The Effect of the Employer Match and Defaults on Federal Workers' Savings Behavior in the Thrift Savings Plan

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Abstract

Policymakers are weighing options that would change the retirement system for federal workers by shifting more of their deferred compensation from the defined benefit plan toward the defined contribution plan, called the Thrift Savings Plan (TSP). We use administrative longitudinal data on federal workers' demographics, compensation, and TSP behavior to estimate the effects of an employer match and plan default options on workers' TSP savings behavior and the cost of employer contributions. We rely primarily on two sources of exogenous variation stemming from policy changes to the TSP: the availability of an employer match for workers hired after 1983 and the introduction of automatic enrollment for workers hired after July 2010. Further, we develop a discrete choice model that can predict how simultaneous changes in the default rate and matching structure affect contributions. That empirical model is flexible enough to accommodate behavior rooted in both neoclassical models and theories from behavioral economics. The neoclassical specification indicates that the match has little effect on employee contributions. But a specification based on psychological anchoring fits the data better and shows that a match can affect employee contributions far more than a default contribution rate. We find that raising the matching threshold from zero percent to 5 percent leads to employees contributing 3.3 percent more of their salaries to TSP. In contrast, an increase in the default contribution rate from zero percent to 3 percent increases employee contributions by 0.3 percent of their salary.

Keywords: defined contribution plans, employer matching, defaults, savings outcomes

JEL Classification: E21, E27, G41, J26, J32

Contents

I. Introduction

Over the past three decades, firms in the private sector have shifted from defined benefit (DB) to defined contribution (DC) retirement plans. Federal, state, and local governments are considering similar changes, such as offsetting reductions in DB pensions with increases in the employer match and the default employee contribution rate. This paper develops an empirical model to forecast the effects such changes have on employee contribution rates and on employer costs. In doing so, it enhances the transparency of the Congressional Budget Office's work by offering a technical description of the analysis underlying a previous agency report (Congressional Budget Office 2017).

Although many studies have examined the effects of an employer match, automatic enrollment, and other defaults on employee savings behavior, those analyses have not developed a comprehensive empirical framework than can accommodate simultaneous changes in match incentives and the default contribution rate. Moreover, most of the previous literature has examined changes in DC plan characteristics in the private sector—an approach that makes extrapolating findings to the population of public-sector workers difficult. Unlike firms in the private sector, federal, state, and local governments have often considered incorporating DC plans into retirement systems that would continue to include a DB component.

This paper contributes to the literature on DC plans by using administrative longitudinal data on almost all civilian federal employees to estimate the effect of a match and defaults on participation, contributions, and employer costs. The data encompass multiple changes to the retirement plan, including the introduction of both the match and automatic enrollment. Those policy interventions support a causal interpretation of our findings.

In addition, we develop an empirical model that forecasts the effects of changes in the match and default contribution rates on the distribution of contribution rates. The literature is limited mostly to estimates of how those policies affect average employee contribution rates. Such estimates are rarely sufficient for forecasting the cost employers would incur by changing their matching and default rates because matching contributions are generally nonlinear functions of employee contribution rates. Our discrete choice approach allows us to forecast the distribution of contribution rates on the basis of behavior rooted in neoclassical models or theories from behavioral economics.

A specification motivated by psychological anchoring fits the data better than one rooted in neoclassical theory and indicates that raising matching rates can boost employee contributions more than raising the default contribution rate. When specified to permit behavior predicted by anchoring, the model explains most of the observed responses to changes in the matching and default rates. In that specification, the matching threshold (the minimum employee contribution necessary to receive the full matching contribution) serves as an anchor that employees are drawn toward. Some employees who would contribute less than that matching threshold in its

absence are pulled up to it, as reported in past studies. Our new finding is that the matching threshold also pulls down employees who would contribute more than the matching threshold in its absence. Thus, raising the matching threshold also increases employee contribution rates by pulling down the contribution rates of high contributors less than a lower threshold would. That finding leads us to conclude that most estimates from the literature might substantially understate the effect of matching rates on employee contributions because they have focused on workers who contribute at the rates where the match varies.

We find that raising the matching threshold from zero percent to 5 percent leads to employees contributing 3.3 percent more of their salaries to the DC plan. In contrast, an increase in the default contribution rate from zero percent to 3 percent is forecast to increase employee contributions by 0.3 percent of their salary. Encouraging saving through matching contributions generally costs employers more than increasing the default rate. However, our finding that the matching threshold has far more influence on worker behavior than the matching rate indicates that a combination of a high threshold with a low matching rate will substantially increase savings at a low cost.

The next section reviews the relevant literature and provides institutional background. We then describe the data. After that, the analyses are divided into two complementary sections. The first section estimates the effect of the match and defaults by using the treatment-effects approaches that are standard in the literature. The second section estimates those effects by using the discrete choice model for the distribution of contribution rates. That empirical model is then used to forecast rates under a policy with higher matching and default rates.

II. Background

To elucidate the role of employer match and defaults on federal employees' contribution rates, this section summarizes the relevant literature and describes the Thrift Savings Plan (TSP).

A. Related Literature

Most studies of DC plans indicate that the default contribution rate has a much larger effect on employee behavior than financial incentives. For example, many empirical studies of the match show relatively small effects on participation and contribution rates (Engelhardt and Kumar 2007; Duflo et al. 2006; Even and Macpherson 2005; Munnell, Sundén, and Taylor 2001/2002; Basset, Fleming, and Rodrigues 1998; Kusko, Poterba, and Wilcox 1998; Papke and Poterba 1995). Some exceptions exist, such as Dworak-Fisher (2011) and Huberman, Iyengar, and Jiang (2007). In contrast, most researchers who examine the effect of defaults find strong effects, particularly in terms of increasing workers' participation in the plan, usually defined as the worker making positive contributions to the plan. Those studies also often show that automatic enrollment is particularly effective for increasing the participation of workers who otherwise would not participate (VanDerhei 2010; Nessmith, Utkus, and Young 2007; Choi et al. 2002, 2004; Madrian and Shea 2001). Researchers who examined the effect of the employer match on

participation in the presence of automatic enrollment (Beshears et al. 2010) or while controlling for automatic enrollment (Butrica and Karamcheva 2015) also have found relatively small effects. Similar to previous studies, and because of the constraints imposed by the TSP policy changes, we can analyze the effect of automatic enrollment only in the presence of an employer match—not in isolation.[1] The degree to which the default's effect on participation and contributions depends on the presence of the match remains an open question.

The available data place substantial limitations on the existing literature, and we face those as well. Previous studies that have examined the effect of defaults have used mostly data from case studies of individual firms or large plan sponsors, which are not necessarily representative of the overall population and often provide few demographic characteristics, making results particularly difficult to extrapolate.[2] In this study, we analyze the effects of both the employer match and defaults on the population of federal civilian workers. As a result, we can extrapolate how changes to the default rate and the match are expected to affect federal workers' participation and contribution rates. However, because federal workers differ from other workers in unobservable ways that affect their savings decisions, caution should be used in extrapolating our findings to the overall population.

The literature offers useful insights on the effects of matching and default contribution rates, but it does not provide an adequate framework for quantifying workers' responses to prospective changes in those features. Most studies have estimated changes in participation or the average employee contribution by using specifications not suited for extrapolation, but some notable exceptions do exist. Englehardt and Kumar (2007) measure the marginal effect of matching rates on employee contributions through changes to the relative price of savings and intertemporal substitution. However, they do not incorporate default contribution rates or accommodate insights from behavioral economics. Choukhmane (2019) finds that a neoclassical model can explain response to the match and default contribution rates if it includes a modest cost to choosing a contribution rate. We find that such a model fits our data poorly. One reason is that the workers in our data tend to choose contribution rates that are multiples of five, as they do in the data used by Choi and colleagues.

B. The Thrift Savings Plan

The TSP is a DC plan, similar to 401(k) plans in the private sector. It was introduced in 1987 as a result of the Federal Employees' Retirement System Act of 1986 (Public Law 99-335). That act also established the new Federal Employees Retirement System (FERS) for employees hired in and after 1984 to replace the Civil Service Retirement System (CSRS), which remains for

[1] Previous research that examined the effects of automatic enrollment and employer match on participation and contribution rates in individual companies has faced similar constraints.

[2] Some exceptions exist—papers that have used nationally representative data include Butrica and Karamcheva (2018), who use nationally representative household survey data of older workers, and Butrica and Karamcheva (2015) and Dworak-Fisher (2011), who use nationally representative establishment-level data.

employees hired before 1984. FERS consists of three elements: Social Security, a DB plan, and TSP. Workers under CSRS are also allowed to contribute to the TSP but do not receive matching contributions. In contrast, CSRS included a DB plan only before the creation of TSP and has never incorporated Social Security.[3]

Whereas employees in both CSRS and FERS are allowed to contribute to TSP, only employees in FERS receive matching and automatic contributions from their employers.[4] Employers match FERS employees' contributions up to 5 percent of salary according to the following schedule: The first 3 percent of pay that an employee contributes is matched dollar for dollar, the next 2 percent is matched at 50 cents on the dollar, and contributions above 5 percent of pay are not matched. In addition, employers automatically contribute 1 percent of salary to the TSP accounts of all FERS employees, regardless of whether workers contribute themselves.

Although TSP participants can choose between two tax treatments of their TSP contributions—traditional and Roth—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.[5] In general, TSP participants can contribute up to the annual limits set by the Internal Revenue Service (IRS) for 401(k) plans.[6] For example, in 2019 the limit on employee elective

[3] Because CSRS was established before Social Security, employees in CSRS are not covered by Social Security during their federal employment. Because the Social Security Amendments of 1983 (P.L. 98-21) required federal employees hired after 1983 to participate in Social Security, the Congress established FERS to replace CSRS. FERS was created in 1986, for workers hired after December 31, 1983, and became effective on January 1, 1987. Since then, new federal civilian employees who have retirement coverage have been covered by FERS.

[4] 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 one year and ended after 1983 and had five 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.

[5] In 2014, only 4 percent of total employee contributions in our data were Roth contributions.

[6] 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 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.

contributions is $19,000 (combined traditional and Roth). Individuals over age 50 are allowed an additional $6,000 of catch-up contributions.[7]

TSP participants in FERS are immediately vested in (that is, entitled to) their own contributions and any matching contributions by agencies. However, TSP participants must work a minimum number of years to be vested in the agencies' automatic contributions and associated earnings in their accounts. The TSP vesting requirement is three years for most FERS employees.[8]

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.

The Thrift Savings Plan Enhancement Act of 2009 authorized several changes to the TSP. Those changes included implementing automatic enrollment in August 2010. Automatic enrollment applies to all newly hired or rehired FERS and CSRS employees. According to the provision, as of August 2010, new federal employees have 3 percent of their pay automatically deducted and placed in their TSP accounts unless they make their own TSP contribution elections. A share of workers' salary was not automatically contributed to TSP for workers hired before August 2010. Instead, those workers had to decide to contribute.

Until September 2015, the G Fund—TSP's risk-free, most conservative investment option—was the default investment plan for the automatic employer contributions and for the default employee deferrals under automatic enrollment.[9] After the passage of the Smart Savings Act

[7] Similar to private-sector 401(k) plans, combined employee and employer contributions are limited. In 2019, that limit is $56,000, but it is not binding for any TSP participants in our sample. As with private plans, TSP participants can withdraw money penalty-free once they reach age 59½ but face a 10 percent early withdrawal penalty before that age. Some exceptions apply. Workers are exempt from the early withdrawal penalty if they separate from federal service in the year in which they reach age 55 or later (50 or later for some special-category employees). As with 401(k) plans, participants in the TSP are allowed to take out loans or make hardship in-service withdrawals.
[8] Employees serving in certain positions, including some senior executive-level positions, Members of Congress, and Congressional employees, need to complete only two years of service to meet the TSP vesting requirement.
[9] 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.

(P.L. 113-255) in 2015, the default investment fund has been the age-appropriate lifecycle fund.[10]

III. Data and Sample Restrictions

We analyze a panel of administrative data that provides a broad array of information on nearly all federal employees from 2008 through 2014.[11] Those data include the dollar amount that individual employees contributed during each year, their balances in each asset at the end of each year, default contribution rates, eligibility for matching contributions, and other information on their TSP activity. The data set also tracks employees' salaries and many other characteristics, including dates of hire. The data show that most of the federal workforce is spread across professional and administrative positions that require various levels of education and experience.[12]

We exclude workers from the analysis if they are not eligible for the standard retirement benefits or if their data are incomplete or inconsistent. Workers in certain occupations—mostly law enforcement—receive augmented retirement benefits, and workers in part-time positions receive reduced benefits. Those workers account for about 20 percent of the workforce. They are excluded because their nonstandard retirement benefits could cause their savings decisions to differ from those of the typical worker. In addition, we drop about 5 percent of workers because we could not ascertain their earnings and exclude an additional 1 percent because of contradictory information regarding their default contribution rate. Finally, to improve the precision of our estimates, we drop workers who appear to contribute more than 30 percent of their salary to TSP—that group represents the top 0.5 percent of employee contribution rates.

After imposing those exclusions, we are left with 10.4 million person-year observations. Our empirical specifications compare workers hired within a year of a change in policy. 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. More specifically, to determine the effect of the employer match on savings behavior, we use 0.2 million observations that represent workers hired within a year of the change from CSRS to FERS. We refer to that sample as our *matching sample*. And to determine the effect of automatic enrollment we use a sample of 1 million observations that represent workers hired within a year

[10] 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 Retirement Thrift Investment Board 2018) based on data through 2017 suggests that changing the default allocation 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 percent in 2014 to 29.5 percent in 2017. According to Goda and others (2018), changes in the default investment plan also might have had spillover effects on employees' contribution rates.

[11] 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.

[12] Falk (2015) describes the federal workforce in more detail.

of the change in the default deferral rate for new employees. We refer to that sample as our *autoenrollment sample*. However, when using the hazard model to forecast the effects of increasing the matching and default rates we do not filter workers according to their hiring date because we want the forecast to be representative of the population of federal workers. To expedite computation, those forecasts and the underlying inferences use a randomly selected 5 percent sample of the full sample, which results in 0.7 million observations.

IV. Estimating Treatment Effects for the Employer Match and Automatic Enrollment

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 the TSP plan. Those are the introduction of the match for workers in FERS but not in CSRS and the introduction of automatic enrollment for workers hired after August 2010.

A. Analytic Method: Treatment-Control Comparisons

We estimate the average effects of those two changes by comparing the behavior of adjacent cohorts of federal workers (that is, 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.[13] 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 observe contributions and portfolio allocations of those individuals in the treatment and control groups annually from 2008 to 2014.

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.[14] Because our data go to the end of 2014, we have information on individuals in the treatment group for five consecutive 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 zero and 4 months of tenure when we first observe their TSP contributions, which is at the end of

[13] 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, for example, Beshears et al. 2010, 2017).
[14] Employees who do not choose an amount to contribute are automatically enrolled in the plan with a 3 percent 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.

2009 and 2010, respectively. For the same reason, they have 5 and 16 months of tenure at the second observation, respectively, and so forth.[15]

Our empirical specifications take the following general form:

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

where y_{it} is the outcome of interest, T_i is 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.

In our empirical specifications, we use linear probability models to analyze several aspects of savings behavior.[16] 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. And finally, we consider the effect on workers' balance accumulations, measured as the ratio of their TSP balance to their annual pay.

B. Differences in Participation, Contribution Rates, Portfolio Allocation, and Balance-to-Pay Ratio by Eligibility for the Employer Match

Sample Characteristics. Overall, treatment and control cohorts in our matching sample appear similar in their characteristics (see Table 1).

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. Average annual earnings also are similar by treatment status.[17] However, the cohorts differ considerably in their TSP outcomes, suggesting a potential significant effect of employer matching on TSP behavior.

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[15] 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.

[16] 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). The results from corresponding probit and Tobit models are similar.

[17] Most differences in the match cohorts' characteristics can be explained by overall differences in the cohort of new employees entering the federal government in 1984. 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. The treatment group in our analysis includes both individuals hired under FERS and those hired in 1983 under CSRS but who later elected to transfer to FERS. We conducted a sensitivity analysis by restricting the treatment group to workers originally hired under FERS but found no significant differences in the results.

Because the two groups are covered by different retirement systems, it is important to ascertain whether our results of the treatment effect of employer matching on TSP participation and contributions is not confounded by differences in expected retirement wealth of treatment and control groups outside TSP. In particular, one might wrongly attribute an increase in TSP contribution rates in the treatment group to the financial incentives from the employer match, when in fact the increase is the result of a wealth effect—a drop in expected retirement wealth and which results in increased savings.

