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# The impact of an employer match and automatic enrollment on the savings behavior of public-sector workers

Justin Falk and Nadia S. Karamcheva\*

Congressional Budget Office, 2nd and D St SW, Washington, DC 20515, USA

\*Corresponding author. Email: [nadia.karamcheva@cbo.gov](mailto:nadia.karamcheva@cbo.gov)

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## Abstract

We use administrative data on federal civilian workers' accounts in their employer-provided defined contribution plan, called the thrift savings plan (TSP), to provide new evidence on the effects of employer matching and defaults on workers' savings behavior. The empirical analysis relies on exogenous variation stemming from two natural experiments caused by policy changes to the TSP: the establishment of an employer match for workers hired after 1983 and the introduction of automatic enrollment for workers hired after July 2010. We find that the introduction of the employer match led to a higher increase in both participation and contribution rates compared to the subsequent switch to automatic enrollment. In terms of portfolio allocations, we find that matching and automatic enrollment had small and minimal effects, respectively.

**Key words:** 401(k); automatic enrollment; defaults; defined contribution plans; employer match; retirement saving; thrift savings plan

**JEL codes:** E21; E27; G41; J26; J32

As traditional pension plans in the USA continue to be replaced by defined contribution (DC) plans that now have taken a dominant role in retirement savings outside of Social Security, understanding how features of DC plans affect workers' savings decisions will be crucial for assessing those plans' capacity to generate sufficient retirement income. Moreover, since the 2007–2009 recession, there has been a renewed interest in DC plans in the public sector. As more state and local governments are opting to shift more of their employees' retirement compensation toward DC-type accounts, and as policy makers discuss changes to the retirement system of federal workers, information about the effect of various plan features on the savings outcomes of public sector workers will be increasingly important.<sup>1</sup>

Plan design features in DC plans such as employer matching and automatic enrollment, separately or in combination, have been established as ways for firms to encourage workers to participate and contribute more to their accounts (see, e.g., Choi *et al.*, 2002; Choi, 2015). Under employer matching, for each dollar voluntarily contributed by the worker, the employer contributes to the employee's account a matching amount up to a certain threshold (a typical employer match would be 50% of the employee contribution up to 6% of compensation).<sup>2</sup> Unlike employer matching, which has

<sup>1</sup>See Munnell *et al.* (2014) and Beshears *et al.* (2011) for overviews of the public sector pension landscape.

<sup>2</sup>According to Vanguard (2021), a major record keeper of DC plans, 50% of the employer-sponsored DC plans in their database offered only matching contributions in 2020, 10% provided only non-contingent contributions, and 36% provided

been a common feature of DC plans since their creation, the adoption of default features, such as automatic enrollment, was relatively rare before the passage of the Pension Protection Act (PPA) of 2006 but has grown dramatically since.<sup>3,4</sup> In contrast to the standard opt-in mechanism in which employees must actively elect to participate and decide how much to contribute and how to invest, under automatic enrollment (also referred to as an opt-out regime) a predetermined percentage of employee's pay starts being deferred and contributed to an account with a default investment allocation as soon as the employee becomes eligible, and unless the employee makes an active choice that differs from the defaults.

Although the effects of both employer matching and automatic enrollment have been extensively studied, the conclusions vary considerably across studies in terms of the magnitude of the effects, and often depend on the population analyzed.<sup>5</sup> Moreover, the most recent literature has almost exclusively focused on emphasizing the powerful effects on participation that automatic features in DC plans can achieve, mostly attributed to workers' high level of inertia. Some authors have even argued that the effect of the default is so powerful that firms might not need to offer standard economic incentives, such as employer matching, in order to achieve high participation rates (Beshears *et al.*, 2010). Most studies find that defaulting workers at a positive deferral rate has large effects on participation among affected employees shortly after implementation, and mitigated effects over time. Estimates typically fall in the range of 20–40 percentage points increase in participation a few years after implementation (Madrian and Shea, 2001; Choi *et al.*, 2002, 2004; Nessmith *et al.*, 2007; Beshears *et al.*, 2010; VanDerhei, 2010; Clark and Young, 2018). At the upper end of estimates, some authors report effects of more than 80 percentage points increase in participation, even in the absence of a match, when the deferral rate is very low (Clark and Pelletier, 2019). At the lower end of the estimates, authors have reported single digit percentage point increase in overall participation, when using nationally representative data (Butrica and Karamcheva, 2015).<sup>6</sup>

The literature on the effect of the employer match is somewhat less recent. Theoretically, the presence of an employer match should induce more participation and employee contributions as the price of saving drops. The level of the match, however, can have an ambiguous effect on contribution rates as substitution and income effects work in opposite directions. Uniformly, the literature finds positive effects on participation but typically small effects on contribution rates (Andrews, 1992; Papke and Poterba, 1995; Bassett *et al.*, 1998; Clark and Schieber, 1998; Kusko *et al.*, 1998; Munnell *et al.*, 2001/2002; Duflo *et al.*, 2006; Engelhardt and Kumar, 2007). With few exceptions such as Dworak-Fisher (2011), Huberman *et al.* (2007), and Even and Macpherson (2005), the reported effects have been typically lower than what is found in the literature examining the effect of defaults. However, the magnitudes of the estimated effects are difficult to compare across studies as the empirical measures of match generosity vary across papers. Papers that report estimates of the effect on participation attributed to the presence of a match, find varied results – increases in participation range from 6 percentage points (Huberman *et al.*, 2007), 7 percentage points (Choi *et al.*, 2002), 9 percentage

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both matching and additional non-contingent contributions. The most common formula adopted by 72% of the plans that offered matching contributions, was \$0.50 on the dollar on the first 6% of the employee's pay contributed.

<sup>3</sup>Some authors have suggested that the increased popularity of the automatic enrollment feature after 2006 can be attributed to the PPA legislation as it removed several of the legal barriers that firms faced before then in terms of automatically deferring workers' pay (see, e.g., Engelhardt, 2011).

<sup>4</sup>According to client data from Vanguard, which captures mostly large DC plans, 54% of plans had adopted automatic enrollment as of 2020 compared with only 5% in 2005 (see Vanguard, 2021). Notwithstanding, Vanguard also reports a considerable variation in the type of plans that contain an autoenrollment feature and notes that although most plans initially applied automatic enrollment only to new hires, increasingly the feature has been applied to other eligible non-participants as well.

<sup>5</sup>See also Choi (2015) for an overview of the literature of employee contributions to DC plans.

<sup>6</sup>Estimates in Butrica and Karamcheva (2015) reflect differences in overall participation between firms that report automatic enrollment as a feature of their plan and those that do not. As such, the measure of overall participation potentially includes workers not affected by the policy if the policy affects only recent hires. Similarly, using nationally representative household survey data on older adults, Butrica and Karamcheva (2019) find that automatic enrollment is associated with an 8 percentage points increase in the probability of being included in a DC plan.

points (Basset *et al.*, 1998), 21 percentage points (Karamcheva and Sanzenbacher, 2014), and 33 percentage points (Even and Macpherson, 2005). Moreover, previous research has highlighted that unaccounted correlation between the employer match rates and workers' savings preference might be biasing downward estimates of the employer match in cross-sectional studies. Indeed, the papers that find largest effects are the ones that correct for the endogeneity of matching.<sup>7</sup>

This study provides new evidence on the effect of the employer match and defaults on workers' savings behavior. We are the first to use rich administrative data to estimate those effects for federal employees.<sup>8</sup> The individual-level data on participation, contributions, balance accumulations, and portfolio allocations in the thrift savings plan (TSP) cover the population of federal civilian workers between the years of 2008 and 2014. Our estimation approach uses plausibly exogenous variation stemming from two policy changes to the TSP. Those are the establishment of an employer match for workers hired after 1983 and the introduction of automatic enrollment for workers hired after July 2010. In these quasi-experiments, the savings behavior of employees hired shortly before a policy change serves as a control for the savings behavior of those hired shortly after the change.

Our empirical approach comes with advantages but also with some limitations. The quasi-experimental design allows us to avoid some of the confounding issues encountered in previous research when identifying the effects of these DC provisions. In addition, our analysis is based on administrative longitudinal data which is less prone to measurement error than self-reported survey data. Moreover, the data provide information on a set of demographic characteristics often not available in prior research based on firm- or plan-level data. That information allows us to examine the heterogeneity in workers' responses. However, due to data availability, we are only able to observe long-term asymptotic effects of the employer match and relatively short-term (within 5 years of tenure) effects of automatic enrollment.

In both of our analyses – that of matching and defaults – because our sample covers most of the federal civilian population, the results can be easily extrapolated to the federal workforce, and likely to the sample of state and local workers, to the extent that those workers are more similar to federal employees than private sector workers. In fact, on average, federal workers are indeed more similar in demographic characteristics to workers in state and local governments than to workers in the private sector (see Table A1 in the [Appendix](#)). However, the federal workforce is substantially more educated and older than the private-sector workforce, and we find that more educated and older federal workers tend to respond less to the match and automatic enrollment than their younger, less-educated colleagues.

Another limitation of our method, imposed by the data, is that we can only analyze the effect of matching and defaults on workers who also have a mandatory defined benefit (DB) plan. Workers in our treatment and control groups have mandatory DB coverage through their federal employment. According to some estimates, outside of their DC plans, long-career federal civilian workers can expect to receive retirement income that replaces between 60% and 80% of their pre-retirement earnings, on average.<sup>9</sup> If such workers are also less likely to respond to incentives created by the match, then our estimates are likely understated.<sup>10</sup> On the other hand, our estimates speak for the effect of automatic

<sup>7</sup>For instance, the endogeneity of the employer match could result from a sorting mechanism where companies that offer a generous match are the ones that attract workers who are more prone to save. However, Dworak-Fisher (2011) argues that instead a different mechanism dominates – that of negative selection on match rates where employers of individuals who are less likely to save might be the ones offering higher match rates to remedy their workers' low saving behavior. That negative selection leads to cross-sectional estimates of the employer match being downward biased. Those findings are also supported by Even and Macpherson (2005).

<sup>8</sup>Goda *et al.* (2018) have used data drawn from some of the same administrative sources to examine how changes in the default allocation affect employees' contribution rates, and Beshears *et al.* (2022) use similar data to estimate the effects of the introduction of automatic enrollment in TSP on civilian employees of the army.

<sup>9</sup>For a comparison of deferred compensation between federal and private sector workers, see also Falk (2012).

<sup>10</sup>The literature has found some evidence that workers covered by a DB plan are less likely to participate in a 401(k) plan (Andrews, 1992).

enrollment in the presence of a DB plan. With a few exceptions (Goda *et al.*, 2018; Clark and Pelletier, 2019), most studies have focused on the effect of automatic enrollment in the private sector where workers do not have access to a DB plan. Finally, another limitation imposed by the TSP policy changes is that we can analyze the effect of automatic enrollment only in the presence of an employer match – not in isolation.<sup>11</sup>

Our results show that the introduction of the employer match increased employee participation in TSP by 22 percentage points (or 32%) at 27 years of tenure, whereas the introduction of automatic enrollment raised participation by 13 percentage points (or 14%) at 5 years of tenure. On average, the presence of an employer match is associated with a 3.5 percentage points increase in employee contribution rates, whereas automatic enrollment is associated with a 0.6 percentage points increase.

We find that the two policy changes had heterogeneous effects. Both matching and automatic enrollment increased participation and contribution rates the most for workers least likely to participate in their absence – those who have low earnings and less education. As a result, both provisions tended to equalize participation and contribution rates across levels of income, and levels of education. These findings might be particularly relevant to employers who are concerned about not meeting the non-discrimination tests in their 401(k) plans. Low participation and contribution rates among lower-paid employees can jeopardize a company's performance on non-discrimination tests – that is, rules forbidding employers from providing benefits exclusively to highly paid employees. Our findings show that by increasing participation and contribution rates among lower-paid employees, both employer matching and automatic enrollment can make it easier for employers to abide by such non-discrimination rules.<sup>12</sup>

Although matching has an equalizing effect on participation and contributions, it is also associated with a 7 percentage points increase in the share of workers' portfolios invested in bonds.<sup>13</sup> That increase in the bonds share was concentrated among workers in those groups that otherwise would have been less likely to contribute, and as a result offset some of the positive effects that higher contribution rates had on their balance accumulation. Because automatic enrollment did not significantly change portfolio allocations, that offsetting effect did not occur.<sup>14</sup> As a result, we find that the overall effect of automatic enrollment on workers' balance-to-pay ratios was equalizing whereas that of matching was not.

