0.02 (0.15)
Birth year 1980+	0.11 (0.31)	0.11 (0.32)	0.11 (0.31)	0.11 (0.32)	0.10 (0.30)	0.10 (0.30)	0.09 (0.29)	0.15 (0.36)
Education: High school or less	0.14 (0.34)	0.16 (0.37)	0.13 (0.33)	0.14 (0.34)	0.15 (0.36)	0.16 (0.37)	0.15 (0.35)	0.17 (0.37)
Education: Some college	0.20 (0.40)	0.24 (0.43)	0.19 (0.39)	0.19 (0.39)	0.22 (0.42)	0.24 (0.42)	0.22 (0.41)	0.23 (0.42)

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TABLE B.3 CONTINUED

	All managers (1)	All Managers Female managers (2)	Male managers (3)	Unidentified managers (4)	All Managers (5)	New managers Female managers (6)	Male managers (7)	Unidentified managers (8)
Education:	0.37	0.34	0.38	0.37	0.34	0.33	0.35	0.31
Bachelor's degree	(0.48)	(0.47)	(0.48)	(0.48)	(0.47)	(0.47)	(0.48)	(0.46)
Education:	0.29	0.26	0.30	0.29	0.25	0.25	0.26	0.23
Graduate degree	(0.45)	(0.44)	(0.46)	(0.45)	(0.43)	(0.43)	(0.44)	(0.42)
Total tenure (years)	19.40 (9.66)	18.34 (9.43)	19.42 (9.72)	20.69 (9.59)	13.26 (9.56)	13.10 (9.23)	13.28 (9.54)	13.53 (10.25)
Managerial tenure (years)	6.60 (6.10)	6.23 (6.06)	6.89 (6.27)	6.33 (5.58)	1.07 (3.32)	0.97 (3.20)	1.18 (3.50)	0.87 (2.87)
N unique individuals	215,954	63,471	109,388	43,095	96,978	28,901	50,214	17,863
N unique individuals (GS sample)	133,638	46,514	63,619	23,505	69,070	23,285	34,086	11,699
N duty stations	5,081	4,518	4,956	4,158	4,698	3,930	4,388	3,282

Note: Standard deviations are in parentheses. Unexplained log pay is residual log pay after controlling for location, age, education, tenure, occupation, agency-subagency-duty station, and share of female employees and managers. Workplace characteristics are at the duty station - quarter level.



TABLE B.4—MANAGERIAL TRANSITIONS

Share of total managerial changes	At Most 5 Managers			6-20 Managers		
	Female managers (1)	Male managers (2)	Unidentified managers (3)	Female managers (4)	Male managers (5)	Unidentified managers (6)
Promotions within Federal Service	0.94	0.94	0.89	0.94	0.94	0.91
Promotions within Duty stations	0.49	0.43	0.42	0.54	0.46	0.48
Managerial additions	0.73	0.73	0.74	0.72	0.72	0.71
Managerial replacements	0.27	0.27	0.26	0.28	0.28	0.29
Increasing female management share	0.71	0.16	0.15	0.75	0.25	0.23
Increasing male management share	0.14	0.54	0.14	0.22	0.60	0.23
>10 years younger	0.15	0.12	0.10	0.16	0.12	0.10
>10 years older	0.17	0.21	0.29	0.18	0.20	0.28
Total managerial changes	19,181	30,270	10,018	33,374	59,494	20,215
N unique individuals	16,448	26,057	8,895	28,901	50,214	17,863
N duty stations	4,729	5,806	3,414	3,930	4,388	3,282

TABLE B.5—DID: EFFECTS OF NEW MANAGER ON EMPLOYEE DEPARTURE (AT MOST 5 MANAGERS SAMPLE)

	Leaving or switching duty station		Switching duty station	
	(1)	(2)	(3)	(4)
New manager	-0.081*** (0.002)	-0.093*** (0.003)	-0.101*** (0.002)	-0.121*** (0.003)
New manager* Male emp.		0.006 (0.004)		0.008** (0.003)
New female manager		0.012*** (0.004)		0.027*** (0.004)
New female manager*Male emp.		0.024*** (0.006)		0.019*** (0.006)
New manager + New female manager		-0.081*** (0.003)		-0.093*** (0.003)
New manager + New manager*Male emp.+ New female manager + New female manager*Male emp.		-0.051*** (0.005)		-0.067*** (0.004)
N person quarters	1,686,872	1,686,872	1,686,872	1,686,872
N unique individuals	74,147	74,147	74,147	74,147
N unique individuals leaving or switching	53,395	53,395	21,502	21,502
Share of unique individuals leaving or switching duty stations	0.72	0.72	0.29	0.29
Fixed effects	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. Estimates reported are for the duty stations with at most 5 managers sample. “N of unique individuals leaving or switching” contains number of unique individuals that either switch duty stations or leave federal service in our sample. Fixed effects include year-quarter, locality, and individual fixed effects. Individual controls include education, age, age<sup>2</sup>, and occupation.

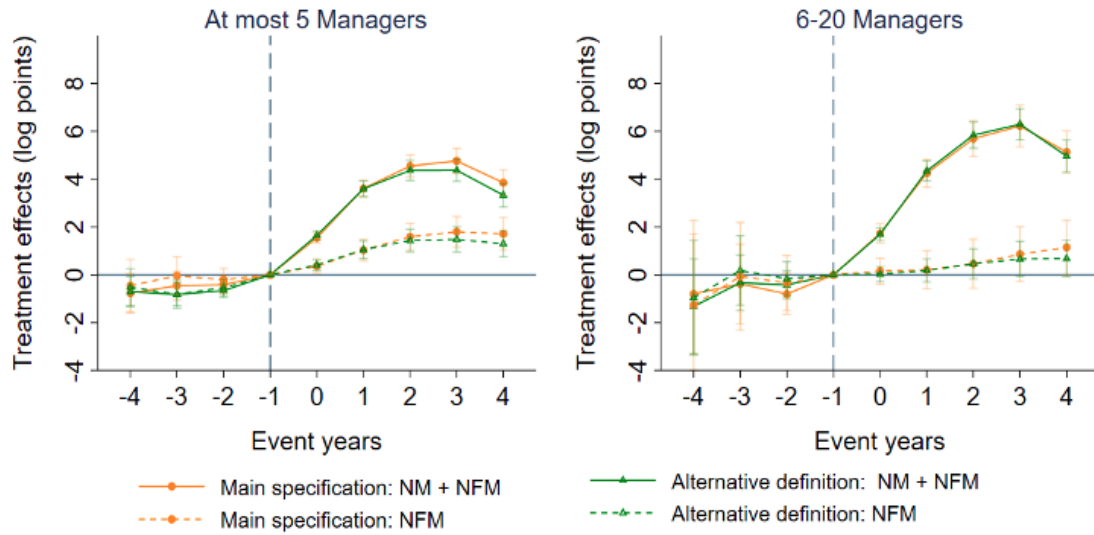


FIGURE B.3. EVENT STUDY ESTIMATES USING ALTERNATIVE TREATMENT DEFINITION

Note: Alternative treatment definition refers to defining individuals as treated when they get their first new manager after having been employed at the Federal Service for at least 1 year. Estimates and standard errors are reported in Table B.6 in Appendix B. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