As noted, workers in our control group are covered by CSRS, whereas workers in our treatment group are covered by FERS. The two systems differ in the generosity of the formula in their DB plans. Because employees participating in FERS are also covered by Social Security, the FERS DB formula was designed to replace a smaller share of earnings than the CSRS formula.[18] We estimate that the net present value of accrued wealth from the DB plan and Social Security tends to be higher for workers in the treatment group than for those in the control group.[19] On average, the accrued DB and Social Security wealth for workers in the first FERS cohort is six times their annual salary. That factor is five for the last CSRS cohort. 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 are inconsistent with the hypothesis that a decline in other sources of retirement wealth drives higher TSP contributions of workers in FERS. We explore that relationship further in section V.B.

Results. Comparisons of the treatment and control groups show that a considerably higher share of workers eligible to receive employer matching contributions contribute to their TSP plan (92 percent vs. 69 percent) than those who are not eligible (see Table 1). Workers who contribute positive amounts also contribute more on average if they are eligible for matching (10.0 percent vs. 8.5 percent). Overall, that pattern results in an average contribution rate that is 3.3 percentage points higher for those who are eligible for matching than for those who are not.

The distribution of employee contribution rates is skewed toward higher contribution rates for workers in the treatment group—that is, those with an employer match (see Figure 1). Overall, more than 30 percent of those in the control group choose not to contribute, compared with less than 10 percent of those in the treatment group. Workers in the treatment group are also more likely to be contributing at 5 percent—the contribution rate at which they maximize their employer match—and less likely to be at rates lower than 5 percent. In addition, both types of workers tend to pick contribution rates in multiples of 5.

[18] See Congressional Budget Office (2017) for a discussion of the DB plans under the two retirement systems.
[19] Falk and Karamcheva (2018) explains how we calculate the expected value of future annuity payments from the DB plans and Social Security.

In terms of portfolio allocations, TSP participants are heavily invested in bonds (see Figure 2). Among workers with positive TSP balances, the average share of bonds is 53 percent among those in the control group and 61 percent among those in the treatment group.[20] For both groups, the G Fund constitutes the biggest share of the portfolio, followed by the C and L Funds.[21]

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 contribution rate, and an almost twofold increase in the workers' TSP balance-to-pay ratio (see Table 2).

Workers in the match cohort maintain a slightly more conservative portfolio allocation. Among those with positive balances, TSP participants in the match cohort are about 2 percentage points more likely to fully invest their portfolio in the G Fund or to fully invest it in bonds and are about 7 percentage points less likely to fully invest it in stocks. On average, the share of one's portfolio made up of the G Fund or the share 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.

Differences in the Effect of Matching by Worker Demographics. We find significant differences in the treatment effect for workers with different demographic characteristics. Tables A1 and A2 in the appendix show that treatment is associated with smaller increases in participation and contribution rates among women than among men. The positive effect of treatment on participation and contributions is 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 and contribution rates of less-educated workers (those with no more than high school diplomas) more than that of workers with more education, but it is lower for black and Hispanic people than it is for white people. Because the effect is overall more positive for those groups of individuals whose rates are lower in its absence, introducing employer matching reduces the intergroup variance of participation and contribution rates.

However, treatment also is 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

[20] 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. In contrast, workers in the control group have to choose a portfolio allocation when they decide to contribute to the plan. Portfolio allocations probably also depend on the riskiness of workers' other assets and expected retirement wealth from the DB plan and Social Security. However, no evidence suggests 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.

[21] The TSP introduced lifecycle funds in 2005. They are invested in various combinations of the five existing TSP funds.

the share invested in bonds is concentrated in workers in the bottom tercile of earnings, workers with low education, and those who are black. Because of those offsetting effects, overall, 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 people by less than it increased it for higher-paid, more-educated, and white workers. Hence, overall treatments increased the intergroup variance in TSP balance accumulations across all employees.[22]

C. Differences in Participation, Contribution Rates, Portfolio Allocation, and Balance-to-Pay Ratio by Automatic Enrollment

Sample Characteristics. Overall, treatment and control cohorts in our autoenrollment sample appear similar in their characteristics (see Table 3). The average age of the sample at the time of hire is 39, 43 percent of the sample is female, and 78 percent is white. Average annual earnings and educational attainment also are similar by treatment status. However, the cohorts differ considerably in their TSP outcomes, suggesting a potential significant effect of automatic enrollment on TSP behavior.

Results. For employees hired after automatic enrollment was implemented on August 1, 2010, a considerably higher share contribute to their TSP plan in the first zero to four months after hire than similar workers hired before that date (97 percent vs. 60 percent; see Table 3). Those who contribute positive amounts contribute less on average if they are hired after automatic enrollment. However, because of the higher propensity of automatically enrolled workers to contribute positive amounts, the overall average contribution rate of all workers in the first zero to four months after hire is about 1.5 percentage points higher for automatically enrolled workers.

The trade-off between higher participation rates but a lower conditional contribution rate also is visible in Figure 3, which traces out participation and average contribution rates for workers in the treated and control group over time. Three main observations emerge:

1. For employees hired before automatic enrollment was implemented, TSP participation is increasing at a declining rate during the first five years of employment, reaching close to 90 percent in the fifth year. Under automatic enrollment, by contrast, participation is close to 100 percent in the first year, declining slightly over time.
2. 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

[22] 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 bond 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.

five years after hire, when participation rates are 10.5 percentage points higher for automatically enrolled workers.

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

Plotting the whole distribution of employee contribution rates before and after automatic enrollment allows us to make two important observations (see Figure 4). First, the distribution of contribution rates for the cohort hired after automatic enrollment is different from that for the cohort hired before automatic enrollment. Second, most of that difference is captured by a decline in the share of individuals contributing zero percent, or nonparticipants (the default rate before automatic enrollment was zero percent), and an almost equal increase in the share of individuals contributing at the new default rate of 3 percent. 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 percent. From Figure 4, it looks as though those individuals are the ones likely to have chosen rates of 1 percent or 2 percent rather than rates higher than 3 percent.

How changes in the distribution of contribution rates after automatic enrollment affect the overall average contribution rate is illustrated in Tables 4 and 5. Whereas the average contribution rate in the first year of observation (months zero to four after hire) is 2.9 percent for employees hired before automatic enrollment, the rate is 4.4 percent for those hired after (see Table 4). 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 zero percent or at rates below 3 percent and more workers contributing at the new default of 3 percent. In marked contrast, virtually no difference is evident in the share of workers that contribute at rates higher than 3 percent by automatic enrollment status past the first four months.

Those differences in the distribution of contribution rates persist when we control for workers' demographics, tenure, and earnings (see Table 5). On average, workers hired after automatic enrollment are 18.5 percentage points less likely to contribute zero percent, 3.8 percentage points less likely to contribute positive amounts but less than 3 percent of salary, and 20.9 percentage points more likely to contribute at the new default rate of 3 percent of salary. The effects weaken with each year after hire but persist even five years after the beginning of federal service. The

decline in nonparticipation and in participation rates lower than the new default fully account for the increase in participation rates at the default.[23]

Who Responds More Strongly to Defaults? Probability of Sticking to Defaults by Demographics?
Passive, or default, behavior after automatic enrollment has two aspects. One relates to remaining at the default contribution rate, and the other relates to remaining with the default portfolio allocation, which for the workers in our sample is the G Fund. Introducing automatic enrollment influenced mostly workers' contribution rate and had almost no effect on their portfolio allocation. Controlling for other factors, we find that automatically enrolled workers are 15.0 percentage points more likely to be at the default rate five years after hire but only 0.08 percentage points less likely to be fully invested in the default fund (see Table 6). Overall, 13.3 percent more workers under automatic enrollment are both at the default rate and default fund than similar workers hired before automatic enrollment. The noneffect of automatic enrollment on workers' portfolio allocations is probably explained by the fact that workers in our sample are predominantly invested in the G Fund even without automatic enrollment (Figure 5). More than 70 percent of the accumulated balance in the accounts of workers in the control group—those hired before automatic enrollment—is invested in the G Fund. That behavior could be driven by the fact that all FERS employees are influenced by defaults in terms of their portfolio allocations. The default investment fund for the employer 1 percent automatic contributions is the G Fund for all workers in our sample, including those hired before August 2010. Thus, a significant share of workers not affected by the change in the default rate to 3 percent might be tied to the default investment fund. Unfortunately, the data do not allow us to separately identify those two effects.[24]

Consistent with previous research (predominantly on case studies of firms), the fraction of participants at the defaults declines monotonically over time and varies significantly with demographic characteristics (see Table 6). In the fifth year after hire (the longest time for which we can observe the two cohorts), women are 1.1 percentage points more likely to be at the default rate and 8.6 percentage points more likely to be in the default fund than men. Perhaps surprisingly, newly hired workers older than 30 are more likely to be at the default contribution rate and in the default fund than younger workers. Black and Hispanic workers are considerably more likely to be at the default rate (6.5 percentage points and 3.3 percentage points,

[23] 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 nonparticipation to the default rate and a movement from higher contribution rates to the default. However, examining the same company, Choi and colleagues (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 nonparticipants into participants at the default rate. Those findings are consistent with our results.

[24] In 2015, the default investment fund for the automatic employer contribution of 1 percent and for the default employee contributions was changed to the worker age-relevant lifecycle funds. We did not have data past that policy change to examine later effects on portfolio allocations.

respectively) and more likely to be in the default fund (15.0 percentage points and 7.5 percentage points, respectively) than white workers.

We also find a gradient with respect to earnings and education. In the earnings distribution, workers in the top and middle terciles are considerably less likely than workers in the bottom tercile to be at the default rate (13.5 percentage points and 8.6 percentage points, respectively) and less likely to be in the default fund (23.4 percentage points and 14.8 percentage points, respectively). Overall, more-educated workers are less likely to be in the default fund or at the default rate. Those with some college are 3.5 percentage points less likely than those with no more than high school education to be at the default rate and 4.0 percentage points less likely to be at the default fund five years after hire. The difference for workers with college or graduate degrees is higher—those with college degrees are 7.9 percentage points and 13.1 percentage points less likely to be at the default rate and in the default fund, respectively; those with graduate degrees are 9.3 percentage points and 15.1 percentage points less likely to be at the default rate and in the default fund, respectively.

We do not have information on workers' financial literacy, but to the extent that educational attainment is related to financial literacy, the effect of education on the propensity to stick to defaults is not surprising. Previous research has shown that financially literate individuals are more likely to plan for retirement (Lusardi and Mitchell 2007), which would explain why less-educated federal workers are more likely to remain at the defaults and not make another choice for saving or investment.

Differences in the Effect of Automatic Enrollment by Worker Demographics. Controlling for demographics, salary, and tenure, we find that introducing automatic enrollment was associated with increases in the participation rate, average contribution rate, and balance-to-pay ratio of federal workers and that those increases declined over time. By the fifth year after hire, workers hired under automatic enrollment had participation rates 12.9 percentage points higher, average contribution rates 0.5 percentage points higher, and balance-to-pay ratios 2.7 percentage points higher than those of workers under the opt-in system. We find no economically significant differences in the portfolio allocations of workers between those hired before automatic enrollment and those hired after (see Table 7).

We also find significant differences in the effect of automatic enrollment by worker demographics and earnings. Tables A3 and A4 in the appendix show that automatic enrollment is associated with a slightly smaller increase in participation rates among women than men (14.0 percentage points vs. 11.3 percentage points). The positive effect of automatic enrollment on participation and contributions is strongest among workers in the bottom earnings tercile and weaker for workers in the middle or top of the earnings distribution; also it is stronger for less-educated workers (those with no more than high school diplomas) and weaker for more-educated workers. The positive effect of automatic enrollment on participation and contributions also is

stronger for black and Hispanic workers than for white workers. Because automatic enrollment did not affect portfolio allocations significantly, and because the effect was strongest among the groups that have lower participation and contribution rates in the absence of automatic enrollment, the overall effect on TSP balances and balance-to-pay ratios is equalizing. Overall, we find that by the fifth year after hire automatic enrollment increased the balance-to-pay ratio of less-educated workers—and for blacks by more than it did for more-educated and white workers. 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.[25]

Keep in mind, however, that in magnitude, the estimated effect of automatic enrollment on the balance-to-pay ratio and the effect on average contribution rates are about 1/20 and 1/5, respectively, as large as the estimated effects of matching. One reason is that automatic enrollment for the federal government was implemented only after employer matching was already in place. Had automatic enrollment been implemented first and only then followed by the introduction of an employer match, the results would probably have been different.[26] Another reason is that even without automatic enrollment, federal employees participate at higher rates than similar workers in the private sector, which could partly explain the relatively weak effect of automatic enrollment.[27] Federal workers might be different from private-sector workers in unobservable ways such as risk aversion, preferences for deferred compensation, or propensity for procrastination and inertia.[28] Also note that we observe the effect of matching on balances only decades after workers were hired, whereas we observe the effect of automatic enrollment 62 months after hire, at most.

V. Estimating the Distribution of Contribution Rates Under Changes to Matching and Default Contribution Rates

In subsection A, we describe the empirical model and the theories we will examine with it. In subsection B, we estimate the various specifications derived from those theories. In the final

[25] We did not find statistically different effects of automatic enrollment on the balance-to-pay ratio between the sexes. Although automatic enrollment increased participation rates of women by less, that is because women were slightly more likely to participate in the TSP in the absence of automatic enrollment.

[26] Beshears and colleagues (2010) find that participation rates under automatic enrollment decline only modestly when the employer match is eliminated or reduced, suggesting a potentially much larger effect of automatic enrollment without an employer match.

[27] For example, using data from Vanguard, Utkus and Young (2015) report an average participation rate of 64 percent and an average employee contribution rate of 7.3 percent among participants in voluntary enrollment plans. In contrast, in our sample of all FERS employees not subject to automatic enrollment, in 2014 the participation and contribution rates were 88 percent and 7.6 percent, respectively. Although Vanguard's recordkeeping data do not cover the whole private sector, as of 2018 it included 4.9 million participants across 10,800 plan sponsors (see Utkus and Young 2018).

[28] For example, Bellante and Link (1981) find evidence that public-sector workers are more risk averse than private-sector workers.

subsection, we use the specification that fits the data best to forecast the effect of further changes to both the matching and default contribution rate.

A. Empirical Approach to Estimating the Distribution of Contribution Rates

We develop a discrete choice model that allows us to illustrate the effects of matching contribution and default rates on the distribution of employee contribution rates. Because matching contributions are generally nonlinear functions of employee contribution rates, estimates of average effects are rarely sufficient for forecasting the cost of changes in the match. Our procedure, however, allows us to forecast the distribution of employee and matching contributions under counterfactual policies that change the match and the default contribution rate. The behavior of most workers is explained by a hazard model. Before that step, we use another discrete choice model to separate the workers whose behavior fits the hazard paradigm from workers who do not choose a contribution rate. That two-step procedure can be specified to accommodate neoclassical models of utility maximization or theories from behavioral economics.

Hazard Model. To explain the distribution of contribution rates, we estimate the hazard function, which is typically used to estimate spell-duration distributions but has also been used to estimate wage distributions by Donald, Green, and Paarsch (2000). For any nonnegative random variable Y, the hazard function is the ratio of the density $f(y)$ at y to the probability that Y is at least as large as y, the latter equaling one less the cumulative distribution function.

$$h(y) = f(y)/\Pr(Y \geq y) = f(y)/[1 - F(y)] \tag{2}$$

Thus, it is natural to estimate the hazard function conditional on the observations having values at least as large as y, which allows it to be a flexible function of the covariates (Meyer 1990) while producing estimates of $f(y)$ that are within the range [0, 1] and sum to 1. For example, the approach is flexible enough to accommodate the spikes in the distribution of contribution rates at multiples of five. In addition, it can accommodate the behavior predicted by neoclassical models or models from behavioral economics. Estimates of the distribution of contribution rates can be recovered from the estimated hazard rates by using the Kaplan–Meier estimator for the survival function, which does not impose any additional restrictions on the model.