The next section provides institutional background on TSP and the policy changes. We then describe the data and method. After that, we present empirical results on the effects on savings behavior of the employer match and automatic enrollment in two subsequent sections. The final section concludes.

<sup>11</sup>The degree to which the default's effect on participation and contributions depends on the presence of the match remains an open question. Previous research that examined the effects of automatic enrollment and the employer match on participation and contribution rates in individual companies has faced similar constraints to ours because most plans that implement automatic enrollment already offer an employer match. Clark and Pelletier (2019) is one exception. The authors examined the effect of automatic enrollment at 1% of salary in a supplemental retirement savings plan without an employer match for a sample of state and local government employees in South Dakota who also have a mandatory DB plan. The authors found increases in participation that are significantly higher than earlier results reported in the literature. However, the deferral rate was set at 1% of pay which is also lower than the typical deferral rate of plans with automatic enrollment. In contrast, Agnew *et al.* (2012) report that in automatic enrollment settings workers' knowledge of an available employer match increases participation suggesting that the match still matters even under automatic enrollment.

<sup>12</sup>To more easily satisfy the non-discrimination requirements, employers also have the option to pick a safe harbor plan design. Recent legislation, such as the PPA and the Secure Act of 2020, have also created incentives for employers to adopt automatic enrollment features in their 401(k) plans to more easily satisfy the non-discrimination requirements.

<sup>13</sup>Although we are not able to quantify it, we suspect that a part of the 7 percentage point difference is attributable to the fact that by default workers in the match cohort have their 1% employer non-contingent contribution invested in bonds, specifically in the G fund, which is the default allocation. Workers in the match cohort are 2 percentage points more likely to be fully invested in the G fund.

<sup>14</sup>What our results show is that the effect of automatic enrollment on portfolio allocations is negligible when workers' contributions are defaulted in the fund which is also the default investment fund for the employer non-contingent contribution. The results could have been different if the default investment fund for the two types of contributions was not the same.

### 1. The thrift savings plan

The TSP is the employer-sponsored DC plan available to federal workers. TSP is similar to 401(k) accounts in the private sector. Workers can make regular contributions to their accounts out of their paychecks and the account balance grows over time with contributions and investment returns. Participants can make contributions up to the annual limits set by the Internal Revenue Service.<sup>15</sup> Similar to other 401(k) plans, participants can withdraw the money penalty-free once they reach age 59.5 but generally face a 10% penalty of withdrawing funds before they reach that age, in addition to any resulting tax liabilities.<sup>16</sup>

TSP was introduced in 1986 as part of a new retirement system for federal employees – the Federal Employee’s Retirement System (FERS). Federal employees had been covered by the Civil Service Retirement System (CSRS), which consists of only a defined benefit plan and excluded participants from Social Security. Changes to that retirement system were necessitated by the Social Security Amendments of 1983, which limited exemptions from Social Security for government employees in order to increase the amount of revenue entering the trust fund. In June 1985, the legislation that became the FERS Act of 1986 was introduced in Congress, it was signed into law in June 1986, and became effective on January 1, 1987. It specified that FERS consists of Social Security and two other components – a DB plan (although with a reduced generosity compared to CSRS) and a DC plan (TSP) – and that employees hired in and after 1984 would be in that system. Workers hired before 1984 could remain in CSRS.<sup>17</sup>

Although workers in both systems are allowed to contribute to TSP, only employees in FERS receive employer contributions. CSRS employees can contribute to TSP but do not receive employer contributions. Employers of FERS employees make an automatic non-contingent contribution of 1% of salary and provide a maximum 4% employer match that has the following schedule: the first 3% of pay that an employee contributes is matched dollar for dollar; the next 2% is matched at 50 cents on the dollar; and contributions above 5% of pay are not matched. FERS participants also vest immediately in their own and any matching contributions but typically have to stay with their employer for three years before they vest in the non-contingent employer contributions and the associated returns in their accounts.<sup>18</sup>

TSP participants can choose between two tax treatments of their TSP contributions – traditional and Roth. However, in the empirical analysis we do not distinguish between the two and instead model total employee contributions for two reasons. One, employer matching contributions are based on the total amount of money (traditional and Roth) that an employee contributes. Two, TSP only began accepting Roth contributions halfway through 2012, or toward the end of the sample period in our data, thus mitigating potential effects on workers’ savings behavior.<sup>19</sup>

<sup>15</sup>For example, in 2021 the limit on employee elective contributions is \$19,500. And the limit on total employee and employer contributions is \$58,000. In addition, workers above the age of 50 are allowed to make additional catch-up contributions up to \$6,500.

<sup>16</sup>Loans and hardship withdrawals while in service are allowed, similarly to private-sector 401(k) plans. In addition, workers are exempt from early withdrawal fees if they separate from federal service in the year in which they reach age 55 or later (50 or later for some special categories of employees).

<sup>17</sup>Another small category of workers fall under the CSRS Offset plan. Typically, that system applies to employees who had a break in service that exceeded 1 year and ended after 1983 and had 5 years of creditable civilian service as of January 1, 1987. CSRS Offset employees are covered by both CSRS and Social Security, with their CSRS retirement benefit reduced, or offset, by the value of the Social Security benefit they earned while working for the government. As with CSRS employees, CSRS Offset employees are allowed to participate in TSP but are not eligible for automatic or matching employer contributions.

<sup>18</sup>Some exceptions exist such as employees serving in certain positions, including some senior executive-level positions, Members of Congress, and Congressional employees, who vest with 2 years of service.

<sup>19</sup>In 2014, only 4% of total employee contributions in our data were Roth contributions. Under traditional tax treatment, the worker defers paying income taxes on contributions and the returns earned on them until he or she withdraws the money in retirement. Under Roth treatment, the worker pays federal income taxes on contributions as he or she makes them but

When designing their investment portfolio, TSP participants can choose from five core funds and several target-date funds. The five core funds are the Government Securities Investment (G) fund, the Fixed Income Index Investment (F) fund, the Common Stock Index Investment (C) fund, the Small Cap Stock Index Investment (S) fund, and the International Stock Index Investment (I) fund. The target-date funds, also known as ‘lifecycle’ funds or L funds, use a mix of the five core funds tailored to balance return and risk to best suit various time horizons.

Similar to other 401(k) plans, TSP was initially established with an opt-in mechanism for enrollment. Workers needed to make a contribution election if they wanted to have a percent of their pay contributed to their accounts. Workers in FERS would automatically have an account established in which they received the 1% automatic non-contingent contribution from their employer, but they still had to make an active decision if they wanted to make contributions out of their pay and receive employer matching contributions.

In 2010, the opt-in mechanism was changed to an opt-out mechanism for new hires. As of August 2010, new employees are automatically enrolled in TSP by having 3% of their pay automatically deducted and placed in their TSP accounts unless they make their own TSP contribution elections. Workers can elect to increase, decrease, or stop their contributions to their TSP account at any time. Until September 2015, those automatic contributions were also automatically invested in the G fund – TSP’s risk-free, most conservative investment option. The G fund was also the default investment fund for the employer 1% non-contingent contribution.<sup>20</sup> After the passage of the Smart Savings Act (P.L. 113-255) in 2015, the default investment fund became the age-appropriate lifecycle fund.<sup>21</sup>

## 2. Data and empirical method

In the analysis we use administrative panel data on federal civilian workers for the years 2008 through 2014.<sup>22</sup> The data contain information on workers’ demographics, salaries, and TSP outcomes.<sup>23</sup> The TSP information includes the dollar amounts that each individual contributed during the year, account balances, asset allocations, worker default contribution rates, match eligibility, and other TSP activities. We restrict the analysis to workers who receive standard retirement benefits, whose earnings and TSP activity data are complete and consistent, and whose reported contribution rate is less than 30% of their salary.<sup>24</sup>

To assess the average effect of the employer match and the effect of automatic enrollment in the presence of the match on TSP participation and contributions, we rely on a quasi-experimental approach centered on the two major policy changes in TSP. Those are the introduction of the match for workers in FERS but not in CSRS and the introduction of automatic enrollment for workers

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does not pay taxes on contributions or returns at withdrawal. Both the traditional and Roth TSPs offer the worker the benefit of tax-free compounding until the account balances are withdrawn.

<sup>20</sup>The interest rate on the G fund resets monthly and is based on the weighted average yield of all outstanding Treasury notes and bonds with four or more years to maturity.

<sup>21</sup>Because our data end in 2014, we cannot observe the effect of changes in the default investment plan on TSP allocations. A recent report (Federal Thrift Retirement Investment Board, 2018) based on data through 2017 suggests that changing the default allocation in 2015 has affected portfolio allocations. According to the report, the share of assets that TSP participants age 29 and under held in the G fund declined from 41.7% in 2014 to 29.5% in 2017. According to Goda *et al.* (2018), changes in the default investment plan also might have had spillover effects on employees’ contribution rates.

<sup>22</sup>The Office of Personnel Management created those data by merging data on workers’ characteristics from the Enterprise Human Resources Integration Data Warehouse Statistical Data Mart with data on their TSP activity from the Federal Thrift Retirement Investment Board, which administers the TSP.

<sup>23</sup>The data show that most of the federal workforce is spread across professional and administrative positions that require various levels of education and experience. See Falk (2012) for a description of the federal workforce in more detail.

<sup>24</sup>For example, workers in certain occupations – mostly law enforcement – receive augmented retirement benefits, and workers in part-time positions receive reduced benefits. For about 5% of the workers, we couldn’t ascertain their earnings data or had contradictory information regarding their default rate. We excluded those observations. To mitigate the effect of outliers, we also dropped workers who appear to contribute more than 30% of their salary to TSP – that group represents the top 0.5% of employee contribution rates.



hired after August 2010. We estimate the average effects of those two changes by comparing the behavior of adjacent cohorts of federal workers (i.e., workers hired close in time to each other on either side of the time cutoff of the policy change) at equivalent levels of job tenure.<sup>25</sup> By comparing the outcomes at a given point in time for similar cohorts of workers but subject to different policies, our research design facilitates a causal interpretation of our estimates.

In the specifications that estimate the effect of employer matching, treated individuals are those hired in 1984 under FERS and individuals in the control group are those hired in 1983 under CSRS. We refer to those groups as the match cohort and no-match cohort, respectively. We observe contributions and portfolio allocations of those individuals in the treatment and control groups annually from 2008 to 2014. Because FERS went into effect in 1987 but applied retroactively to workers hired after 1983, the design of the reform mitigates the risk of workers self-selecting into the system based on unobservable characteristics, potentially related to their savings preferences.<sup>26</sup>

In the specifications that estimate the effect of automatic enrollment, treated individuals are those hired between August 2010 and July 2011, a year or less after automatic enrollment was instituted for new hires; individuals in the control group were those hired a year or less before automatic enrollment was instituted, between August 2009 and July 2010.<sup>27</sup> Because our data go to the end of 2014, we have information on individuals in the treatment group for 5 consecutive calendar years, and we compare their outcomes with those of workers in the control group who have the same amount of job tenure. Because our TSP data are on a calendar year basis (measured at the end of the year) but cohorts of hires are based on the policy's implementation at the beginning of August, workers in the control and treatment groups have accumulated between 0 and 4 months of tenure when we first observe their TSP contributions, which is at the end of 2009 and 2010, respectively. For the same reason, they have 5 and 16 months of tenure at the second observation, respectively, and so forth.<sup>28</sup>

Our empirical specifications take the following general form:

$$y_{it} = \alpha + \beta T_i + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

where  $y_{it}$  is the outcome of interest,  $T_i$  is the dummy variable that indicates whether an individual belongs to a treated cohort, and  $X_{it}$  is a vector of observable worker characteristics. Our identifying assumption is that conditional on observable characteristics, the treatment variable is uncorrelated with the error term. In other words, we assume that no unobservable differences are present between the treatment and control groups in our sample that might be correlated with their TSP savings behavior.