TABLE B.6—EVENT STUDY ESTIMATES USING ALTERNATIVE TREATMENT DEFINITION

Event year	At most 5 managers				6-20 Managers			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	-0.08 (0.40)	-0.52 (0.40)	-0.45 (0.32)	-0.70** (0.32)	0.91 (1.20)	-0.96 (1.22)	-0.26 (0.85)	-1.32 (1.01)
-3	0.42 (0.29)	-0.82*** (0.30)	-0.04 (0.23)	-0.82*** (0.24)	1.16* (0.67)	0.18 (0.74)	0.14 (0.49)	-0.33 (0.59)
-2	0.54*** (0.17)	-0.54*** (0.18)	0.03 (0.13)	-0.66*** (0.14)	-0.13 (0.33)	-0.16 (0.36)	-0.35 (0.26)	-0.42 (0.29)
0	-0.26** (0.11)	0.41*** (0.12)	1.27*** (0.09)	1.65*** (0.10)	-0.04 (0.15)	0.03 (0.16)	1.69*** (0.12)	1.69*** (0.14)
1	-0.25 (0.18)	1.05*** (0.19)	2.84*** (0.14)	3.60*** (0.17)	-0.15 (0.23)	0.18 (0.24)	4.17*** (0.18)	4.35*** (0.21)
2	-0.43* (0.22)	1.44*** (0.24)	3.28*** (0.18)	4.37*** (0.21)	-0.44 (0.29)	0.46 (0.32)	5.37*** (0.24)	5.84*** (0.28)
3	-0.65** (0.25)	1.48*** (0.27)	3.12*** (0.21)	4.38*** (0.24)	-0.79** (0.35)	0.67* (0.37)	5.50*** (0.28)	6.30*** (0.33)
4	-0.69*** (0.27)	1.30*** (0.28)	2.20*** (0.22)	3.33*** (0.25)	-0.40 (0.36)	0.68* (0.39)	4.36*** (0.29)	4.97*** (0.34)
N duty stations	8,538	8,538	8,538	8,538	5,314	5,314	5,314	5,314
N unique individuals	82,416	82,416	82,416	82,416	102,142	102,142	102,142	102,142
N person years	1,805,324	1,763,700	1,805,324	1,763,700	2,236,446	2,199,513	2,236,446	2,199,513

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered at the duty station are in parentheses. Event year treatment effects are reported in log points. Alternative treatment definition refers to defining individuals as treated when they get their first new manager after having been employed at the Federal Service for at least 1 year. Estimates in this Table are graphed in Figure B.3 in Appendix B. All event study specifications include quarter-year and individual-duty station fixed effects, see event study equation 2. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

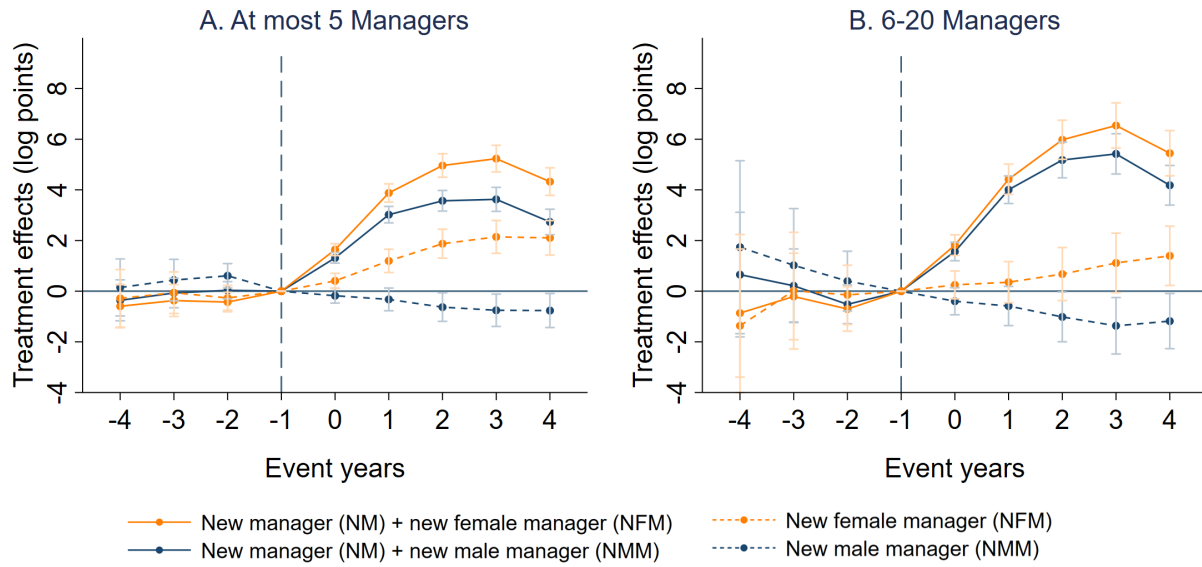


FIGURE B.4. EVENT STUDY ESTIMATES FOR GS SUBSAMPLE

Note: Estimates and standard errors are reported in Table B.7 in Appendix B. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

TABLE B.7—EVENT STUDY ESTIMATES FOR THE GS SUBSAMPLE

Event year	At most 5 managers				6-20 Managers			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.15 (0.57)	-0.28 (0.58)	-0.36 (0.41)	-0.59 (0.43)	1.74 (1.74)	-1.36 (1.84)	0.65 (1.25)	-0.86 (1.29)
-3	0.44 (0.42)	-0.06 (0.42)	-0.07 (0.30)	-0.37 (0.32)	1.02 (1.14)	0.02 (1.18)	0.22 (0.74)	-0.21 (0.87)
-2	0.61** (0.25)	-0.26 (0.25)	0.04 (0.17)	-0.43** (0.20)	0.40 (0.60)	-0.15 (0.60)	-0.52 (0.39)	-0.70 (0.45)
0	-0.18 (0.15)	0.41*** (0.15)	1.31*** (0.11)	1.64*** (0.12)	-0.40 (0.27)	0.25 (0.28)	1.56*** (0.19)	1.82*** (0.21)
1	-0.32 (0.23)	1.19*** (0.23)	3.02*** (0.17)	3.88*** (0.18)	-0.59 (0.39)	0.35 (0.41)	4.00*** (0.28)	4.42*** (0.30)
2	-0.63** (0.29)	1.87*** (0.29)	3.57*** (0.21)	4.96*** (0.24)	-1.02** (0.50)	0.68 (0.53)	5.18*** (0.36)	5.98*** (0.39)
3	-0.75** (0.33)	2.14*** (0.33)	3.63*** (0.24)	5.23*** (0.27)	-1.37** (0.57)	1.11* (0.60)	5.42*** (0.41)	6.54*** (0.45)
4	-0.76** (0.34)	2.11*** (0.35)	2.73*** (0.26)	4.32*** (0.28)	-1.18** (0.56)	1.40** (0.60)	4.18*** (0.40)	5.45*** (0.45)
N duty stations	7,906	7,899	7,906	7,899	5,118	5,119	5,118	5,119
N unique individuals	74,711	74,699	74,711	74,699	95,164	95,160	95,164	95,160
N person years	1,600,512	1,580,471	1,600,512	1,580,471	2,054,345	2,039,416	2,054,345	2,039,416

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered at the duty station are in parentheses. Event year treatment effects are reported in log points. Estimates in this Table are graphed in Figure B.4 in Appendix B. All event study specifications include quarter-year and individual-duty station fixed effects, see event study equation 2. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