In our general empirical specification for the hazard functions, the probability that worker i contributes k percent of his or her salary in year t is estimated with a binary logit model in which k is any whole number and k^{obs} is the observed choice.[29]

[29] We group observed contribution rates into whole-number bins such that $k = k^{obs}$ if k^{obs} is in $[k, k + 1)$. Most employee contributions are whole numbers when measured as a percentage of their salary, and matching rates are constant from $[k, k + 1)$ for all k.

$$\Pr\left(k_{i,t} = k_{i,t}^{obs} \mid k_{i,t} \leq k_{i,t}^{obs}, k_{i,t} < k_{i,t}^{max}\right) =$$
$$\Pr\left(\tau_k + matching\ fx_{i,t,k} + default\ fx_{i,t,k} + X_{i,t,k}\gamma_{i,t,k} > \varepsilon \mid k_{i,t} \leq k_{i,t}^{obs}, k_{i,t} < k_{i,t}^{max}\right) \quad (3)$$

For each worker in each year of federal employment, an observation is included for each rate *k* that he or she considers contributing above. Per the survival paradigm, the model can be viewed as representing a sequence of choices. For example, a worker who contributes 3 percent is viewed as choosing to contribute more than zero percent, 1 percent, and 2 percent but not more than 3 percent. Because the worker was not willing to contribute more than 3 percent, he or she is not viewed as a candidate for choosing to contribute in excess of rates higher than 3 percent. Thus, the model is estimated only for *k* less than or equal to k^{obs}. In addition, we do not view workers whose contribution rates equal k^{max}, the maximum amount allowed by the IRS, as having chosen to not contribute above that rate. For other contribution rates, we model the worker's choice as a function of a flexible baseline that captures average behavior in the absence of matching and default effects and as a function of deviations from that baseline attributable to the availability of matching contributions *matching fx*, default effects *default fx*, and the worker's characteristics *X*. We measure the flexible baseline hazard τ by including an indicator for each contribution rate [that is, $1(k = k^{obs})$]. The various specifications for the matching and default effects are explained in subsection B. The included worker characteristics *X* are polynomials in job tenure, age, and salary as well as indicators for black, Hispanic, female, and three categories of educational attainment.[30] Each of those characteristics is interacted with the indicators for the contribution rates.

"Nonchoosers." In recent studies, researchers have found heterogeneity in savings behavior that the hazard paradigm might be ill-suited to explain (for example, Chetty et al. 2014). Specifically, workers who behave passively might contribute at the default rate without evaluating whether they should contribute at lower rates. Thus, asserting that they are willing to contribute in excess of those lower rates, as the hazard paradigm implies, might be inappropriate. Instead of forcing those "nonchoosers" into that paradigm, we identify them probabilistically and move them to the new default rate in the policy simulations. In addition, we reweight the sample for the hazard model so that it is representative of "choosers."

We define nonchoosers as workers who would remain at the default rate regardless of whether it is 3 percent or zero percent, and we identify them from the increase in nonparticipation at a default rate of zero percent relative to a default rate of 3 percent. Specifically, we estimate the probability that a worker is a nonchooser by using a logit models to compare nonparticipation rates at default rates of 3 percent and zero percent. We generally model the probability of not contributing as a function of the default rate *d* and the same characteristics included in the hazard

[30] As is common in the literature, job tenure gives the amount of time that has elapsed since the employee first had the opportunity to contribute. Thus, job tenure will differ from the length of the current job spell for employees who were hired before 1987, when TSP was established.

model. However, instead of including job tenure as a covariate, we estimate separate equations for each value of that factor to better capture its interactions with the other characteristics.

$$\begin{aligned}\Pr\left(k_{i,t}^{obs}=0 \mid d,X\right) &= \Pr\big(\delta_{0,l}+\delta_{1,l}1(d_{i,t}=0)+X_{i,t}\delta_{2,l}+1(d_{i,t}=0)X_{i,t}\delta_{3,l} \\ &\quad > \epsilon_{i,t} \mid Tenure=l\big)\end{aligned} \tag{4a}$$

For each value of the covariates, we interpret the difference between the estimated nonparticipation rates as the probability of workers with those covariates being nonchoosers.[31]

$$\widehat{\Pr}(nonchooser \mid X)=\widehat{\Pr}(k^{obs}=0 \mid d=\ 0,X)-\widehat{\Pr}(k^{obs}=0 \mid d=\ 3,X) \tag{4b}$$

For the hazard analysis, we use an approach analogous to inverse probability weighting to make the sample representative of the population of workers who would make an election under at least one of the default rates, whom we term choosers.[32] That is equal to the portion of workers at the specified contribution rate who are choosers.

$$\Psi\left(k_{i,t}^{obs},d,X\right)=\Pr\left(chooser \mid k_{i,t}^{obs},d,X\right)=1-\Pr\left(nonchooser \mid k_{i,t}^{obs},d,X\right) \tag{4c}$$

Thus, given our estimates for the probabilities of participation and estimates from an analogous model for the probability of contributing 3 percent, we calculate the weights for workers who contribute at default rates as one less the portion of workers at that rate who are nonchoosers.

$$\widehat{\Psi}(k^{obs},d,X)=1-\frac{\widehat{\Pr}(nonchooser \mid X)}{\widehat{\Pr}(k^{obs}=d \mid d,X)} \tag{4d}$$

Because all workers at other contribution rates have made an election, they have weights of one. However, we reweight the workers at all contribution rates by a factor of one over one minus the probability of being a nonchooser so that the predicted densities integrate to one.

Three Theoretical Models of Savings Behavior. Researchers have employed a wide array of theoretical models in their attempts to explain the amounts that workers contribute to their DC accounts. Prominent examples include Englehardt and Kumar (2007), who use a neoclassical model of lifecycle utility maximization to examine responses to the availability of matching contributions, and Bernheim, Fradkin, and Popov (2015), who use models of psychological anchoring and inattentiveness to explain responses to default contribution rates. We use our

[31] Note that our approach will imply negative masses at a default rate of 3 percent if the difference in the probability of workers contributing zero percent is larger than the difference in the probability of workers contributing 3 percent. That does not occur when we use broader categorizations of the worker characteristics than in our hazard specifications, and the occurrences of it under the more detailed categorization can be attributed to small cell sizes.
[32] Under inverse probability weighting the weights are the inverse of the probability that an observation in the sample is in a select group. In contrast, we weight by the probability that the workers are in the population of interest because we want to make the broad sample representative of a select group.

empirical model to test variants of those three theories. This subsection summarizes the predictions of those theories. The next subsection describes the empirical specification we employ to test them.

In neoclassical models, workers respond to changes in the price of consumption during retirement while smoothing consumption over their life cycle. On the one hand, matching contributions can cause workers to contribute more of their salaries to their DC accounts by decreasing the price of retirement consumption relative to that of contemporaneous consumption. On the other hand, matching contributions increase life cycle income, which can cause workers to reduce their contributions in order to consume some of the additional income before retirement. In contrast, default rates do not directly change life cycle income or the price of retirement consumption and thus affect only the amount workers contribute if choosing a contribution rate is costly.

In anchoring models, workers gravitate toward a focal point of little relevance from the decision they would have made in its absence. Bernheim, Fradkin, and Popov (2015) examine whether the default contribution rate serves as such an anchor, and Madrian (2012) suggests that the matching threshold (that is, the minimum contribution necessary to get the entire match) might be an anchor. Workers facing the complex decision of how much to save might gravitate toward those rates, interpreting them as an implicit recommendation from their employer. Some of those workers might not contribute at the anchor because they also place weight on other information, but they move toward it.

In models of inattentiveness, workers remain at the default rate if they believe that choosing a rate is not consequential enough. For example, workers might stay at the default rate because they suspect that it is similar to the rate they would choose if they undertook the costly task of collecting additional information. Thus, like anchoring models, models of inattentiveness allow for many workers remaining at the default rate or choosing the matching threshold. Inattentive workers might choose the matching threshold because they easily determine that they should not forgo matching contributions but think that determining how much more than that they should contribute would be costly.

In some respects, the predictions of inattentiveness models differ substantially from those of anchoring models. Under inattentiveness, workers are less likely to contribute at rates close to the default rate because the smaller differences between those rates and the default rate reduce the consequences of making an election. In contrast, anchors could draw workers who would have made different elections in their absence. In fact, lab experiments have shown that anchors substantially affect subjects' responses to questions even when the anchors are outside the range of plausible answers (Chapman and Johnson 2002).

B. Estimates of the Effect of Matching and Default Rates on the Distribution of Contribution Rates

We begin this section by examining the prevalence of intertemporal substitutions. Finding it to be of little relevance, we focus the neoclassical specification for the effects of the match on responses to differences in the price of savings. We find that a specification that treats the matching threshold as an anchor fits the data better. Neoclassical theory also fails to adequately explain the effect of the default contribution rate on employee contributions. In contrast, a specification that allows for both anchoring and inattentiveness explains the responses to the change in the default rate.

Intertemporal Substitution. In neoclassical models of intertemporal utility maximization, an increase in saving that stems from a decrease in the price of saving is partially offset by workers smoothing consumption over their life cycle. According to several studies, such smoothing "crowds out" a substantial portion of the saving increase from matching contributions or preferential tax treatment (Gale and Scholz 1994; Engelhardt and Kumar 2011), but other studies find little evidence of any crowd out (Poterba, Venti, and Wise 1996; Gelber 2011). Our examination of the switch from CSRS to FERS produces no evidence of crowd out from matching contributions. In addition, two exogenous shocks to workers' life cycle income appear to have had little effect on the amount they contribute to TSP.

Our comparisons of employee contributions between workers in CSRS and FERS are inconsistent with the prevalence of intertemporal substitution. First, combined DB pension and Social Security wealth is about 20 percent higher for the first FERS cohort than the last CSRS cohort, on average (see Table 8). Yet the FERS cohort contributes about 50 percent more to their TSP accounts. That increase is not driven by matching contributions lowering the price of saving in FERS because the first FERS cohort is more likely to contribute above the matching threshold than the last CSRS cohort and contributes more conditional on being above that threshold. Second, because including Social Security makes the combined DB and Social Security wealth in FERS more progressive than the CSRS DB pension, models of consumption smoothing predict that TSP crowd out should be more prevalent among lower-salaried workers in FERS. However, lower-salaried workers in the first FERS cohort contribute about 65 percent more than lower-salaried workers in the last CSRS cohort. Those differences exist despite supplementary data indicating that the match under FERS does not crowd out other sources of retirement income. Specifically, workers in FERS are about as likely as workers in CSRS to report that personal savings, nongovernment retirement plans, and home equity will be important sources of retirement income (Federal Thrift Retirement Investment Board 2008).

We find additional evidence for lack of intertemporal substitution in our data by analyzing changes in workers' TSP contribution rates after two exogenous changes to income. One such change is the increase in required employee contributions to the DB plan for FERS workers hired in 2013. Federal employees under FERS hired before 2013 contribute 0.8 percent of their salaries

to the DB pension, whereas FERS employees hired in 2013 contribute 3.1 percent. With the increase in required DB contributions resembling a permanent negative income shock, standard neoclassical theory would suggest a decline in consumption and a proportional decline in saving in the form of lower employee contributions to TSP. Given that on average federal employees have about 20 percent of their compensation deferred until retirement, we would expect a 2.3 percent decline in income to translate to a decline of about 0.5 percentage points in employee TSP contribution rates.[33] Instead, the estimated difference in contribution rates is only 0.1 percentage points, or about one-fifth as large (see Figure 6 and Table A5 in the appendix).

The temporary reduction in the employee share of payroll taxes in 2011 and 2012 is another policy-related change in income that we use as a source of exogenous variation to test for intertemporal substitution. The Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 reduced the employee Social Security tax rate from 6.2 percent to 4.2 percent of wages under the Social Security taxable maximum. That reduction was further extended to 2012. Because workers under CSRS do not participate in Social Security and do not pay payroll taxes, the change affected only workers under FERS, who experienced on average a 2 percent increase in their after-tax income in 2011 and a 2 percent decline in 2013 when the temporary reduction in the payroll tax expired. In contrast, workers under CSRS did not see a similar change in income. With the temporary decrease and then increase in payroll taxes resembling a transitory positive, followed by a transitory negative income shock, standard neoclassical theory would suggest a negligible effect on consumption and a one-for-one response in saving. In contrast, as Table A6 in the appendix shows, the response in consumption is strong, and at most a weak response is present in employee contribution rates and saving. The strongest effect on contribution rates is found in the second year after an income increase. A 10 percent increase in income is estimated to increase in TSP contribution rates of 0.35 percentage points.

Effect of the Employer Match. We estimate the effect of matching rates on the distribution of employees' contribution rates by using two specifications of equation (1). The first specification allows us to evaluate whether behavior adheres to utility maximization under a convex budget set by examining whether employees respond to changes in the price of retirement savings. With the second specification, we examine whether behavior can be explained by the predictions of anchoring or inattentiveness models.

Utility Maximization With a Convex Budget Set. The standard neoclassical model of utility maximization leads to several predictions on the effect of the match that we test with the hazard model. The changes in the price of retirement consumption created by the changes in the matching rate (that is, the amount of employer match for an additional dollar of employee contributions) leads to a convex budget set. If preferences between retirement and contemporaneous consumption adhere to conventional conditions, the model predicts that

[33] Falk (2012) compares contemporaneous and deferred compensation for federal workers.

workers are more likely to contribute at the kinks where the matching rate changes and are less likely to contribute in the segments where the matching rate remains elevated (see Figure 7). We test those predictions by parameterizing the *matching fx* in equation (1) so that it allows the hazard rate to change at those points.

$$\begin{aligned} matching\ fx^{u}_{i,k} &\stackrel{\text{def}}{=} \beta_1^{m,u} price_{i,k} + \beta_2^{m,u} price_{i,k}^2 + \beta_3^{m,u} \%\Delta price_{i,k} + \beta_4^{m,u} \%\Delta \text{price}_{i,k}^2 \\ &+ \beta_5^{m,u} 1(k=0) \times price_{i,k}, \text{where } price_k = \frac{1}{1 + matching\ rate_k} \end{aligned} \tag{5a}$$

In that equation, *price* gives the price of consumption during retirement relative to that of contemporaneous consumption.[34] To capture the change in that price for the first dollar contributed, which is undefined in percentage terms, we interact an indicator for nonparticipation with the *price*. Standard neoclassical models predict a negative coefficient for that indicator because the kink in the budget constraint is less acute for workers eligible for the match.[35] We estimate the specification by using data for workers hired within a year of the switch from CSRS to FERS. We do not incorporate default effects because all those workers had the same default rate. The estimates adhere to some of the model's predictions—specifically, match-eligible workers are less likely to not participate, less likely to contribute at rates where additional contributions would be fully matched, and more likely to contribute at the rate where the match ceases—but not the other two (see Figure 7). Overall, we estimate that the match causes a small increase in the average employee contribution rate (see Table 9), similar to findings of Engelhardt and Kumar (2007).

Anchoring and Inattentiveness. We accommodate the two theories from behavioral economics by allowing the prevalence of a contribution rate to depend on its distance from the matching threshold *h*, which we view as zero for workers ineligible for the match. Specifically, we include in the matching effects of equation (1) a polynomial in distance above *h*, an indicator for workers who contribute at a rate below *h*, and indicators for workers who contribute at rate *h*.[36]

$$\begin{aligned} matching\ fx^{b}_{i,k} &\stackrel{\text{def}}{=} \beta_1^{m,b} \min(k-h,0)_{i,k} + \beta_2^{m,b} \min(k-h,0)^2_{i,k} + \beta_3^{m,b} 1(k<h)_{i,k} \\ &+ \sum_h \delta_h^{m,b} 1(k=h)_{i,k} \end{aligned} \tag{5b}$$

[34] We make the specification of the relationship between employees' contributions and the price of savings as flexible as possible by setting the order of the polynomials so that the coefficients are just identified.

[35] We do not provide estimates of the coefficients because they generally correspond to hypotheses about the hazard rates, whereas the theories we explore make predictions about the density. Instead, we recover differences in the densities from the estimated hazard function by estimating the survival function.

[36] We use an indicator for rates below *h* instead of the distance below because we suspect that the effect of distance below would extrapolate poorly in forecasting outcomes under prospective policies with higher matching thresholds.

Models of anchoring can justify more general specifications, but we have chosen to match the number of parameters in the neoclassical specification. The specification allows for inattentiveness because $\beta_1^{m,b} < 0$ and $\beta_2^{m,b} > 0$ could correspond to a model in which electing a rate is more consequential for workers who would prefer their contributions to exceed the matching threshold by a larger amount.