Saving for retirement is a complex and consequential task and TSP, similar to other DC plans, places a lot of responsibility in the hands of workers. Participation, contribution, and investment decisions along the way can have a considerable impact on balance accumulation over time and on workers' ability to ensure that they have adequate income in retirement. The data provide us with a unique opportunity to explore the effect of matching and defaults not only on participation and contribution rates but also on workers' portfolio allocations and balance accumulation. Thus, our analysis adds to a wide body of literature on the effect of financial incentives and default arrangements on workers'

<sup>25</sup>This approach is in keeping with the previous literature on the effect of changes in the default deferral rate or employer matching in 401(k) plans on various outcomes (see, e.g., Beshears *et al.*, 2010, 2022).

<sup>26</sup>All federal workers had the option to convert from CSRS to FERS when FERS was first created in 1987. Relatedly, workers re-hired after 1983 with sufficient prior federal service to be eligible for an annuity could choose to remain in CSRS. We exclude both types of workers – those re-hired after 1983 and those who voluntarily switched from CSRS to FERS. A robustness analysis shows that results are largely invariable to their inclusion. See the Robustness section for a discussion.

<sup>27</sup>Employees who do not choose an amount to contribute are automatically enrolled in the plan with a 3% contribution rate allocated entirely to the G fund. Individuals in the treatment and control groups are both covered under FERS with the same matching structure.

<sup>28</sup>In most specifications, we do not restrict the analysis to new hires, which allows individuals with prior federal service to be included in the sample.

savings and investment decisions.<sup>29</sup> The portfolio allocation information also allows us to explore the interplay between two default domains – that of the default contribution rate and that of the default fund.

In our empirical specifications, we mostly use the linear probability model to analyze several aspects of savings behavior.<sup>30</sup> The first one is the extent to which employees participate in TSP, where participation is defined as making positive employee contributions. A second aspect is the level of employee contribution rates to TSP. A third aspect is the investment portfolio that workers choose. In particular, we estimate the share of workers' portfolios allocated to the six available funds, jointly; the overall share of bonds; and the probability of being fully invested in the G fund.<sup>31</sup> And finally, we consider the effect on workers' balance accumulations, measured as the ratio of their TSP balance to their annual pay, or balance-to-pay ratio. That last measure expresses workers' TSP balance relative to their annual salary and eases the comparison across different types of workers, such as workers in different parts of the earnings distribution.

### 3. Results: effect of an employer match

#### 3.1 Descriptive statistics

Differences in TSP behavior between the cohorts appear to be driven by the effect of the employer match since the cohorts are very similar in most other observable characteristics that might be correlated with their savings behavior (see Table 1).<sup>32</sup> Workers in both groups are in their mid-50s, about three-quarters of them are white, slightly less than half are female, and about a half have college or graduate degrees. The average earnings of the no-match cohort are about 3% higher than the average for the match cohort, which is consistent with the no-match cohort having 1 more year of job tenure because it was hired a year earlier. Because our sample is large, some of the difference in characteristics are statistically significant, but they are not economically significant in that controlling for them only increases the estimated effects of employer matching slightly (see Section 4.2). In contrast, the cohorts differ considerably in their TSP outcomes, suggesting a potential significant effect of employer matching on TSP behavior.

Retirement wealth from sources other than TSP varies between the two cohorts because of dissimilarities in the other components of their retirement plans. FERS and CSRS differ in the generosity of the formulas in their DB plans. The FERS DB formula was designed to replace a smaller share of earnings than the CSRS formula because employees participating in FERS are also covered by Social Security and receive matching contributions through TSP.<sup>33</sup> It is important to ascertain whether those differences will confound our results. In particular, one might wrongly attribute an increase in TSP contribution rates in the match cohort to the financial incentives from the employer match, when in fact the increase is the result of a wealth effect – an increase in TSP savings caused by less

<sup>29</sup>Some recent papers that have explored how fund menus and default fund allocations affect portfolio allocations and ultimately wealth accumulation include Mitchell and Utkus (2021) and Clark and Mitchell (2019).

<sup>30</sup>We prefer linear probability models to probit or logit models because the linear framework makes the marginal effects on the interaction terms easier to interpret (interaction terms include employer matching or automatic enrollment interacted with demographic categories or earnings quintiles). We supplement the results on the participation equations with probit estimates for robustness. The complete set of result from the probit models is available from the authors upon request.

<sup>31</sup>By construction, workers' decision of how much of their TSP balance to allocate to a given fund is made simultaneously with the decision of how much to allocate to each of the other available funds. In order to model jointly workers' portfolio shares in each of the six available funds, we use a seemingly unrelated regression (SUR) model as developed by Zellner (1962).

<sup>32</sup>Another potential issue is that the cohorts differ in unobservable traits, such as their taste for saving. That concern is mitigated by the workers hired in 1984 not knowing that they would eventually be eligible for matching contributions. However, the uncertainty in the terms of the retirement benefits may have made workers who have higher savings propensities less likely to take a federal job in 1984. If that was the case, our finding could understate the effects of matching contribution.

<sup>33</sup>See Congressional Budget Office (2017) for a discussion of the DB plans under the two retirement systems.



**Table 1.** Sample characteristics: federal workers in 2008 to 2014 – adjacent cohorts with and without an employer match

	No-match cohort (Hired in 1983)	Match cohort (Hired in 1984)
<i>TSP behavior</i>		
Workers who contribute (%)	69.5	91.7
Average employee contribution rate (% of salary)	5.9	9.2
Average employee contribution rate for those who contributed (% of salary)	8.5	10.0
Average total (employee + employer)	5.9	13.6
Average ratio of balance to pay	0.8	2.5
Average TSP balance (2014 dollars)	\$81,400	\$254,700
Portfolio allocation (%)		
Bonds	56.8	63.7
Stocks	43.2	36.3
Portfolio allocation by type of fund (%)		
G fund	45.5	53.1
F fund	6.8	5.9
C fund	27.3	21.4
S fund	6.1	5.6
I fund	5.2	4.3
L Fund	9.0	9.7
Workers with entire portfolio invested in G fund (%)	16.7	24.1
<i>Demographic</i>		
Average age	55.5	54.6
Female (%)	43.7	47.8
White (%)	76.8	73.6
Black (%)	16.7	19.6
Hispanic (%)	6.5	6.8
High school or less (%)	26.4	27.0
Some college (%)	24.7	24.3
College (%)	32.4	31.8
Graduate school (%)	16.6	16.9
Average annual earnings (2014 dollars)	\$98,300	\$95,700
Average ratio of accrued DB and Social Security wealth to annual earnings	5.4	6.4
Number of observations	90,470	132,912

*Source:* Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Comparison is between workers hired in 1983 under the Civil Service Retirement System (CSRS; 'No-Match Cohort') and workers hired in 1984 under the Federal Employees Retirement System (FERS; 'Match Cohort'). Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible.

G fund, Government Securities Investment Fund; F fund, Fixed Income Index Investment Fund; C fund, Common Stock Index Investment Fund; S fund, Small Cap Stock Index Investment Fund; I fund, International Stock Index Investment Fund; L fund, Lifecycle Fund.

retirement wealth from other sources. However, the Social Security benefits received through FERS tend to more than make up for the smaller DB pension.

The match cohort tends to have accrued more retirement wealth through their DB pension and Social Security than the no-match cohort, which might lead to our research design understating the effect of matching contributions. We estimate that the net present value of accrued wealth from the DB plan and Social Security is about 15% higher for workers in the match cohort than the no-match cohort, on average.<sup>34</sup> That difference is in alignment with Martin (2003/2004), who finds that the percentage of preretirement salary replaced by the combination of the DB plan and Social Security is higher for workers in FERS than for those in CSRS. Those results suggest that our estimates for the effect of matching contribution could be viewed as a lower bound. However, Falk and Karamcheva (2019) find little evidence on federal employees changing their TSP contributions in response to policy-driven variation in other forms of retirement income.

TSP contributions could also replace wealth from sources other than the DB pension or Social Security, but the available evidence indicates that the match cohort does not offset much of their

<sup>34</sup>Falk and Karamcheva (2018) explain how we calculate the expected value of future annuity payments from the DB plans and Social Security.

additional TSP wealth by reducing other forms of savings or increasing debt. Based on a sample of older workers in the private and public sectors, Engelhardt and Kumar (2011) find that an additional dollar of pension wealth is associated with a 53–67 cent decline in non-pension wealth. But the evidence indicates that federal workers offset TSP wealth at a substantially lower rate. In addition to the evidence mentioned in the previous paragraph, a survey of federal employees conducted by the administrator of TSP indicates that workers in FERS are almost as likely as workers in CSRS to report that personal savings, non-government retirement plans, and home equity, will be important sources of retirement income (Federal Thrift Retirement Investment Board, 2008). And Beshears *et al.* (2022) find little evidence on automatic enrollment in TSP increasing debt.

Comparisons of the treatment and control groups in our analysis show that a considerably higher share of workers eligible to receive employer matching contributions contribute to their TSP than those who are not eligible (92% vs. 70%, see Table 1). Moreover, the distribution of employee contribution rates is skewed toward higher contribution rates for workers in the treatment group (see Figure 1). Workers in the treatment group are less likely to be at 0% (not contributing), more likely to be contributing at 5% – the contribution rate at which they maximize their employer match – and less likely to be at rates lower than 5%. In addition, both types of workers tend to pick contribution rates in multiples of 5.<sup>35</sup> On average, workers who contribute positive amounts contribute more if they are eligible for matching – 10.0% vs. 8.5% (see Table 1). And overall, those patterns result in an average employee contribution rate that is 3.3 percentage points higher for those who are eligible for matching than for those who are not. Because workers in the match cohort also receive a matching contribution and an automatic 1% contribution from their employers, the difference in total contribution rate (employee + employer) is 7.7 percentage points – 5.9% for those in the no-match cohort and 13.6% for those in the match cohort.

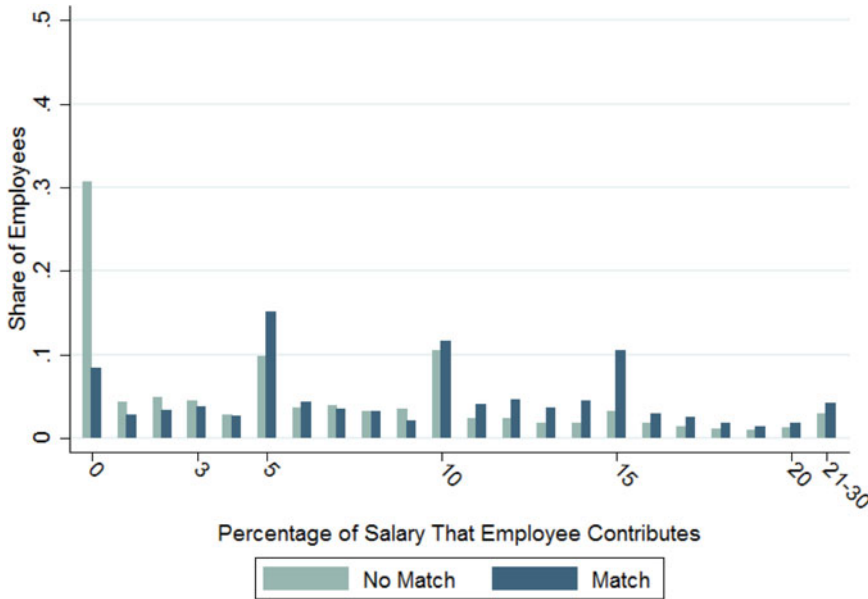
In terms of portfolio allocations, TSP participants are heavily invested in bonds (see Table 1). Among workers with positive TSP balances, more than half of their assets are invested in bonds. The average share of the balance held in bonds is 57% among those in the control group and 64% among those in the treatment group. Some of this difference might be driven by the fact that workers in the treated cohort have their employer's automatic contributions invested by default in the G fund and might be influenced by that choice. The G fund remains the default allocation for any contributions that workers might make, unless workers actively choose a different portfolio allocation. In contrast, workers in the control group have to choose a portfolio allocation when they decide to contribute to the plan.<sup>36</sup> For both groups, the G fund constitutes the largest share of the portfolio – about a half – 46% for workers in the no-match cohort and 53% for the match cohort, followed by the C and L funds.<sup>37</sup>

Differences in contribution rates and portfolio allocations ultimately affect the asset accumulation patterns of workers in the two cohorts. The more conservative portfolio allocation of the workers in the match cohort offsets some of the balance accumulation stemming from the higher percent of pay that those workers invest in the plan. Overall, by the time we observe them in the TSP data, some 27 years after hire, workers in the match cohort have accumulated on average \$255,000 in their accounts, or about \$173,000 more than their counterparts in the no-match cohort. Expressed as a percent of their annual salary, workers in the match cohort have saved about 2.5 times their annual

<sup>35</sup>Although contributing at 5% is the rate at which workers in FERS receive the maximum employer match, other rates that are also multiples of 5, like 10% or 15%, have no special economic significance. Moreover, workers in CSRS do not receive an employer match but are also more likely to pick contribution rates in multiples of 5 than other rates. However, this result is not surprising and confirms findings in the literature which suggest that workers only consider a subset of possible contribution rates (see Benartzi and Thaler, 2007).