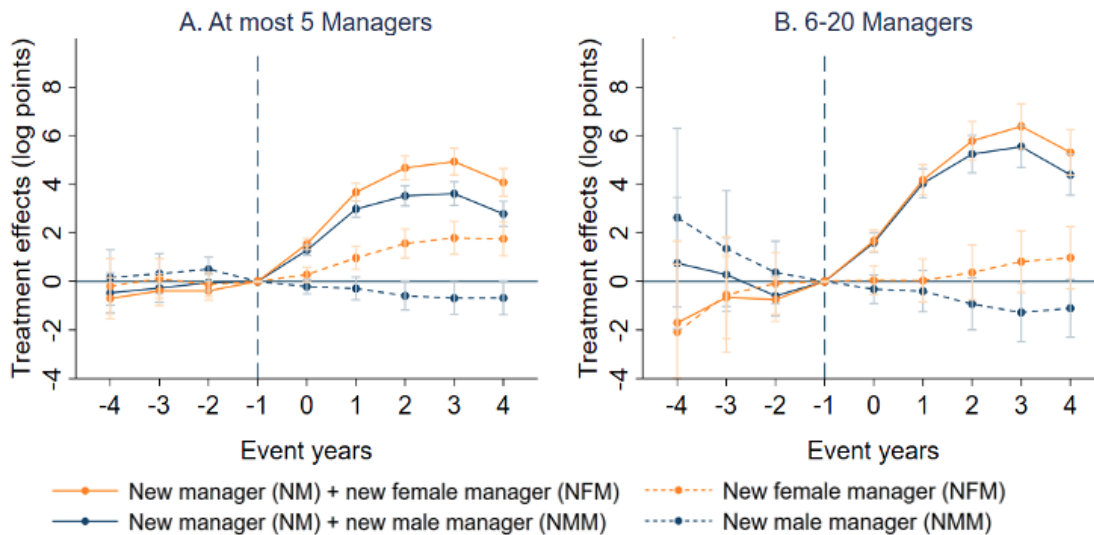


FIGURE B.5. EVENT STUDY ESTIMATES FOR SUBSAMPLE STARTING 1993

Note: Estimates and standard errors are reported in Table B.8 in Appendix B. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

TABLE B.8—EVENT STUDY ESTIMATES FOR SUBSAMPLE STARTING 1993

Event year	At most 5 managers				6-20 Managers			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.16 (0.58)	-0.20 (0.58)	-0.47 (0.42)	-0.70 (0.43)	2.63 (1.88)	-2.08 (1.91)	0.75 (1.38)	-1.70 (0.17)
-3	0.32 (0.42)	0.12 (0.42)	-0.27 (0.30)	-0.39 (0.31)	1.35 (1.22)	-0.55 (1.21)	0.28 (0.78)	-0.66 (0.87)
-2	0.50** (0.25)	-0.13 (0.25)	-0.05 (0.18)	-0.39** (0.20)	0.37 (0.66)	-0.08 (0.64)	-0.60 (0.42)	-0.75 (0.46)
0	-0.21 (0.15)	0.28* (0.16)	1.28*** (0.11)	1.54*** (0.12)	-0.32 (0.30)	0.05 (0.30)	1.59*** (0.20)	1.67*** (0.22)
1	-0.29 (0.24)	0.97*** (0.24)	2.98*** (0.17)	3.67*** (0.19)	-0.40 (0.43)	0.03 (0.45)	4.04*** (0.31)	4.18*** (0.32)
2	-0.59** (0.30)	1.56*** (0.30)	3.52*** (0.21)	4.67*** (0.25)	-0.93* (0.54)	0.37 (0.58)	5.24*** (0.39)	5.78*** (0.41)
3	-0.69** (0.34)	1.79*** (0.34)	3.61*** (0.25)	4.93*** (0.28)	-1.28** (0.62)	0.81 (0.65)	5.54*** (0.44)	6.38*** (0.47)
4	-0.68* (0.35)	1.75*** (0.36)	2.78*** (0.26)	4.07*** (0.29)	-1.11* (0.61)	0.97 (0.65)	4.39*** (0.43)	5.31*** (0.48)
N duty stations	7,652	7,648	7,652	7,648	4,688	4,686	4,688	4,686
N unique individuals	77,741	77,720	77,741	77,720	96,345	96,344	96,345	96,344
N person years	1,631,838	1,610,729	1,631,838	1,610,729	2,000,684	1,983,971	2,000,684	1,983,971

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered at the duty station are in parentheses. Event year treatment effects are reported in log points. Estimates in this Table are graphed in Figure B.5 in Appendix B. All event study specifications include quarter-year and individual-duty station fixed effects, see event study equation 2. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.



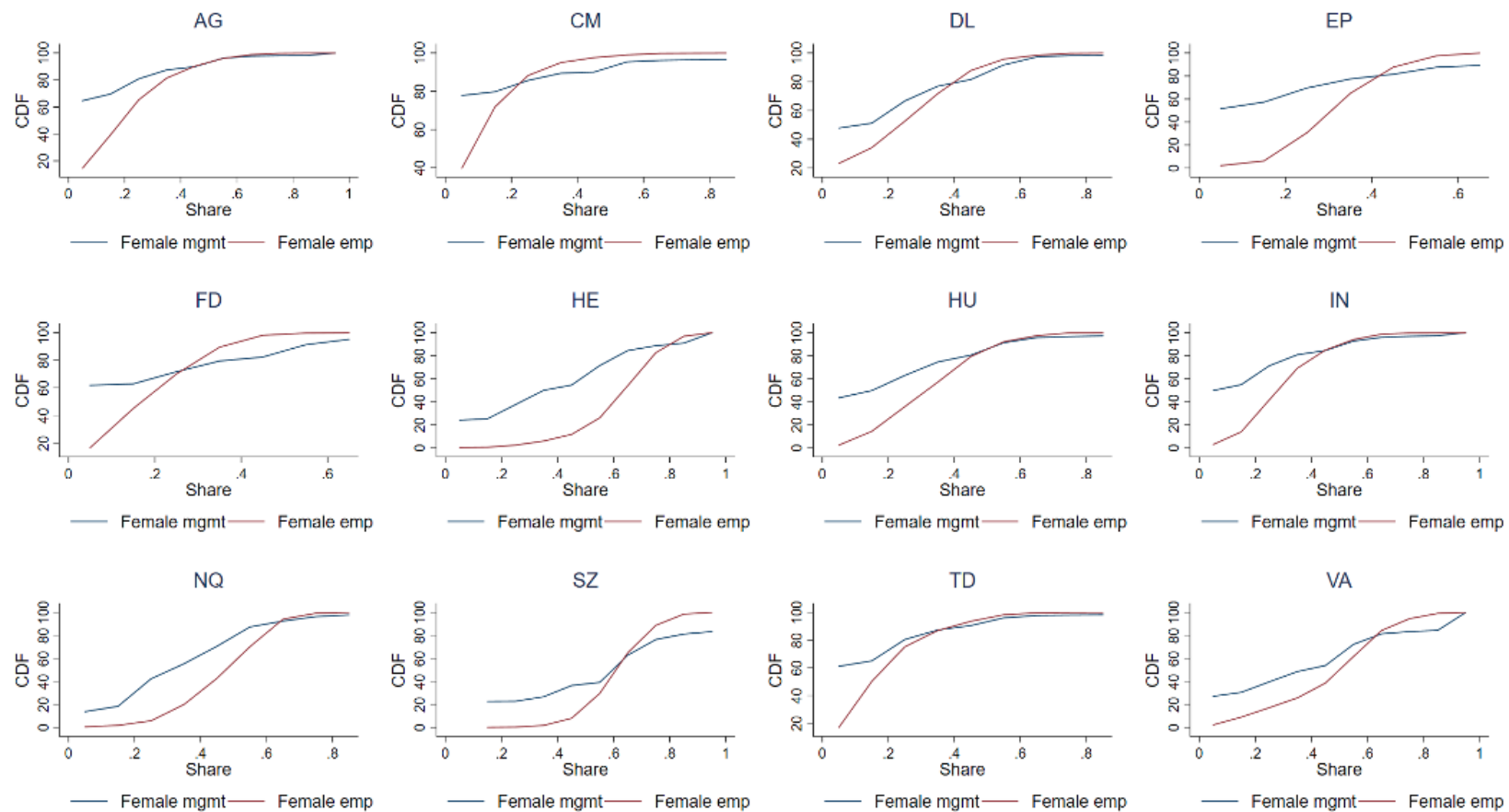


FIGURE B.6. FEMALE MANAGEMENT AND EMPLOYEE SHARE CDFs FOR SELECT AGENCIES

Note: Agency abbreviations: AG – Department of Agriculture; CM – Department of Commerce; DL – Department of Labor; EP – Environmental Protection Agency; FD – Federal Deposit Insurance Corporation; HE – Department of Health and Human Services; HU – Department of Housing and Urban Development; IN – Department of the Interior; NQ – National Archives and Records Administration; SZ – Social Security Administration; TD – Department of Transportation; VA – Department of Veterans Affairs.