The differences between the predicted distributions of contribution rates are consistent with anchoring and offer insight into how workers would behave without the anchors. Generally, workers appear to be pulled toward the matching threshold (see top panel of Figure 8). Workers in the last CSRS cohort are more likely to contribute nothing than workers in the first FERS cohort. The last CSRS cohort also is more likely to contribute at rates slightly above zero, which defies the predictions of models of inattentiveness (and neoclassical models). One possibility is that workers interpret the absence of a match as indicating the DB pension under CSRS provides enough savings, despite its generosity actually being similar to that of the DB pension and Social Security benefits received by workers in FERS. Also evident is additional mass at 5 percent for the first FERS cohort. The behavior of higher contributors also appears to be affected by the anchors. Note that the frequency with which the CSRS cohort contributes 10 percent is similar to that with which the FERS cohort contributes 15 percent, whereas the masses at 15 percent differ greatly between the two cohorts. More generally, for *k* greater than 5 percent, the mass for the CSRS cohort is similar to the mass for the FERS cohort at *k* plus 5 percentage points, and 5 percentage points is also the distance between the matching thresholds. That relationship could result from workers who would have contributed a large portion of their salaries being pulled down toward their respective matching threshold. We explore that hypothesis by trying to gain more insight into how workers behave in the absence of anchors.

Another way of exploring whether the matching threshold serves as an anchor is to compare FERS employees who set their contributions as a percentage of their salary with FERS employees who set a dollar amount per pay period. The latter group is unlikely to be guided by the matching threshold because they set their election in different units. That supposition is supported by Kahneman and Knetsch (1993), who find that an anchor in dollars affects later judgments about dollar values but not percentage values.[37] Comparing FERS workers who made their elections in different scales has two advantages over the CSRS-with-FERS comparison. First, it allows us to examine the effect of the match early in a worker's career. Second, it allows us to compare a distribution that we view as having no relevant anchors to the distribution anchored by the matching threshold. A disadvantage is that the two groups of workers are less similar—the workers who contribute a percentage of their salary tend to be higher paid, more educated, and younger. However, those differences are small enough that they can account for only a small portion of the differences in the distribution of contribution rates. For this analysis,

[37] See Chapman and Johnson (2002) for a description of Kahneman and Knetsch (1993) research.

we drop workers who do not contribute or who contribute the maximum allowed by the IRS because which scale they consider is unclear.

Like the comparison between CSRS and FERS, the second comparison indicates that many workers anchor to the matching threshold (see Figure 9). Examining the distribution for workers who elect a dollar amount validates the identification strategy because no spike exists at the matching threshold. In contrast, the distributions for workers who elect a percentage exhibit a substantial spike at the threshold for all values of job tenure. It appears as though the additional workers at the matching threshold would have contributed in the ranges of 1 percent to 4 percent or more than 10 percent without the anchor. Workers who elect a percentage are 69 percent less likely to contribute in the 1 percent to 4 percent range and 57 percent less likely to contribute more than 10 percent during their first year in TSP. The latter gap falls to 26 percent for workers who are in the plan for 25 years, suggesting that workers adjust away from the anchor as they have more time to consider their choice.

The anchoring specification yields a much larger estimate for the effect of the matching rate on employee contributions and fits the data better than the neoclassical specification. The estimate of the average effect from the anchoring specification is over 10 times larger than the estimate from the neoclassical specification because the latter cannot account for the differences in the distributions above the matching threshold (see Table 9). However, those differences have little effect on the amount of matching contributions. Thus, offering the match is a far more cost-effective way for employers to increase employee contributions when anchoring is considered. The anchoring specification also yields predicted distributions of employee contribution rates that account for 96 percent of the squared differences between the observed distributions for the last CSRS cohort and first FERS cohort (see Figure 8). In contrast, the neoclassical specification accounts for 88 percent of those observed differences.

Effect of the Default Rate. We examine whether neoclassical theory, anchoring, and inattentiveness can account for the differences in contributions between employees facing default rates of zero percent and 3 percent.

Utility Maximization With Opt-Out Cost. Following recent research, we consider a neoclassical model in which the default contribution rate can affect savings because choosing a contribution rate is costly to the employee. Such transaction costs appear small because federal employees can elect a contribution rate online or by submitting a one-page form. For the model to fit the data, the transaction costs must exceed the benefits of contributing at a nondefault rate for a substantial portion of the workforce because the probability of participation increased by 40 percentage points for recent hires after the default rate was raised above zero percent..

Using two methods for measuring the benefits of contributing at a higher rate, we find that the transaction costs needed for a neoclassical model to fit the data are implausibly large. DellaVigna (2009) suggests measuring the benefits of contributing more than the default rate as

the amount of matching contributions forgone when a worker remains at that rate. At the average salary in our sample, that cost of not electing a rate when the default rate is zero is about $2,580 in forgone matching. The validity of that measure rests on several simplifying assumptions and, in particular, may overstate the net benefits for workers who face liquidity constraints. Instead, Bernheim, Fradkin, and Popov (2015) infer the benefits of the additional contributions from the bunching of employee contribution rates at the percentages where the matching rate changes. We examine bunching at a contribution rate of 3 percent, focusing on workers who face a default contribution rate of zero percent to avoid conflating the effects of matching and the default rates. Recall that the matching rate falls from 100 percent to 50 percent at a contribution rate of 3 percent, whereas the matching rate is constant at contribution rates of 2 percent and 4 percent. However, the amount of mass at 3 percent is only slightly higher than the masses at the adjacent percentages (see Figure 10),[38] which implies that demand for TSP saving is inelastic near that point and thus that the inframarginal benefits of contributing up to 3 percent are high. So transaction costs must also be high for participation to be so much lower when the default rate is zero percent.

Anchoring and Inattentiveness. The default contribution rate might serve as an anchor that workers are drawn toward, as the matching threshold appears to do, or inattentiveness might lead to workers choosing to remain at the default rate because they do not view making an election as consequential enough. Both stages of our two-step estimation process yield insight into how well those theories fit the data.

Before estimating the hazard model, we infer the likelihood of workers contributing at the default rate regardless of whether it is zero percent or 3 percent. Using equation (2), we estimate that 26 percent of workers are nonchoosers during their first year on the job and that the probability falls to 12 percent by the fifth year. The extent to which workers move away from the default rate as their job tenure increases is difficult for us to reconcile with models of inattentiveness because we cannot think of a reason that electing a rate would rapidly become more consequential. However, that behavior is consistent with anchor-and-adapt models, in which workers tend to move away from the anchor as they have more time to evaluate their decision. In those models, workers shift from the anchor toward more informed choices over time as they continue evaluating their options.

Turning to the hazard-based analysis of choosers' behavior, we accommodate theories of anchoring and inattentiveness by allowing the prevalence of a contribution rate to depend on its distance from the default rate d. Specifically, we include in the default effects of equation (1) a polynomial in distance above d, an indicator for workers who contribute at a rate below d, and

[38] In contrast, more bunching occurs at 5 percent among match-eligible workers, but that could be the result of anchoring instead of inelastic demand.

indicators for workers who contribute at the default rate.[39] We allow the effect of all those factors to vary with years of job tenure to allow choosers to adjust away from the default rate over time.

$$default\ effects^{b}_{i,k,l} \stackrel{\text{def}}{=} \beta^{d,b}_{1,l} \min(k-d, 0 \mid l)_{i,k} + \beta^{d,b}_{2,l} \min(k-d, 0 \mid l)^2_{i,k} + \beta^{d,b}_{3,l} 1(k < d \mid l)_{i,k} + \sum_{d} \delta^{d,b}_{d,l} 1(k = d \mid l)_{i,k} \quad (6)$$

The model fits the data well and gives an estimate for the average effects of the default rate on contributions that is similar to earlier findings (for example, Choi et al. 2002; 2004). We find that the increase in the default rate raised the average employee contribution rate by 0.5 percentage points among the adjacent cohorts during their first five years of service (see Table 10). The average effect on matching contributions is of a similar magnitude because employee contributions are matched 100 percent up to the new default rate. Underlying those estimates of average effects are predicted distributions of employee contribution rates under both default rates. The squared differences between those predicted distributions account for 99.8 percent of the squared differences between the observed distributions.

The predicted differences in contribution rates could result from a combination of inattentiveness and anchoring, but the underlying sources of the heterogeneity in behavior are unclear (see Figure 10). Consistent with inattentiveness, workers in the first cohort with a default rate of 3 percent are less likely to contribute 1 percent or 2 percent than workers in the last cohort with a default rate of zero percent. However, little evidence exists of such a difference above the default rate. That observation seems at odds with inattentiveness because raising the default rate to 3 percent probably decreases the consequence of making an election for workers who would elect a rate above it. For example, by not making an election, a worker who would elect 4 percent gives up 0.5 percent in matching contributions at a default rate of 3 percent, compared with 3.5 percent at a default rate of zero percent. One possibility is that anchoring toward the default rate by workers who would contribute substantially more than 3 percent without a default effect offsets the behavior of workers who would have contributed slightly more than 3 percent if they thought that making an election was worth their attention.

Applying the model to workers of all job tenures substantially reduces our estimates of the effects of increasing the default rate. Like past researchers, we are limited in how long we can monitor the behavior of workers in adjacent cohorts. However, the 5 years of data we do have for them indicates that the average probability of being a nonchooser is asymptotically approaching 3 percent. Specifically, we estimate that the portion of workers who are nonchoosers has fallen to

[39] We do not include an indicator for workers who contribute zero percent when it is the default rate because we reweight the sample to exclude those workers from the choosers.

12 percent at 5 years of tenure, and we project that it will be near 3 percent at 15 years of tenure. Having incorporated that extrapolation into the model, we calculate counterfactual rates of contribution for all the cohorts. The resulting forecast is that the increase in the default rate will raise employee contributions by 0.3 percentage points, on average.

C. Forecast for a Simultaneous Change to the Matching and Default Contribution Rates

We use the behavioral specifications that we tested in the previous section to forecast the effects of simultaneously doubling the maximum match and the default contribution rate. Specifically, we forecast the effects of raising the default rate to 6 percent while matching 100 percent of the first 6 percent employees contribute and 50 percent of the next 4 percent they contribute. We obtain those forecasts by simultaneously including the *matching* fx^b and *default* fx^b specifications in the hazard model (equation 1). We estimate the model and forecast the effect of the policy by using the broad sample of federal employees so that we measure average effects across the relevant ranges of age and job tenure.

We forecast that the policy will substantially increase both employee and matching contributions, with the higher matching rates causing most of those increases (see Table 11). Under our model, the rise in matching rates causes many workers who would have contributed 5 percent to shift to the new matching threshold of 10 percent (see Figure 11). By raising the anchor, the policy also increases the portion of the workforce that contributes between 11 percent and 20 percent. In total, the increase in the matching rate is forecast to increase the employee contribution rate by 1.3 percentage points, on average. In contrast, we forecast that raising the default rate to 6 percent increases average employee contributions by 0.4 percentage points, by causing some employees who would have contributed 3 percent to 5 percent to switch to the new default rate.

We hesitate to apply our fitted specifications to larger changes in matching contributions or the default contribution rate. In particular, we cannot quantify nonlinearity in the effects of the matching and default rates because our data include only one change to each of those features. A nonlinearity examined in the research is whether setting the default rate well above most workers' preferred rate drives more of them to make elections by increasing the importance of doing so. Using data on 86 firms, Choukhmane (2019) finds that raising the default rate by 4 percentage points causes an additional 6 percent of the workforce to contribute below the initial default rate.

VI. Summary and Discussion

Using administrative longitudinal data on federal workers' demographics, compensation, and TSP behavior, we estimate the effects of the employer match and plan default options on workers' TSP savings behavior and the cost of employer contributions. To strengthen the causal interpretation of our results, we rely on two sources of exogenous variation stemming from

policy changes to the 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 employee participation rates increased by 22 percentage points after the introduction of the employer match and by 19 percentage points after the introduction of automatic enrollment. Average employee contribution rates to the TSP increased by 3.5 percentage points and 0.6 percentage points after the two policy changes, respectively. The reforms had negligible effect on portfolio allocations. Consistent with previous work, we also find that automatic enrollment increases participation and contribution rates the most for workers least likely to participate in its absence—those in the bottom tercile of earnings, who are not white, and who have lower education. Those categories of workers also are more likely to stick to the default rate and fund.

When modeling the distribution of contribution rates, we find that psychological anchoring explains workers' behavior better than neoclassical theory. We use a specification motivated by anchoring to forecast the effects of simultaneously doubling the match and the default contribution rate. We predict that the policy will substantially increase both employee and matching contributions, with the higher matching rates causing most of those increases.

A limitation of our research is that the anchoring specification is not grounded in deep parameters. In theory, our hazard model could be specified to estimate the distribution of contribution rates in the absence of anchors and to estimate parameters that summarize deviations from that unanchored distribution. However, our data provide only a rough sketch of the unanchored distribution because they cover only a single change to the match and the default contribution rate.

References Cited

Bassett, William F., Michael J. Fleming, and Anthony P. Rodrigues. 1998. "How Workers Use 401(k) Plans: The Participation, Contribution, and Withdrawal Decisions," *National Tax Journal* vol. 51, no. 2 (June), pp. 263–289, https://tinyurl.com/BFR1998.

Bellante, Don, and Albert N. Link. 1981. "Are Public Sector Workers More Risk Averse Than Private Sector Workers?" *ILR Review*, vol. 34, no. 3 (April), pp. 408–412, http://doi.org/10.1177/001979398103400307.

Bernheim, B. Douglas, Andrey Fradkin, and Igor Popov. 2015. "The Welfare Economics of Default Options in 401(k) Plans," *American Economic Review*, vol. 105, no. 9 (September), pp. 2798–2837, http://doi.org/10.1257/aer.20130907.

Beshears, John, James J. Choi, David Laibson, and Brigitte C. Madrian. 2010. "The Impact of Employer Matching on Savings Plan Participation Under Automatic Enrollment," in David A. Wise, ed., *Research Findings in the Economics of Aging*, University of Chicago Press) pp. 311–327, https://tinyurl.com/BCLM2010.

Beshears, John, James J. Choi, David Laibson, Brigitte C. Madrian, and William L. Skimmyhorn. 2017. "Borrowing to Save? The Impact of Automatic Enrollment on Debt" (unpublished manuscript, last modified December 6), https://tinyurl.com/Beshears2017.

Butrica, Barbara A., and Nadia S. Karamcheva. 2015. "Automatic Enrollment, Employer Match Rates, and Employee Compensation in 401(k) Plans," *Monthly Labor Review*, May 2015, https://go.usa.gov/xmmHA.

———. 2018. "Automatic Enrollment and Its Relation to the Incidence and Distribution of DC Plan Contributions: Evidence From a National Survey of Older Workers," *Journal of Consumer Affairs*, version of record published online August 27, https://doi.org/10.1111/joca.12223.

Chapman, Gretchen B,. and Eric J. Johnson. 2002. "Incorporating the Irrelevant: Anchors in Judgments of Belief and Value," in Thomas Gilovich, Dale Griffin, and Daniel Kahneman, eds., *Heuristics and Biases: The Psychology of Intuitive Judgment* (Cambridge University Press), pp. 120–128, https://tinyurl.com/CJGGK2002.

Chetty, Raj, John N. Friedman, Soren Leth-Petersen, Torben Heien Nielsen, and Tore Olsen. 2014. "Active vs. Passive Decisions and Crowd-Out in Retirement Savings Accounts: Evidence From Denmark." *Quarterly Journal of Economics*, vol. 129, no. 3 (August), pp. 1141–1219, http://doi.org/10.1093/qje/qju013.

Choi, James J., David Laibson, Brigitte C. Madrian, and Andrew Metrick. 2002. "Defined Contribution Pensions: Plan Rules, Participant Decisions, and the Path of Least Resistance," in James M. Poterba, ed., *Tax Policy and the Economy*, vol. 16 (MIT Press), pp. 67–114, https://tinyurl.com/CLMM2002.

———. 2004. “For Better or Worse: Default Effects and 401(k) Savings Behavior,” in David A. Wise, ed., *Perspectives on the Economics of Aging* (University of Chicago Press), pp. 81–121, https://tinyurl.com/CLMM2004.

Choukhmane, Taha. 2019. “Default Options and Retirement Saving Dynamics” (unpublished manuscript, last modified January 2), www.tahachoukhmane.com/research/.

Congressional Budget Office. 2017. *Options for Changing the Retirement System for Federal Civilian Workers* (August), www.cbo.gov/publication/53003.

DellaVigna, Stefano. 2009. “Psychology and Economics: Evidence From the Field,” *Journal of Economic Literature*, vol. 47, no. 2 (June), pp. 315–372, http://doi.org/10.1257/jel.47.2.315.

Donald, Stephen G., David A. Green, and Harry J. Paarsch. 2000. “Differences in Wage Distributions Between Canada and the United States: An Application of a Flexible Estimator of Distribution Functions in the Presence of Covariates,” *Review of Economic Studies*, vol. 67, no. 4 (October), pp. 609–633, https://doi.org/10.1111/1467-937X.00147.

