Who Is Easier to Nudge?

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Abstract: Identifying who is more influenced by a default is challenging, since individuals may be more likely to remain at the default either because they are more susceptible to defaults in general or because the default is closer to their preferred choice. We apply a statistical model to ten large companies' 401(k) plans to distinguish between these two channels. Even after controlling for contribution rate preferences, low-income and young individuals are slower to opt out of contribution rate defaults. The evidence is consistent with the default changing contribution rate preferences, as predicted by anchoring or endorsement effects, and there is weaker evidence that low-income and young employees are more affected.

Keywords: choice architecture, nudge, default, automatic enrollment, savings, 401(k), defined contribution plan, plan design, heterogeneity

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A large literature has documented that choice architecture—the design of the environment in which choices are made—can powerfully influence outcomes (Thaler and Sunstein, 2008; Sunstein, 2013, 2014). One of the most commonly used tools of choice architecture is the default option—what is implemented when individuals do not actively make a choice. Defaults are powerful because many individuals accept the default passively (Park, Jun, and MacInnis, 2000; Madrian and Shea, 2001; Choi et al., 2002, 2004; Johnson, Bellman, and Lohse, 2002; Abadie and Gay, 2006; Beshears et al., 2008). What remains unknown, however, is which types of individuals are more influenced by the default option.

The answer to this question is important for determining the optimal default to apply to a population whose optimal choices are heterogeneous when one cannot customize the default according to individuals' observable characteristics. If certain identifiable groups are only minimally swayed by the default, then these groups' needs should carry minimal weight in determining the optimal default. Conversely, defaults should cater most to people who are most likely to accept them passively for a long time.

Previous research has shown that low-income individuals are less likely to opt out of 401(k) contribution rate defaults than high-income individuals (Madrian and Shea, 2001; Choi et al., 2004). However, the default contribution rates studied were relatively low, as is currently typical in 401(k) plans (Vanguard, 2014). Carroll et al. (2009) show that individuals who opt out to contribution rates that are closer to the default tend to opt out more slowly. This is consistent with opting out being a low priority when the gap between the default and one's optimal choice is small. If low contribution rate defaults are closer to what low-income individuals would prefer to save anyway,[1] then it is unclear to what extent low-income individuals persist longer at low contribution rate defaults because such defaults are closer to what they want versus their having a stronger general tendency to accept defaults.

The central contribution of this paper is to separately identify these two sources of heterogeneity in responsiveness to contribution rate defaults. Our empirical approach takes advantage of the dynamic nature of contribution rate decisions. We conceive of

[1] Potential reasons low-income individuals might optimally save less include greater income growth expectations and the progressivity of Social Security benefits.

each employee for whom the default is not ideal as drawing an opt-out cost each period. In the first period where that cost is sufficiently low, she will opt out to her target contribution rate, which we assume is fixed for the first two years after hire. A crucial identifying assumption is that following an initial period immediately after hire when the hazard rate of opting out might fluctuate over time (because of automatic enrollment opt-out deadlines and the salience of benefit elections during new employee orientation), there is a time interval during which the opt-out hazard rate is constant and equal across all people within a demographic group who share a given target contribution rate. Then the number of people who opt out each period to a given contribution rate and the speed at which opt-outs to that contribution rate decline over time jointly identify the number of people who had that target contribution rate upon hire and the hazard rate of opting out to that target rate.

We estimate our statistical model using maximum likelihood methods applied to monthly contribution rate data from ten large firms, five of which have a default contribution rate of zero and five of which have a strictly positive default contribution rate. Our primary specification compares employees with income at or below the sample-wide median to employees with income above the sample-wide median. While estimates vary across the ten firms, as would be expected given the firms' different employee populations, the qualitative patterns are broadly consistent. During the initial few months after hire, holding constant the target contribution rate, the low-income group has opt-out odds that are smaller than the opt-out odds of the high-income group by 10 to 66%, depending on the firm. Beyond the initial period, conditional on not having opted out previously, opt-out odds of the low-income group are 5% to 68% lower.

To better interpret the magnitude of these effects, we conduct counterfactual exercises using our estimates. For each company, we assume that the opt-out hazard rates of the low- and high-income groups take the values that we estimated, but we set the non-default target rate distributions for the low- and high-income groups equal to the average of the two groups' estimated distributions. We then calculate the probability that a low- or high-income employee who has a target contribution rate different from the default remains at the default two years after hire. Pooling across companies, we find that this probability is 7.1 percentage points higher for low-income employees. Thus, the evidence indicates that the contribution rates of low-income individuals are more influenced by defaults than those of high-income individuals, holding fixed the degree of alignment between individuals' preferences and the particular option that is selected as the default. If we do not control for target rate distributions, the difference is 10.2 percentage points, indicating that the greater appeal of the low defaults in our data for low-income individuals accounts for approximately one-third of the overall higher likelihood of low-income employees remaining at the default.

We also assess how inertia at defaults varies by age and gender. We find that younger employees are less likely to opt out of the default than older employees, and one-third of this difference is due to the difference in target rate distributions. We do not find meaningful differences between male and female employees in their likelihood of opting out of the default.

Finally, we examine whether the choice of the contribution rate default influences target contribution rates themselves—as would occur if the default serves as an anchor (Tversky and Kahneman, 1974; Bernheim, Fradkin, and Popov, 2015) or if employees interpret the default as containing valuable implicit advice from their company (Madrian and Shea, 2001; Beshears et al. 2008)—and whether the strength of this influence varies by demographic characteristics. We study two additional companies, both of which changed the default contribution rate in their plans—one from 0% to 3% of income and the other from 3% to 0% of income. For each company, we estimate our statistical model separately for the 0% default regime and for the 3% default regime. We find that employees are much more likely to make a contribution rate their target rate if it becomes the default. At one company, the default change causes the fraction of low-income employees who have the old default as their target rate to decrease by 21 percentage points, while the fraction who have the new default as their target rate increases by 23 percentage points. For high-income employees at this company, the fraction who have the old default as their target rate decreases by 17 percentage points, while the fraction who have the new default as their target *decreases* (insignificantly) by 2 percentage points. At the second company, the comparable changes for low-income employees are a 13 percentage point decrease and a 21 percentage point increase, respectively, while the comparable numbers for high-income employees are a 7 percentage point decrease and a

13 percentage point increase, respectively. However, the differences by income become smaller and lose statistical significance after controlling for age and gender at the first firm. At the second firm, we also find stronger effects among younger workers, but this too becomes smaller and less statistically significant after controlling for income and gender.

Low-income and young individuals might be slower to opt out of defaults conditional on their target contribution rates because they have higher cognition or action costs for opting out, a higher tendency towards time-inconsistent procrastination, a lack of knowledge about financial decisions, or a greater willingness to interpret the default as containing implicit advice and to accept that advice. In addition, a given deviation from the target contribution rate may have smaller utility consequences for a young, low-income individual because of the shape of the individual's utility function or tax schedule. We do not attempt to separately identify the relative importance of each of these factors.

This research is most closely related to the work of Chetty et al. (2014), who use Danish tax records to study individual responses to government and employer savings policies. They document that individuals with a higher ratio of wealth to income have a greater propensity to offset changes in employer-mandated pension contributions by adjusting savings on other margins, a finding that is similar in spirit to our result that high-income individuals are more likely to opt out of defaults in employer-sponsored savings plans.

The paper proceeds as follows. Section I explains our statistical model and empirical methodology. Section II describes the ten retirement savings plans that we study and the construction of the data set for our primary analysis. We report our main findings regarding heterogeneity by income group in Section III, the results of robustness checks in Section IV, and our findings regarding heterogeneity by age group and gender in Section V. In Section VI, we explore the influence of the default on target rate distributions. We offer concluding remarks in Section VII.

I. Methodology

Upon joining the firm, an employee begins contributing at a default savings rate d until he opts out.[2] We assume that if the default is not ideal for the employee, he suffers a flow utility loss every period he remains at the default. At the beginning of each period, the employee draws a random opt-out cost. If that cost is sufficiently low, he chooses to incur it and move to his target contribution rate c, stopping the flow utility losses. It is possible that the infimum of the opt-out cost support is far enough away from zero that some individuals whose ideal contribution rate is sufficiently close to the default will never find it worthwhile to opt out, despite the fact that they will incur flow losses in perpetuity. We will not be able to empirically distinguish such individuals from those whose ideal contribution rate equals the default, and we will classify both individuals as having a target contribution rate equal to the default.

The primary empirical challenge in this setting arises from the fact that if only a small number of people have opted out to c over an observation period, this could be consistent either with c being an unpopular target contribution rate, or with c being a popular target contribution rate but the population having a very slow hazard rate of opting out to it. We make two key assumptions to surmount this challenge. First, we assume that each employee has a constant target rate upon joining the firm, at least until he switches to that target rate. Second, we assume that after the initial flurry of opt-out activity when employees first join a firm, there is a period of time when the month-to-month probability of opt-out to a given target rate for employees in a similar income group is constant.[3] We check our constant hazard rate assumption in Section IV, and do not find any evidence that hazard rates change systematically during the later period where we assume a constant hazard.

To build intuition for how these two assumptions allow us to estimate the distribution of target rate preferences and switching hazard rates, suppose that we observe

[2] An opt-in savings plan is equivalent to $d = 0$. In practice, firms that automatically enroll employees in the savings plan have a deadline before which the employee contributes nothing and after which he contributes a strictly positive amount unless he opts out.

[3] A constant hazard rate arises naturally from the Carroll et al. (2009) framework, where individuals independently draw opt-out costs from a time-invariant common distribution at the beginning of each period. If there is time-invariant hazard heterogeneity within a demographic × target rate cell, then that cell's opt-out hazard rate would decline over time as higher-hazard individuals opt out, leaving only lower-hazard individuals at the default.

20 people opting out to a 5% contribution rate in month 4 and 16 people opting out to 5% in month 5. Let *n* be the total number of people with a target contribution rate of 5% at the beginning of month 4 who have not opted out yet and *h* be the hazard rate of opting out to 5% if that is your target contribution rate. Then there are two equations with two unknowns: 20 = *hn* and 15 = *h*(*n* – 20). Thus, we can infer that *h* = 0.25 and *n* = 80. If we observe 30 people in total opting out to 5% from month 0 to month 3, then even if the hazard rate varies during these early months, we know that at the beginning of month 0, there were 80 + 30 = 110 people with a 5% target contribution rate.

In our actual estimation, we impose some additional structure in order to reduce the number of parameters we need to estimate. To assess heterogeneity, we divide new hires at a firm into two groups for comparison along one dimension. For ease of exposition, we will describe these two groups as low- and high-income, but our method generalizes to any arbitrary definition of groups. We separate the first T months of tenure for each employee into two ranges: the initial period, $\{1, \ldots, T_s - 1\}$, and the later period, $\{T_s, \ldots, T\}$. We set $T = 24$. We define a partition of the set of all possible non-default contribution rates at a firm as $C = \{c_i\}_{0 \leq i \leq n}$. While it is possible to define the partition so that each element contains only one contribution rate—in which case $c_0 = \{0\%\}, c_1 = \{1\%\}$, etc.—we allow for the possibility of estimating a single set of parameters for a group of contribution rates. We also define $c_d = \{d\}$ as a singleton that always contains the default rate, so $C \cup \{c_d\}$ partitions the set of all possible contribution rates. We let $p_{Hc_i} \in [0,1]$ be the probability that an employee from the high-income group has a target rate in c_i, and p_{Lc_i} be the probability that an employee from the low-income group has a target rate in c_i.

Over the duration of the initial period, a high-income employee with a non-default target rate in c_i has a probability of switching from the default to his target rate equal to $F(x_{c_i})$, while a low-income employee with the same target rate has a probability of switching equal to $F(x_{c_i} + \theta_1)$, where $x_{c_i}, \theta_1 \in (-\infty, \infty)$ and $F(\cdot)$ is the logistic CDF.[4] In other words, the initial period switching odds ratios between low- and high-income employees are constant across target rates. During each month in the later period, an

[4] For simplicity, we scale the logistic distribution parameters so that $F(x) = 1/(1 + e^{-x})$.

employee with a non-default target rate in c_i from the high-income group (who is still at the default) has a monthly switching hazard rate equal to $F(y_{c_i})$. An analogous employee from the low-income group has a monthly switching hazard rate equal to $F(y_{c_i} + \theta_2)$.

It follows that a high-income employee switches from the default to c_i in tenure month t with probability

$$Pr\left(I_{Hc_it}|T_s,d\right)=\begin{cases} p_{Hc_i}F\left(x_{c_i}\right) & t<T_s \\ p_{Hc_i}F\left(y_{c_i}\right)\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{t-T_s} & T_s\leq t\leq T \end{cases} \tag{1}$$

A high-income employee remains at the default at the end of month T with probability

$$Pr\left(I_{Hd}|T_s,d\right)=\sum_{i=0}^{n}p_{Hc_i}\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{T+1-T_s}+1-\sum_{i=0}^{n}p_{Hc_i} \tag{2}$$

The corresponding probabilities for an employee in the low-income group are obtained by substituting p_{Lc_i} for p_{Hc_i}, $F(x_{c_i} + \theta_1)$ for $F(x_{c_i})$, and $F(y_{c_i} + \theta_2)$ for $F(y_{c_i})$ in the above expressions.

We observe N_{Hc_it} high-income employees and N_{Lc_it} low-income employees who switch from the default to a rate in c_i in month t, and N_{Hd} high-income employees and N_{Ld} low-income employees who remain at the default rate through the end of month T. By taking the logarithm of the product over all individual likelihood functions, we can reduce the total log-likelihood function to

$$\begin{aligned} L= & \sum_{i=0}^{n}\left[\sum_{t=1}^{T}N_{Hc_it}log\left[Pr\left(I_{Hc_it}|T_s,d\right)\right]\right]+N_{Hd}log\left[Pr(I_{Hd}|T_s,d)\right] \\ & +\sum_{i=0}^{n}\left[\sum_{t=1}^{T}N_{Lc_it}log\left[Pr\left(I_{Lc_it}|T_s,d\right)\right]\right]+N_{Ld}log\left[(Pr(I_{Ld}|T_s,d))\right] \end{aligned} \tag{3}$$

To estimate our parameters, we maximize this total log-likelihood function with respect to $p_{Hc_i}, p_{Lc_i}, x_{c_i}, y_{c_i}, \theta_1$, and θ_2 with the constraint that $\sum_{i=0}^{n} p_{Hc_i} \leq 1$, $\sum_{i=0}^{n} p_{Lc_i} \leq 1$, $p_{Hc_i} \geq 0$, and $p_{Lc_i} \geq 0$. It follows that for each income group, the probability that an employee has the default contribution rate as his target rate is $p_{c_d} = 1 - \sum_{i=0}^{n} p_{c_i}$.