## APPENDIX C   Tables Underlying Figures

TABLE C.1—HETEROGENEITY OF EVENT STUDY ESTIMATES BY INITIAL AGENCY FEMALE MANAGEMENT SHARE (AT MOST 5 MANAGERS; FIGURE N)

Event year	Below median				Above median			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.11 (0.96)	-0.66 (0.97)	-0.21 (0.58)	-0.73 (0.79)	0.21 (0.69)	-0.48 (0.68)	-0.18 (0.56)	-0.54 (0.50)
-3	-0.04 (0.67)	0.07 (0.70)	-0.22 (0.43)	-0.15 (0.58)	0.49 (0.50)	-0.21 (0.49)	-0.06 (0.39)	-0.44 (0.36)
-2	0.68* (0.37)	-0.48 (0.40)	0.11 (0.24)	-0.52 (0.34)	0.40 (0.31)	-0.03 (0.31)	-0.06 (0.24)	-0.31 (0.23)
0	0.19 (0.26)	0.47* (0.28)	0.63*** (0.17)	0.90*** (0.24)	-0.35 (0.23)	0.32 (0.22)	0.41** (0.18)	0.77*** (0.15)
1	0.33 (0.33)	0.68* (0.38)	1.90*** (0.22)	2.26*** (0.33)	-0.50* (0.30)	0.62** (0.30)	2.25*** (0.23)	2.85*** (0.21)
2	0.41 (0.37)	0.68 (0.43)	2.88*** (0.25)	3.21*** (0.38)	-0.95*** (0.35)	1.03*** (0.35)	4.02*** (0.27)	5.04*** (0.26)
3	0.30 (0.42)	0.96** (0.48)	3.00*** (0.28)	3.58*** (0.42)	-1.11*** (0.39)	1.17*** (0.39)	4.95*** (0.30)	6.13*** (0.29)
4	0.25 (0.45)	1.14** (0.52)	2.62*** (0.31)	3.36*** (0.46)	-1.21*** (0.40)	1.10*** (0.41)	4.81*** (0.32)	6.00*** (0.31)
N duty stations	5,086	5,086	5,086	5,086	3,624	3,624	3,624	3,624
N unique individuals	46,385	46,385	46,385	46,385	36,526	36,526	36,526	36,526
N person years	1,012,801	1,012,801	1,012,801	1,012,801	804,755	804,755	804,755	804,755

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure 5. All event study specifications include quarter-year and individual-duty station fixed effects. The median initial female management share is 16%. The initial female management share of each agency is calculated based on the female management share at the agency level in the first three years of the agency's existence. Agencies must exist for at least 5 years to be included in the sample. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE C.2—HETEROGENEITY OF EVENT STUDY ESTIMATES BY EMPLOYEE EDUCATIONAL ATTAINMENT (AT MOST 5 MANAGERS)

Event year	Less than Bachelor's degree				Bachelor's degree or higher			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.52 (0.68)	-0.77 (0.67)	-0.50 (0.51)	-1.32*** (0.49)	-0.09 (0.95)	0.09 (0.94)	-0.45 (0.65)	-0.25 (0.68)
-3	0.26 (0.49)	0.08 (0.49)	-0.25 (0.36)	-0.33 (0.37)	0.20 (0.66)	0.24 (0.66)	-0.55 (0.44)	-0.59 (0.50)
-2	0.30 (0.29)	-0.02 (0.30)	-0.10 (0.21)	-0.26 (0.23)	0.61 (0.38)	-0.22 (0.39)	-0.16 (0.26)	-0.63** (0.29)
0	-0.16 (0.17)	0.40** (0.17)	0.86*** (0.13)	1.17*** (0.14)	-0.25 (0.22)	0.37 (0.23)	1.63*** (0.15)	1.96*** (0.18)
1	-0.31 (0.26)	1.04*** (0.26)	1.93*** (0.19)	2.70*** (0.20)	-0.32 (0.34)	1.03*** (0.34)	3.91*** (0.23)	4.64*** (0.27)
2	-0.64** (0.31)	1.77*** (0.32)	2.29*** (0.22)	3.61*** (0.27)	-0.55 (0.44)	1.48*** (0.44)	4.63*** (0.30)	5.72*** (0.35)
3	-0.80** (0.37)	2.17*** (0.37)	2.37*** (0.26)	4.00*** (0.31)	-0.67 (0.49)	1.45*** (0.50)	4.63*** (0.35)	5.74*** (0.39)
4	-0.95** (0.39)	2.08*** (0.40)	1.78*** (0.28)	3.43*** (0.33)	-0.47 (0.50)	1.24** (0.51)	3.52*** (0.36)	4.41*** (0.41)
N duty stations	7,845	7,845	7,845	7,845	7,305	7,305	7,305	7,305
N unique individuals	39,155	39,155	39,155	39,155	45,732	45,732	45,732	45,732
N person years	879,048	870,181	879,048	870,181	961,149	946,933	961,149	946,933

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure 5. All event study specifications include quarter-year and individual-duty station fixed effects. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE C.3—EVENT STUDY ESTIMATES BY PRESIDENTIAL ERA (AT MOST 5 MANAGERS)

Event year	Reagan and Bush (1987-1992)				Clinton (1993-2000)			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	1.64* (0.97)	1.06 (0.96)	0.78 (0.84)	0.62 (0.85)	0.18 (0.83)	-0.08 (0.80)	0.24 (0.62)	0.00 (0.62)
-3	0.36 (0.72)	1.76** (0.78)	0.33 (0.63)	1.46** (0.70)	-0.03 (0.58)	0.50 (0.58)	-0.01 (0.44)	0.34 (0.47)
-2	-0.15 (0.42)	0.91* (0.48)	-0.34 (0.34)	0.82* (0.42)	-0.14 (0.36)	0.05 (0.37)	-0.14 (0.28)	0.02 (0.30)
0	0.31 (0.30)	0.44 (0.32)	0.32 (0.25)	0.47* (0.27)	0.32 (0.25)	0.44 (0.27)	0.66*** (0.19)	0.79*** (0.23)
1	0.48 (0.37)	0.98** (0.40)	1.14*** (0.31)	1.54*** (0.35)	0.54* (0.33)	0.76** (0.36)	2.00*** (0.25)	2.23*** (0.31)
2	0.54 (0.42)	1.17*** (0.45)	1.73*** (0.35)	2.24*** (0.39)	0.36 (0.36)	1.17*** (0.41)	2.75*** (0.28)	3.33*** (0.35)
3	0.55 (0.45)	1.07** (0.47)	1.91*** (0.38)	2.33*** (0.41)	0.32 (0.40)	1.27*** (0.44)	2.99*** (0.31)	3.66*** (0.37)
4	0.65 (0.48)	0.95* (0.49)	1.77*** (0.40)	2.03*** (0.43)	0.05 (0.43)	1.64*** (0.46)	2.64*** (0.33)	3.70*** (0.40)
N duty stations	7,357	7,357	7,357	7,357	7,770	7,770	7,770	7,770
N unique individuals	41,135	41,135	41,135	41,135	63,591	63,591	63,591	63,591
N person years	736,401	728,061	736,401	728,061	1,169,988	1,153,962	1,169,988	1,153,962