Duflo, Esther, William Gale, Jeffrey Liebman, Peter Orszag, and Emmanuel Saez. 2006. “Savings Incentives for Low- and Middle-Income Families: Evidence From a Field Experiment with H&R Block,” *Quarterly Journal of Economics*, vol. 121, no. 4 (November), pp. 1311–1346, https://doi.org/10.1093/qje/121.4.1311.

Dworak-Fisher, Keenan. 2011. “Matching Matters in 401(k) Plan Participation.” *Industrial Relations: A Journal of Economy and Society*, vol. 50, no. 4 (October), pp. 713–737, https://doi.org/10.1111/j.1468-232X.2011.00658.x.

Engelhardt, Gary V., and Anil Kumar. 2007. “Employer Matching and 401(k) Saving: Evidence From the Health and Retirement Study,” *Journal of Public Economics*, vol. 91, no. 10 (November), pp. 1920–1943, http://doi.org/10.1016/j.jpubeco.2007.02.009.

———. 2011. “Pensions and Household Wealth Accumulation,” *Journal of Human Resources*, vol. 46, no. 1 (January), pp. 203–236, http://doi.org/10.3368/jhr.46.1.203.

Even, William E., and David A. Macpherson. 2005. “The Effects of Employer Matching in 401(k) Plans,” *Industrial Relations: A Journal of Economy and Society*, vol. 44, no. 3 (July), pp. 525–549, https://doi.org/10.1111/j.0019-8676.2005.00399.x.

Falk, Justin R. 2012. “Comparing Benefits and Total Compensation Between Similar Federal and Private-Sector Workers,” *B.E. Journal of Economic Analysis & Policy*, vol. 12, no. 1, pp. 176–189, http://doi.org/10.1515/1935-1682.3256.

———. 2015. “Comparing Federal and Private-Sector Wages Without Logs,” *Contemporary Economic Policy*, vol. 33, no. 1 (January), pp. 176–189, http://doi.org/10.1111/coep.12061.

Falk, Justin R., and Nadia S. Karamcheva. 2018. *Comparing the Effects of Current Pay and Defined Benefit Pensions of Employee Retention*, Working Paper 2018-06 (Congressional Budget Office, June), www.cbo.gov/publication/54056.

Federal Thrift Retirement Investment Board. 2008. *2008 TSP Participant Survey Results* (prepared by Watson Wyatt Worldwide), http://go.usa.gov/xQfKA (PDF, 477 KB).

———. 2018. "Annual Report of the Thrift Savings Plan Required by §105 of the TSP Enhancement Act of 2009," https://go.usa.gov/xmmFN (PDF, 647 KB).

Gale, William G., and John Karl Scholz. 1994. "IRAs and Household Saving," *American Economic Review*, vol. 84, no. 5 (December), pp. 1233–1260, www.jstor.org/stable/2117770.

Gelber, Alexander M. 2011. "How Do 401(k)s Affect Saving? Evidence From Changes in 401(k) Eligibility," *American Economic Journal: Economic Policy*, vol. 3, no. 4 (November), pp. 103–122, http://doi.org/10.1257/pol.3.4.103.

Goda, Gopi Shah, Matthew R. Levy, Colleen Flaherty Manchester, Aaron J. Sojourner, and Joshua Tasoff. 2018. "Do Defaults Have Spillover Effects? The Effect of the Default Asset on Retirement Plan Contributions" (paper presented at 20th Annual Joint Meeting of the Retirement Research Consortium, Washington, DC, August 2–3, 2018), https://tinyurl.com/GLMST2018b (PDF, 100 KB).

Huberman, Gur, Sheena S. Iyengar, and Wei Jiang. 2007. "Defined Contribution Pension Plans: Determinants of Participation and Contributions Rates," *Journal of Financial Services Research*, vol. 31, no. 1 (February), pp. 1–32, http://doi.org/10.1007/s10693-007-0003-6.

Kusko, Andrea L., James M. Poterba, and David W. Wilcox. 1998. "Employee Decisions With Respect to 401(k) Plans," in Olivia Mitchell and Sylvester Schieber, eds., *Living With Defined Contribution Pensions: Remaking Responsibility for Retirement* (University of Pennsylvania Press), pp. 98–112.

Lusardi, Annamaria, and Olivia S. Mitchell. 2007. "Baby Boomer Retirement Security: The Roles of Planning, Financial Literacy, and Housing Wealth," *Journal of Monetary Economics*, vol. 54, no. 1 (January), pp. 205–224, doi:10.1016/j.jmoneco.2006.12.001.

Madrian, Brigitte C. 2012. "Matching Contributions and Savings Outcomes: A Behavioral Economics Perspective," in Richard Hinz, Robert Holzmann, David Tuesta, and Noriyuki Takayama, eds., *Matching Contributions for Pensions: A Review of International Experience* (World Bank Publications), pp. 289–309, https://doi.org/10.1596/9780821394922_CH15.

Madrian, Brigitte C., and Dennis F. Shea 2001. "The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior," *Quarterly Journal of Economics*, vol. 116, no. 4 (November), pp. 1149–1187, http://doi.org/10.1162/003355301753265543.

Martin, Patricia P. 2003/2004. "Comparing Replacement Rates Under Private and Federal Retirement Systems," *Social Security Bulletin*, vol. 65, no. 1, https://www.ssa.gov/policy/docs/ssb/v65n1/v65n1p17.html.

Meyer, Bruce D. 1990. "Unemployment Insurance and Unemployment Spells," *Econometrica*, vol. 58, no. 4 (July), pp. 757–782, http://doi.org/10.2307/2938349.

Munnell, Alicia H., Annika Sundén, and Catherine Taylor. 2001/2002. "What Determines 401(k) Participation and Contributions?" *Social Security Bulletin*, vol. 64, no. 3, www.ssa.gov/policy/docs/ssb/v64n3/v64n3p64.html.

Nessmith, William E., Stephen P. Utkus, and Jean A. Young. 2007. "Measuring the Effectiveness of Automatic Enrollment," Vanguard Center for Retirement Research, vol. 31 (December), https://tinyurl.com/NUY2007 (PDF, 259 KB).

Papke, Leslie E., and James M. Poterba. 1995. "Survey Evidence on Employer Match Rates and Employee Saving Behavior in 401(k) Plans" *Economics Letters*, vol. 49, no. 3 (September), pp. 313–317, https://doi.org/10.1016/0165-1765(95)00683-7.

Poterba, James M., Steven F. Venti, and David A. Wise. 1996. "How Retirement Saving Programs Increase Saving," *Journal of Economic Perspectives*, vol. 10, no. 4 (Fall), pp. 91–112, http://doi.org/10.1257/jep.10.4.91.

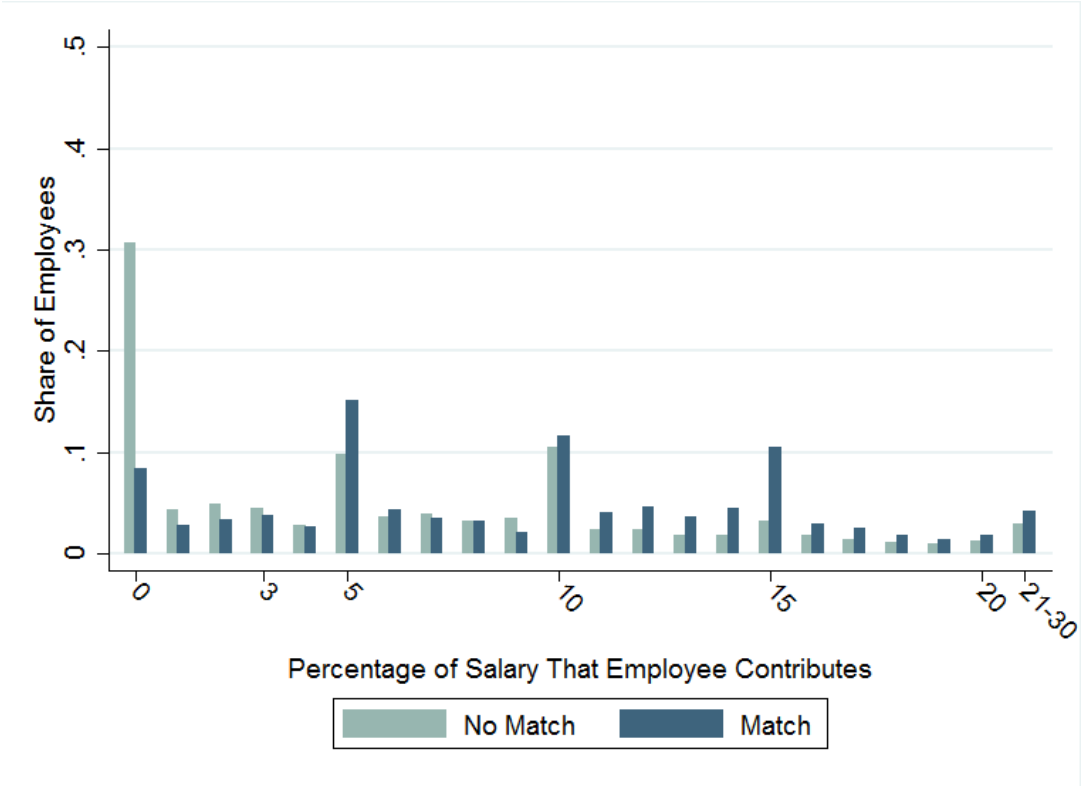
Utkus, Stephen P., and Jean A. Young. 2015. "How America Saves 2015: A Report on Vanguard 2014 Defined Contribution Plan Data." Valley Forge, PA: Vanguard Institutional Investor Group, https://tinyurl.com/Vanguard2015ish [press release with outdated link to source].

———. 2018. "How America Saves 2018: Vanguard 2017 Defined Contribution Plan Data." Valley Forge, PA: Vanguard Institutional Investor Group, https://tinyurl.com/utkusyoung2018 (PDF, 3.5 MB).

VanDerhei, Jack. 2010. "The Impact of Automatic Enrollment in 401(k) Plans on Future Retirement Accumulations: A Simulation Study Based on Plan Design Modifications of Large Plan Sponsors," EBRI Issue Brief no. 341 (April), Washington, D.C.: Employee Benefit Research Institute, https://tinyurl.com/V-EBRI2010 (PDF, 492 KB).

Figure 1. **[Return to Text]**

Distribution of Employee Contribution Rates for Employees With and Without an Employer Match (Adjacent Cohorts)

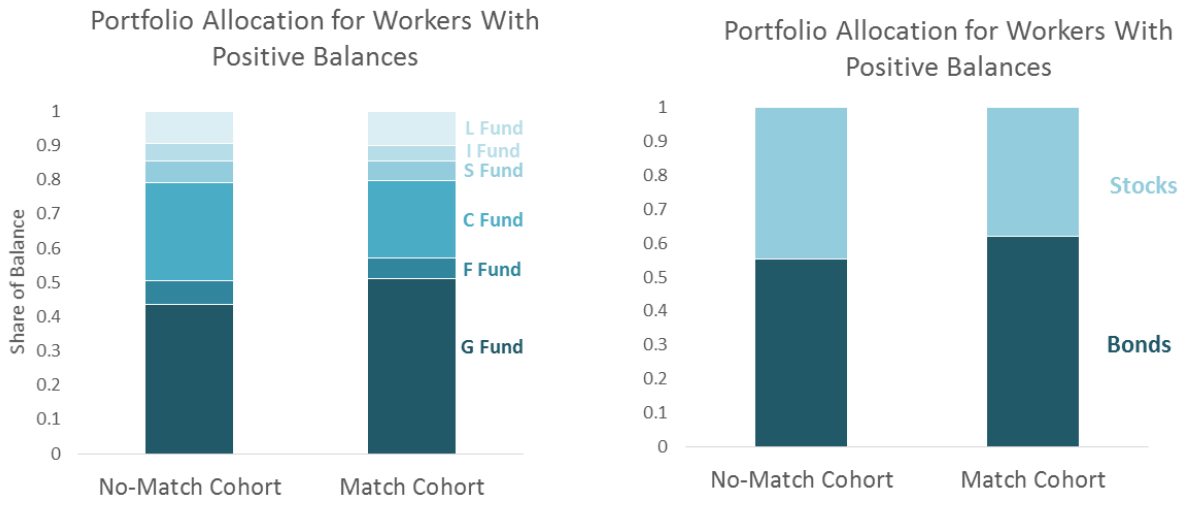


Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

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.

Figure 2. [Return to Text]

Thrift Savings Plan Portfolio Allocations for Employees With and Without an Employer Match (Adjacent Cohorts)



Source: Congressional Budget Office, 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. The L Fund category in the figure includes all lifecycle funds currently available in TSP: L Income, L 2020, L 2030, L 2040, and L 2050.

Figure 3. [Return to Text]

Participation Rate and Average Contribution Rates for Employees Hired Before and After Automatic Enrollment by Tenure (Adjacent Cohorts)

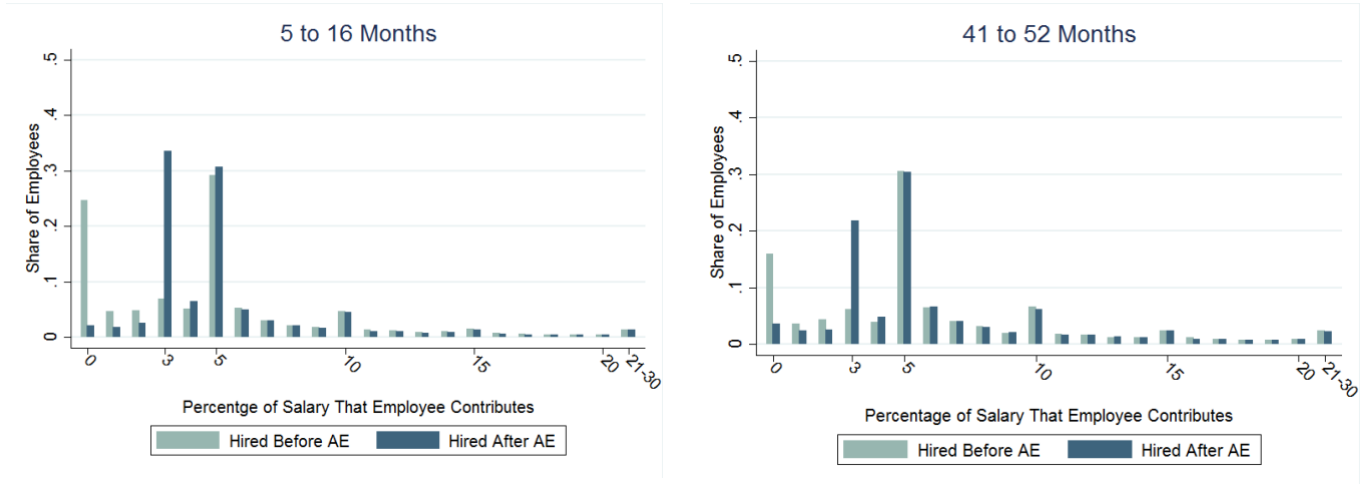
Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

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.

Figure 4. **[Return to Text 1; 2]**

Distribution of Employee Contribution Rates for Employees Hired Before and After Automatic Enrollment (Adjacent Cohorts)



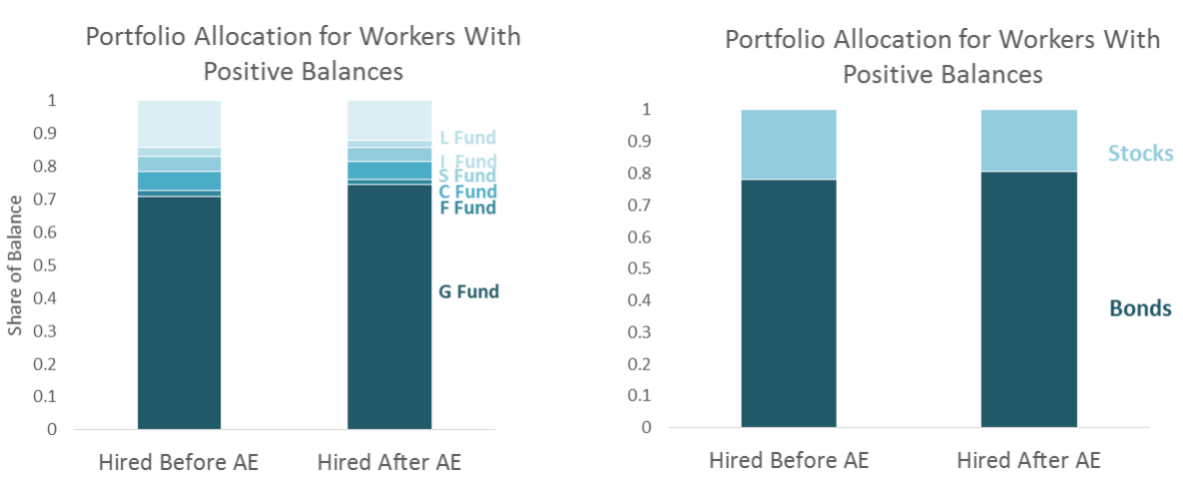
Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

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.