With these estimates, we can calculate the probability that high-income employees with non-default target rates remain at the default through the end of month T, taking as given the distribution of their target contribution rates,

$$\Omega_H=\sum_{i=0}^{n}\frac{p_{Hc_i}}{1-p_{Hc_d}}\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{T+1-T_s} \tag{4}$$

as well as its analog for the low-income group, Ω_L, which substitutes p_{Lc_i} for p_{Hc_i}, $F(x_{c_i} + \theta_1)$ for $F(x_{c_i})$ and $F(y_{c_i} + \theta_2)$ for $F(y_{c_i})$.

Carroll et al. (2009) provide evidence that employees opt out more slowly when their target rates are closer to the default. Most firms that we will study have a default contribution rate of 3% of income or lower. If low-income employees are more likely to prefer lower contribution rates, then we would expect to observe a larger proportion of low-income employees to remain at the default due to differences in target rate preferences alone. To eliminate differences arising from this channel, we compute the probability that high-income employees with non-default target rates remain at the default through the end of month T if their distribution of non-default target rates were the average of the high- and low-income distributions,

$$\Psi_H = \sum_{i=0}^{n} \frac{p_{Lc_i} + p_{Hc_i}}{2 - p_{Lc_d} - p_{Hc_d}} \left(1 - F\left(x_{c_i}\right)\right)\left(1 - F\left(y_{c_i}\right)\right)^{T+1-T_s} \tag{5}$$

as well as its analog for the low-income group, Ψ_L, which substitutes $F(x_{c_i} + \theta_1)$ for $F(x_{c_i})$ and $F(y_{c_i} + \theta_2)$ for $F(y_{c_i})$.

Wherever possible, we calculate the analytic variance-covariance matrix for our parameters by taking the inverse of the negative expectation of the likelihood Hessian. Analytic estimates of standard errors for functions of directly estimated parameters come from applying the multivariate delta method (while allowing for covariance between parameters). In some cases, the inequality constraints on the parameter space are binding, so the constrained maximum of our likelihood function is not necessarily the unconstrained maximum and the analytic method for calculating the variance-covariance matrix is not valid. In those cases, we use the bootstrap procedure outlined in Efron and Tibshirani (1993), where we randomly draw with replacement from our original sample 999 times, estimate all parameters and test statistics for each resample by maximum likelihood, and use the variance of resampled estimates to conduct inference on the original estimate.[5]

[5] A small fraction of the time, we obtain a resample where the later period hazard parameter for an income group × target contribution rate cell is unidentified because nobody from that cell opts out in the later period, or both periods' hazard parameters are unidentified because nobody from that cell ever opts out. In this case, we set each unidentified hazard to the value (either 0 or 1) that maximizes the bootstrapped standard error of the hazard. We assign a hazard rate of 1 to the initial period if there are initial period opt-outs but no later period opt-outs to the contribution rate, and a hazard rate of 0 if there are no initial period opt-outs but there are later period opt-outs to the contribution rate. We assign a hazard rate of 1 to the later period if in the later period, there are opt-outs only in the first month. We exclude from the maximum likelihood estimation procedure any income group × rate × period where we assign the hazard.

II. Data

We use 401(k) plan administrative data covering 2002 to 2013 from Aon Hewitt, a benefits administrator. These data contain annual snapshots of employee demographics, compensation, and 401(k) eligibility, and monthly snapshots of employee contributions, all at the individual employee level. We exclude firms at which we cannot observe any employees for whom the constant later-period opt-out hazard assumption is plausible over some window during their first two years of tenure. Therefore, we drop firms that did not have sufficiently long observed periods without automatic contribution escalation (Thaler and Benartzi, 2004), default contribution rate changes, employer match structure changes, or a Quick Enrollment[6] campaign. We also drop any firms that allow employees to specify a flat dollar amount (rather than a percent of salary) or a non-integer percent of salary to contribute. These policies are fairly rare. Finally, we exclude firms that offer a Roth 401(k) option or have unclear or missing pay, 401(k) participation, or contribution rate data. We then select the five firms that automatically enroll employees in the 401(k) that have the most employees satisfying the criteria described below, and the five firms that require employees to opt into 401(k) participation that have the most employees satisfying these same criteria.

The employees in our sample are newly hired, U.S.-based employees who are at least 21 years old at the time of hire and stayed with the firm for at least the full observation period (which is 24 months long in the main specifications). We do not explicitly drop part-time workers, but we eliminate many of them by requiring that all included employees have compensation of at least $5,000 (in 2010 levels[7]) in the year of hire and become eligible to contribute to the 401(k) within 60 days of hire. We also restrict our attention to before-tax contribution elections, since they are the primary source of payroll-deducted savings in the firms that we study.

[6] Quick Enrollment presents a simplified menu of 401(k) election options to employees. Choi, Laibson, and Madrian (2009) and Beshears et al. (2013) show that Quick Enrollment campaigns substantially increase 401(k) enrollment, and affected employees tend to choose one of the options present in the simplified menu.

[7] We inflate compensation to 2010 levels using the median weekly earnings for full-time workers 16 years and older in the U.S. Bureau of Labor Statistics Current Population Survey.

Table 1 summarizes the ten firms' characteristics. By virtue of our selection criteria, all of the firms that we study are large. We do, however, observe substantial variation in other characteristics. The firms operate in eight different industries, and new hire median compensation in the year of hire ranges from $27,802 to $86,044. At the five automatic enrollment firms, default contribution rates range from 2% to 6% of income. All ten firms provide matching employer contributions up to a level that varies from 2% to 6% of income. All the firms have maximum employee contribution limits that exceed 10% of income, and seven firms allow employees to contribute as little as 1% of income to the plan (not shown in table). The three exceptions to the 1% minimum are Firm A, which requires employees to contribute at least 3% of income to participate, and Firms B and D, which require employees to contribute at least 2% of income to participate.

The median compensation across all new hires in the final sample is $62,470. We classify any new hires with income above the overall median as high-income employees, and any new hires with income at or below the overall median as low-income employees. Since we observe employees' contribution rates only at the beginning of each month, we define an employee as having first switched to a rate in c_i in month t of tenure if t full calendar months have elapsed since the hire date when we first observe the employee contributing at a rate in c_i instead of the default rate.[8]

We usually define the initial period to be two months long to cover any administrative delays in implementing rate elections at the time of hire, as well as to allow for 401(k) eligibility and automatic enrollment delays. However, for three firms, we define longer initial periods. At Firm B, new hires are not automatically enrolled until their third month of tenure, so we extend the initial period for the firm to three months. Firm A's employees become eligible for employer matching contributions after one year of tenure, and we observe a corresponding increase in contribution rate switching activity for up to two months after match eligibility. We therefore extend Firm A's initial period to 14 months. Similarly, Firm I's employees become eligible for employer matching contributions after one year of tenure, and we see a corresponding spike in opt-out

[8] We do not consider an employee at an automatic enrollment company to have opted out before the opt-out deadline if she contributes 0% before the deadline but begins contributing at the automatic enrollment default after the deadline. She is only classified as having opted out once she starts contributing at a non-default rate after the opt-out deadline.

activity in employees' 12th month of tenure. We therefore extend Firm I's initial period to 12 months.

We determine the partition of non-default contribution rates separately for each firm based on its plan characteristics. While we would prefer to be able to define all c_i as singletons and estimate parameters separately for each contribution rate, we do not observe enough new hires switching to unpopular contribution rates like 1%, 7%, or 9% at every firm to precisely estimate parameters for those contribution rates alone. Therefore, we use a systematic rule to determine the contribution rate partitions. We always set aside the default contribution rate as its own rate group. In addition, where possible, we estimate focal contribution rates like 0%, match thresholds, and 10% by themselves. Any remaining consecutive interval of contribution rates forms a group. In the case that a non-focal contribution rate remains a singleton after applying this procedure (which occurred with Firm B's 2% contribution rate and Firm J's 1% contribution rate), we group the remaining contribution rate with the nearest non-default contribution rate.

III. Income-Related Differences

Figure 1 presents estimates and confidence intervals for each rate group's target rate probabilities. The most popular target rate tends to be a match threshold (a point where the match rate changes), which is consistent with the kink in the intertemporal budget curve introduced by a match threshold creating a natural accumulation point for employees with a range of savings preferences, as well as the hypothesis that the match threshold serves as a psychological focal point (Choi et al., 2002; Benartzi and Thaler, 2007; Choi et al., 2012). A notable exception is Firm H, where an estimated 70.5% of low-income hires and 39.4% of high-income hires have target rates below its 6% match threshold. This may be because Firm H only matches 25% of employee contributions up to the threshold, which is the lowest match rate out of the ten firms that we study.

In contrast, the default contribution rate is a remarkably unpopular target rate. At seven out of the eight firms where the default contribution rate is not a match threshold, at least 85% of new hires in both income groups have a non-default target rate. Again, the only exception is Firm H, where 34.7% of low-income hires and 19.9% of high-income hires have a target rate equal to the default of 0%. Recall that it is possible that some employees have an ideal contribution rate different from the default and yet will never find it worthwhile to opt out. Our empirical strategy classifies these employees as having a target rate equal to the default. Therefore, our target rate estimates, if anything, overstate how well the observed defaults accord with employee preferences. If the optimal default minimizes opt-outs—the rule of thumb suggested by Thaler and Sunstein (2003)—then the firms in our sample are choosing the default poorly.[9]

We also find consistent evidence that low-income employees have lower target contribution rates than their high-income counterparts. At every firm, employees from the low-income group are 3 to 34 percentage points more likely to have a target rate that is below the match threshold, while employees from the high-income group are 3 to 29 percentage points more likely to have a target rate that is above the match threshold. The difference is most pronounced at high contribution rates; high-income employees are 16 to 27 percentage points more likely to have a target contribution rate of 10% or higher.

Figure 2 presents estimates by income group of the probability that an employee switches from the default to her target contribution rate during the initial period. Although our estimates for the initial period switching probabilities are reasonably precise, we obtain a wide range of estimates across firms and across contribution rates. Since we vary the length of the initial period across firms due to different plan designs, we cannot directly compare the initial period switching probabilities across all ten firms. We can, however, look at the trend of switching probabilities within each firm. Consistent with Carroll et al. (2009), we find that employees tend to opt out more quickly when their target contribution rates are far from the default.

Figure 3 shows estimates by income group of the probability that an employee first switches to her target contribution rate during a given month in the later period, conditional on having remained at the default contribution rate up to that month. Our estimates for the later-period switching hazards are less precise than the estimates for the initial-period switching probabilities, but we do observe the same general trend that employees from both income groups tend to opt out more quickly when their target contribution rate is far from the default.

[9] However, Carroll et al. (2009) show that the optimal default does not always minimize opt-outs.

Comparing income groups, our point estimates indicate that for any target contribution rate, low-income hires are less likely than high-income hires to opt out during both the initial and later periods at all ten firms. The fact that this result is consistent across all target contribution rates within a firm × income group × period cell is not surprising, since our estimation procedure constrains the relative switching probabilities across income groups to be constant in log odds for all contribution rates within this cell. However, we do not constrain the relative probabilities and hazards to be constant across firms, nor across the initial and later periods within a firm. The fact that low-income employees are slower to opt out in both periods at all firms is therefore remarkable.

We formally test for differences in switching probabilities in Table 2. Column 1 shows estimates of the ratio of low-income to high-income initial period switching odds, and column 2 reports the same for the later period. The initial period odds ratio is significantly less than one at the 1% level for nine out of ten firms, and the point estimate is 0.899 for the tenth firm, suggesting that low-income employees opt out more slowly at that firm as well. Our estimates for the later period switching odds ratios are less precise, but significantly less than one at the 1% level for six firms, significantly less than one at the 5% level for one firm, and marginally significantly less than one at the 10% level for another firm. At the two firms where there are no significant differences from one, the point estimates of 0.936 and 0.954 remain less than one.

To get a sense for the cumulative effect of these switching probabilities, Table 3 shows the probability that employees with non-default target rates will remain at the default at the end of two years of tenure. The last three columns calculate this probability taking as given the distribution of target rates we estimated for each income group. The first three columns set, for both income groups, the distribution of non-default target rates equal to the average distribution of the high- and low-income groups. When controlling for differences in target rates between low- and high-income employees, we estimate that low-income employees with non-default target rates are 3 to 21 percentage points more likely than their high-income peers to remain stuck at the default contribution rate. These differences are significantly different from zero at the 1% level for seven firms, and significant at the 5% level for one additional firm. Averaging across all firms, low-income employees are 7.1 percentage points more likely to remain at the default, holding target rate preferences constant, a difference that is significant at the 1% level.

We also find some evidence that income-based differences in the distribution of target rates lead to more low-income employees remaining at the default rate. At firms where the default contribution rate is low, low-income employees should be more likely to remain at the default because their target rates are more likely to also be low. Column 6 reports the difference in sticking probabilities when we do not hold non-default target rate distributions constant across income groups. At all eight firms where the default contribution rate is 3% or lower, moving from the average target rate distribution to the income group-specific target rate distribution increases the difference in the proportion of employees stuck at the default contribution rate.

IV. Robustness

We conduct nine robustness checks that can be separated into three categories. Those in the first category change the method for treating unpopular contribution rates to see if our results depend on any special grouping of the rates. Those in the second category change the definition of high- and low-income employees. Those in the third category test the sensitivity of our results to changes in our identifying assumptions.

A. Treatment of unpopular contribution rates

Our first alternative way to treat contribution rates uses the simplest rate grouping possible: we estimate target rate and opt-out probabilities separately for each contribution rate between 0% and 10%, and only group together contribution rates of 11% or greater. To make sure our results are not solely driven by switches to high contribution rates, our second alternative specification assumes that any employee with a target rate of 11% or greater has switched to that contribution rate by the end of two years, and we do not estimate switching probabilities for that rate group. Our odds ratio results remain qualitatively unchanged under both these specifications (see Table A1, columns 2, 3, 6, and 7).

Although our rate-preference-adjusted and overall sticking probability differences are qualitatively similar under the new specifications, we do see substantial changes in the magnitude of the point estimates for Firms C, G, H, and I (see Table A2, columns 2, 3, 6, and 7). The variation in sticking probabilities stems from small sample issues that are introduced when we separately estimate parameters for unpopular contribution rates like 7% or 9%. Since we only observe a handful of employees ever switching to any unpopular contribution rate in the later period, we tend to fit the flat, sporadic switching behavior with very high target rate probabilities and very low hazard rates. This issue does not affect our odds ratio estimates, which give the most weight to the most populous contribution rate groups. However, it does strongly affect sticking probabilities, since the low hazard rates and high target rate probabilities stack on top of each other when we calculate the sticking probability. To eliminate the influence of unpopular contribution rates from our individual rate groups specification, we assume in a third alternative specification that any employee with an unpopular rate[10] as his target rate has switched within his first two years of tenure, and we exclude those rates from the maximum likelihood estimation. Columns 4 and 8 in Tables A1 and A2 report the results from this additional specification check, and we verify that our results are largely in line with our baseline estimates.