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Event year	Bush (2001-2008)				Obama (2009-2014)			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.02 (0.68)	-0.43 (0.69)	-0.46 (0.51)	(0.72) (0.55)	0.27 (1.02)	-0.36 (1.00)	-0.11 (0.72)	-0.34 (0.71)
-3	0.47 (0.52)	-0.47 (0.53)	-0.01 (0.38)	(0.53) (0.42)	0.44 (0.68)	-0.14 (0.67)	-0.06 (0.48)	-0.42 (0.48)
-2	0.40 (0.31)	-0.37 (0.32)	-0.02 (0.23)	-0.47* (0.26)	0.74* (0.39)	-0.54 (0.40)	0.12 (0.26)	-0.60** (0.30)
0	-0.15 (0.22)	0.31 (0.23)	0.46** (0.17)	0.69*** (0.18)	0.17 (0.28)	0.42 (0.27)	0.98*** (0.20)	1.13*** (0.20)
1	-0.24 (0.29)	0.92*** (0.30)	2.21*** (0.22)	2.85*** (0.24)	0.10 (0.38)	0.67* (0.37)	2.37*** (0.27)	2.73*** (0.29)
2	-0.72** (0.34)	1.75*** (0.35)	3.87*** (0.25)	5.26*** (0.30)	-0.10 (0.45)	0.60 (0.45)	3.60*** (0.32)	4.07*** (0.36)
3	-1.01*** (0.38)	2.13*** (0.40)	4.57*** (0.29)	6.34*** (0.33)	-0.33 (0.51)	0.94* (0.52)	4.29*** (0.36)	5.09*** (0.42)
4	-1.17*** (0.39)	1.93*** (0.41)	4.28*** (0.30)	6.03*** (0.35)	-0.51 (0.56)	1.12* (0.57)	4.41*** (0.41)	5.40*** (0.46)
N duty stations	7,751	7,751	7,751	7,751	7,490	7,490	7,490	7,490
N unique individuals	89,751	89,751	89,751	89,751	82,735	82,735	82,735	82,735
N person years	1,595,345	1,574,278	1,595,345	1,574,278	1,472,465	1,452,350	1,472,465	1,452,350

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure 6. All event study specifications include quarter-year and individual-duty station fixed effects. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE C.4—EVENT STUDY ESTIMATES FOR ALTERNATIVE SPECIFICATIONS

Event year	At most 5 managers				6-20 Managers			
	Individual FE: NFM	Individual FE: NM+NFM	No duty stations FE: NFM	No duty stations FE: NM+NFM	Individual FE: NFM	Individual FE: NM+NFM	No duty stations FE: NFM	No duty stations FE: NM+NFM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	-0.80 (0.54)	-1.03** (0.40)	-0.90 (0.66)	-1.32*** (0.49)	-2.01 (1.78)	-2.42* (1.28)	-2.77 (2.06)	-2.07 (1.46)
-3	-0.38 (0.40)	-0.82*** (0.31)	-0.75 (0.48)	-1.18*** (0.37)	-0.83 (1.16)	-2.10** (0.87)	-0.39 (1.37)	-0.83 (0.96)
-2	-0.51* (0.29)	-0.93*** (0.22)	-0.56** (0.28)	-0.82*** (0.22)	-1.04 (0.70)	-2.65*** (0.53)	-0.30 (0.68)	-0.90* (0.53)
0	-0.11 (0.20)	0.66*** (0.15)	0.22 (0.16)	-1.51*** (0.13)	-0.31 (0.35)	-0.27 (0.28)	0.17 (0.29)	1.93*** (0.22)
1	0.58** (0.23)	2.69*** (0.17)	0.53** (0.25)	3.47*** (0.20)	-0.32 (0.38)	2.20*** (0.29)	0.00 (0.43)	4.49*** (0.32)
2	1.19*** (0.26)	3.61*** (0.21)	0.98*** (0.33)	4.52*** (0.26)	-0.07 (0.45)	3.63*** (0.33)	0.35 (0.56)	6.23*** (0.42)
3	1.44*** (0.29)	3.81*** (0.23)	1.33*** (0.38)	4.69*** (0.30)	0.31 (0.49)	4.14*** (0.37)	0.90 (0.63)	6.86*** (0.48)
4	1.38*** (0.30)	2.90*** (0.24)	1.36*** (0.39)	3.71*** (0.32)	0.59 (0.50)	3.00*** (0.37)	1.30** (0.62)	5.57*** (0.49)
N duty stations	8,532	8,532	8,532	8,532	5,310	5,310	5,310	5,310
N unique individuals	82,596	82,596	82,596	82,596	102,721	102,721	102,721	102,721
N person years	1,750,461	1,750,461	1,750,461	1,750,461	2,191,958	2,191,958	2,191,958	2,191,958

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Panels A and B in Figure 7. All event study specifications include quarter-year fixed effects. The "individual FE" estimates replace individual-duty station FEs with individual effects that do not vary with duty station changes. "No duty stations FE" estimates exclude duty station FEs in the first stage, but contain individual-duty station FEs in the second stage. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE C.5—EVENT STUDY ESTIMATES FOR ALTERNATIVE SAMPLES

Event year	At most 5 managers				6-20 Managers			
	Full time only: NFM	Full time only: NM+NFM	No switching: NFM	No switching: NM+NFM	Full time only: NFM	Full time only: NM+NFM	No switching: NFM	No switching: NM+NFM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	-0.51 (0.59)	-0.77* (0.45)	-0.63 (0.91)	-1.00 (0.64)	-0.61 (1.84)	-0.72 (1.30)	-1.52 (2.48)	0.12 (2.00)
-3	-0.15 (0.42)	-0.44 (0.32)	-0.37 (0.61)	-0.96** (0.44)	0.72 (1.12)	0.07 (0.81)	-0.51 (1.52)	-0.11 (1.15)
-2	-0.17 (0.25)	-0.40** (0.20)	-0.18 (0.35)	-0.60** (0.26)	0.13 (0.61)	-0.60 (0.45)	-0.72 (0.75)	-1.08* (0.58)
0	0.43*** (0.15)	1.64*** (0.12)	0.48** (0.21)	1.82*** (0.16)	0.17 (0.28)	1.83*** (0.21)	0.17 (0.36)	2.08*** (0.28)
1	1.14*** (0.24)	3.76*** (0.19)	1.27*** (0.32)	4.42*** (0.25)	0.21 (0.42)	4.37*** (0.31)	0.27 (0.53)	5.33*** (0.40)
2	1.73*** (0.30)	4.73*** (0.24)	1.78*** (0.40)	5.58*** (0.32)	0.42 (0.53)	5.89*** (0.40)	0.87 (0.68)	7.40*** (0.52)
3	1.94*** (0.34)	4.94*** (0.28)	1.87*** (0.46)	5.72*** (0.36)	0.76 (0.59)	6.40*** (0.46)	1.46* (0.77)	8.13*** (0.60)
4	1.85*** (0.36)	4.00*** (0.29)	1.72*** (0.48)	4.47*** (0.38)	1.05* (0.60)	5.33*** (0.46)	1.63** (0.76)	6.46*** (0.60)
N duty stations	8,434	8,434	7,197	7,197	5,254	5,254	4,395	4,395
N unique individuals	80,982	80,982	60,731	60,731	100,809	100,809	78,701	78,701
N person years	1,679,687	1,679,687	1,026,348	1,026,348	2,111,105	2,111,105	1,453,045	1,453,045