Figure 5. [Return to Text]

Thrift Savings Plan Portfolio Allocations for Employees Hired Before and After Automatic Enrollment (Adjacent Cohorts)



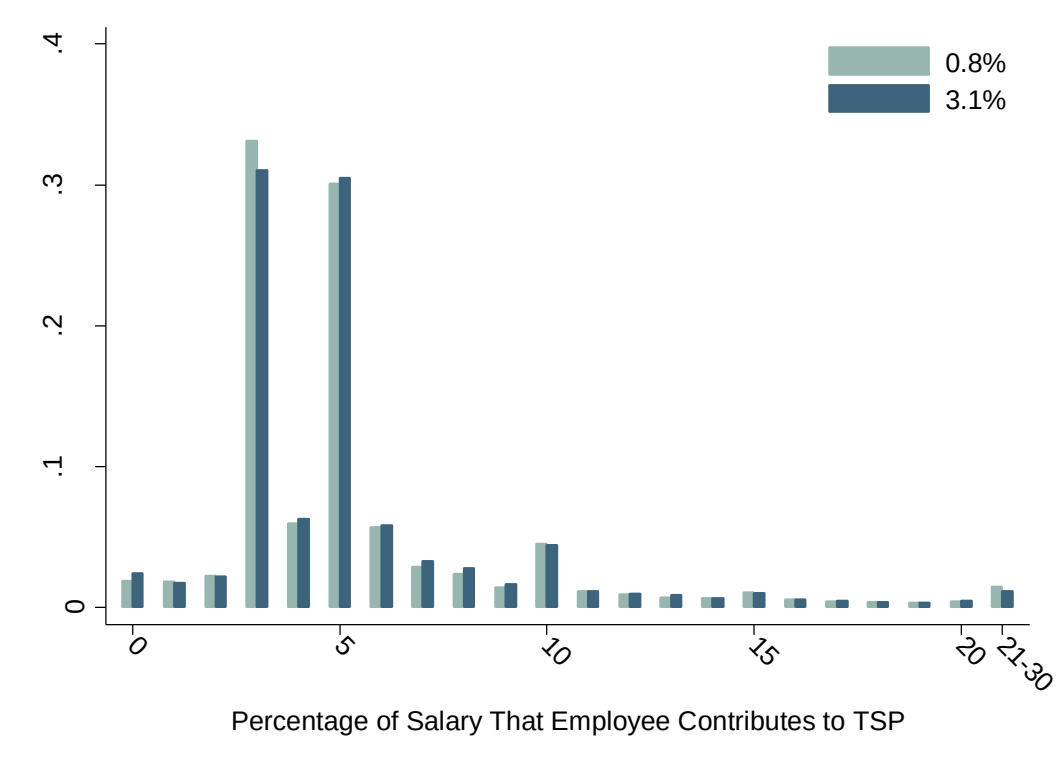
Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

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.

Figure 6. **[Return to Text]**

Employee Contribution Rates to the Thrift Savings Plan, by Percentage of Salary Workers Must Contribute to the Defined Benefit Pension



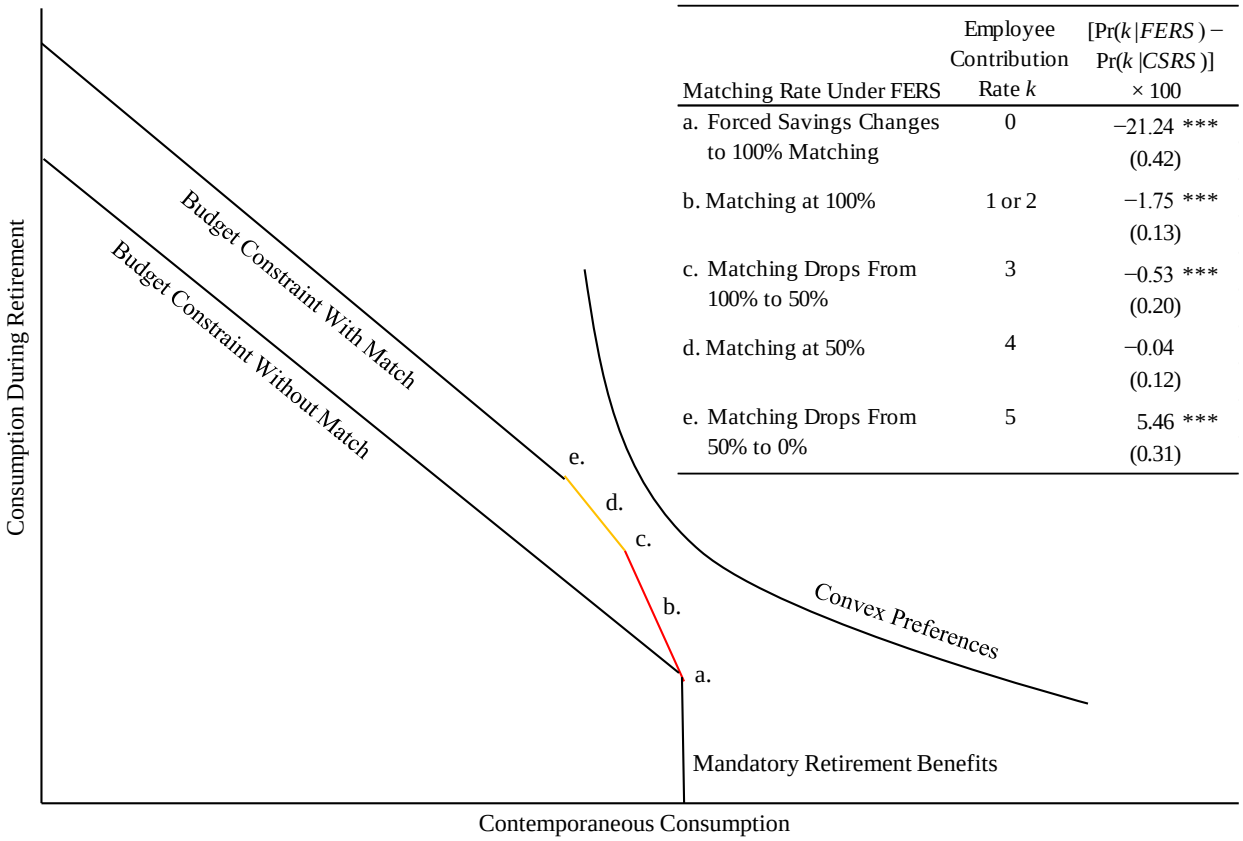
Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Comparison is between workers hired in 2012, who are required to contribute 0.8 percent of salary to the defined benefit pension, and workers hired in 2013, who are required to contribute 3.1 percent.

TSP = Thrift Savings Plan.

Figure 7. **[Return to Text 1; 2]**

Relationship Between Employee Contribution Rates and Price of Savings



Matching Rate Under FERS	Employee Contribution Rate k	$[\Pr(k \mid FERS) - \Pr(k \mid CSRS)] \times 100$
a. Forced Savings Changes to 100% Matching	0	–21.24 *** (0.42)
b. Matching at 100%	1 or 2	–1.75 *** (0.13)
c. Matching Drops From 100% to 50%	3	–0.53 *** (0.20)
d. Matching at 50%	4	–0.04 (0.12)
e. Matching Drops From 50% to 0%	5	5.46 *** (0.31)

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Sample is limited to workers hired in 1983 under the Civil Service Retirement System (CSRS) and workers hired in 1984 under the Federal Employees Retirement System (FERS). Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. Mandatory retirement benefits include the defined benefit pension, Social Security, and automatic employer contributions to the Thrift Savings Plan.

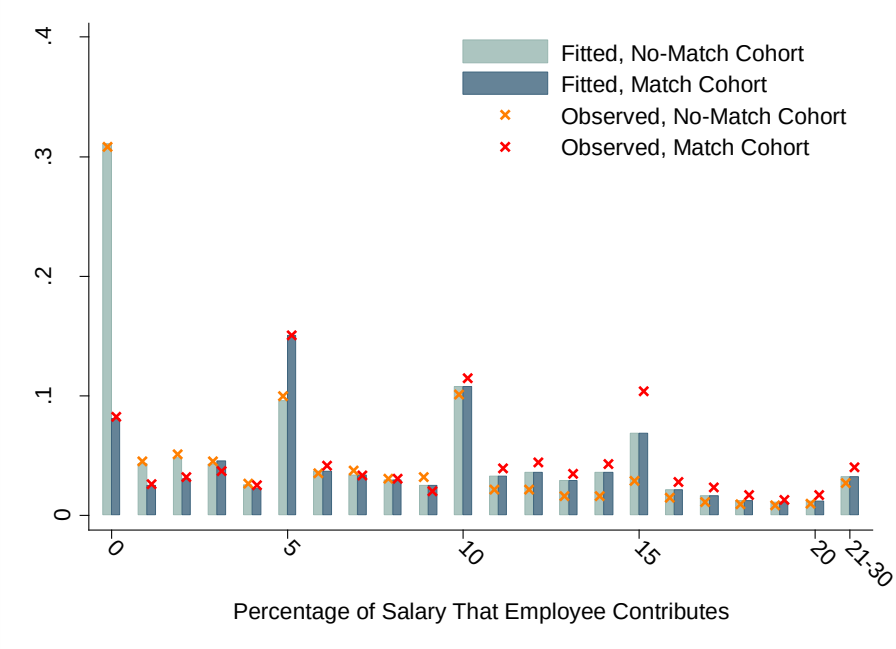
Standard errors are in parentheses.

*** = $p < .01$.

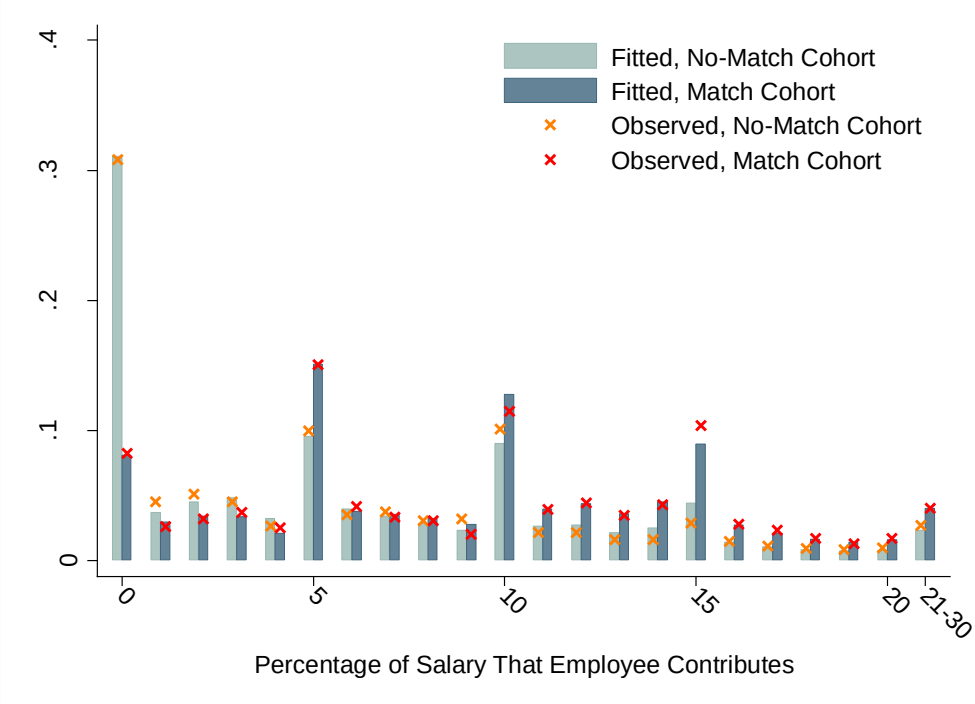
Figure 8. **[Return to Text 1; 2]**

Fit of Specifications for the Effect of the Match on Employee Contribution Rates

Panel A: Neoclassical Specification



Panel B: Anchoring Specification



Source: Congressional Budget Office, 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"). Under FERS, workers are eligible to receive a 100 percent employer match on the first 3 percent they contribute and a 50 percent employer match on the next 2 percent they contribute. By contrast, workers in CSRS are not eligible for an employer match.

Fitted values are estimated using the empirical model described by equation (3). The details of the neoclassical specification and anchoring specification are given by equations (5a) and (5b), respectively.

Figure 9. [Return to Text]

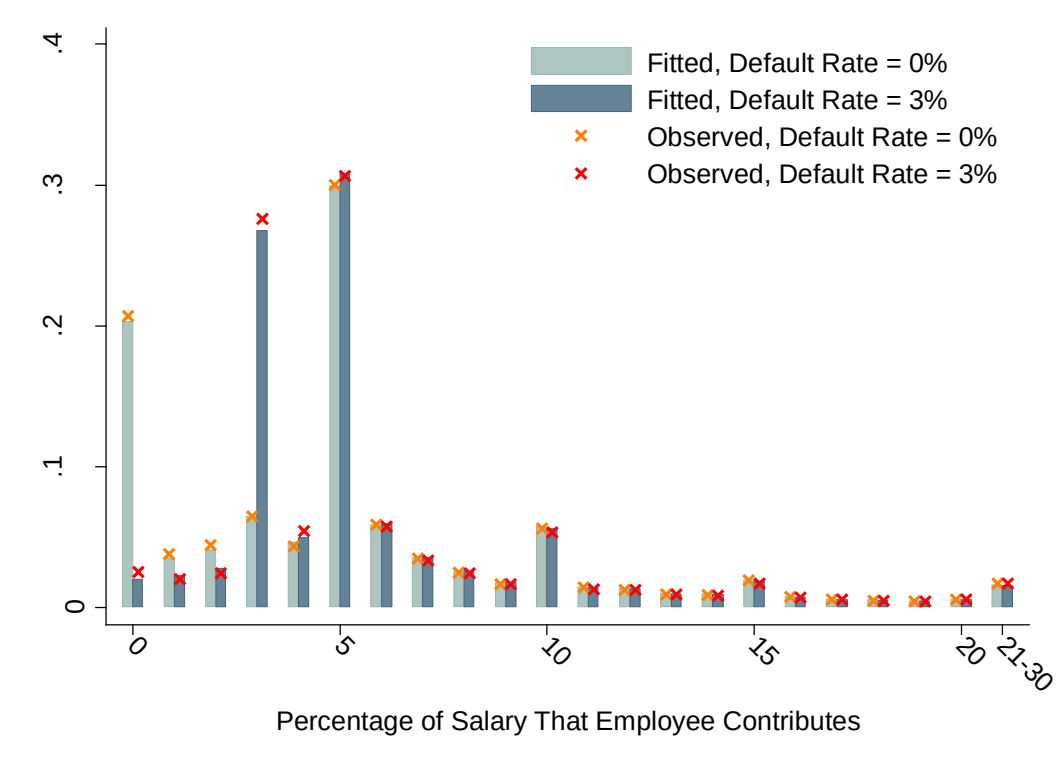
Comparison of Employee Contribution Rates Between Employees Who Make Contributions in Different Units, by Job Tenure

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Workers can set their contributions either as a dollar amount per pay period or as a percentage of their salary. The figures show the observed contribution rates for those two groups of workers. The sample is limited to workers who are eligible for matching contributions and face a default contribution rate of zero percent. We exclude workers who do not contribute or contribute the maximum amount allowed by the Internal Revenue Service because we cannot determine which unit of measure they use.