B. Alternative income group definitions

We try three alternative definitions for income groups: top and bottom income terciles, income controlling for age and gender, and income relative to others at the same firm.

For the income terciles analysis, we assign an employee to the low-income group if his income is at or below $48,516, the 33rd percentile of income for the sample across all firms, and to the high-income group if his income is at or above $80,395, the 66th percentile. Columns 2 and 6 in Tables A3 and A4 show that our results are generally unaffected or stronger when we use this more extreme division.

To verify that our income effects are not simply due to age or gender effects, we subtract from each employee’s income the sample-wide average income of his or her corresponding 5-year age bracket × gender cell, and then we allocate employees into low- and high-income groups depending on whether this de-meaned income is above or below

[10] Unpopular rates are defined as those with an estimated later period hazard rate of 0.01 or less.

the median de-meaned income of -$4,491. Our results remain largely unchanged after controlling for age and gender in this way (see columns 3 and 7 in Tables A3 and A4).

We also estimate a version of our model that uses each firm's own median income for new hires as the cutoff for separating its own new hires into income groups. This ensures that none of the income groups within a firm are too small, allowing a small number of outliers to become overly influential. Our results remain largely unchanged (see columns 4 and 8 in Tables A3 and A4).

C. Sensitivity of results to identifying assumptions

One possible explanation for low-income employees' slower opt-outs is that they gain fewer tax advantages from contributing to a 401(k) plan, and they therefore face lower costs for delaying any desired savings rate increases. Given the asymmetry in incentives, we may expect to see differences between employees who opt out to increase their contribution rates and employees who opt out to decrease their contribution rates. Therefore, for the five automatic enrollment firms, we estimate separate odds ratios for contributions rate groups above and below the default rate. Columns 2, 3, 7, and 8 in Table A5 and columns 2 and 6 in Table A6 report our results from this exercise. While we lose some precision in our estimates, we find evidence that low-income employees opt out more slowly than high-income employees, regardless of the direction of opt-out.

We may also be concerned that, although we select employees for whom key plan characteristics remain constant during their first two years of tenure, we are picking up effects of people anticipating upcoming rule changes that will occur beyond our sample period. If there is an anticipatory response, then our assumption that the later period switching hazard is constant may not hold. We try dropping the last year of hire in each firm's sample (where possible—we only observe a single year of hires at Firm F) to eliminate any potential anticipatory effects, and our results remain unchanged (see columns 4 and 9 in Table A5, and columns 3 and 7 in Table A6).[11]

Our final robustness check relaxes the assumption that the month-to-month opt-out hazard rate in the later period is constant within each target rate × income group cell.

[11] This approach also drops any employees whose later period overlapped with the start of the Great Recession, so we are also able to verify that our results are not driven by asymmetric responses to the Recession.

We expand our original model by dividing the later period evenly into two and allowing the hazard rate to differ across these two periods within each target rate × income group cell.[12] While we lose substantial precision by splitting the later period in half in this specification, our results remain qualitatively unchanged (see columns 5, 10, and 11 in Table A5, and columns 4 and 8 in Table A6). We also do not find any systematic differences in the estimated hazard rates between the first and second later periods (see Tables A7 and A8).

V. Age- and Gender-Related Differences

Our methods extend naturally to dimensions of heterogeneity other than income. In this section, we examine how responses to defaults vary with age and gender.

We define younger employees as employees who are at most 33 years old at the time of hire (the sample-wide median age of new hires), and we define older employees as employees who are at least 34 years old at the time of hire. Figure 4 presents estimates of target rate probabilities for younger versus older employees. Match thresholds tend to be the most popular target rates for both younger and older employees, whereas the default contribution rate is relatively unpopular at the eight firms where the default rate is not a match threshold. Younger employees are more likely to have a target rate at or below a match threshold, and they are less likely to have target contribution rates of 10% or higher.

Column 1 of Table 4 presents estimates for the age-related odds ratios in the initial period, and Column 2 of Table 4 presents the same for the later period. We find clear evidence that younger employees switch more slowly away from the default rate in the initial period. The ratio of younger employee switching odds to older employee switching odds is below one at all ten firms, statistically significant at the 1% level for eight firms, and statistically significant at the 5% level for one other firm. Our estimates are less precise in the later period. The switching hazard odds ratios are substantially less than one at five out of the ten firms (and statistically significant so for four of them),

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[12] Specifically, high-income employees with target rate c_i have a monthly switching hazard of $F(y_{c_i})$ in the first later period and $F(z_{c_i})$ in the second later period, while low-income employees have a monthly switching hazard of $F(y_{c_i} + \theta_2)$ in the first later period and $F(z_{c_i} + \theta_3)$ in the second later period.

approximately one at four firms, and greater than one at one firm (but not statistically significantly so).

Columns 3 and 6 of Table 5 report two-year sticking probabilities. Despite the statistically significant differences in switching probabilities in the initial period, the accumulated differences in sticking probabilities over the first two years of tenure between younger and older employees are fairly small at most of the firms. For seven out of ten firms, the difference in rate-preference-adjusted sticking probabilities is within 2.5 percentage points, and the difference in overall sticking probabilities is within 3.2 percentage points. However, we observe large differences in sticking probabilities between younger and older employees at three firms, and statistically significant differences at two firms. Moreover, the sample-wide average sticking probability differences are both statistically significant from zero at the 1% level.

Since income and age are positively correlated, these age correlations could simply be due to income effects. To explore this possibility, we subtract from each employee's age the cross-firm average age of employees with the same gender whose income is in the same $5,000 income bracket. We then separate employees into the younger or older group based on this adjusted age. Our odds ratio results remain qualitatively similar, although the initial period odds ratios are only statistically significant for three firms, and the later period odds ratios are statistically significant for only two firms (see Table A9). However, our sticking probability results become somewhat stronger, as the differences become marginally statistically significant for Firm C as well (see Table A10). Our results on age-related differences match theoretical analysis by Gabaix (2016), who proposes that the influence of default options in retirement savings plans will diminish as people approach retirement and begin paying closer attention to their savings.

Figure 5 presents estimates of the target rate probabilities of female employees separately from male employees. We find some tendency for women to have lower target contribution rates than men. Column 1 of Table 6 presents the estimates of gender-related odds ratios in the initial period, and Column 2 of Table 6 presents the same for the later period. We find some evidence that female employees opt out more slowly in the initial period. The point estimates for the odds ratios are less than one for eight firms, and the difference from one is statistically significant at the 1% level for three firms and at the 5% level for one other firm. Our estimates are generally imprecise in the later period and widely distributed around 1. Only one point estimate is marginally significantly less than one at the 10% level.

Columns 3 and 6 of Table 7 show no systematic evidence that female and male employees with non-default target rates have different probabilities of being stuck at the default contribution rate after two years. The sample-wide average differences in sticking probabilities are reasonably precisely estimated, but they are insignificant both in magnitude and statistically.

VI. Target Rate Probabilities Under Different Default Rates

So far, we have taken the target contribution rate as given. However, the default contribution rate may itself affect the distribution of target rates. There are several channels (which are not mutually exclusive) through which this may happen. First, the default may be interpreted as containing implicit advice, changing employees' perceptions of their ideal contribution rate. Second, the default may serve as a psychological anchor (Tversky and Kahneman, 1974), shifting the perceived ideal contribution rate towards the default. Third, at any status quo, there may be some people whose ideal contribution rate differs from the default but who perceive the benefit to opting out to be sufficiently small relative to their minimum possible opt-out cost draw that they will never opt out. These individuals will be observationally equivalent to those who perceive the default to be their ideal contribution rate. If such individuals exist, then target rates would move with the default contribution rate, even if ideal contribution rates remained fixed.

To identify how defaults affect target rates, we use firms that changed their default contribution rates for new hires. Due to the limited availability of full panel data for many firms in our sample, our criteria for selecting firms for this analysis are more relaxed than the criteria used in the main analyses. We allow firms to offer a Roth 401(k) contribution option concurrently with a before-tax contribution option, although we do drop any hires whose observed tenure overlapped with the introduction of the Roth. In addition, when we are missing a month of contribution rate data, we interpolate the rate for that month.[13] Among the set of firms in our dataset that switched default contribution rates at some point, we identified two firms that have contributions panel data that are missing no more than one month for employees hired both before and after the change in the default. Table 8 summarizes the characteristics of the two firms that we study in this section.

Firm K switched the default contribution rate for new hires from 3% to 0% on November 1, 2003, but this change did not affect any previously auto-enrolled hires. We are therefore able to include employees hired as late as October 31, 2003 in the automatic enrollment cohort. Since employees at this firm become eligible to participate in the plan after 60 to 90 days of tenure, we include any employees who become eligible within 90 days of hire, and we define the initial period for the firm to be three months long. We do observe a spike in opt-out activity at the end of each calendar year in this firm that is not a result of any mechanical plan features like automatic escalation. Therefore, we include a full calendar year of hires in each enrollment cohort to ensure that the two samples both contain this spike.

Firm L introduced automatic enrollment for new hires on June 1, 2008 and also automatically enrolled any past hires who were not already participating in the plan. We truncate the observational period for employees in the opt-in enrollment cohort to ensure that it does not overlap with any retroactive automatic enrollment. The firm differs from the other firms in our sample in that it offers a Roth 401(k) option concurrently with the tax-deferred plan for both enrollment cohorts. In addition, the firm has nonstandard rules that make an employee eligible for matching contributions anywhere from 12 months to 18 months after hire, depending on the calendar month in which the employee joined the firm. A change in match eligibility status during the later period may violate our assumption that the later-period opt-out hazard rate is constant, and data availability constraints render an 18 month initial period infeasible to implement. As a result, we

[13] When contribution rate data are missing, they are missing only for certain calendar months. Therefore, when the missing calendar month corresponds to tenure month t for employee i, we can use other employees at the firm who were hired on a different date to compute opt-out probabilities in tenure month t. (We do not estimate separate opt-out probabilities by destination contribution rate.) If i's contribution rate did not change between $t-1$ and $t+1$, then we assume that i did not opt out in t. If i's contribution rate changed between $t-1$ and $t+1$, then we use other employees' data to estimate the probability that i switched in t conditional on knowing that she switched in either t or $t+1$. We then randomly assign i to have either opted out or not in t based on this conditional probability.

reduce the observational period for this firm to the first ten months of tenure, although to ensure that the employees are still as comparable as possible to the others we have studied, we only include employees who stay with the firm for at least two years.[14] Finally, note that the introduction of automatic enrollment at this firm occurred shortly before the collapse of Lehman Brothers. While it is less likely that the recession prompted a large mass of employees to favor a contribution rate of 3%, we may expect to see a greater proportion of employees moving to 0% as a response, which would lead us to underestimate the reduction in the 0% target rate probability caused by the introduction of automatic enrollment.

Our estimates here are less stable than our estimates in the main analysis for three reasons. First, the sample size at Firm K is fairly small. Second, the observation period at Firm L is substantially shorter than the two years that are used elsewhere. Finally, we focus on precisely estimating the default target rate probabilities, which are the most sensitive parameters in our model. As a result, our basic rate grouping algorithm described in Section II is too demanding for the limited data available here, and we need to adopt a coarser rule for grouping contribution rates. We estimate parameters for 0%, the match threshold, and the automatic enrollment default rate separately, while combining contribution rates that fall between 0% and the match threshold into one group, and contribution rates above the match threshold into a second group.

We begin by separating employees into high- and low- income groups using the primary analysis's cross-firm median income of $62,470. Figure 6 presents the estimated target rate probability distributions for the two enrollment cohorts at Firm K under this definition, and Table 9 reports the changes to target rate probabilities from implementing automatic enrollment. Low-income employees are 21.4 percentage points less likely to have a target contribution rate of 0% when it is no longer the default rate, while high-income employees are 16.6 percentage points less likely to do the same. Both estimates are statistically significant at the 1% level. Meanwhile, low-income employees are 23.3

[14] One may be concerned that if the later period ends at ten months of tenure, the assumption of a constant opt-out hazard rate during the later period will be violated, since employees know that the time remaining until they are eligible for the match is decreasing over the course of this period. However, analysis of switching behavior at Firm L, along with Firms A and I in the main sample, suggests that the empirical opt-out rates at firms with a one-year wait for match eligibility do not increase substantially until the 11th month of tenure.

percentage points more likely to have a target contribution rate of 3% when it is the default, and high-income employees are 1.8 percentage points *less* likely to do the same. This change is only statistically significant for the low-income group, and we have very little precision in our estimate for the high-income group. The last column shows the difference in differences across income groups. We cannot reject that the drop in the 0% target rate probability is equal across low-and high-income employees, but we can marginally reject the equality in the increase in the 3% target rate probability.

Table 10 expands our analysis to consider differences in target rate sensitivity to the default by age and gender, as well as differences in sensitivity by income and age that control for other characteristics. In our age analysis, we divide employees into younger and older groups by the primary analysis's cross-firm median age of 33. Once we control for age and gender, the difference in differences across income groups loses significance. We also do not see significant differences in differences across age and gender groups. However, our standard errors are generally too large to reject even large differences.

Figure 7 presents the estimated target rate probability distributions for the two enrollment cohorts at Firm L by income group, and Table 11 reports the changes to target rate probabilities after the introduction of automatic enrollment. Low-income employees are 13.2 percentage points less likely to have a target contribution rate of 0% when it is no longer the default, and high-income employees are 7.0 percentage points less likely to do the same. On the other hand, low-income employees are 20.6 percentage points more likely to have a target contribution rate of 3% when it is the default contribution rate, whereas high-income employees are 13.0 percentage points more likely to do the same. Both sets of differences are statistically significant, as well as the differences between the two income groups' responses at the 3% target rate.

Table 12 expands our analysis of the heterogeneity in responses to the default change at Firm L. Given our greater precision due to larger sample sizes at this firm, we are able to detect smaller differences in default responses than at Firm K. We find that when the default changes to 3%, low-income and younger employees are more likely to change their target rate to 3%. However, once we control for age and gender, the difference in differences by income at 3% disappear, and the significance shifts to a greater propensity of low-income employees to cease having 0% as their target rate. The low-income are also more likely to move their target rate to 6% or greater when the default rises to 3%. Once we control for income and gender, the significance of the differential propensity of the young to move their target rate to 3% weakens. The young are also less likely to move their target rate to 7% or greater. Meanwhile, mirroring our sticking probability results from the primary analysis, we find no strongly statistically significant differences in the target rate response to defaults when comparing male and female employees.

VII. Conclusion

This paper develops and estimates a statistical model to study the propensity of employees to opt out of the default contribution rate in a savings plan, conditional on the gap between the default and the target contribution rate they would select upon opting out. Low-income employees are slower than high-income employees to opt out of the default, holding fixed the target contribution rate. Applying the methodology to other dimensions of heterogeneity, we find that younger employees are slower to opt out of the default than older employees, but this effect is smaller than the effect for income. We do not find heterogeneity by gender. Examining how target contribution rates are affected by the default itself, we find some evidence that young, low-income employees' target rates are more sensitive to the default.