<sup>36</sup>Portfolio allocations probably also depend on the riskiness of workers' other assets and expected retirement wealth from the DB plan and Social Security. However, there is no evidence that the riskiness of the non-TSP portfolio of treated individuals is higher than that of workers in the control group. On the contrary, because Social Security, which is less risky than a DB plan, accounts for a bigger portion of the retirement wealth of FERS employees than of CSRS employees, we would expect FERS employees to be less likely to invest in the risk-free G fund.

<sup>37</sup>The TSP introduced lifecycle funds in 2005. They are invested in various combinations of the five existing TSP funds.



**Figure 1.** Distribution of employee contribution rates for employees with and without an employer match (adjacent cohorts). *Source:* Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Comparison is between workers hired in 1983 under the Civil Service Retirement System (CSRS; the cohort labeled 'No Match') and workers hired in 1984 under the Federal Employees Retirement System (FERS; 'Match'). Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. Data span 2008 through 2014.

salary, compared with only 0.8 times their annual salary for workers in the no-match cohort (see Table 1).

### 3.2 Main results

The differences in TSP outcomes between treatment and control groups persist even when we control for differences in worker demographics and salary. Treatment is associated with an increase of 22 percentage points in the average participation rate, 3.5 percentage points in the average employee contribution rate, 8.0 percentage points in the total contribution rate, and an additional \$171,000 in TSP balance. Expressed as a ratio of TSP balance to annual pay (or balance-to-pay ratio), that difference in TSP balance between the match and no-match cohorts is 180% of workers' annual salaries (see Table 2).

Differences in portfolio allocations between the cohorts also persist even after controlling for other characteristics. Because of our large sample size, those differences are precisely estimated and statistically significant with a 99% confidence, even when they are not economically meaningful. Overall, the main difference is that workers in the match cohort maintain a slightly more conservative portfolio allocation, as we saw in the descriptive results. On average, the share of one's portfolio that is made up of bonds is about 7 percentage points higher for workers in the match cohort than it is for similar workers in the no-match cohort, and that difference is fully reflected in the higher share of G fund and a lower share of C fund that those workers hold.<sup>38</sup> The difference between the two cohorts in the share of workers who keep their full balance invested in the G fund is also about 7 percentage points – 17% of workers in the no-match cohort and 24% of workers in

<sup>38</sup>With 99% confidence, we reject the hypothesis that the coefficient on match cohort is jointly equal to zero in the six portfolio share equations in the SUR model. In addition, the Breusch–Pagan test of independence strongly rejects the hypothesis that the error terms are uncorrelated ( $p < 0.01$ ). This result indicates that the SUR model is the appropriate specification.

**Table 2.** Treatment effect of the employer match on participation, contribution rates, portfolio allocations, balance, and balance-to-pay ratio

	Participation rate	Employee contribution rate	Total contribution rate	Balance-to-pay ratio	Balance (\$)
Match cohort	0.222*** (0.004)	3.482*** (0.060)	7.953*** (0.063)	1.825*** (0.011)	171,147*** (1,120)
Adjusted R <sup>2</sup>	0.137	0.197	0.360	0.429	0.571
Mean (no-match cohort)	0.70	5.90	5.90	0.76	77,293
Number of observations	223,382	223,382	223,382	223,382	223,382

	Portfolio shares						Probability of Investing 100% in G fund	Bonds share
	G fund	F fund	S fund	C fund	I fund	L fund		
Match cohort	0.070*** (0.002)	-0.007*** (0.001)	-0.005*** (0.001)	-0.060*** (0.001)	-0.009*** (0.001)	0.010*** (0.001)	0.020*** (0.004)	0.068*** (0.004)
Adjusted R <sup>2</sup>	0.10	0.01	0.03	0.05	0.02	0.02	0.066	0.092
Mean (no-match cohort)	0.46	0.07	0.06	0.27	0.05	0.09	0.17	0.57
Number of observations	203,563	203,563	203,563	203,563	203,563	203,563	203,563	203,563

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. G fund, Government Securities Investment Fund; F fund, Fixed Income Index Investment Fund; C fund, Common Stock Index Investment Fund; S fund, Small Cap Stock Index Investment Fund; I fund, International Stock Index Investment Fund; L fund, Lifecycle Fund. Each column reports coefficients from a regression whose dependent variable is in the column heading. The coefficient on 'Match cohort' represents the difference in the outcome variable between the match and no-match cohorts, with the no-match cohort being the omitted category in the regression. Comparison is between workers hired in 1983 under the Civil Service Retirement System (CSRS; 'no-match cohort') and workers hired in 1984 under the Federal Employees Retirement System (FERS; 'match cohort'). Data span 2008 through 2014. Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. Models of portfolio allocations are estimated only on the population with positive TSP balances. Allocations across the six funds are estimated jointly using a seemingly unrelated regression (SUR) model. All regressions include controls for sex, age, race, education, years of service, earnings, time fixed effects, and state fixed effects. Participation is defined as the worker making positive contributions to his or her TSP account. Total contribution rate includes employee contributions, employer matching contributions, and employer automatic contributions. Robust standard errors, clustered at the employee level, are in parentheses.

\*p < 0.10; \*\*p < 0.05; \*\*\*p < 0.01.

the match cohort. The differences in portfolio allocations across the other funds are close to 0 and not economically meaningful.

### 3.3 Results by worker characteristics

We find that matching is associated with increases in participation and contribution rates, as well as increases in the bonds share and the balance-to-pay ratio across all examined socio-economic groups of individuals. However, the magnitude of the treatment effect differs for workers with different demographic characteristics. Table 3 shows that treatment is associated with larger increases in participation and contribution rates among men than among women, and larger increases among white workers than among black or Hispanic workers. The treatment effect on participation is also strongest among workers in the bottom earnings tercile and weaker for workers in the middle or top of the earnings distribution. Treatment also increases the participation of less-educated workers (those with no more than high school diplomas) more than that of workers with more education. The effect on average employee contribution rates by education or earnings is more nuanced. On average, treatment increases contribution rates of those in the middle tercile of earnings the most, followed by those in the bottom and top terciles. The treatment effect on average contribution rates is also largest for those with some college, and not statistically different between those with high school degrees or those with college or more. Overall, because the effect is generally more positive for lower-income and less-educated individuals, whose rates are lower in its absence, introducing employer matching has an equalizing effect on participation and contribution rates across education and earnings groups. However, the opposite is true across racial groups where the effect on participation and contribution rates is higher among white workers – those more likely to participate and contribute even with no match – than among black and Hispanic workers.

**Table 3.** Treatment effect of the employer match on participation, employee contribution rates, balance-to-pay ratio, and bonds share, by demographics

	Participation rate	Employee contribution rate	Bonds share	Balance-to-pay ratio
Match cohort	0.222***	3.482***	0.068***	1.825***
Adjusted $R^2$	0.137	0.197	0.092	0.429
<i>By Sex (omitted: male)</i>				
Match cohort	0.257***	3.742***	0.074***	2.020***
Match cohort × Female	-0.078***	-0.605***	-0.012*	-0.454***
Adjusted $R^2$	0.139	0.197	0.092	0.432
<i>By Earnings (omitted: bottom earnings tercile)</i>				
Match cohort	0.300***	3.481***	0.113***	1.576***
Match cohort × Middle Earnings Tercile	-0.091***	0.328**	-0.048***	0.277***
Match cohort × Top Earnings Tercile	-0.141***	-0.342***	-0.079***	0.447***
Adjusted $R^2$	0.142	0.197	0.094	0.431
<i>By Education (omitted: high school or less)</i>				
Match cohort	0.272***	3.346***	0.114***	1.482***
Match cohort × Some College	-0.013	0.342**	-0.044***	0.142***
Match cohort × College	-0.086***	0.209	-0.060***	0.566***
Match cohort × Graduate School	-0.106***	-0.133	-0.083***	0.688***
Adjusted $R^2$	0.140	0.196	0.093	0.435
<i>By Race (omitted: white)</i>				
Match cohort	0.229***	3.752***	0.062***	1.976***
Match cohort × Black	-0.030***	-1.327***	0.025***	-0.768***
Match cohort × Hispanic	-0.033**	-0.684***	0.021	-0.341***
Adjusted $R^2$	0.137	0.198	0.092	0.436
Mean (no-match cohort)	0.70	5.90	0.57	0.76
Number of observations	223,382	223,382	203,563	223,382

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Each column reports coefficients from ordinary least squares regressions whose dependent variable is in the column heading. Comparison is between workers hired in 1983 under the Civil Service Retirement System (CSRS) and workers hired in 1984 under the Federal Employees Retirement System (FERS). Data span 2008 through 2014. Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. Match cohort defines FERS workers hired in 1984.

Each panel reflects results from separate regressions with interaction terms for sex, earnings, education, and race, respectively. The coefficient on 'Match cohort' in each regression reflects the average effect of employer matching on the omitted group in that regression. All regressions include controls for sex, age, race, education, years of service, earnings, time fixed effects, and state fixed effects. Significance tests use robust standard errors clustered at the employee level.

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

Treatment is also associated with an increased average share of bonds in workers' portfolios that offsets some of the positive effects of higher contribution rates. The increase in the share invested in bonds is concentrated in workers in the bottom tercile of earnings, workers with low education, and those who are black. Partly because of those offsetting effects, treatment increased the balance-to-pay ratio of less-educated workers, of workers in the bottom of the earnings distribution, and of black and Hispanic workers, by less than it increased it for higher-paid, more-educated, and white workers. Hence, overall, treatment increased the intergroup variance in TSP balance accumulations across all employees.<sup>39</sup>

For example, on average, workers in the bottom tercile in the match cohort have accumulated the equivalent of 1.6 times their annual salary more wealth in their TSP accounts than workers in the no-match cohort. However, the differences are larger for those in the middle and top terciles of income – they have TSP balances that are higher by 1.9 times and 2 times their annual salary than those in the no-match cohort. For workers with no more than high school education, the difference in balance-to-pay ratio is 1.5 times their annual salary as compared with workers in the no-match cohort. But for those with some college, college, and graduate education, the differences are larger – 1.6, 2, and

<sup>39</sup>The effect on women is more nuanced. Treatment increases women's participation rates and contribution rates by less than that of men. However, it also increases women's bonds share by less than that of men. However, because women invest more heavily in bonds, even in the control group, the latter effect is not strong enough to offset the former. As a result, treatment is associated with a lower increase in the balance-to-pay ratio of women than that of men.

2.2 times their annual salary. Finally, the average increase in the TSP balance is 2 times the annual salary among white workers, but 1.6 times among Hispanic workers and only 2.4 times among black workers.

### 3.4 Robustness of the results

Employees in the no-match cohort tend to retire earlier than their counterparts in the match cohort, in part because of dissimilarities between their DB pensions, but the differences in attrition do not confound the estimate for the effect of employer matching. The no-match cohort receives their retirement benefits through CSRS, whereas the match cohort is in its replacement, FERS. CSRS generally provides workers a larger financial incentive to retire once they become eligible to begin receiving an annuity immediately upon separation (see Falk and Karamcheva, 2018). Through 2009, the two cohorts' separation rates are similar. But as more employees become eligible for immediate annuities, the separation rates rise more for the cohort in CSRS than the cohort in FERS. However, the additional attrition appears to have little effect on the difference in TSP contribution rates between the cohorts because the differences in contribution rates between the cohorts is about 3.5 percentage points among both the workers who separate and those who stay.