Figure 10. **[Return to Text 1; 2]**

Fit of Anchoring Specification for the Effect of the Default Rate on Employee Contribution Rates



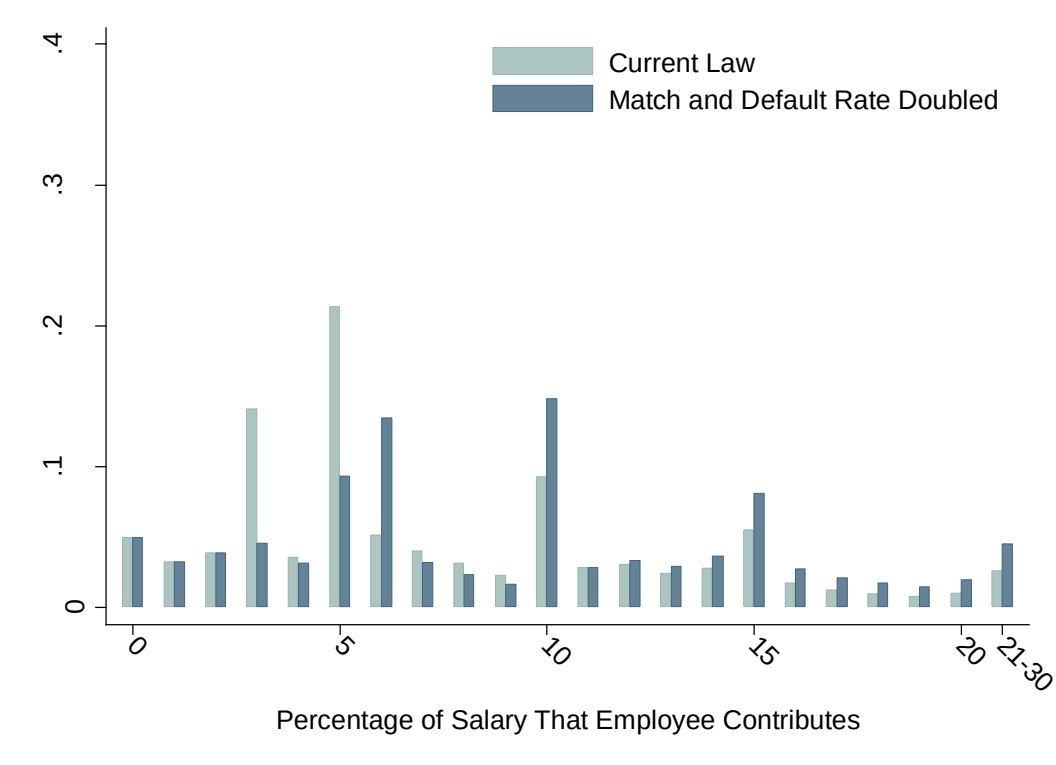
Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Comparison is between workers hired from August 2009 to July 2010, who have a default contribution rate of zero percent, and workers hired from August 2010 to July 2011, who have a default contribution rate of 3 percent. The share of employees at a contribution rate represents an average over the first 64 months of job tenure.

Fitted values are estimated using the empirical model described by equation (3), as specified in equation (6).

Figure 11. **[Return to Text]**

Simulated Employees' Contribution Rates, by Maximum Match and Default Contribution Rate



Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

In this policy simulation, matching increases from 100 percent on the first 3 percent that employees contribute and 50 percent on the next 2 percent to 100 percent on the first 6 percent and 50 percent on the next 4 percent. The default rate for employee contributions is increased from 3 percent to 6 percent. The distributions are estimated using the anchoring and inattentiveness specification.

Fitted values are estimated using the empirical model described by equation (3), with the anchoring specification given by equations (5b) and (6).

Table 1. [Return to Text 1; 2]

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)*
Thrift Savings Plan Behavior		
Workers who contribute (%)	69.5	91.7
Average contribution rate (% of salary)	5.9	9.2
Average contribution rate for those who contributed (% of salary)	8.5	10.0
Workers with entire portfolio invested in G Fund (%)	16.7	24.1
Portfolio invested in G Fund (%)	45.5	53.1
Average ratio of balance to pay	0.8	2.5
Demographic		
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	27.1
Some college (%)	24.7	24.3
College (%)	32.4	31.8
Graduate school (%)	16.5	16.9
Average annual earnings (2014 dollars)	$97,100	$94,600
Average ratio of accrued defined benefit and Social Security wealth to annual earnings	5.4	6.4
Number of observations	90,533	133,015

Source: Congressional Budget Office, 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 = Thrift Savings Plan's Government Securities Investment Fund.

Table 2.

[Return to Text]

Treatment Effect of the Employer Match on Participation, Contribution Rates, Portfolio Allocations, and Balance-to-Pay Ratio

	Participation (OLS)	Participation (Probit)	Employee Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)
Match Cohort	0.222***	0.206***	3.480***	1.824***
	(0.004)	(0.003)	(0.060)	(0.011)
Adjusted or pseudo-R^2	0.137	0.155	0.197	0.429
Number of observations	223,548	223,548	223,548	223,548

	Probability of Investing 100% in G Fund (OLS)	G Fund Share (OLS)	Bond Share (OLS)	Probability of Investing 100% in Bonds (OLS)	Probability of Investing 100% in Stocks (OLS)
Match Cohort	0.020***	0.070***	0.068***	0.022***	−0.068***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)
Adjusted R^2	0.066	0.102	0.092	0.066	0.030
Number of observations	203,563	203,563	203,563	203,563	203,563

Source: Congressional Budget Office, 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. 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"). 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 Thrift Savings Plan balances. 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.

*** = $p < .01$.

G Fund = Thrift Savings Plan's Government Securities Investment Fund; OLS = ordinary least squares.

Table 3. **[Return to Text 1; 2]**

Sample Characteristics: Federal Workers in 2009 and 2010 Observed Zero to Four 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)*
Thrift Savings Plan Behavior		
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
Workers with entire portfolio invested in G Fund (%)	76.0	79.7
Portfolio invested in G Fund (%)	84.3	85.5
Average ratio of balance to pay	0.2	0.2
Demographic		
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	51,732	53,386

Source: Congressional Budget Office, 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 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 zero to four months after hire.

AE = automatic enrollment; G Fund = Thrift Savings Plan's Government Securities Investment Fund.

Table 4. [Return to Text 1; 2]

Distribution of Employee Contribution Rates for Employees Hired Before and After Automatic Enrollment

	Nonparticipant		<Default Rate		Default Rate		>Default Rate		Average Contribution	
	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	2.9	4.4
Second Year	0.25	0.02	0.09	0.04	0.07	0.33	0.59	0.60	4.5	5.1
Third Year	0.20	0.02	0.08	0.04	0.06	0.30	0.66	0.64	5.2	5.5
Fourth Year	0.18	0.03	0.08	0.05	0.06	0.25	0.68	0.67	5.4	5.9
Fifth Year	0.16	0.04	0.08	0.05	0.06	0.22	0.70	0.70	5.8	6.1
Sixth Year	0.15		0.07		0.06		0.72		6.1	

Source: Congressional Budget Office, 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 5. [Return to Text 1; 2]

Treatment Effect of Automatic Enrollment on the Distribution of Employee Contribution Rates Over Time

	Nonparticipant (OLS)		<Default Rate (OLS)		Default Rate (OLS)		>Default Rate (OLS)	
Autoenrolled cohort	−0.185***		−0.038***		0.209***		0.015***	
	(0.001)		(0.001)		(0.001)		(0.002)	
Effect over time								
Autoenrolled cohort (First year)		−0.371***		−0.057***		0.317***		0.111***
		(0.002)		(0.002)		(0.003)		(0.003)
Autoenrolled cohort (Second year)		−0.232***		−0.053***		0.260***		0.025***
		(0.001)		(0.001)		(0.002)		(0.002)
Autoenrolled cohort (Third year)		−0.188***		−0.035***		0.225***		−0.001
		(0.001)		(0.001)		(0.002)		(0.002)
Autoenrolled cohort (Fourth year)		−0.163***		−0.030***		0.184***		0.009***
		(0.001)		(0.001)		(0.002)		(0.002)
Autoenrollment cohort (Fifth year)		−0.129***		−0.033***		0.150***		0.013***
		(0.001)		(0.001)		(0.002)		(0.002)
Adjusted R^2	0.103	0.108	0.023	0.023	0.115	0.118	0.093	0.093
Number of observations	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838

Source: Congressional Budget Office, 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 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.

*** = $p < .01$.

OLS = ordinary least squares.

Table 6. [Return to Text 1; 2]

Probability of Sticking to Defaults, by Automatic Enrollment and by Demographics

	Default Rate (OLS)	Default Fund (OLS)	Default Rate and Fund (OLS)
Autoenrolled cohort (First year)	0.317***	0.022***	0.302***
	(0.003)	(0.003)	(0.002)
Autoenrolled cohort (Second year)	0.260***	0.026***	0.244***
	(0.002)	(0.002)	(0.002)
Autoenrolled cohort (Third year)	0.225***	0.030***	0.206***
	(0.002)	(0.002)	(0.002)
Autoenrolled cohort (Fourth year)	0.184***	0.005**	0.166***
	(0.002)	(0.002)	(0.001)
Autoenrolled cohort (Fifth year)	0.150***	−0.008***	0.133***
	(0.002)	(0.002)	(0.001)
Adjusted R^2	0.118	0.130	0.125
Number of observations	1,010,838	1,010,838	1,010,838

Probability of Being at the Default Rate, Default Fund, or Both in the Fifth Year After Hire, By Demographics

Demographic	Default Rate (OLS)	Default Fund (OLS)	Default Rate and Fund (OLS)
Age 30–39	0.044***	0.017***	0.028***
	(0.005)	(0.005)	(0.004)
Age 40–49	0.054***	0.029***	0.037***
	(0.005)	(0.006)	(0.004)
Age ≥50	0.040***	0.076***	0.037***
	(0.005)	(0.006)	(0.004)
Female	0.011***	0.086***	0.017***
	(0.003)	(0.003)	(0.003)
Black	0.065***	0.150***	0.068***
	(0.004)	(0.004)	(0.004)
Hispanic	0.033***	0.075***	0.035***
	(0.006)	(0.007)	(0.006)
Middle earnings tercile	−0.086***	−0.148***	−0.087***
	(0.004)	(0.004)	(0.004)
Top earnings tercile	−0.135***	−0.234***	−0.131***
	(0.004)	(0.005)	(0.004)
Some college	−0.035***	−0.040***	−0.038***
	-0.005	(0.005)	(0.004)
College	−0.079***	−0.131***	−0.083***
	(0.004)	(0.005)	(0.004)
Graduate school	−0.093***	−0.151***	−0.091***
	(0.004)	(0.005)	(0.004)
Adjusted R^2	0.050	0.119	0.057
Number of observations	89,807	89,807	89,807

Source: Congressional Budget Office, 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 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. Regressions in the top panel include controls for sex, age, race, education, years of service, earnings, and state fixed effects. Regressions in the bottom panel include state fixed effects in addition to the listed variables. Omitted categories in the second panel are workers under age 30, males, white workers, workers in the bottom earnings tercile, and workers with high school education or less. Robust standard errors clustered at the employee level are in parentheses.

*** = $p < .01$.

OLS = ordinary least squares.

Table 7. [Return to Text]

Treatment Effect of Automatic Enrollment on Participation, Employee Contribution Rates, Portfolio Allocations, and Balance-to-Pay Ratio

	Participation (OLS)		Participation (Probit)		Contribution Rate (OLS)		Balance-to-Pay Ratio (OLS)	
Autoenrolled cohort	0.185***		0.208***		0.630***		0.090***	
	(0.001)		(0.002)		(0.017)		(0.003)	
Effect over time								
Autoenrolled cohort (First year)		0.371***		0.287***		1.606***		0.066***
		(0.002)		(0.002)		(0.023)		(0.012)
Autoenrolled cohort (Second year)		0.232***		0.251***		0.825***		0.161***
		(0.001)		(0.002)		(0.018)		(0.005)
Autoenrolled cohort (Third year)		0.188***		0.222***		0.528***		0.096***
		(0.001)		(0.002)		(0.019)		(0.004)
Autoenrolled cohort (Fourth year)		0.163***		0.190***		0.551***		0.082***
		(0.001)		(0.002)		(0.020)		(0.003)
Autoenrolled cohort (Fifth year)		0.129***		0.150***		0.478***		0.027***
		(0.001)		(0.002)		(0.021)		(0.002)
Adjusted or pseudo-R^2	0.103	0.108	0.155	0.16	0.128	0.129	0.072	0.073
Number of observations	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838	1,010,838

	Probability of Investing 100% in G Fund (OLS)		G Fund Share (OLS)		Bonds Share (OLS)		Probability of Investing 100% in Bonds (OLS)		Probability of Investing 100% in Stocks (OLS)	
Autoenrolled cohort	0.008***		0.011***		0.003**		0.006***		0.004***	
	(0.002)		(0.002)		(0.001)		(0.002)		(0.001)	
Effect over time										
Autoenrolled cohort (First year)		−0.006**		0.002		0.002		−0.006**		0.002**
		(0.003)		(0.002)		(0.002)		(0.003)		(0.001)
Autoenrolled cohort (Second year)		0.022***		0.027***		0.019***		0.023***		−0.000
		(0.002)		(0.002)		(0.001)		(0.002)		(0.001)
Autoenrolled cohort (Third year)		0.025***		0.025***		0.018***		0.027***		−0.002***
		(0.002)		(0.002)		(0.001)		(0.002)		(0.001)
Autoenrolled cohort (Fourth year)		−0.004**		−0.002		−0.017***		−0.012***		0.011***
		(0.002)		(0.002)		(0.001)		(0.002)		(0.001)
Autoenrolled cohort (Fifth year)		−0.010***		−0.002		−0.008***		−0.012***		0.010***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.001)
Adjusted R^2	0.134	0.134	0.139	0.139	0.132	0.132	0.131	0.131	0.016	0.016
Number of observations	1,001,970	1,001,970	1,001,970	1,001,970	1,001,970	1,001,970	1,001,970	1,001,970	1,001,970	1,001,970

Source: Congressional Budget Office, 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 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 Thrift Savings Plan. 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.

** = $p < .05$; *** = $p < .01$.

G Fund = Thrift Savings Plan's Government Securities Investment Fund; OLS = ordinary least squares.

Table 8. [Return to Text]

Relationship Between Employee Contribution Rates to the Thrift Savings Plan and Retirement Wealth From Other Sources

Percentage Difference, FERS Average Over CSRS Average	All Workers	Workers With Salary Below Median
First-Stage Relationship		
Ratio of accrued wealth from defined benefit pension and Social Security to salary	19.7 ***	29.5 ***
	(0.6)	(0.9)
Reduced-Form Relationships, by Outcome		
Employee contribution rate	48.9 ***	64.3 ***
	(2.6)	(4.8)
Probability that employee contribution rate exceeds FERS matching threshold	41.8 ***	55.8 ***
	(2.6)	(4.8)
Employee contribution rate among workers whose contributions exceed FERS matching threshold	7.8 ***	10.2 ***
	(1.1)	(2.1)

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Using the worker's retirement system as an instrumental variable, the analysis explores whether workers reduce their Thrift Savings Plan contributions in response to increases in other sources of retirement income. The sample is limited to workers hired in 1983 under the Civil Service Retirement System (CSRS) and workers hired in 1984 under the Federal Employees Retirement System (FERS). In FERS, the matching threshold is 5 percent (that is, workers in FERS do not receive an employer match on the portion of their contributions that exceeds 5 percent of their salary). Workers in CSRS are not eligible for an employer match. The sample is limited to workers for whom we could accurately measure the years of service credited toward their defined benefit pension.

Standard errors are in parentheses and are calculated using the delta method.

*** = $p < .01$.

Table 9. **[Return to Text 1; 2]**

Average Effects of Adding the Employer Match, by Specification

Change in Percentage Points

	Observed Difference Between Cohorts	Fitted Differences	
		Neoclassical	Anchoring
Employees' Contributions	3.29 ***	0.20 ***	3.32 ***
	(0.03)	(0.02)	(0.05)
Matching Contributions	3.44 ***	3.05 ***	3.48 ***
	(0.00)	(0.00)	(0.01)

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

The sample is limited to workers hired in 1983 under the Civil Service Retirement System (CSRS) and workers hired in 1984 under the Federal Employees Retirement System (FERS). Under FERS, workers are eligible to receive a 100 percent employer match on the first 3 percent they contribute and a 50 percent employer match on the next 2 percent they contribute. By contrast, workers in CSRS are not eligible for an employer match.

The empirical model is described by equation (3). The details of the neoclassical and anchoring specification are given by equations (5a) and (5b), respectively.

Standard errors are in parentheses and are calculated using 1,000 bootstrapped samples.

*** = $p < .01$.

Table 10. [Return to Text]

Average Effects of Increasing the Default Contribution Rate, by Sample

Change in Percentage Points

	Workers Hired Within 1 Year of Increase	All Workers Hired After 1983
Employees' Contributions	0.53 ***	0.29 ***
	(0.02)	(0.01)
Matching Contributions	0.59 ***	0.29 ***
	(0.01)	(0.01)

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Federal workers hired before August 2010 had a default contribution rate of zero percent, and workers hired at later dates had a default contribution rate of 3 percent. Thus, restricting the sample to the cohorts hired the year before and year after that increase limits it to workers with less than five years of job tenure. We use the approach described in the text to extrapolate the effect of the default rate on workers with more than five years of job tenure.

The effects are estimated using the empirical model described by equation (3), with the anchoring specification given by equation (6).

Standard errors are in parentheses and are calculated using 150 bootstrapped samples.

*** = $p < .01$.

Table 11. [Return to Text]

Simulated Average Effects of Doubling the Maximum Match and the Default Rate

Change in Percentage Points

	Effect of Match	Effect of Default Rate	Total Effect (Includes Interactions)
Employees' Contributions	1.34	0.38	1.74
Matching Contributions	2.36	0.10	2.69

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

In this policy simulation, matching increases from 100 percent on the first 3 percent that employees contribute and 50 percent on the next 2 percent to 100 percent on the first 6 percent and 50 percent on the next 4 percent. The default rate for employee contributions increases from 3 percent to 6 percent. The effects are estimated using the anchoring and inattentiveness specification.

The effects are estimated using the empirical model described by equation (3) with the anchoring specification given by equations (5b) and (6).

Appendix

Table A1. **[Return to Text]**

Descriptive Statistics: Participation Rate, Contribution Rate, Bonds Share, and Balance-to-Pay Ratio, by Demographic Characteristics and Employer Matching

	Participation Rate			Conditional Contribution Rate			Contribution Rate			Bonds Share			Balance-to-Pay Ratio		
Demographic	No match *(Hired in 1983)*	Match *(Hired in 1984)*	Diff	No match *(Hired in 1983)*	Match *(Hired in 1984)*	Diff	No match *(Hired in 1983)*	Match *(Hired in 1984)*	Diff	No match *(Hired in 1983)*	Match *(Hired in 1984)*	Diff	No match *(Hired in 1983)*	Match *(Hired in 1984)*	Diff
Male	0.67	0.92	0.26	8.8	10.4	1.5	5.9	9.6	3.7	0.54	0.62	0.08	0.8	2.8	2.0
Female	0.73	0.91	0.18	8.1	9.7	1.6	5.9	8.8	2.9	0.61	0.66	0.05	0.7	2.2	1.5
White	0.71	0.94	0.23	9.0	10.8	1.7	6.4	10.1	3.7	0.55	0.61	0.06	0.8	2.8	2.0
Black	0.63	0.83	0.20	6.0	7.2	1.2	3.8	6.0	2.2	0.64	0.72	0.08	0.5	1.6	1.2
Other	0.63	0.83	0.20	6.0	7.2	1.2	3.8	6.0	2.2	0.64	0.72	0.08	0.5	1.6	1.2
High school or less	0.64	0.86	0.22	7.6	8.5	0.9	4.9	7.3	2.4	0.61	0.72	0.11	0.6	1.9	1.3
Some college	0.64	0.90	0.26	7.6	9.2	1.6	4.9	8.3	3.4	0.61	0.68	0.06	0.6	2.2	1.6
College	0.77	0.95	0.18	9.2	11.0	1.8	7.1	10.5	3.4	0.53	0.58	0.05	0.9	3.0	2.0
Graduate school	0.80	0.97	0.17	9.9	11.5	1.6	7.9	11.1	3.2	0.53	0.56	0.02	1.1	3.3	2.2
Bottom tercile of earnings	0.55	0.85	0.31	6.7	8.2	1.5	3.7	7.0	3.4	0.63	0.74	0.10	0.5	2.0	1.5
Middle tercile of earnings	0.72	0.94	0.21	8.7	10.7	2.0	6.3	10.0	3.7	0.57	0.63	0.05	0.8	2.6	1.8
Top tercile of earnings	0.80	0.97	0.16	9.4	11.0	1.6	7.6	10.7	3.1	0.52	0.54	0.02	1.0	3.0	2.0
All	0.69	0.92	0.22	8.5	10.0	1.5	5.9	9.2	3.3	0.57	0.64	0.07	0.8	2.5	1.8

Source: Congressional Budget Office, 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) and workers hired in 1984 under the Federal Employees Retirement System (FERS). Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. Match cohort defines FERS workers hired in 1984. "Diff" refers to the estimated difference in means by matching within each demographic category. All estimated differences are significant at the $p < .01$ level.

Table A2. **[Return to Text]**

Treatment Effect of the Employer Match on Participation, Employee Contribution Rates, Balance-to-Pay Ratio, and Portfolio Allocation, by Demographics

	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Bonds Share (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Bonds Share (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Bonds Share (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Bonds Share (OLS)
Match cohort (effect on omitted group)	0.256***	3.739***	2.019***	0.074***	0.299***	3.474***	1.572***	0.114***	0.271***	3.344***	1.481***	0.114***	0.229***	3.751***	1.975***	0.062***
	(0.005)	(0.080)	(0.014)	(0.005)	(0.008)	(0.090)	(0.017)	(0.007)	(0.008)	(0.103)	(0.018)	(0.008)	(0.004)	(0.070)	(0.013)	(0.004)
By Sex (Omitted: Male)																
Match cohort × Female	−0.078***	−0.602***	−0.453***	−0.012*												
	(0.008)	(0.114)	(0.021)	(0.007)												
By Earnings (Omitted: Bottom Earnings Tercile)																
Match cohort × Middle Earnings Tercile					−0.090***	0.335**	0.280***	−0.048***								
					(0.009)	(0.132)	(0.022)	(0.009)								
Match cohort × Top Earnings Tercile					−0.140***	−0.335***	0.450***	−0.079***								
					(0.009)	(0.126)	(0.026)	(0.009)								
By Education (Omitted: High School or Less)																
Match cohort × Some College									−0.012	0.344**	0.143***	−0.044***				
									(0.011)	(0.149)	(0.025)	(0.010)				
Match cohort × College									−0.086***	0.208	0.565***	−0.060***				
									(0.010)	(0.146)	(0.024)	(0.010)				
Match cohort × Graduate School									−0.106***	−0.132	0.688***	−0.083***				
									(0.011)	(0.173)	(0.040)	(0.011)				
By Race (Omitted: White)																
Match cohort × Black													−0.031***	−1.329***	−0.769***	0.025***
													(0.011)	(0.131)	(0.023)	(0.010)
Match cohort × Hispanic													−0.033**	−0.689***	−0.342***	0.021
													(0.016)	(0.223)	(0.039)	(0.015)
Adjusted R^2	0.139	0.197	0.432	0.092	0.142	0.197	0.431	0.094	0.140	0.197	0.434	0.093	0.137	0.198	0.435	0.092
Number of observations	223,548	223,548	223,548	203,563	223,548	223,548	223,548	203,563	223,548	223,548	223,548	203,563	223,548	223,548	223,548	203,563

Source: Congressional Budget Office, 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 in 1983 under the Civil Service Retirement System (CSRS) and workers hired in 1984 under the Federal Employees Retirement System (FERS). Workers under CSRS are not eligible for an employer match, whereas those under FERS are eligible. Match cohort defines FERS workers hired in 1984. Data span 2008 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.

* = $p < .10$; ** = $p < .05$; *** = $p < .01$.

OLS = ordinary least squares.

Table A3. **[Return to Text]**

Descriptive Statistics: Participation Rate, Contribution Rate, Bonds Share, and Balance-to-Pay Ratio, by Demographic Characteristics and Automatic Enrollment in Fifth Year After Hire

	Participation Rate			Conditional Contribution Rate			Contribution Rate			Bonds Share			Balance-to-Pay Ratio		
	Hired Before AE	*Hired After AE*	Diff	*Hired Before AE*	*Hired After AE*	Diff	*Hired Before AE*	*Hired After AE*	Diff	*Hired Before AE*	*Hired After AE*	Diff	*Hired Before AE*	*Hired After AE*	Diff
Male	0.83	0.96	0.13	7.1	6.5	−0.6	5.9	6.3	0.3	0.67	0.68	0	0.49	0.48	0
Female	0.86	0.96	0.11	6.6	6.2	−0.5	5.7	6.0	0.3	0.75	0.76	0.01	0.46	0.46	0
White	0.86	0.97	0.11	7.2	6.7	−0.5	6.2	6.5	0.3	0.67	0.67	0	0.51	0.50	−0.01
Black	0.77	0.94	0.17	5.7	5.3	−0.5	4.4	4.9	0.5	0.82	0.83	0.01	0.34	0.36	0.02
Other	0.77	0.94	0.17	5.7	5.3	−0.5	4.4	4.9	0.5	0.82	0.83	0.01	0.34	0.36	0.02
High school or less	0.79	0.95	0.16	5.9	5.4	−0.5	4.7	5.1	0.4	0.78	0.81	0.02	0.37	0.40	0.03
Some college	0.79	0.95	0.16	5.9	5.5	−0.5	4.7	5.2	0.5	0.78	0.79	0	0.37	0.39	0.02
College	0.88	0.97	0.09	6.9	6.6	−0.3	6.1	6.5	0.3	0.66	0.66	0.01	0.49	0.49	0
Graduate school	0.91	0.98	0.07	8.1	7.6	−0.5	7.4	7.4	0.1	0.62	0.61	0	0.61	0.58	−0.04
Bottom tercile of earnings	0.74	0.95	0.20	5.3	4.9	−0.4	4.0	4.6	0.7	0.83	0.83	0	0.30	0.35	0.04
Middle tercile of earnings	0.86	0.97	0.11	6.5	6.5	−0.1	5.7	6.3	0.6	0.69	0.68	−0.01	0.42	0.46	0.03
Top tercile of earnings	0.90	0.98	0.07	8.4	7.9	−0.5	7.6	7.8	0.2	0.61	0.60	−0.01	0.67	0.64	−0.04
All	0.84	0.96	0.12	6.9	6.4	−0.6	5.8	6.1	0.3	0.70	0.71	0.01	0.47	0.47	0

Source: Congressional Budget Office, 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. 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. "Diff" refers to the estimated difference in means by automatic enrollment within each demographic category. Significance levels refer to *t*-tests of difference in means by automatic enrollment within each demographic category. Estimated differences in means are significant at the $p < .01$ level, with a few exceptions in the balance-to-pay category. No significant difference exists in the balance-to-pay ratio for workers with graduate-level education; a significant, although small in magnitude, difference exists at the $p < .05$ level in the balance-to-pay ratio of workers in the other race category, and a significant, also small in magnitude, difference only at the $p < .10$ level exists in the balance-to-pay ratio of white workers.

AE = automatic enrollment.

Table A4. **[Return to Text]**

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 (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)	Participation Rate (OLS)	Contribution Rate (OLS)	Balance-to-Pay Ratio (OLS)
Autoenrolled cohort (effect on omitted group)	0.140***	0.534***	0.032***	0.091***	0.550***	0.026***	0.204***	0.693***	0.053***	0.205***	0.717***	0.060***	0.115***	0.424***	0.021***
	(0.002)	(0.028)	(0.003)	(0.003)	(0.049)	(0.003)	(0.003)	(0.029)	(0.003)	(0.003)	(0.037)	(0.004)	(0.001)	(0.025)	(0.003)
By Sex (omitted: Male)															
Autoenrolled cohort × Female	−0.027***	−0.125***	−0.005												
	(0.003)	(0.043)	(0.004)												
By Age (omitted: <30)															
Autoenrolled cohort × (Age 30–39)				0.018***	−0.077	0.009**									
				(0.004)	(0.058)	(0.004)									
Autoenrolled cohort × (Age 40–49)				0.054***	−0.004	0.008									
				(0.004)	(0.062)	(0.005)									
Autoenrolled cohort × (Age ≥50)				0.055***	−0.141**	−0.003									
				(0.004)	(0.067)	(0.006)									
By Earnings (omitted: Bottom Earnings Tercile)															
Autoenrolled cohort × Middle Earnings Tercile							−0.096***	−0.124***	−0.009**						
							(0.003)	(0.047)	(0.004)						
Autoenrolled cohort × Top Earnings Tercile							−0.131***	−0.509***	−0.061***						
							(0.003)	(0.051)	(0.006)						
By Education (omitted: High School or Less)															
Autoenrolled cohort × Some College										−0.040***	−0.054	−0.009			
										(0.005)	(0.059)	(0.006)			
Autoenrolled cohort × College										−0.110***	−0.251***	−0.035***			
										(0.004)	(0.055)	(0.006)			
Autoenrolled cohort × Graduate School										−0.135***	−0.547***	−0.068***			
										(0.004)	(0.059)	(0.006)			
By Race (omitted: White)															
Autoenrolled cohort × Black													0.061***	0.257***	0.037***
													(0.004)	(0.051)	(0.005)
Autoenrolled cohort × Hispanic													0.041***	0.199**	0.032***
													(0.006)	(0.079)	(0.008)
Adjusted R^2	0.076	0.122	0.173	0.077	0.122	0.173	0.084	0.123	0.173	0.084	0.123	0.173	0.077	0.123	0.173
Number of obsevations	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107	190,107

Source: Congressional Budget Office, 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. 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.

* = $p < .10$; ** = $p < .05$; *** = $p < .01$.

AE = automatic enrollment; OLS = ordinary least squares.

Table A5. **[Return to Text]**

Effect on Contribution Rates After a Permanent Change in Income

	Contribution Rate Overall (OLS)	Contribution Rate 1st Year After Hire (OLS)	Contribution Rate 2nd Year After Hire (OLS)
Panel A: Whole Sample			
I(FERS_RAE = 1)	−0.098***	−0.024	−0.164***
	(0.026)	(0.027)	(0.029)
Panel B: Excludes Rehires			
I(FERS_RAE = 1)	−0.078***	−0.012	−0.139***
	(0.029)	(0.029)	(0.031)

Source: Congressional Budget Office, using data from the Office of Personnel Management and the Federal Retirement Thrift Investment Board.

Comparison is between workers hired from January 2011 to July 2011 or from January 2012 to July 2012, who were subject to automatic enrollment and had a required defined benefit contribution rate of 0.8 percent of salary and workers hired from January 2013 to July 2013, who were subject to automatic enrollment and had a required defined benefit contribution rate of 3.1 percent. The latter group of workers is referred to as FERS-Revised Annuity Employees (FERS-RAE). All regressions include controls for sex, age, race, education, job tenure, earnings, and state fixed effects.

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

*** = $p < .01$.

OLS = ordinary least squares.

Table A6. [Return to Text]

Effect on Contribution Rates, Consumption, and Saving After a Transitory Change in Income

Panel A: 1-Year Change	**ΔContribution rate$_{t+1}$ (OLS)**	**ΔConsumption$_{t+1}$ (OLS)**	**ΔSaving$_{t+1}$ (OLS)**
Δy_{t+1} Unanticipated positive income shock	0.009	1.034***	−0.027**
	(0.012)	(0.028)	(0.011)
Δy_{t+1} Anticipated negative income shock	−0.014	1.835***	0.062*
	(0.014)	(0.370)	(0.033)
Panel B: 2-Year Change	**ΔContribution rate$_{t+2}$ (OLS)**	**ΔConsumption$_{t+2}$ (OLS)**	**ΔSaving$_{t+2}$ (OLS)**
Δy_{t+2} Unanticipated positive income shock	0.035**	1.029***	−0.016
	(0.016)	(0.036)	(0.016)
Δy_{t+2} Anticipated negative income shock	0.000	1.345***	−0.007
	(0.020)	(0.168)	(0.023)

Source: Congressional Budget Office, 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) and workers hired in 1984 under the Federal Employees Retirement System (FERS). Although workers under CSRS do not participate in Social Security and do not pay Social Security payroll taxes, workers under FERS do. The transitory changes in income are the result of the reduction in the employee Social Security payroll tax rate from 6.2 percent to 4.2 percent of wages under the taxable maximum in 2011 and 2012. The temporary reduction expired in 2013. Income is defined as annual earnings minus payroll taxes (only the employee share). Change in income is defined as the percentage change in after-tax income caused by the change in the payroll tax rate. The contribution rate is measured as a share of salary. Changes in consumption and saving are measured as change in the level of consumption (or saving) as a share of lagged income. Saving is defined as the employee contribution rate times annual salary. Consumption is defined as after-tax income minus saving. All regressions include controls for sex, age, race, education, job tenure, earnings, and state fixed effects.

Robust standard errors are in parentheses.

* = $p < .10$; ** = $p < .05$; *** = $p < .01$.

OLS = ordinary least squares.