The greater influence that defaults have on young, low-income employees suggests that their interests should be more heavily weighed when choosing a plan's default if a single default must be applied to all employees. Of course, an institutional designer may be able to do even better if she can apply different defaults to different employees based upon their observable characteristics.

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Table 1. Characteristics of firms in the main analysis

Firm	Industry	Hire Dates Covered	Sample Size	Median Income (2010 levels)	Initial Period (months)	Default Contrib. Rate	Employer Matching Contributions
A	Pharmaceutical/ Healthcare	01/01/2002 - 12/31/2005	14,753	$68,026	14	3%	75% on the first 6% of income contributed
B	Medical Equipment/ Technology	01/01/2002 - 11/01/2003	5,444	$60,635	3	3%	Varies between 50% and 75% on the first 6% of income contributed
C	Diversified Manufacturing	10/02/2008 - 12/31/2010	1,931	$37,167	2	6%	100% on the first 6% of income contributed
D	Diversified Manufacturing	01/01/2002 - 12/31/2006	5,193	$50,942	2	6%	Varies between 35% and 50% on the first 6% of income contributed
E	Electronics	01/01/2004 - 12/31/2006	2,416	$80,692	2	2%	100% on the first 4% of income contributed
F	Computer Hardware	01/01/2002 - 12/31/2002	1,872	$40,828	2	0%	100% on the first 3% of income contributed
G	Insurance	08/02/2003 - 12/31/2006	5,819	$40,666	2	0%	Varies between 50% and 150% on the first 5% of income contributed
H	IT Services	03/02/2002 - 12/31/2004	8,289	$66,124	2	0%	25% on the first 6% of income contributed
I	Pharmaceutical/ Healthcare	01/01/2002 - 12/31/2004	5,453	$86,044	12	0%	100% on the first 4% of income contributed
J	Telecom Services	01/01/2002 - 12/31/2003	2,169	$27,802	2	0%	100% on the first 2% of income contributed, 40% on the next 4% of income contributed

Table 2. Income specification: initial period and later period switching odds ratios

This table reports the ratio of the odds that a low-income employee will switch from the default contribution rate to his target rate in each period to the odds that a high-income employee will do the same. For the initial period, the switching odds are defined as the probability that the employee switches at any point during the entire period, divided by the probability that the employee does not switch during the period. For the later period, the switching odds are defined as the monthly probability of switching in any given month, conditional on having remained at the default contribution rate up to that month, divided by the probability of staying at the default over the month, conditional on having remained at the default contribution rate up to that month. Standard errors are in parentheses, and any estimates statistically significantly different from one at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Firm	Initial Period	Later Period
A	**0.440*** **	**0.626*** **
	(0.021)	(0.069)
B	**0.476*** **	**0.936**
	(0.022)	(0.118)
C	**0.363*** **	**0.385*** **
	(0.027)	(0.041)
D	**0.519*** **	**0.954**
	(0.029)	(0.136)
E	**0.408*** **	**0.650** **
	(0.069)	(0.158)
F	**0.338*** **	**0.318*** **
	(0.052)	(0.076)
G	**0.625*** **	**0.630*** **
	(0.042)	(0.065)
H	**0.512*** **	**0.534*** **
	(0.025)	(0.039)
I	**0.899**	**0.689* **
	(0.189)	(0.175)
J	**0.410*** **	**0.531*** **
	(0.031)	(0.069)

Table 3. Income specification: probability of being stuck at the default contribution rate after 2 years

This table reports the probability that an employee with a non-default target rate will remain at the default rate two years after joining the firm. The first three columns assume that employees from both income groups have the same distribution of target contribution rates, so any differences result purely from differences in the target rate-dependent switching probabilities. The last three columns apply each income group's estimated distribution of target contribution rates to calculate the total probability of being stuck at the default rate. Cross-firm averages are weighted by the total number of observed hires at each firm. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Firm	Rate preference adjusted sticking probabilities (Ψ)			Overall sticking probabilities (Ω)		
	Low income	High income	Difference	Low income	High income	Difference
A	**0.056**	**0.017**	**0.039*****	**0.064**	**0.015**	**0.049*****
	(0.014)	(0.006)	(0.012)	(0.017)	(0.005)	(0.015)
B	**0.189**	**0.134**	**0.055****	**0.226**	**0.104**	**0.122**
	(0.101)	(0.087)	(0.023)	(0.124)	(0.068)	(0.074)
C	**0.272**	**0.073**	**0.199*****	**0.271**	**0.069**	**0.202*****
	(0.078)	(0.039)	(0.064)	(0.088)	(0.034)	(0.077)
D	**0.202**	**0.157**	**0.045**	**0.190**	**0.165**	**0.025**
	(0.052)	(0.048)	(0.028)	(0.051)	(0.051)	(0.035)
E	**0.120**	**0.039**	**0.081*****	**0.135**	**0.033**	**0.102*****
	(0.017)	(0.015)	(0.022)	(0.019)	(0.014)	(0.024)
Auto Enroll Avg	**0.125**	**0.068**	**0.057*****	**0.135**	**0.062**	**0.073*****
	(0.021)	(0.017)	(0.013)	(0.024)	(0.015)	(0.019)
F	**0.248**	**0.042**	**0.206*****	**0.289**	**0.028**	**0.261*****
	(0.024)	(0.020)	(0.034)	(0.026)	(0.014)	(0.029)
G	**0.045**	**0.013**	**0.032*****	**0.054**	**0.010**	**0.044*****
	(0.008)	(0.005)	(0.009)	(0.009)	(0.004)	(0.010)
H	**0.207**	**0.083**	**0.123*****	**0.264**	**0.059**	**0.205*****
	(0.034)	(0.018)	(0.028)	(0.044)	(0.012)	(0.039)
I	**0.081**	**0.050**	**0.031**	**0.094**	**0.042**	**0.052**
	(0.041)	(0.012)	(0.041)	(0.048)	(0.009)	(0.048)
J	**0.260**	**0.104**	**0.156*****	**0.325**	**0.071**	**0.254*****
	(0.055)	(0.047)	(0.046)	(0.073)	(0.033)	(0.065)
Opt-In Avg	**0.146**	**0.057**	**0.089*****	**0.180**	**0.042**	**0.139*****
	(0.018)	(0.010)	(0.017)	(0.021)	(0.007)	(0.020)
All Avg	**0.134**	**0.063**	**0.071*****	**0.155**	**0.053**	**0.102*****
	(0.014)	(0.010)	(0.010)	(0.017)	(0.009)	(0.014)

Table 4. Age specification: initial period and later period switching odds ratios

This table reports the ratio of the odds that a younger employee will switch from the default contribution rate to his target rate in each period to the odds that an older income employee will do the same. For the initial period, the switching odds are defined as the probability that the employee switches at any point during the entire period, divided by the probability that the employee does not switch during the period. For the later period, the switching odds are defined as the monthly probability of switching in any given month, conditional on having remained at the default contribution rate up to that month, divided by the probability of staying at the default over the month, conditional on having remained at the default contribution rate up to that month. Standard errors are in parentheses, and any estimates statistically significantly different from one at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Firm	Initial Period	Later Period
A	**0.834****	**1.020**
	(0.072)	(0.183)
B	**0.739*****	**1.066**
	(0.052)	(0.146)
C	**0.931**	**0.550*****
	(0.181)	(0.089)
D	**0.785*****	**1.024**
	(0.060)	(0.143)
E	**0.689*****	**1.259**
	(0.111)	(0.549)
F	**0.723*****	**1.079**
	(0.095)	(0.292)
G	**0.804*****	**0.882**
	(0.060)	(0.114)
H	**0.663*****	**0.718*****
	(0.037)	(0.062)
I	**0.743*****	**0.775***
	(0.068)	(0.124)
J	**0.547*****	**0.487*****
	(0.068)	(0.067)

Table 5. Age specification: probability of being stuck at the default contribution rate after 2 years

This table reports the probability that an employee with a non-default target rate will remain at the default rate two years after joining the firm. The first three columns assume that employees from both income groups have the same distribution of target contribution rates, so any differences result purely from differences in the target rate-dependent switching probabilities. The last three columns apply each income group's estimated distribution of target contribution rates to calculate the total probability of being stuck at the default rate. Cross-firm averages are weighted by the total number of observed hires at each firm. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

	Rate preference adjusted sticking probabilities (Ψ)			Overall sticking probabilities (Ω)		
Firm	**Younger**	**Older**	**Difference**	**Younger**	**Older**	**Difference**
A	**0.030**	**0.026**	**0.004**	**0.032**	**0.024**	**0.008**
	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)
B	**0.181**	**0.166**	**0.015**	**0.186**	**0.161**	**0.025**
	(0.122)	(0.114)	(0.018)	(0.124)	(0.114)	(0.029)
C	**0.282**	**0.169**	**0.113**	**0.300**	**0.152**	**0.149**
	(0.100)	(0.072)	(0.070)	(0.116)	(0.061)	(0.097)
D	**0.184**	**0.174**	**0.010**	**0.190**	**0.168**	**0.021**
	(0.050)	(0.049)	(0.026)	(0.053)	(0.048)	(0.034)
E	**0.078**	**0.072**	**0.006**	**0.083**	**0.066**	**0.017**
	(0.036)	(0.038)	(0.034)	(0.036)	(0.038)	(0.034)
Auto Enroll Avg	**0.105**	**0.090**	**0.014**	**0.109**	**0.086**	**0.023***
	(0.020)	(0.020)	(0.010)	(0.021)	(0.019)	(0.012)
F	**0.181**	**0.163**	**0.019**	**0.188**	**0.156**	**0.032**
	(0.081)	(0.081)	(0.044)	(0.082)	(0.083)	(0.055)
G	**0.046**	**0.032**	**0.014**	**0.049**	**0.029**	**0.021***
	(0.008)	(0.008)	(0.011)	(0.009)	(0.007)	(0.011)
H	**0.177**	**0.110**	**0.067*****	**0.203**	**0.092**	**0.111*****
	(0.031)	(0.022)	(0.021)	(0.036)	(0.018)	(0.029)
I	**0.060**	**0.034**	**0.025**	**0.061**	**0.034**	**0.027**
	(0.015)	(0.011)	(0.016)	(0.016)	(0.011)	(0.017)
J	**0.324**	**0.143**	**0.181*****	**0.347**	**0.128**	**0.219*****
	(0.012)	(0.028)	(0.028)	(0.013)	(0.027)	(0.029)
Opt-In Avg	**0.131**	**0.080**	**0.051*****	**0.144**	**0.071**	**0.073*****
	(0.014)	(0.011)	(0.012)	(0.015)	(0.010)	(0.014)
All Avg	**0.116**	**0.086**	**0.030*****	**0.125**	**0.079**	**0.045*****
	(0.013)	(0.012)	(0.008)	(0.014)	(0.011)	(0.009)

Table 6. Gender specification: initial period and later period switching odds ratios

This table reports the ratio of the odds that a female employee will switch from the default contribution rate to her target rate in each period to the odds that a male income employee will do the same. For the initial period, the switching odds are defined as the probability that the employee switches at any point during the entire period, divided by the probability that the employee does not switch during the period. For the later period, the switching odds are defined as the monthly probability of switching in any given month, conditional on having remained at the default contribution rate up to that month, divided by the probability of staying at the default over the month, conditional on having remained at the default contribution rate up to that month. Standard errors are in parentheses, and any estimates statistically significantly different from one at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Firm	Initial Period	Later Period
A	**0.806*** **	**0.839**
	(0.067)	(0.121)
B	**0.821** **	**0.840**
	(0.071)	(0.100)
C	**0.977**	**1.384**
	(0.190)	(0.532)
D	**1.161**	**1.052**
	(0.137)	(0.158)
E	**0.897**	**1.446**
	(0.169)	(0.458)
F	**1.041**	**1.654**
	(0.175)	(0.444)
G	**0.657*** **	**1.013**
	(0.040)	(0.152)
H	**0.902**	**0.944**
	(0.062)	(0.098)
I	**0.663*** **	**0.777* **
	(0.054)	(0.124)
J	**0.871**	**1.100**
	(0.121)	(0.261)

Table 7. Gender specification: probability of being stuck at the default contribution rate after 2 years

This table reports the probability that an employee with a non-default target rate will remain at the default rate two years after joining the firm. The first three columns assume that employees from both income groups have the same distribution of target contribution rates, so any differences result purely from differences in the target rate-dependent switching probabilities. The last three columns apply each income group's estimated distribution of target contribution rates to calculate the total probability of being stuck at the default rate. Cross-firm averages are weighted by the total number of observed hires at each firm. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

	Rate preference adjusted sticking probabilities (Ψ)			Overall sticking probabilities (Ω)		
Firm	**Female**	**Male**	**Difference**	**Female**	**Male**	**Difference**
A	**0.036**	**0.025**	**0.011**	**0.037**	**0.025**	**0.012**
	(0.010)	(0.007)	(0.008)	(0.010)	(0.007)	(0.009)
B	**0.196**	**0.167**	**0.029**	**0.201**	**0.162**	**0.039**
	(0.118)	(0.112)	(0.020)	(0.120)	(0.111)	(0.034)
C	**0.128**	**0.182**	**-0.055**	**0.121**	**0.190**	**-0.069**
	(0.057)	(0.054)	(0.053)	(0.057)	(0.060)	(0.064)
D	**0.167**	**0.183**	**-0.017**	**0.156**	**0.194**	**-0.038**
	(0.050)	(0.049)	(0.026)	(0.048)	(0.054)	(0.035)
E	**0.062**	**0.082**	**-0.020**	**0.062**	**0.081**	**-0.019**
	(0.023)	(0.015)	(0.028)	(0.023)	(0.015)	(0.029)
Auto Enroll Avg	**0.096**	**0.094**	**0.003**	**0.095**	**0.095**	**0.000**
	(0.021)	(0.019)	(0.012)	(0.021)	(0.020)	(0.014)
F	**0.131**	**0.202**	**-0.071**	**0.128**	**0.206**	**-0.078***
	(0.043)	(0.025)	(0.044)	(0.044)	(0.025)	(0.047)
G	**0.046**	**0.034**	**0.012**	**0.050**	**0.031**	**0.019**
	(0.009)	(0.008)	(0.011)	(0.010)	(0.008)	(0.011)
H	**0.137**	**0.124**	**0.013**	**0.145**	**0.117**	**0.028**
	(0.026)	(0.023)	(0.017)	(0.028)	(0.022)	(0.021)
I	**0.063**	**0.033**	**0.030***	**0.063**	**0.033**	**0.030***
	(0.016)	(0.009)	(0.016)	(0.016)	(0.010)	(0.017)
J	**0.297**	**0.309**	**-0.012**	**0.317**	**0.289**	**0.028**
	(0.077)	(0.082)	(0.054)	(0.085)	(0.082)	(0.077)
Opt-In Avg	**0.112**	**0.104**	**0.008**	**0.117**	**0.099**	**0.018**
	(0.012)	(0.010)	(0.010)	(0.013)	(0.010)	(0.011)
All Avg	**0.103**	**0.098**	**0.005**	**0.105**	**0.097**	**0.008**
	(0.013)	(0.012)	(0.008)	(0.014)	(0.012)	(0.010)