We conduct a robustness check to directly test whether differences in retention taint our estimates. The sample is restricted to workers who were under the age of 25 at the time they were hired – referred to as 'only young hires' sample. During the period covered by the data, 2008–2014, those workers are not yet eligible to start receiving a DB annuity, so their behavior is less affected by the retirement incentives in FERS vs. CSRS related to the DB plan. Indeed, our analysis shows that the observed retention rates of young hires under FERS are very similar to the retention rates of young hires under CSRS.<sup>40</sup> The employer match is associated with a 19 percentage points increase in the participation rates of workers in the 'only young hires' sample, which is very similar to the estimate from the main sample of 22 percentage points (see Table A2 in the Appendix).

Another difference between the two cohorts is that most workers hired in 1983 had the option to switch to the retirement plan with matching contributions.<sup>41</sup> In contrast, workers hired in 1984 could not switch to the plan without matching contributions unless they were originally hired under that plan and later rehired.<sup>42</sup> Our main sample excludes both groups – those hired in 1983 who became eligible for matching contributions by switching to FERS and the small fraction of workers hired in 1984 who are in CSRS.

We find that the exclusion of employees who were hired in 1983 and then elected to switch to FERS does not lead to a notable bias in our estimator for the effect of matching contribution on participation. We reach that conclusion by adding those switchers to the match cohort. Even though the switchers account for 16% of the expanded match cohort, their inclusion only adds 0.2 percentage points to our estimate of the increased participation from matching (see Table A2 in the Appendix), whereas the standard error is 0.4 percentage points. That slight difference in the estimates is consistent with switchers participating at a rate that is similar to that of the match cohort for our main analysis, 92.6% and 91.7%, respectively. Thus, both groups have participation rates that are about 22 percentage points higher than the no-match cohort, which suggests that the differences are driven by the matching contributions, not by more taste for TSP savings among those who elect to switch to FERS.

<sup>40</sup>Of workers under CSRS in the 'only young hires' sample observed working for the federal government in 2008, 87% are still working 5 years later. The corresponding retention rate for FERS is 92%.

<sup>41</sup>Two FERS open seasons – one in 1987 and one in 1998 – were conducted that allowed workers covered by the CSRS or by CSRS Offset to elect to transfer to FERS.

<sup>42</sup>Under certain circumstances, a worker who was initially hired under CSRS and then re-hired after 1983 could elect to remain in CSRS, others would choose between of FERS and CSRS Offset, and the remainder must participate in FERS. We exclude those re-hires from the analysis, as well as re-hires who were initially in FERS. The latter group is excluded to maintain the similarity between the match and no-match cohort, even though they returned to FERS once re-hired.



Alternatively, adding the CSRS-to-FERS switchers to the no-match cohort can provide us with some insight as to the potential lower bound of the effect of the match. We view that sample specification as providing a lower bound because it attributes the entire difference in participation rates between switchers and those who remain in CSRS to unobservable traits, such as their preference for TSP saving, and none to matching contributions. Table A2 in the Appendix shows that that specification yields a somewhat lower estimate for the effect of the employer match on the participation rate, 15 percentage points.

## 4. Results: effect of automatic enrollment

### 4.1 Descriptive statistics

Differences in TSP behavior between the treatment and control cohorts appear to be driven by the effect of automatic enrollment since the cohorts are very similar in all other observable characteristics that might be correlated with their savings behavior (see Table 4). The average age of both cohorts at the time of hire is 39, 43% of them are female, and 78% are white. Average annual earnings and educational attainment are also similar by treatment status. Note that because of our large sample size, most of these differences between the cohorts are statistically significant even if very small in magnitude and economically not meaningfully different.<sup>43</sup> Similar to the analysis of the employer match, we find that controlling for these characteristics results in negligible changes to our estimates for the effect of automatic enrollment. In contrast, even descriptively, the cohorts differ considerably in their TSP outcomes, suggesting a potential significant effect of automatic enrollment on TSP behavior.

Among employees hired after automatic enrollment was implemented on August 1, 2010, a considerably higher share contributes to their TSP in the first 4 months of their employment than similar workers hired before that date (97% vs. 60%, see Table 4). Employees who contribute positive amounts contribute on average 0.3 percentage points less if they are hired after automatic enrollment. However, because of the higher propensity of the cohort under automatic enrollment to contribute positive amounts, the overall average contribution rate of all workers in the first 4 months after hire is about 1.5 percentage points higher in the autoenrollment cohort (see Table 4).

The trade-off between higher participation rates but a lower conditional employee contribution rate also is shown in Figure 2, which traces out participation and average contribution rates for workers in the treated and control group over time. Three main observations emerge:

First, for employees hired before automatic enrollment was implemented, TSP participation is increasing at a declining rate during the first 5 years of employment, reaching close to 90% in the fifth year. Under automatic enrollment, by contrast, participation is close to 100% in the first year, declining slightly over time.

Second, although the difference in participation rates between workers with and without automatic enrollment is shrinking with tenure, a significant gap remains even as late as 5 years after hire, when participation rates are 12 percentage points higher for automatically enrolled workers.

And third, average contribution rates for workers who contribute positive amounts also are increasing with tenure but are consistently lower for those automatically enrolled even 5 years after hire, eliminating most of the difference in overall average contribution rate 5 years out between automatically enrolled and voluntarily enrolled workers.

Our results are consistent with the existing literature in that automatic enrollment at a low default contribution rate only weakly raises the average contribution rate (see, e.g., Choi *et al.*, 2004).

Exploring the distribution of employee contribution rates before and after automatic enrollment allows us to make two important observations (see Figure A1 in the Appendix). First, the distribution of contribution rates for the cohort hired after automatic enrollment is different from that for the

<sup>43</sup>There is also a small difference in retention rates. Specifically, 78% of those hired before automatic enrollment remained in federal employment for at least 5 years compared to 72% of those hired after automatic enrollment.

**Table 4.** Sample characteristics: federal workers in 2009 and 2010 observed 0–4 months after hire – adjacent cohorts hired before and after automatic enrollment

	Hired before AE (Hired between August 2009 and July 2010)	Hired after AE (Hired between August 2010 and July 2011)
<i>TSP behavior</i>		
Workers who contribute (%)	60.0	96.7
Average contribution rate (% of salary)	2.9	4.4
Average contribution rate for those who contributed (% of salary)	4.8	4.5
Average total (employee + employer) contribution rate (% of salary)	5.8	8.6
Average ratio of balance to pay	0.2	0.2
Average TSP balance (2014 dollars)	\$3,300	\$3,900
Portfolio allocation (%)		
Bonds	88.2	89.1
Stocks	11.8	10.9
Portfolio allocation by type of fund (%)		
G fund	84.3	85.5
F fund	1.0	1.0
C fund	2.8	2.5
S fund	1.7	1.9
I fund	2.0	1.6
L fund	8.0	7.6
Workers with entire portfolio invested in G fund (%)	80.0	80.6
<i>Demographic</i>		
Average age	38.9	38.9
Female (%)	42.3	42.9
White (%)	77.9	77.7
Black (%)	16.9	17.2
Hispanic (%)	5.2	5.1
High school or less (%)	29.7	30.0
Some college (%)	15.6	16.3
College (%)	29.4	27.4
Graduate school (%)	25.3	26.3
Average annual earnings (2014 dollars)	\$65,400	\$65,100
Number of observations	51,726	53,374

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. AE, automatic enrollment; G fund, Government Securities Investment Fund; F fund, Fixed Income Index Investment Fund; C fund, Common Stock Index Investment Fund; S fund, Small Cap Stock Index Investment Fund; I fund, International Stock Index Investment Fund; L fund, Lifecycle Fund.

Comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment, and workers hired from August 2010 to July 2011, who were subject to automatic enrollment. Data come from 2009 for the cohort hired before automatic enrollment and from 2010 for the cohort hired after automatic enrollment. Thus, both cohorts are observed on average 0 to 4 months after hire.

cohort hired before automatic enrollment. Second, most of that difference is captured by a decline in the share of individuals contributing 0%, or non-participants (the default rate before automatic enrollment was 0%), and an almost equal increase in the share of individuals contributing at the new default rate of 3%. Automatic enrollment also seems to have moved an additional small fraction of employees who would have participated even without automatic enrollment to a contribution rate of 3%. From Figure A1, it looks as though those individuals are the ones likely to have chosen rates of 1% or 2% rather than rates higher than 3%.<sup>44</sup>

<sup>44</sup>Figure A1 also sheds light on the somewhat counterintuitive result that average employee contribution rates among those that contribute positive amounts are lower under automatic enrollment. The reason is that the main effect of automatic enrollment is the shift of the mass of workers who otherwise would not participate (or be at 0%) to the new default contribution rate of 3%. Although automatic enrollment also pulls to the new default a small share of workers who otherwise would have contributed at 1% and 2%, that effect is small. As a result, conditional on contributing positive amounts, the distribution of contribution rates is quite different between those hired before and those hired after automatic enrollment. For example, in the fifth year after hire, conditional on contributing positive amounts, 83% of those hired before automatic enrollment



**Figure 2.** Participation rate and average contribution rates for employees hired before and after automatic enrollment by tenure (adjacent cohorts).

Source: Authors’ calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment, and workers hired from August 2010 to July 2011, who were subject to automatic enrollment. Data span 2009 through 2014. Participation is defined as the worker making positive contributions to his or her account. AE, automatic enrollment.

How changes in the distribution of contribution rates after automatic enrollment affect the overall average contribution rate is illustrated in Table 5. Whereas the average contribution rate in the first year of observation (months 0 to 4 after hire) is 2.9% for employees hired before automatic enrollment, the rate is 4.4% for those hired after (see Table 5). That difference of about 1.5 percentage points diminishes with time but remains positive at 0.3 percentage points even in the fifth observation year as contribution rates rise for both groups of workers. That higher average contribution rate is the result of fewer workers contributing at 0% or at rates below 3% and more workers contributing at the new default of 3%. In marked contrast, virtually no difference is evident in the share of workers that contribute at rates higher than 3% by automatic enrollment status past the first 4 months.

#### 4.2 Main results

The differences in the distribution of contribution rates persist when we control for workers’ demographics, tenure, and earnings (see Table 6). On average, in the first 5 years of their employment, workers hired after automatic enrollment are 18.5 percentage points less likely to contribute 0%, 3.8 percentage points less likely to contribute positive amounts but less than 3% of salary, and 20.9 percentage points more likely to contribute at the new default rate of 3% of salary. The effects weakened with each year after hire but persist even 5 years after the beginning of federal service. The decline in the share of workers who don’t contribute (i.e., who chose 0%) and in participation rates that are

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contributed more than 3%, but only 73% of those hired after automatic enrollment did. Similarly, of those contributing, 18% contributed more than 10% after automatic enrollment but 14% did before automatic enrollment.

**Table 5.** Distribution of employee contribution rates for employees hired before and after automatic enrollment

	Employee contributes								Average participation rate		Average employee contribution rate	
	At 0%		More than 0% less than 3%		At 3%		More than 3%					
	Hired before AE	Hired after AE	Hired before AE	Hired after AE	Hired before AE	Hired after AE	Hired before AE	Hired after AE	Hired before AE	Hired after AE	Hired before AE	Hired after AE
First year	0.40	0.03	0.09	0.04	0.08	0.40	0.42	0.52	0.60	0.97	2.9	4.4
Second year	0.24	0.02	0.09	0.04	0.07	0.33	0.59	0.60	0.76	0.98	4.5	5.1
Third year	0.20	0.02	0.08	0.04	0.06	0.30	0.66	0.64	0.80	0.98	5.2	5.5
Fourth year	0.18	0.03	0.08	0.05	0.06	0.25	0.68	0.67	0.82	0.97	5.4	5.9
Fifth year	0.16	0.04	0.08	0.05	0.06	0.22	0.70	0.70	0.84	0.96	5.8	6.1
Sixth year	0.15		0.07		0.06		0.72		0.85		6.1	

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. AE, automatic enrollment. Comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment, and workers hired from August 2010 to July 2011, who were subject to automatic enrollment. Data span 2009 through 2014. Participation is defined as the worker making positive contributions to his or her TSP account.

positive but lower than the new default of 3%, almost fully account for the increase in participation rates at the default of 3%.<sup>45</sup>

Overall, we find that the introduction of automatic enrollment led to increases in the participation rate, in the average employee contribution rate, and in the total contribution rate (employee + employer) and that those increases declined over time (see Table 6). By the fifth year after hire, workers hired under automatic enrollment had participation rates that were 12.9 percentage points higher, average contribution rates that were 0.5 percentage points higher, and total contribution rates that were 0.9 percentage points higher than those of workers under the opt-in system.