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Panels C and D in Figure 7. All event study specifications include quarter-year and individual-duty station fixed effects. "Full time only" excludes the 8% of employees who have a part-time spell during their federal service. "No duty station switching" excludes the 25% of employees that switch duty stations at any point in the sample. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE C.6—EVENT STUDY ESTIMATES BY SOURCE AND TYPE OF MANAGERIAL CHANGE

Event year	External hires vs Internal promotions				Changes in management size			
	External hires		Internal promotions		Additions		Replacements	
	New female manager	New manager + New female manager	New female manager	New manager + New female manager	New female manager	New manager + New female manager	New female manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	1.65 (1.22)	0.08 (0.72)	-0.11 (1.43)	-0.26*** (1.01)	1.26 (1.04)	-0.04 (0.74)	-1.01 (3.00)	0.01 (1.04)
-3	0.93 (0.78)	-0.17 (0.52)	0.08 (1.04)	-0.55 (0.65)	0.85 (0.70)	0.20 (0.49)	-0.34 (1.75)	-0.35 (0.68)
-2	-0.33 (0.44)	-0.51 (0.32)	-0.45 (0.58)	-0.67* (0.39)	-0.04 (0.39)	-0.58** (0.29)	-1.24 (0.91)	-0.78* (0.40)
0	0.84*** (0.26)	1.33*** (0.18)	0.16 (0.32)	1.04*** (0.22)	0.49** (0.22)	1.37*** (0.17)	0.48 (0.56)	1.08*** (0.24)
1	1.40*** (0.42)	2.46*** (0.29)	0.07 (0.50)	2.19*** (0.34)	1.07*** (0.35)	2.84*** (0.27)	0.80 (0.91)	1.87*** (0.39)
2	2.02*** (0.55)	2.98*** (0.40)	0.29 (0.69)	2.74*** (0.47)	1.59*** (0.47)	3.52*** (0.36)	1.09 (1.21)	2.21*** (0.57)
3	2.99*** (0.66)	3.04*** (0.48)	0.01 (0.85)	2.38*** (0.61)	1.53*** (0.56)	3.17*** (0.42)	1.91 (1.52)	1.79** (0.73)
4	2.99*** (0.72)	2.28*** (0.54)	-0.13 (0.99)	1.50*** (0.71)	1.45** (0.60)	2.20*** (0.46)	1.74 (1.76)	0.52 (0.92)
N duty stations	7,488	7,488	7,002	7,002	7,711	7,711	7,028	7,028
N unique individuals	40,740	40,740	35,225	35,225	47,720	47,720	31,680	31,680
N person years	452,688	452,688	351,993	351,993	642,126	642,126	246,675	246,675

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TABLE C.6—CONTINUED

Event year	Increasing female managerial representation				New manager age difference			
	Increasing	Same or decreasing		New female manager	Younger by 10 years		Older by 10 years	
	New female manager	New manager + New female manager	New female manager		New manager + New female manager	New female manager	New manager + New female manager	New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	-0.45 (0.77)	-0.94 (0.59)	0.82 (0.99)	-0.44 (0.66)	0.62 (0.95)	-0.06 (0.66)	-0.37 (0.82)	-1.23** (0.55)
-3	0.00 (0.51)	-0.57 (0.40)	0.36 (0.64)	-0.38 (0.45)	0.33 (0.65)	-0.11 (0.45)	0.01 (0.54)	-0.97*** (0.37)
-2	-0.22 (0.30)	-0.52** (0.24)	-0.06 (0.37)	-0.51* (0.27)	-0.01 (0.38)	-0.39 (0.27)	-0.07 (0.32)	-0.74*** (0.23)
0	0.33* (0.18)	1.45*** (0.15)	0.21 (0.21)	1.18*** (0.16)	0.09 (0.22)	1.32*** (0.17)	0.33* (0.18)	1.40*** (0.14)
1	0.86*** (0.29)	3.17*** (0.24)	0.38 (0.33)	2.44*** (0.25)	0.53 (0.34)	2.95*** (0.25)	0.71** (0.30)	2.93*** (0.23)
2	1.57*** (0.37)	4.12*** (0.31)	0.68 (0.45)	2.89*** (0.35)	1.29*** (0.45)	3.84*** (0.34)	1.12*** (0.38)	3.72*** (0.30)
3	2.03*** (0.43)	4.36*** (0.36)	0.55 (0.54)	2.50*** (0.41)	1.34** (0.53)	3.63*** (0.40)	1.27*** (0.45)	3.71*** (0.35)
4	2.05*** (0.45)	3.57*** (0.37)	0.57 (0.59)	1.61*** (0.45)	1.23** (0.57)	2.64*** (0.42)	1.15** (0.48)	2.90*** (0.38)
N duty stations	8,265	8,265	8,066	8,066	7,818	7,818	8,188	8,188
N unique individuals	69,529	69,529	53,753	53,753	50,541	50,541	61,670	61,670
N person years	1,268,946	1,268,946	748,382	748,382	705,185	705,185	1,027,051	1,027,051

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Panels C and D in Figure 7. All event study specifications include quarter-year and individual-duty station fixed effects. "Full time only" excludes the 8% of employees who have a part-time spell during their federal service. "No duty station switching" excludes the 25% of employees that switch duty stations at any point in the sample. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