Table 8. Characteristics of firms that switched default contribution rates

Firm	Industry	Hire Dates Covered	Sample Size	Median Income (2010 levels)	Initial Period (months)	Default Contrib. Rate	Match Structure
K	Healthcare	11/01/2003 - 10/31/2004	2,722	$30,643	3	0%	50% on the first 3% of income contributed
K	Healthcare	11/01/2002 - 10/31/2003	2,585	$30,753	3	3%	50% on the first 3% of income contributed
L	Business Services	02/02/2006 - 06/01/2007	5,146	$67,243	2	0%	Between 33% and 100% on the first 6% of income contributed
L	Business Services	06/01/2008 - 12/31/2011	10,424	$71,619	2	3%	Between 33% and 100% on the first 6% of income contributed

Table 9. Effect of automatic enrollment on target contribution rates at Firm K

This table reports the difference between the target rate probability (the probability that an employee has a given target contribution rate) for each rate group when Firm K has a default contribution rate of 3% versus 0%. The last column reports the difference between the low-income group's changes and the high-income group's changes. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Rate Group	Median or below income	Above median income	Difference
0%	**-0.214*** **	**-0.166*** **	**-0.048**
CI	(0.075)	(0.036)	(0.076)
1-2%	**-0.062**	**-0.026**	**-0.037**
CI	(0.044)	(0.016)	(0.039)
3%	**0.233*** **	**-0.018**	**0.251***
CI	(0.081)	(0.127)	(0.139)
4%+	**0.044**	**0.209***	**-0.166**
CI	(0.068)	(0.126)	(0.132)

Table 10. Heterogeneity in default responses at Firm K

This table reports the differences in responses to a change in the default contribution rate from 0% to 3% at Firm K. The first column reports the difference between the low-income group's changes in target rate probabilities and the high-income group's changes in target rate probabilities, and the second column reports the same after controlling for age and gender. The third column reports the difference between the younger group's changes in target rate probabilities and the older group's changes in target rate probabilities, and the fourth column reports the same after controlling for income and gender. Finally, the fifth column reports the difference between the female group's changes in target rate probabilities and the male group's changes in target rate probabilities. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Rate Group	Income	Residual Income	Age	Residual Age	Gender
0%	**-0.048**	**0.025**	**0.097**	**0.032**	**-0.055**
	(0.076)	(0.145)	(0.108)	(0.083)	(0.123)
1-2%	**-0.037**	**-0.048**	**-0.008**	**-0.001**	**-0.027**
	(0.039)	(0.084)	(0.027)	(0.021)	(0.030)
3%	**0.251***	**0.060**	**-0.006**	**0.096**	**0.135**
	(0.139)	(0.123)	(0.105)	(0.125)	(0.131)
4%+	**-0.166**	**-0.037**	**-0.083**	**-0.126**	**-0.053**
	(0.132)	(0.092)	(0.086)	(0.104)	(0.117)

Table 11. Effect of automatic enrollment on target contribution rates at Firm L

This table reports the difference between the target rate probability (the probability that an employee has a given target contribution rate) for each rate group when Firm L has a default contribution rate of 3% versus 0%. The last column reports the difference between the low-income group's changes and the high-income group's changes. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Rate Group	Median or below income	Above median income	Difference
0%	**-0.132*****	**-0.070*****	**-0.062**
	(0.040)	(0.025)	(0.042)
1-2, 4-5%	**-0.038***	**-0.035****	**-0.003**
	(0.021)	(0.014)	(0.019)
3%	**0.206*****	**0.130*****	**0.076*****
	(0.022)	(0.017)	(0.020)
6%	**0.031**	**0.051****	**-0.020**
	(0.026)	(0.023)	(0.021)
7%+	**-0.068*****	**-0.076*****	**0.009**
	(0.012)	(0.012)	(0.016)

Table 12. Heterogeneity in default responses at Firm L

This table reports the differences in responses to a change in the default contribution rate from 0% to 3% at Firm L. The first column reports the difference between the low-income group's changes in target rate probabilities and the high-income group's changes in target rate probabilities, and the second column reports the same after controlling for age and gender. The third column reports the difference between the younger group's changes in target rate probabilities and the older group's changes in target rate probabilities, and the fourth column reports the same after controlling for income and gender. Finally, the fifth column reports the difference between the female group's changes in target rate probabilities and the male group's changes in target rate probabilities. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Rate Group	Income	Residual Income	Age	Residual Age	Gender
0%	**-0.062**	**-0.092****	**0.062***	**0.055**	**-0.047**
	(0.042)	(0.039)	(0.036)	(0.037)	(0.039)
1-2, 4-5%	**-0.003**	**-0.034***	**0.004**	**0.017**	**0.009**
	(0.019)	(0.019)	(0.018)	(0.017)	(0.018)
3%	**0.076*****	**0.005**	**0.126*****	**0.040***	**-0.025**
	(0.020)	(0.024)	(0.048)	(0.022)	(0.028)
6%	**-0.020**	**0.062*****	**-0.091*****	**-0.032**	**0.040***
	(0.021)	(0.022)	(0.032)	(0.020)	(0.024)
7%+	**0.009**	**0.059*****	**-0.101*****	**-0.080*****	**0.024**
	(0.016)	(0.017)	(0.022)	(0.017)	(0.018)

Figure 1. Target rate probabilities by income

For each firm and income group, this figure plots the probability that an employee has a target contribution rate in each rate group. We denote the default contribution rate for each firm with (d), and any match thresholds with (m). The tick marks on the horizontal axis indicate the boundaries of each rate group, and the line segments on each bar indicate 95% confidence intervals.

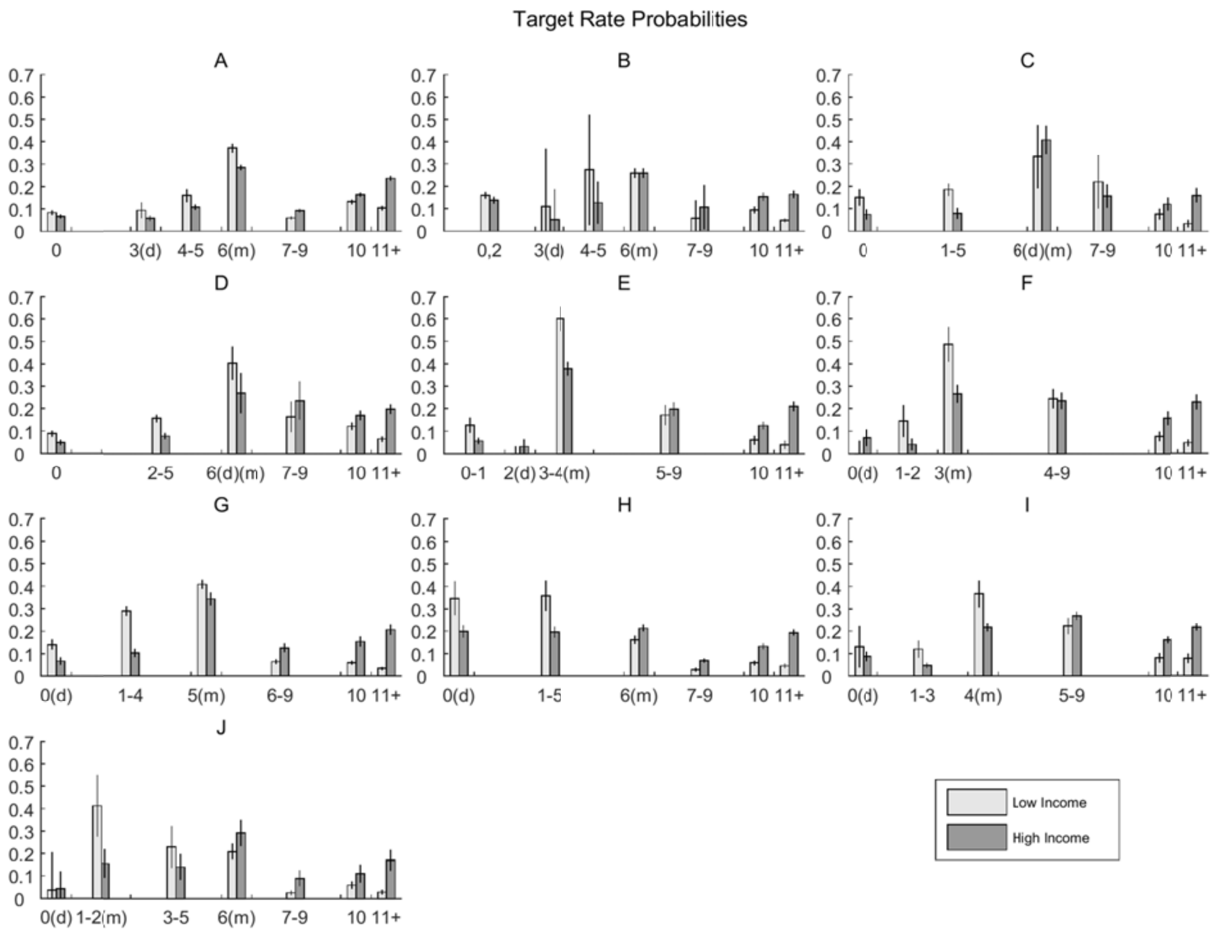

Figure 2. Initial period switching probabilities by income

For each firm and income group, this figure plots the probability that an employee with a target contribution rate in each rate group will switch from the default rate to the target rate at some point during the initial period. We denote the default contribution rate for each firm with (d), and any match thresholds with (m). The tick marks on the horizontal axis indicate the boundaries of each rate group, and the line segments on each bar indicate 95% confidence intervals.

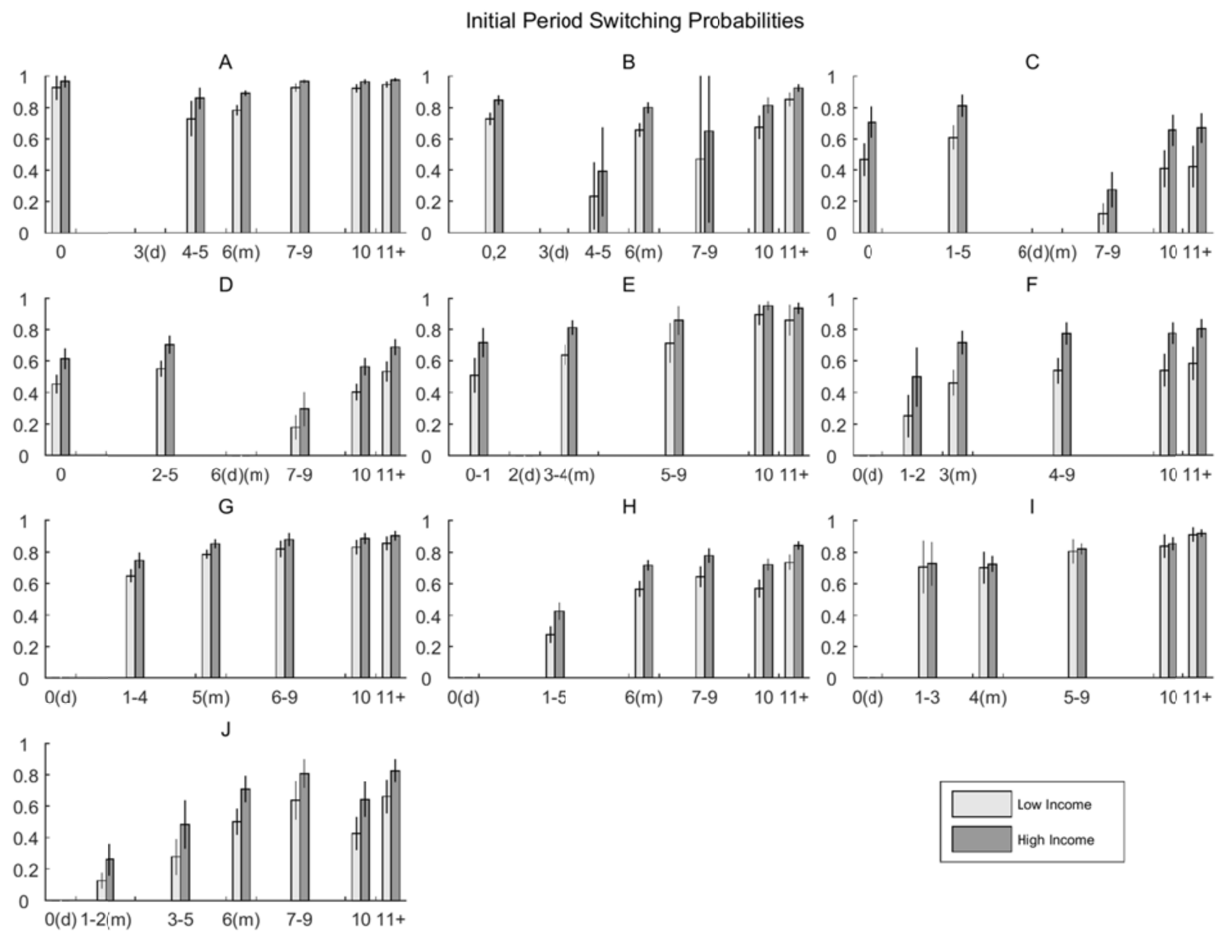

Figure 3. Later period switching hazards by income

For each firm and income group, this figure plots the probability that an employee with a target contribution rate in each rate group will switch from the default rate to the target rate during each month of the later period, conditional on having stayed at the default up to that month. We denote the default contribution rate for each firm with (d), and any match thresholds with (m). The tick marks on the horizontal axis indicate the boundaries of each rate group, and the line segments on each bar indicate 95% confidence intervals.