We find that on average the balance-to-pay ratio of automatically enrolled workers was 9 percentage points higher than that of opt-in workers – that is, automatically enrolled workers had saved 9% more of their salary than opt-in workers during the period observed, or about \$3,000 more (see Table 7).<sup>46</sup> We also find no economically significant differences in the portfolio allocations of workers in the two cohorts.<sup>47</sup> Under both policies, we find that workers are predominantly invested in the G fund – 66% of the account balance of workers in the control group – those hired before automatic enrollment – is invested in the G fund and automatic enrollment further increases it by 1.2 percentage points. In fact, more than half of the workers in both cohorts are fully invested in the G fund. Overall,

<sup>45</sup>This finding is contrary to that of Madrian and Shea (2001), who find that the shift in the modal contribution rate to the automatic enrollment default rate for employees hired after automatic enrollment is driven by both a movement from non-participation to the default rate and a movement from higher contribution rates to the default. However, examining the same company, Choi *et al.* (2004) find that for workers that passed the first 12 months of tenure, the substantial mass of participants at the automatic enrollment default contribution rate results largely from a conversion of non-participants into participants at the default rate. Those findings are consistent with our results.

<sup>46</sup>Our findings show that automatic enrollment had a negligible effect on DC wealth in the short-term. Using a dynamic setup, Choukhmane (2019) argues that the long-term effect of automatic enrollment on wealth is also negligible for the majority of people.

<sup>47</sup>For balance accumulation and portfolio allocations, we report average effects over the observed period because the regressions did not reveal any economically meaningful time effects. Full results with time dummies are available from the authors upon request.

**Table 6.** Treatment effect of automatic enrollment on the distribution of employee contribution rates over time

	Employee contributes										Employee contribution rate		Total contribution rate	
	At 0%	More than 0% less than 3%		At 3%	More than 3%		Participation rate	Employee contribution rate		Total contribution rate				
Autoenrolled cohort	-0.185*** (0.001)	-0.038*** (0.001)		0.209*** (0.001)	0.015*** (0.002)		0.185*** (0.001)	0.629*** (0.017)		1.260*** (0.020)				
Effect over time														
Autoenrolled cohort (first year)	-0.371*** (0.002)	-0.057*** (0.002)		0.317*** (0.003)	0.111*** (0.003)		0.371*** (0.002)	1.606*** (0.023)		2.955*** (0.030)				
Autoenrolled cohort (second year)	-0.232*** (0.001)	-0.053*** (0.001)		0.260*** (0.002)	0.025*** (0.002)		0.232*** (0.001)	0.825*** (0.018)		1.644*** (0.022)				
Autoenrolled cohort (third year)	-0.188*** (0.001)	-0.035*** (0.001)		0.225*** (0.002)	-0.001 (0.002)		0.188*** (0.001)	0.527*** (0.019)		1.138*** (0.022)				
Autoenrolled cohort (fourth year)	-0.163*** (0.001)	-0.030*** (0.001)		0.184*** (0.002)	0.009*** (0.002)		0.163*** (0.001)	0.549*** (0.020)		1.089*** (0.023)				
Autoenrollment cohort (fifth year)	-0.129*** (0.001)	-0.033*** (0.001)		0.150*** (0.002)	0.012*** (0.002)		0.129*** (0.001)	0.476*** (0.021)		0.927*** (0.025)				
Adjusted R <sup>2</sup>	0.103	0.108	0.023	0.023	0.115	0.118	0.092	0.093	0.103	0.108	0.128	0.129	0.135	0.137
Mean (non-autoenrolled cohort)	0.19	0.19	0.08	0.08	0.06	0.06	0.66	0.66	0.81	0.81	5.33	5.33	9.22	9.22
Number of observations	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572	1,010,572

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Each column reports coefficients from an ordinary least squares regression whose dependent variable is in the column heading. Comparison is between workers hired from August 2009 to July 2010 who were not subject to automatic enrollment and workers hired from August 2010 to July 2011 who were subject to automatic enrollment ('autoenrolled cohort'). Data span 2009 through 2014. All regressions include controls for sex, age, race, education, years of service, earnings, time fixed effects, and state fixed effects. Robust standard errors clustered at the employee level are in parentheses. Participation is defined as the worker making positive contributions to his or her TSP account. Total contribution rate includes employee contributions, employer matching contributions, and employer automatic contributions. \*p < 0.10; \*\*p < 0.05; \*\*\*p < 0.01.

there is almost no difference in the share of bonds in the portfolio of the two cohorts – bonds account for about three-quarters of the portfolio. Because of these negligible differences in portfolio allocations, it is safe to conclude that any observable differences in balance accumulations between the cohorts are mostly the results of differences in contribution rates and not in investment choices.<sup>48</sup>

### 4.3 Results by worker characteristics

We also find notable differences in the effect of automatic enrollment by worker demographics and earnings. The effects of automatic enrollment on participation, contribution rates, the bonds share, and balance-to-pay ratio of workers in the fifth year after hire are shown in Table 8. Automatic enrollment is associated with a larger increase in participation rates and contribution rates among men than women (13.9 percentage points increase in participation and 0.53 in contribution rates among men vs. 11.2 and 0.41 percentage points among women, respectively). The positive effect of automatic enrollment on participation and average employee contribution rates is strongest among workers in the bottom earnings tercile (20.3 and 0.69 percentage points, respectively) and weaker for workers in the middle (10.8 and 0.57 percentage points, respectively) or top of the earnings distribution (7.3 and 0.18 percentage points, respectively); also it is stronger for less-educated workers (those with no more than high school diplomas – 20.4 and 0.72 percentage points, respectively) and weaker for more-educated workers (e.g., 6.9 and 0.17 percentage points, respectively, for those with graduate degrees). The positive effect of automatic enrollment on participation is also stronger for black and Hispanic workers than for white workers (17.6 vs. 15.6 vs. 11.5 percentage points, respectively) and so is the effect on contribution rates (0.68, 0.62, and 0.42 percentage points, respectively). Overall, we find that the effects generally are strongest among those groups of workers who also happen to be most likely to stick to the default contribution rate of 3% or to the default contribution rate and the default allocation jointly (see Table 8).<sup>49</sup>

Because automatic enrollment did not affect portfolio allocations significantly, and because the effect on participation and contribution rates was strongest among the groups that have lower rates in the absence of automatic enrollment, the overall effect of automatic enrollment on the balance-to-pay ratios was equalizing. Overall, we find that by the fifth year after hire automatic enrollment increased the balance-to-pay ratio of less-educated workers, of lower-earning workers, and of black and Hispanic workers by more than it did for more-educated, higher-earning, and white workers. For example, by the fifth year after hire workers in the bottom tercile of earnings under automatic enrollment had accumulated 5.2% more of their annual salary than workers hired before automatic enrollment. Those in the middle tercile of earnings had accumulated 4.3% of their annual salary more, and those in the top tercile had saved 0.9% of their annual salary less than comparable workers hired before automatic enrollment. Balance accumulations were also highest among those with some college or less education – about 6% of their annual salary, than among those with college degrees and graduate degrees – 2.5% of salary more and 0.8% of salary less, respectively. Automatic enrollment also resulted in a higher balance accumulation for black and Hispanic workers – 5.8% and 5.2% more of annual salary saved – than white workers – 2.1%. Hence, contrary to the effect of employer matching discussed earlier, the overall effect of automatic enrollment is a decreased intergroup variance in TSP balance accumulations across all employees.<sup>50</sup>

<sup>48</sup>In the SUR model, we reject the hypothesis that the coefficient on automatic enrollment is jointly equal to zero in the six portfolio share equations. In addition, the Breusch–Pagan test of independence strongly rejects the hypothesis that the error terms are uncorrelated ( $p < 0.01$ ). Although statistically significant from zero, the results do not show economically meaningful differences in the portfolio allocations by autoenrollment status, on average.

<sup>49</sup>We find that less-educated workers are more likely to stick to the defaults than more educated workers. Previous research has shown that financially literate individuals are more likely to plan for retirement (Lusardi and Mitchell, 2007). To the extent that education is a proxy of financial literacy, the result is not surprising.

<sup>50</sup>We did not find statistically different effects of automatic enrollment on the balance-to-pay ratio between the two genders. Although automatic enrollment increased participation rates of women by less, women were also slightly more likely to participate in the TSP in the absence of automatic enrollment.



**Table 7.** Treatment effect of automatic enrollment on balance, balance-to-pay ratio, and portfolio allocations

	Balance-to-pay ratio	Balance (\$)	G fund	F fund	Portfolio shares				Probability of investing 100% in G fund	Bonds share
					S fund	C fund	I fund	L fund		
Autoenrolled cohort	0.090*** (0.003)	2.994*** (136.8)	0.012*** (0.001)	-0.002*** (0.000)	0.003*** (0.000)	0.004*** (0.000)	-0.004*** (0.000)	-0.013*** (0.001)	0.008*** (0.002)	0.003** (0.001)
Adjusted $R^2$	0.07	0.30	0.15	0.02	0.04	0.07	0.03	0.06	0.134	0.132
Mean (non-autoenrolled cohort)	0.35	27,863	0.66	0.02	0.05	0.07	0.03	0.16	0.57	0.75
Number of observations	1,010,572	1,010,572	1,001,944	1,001,944	1,001,944	1,001,944	1,001,944	1,001,944	1,001,944	1,001,944

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

G fund, Government Securities Investment Fund; F fund, Fixed Income Index Investment Fund; C fund, Common Stock Index Investment Fund; S fund, Small Cap Stock Index Investment Fund; I fund, International Stock Index Investment Fund; L fund, Lifecycle Fund.

Each column reports coefficients from a regression whose dependent variable is in the column heading. Comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment, and workers hired from August 2010 to July 2011, who were subject to automatic enrollment and referred to as 'autoenrolled cohort'. Data span 2009 through 2014. Models of portfolio allocations are estimated only on the population with positive balances in the TSP. Allocations across the six funds are estimated jointly using a SUR model. All regressions include controls for sex, age, race, education, job tenure, earnings, and time and state fixed effects. Robust standard errors clustered at the employee level are in parentheses.