## APPENDIX D Tables and Figures – At most 20 Managers Sample

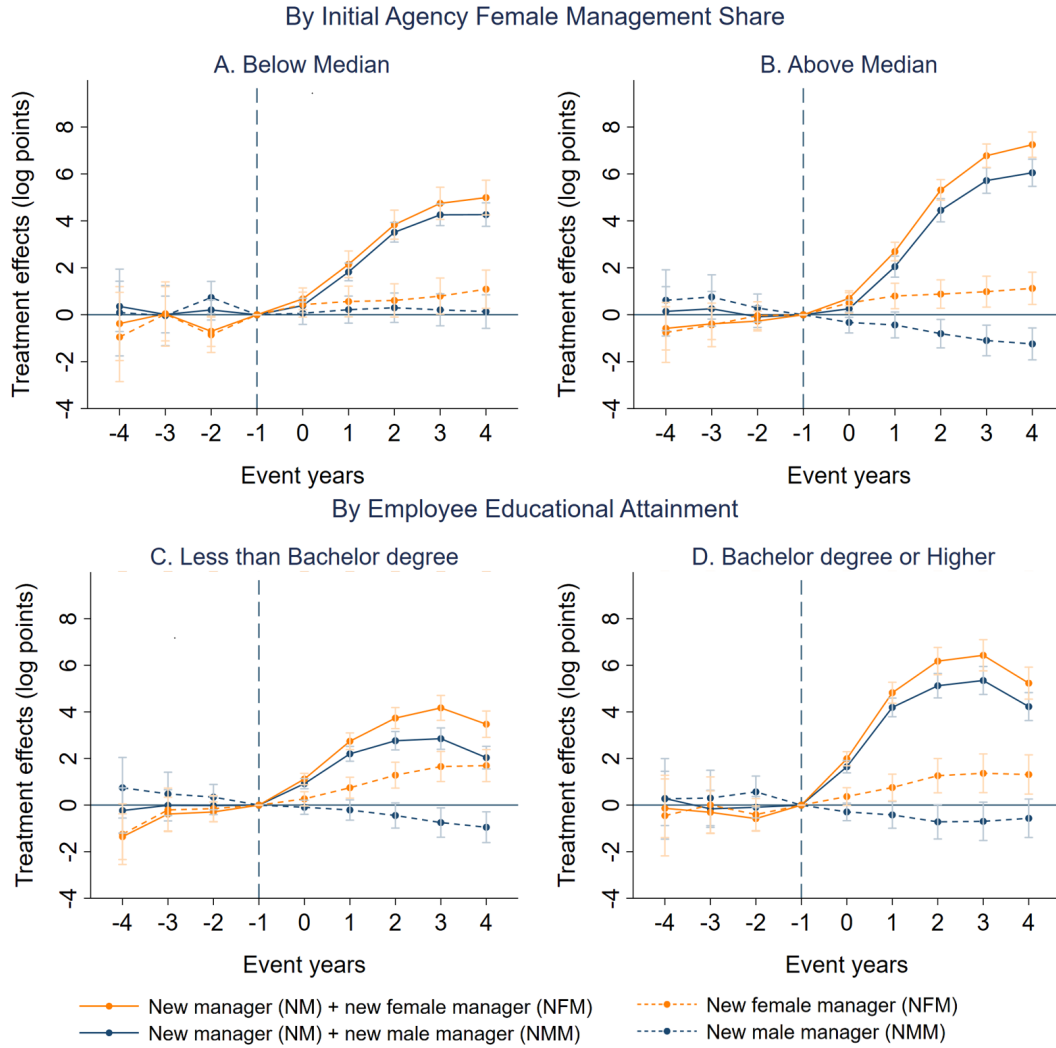


FIGURE D.1. HETEROGENEITY OF EVENT STUDY ESTIMATES (AT MOST 20 MANAGERS)

Note: Estimates and standard errors are reported in Tables D.1 and D.2 in Appendix D . In panels A and B, the initial female management share is calculated in the first three years of the agency's existence. To be included agencies must exist for at least 5 years. The median is 16%. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

TABLE D.1—HETEROGENEITY OF EVENT STUDY ESTIMATES BY INITIAL AGENCY FEMALE MANAGEMENT SHARE (AT MOST 20 MANAGERS)

Event year	Below median				Above median			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.09 (0.94)	-0.95 (0.97)	0.36 (0.55)	-0.38 (0.80)	0.62 (0.66)	-0.75 (0.65)	0.14 (0.54)	-0.58 (0.47)
-3	-0.03 (0.65)	0.03 (0.70)	0.01 (0.40)	0.04 (0.59)	0.76 (0.48)	-0.43 (0.47)	0.25 (0.38)	-0.39 (0.34)
-2	0.73** (0.35)	-0.85** (0.39)	0.20 (0.22)	-0.70** (0.33)	0.28 (0.31)	-0.04 (0.30)	-0.09 (0.23)	-0.27 (0.21)
0	0.06 (0.24)	0.43 (0.27)	0.39** (0.16)	0.68*** (0.24)	-0.33 (0.23)	0.50** (0.22)	0.26 (0.19)	0.70*** (0.16)
1	0.22 (0.29)	0.57* (0.33)	1.82*** (0.19)	2.15*** (0.29)	-0.43 (0.28)	0.80*** (0.28)	2.05*** (0.23)	2.69*** (0.20)
2	0.30 (0.32)	0.61* (0.36)	3.51*** (0.21)	3.84*** (0.32)	-0.81*** (0.31)	0.88*** (0.31)	4.45*** (0.25)	5.32*** (0.23)
3	0.21 (0.35)	0.80** (0.39)	4.26*** (0.24)	4.75*** (0.35)	-1.10*** (0.33)	0.98*** (0.34)	5.72*** (0.28)	6.78*** (0.25)
4	0.14 (0.36)	1.09*** (0.42)	4.27*** (0.25)	4.99*** (0.38)	-1.24*** (0.35)	1.12*** (0.35)	6.05*** (0.30)	7.25*** (0.28)
N duty stations	6,165	6,165	6,165	6,165	4,437	4,437	4,437	4,437
N unique individuals	70,090	70,090	70,090	70,090	55,598	55,598	55,598	55,598
N person years	2,044,169	2,044,169	2,044,169	2,044,169	1,560,043	1,560,043	1,560,043	1,560,043

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure D.1 in Appendix D. All event study specifications include quarter-year and individual-duty station fixed effects. The median initial female management share is 16%. The initial female management share of each agency is calculated based on the female management share at the agency level in the first three years of the agency's existence. Agencies must exist for at least 5 years to be included in the sample. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

TABLE D.2—HETEROGENEITY OF EVENT STUDY ESTIMATES BY EMPLOYEE EDUCATIONAL ATTAINMENT (AT MOST 20 MANAGERS)

Event year	Less than Bachelor's degree				Bachelor's degree or higher			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.75 (0.66)	-1.25* (0.66)	-0.23 (0.49)	-1.35*** (0.50)	0.27 (0.88)	-0.45 (0.88)	0.28 (0.59)	-0.14 (0.64)
-3	0.48 (0.48)	-0.20 (0.48)	-0.01 (0.34)	-0.38 (0.37)	0.30 (0.61)	0.01 (0.61)	-0.16 (0.41)	-0.31 (0.47)
-2	0.34 (0.28)	-0.15 (0.28)	-0.02 (0.20)	-0.29 (0.22)	0.57* (0.35)	-0.41 (0.35)	-0.09 (0.23)	-0.58** (0.28)
0	-0.09 (0.15)	0.27* (0.16)	0.92*** (0.11)	1.12*** (0.12)	-0.29 (0.19)	0.37* (0.19)	1.65*** (0.13)	1.99*** (0.15)
1	-0.21 (0.22)	0.75*** (0.23)	2.20*** (0.16)	2.74*** (0.18)	-0.42 (0.29)	0.76*** (0.29)	4.19*** (0.20)	4.82*** (0.23)
2	-0.45 (0.28)	1.29*** (0.28)	2.76*** (0.20)	3.73*** (0.23)	-0.72* (0.37)	1.26*** (0.38)	5.12*** (0.27)	6.18*** (0.30)
3	-0.75** (0.32)	1.66*** (0.33)	2.85*** (0.23)	4.17*** (0.27)	-0.70* (0.42)	1.37*** (0.42)	5.35*** (0.31)	6.43*** (0.34)
4	-0.95*** (0.34)	1.70*** (0.35)	2.04*** (0.25)	3.47*** (0.29)	-0.57 (0.42)	1.31*** (0.43)	4.23*** (0.31)	5.23*** (0.35)
N duty stations	9,334	9,334	9,334	9,334	8,780	8,780	8,780	8,780
N unique individuals	68,263	68,263	68,263	68,263	76,802	76,802	76,802	76,802
N person years	1,976,123	1,971,937	1,976,123	1,971,937	2,094,060	2,089,883	2,094,060	2,089,883

Note: \* p<0.10 \*\* p<0.05 \*\*\* p<0.01. Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure D.1 in Appendix D. All event study specifications include quarter-year and individual-duty station fixed effects. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.

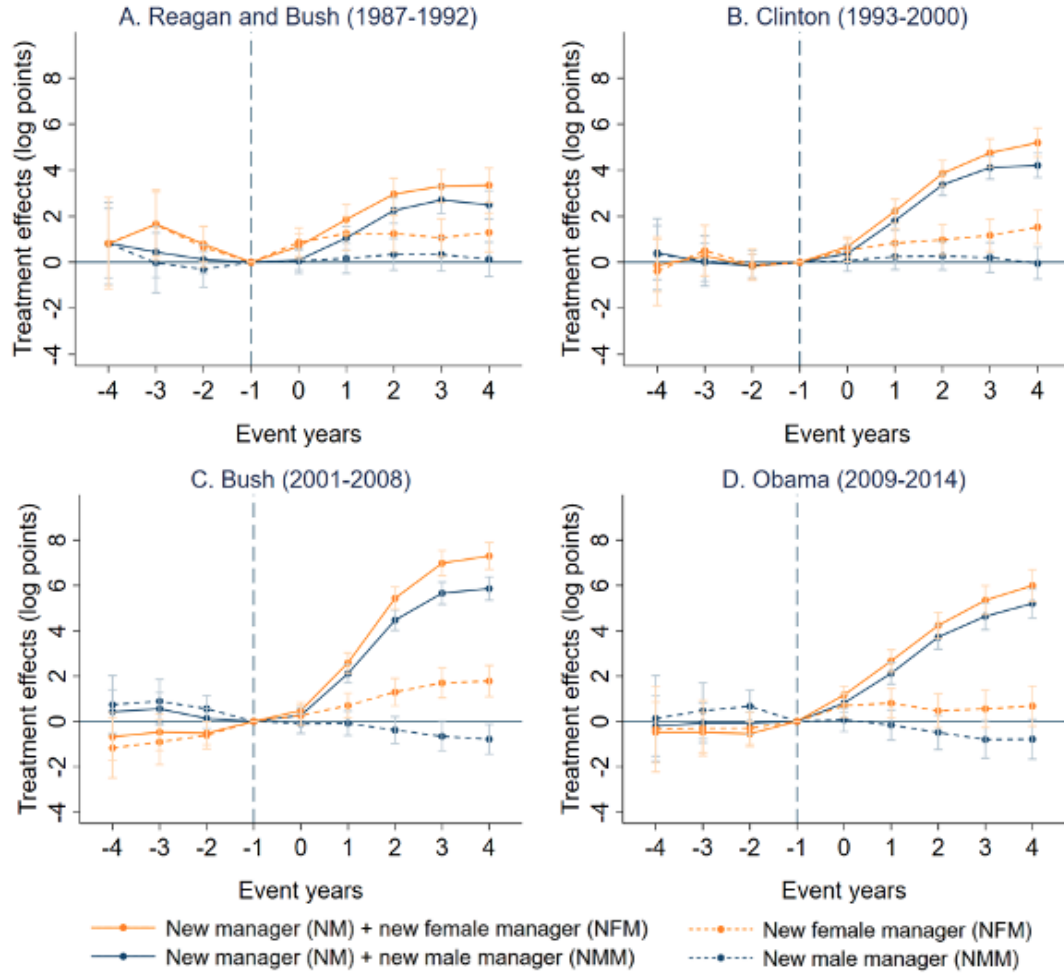


FIGURE D.2. EVENT STUDY ESTIMATES BY PRESIDENTIAL ERA (AT MOST 20 MANAGERS)

Note: Estimates and standard errors are reported in Table D.3 in Appendix D. Treatments effects are defined as in Figure 4. Vertical bars represent 95% confidence intervals with standard errors clustered by duty station.

TABLE D.3—EVENT STUDY ESTIMATES BY PRESIDENTIAL ERA (AT MOST 20 MANAGERS)

Event year	Reagan and Bush (1987-1992)				Clinton (1993-2000)			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.82 (0.91)	0.83 (1.01)	0.83 (0.77)	0.80 (0.92)	0.35 (0.79)	-0.39 (0.76)	0.42 (0.60)	-0.14 (0.59)
-3	-0.02 (0.67)	1.62** (0.79)	0.44 (0.56)	1.66** (0.71)	0.06 (0.56)	0.51 (0.56)	0.00 (0.42)	0.28 (0.45)
-2	-0.31 (0.39)	0.66 (0.45)	0.12 (0.12)	0.79** (0.40)	-0.13 (0.33)	-0.11 (0.35)	-0.16 (0.25)	-0.18 (0.28)
0	0.06 (0.28)	0.86*** (0.32)	0.09 (0.22)	0.70** (0.28)	0.07 (0.24)	0.52** (0.25)	0.38** (0.18)	0.67*** (0.22)
1	0.16 (0.33)	1.25*** (0.38)	1.05*** (0.26)	1.86*** (0.33)	0.25 (0.29)	0.83*** (0.31)	1.80*** (0.22)	2.22*** (0.27)
2	0.34 (0.35)	1.24*** (0.40)	2.24*** (0.28)	2.96*** (0.35)	0.27 (0.31)	0.98*** (0.34)	3.37*** (0.24)	3.86*** (0.29)
3	0.33 (0.37)	1.07** (0.42)	2.71*** (0.30)	3.31*** (0.37)	0.20 (0.33)	1.17*** (0.36)	4.11*** (0.25)	4.75*** (0.31)
4	0.13 (0.38)	1.29*** (0.43)	2.50*** (0.31)	3.35*** (0.38)	-0.05 (0.35)	1.53*** (0.37)	4.21*** (0.27)	5.20*** (0.32)
N duty stations	8,867	8,867	8,867	8,867	9,233	9,233	9,233	9,233
N unique individuals	78,027	78,027	78,027	78,027	116,605	116,605	116,605	116,605
N person years	1,727,467	1,725,767	1,727,467	1,725,767	2,618,162	2,612,973	2,618,162	2,612,973

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TABLE D.3—CONTINUED

Event year	Bush (2001-2008)				Obama (2009-2014)			
	New male manager	New female manager	New manager + New male manager	New manager + New female manager	New male manager	New female manager	New manager + New male manager	New manager + New female manager
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
-4	0.74 (0.66)	-1.18* (0.68)	0.43 (0.49)	-0.68 (0.53)	0.13 (0.97)	-0.35 (0.96)	-0.21 (0.68)	-0.48 (0.68)
-3	0.89* (0.49)	-0.91* (0.51)	0.55 (0.37)	-0.47 (0.41)	0.47 (0.63)	-0.30 (0.62)	-0.07 (0.44)	-0.48 (0.46)
-2	0.56* (0.30)	-0.61** (0.31)	0.13 (0.22)	-0.52** (0.26)	0.67* (0.36)	-0.30 (0.37)	-0.08 (0.24)	-0.55* (0.29)
0	-0.10 (0.22)	0.27 (0.23)	0.26 (0.17)	0.48** (0.19)	0.07 -0.27	0.69*** (0.26)	0.81*** (0.20)	1.17*** (0.20)
1	-0.09 (0.27)	0.70** (0.28)	2.11*** (0.21)	2.58*** (0.23)	-0.16 (0.34)	0.80** (0.33)	2.12*** (0.24)	2.66*** (0.25)
2	-0.39 (0.30)	1.29*** (0.31)	4.47*** (0.23)	5.43*** (0.25)	-0.49 (0.38)	0.47 (0.38)	3.72*** (0.28)	4.24*** (0.29)
3	-0.66** (0.32)	1.70*** (0.34)	5.66*** (0.25)	6.98*** (0.28)	-0.80* (0.42)	0.55 (0.42)	4.63*** (0.30)	5.34*** (0.33)
4	-0.79** (0.34)	1.78*** (0.35)	5.86*** (0.26)	7.30*** (0.30)	-0.79* (0.45)	0.67 (0.45)	5.20*** (0.32)	5.99*** (0.36)
N duty stations	9,633	9,633	9,633	9,633	9,458	9,458	9,458	9,458
N unique individuals	156,361	156,361	156,361	156,361	138,423	138,423	138,423	138,423
N person years	2,648,321	2,644,342	2,648,321	2,644,342	2,096,957	2,095,687	2,096,957	2,095,687

Note: \*  $p < 0.10$  \*\*  $p < 0.05$  \*\*\*  $p < 0.01$ . Standard errors clustered by duty station are in parentheses. Yearly treatment effects are reported in log points. Estimates in this Table are graphed in Figure D.2 in Appendix D. All event study specifications include quarter-year and individual-duty station fixed effects. The dependent variable is the residual log pay gap after controlling for locations (52 categories), five-year birth cohorts (7 categories, 1965 is the omitted category), education (3 categories), tenure (3 categories), and occupation dummies (18 categories), part-time status, and share of total female federal workers at duty station (employees and managers) in yearly regressions. See footnote 26 and equation 1 for details.