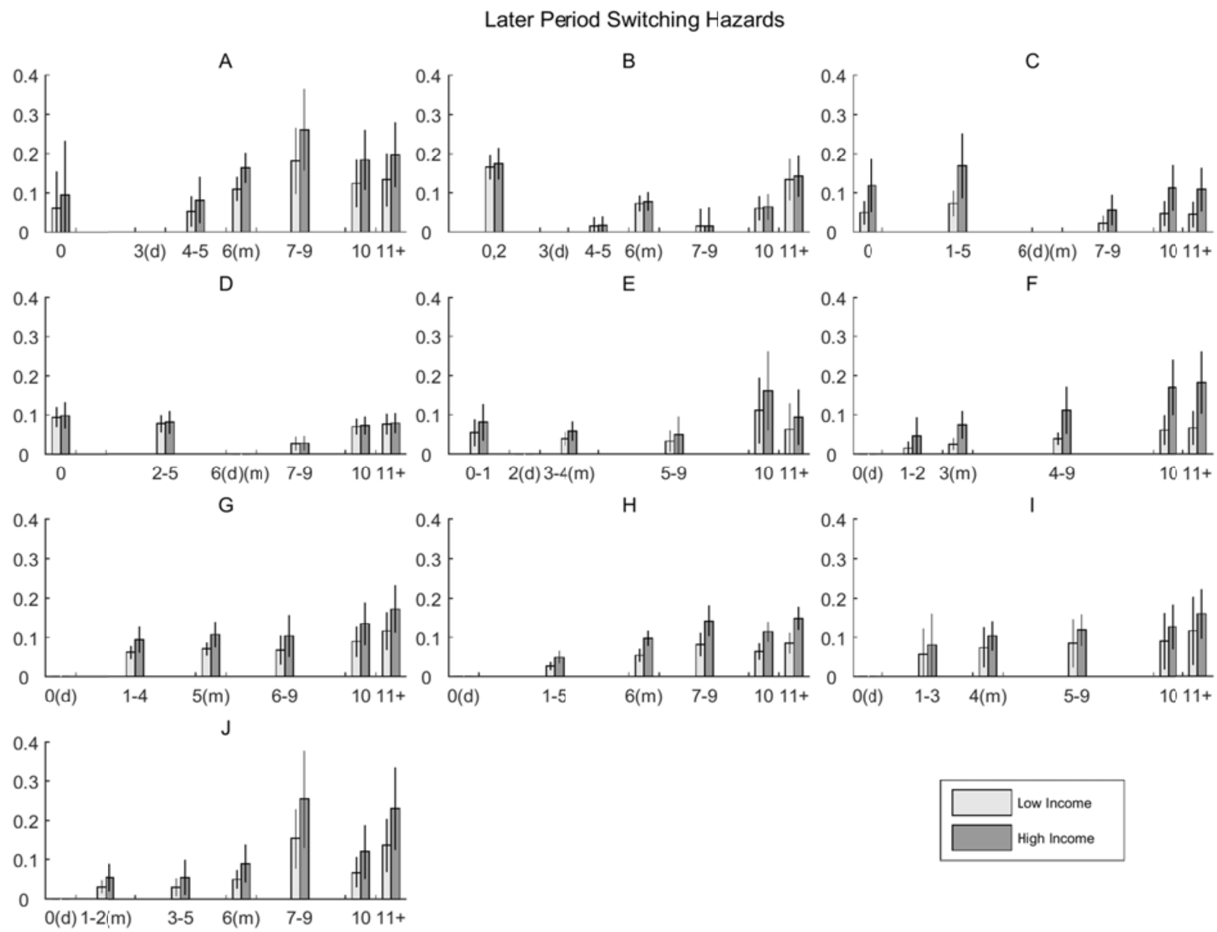

Figure 4. Target rate probabilities by age

For each firm and income group, this figure plots the probability that an employee will have a target contribution rate in each rate group. We denote the default contribution rate for each firm with (d), and any match thresholds with (m). Tick marks on the x axis indicate the end points of each rate group, and line segments on each bar indicate 95% confidence intervals.

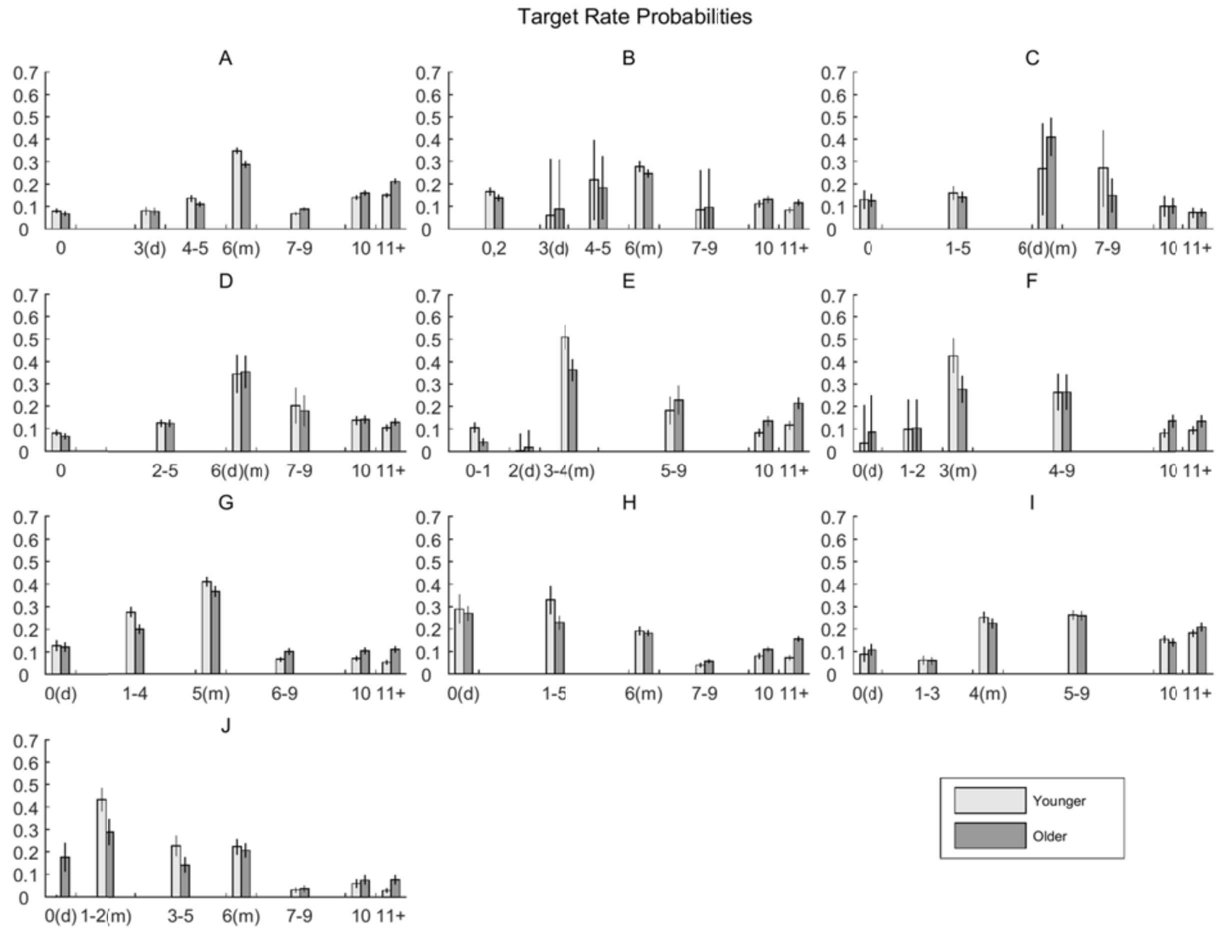

Figure 5. Target rate probabilities by gender

For each firm and income group, this figure plots the probability that an employee will have a target contribution rate in each rate group. We denote the default contribution rate for each firm with (d), and any match thresholds with (m). Tick marks on the x axis indicate the end points of each rate group, and line segments on each bar indicate 95% confidence intervals.

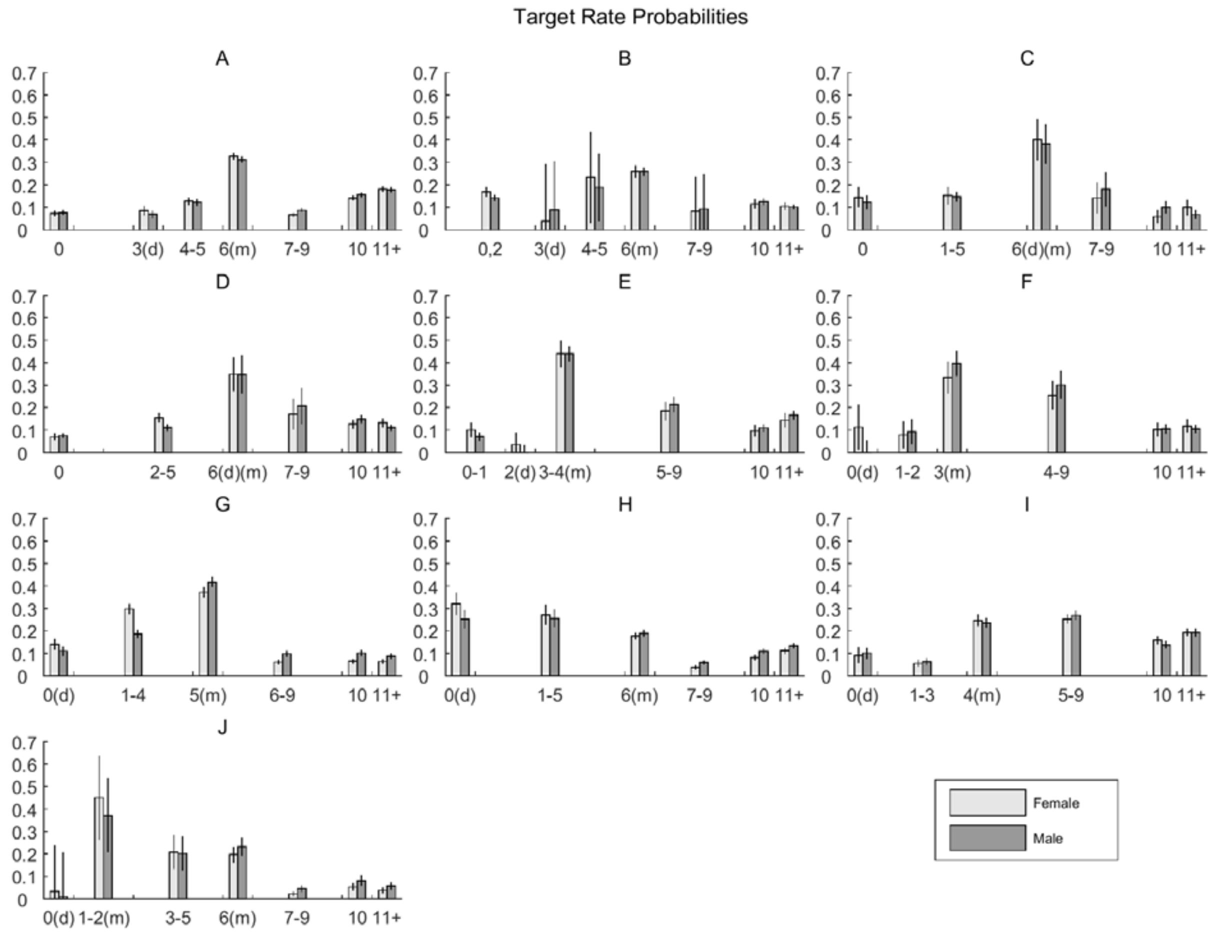

Figure 6. Target rate probabilities for Firm K

This figure plots the estimated target rate probabilities for each rate group under a default contribution rate of 0% (opt-in) and under a default contribution rate of 3% (automatic enrollment). At this firm, the match threshold is at 3% for both enrollment regimes. Error bars indicate 95% confidence intervals.

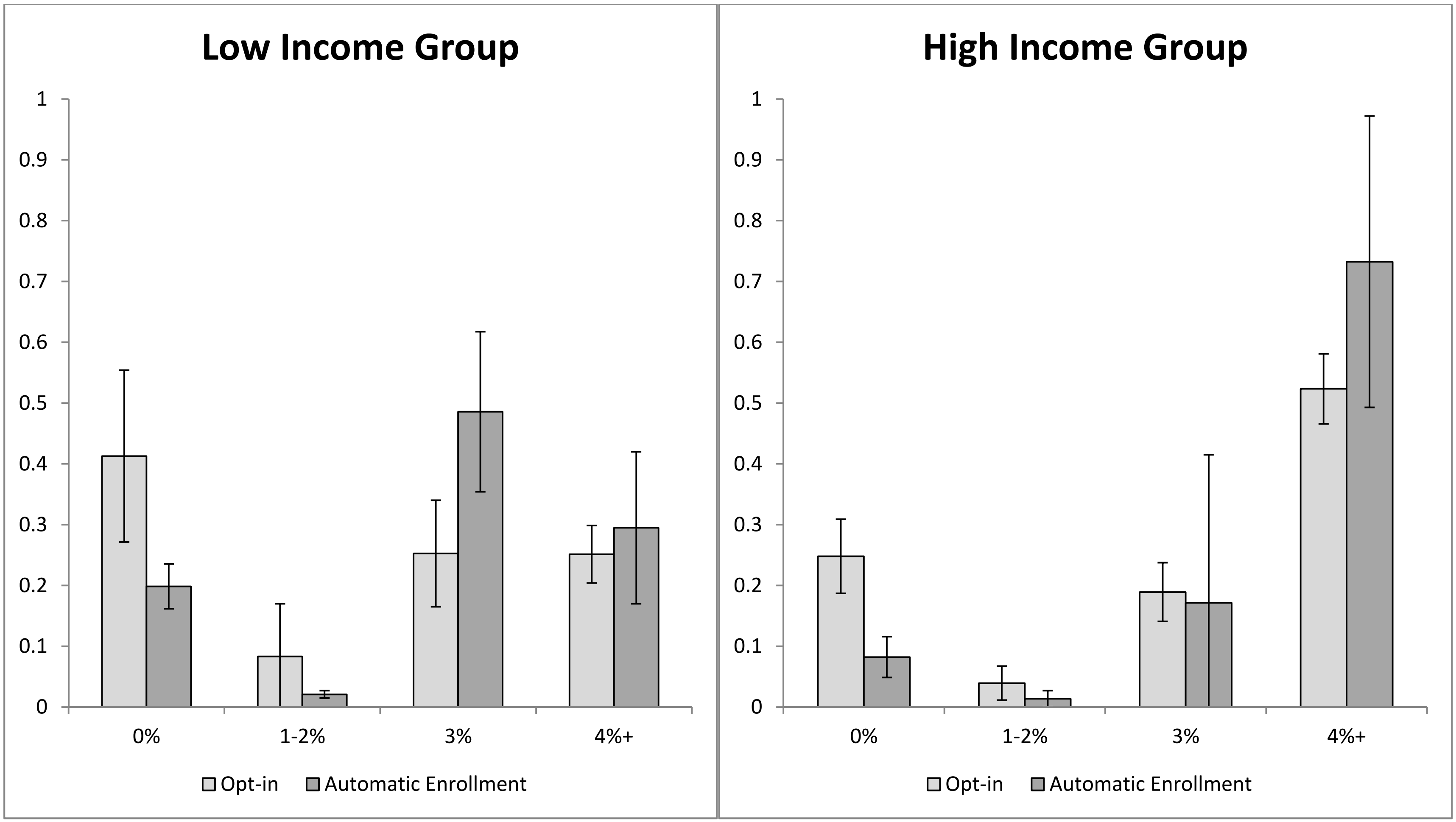

Figure 7. Target rate probabilities for Firm L

This figure plots the estimated target rate probabilities for each rate group under a default contribution rate of 0% (opt-in) and under a default contribution rate of 3% (automatic enrollment). At this firm, the match threshold is at 6% for both enrollment regimes. Error bars indicate 95% confidence intervals.

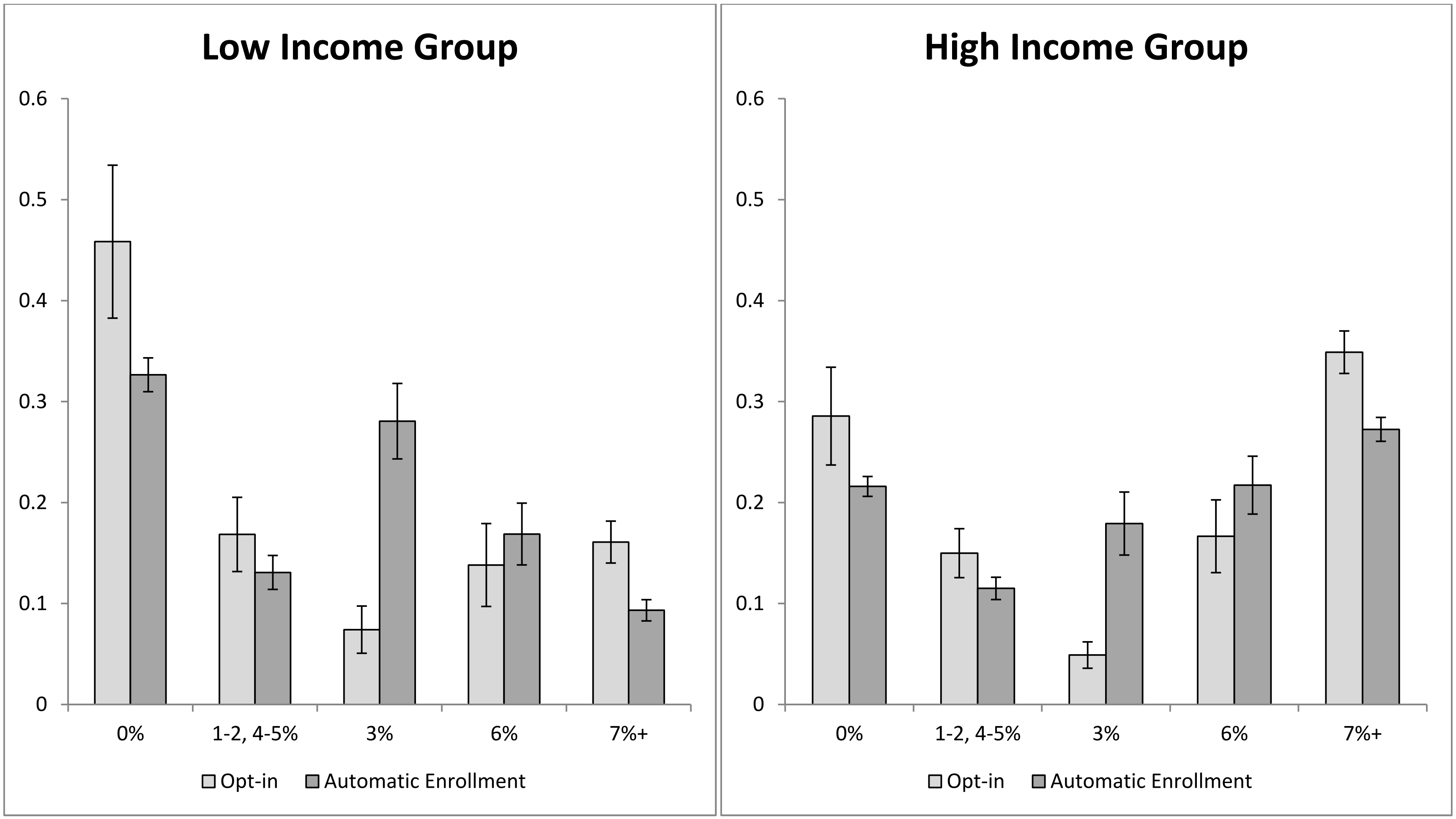

Table A1. Robustness of odds ratios to various rate groupings

Firm	Initial Period Odds Ratios				Later Period Odds Ratios			
	Base Estimates	Individual Target Rates	Individual, Excluding 11%+ Rates	Indiv., Excl. 11%+ & Unpopular	Base Estimates	Individual Target Rates	Individual, Excluding 11%+ Rates	Indiv., Excl. 11%+ & Unpopular
A	**0.440*****	**0.441*****	**0.473*****	**0.473*****	**0.626*****	**0.635****	**0.649****	**0.649****
	(0.021)	(0.068)	(0.071)	(0.071)	(0.069)	(0.171)	(0.172)	(0.172)
B	**0.476*****	**0.476*****	**0.444*****	**0.448*****	**0.936**	**0.934**	**0.906**	**0.849**
	(0.022)	(0.052)	(0.052)	(0.052)	(0.118)	(0.181)	(0.176)	(0.173)
C	**0.363*****	**0.306*****	**0.349*****	**0.339*****	**0.385*****	**0.285*****	**0.274*****	**0.290*****
	(0.027)	(0.073)	(0.089)	(0.092)	(0.041)	(0.089)	(0.096)	(0.108)
D	**0.519*****	**0.523*****	**0.596*****	**0.596*****	**0.954**	**0.947**	**0.948**	**0.948**
	(0.029)	(0.063)	(0.085)	(0.085)	(0.136)	(0.179)	(0.215)	(0.215)
E	**0.408*****	**0.464*****	**0.468*****	**0.468*****	**0.650****	**0.726**	**0.732**	**0.732**
	(0.069)	(0.079)	(0.083)	(0.085)	(0.158)	(0.180)	(0.190)	(0.197)
F	**0.338*****	**0.384*****	**0.371*****	**0.371*****	**0.318*****	**0.344*****	**0.355*****	**0.355*****
	(0.052)	(0.061)	(0.068)	(0.068)	(0.076)	(0.083)	(0.101)	(0.101)
G	**0.625*****	**0.606*****	**0.596*****	**0.596*****	**0.630*****	**0.566*****	**0.538*****	**0.538*****
	(0.042)	(0.070)	(0.073)	(0.073)	(0.065)	(0.122)	(0.121)	(0.121)
H	**0.512*****	**0.537*****	**0.581*****	**0.578*****	**0.534*****	**0.557*****	**0.624*****	**0.629*****
	(0.025)	(0.050)	(0.055)	(0.056)	(0.039)	(0.078)	(0.089)	(0.100)
I	**0.899**	**0.842**	**0.742**	**0.775**	**0.689***	**0.657**	**0.559****	**0.636**
	(0.189)	(0.206)	(0.184)	(0.216)	(0.175)	(0.259)	(0.215)	(0.277)
J	**0.410*****	**0.409*****	**0.456*****	**0.456*****	**0.531*****	**0.523*****	**0.589****	**0.589****
	(0.031)	(0.031)	(0.100)	(0.100)	(0.069)	(0.067)	(0.207)	(0.207)

Table A2. Robustness of sticking probability differences to various rate groupings

Firm	Rate preference adjusted sticking probabilities (Ψ)				Overall sticking probabilities (Ω)			
	Base Estimates	Individual Target Rates	Individual, Excluding 11%+ Rates	Indiv., Excl. 11%+ & Unpopular	Base Estimates	Individual Target Rates	Individual, Excluding 11%+ Rates	Indiv., Excl. 11%+ & Unpopular
A	**0.039*** ** (0.012)	**0.038*** (0.021)	**0.033*** (0.019)	**0.033*** (0.019)	**0.049*** ** (0.015)	**0.049** (0.032)	**0.044** (0.031)	**0.044** (0.031)
B	**0.055** ** (0.023)	**0.052** ** (0.022)	**0.058*** ** (0.022)	**0.041** (0.032)	**0.122** (0.074)	**0.166*** ** (0.043)	**0.175*** ** (0.042)	**0.064** (0.062)
C	**0.199*** ** (0.064)	**0.259*** ** (0.073)	**0.231*** ** (0.071)	**0.205*** ** (0.075)	**0.202*** ** (0.077)	**0.384*** ** (0.088)	**0.349*** ** (0.095)	**0.239** ** (0.097)
D	**0.045** (0.028)	**0.048** (0.032)	**0.035** (0.034)	**0.035** (0.034)	**0.025** (0.035)	**0.037** (0.087)	**0.032** (0.091)	**0.032** (0.091)
E	**0.081*** ** (0.022)	**0.047** ** (0.019)	**0.043** ** (0.019)	**0.061*** ** (0.022)	**0.102*** ** (0.024)	**0.071*** ** (0.020)	**0.071*** ** (0.020)	**0.099*** ** (0.023)
F	**0.206*** ** (0.034)	**0.203*** ** (0.027)	**0.193*** ** (0.028)	**0.193*** ** (0.028)	**0.261*** ** (0.029)	**0.261*** ** (0.019)	**0.260*** ** (0.022)	**0.260*** ** (0.022)
G	**0.032*** ** (0.009)	**0.108*** ** (0.031)	**0.108*** ** (0.030)	**0.040** ** (0.020)	**0.044*** ** (0.010)	**0.174*** ** (0.055)	**0.176*** ** (0.054)	**0.051*** (0.030)
H	**0.123*** ** (0.028)	**0.090*** ** (0.024)	**0.068*** ** (0.021)	**0.059*** (0.035)	**0.205*** ** (0.039)	**0.344*** ** (0.028)	**0.325*** ** (0.030)	**0.088** (0.064)
I	**0.031** (0.041)	**0.029** (0.045)	**0.047** (0.046)	**0.032** (0.052)	**0.052** (0.048)	**0.130** ** (0.065)	**0.142** ** (0.063)	**0.052** (0.071)
J	**0.156*** ** (0.046)	**0.158*** ** (0.047)	**0.133** ** (0.056)	**0.133** ** (0.056)	**0.254*** ** (0.065)	**0.257*** ** (0.068)	**0.239*** ** (0.044)	**0.239*** ** (0.044)

Table A3. Robustness of odds ratios to various income group definitions

Firm	Initial Period Odds Ratios: Base Estimates	Initial Period Odds Ratios: Terciles	Initial Period Odds Ratios: Residual Pay	Initial Period Odds Ratios: Firm Median Pay	Later Period Odds Ratios: Base Estimates	Later Period Odds Ratios: Terciles	Later Period Odds Ratios: Residual Pay	Later Period Odds Ratios: Firm Median Pay
A	**0.440***** (0.021)	**0.183***** (0.042)	**0.445***** (0.023)	**0.417***** (0.018)	**0.626***** (0.069)	**0.283***** (0.098)	**0.577***** (0.063)	**0.643***** (0.072)
B	**0.476***** (0.022)	**0.256***** (0.038)	**0.479***** (0.023)	**0.454***** (0.020)	**0.936** (0.118)	**0.399***** (0.099)	**0.755***** (0.078)	**0.862** (0.099)
C	**0.363***** (0.027)	**0.394***** (0.046)	**0.557***** (0.066)	**0.550***** (0.064)	**0.385***** (0.041)	**0.408***** (0.065)	**0.545***** (0.087)	**0.586***** (0.102)
D	**0.519***** (0.029)	**0.383***** (0.020)	**0.527***** (0.029)	**0.554***** (0.032)	**0.954** (0.136)	**1.056** (0.220)	**0.922** (0.126)	**1.044** (0.158)
E	**0.408***** (0.069)	**0.245***** (0.051)	**0.445***** (0.072)	**0.303***** (0.056)	**0.650**** (0.158)	**0.464***** (0.156)	**0.594***** (0.142)	**0.462***** (0.154)
F	**0.338***** (0.052)	**0.244***** (0.045)	**0.295***** (0.049)	**0.274***** (0.040)	**0.318***** (0.076)	**0.260***** (0.076)	**0.332***** (0.094)	**0.325***** (0.065)
G	**0.625***** (0.042)	**0.477***** (0.033)	**0.580***** (0.036)	**0.599***** (0.036)	**0.630***** (0.065)	**0.545***** (0.064)	**0.461***** (0.033)	**0.641***** (0.065)
H	**0.512***** (0.025)	**0.395***** (0.020)	**0.644***** (0.035)	**0.539***** (0.026)	**0.534***** (0.039)	**0.423***** (0.033)	**0.569***** (0.039)	**0.552***** (0.039)
I	**0.899** (0.189)	**0.800** (0.294)	**0.979** (0.211)	**0.682***** (0.059)	**0.689*** (0.175)	**0.973** (0.596)	**0.761** (0.206)	**0.725**** (0.111)
J	**0.410***** (0.031)	**0.334***** (0.076)	**0.408***** (0.031)	**0.337***** (0.048)	**0.531***** (0.069)	**0.459***** (0.132)	**0.584***** (0.087)	**0.556***** (0.097)

Table A4. Robustness of sticking probability differences to various income group definitions

Firm	Rate preference adjusted sticking probabilities (Ψ)				Overall sticking probabilities (Ω)			
	Base Estimates	Terciles	Residual Pay	Firm Median Pay	Base Estimates	Terciles	Residual Pay	Firm Median Pay
A	**0.039***** (0.012)	**0.146***** (0.033)	**0.045***** (0.014)	**0.034***** (0.010)	**0.049***** (0.015)	**0.192***** (0.041)	**0.054***** (0.017)	**0.043***** (0.012)
B	**0.055**** (0.023)	**0.169***** (0.033)	**0.067***** (0.020)	**0.064***** (0.022)	**0.122** (0.074)	**0.312***** (0.045)	**0.138*** (0.071)	**0.135*** (0.075)
C	**0.199***** (0.064)	**0.186**** (0.081)	**0.129**** (0.059)	**0.126*** (0.067)	**0.202***** (0.077)	**0.194**** (0.095)	**0.100** (0.063)	**0.100** (0.076)
D	**0.045** (0.028)	**0.046** (0.034)	**0.050*** (0.028)	**0.027** (0.028)	**0.025** (0.035)	**0.030** (0.042)	**0.032** (0.034)	**0.006** (0.035)
E	**0.081***** (0.022)	**0.112***** (0.024)	**0.087***** (0.024)	**0.088***** (0.019)	**0.102***** (0.024)	**0.140***** (0.027)	**0.108***** (0.026)	**0.106***** (0.020)
F	**0.206***** (0.034)	**0.240***** (0.037)	**0.210***** (0.038)	**0.240***** (0.029)	**0.261***** (0.029)	**0.296***** (0.029)	**0.260***** (0.033)	**0.293***** (0.022)
G	**0.032***** (0.009)	**0.044***** (0.011)	**0.045***** (0.009)	**0.044***** (0.014)	**0.044***** (0.010)	**0.062***** (0.013)	**0.056***** (0.011)	**0.060***** (0.016)
H	**0.123***** (0.028)	**0.170***** (0.043)	**0.093***** (0.022)	**0.112***** (0.025)	**0.205***** (0.039)	**0.272***** (0.059)	**0.155***** (0.030)	**0.192***** (0.036)
I	**0.031** (0.041)	**0.009** (0.069)	**0.019** (0.035)	**0.033*** (0.018)	**0.052** (0.048)	**0.026** (0.092)	**0.036** (0.040)	**0.045**** (0.020)
J	**0.156***** (0.046)	**0.174***** (0.042)	**0.139***** (0.046)	**0.199***** (0.043)	**0.254***** (0.065)	**0.318***** (0.033)	**0.246***** (0.066)	**0.257***** (0.041)