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

**Table 8.** Treatment effect of automatic enrollment on participation, employee contribution rates, balance-to-pay ratio, and portfolio allocation by demographics in fifth year after hire

	Participation Rate	Employee contribution rate	Balance-to-pay ratio	Bonds share	Employee contributes at 3% (Default rate)	Employee invests 100% in G fund (Default allocation)	Employee contributes at 3% and invests 100% in G fund (Default rate and default allocation)
Autoenrolled cohort	0.128***	0.481***	0.029***	-0.009***	0.150***	-0.011***	0.133***
Adjusted R <sup>2</sup>	0.075	0.122	0.173	0.122	0.077	0.116	0.081
By sex (omitted: male)							
Autoenrolled cohort	0.139***	0.532***	0.031***	-0.014***	0.152***	-0.016***	0.133***
Autoenrolled cohort × Female	-0.027***	-0.125***	-0.005	0.011***	-0.004	0.012***	0.000
Adjusted R <sup>2</sup>	0.076	0.122	0.173	0.122	0.077	0.116	0.081
By age (omitted: <30)							
Autoenrolled cohort	0.091***	0.549***	0.026***	-0.005	0.117***	0.000	0.108***
Autoenrolled cohort × (Age 30–39)	0.018***	-0.077	0.009**	-0.001	0.021***	-0.009	0.012***
Autoenrolled cohort × (Age 40–49)	0.054***	-0.005	0.008	-0.003	0.049***	-0.008	0.037***
Autoenrolled cohort × (Age >50)	0.055***	-0.142**	-0.003	-0.011**	0.044***	-0.021***	0.036***
Adjusted R <sup>2</sup>	0.076	0.122	0.173	0.122	0.077	0.116	0.082
By earnings (omitted: bottom earnings tercile)							
Autoenrolled cohort	0.203***	0.687***	0.052***	-0.000	0.230***	0.000	0.213***
Autoenrolled cohort × Middle Earnings Tercile	-0.095***	-0.118**	-0.009**	-0.015***	-0.101***	-0.020***	-0.101***
Autoenrolled cohort × Top Earnings Tercile	-0.130***	-0.503***	-0.061***	-0.012***	-0.140***	-0.014***	-0.139***
Adjusted R <sup>2</sup>	0.084	0.123	0.173	0.122	0.084	0.116	0.090
By education (omitted: high school or less)							
Autoenrolled cohort	0.204***	0.715***	0.060***	-0.008***	0.227***	-0.007*	0.209***
Autoenrolled cohort × Some College	-0.040***	-0.055	-0.009	-0.002	-0.040***	-0.003	-0.038***
Autoenrolled cohort × College	-0.109***	-0.250***	-0.035***	0.000	-0.112***	-0.006	-0.111***
Autoenrolled cohort × Graduate School	-0.135***	-0.546***	-0.068***	-0.005	-0.136***	-0.007	-0.134***
Adjusted R <sup>2</sup>	0.084	0.123	0.173	0.122	0.083	0.116	0.089
By race (omitted: White)							
Autoenrolled cohort	0.115***	0.422***	0.021***	-0.009***	0.134***	-0.011***	0.116***
Autoenrolled cohort × Black	0.061***	0.257***	0.037***	0.001	0.070***	-0.001	0.072***
Autoenrolled cohort × Hispanic	0.041***	0.195**	0.031***	-0.005	0.052***	0.002	0.055***
Adjusted R <sup>2</sup>	0.077	0.122	0.173	0.122	0.078	0.116	0.083
Mean (non-autoenrolled cohort)	0.84	5.83	0.47	0.70	0.06	0.51	0.04
Number of observations	190,067	190,067	190,067	189,784	190,067	189,784	189,784

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Each column reports coefficients from a regression whose dependent variable is in the column heading. Comparison is between workers hired between August 2009 and July 2010, who were not subject to automatic enrollment, and workers hired between August 2010 and July 2011, who were subject to automatic enrollment and referred to as 'autoenrolled cohort'. Both cohorts of workers are observed at similar times since hire. The data come from 2013 for workers not subject to automatic enrollment and from 2014 for those in the autoenrolled cohort. Participation is defined as the worker making positive contributions to his or her TSP account.

Each panel reflects results from separate regressions with interaction terms for sex, earnings, education, or race, respectively. The coefficient on 'Autoenrolled cohort' in each regression reflects the average effect of automatic enrollment on the omitted group in that regression. All regressions include controls for sex, age, race, education, years of service, earnings, time fixed effects, and state fixed effects. Robust standard errors are in parentheses.

\*p < 0.10; \*\*p < 0.05; \*\*\*p < 0.01.

#### 4.4 Robustness of the results

As discussed earlier, the treatment and control cohorts in the analysis of automatic enrollment are observationally indistinguishable in their socio-economic characteristics, which allows us to infer that the differences in their TSP savings outcomes are caused by the implementation of automatic enrollment. We perform some additional analysis examining the behavior of neighboring cohorts of hires to assess the robustness of our results. One concern is that marketing for the change to automatic enrollment might have increased savings in our control group. Peer effects are another reason that automatic enrollment could increase savings for the control group. More specifically, higher participation might lead to increases in future enrollment if, for example, current participants encourage others to enroll. Finally, it would be problematic if we wrongly generalize the effect of the policy to all workers subject to the policy when instead it is concentrated on the initially affected cohort and dissipates for later cohorts of hire. That would be the case if later cohorts are less responsive to the policy as more time has elapsed between the policy implementation and the time they join the federal government, hence they could have gathered more information and might be better able to adjust their savings behavior.

We find little evidence on marketing effects, peer effect, or the passage of time tainting our results. Table A3 in the Appendix shows the participation rates and average employee contribution rates by tenure of alternative control and treatment cohorts. Similar to our main treatment and control cohorts, those alternative cohorts are hired within a 'window' around automatic enrollment implementation – from August to July of either earlier or later years, respectively. All cohorts are compared with each other at the same points of their tenure. The results show that both participation and conditional contribution rates of earlier cohorts hired before automatic enrollment are similar to the behavior of workers in our control group. The savings behavior of those earlier cohorts of hires is much less likely to be affected by peer effects since a lot of their saving decisions are observed in periods before the implementation of automatic enrollment in 2010. The results for those cohorts also indicate that news of automatic enrollment had little effect on the behavior of the control group because the law mandating automatic enrollment was not passed until June of 2009. Finally, we do not find substantive differences in the participation and contribution rates of our treatment group and that of later cohorts hired under automatic enrollment.

To quantify the potential importance of marketing effects and peer effects, we perform the regression analysis for our main outcomes of interest – participation and the contribution rate, using an alternative control group that is comprised of those earlier cohorts of workers hired before automatic enrollment. The estimates are similar to those in our main specifications, which is inconsistent with automatic enrollment materially affecting the savings of the control group (see Table A4).

#### 4.5 Is there evidence for spillover effects between the default domains?

Passive, or default behavior in the context of TSP has two aspects. One relates to the default contribution rate and the other relates to the default allocation. In this section, we analyze the interaction of these two default domains, and we explore whether increasing the default contribution rate from 0% to 3% has changed employees' tendency to passively accept the default allocation in the G fund. Note that the portfolio allocation is a relevant decision even for workers who currently do not contribute to the plan because they still receive the employer 1% automatic contribution which is invested in the default fund unless the worker makes an active portfolio allocation decision.

How might a change in the deferral rate from 0% to 3% affect the propensity of workers to remain fully invested in the G fund? If the 3% contribution rate is closer to what more workers would have chosen on their own, then that could make the passive approach more attractive by reducing the cost of not making any active decisions, including both electing a contribution rate and electing a portfolio allocation. Or, on the contrary, if the 3% deferral rate is further away from what the workers would have chosen, then the consequences of indecision increase and workers might be more inclined to think more carefully about both their contribution and allocation decisions and might be more inclined to move away from the default allocation. The 3% deferral rate also increases the consequences of not choosing an allocation by increasing the TSP balances of those who do not elect a deferral rate.

Overall, what we find is that changing the deferral rate from 0% to 3%, while keeping the default portfolio allocation unchanged and set to the risk-free fund, results in a large increase in the share of workers at the new default contribution rate and a smaller decline in the share of workers fully invested in the default allocation (see Table 8). (Those results are observed in the fifth year after hire – the longest time for which we can observe the two cohorts of workers.) The change in the deferral rate lead to a 15.0 percentage points (or 150%) increase in the share of workers contributing at the new rate of 3%, and a 1.1 percentage point (or 2%) decline in the share of workers fully invested in the default fund.

The results suggest that the increase in the default rate from 0% to 3% of salary had, on average, a minimal spillover effect on the propensity to remain at the default allocation – a 1.1 percentage point decrease in the fifth year after hire. However, that average effect might be masking a stronger effect among the population of ‘inert’ savers – those who remain at the default rate corresponding to the regime they are under (the default rate being 0% for those hired under opt-in and 3% for those hired under opt-out). We find that most workers who remain at the default contribution rate under their specific regime are also fully invested in the default allocation fund – the G fund. However, the share of those at the default allocation is lower among those who are defaulted at 3% contribution than among those who are defaulted at 0% contribution. For example, at 41–52 months of tenure, 93% of workers hired before automatic enrollment and who contribute 0% are fully invested in the default fund (Figure 3). In contrast, among workers hired after automatic enrollment who contribute at 3%, 83% are fully invested in the default fund at the same point in time since hire. In contrast, among workers who choose a contribution rate different from the default, the share fully invested in the default fund is considerably lower and similar for workers hired both before and after automatic enrollment – about 45% at 41–52 months of tenure.

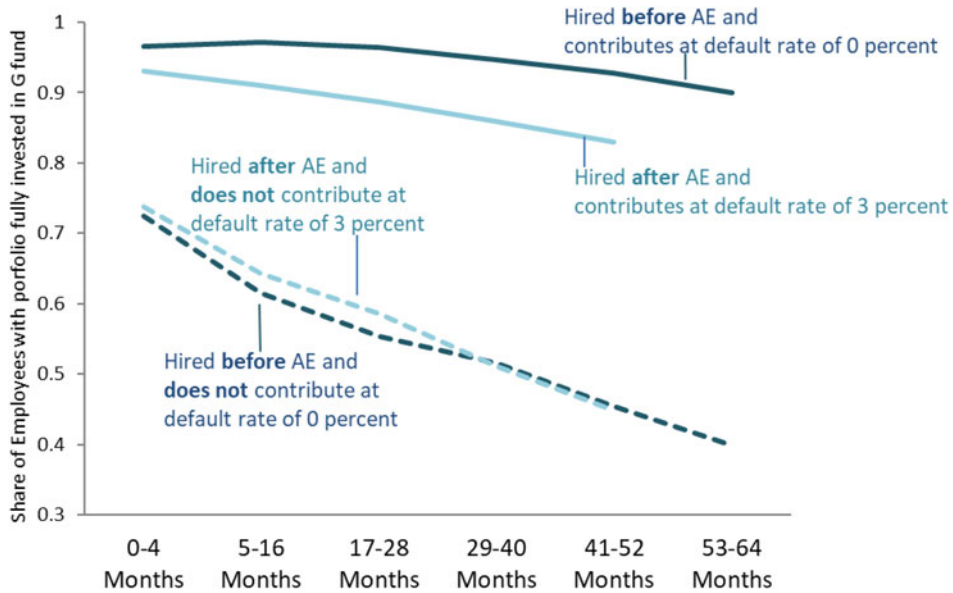
The above finding suggests that workers who are passive in their contribution rate choice tend to be passive toward their portfolio allocation choice. However, the trends in Figure 3 still suggest that the rise in the deferral rate to 3% had a spillover effect on the tendency to passively accept the default allocation, particularly among those ‘inert’ savers – those who remain at their corresponding default rate. The comparison is confounded, however, by the fact that there are more workers who actively choose to contribute at 3% than workers who actively choose 0% and those active choosers are less likely to be fully invested in the G fund. (We deduce the percent active choosers from the shares of workers at 0% under opt-out and at 3% under opt-in; Table 5.) A back-of-the-envelope calculation in which we control for the portfolio choice of the active choosers at 0% and 3% suggests that the increase in the default rate from 0% to 3% reduced the propensity of ‘inert’ savers to remain fully at the default fund by 6.4 percentage points or 7% (from 96.7% to 90.5%).<sup>51</sup> This result suggests a small positive spill-over effect on portfolio allocation as a result of an increase in the default deferral rate from 0% to 3%.

A 2018 study by Goda *et al.* explores a similar question – how the features of a default in one domain affect outcomes in separate but related domains. Also using data on TSP, those authors examine the effect of a change in the default asset fund on contribution rates for new employees. The default allocation was changed from the G fund to the lifecycle fund, which the authors presume is preferred by a higher percentage of employees. They find negative spillover effects on contribution rates – employees have a greater tendency to passively accept the default contribution decisions under the lifecycle default fund compared to under the G fund.

## 5. Discussion

This paper uses administrative panel data on federal civilian workers’ demographics, compensation, and TSP behavior to estimate the effects of the employer match and plan default options on workers’ TSP

<sup>51</sup>Our implicit assumption in this calculation is that the share of workers under the opt-out regime who actively choose to contribute at 3% equals the observed share of workers contributing at 3% under the opt-in regime and so does their propensity to be fully in the default fund. And similarly, our assumption is that the share of workers under the opt-in regime who actively choose to contribute at 0% equals the observed share of workers contributing at 0% under the opt-out regime and so does their propensity to be fully in the default fund. Thus, the observed contribution and allocation decisions of the two adjacent cohorts provide information on the counterfactual outcomes.



**Figure 3.** Share of workers fully invested in the default fund over time for employees hired before and after automatic enrollment (adjacent cohorts).

*Source:* Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment, and workers hired from August 2010 to July 2011, who were subject to automatic enrollment. Data span 2009 through 2014 and includes only newly hired workers with no prior federal service. The default employee contribution rate before automatic enrollment is 0% whereas the default employee contribution rate under automatic enrollment is 3%. AE, automatic enrollment.

savings outcomes. To achieve causal interpretation of our results, we rely on two sources of exogenous variation stemming from policy changes to TSP – the availability of employer matching for workers hired after 1983 and the introduction of automatic enrollment for workers hired after July 2010.