Table A5. Robustness of odds ratios to various specification changes

Firm	Initial Period Odds Ratios					Later Period Odds Ratios					
	Base Estimates	2 Thetas - Decrease	2 Thetas - Increase	Antici-patory	2 Later Periods	Base Estimates	2 Thetas - Decrease	2 Thetas - Increase	Antici-patory	2 Later Periods 1	2 Later Periods 2
A	**0.440***** (0.021)	**0.022***** (0.029)	**0.447***** (0.069)	**0.429***** (0.021)	**0.304***** (0.057)	**0.626***** (0.069)	**0.010***** (0.015)	**0.662*** (0.181)	**0.622***** (0.072)	**0.427***** (0.110)	**0.303***** (0.117)
B	**0.476***** (0.022)	**0.505***** (0.092)	**0.470***** (0.091)	**0.337***** (0.015)	**0.500***** (0.082)	**0.936** (0.118)	**0.899** (0.235)	**0.940** (0.322)	**0.515***** (0.046)	**0.940** (0.244)	**1.178** (0.519)
C	**0.363***** (0.027)	**0.558***** (0.167)	**0.192***** (0.074)	**0.317***** (0.143)	**0.361***** (0.132)	**0.385***** (0.041)	**0.417***** (0.194)	**0.215***** (0.105)	**0.817** (0.555)	**0.344***** (0.172)	**0.555** (0.444)
D	**0.519***** (0.029)	**0.835** (0.162)	**0.395***** (0.057)	**0.523***** (0.039)	**0.531***** (0.099)	**0.954** (0.136)	**1.022** (0.341)	**0.803** (0.165)	**1.012** (0.204)	**0.974** (0.261)	**1.035** (0.460)
E	**0.408***** (0.069)	**0.472**** (0.225)	**0.392***** (0.074)	**0.360***** (0.066)	**0.359***** (0.069)	**0.650**** (0.158)	**1.055** (0.697)	**0.588***** (0.156)	**0.743** (0.184)	**0.564***** (0.147)	**0.360***** (0.188)
F	**0.338***** (0.052)				**0.325***** (0.071)	**0.318***** (0.076)				**0.295***** (0.091)	**0.262***** (0.180)
G	**0.625***** (0.042)			**0.477***** (0.034)	**0.636***** (0.095)	**0.630***** (0.065)			**0.581***** (0.077)	**0.641**** (0.155)	**0.715** (0.335)
H	**0.512***** (0.025)			**0.514***** (0.031)	**0.546***** (0.137)	**0.534***** (0.039)			**0.495***** (0.042)	**0.577**** (0.185)	**0.669** (0.358)
I	**0.899** (0.189)			**0.952** (0.274)	**1.058** (0.382)	**0.689*** (0.175)			**0.698** (0.229)	**0.807** (0.410)	**1.175** (0.877)
J	**0.410***** (0.031)			**0.572***** (0.152)	**0.562***** (0.139)	**0.531***** (0.069)			**0.724** (0.206)	**0.784** (0.278)	**1.692** (1.184)

Table A6. Robustness of sticking probability differences to various specification changes

Firm	Rate preference adjusted sticking probabilities (Ψ)				Overall sticking probabilities (Ω)			
	Base Estimates	2 Thetas	Antici-patory	2 Later Periods	Base Estimates	2 Thetas	Antici-patory	2 Later Periods
A	**0.039***** (0.012)	**0.101***** (0.027)	**0.037***** (0.012)	**0.104***** (0.022)	**0.049***** (0.015)	**0.137***** (0.036)	**0.046***** (0.015)	**0.131***** (0.024)
B	**0.055**** (0.023)	**0.056** (0.037)	**0.125***** (0.035)	**0.046** (0.041)	**0.122** (0.074)	**0.123**** (0.062)	**0.217*** (0.129)	**0.161***** (0.061)
C	**0.199***** (0.064)	**0.316***** (0.091)	**0.073** (0.117)	**0.200** (0.134)	**0.202***** (0.077)	**0.340***** (0.111)	**0.188** (0.156)	**0.240** (0.171)
D	**0.045** (0.028)	**0.075**** (0.036)	**0.042** (0.043)	**0.028** (0.068)	**0.025** (0.035)	**0.062** (0.044)	**0.013** (0.056)	**0.015** (0.081)
E	**0.081***** (0.022)	**0.084***** (0.023)	**0.092***** (0.026)	**0.097***** (0.029)	**0.102***** (0.024)	**0.104***** (0.023)	**0.112***** (0.026)	**0.120***** (0.028)
F	**0.206***** (0.034)			**0.219***** (0.063)	**0.261***** (0.029)			**0.257***** (0.065)
G	**0.032***** (0.009)		**0.044***** (0.013)	**0.028** (0.024)	**0.044***** (0.010)		**0.058***** (0.015)	**0.038** (0.027)
H	**0.123***** (0.028)		**0.137***** (0.037)	**0.100** (0.093)	**0.205***** (0.039)		**0.213***** (0.050)	**0.193**** (0.095)
I	**0.031** (0.041)		**0.029** (0.054)	**0.002** (0.070)	**0.052** (0.048)		**0.049** (0.062)	**0.025** (0.087)
J	**0.156***** (0.046)		**0.079** (0.053)	**0.000** (0.086)	**0.254***** (0.065)		**0.248***** (0.042)	**0.054** (0.085)

Table A7. High-income group hazard rate differences between the 2 later periods

This table reports the difference between the first later period and the second later period high-income hazard rate for each firm and rate group. Match thresholds are highlighted in grey, and unavailable rates are colored in black. We do not estimate hazard rates for any default contribution rates, so those cells are left blank. At Firm B, we group the 2% contribution rate with 0%. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

<table>
<tr><th>Firm</th><th>0%</th><th>1%</th><th>2%</th><th>3%</th><th>4%</th><th>5%</th><th>6%</th><th>7%</th><th>8%</th><th>9%</th><th>10%</th><th>11%+</th></tr>
<tr><td>A</td><td>-0.067
(0.125)</td><td></td><td></td><td></td><td colspan="2">0.007
(0.013)</td><td>0.008
(0.018)</td><td colspan="3">-0.132
(0.138)</td><td>0.000
(0.046)</td><td>0.013
(0.060)</td></tr>
<tr><td>B</td><td>0.053
(0.062)</td><td></td><td>See Caption</td><td></td><td colspan="2">0.004
(0.003)</td><td>0.014
(0.015)</td><td colspan="3">0.000
(0.037)</td><td>0.015
(0.016)</td><td>0.037
(0.114)</td></tr>
<tr><td>C</td><td>0.051
(0.039)</td><td colspan="5">0.080
(0.060)</td><td></td><td colspan="3">0.015
(0.014)</td><td>-0.010
(0.091)</td><td>-0.007
(0.077)</td></tr>
<tr><td>D</td><td>0.002
(0.025)</td><td></td><td colspan="4">0.009
(0.012)</td><td></td><td colspan="3">-0.016
(0.014)</td><td>-0.022
(0.026)</td><td>0.012
(0.013)</td></tr>
<tr><td>E</td><td colspan="2">0.013
(0.028)</td><td></td><td>-0.062
(0.040)</td><td></td><td colspan="5">-0.037
(0.037)</td><td>-0.110
(0.345)</td><td>-0.023
(0.069)</td></tr>
<tr><td>F</td><td></td><td colspan="2">-0.066
(0.080)</td><td>-0.001
(0.031)</td><td colspan="6">-0.059
(0.108)</td><td>-0.052
(0.233)</td><td>0.075
(0.108)</td></tr>
<tr><td>G</td><td></td><td colspan="4">0.002
(0.027)</td><td>0.007
(0.030)</td><td colspan="4">0.018
(0.031)</td><td>0.020
(0.107)</td><td>0.042
(0.143)</td></tr>
<tr><td>H</td><td></td><td colspan="5">0.006
(0.007)</td><td>0.004
(0.017)</td><td colspan="3">-0.031
(0.047)</td><td>0.018
(0.014)</td><td>0.028
(0.028)</td></tr>
<tr><td>I</td><td></td><td colspan="3">-0.025
(0.044)</td><td>0.024**
(0.009)</td><td colspan="5">0.002
(0.025)</td><td>-0.007
(0.058)</td><td>-0.047
(0.052)</td></tr>
<tr><td>J</td><td></td><td>0.015
(0.052)</td><td></td><td colspan="3">0.017
(0.029)</td><td>0.017
(0.062)</td><td colspan="3">0.022
(0.398)</td><td>0.039
(0.058)</td><td>0.125
(0.178)</td></tr>
</table>

Table A8. Low-income group hazard rate differences between the 2 later periods

This table reports the difference between the first later period and the second later period low-income hazard rate for each firm and rate group. Match thresholds are highlighted in grey, and unavailable rates are colored in black. We do not estimate hazard rates for any default contribution rates, so those cells are left blank. At Firm B, we group the 2% contribution rate with 0%. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Firm	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%+
A	**-0.009** (0.042)				**0.010** (0.006)		**0.022**** (0.009)	**-0.032** (0.064)			**0.024** (0.023)	**0.034** (0.027)
B	**0.025** (0.029)		See Caption		**0.002** (0.003)		**0.000** (0.010)	**-0.005** (0.024)			**0.004** (0.028)	**0.013** (0.076)
C	**0.007** (0.010)	**0.020** (0.025)						**0.000** (0.013)			**-0.032** (0.024)	**-0.028** (0.039)
D	**-0.004** (0.018)		**0.004** (0.013)					**-0.019** (0.019)			**-0.028** (0.023)	**0.008** (0.013)
E	**0.018** (0.013)			**-0.011** (0.024)		**-0.002** (0.017)					**-0.020** (0.125)	**0.011** (0.483)
F		**-0.018** (0.057)		**0.002** (0.009)	**-0.015** (0.015)						**-0.013** (0.054)	**0.031** (0.030)
G		**-0.005** (0.015)				**-0.002** (0.013)	**0.006** (0.030)				**0.006** (0.043)	**0.021** (0.117)
H		**0.000** (0.004)					**-0.006** (0.026)	**-0.035** (0.041)			**0.003** (0.012)	**0.008** (0.015)
I		**-0.062** (0.094)			**0.000** (0.021)	**-0.036** (0.048)					**-0.048** (0.072)	**0.134** (0.307)
J		**-0.020** (0.013)		**-0.018** (0.014)			**-0.041** (0.029)	**-0.115** (0.112)			**-0.005** (0.024)	**0.056** (0.264)

Table A9. Residual age specification: initial period and later period switching odds ratios

This table reports the ratio of the odds that a younger employee will switch from the default contribution rate to his target rate in each period to the odds that an older income employee will do the same, after controlling for income and gender. For the initial period, the switching odds are defined as the probability that the employee switches at any point during the entire period, divided by the probability that the employee does not switch during the period. For the later period, the switching odds are defined as the monthly probability of switching in any given month, conditional on having remained at the default contribution rate up to that month, divided by the probability of staying at the default over the month, conditional on having remained at the default contribution rate up to that month. Standard errors are in parentheses, and any estimates statistically significantly different from one at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

Firm	Initial Period	Later Period
A	**1.189**	**1.197**
	(0.146)	(0.249)
B	**0.864***	**1.077**
	(0.071)	(0.149)
C	**0.777**	**0.387*****
	(0.162)	(0.054)
D	**0.939**	**1.031**
	(0.086)	(0.145)
E	**0.925**	**1.286**
	(0.197)	(0.567)
F	**0.957**	**1.430**
	(0.185)	(0.565)
G	**0.744*****	**0.885**
	(0.051)	(0.114)
H	**0.702*****	**0.837****
	(0.039)	(0.079)
I	**0.797*****	**0.742****
	(0.078)	(0.114)
J	**0.606*****	**0.535*****
	(0.077)	(0.079)

Table A10. Residual age specification: probability of being stuck at the default contribution rate after 2 years

This table reports the probability that an employee with a non-default target rate will remain at the default rate two years after joining the firm. The first three columns assume that employees from both income groups have the same distribution of target contribution rates, so any differences result purely from differences in the contribution rate-dependent switching probabilities. The last three columns apply each income group's estimated distribution of target contribution rates to calculate the total probability of being stuck at the default rate. Cross-firm averages are weighted by the total number of observed hires at each firm. Standard errors are in parentheses, and any differences statistically significantly different from zero at the 10%, 5% and 1% levels are marked by *, **, and ***, respectively.

	Rate preference adjusted sticking probabilities (Ψ)			Overall sticking probabilities (Ω)		
Firm	**Younger**	**Older**	**Difference**	**Younger**	**Older**	**Difference**
A	**0.025**	**0.035**	**-0.010**	**0.025**	**0.034**	**-0.008**
	(0.007)	(0.010)	(0.008)	(0.008)	(0.009)	(0.008)
B	**0.175**	**0.171**	**0.004**	**0.172**	**0.173**	**-0.001**
	(0.129)	(0.124)	(0.016)	(0.128)	(0.126)	(0.024)
C	**0.375**	**0.181**	**0.194***	**0.400**	**0.154**	**0.247***
	(0.138)	(0.081)	(0.101)	(0.160)	(0.063)	(0.142)
D	**0.178**	**0.179**	**-0.001**	**0.187**	**0.170**	**0.017**
	(0.049)	(0.049)	(0.026)	(0.054)	(0.047)	(0.035)
E	**0.068**	**0.081**	**-0.013**	**0.070**	**0.078**	**-0.007**
	(0.029)	(0.039)	(0.035)	(0.028)	(0.040)	(0.037)
F	**0.166**	**0.209**	**-0.044**	**0.160**	**0.215**	**-0.054**
	(0.073)	(0.089)	(0.055)	(0.065)	(0.101)	(0.073)
G	**0.047**	**0.031**	**0.016**	**0.050**	**0.029**	**0.021**
	(0.009)	(0.007)	(0.011)	(0.010)	(0.007)	(0.011)
H	**0.158**	**0.116**	**0.042****	**0.175**	**0.103**	**0.072*****
	(0.028)	(0.023)	(0.019)	(0.033)	(0.020)	(0.024)
I	**0.059**	**0.034**	**0.025**	**0.059**	**0.034**	**0.024**
	(0.015)	(0.011)	(0.016)	(0.015)	(0.011)	(0.016)
J	**0.329**	**0.169**	**0.161*****	**0.346**	**0.157**	**0.189*****
	(0.014)	(0.033)	(0.033)	(0.014)	(0.033)	(0.035)