Treatment-control comparisons suggest that the long-run effect of employer matching on employee participation rates was a 22 percentage point increase. In contrast, the introduction of automatic enrollment raised participation rates by 37 percentage points at 0–4 months of tenure, and by 13 percentage points at 41–52 months of tenure. Average employee contribution rates to TSP increased by 3.5 percentage points and 0.6 percentage points after the two policy changes, respectively. Consistent with previous research, we also find that automatic enrollment increases participation and contribution rates the most for workers least likely to participate in its absence – those whose earnings are in the bottom tercile, who are not white, and who have lower education. We also find considerable heterogeneity in the effect of the employer match. The effect of matching on participation and contribution rates is overall more positive for those groups of workers whose rates are lower in its absence – such as lower-earning, less-educated workers, and men.

We find that the reforms had a small effect on portfolio allocations in the case of employer matching and negligible effect in the case of automatic enrollment. In the case of employer matching, we find that workers who are eligible for a match hold about 7 percentage points more bonds in their portfolios than those who do not have employer matching. Because this increase in the bond share is concentrated among lower-earning, less-educated workers, we find that the increase in the bond share had an offsetting effect on the balance-to-pay ratio and overall increased the intergroup variance in TSP balance accumulations across all employees. In contrast, because automatic enrollment had no economically significant effect on portfolio allocations, and because the effect on contribution rates was strongest among the groups that are less likely to participate and contribute in the absence of automatic enrollment, the policy had an equalizing effect on TSP balances and balance-to-pay ratios. The

overall effect of automatic enrollment is a decreased intergroup variance in TSP balance accumulations across all employees.

Our findings also confirm results in the literature that show workers who are least likely to participate without being automatically enrolled to be also the ones more likely to stick to the default provisions. However, our findings also suggest that federal workers are more likely to move away from the defaults and faster in doing so than what has been reported in studies based on private sector workers. For example, Choi *et al.* (2004) report that in a private-sector company that introduced automatic enrollment with the same deferral rate as TSP, over 70% of automatically enrolled workers are at the default rate after 4 months of hire and over 40% are still there after 2 years. In contrast, we find only 40% and 30% of automatically enrolled workers to be at the default rate at equivalent points in time among federal workers. According to the same authors, automatically enrolled workers are about 40 percentage points more likely to be both at the default rate and fund 2 years after hire than workers under the opt-in regime. In contrast, we find that among federal workers that difference is only 25 percentage points. Federal workers tendency to move away from defaults more quickly can be explained in part by them being older and more educated.

Our estimates for the effect of automatic enrollment on federal employees' participation are below the range of typical estimates for private-sector workers, which can be explained by difference in their education, age, earnings, and retention rates. The literature typically finds that participation is elevated by 20–40 percentage points a few years after private-sector workers are hired, and we estimate that the participation among federal employees is 18.8 percentage points higher in their third year. We also find that more educated, older, and higher paid federal employees tend to be less affected by automatic enrollment, and the federal workforce is more educated, older, higher paid than the private-sector workforce. Adjusting the federal data to match the distribution of education in the private sector increases our estimate for the rise in participation by 2.9 percentage points.<sup>52</sup> Similar adjustments for age and earnings would boost it further.<sup>53</sup> Another difference is that federal employees have higher retention rates than their counterparts in the private sector (Congressional Budget Office, 2017). That causes the average of effects across federal workers of varying job tenure to be smaller because the effect of autoenrollment dissipates with job tenure.

Our estimates for the effect of the employer match on federal employees' participation are toward the higher end of the range of the estimates for private-sector workers. In ongoing research, we argue that that is because federal employees were particularly likely to view the minimum employee contribution needed to receive the full match as advice on how much they should contribute. More specifically, because the introduction of matching contribution coincided with changes to the DB pension, employees thought they needed to increase TSP contributions to offset the changes to the DB pension, even though the addition of Social Security coverage meant that expected retirement wealth outside TSP increased.

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<sup>52</sup>Let  $\beta$  be the vector of coefficient estimates by education shown in Table 8, and let  $X_{\text{fed}}$  and  $X_{\text{ps}}$  be the vectors of educational attainment from Table A1 for federal employees and private-sector workers, respectively. We calculate the adjustment factor for the differences in education as  $\beta X_{\text{ps}}/\beta X_{\text{fed}} - 1 = 0.154$ , and then apply it to our estimate for the participation effect for federal workers hired 3 years ago,  $0.154 \times 18.8 = 2.9$ .

<sup>53</sup>Falk (2015) shows that federal workers tend to have higher earnings than private-sector workers of similar age and educational attainment.



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Appendix A

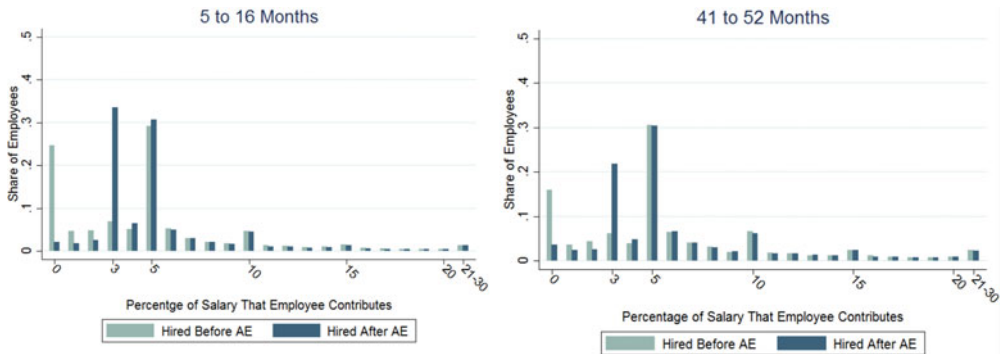


Figure A1. Distribution of employee contribution rates for employees hired before and after automatic enrollment (adjacent cohorts).

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. Comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment, and workers hired from August 2010 to July 2011, who were subject to automatic enrollment. Data span 2009 through 2014. AE, automatic enrollment.

Table A1. Workers' characteristics, by sector

	Federal Government	State and local Governments	Private sector
Age	45.5	44.3	40.8
Female (%)	45.4	58.6	46.5
High school or less (%)	19.7	19.7	37.2
Some college (%)	30.2	24.4	28.7
College (%)	27.6	28.3	23.2
Graduate school (%)	22.5	27.5	10.9

Source: Authors' calculations, using data from the 2018 Current Population Survey.

Table A2. Effect of matching on participation: robustness checks

	Main sample OLS	Main sample Probit	Only young hires OLS	Main sample + Those who switched from CSRS to FERS Switchers added to 'no match cohort' OLS	Main sample + Those who switched from CSRS to FERS Switchers added to 'match cohort' OLS
Match cohort	0.222*** (0.004)	0.206*** (0.003)	0.191*** (0.007)	0.152*** (0.003)	0.224*** (0.004)
Adjusted or pseudo-R <sup>2</sup>	0.137	0.16	0.112	0.100	0.137
Mean (no-match cohort)	0.70	0.70	0.74	0.76	0.70
Number of observations	223,382	223,382	89,735	258,803	258,803

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. OLS, ordinary least squares.

The coefficient on 'Match cohort' represents the difference in the outcome variable between the match and no-match cohorts, with the no-match cohort being the omitted category in the regression. Comparison is between workers hired in 1983 under the Civil Service Retirement System (CSRS; 'no-match cohort') and workers hired in 1984 under the Federal Employees Retirement System (FERS; 'match cohort'). Data span 2008 through 2014. Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. All regressions include controls for sex, age, race, education, years of service, earnings, time fixed effects, and state fixed effects.

The 'main sample' excludes workers who switched from CSRS to FERS during the two open seasons and excludes workers who were rehired after 1984 but chose CSRS, although they would have been eligible for FERS. The 'only young hires' sample restricts observations in the main sample to only those workers who were hired before age 25.

Robust standard errors, clustered at the employee level, are in parentheses.

\*p < 0.10; \*\*p < 0.05; \*\*\*p < 0.01.

**Table A3.** Effect of automatic enrollment on participation and contribution rates among participants: robustness checks – alternative control and treated groups

## Panel A: Participation rate

	Alternative control groups				Control Hired before AE (August 09–July 10)	Treated Hired after AE (August 10–July 11)	Alternative treated groups		
	Hired before AE (August 05–July 06)	Hired before AE (August 06–July 07)	Hired before AE (August 07–July 08)	Hired before AE (August 08–July 09)			Hired after AE (August 11–July 12)	Hired after AE (August 12–July 13)	Hired after AE (August 13–July 14)
First year				0.57	0.60	0.97	0.98	0.97	0.98
Second year			0.71	0.69	0.76	0.98	0.98	0.98	0.98
Third year		0.79	0.76	0.78	0.80	0.98	0.98	0.97	
Fourth year	0.81	0.81	0.82	0.82	0.82	0.97	0.97		
Fifth year	0.82	0.84	0.84	0.83	0.84	0.96			
Sixth year	0.85	0.86	0.85	0.85	0.85				
Seventh year	0.86	0.86	0.86	0.86					
Eight year	0.86	0.87	0.86						
Ninth year	0.87	0.87							
Tenth year	0.87								

## Panel B: Average employee contribution rate conditional on participating

Year	Alternative control groups				Control Hired before AE (August 09–July 10)	Treated Hired after AE (August 10–July 11)	Alternative treated groups		
	Hired before AE (August 05–July 06)	Hired before AE (August 06–July 07)	Hired before AE (August 07–July 08)	Hired before AE (August 08–July 09)			Hired after AE (August 11–July 12)	Hired after AE (August 12–July 13)	Hired after AE (August 13–July 14)
First year				4.77	4.84	4.53	4.39	4.17	4.43
Second year			5.86	5.72	5.91	5.24	4.98	5.14	5.08
Third year		6.68	6.35	6.27	6.47	5.63	5.51	5.67	
Fourth year	7.22	6.84	6.56	6.63	6.67	6.01	5.96		
Fifth year	7.34	6.99	6.83	6.84	6.92	6.37			
Sixth year	7.41	7.25	6.99	7.06	7.17				
Seventh year	7.60	7.35	7.17	7.27					
Eight year	7.70	7.51	7.33						
Ninth year	7.83	7.64							
Tenth year	7.97								

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

AE, automatic enrollment.

In the main sample, the comparison is between workers hired from August 2009 to July 2010, who were not subject to automatic enrollment ('control group'), and workers hired from August 2010 to July 2011, who were subject to automatic enrollment (treated group). Contribution rates are conditional on employee participation, that is on contributing a positive amount.

The alternative control and treated groups include similar workers hired before August 2009 or after July 2011 and observed at similar points in their tenure. Data span 2008 through 2014.

**Table A4.** Effect of automatic enrollment on participation and average contribution rate: robustness checks

	Main sample OLS	Main sample probit	Alternative control group sample OLS
<i>Panel A: Participation rate</i>			
Autoenrolled cohort	0.185*** (0.001)	0.208*** (0.001)	0.216*** (0.001)
Adjusted or pseudo- $R^2$	0.103	0.15	0.123
Mean (no-match cohort)	0.81	0.81	0.76
<i>Panel B: Average employee contribution rate</i>			
Autoenrolled cohort	0.629*** (0.017)		0.566*** (0.014)
Adjusted or pseudo- $R^2$	0.128		0.140
Mean (no-match cohort)	5.33		4.93
Number of observations	1,010,572	1,010,572	1,105,399

Source: Authors' calculations, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board. OLS, ordinary least squares.

In the 'main sample', the control group includes those hired August 2009–July 2010; treated group includes those hired in August 2010–July 2011. In the 'alternative-control-group sample', the control group includes those hired in August 2005–July 2006, August 2006–July 2007, August 2007–July 2008, and August 2008–July 2009, and observed in years prior to 2010; the treated group includes those hired from August 2010 to July 2011. All regressions include controls for sex, age, race, education, time since hire, earnings, time fixed effects, and state fixed effects.

Robust standard errors, clustered at the employee level, are in parentheses.

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .