Who Is Easier to Nudge?

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Abstract: We study heterogeneity in responsiveness to choice architecture, focusing on the propensity of low-income versus high-income employees to opt out of the default contribution rate in 401(k) retirement savings plans. We develop a statistical model to distinguish between two underlying sources of heterogeneity: low-income employees may be more likely to remain at the default because (i) it is similar to the target contribution rates that they would have selected for themselves anyway or (ii) they are simply slower to opt out of the default, controlling for the target contribution rates that they would select upon opting out. Applying the model to compare below-median-income and above-median-income employees at ten large companies, we estimate that the second source of heterogeneity accounts for two-thirds of the 10 percentage point difference in the probability of remaining at the default after two years of tenure, conditional on having a non-default target contribution rate. We also study two firms that changed the default, and we find that low-income employees are more likely to respond to the change in the default by switching their target contribution rates to correspond with the new default.

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

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Inspired by Thaler and Sunstein's book *Nudge: Improving Decisions about Health, Wealth, and Happiness* (2008) and related work in the fields of behavioral economics and psychology, academics and policymakers have become increasingly interested in choice architecture—the design of the environment in which choices are made—as a tool for influencing individuals' economic decisions and outcomes. In the words of David Brooks, a columnist for *The New York Times*, "We're entering the age of what's been called 'libertarian paternalism.' Government doesn't tell you what to do, but it gently biases the context so that you find it easier to do things you think are in your own self-interest" (2013). Indeed, governments around the world have set up "nudge units," teams of behavioral scientists who incorporate choice architecture techniques into the design and execution of policy to improve government functioning.

A large literature has documented that choice architecture techniques can produce powerful effects.[1] However, much of the existing literature has focused on the average effects of choice architecture techniques, and less attention has been devoted to studying which types of people are more influenced by nudges and the reasons for such heterogeneity. This paper studies heterogeneity in responsiveness to choice architecture in the context of retirement savings plans, focusing on the responses of low-income and high-income individuals to contribution rate defaults.

The default is the option that is implemented when individuals do not actively make selections themselves. The default in a retirement savings plan is an important determinant of outcomes because individuals are likely to accept the default passively (Madrian and Shea, 2001; Choi et al., 2002 and 2004; Beshears et al., 2008),[2] and previous research has shown that low-income individuals are less likely to opt out of savings plan defaults than high-income individuals (Madrian and Shea, 2001; Choi et al., 2004). However, a key challenge that previous research has not addressed is the fact that a person's characteristics are often correlated with the person's preferences over options within the choice set. In the savings plan context, low-income people tend to prefer lower contribution rates than high-income people do, perhaps because low-income people

[1] For a discussion of the range of choice architecture techniques that have been studied, see Sunstein (2013, 2014).

[2] The default also drives outcomes in domains as diverse as e-mail marketing (Johnson, Bellman, and Lohse, 2002), organ donation (Johnson and Goldstein, 2003; Abadie and Gay, 2006), and automobile purchases (Park, Jun, and MacInnis, 2000).

expect to experience greater income growth in the future or because the progressivity of the Social Security system implies that Social Security benefits to low-income people represent a higher income replacement rate.[3] Default contribution rates are also typically low, often 0%–6% of income, so observed defaults coincide with the preferred contribution rates of low-income individuals. 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. Therefore, it is unclear whether low-income individuals are less likely to opt out of savings plan defaults primarily because defaults implement outcomes close to those that low-income individuals would have selected for themselves anyway, or primarily because low-income individuals have a stronger general tendency to accept defaults passively.

The central contribution of this paper is to distinguish between these two sources of heterogeneity in responsiveness to savings plan defaults. The distinction is crucial for policymakers and managers who are responsible for selecting defaults. As noted above, default contribution rates tend to be modest—in a survey of large companies, Towers Watson found that the median default among plans that had a non-zero default was 3% of income (2009). Many observers worry that plans with these defaults will leave employees with inadequate retirement savings,[4] so a natural solution is to increase default contribution rates beyond the 0%–6% range. However, if low-income employees tend not to opt out of low default contribution rates primarily because they would have selected those contribution rates for themselves anyway, defaults higher than 0%–6% would not necessarily produce more savings, as low-income employees might opt out of the higher default and implement the lower contribution rates that they prefer. On the other hand, if low-income employees are simply slower to opt out of defaults, controlling for the contribution rates that they would select for themselves, it is more likely that higher defaults would produce additional savings. More generally, policymakers and managers who are designing retirement savings plans should be cognizant of the groups that are more impacted by plan defaults.

[3] Our analysis is agnostic as to the reason behind the correlation between income and contribution rate preferences.
[4] See, for example, (Defined Contribution Institutional Investment Association, 2010).

Our empirical approach takes advantage of the dynamic nature of contribution rate decisions and has the following conceptual underpinnings. When a newly hired employee joins a firm, the employee draws a target contribution rate from a probability distribution that is specific to a group of employees with similar characteristics (e.g., the group of low-income employees).[5] An employee's target contribution rate is defined as the contribution rate where the employee would eventually end up if given a sufficiently long time. Upon hire, the employee begins contributing to the retirement savings plan at the default contribution rate, which may be zero, until the employee actively elects a different contribution rate. We conceptualize the employee as having an opportunity in each time period after hire to opt out of the default by incurring an effort cost, which varies stochastically over time. If the individual's target rate is equal to the default, the individual simply remains at the default. Otherwise, we assume that the individual has a group- and target-rate-specific probability of opting out of the default within the first few months of hire.[6] If the individual with a target rate different from the default does not opt out within this initial period, we assume that the individual has a constant group- and target-rate-specific hazard rate for opting out in each subsequent month. Our objective is to distinguish between the two basic channels that give rise to heterogeneity in individuals' likelihood of remaining at the default contribution rate after a given amount of time has passed since hire. First, there may be heterogeneity in target contribution rates.[7] Second, holding the target contribution rate constant, there may be heterogeneity in the speed at which individuals opt out of the default to the 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 model specification compares low-income employees, defined as

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[5] In our primary model specification, we collapse unpopular contribution rates into bins and treat each bin as a single contribution rate. Our results are similar if we do not use this binning procedure.

[6] The exact number of months in this initial period varies across the companies that we study in order to improve the match between the data and our statistical assumptions.

[7] The target contribution rate for an individual may or may not be the individual's ideal contribution rate. If we were to force the individual to actively choose a contribution rate, the individual would select the ideal contribution rate. However, if we instead wait to observe the contribution rate where the individual ends up, the individual may never opt out of the default even though the ideal is different, as the benefit of switching may never exceed the cost. Note that we treat an individual's target contribution rate as fixed over time, a reasonable assumption given the two-year time horizon that we consider in our empirical analysis.

employees with income at or below the sample-wide median, to high-income employees, defined as employees with income above the sample-wide median. We apply our model to each company separately, but within each company we estimate the model parameters for the low-income and high-income groups simultaneously, linking the opt-out probabilities of the two groups parametrically.[8] Our key identifying assumption, which is consistent with the data, is that individuals from a given group with a given target contribution rate have a constant monthly hazard rate of opting out to the target rate after the initial few months employed at the firm. Intuitively, with this assumption, we can use the month to month trend of opt-outs to a given target contribution rate to estimate the target rate's monthly opt-out hazard rate. We can then use the absolute number of opt-outs and the estimated opt-out hazard rate to infer the size of the target rate population.[9] Building on these estimates, we can calculate the opt-out probability for the group and target rate during the initial few months after hire.

While the estimates from the model 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, the low-income group has opt-out odds that are smaller than the opt-out odds of the high-income group, holding constant the target contribution rate, by a factor that ranges from 0.34 to 0.90 across companies, a ratio that is statistically significantly different from one for nine of the ten cases. The difference persists beyond this initial period. Again holding the target rate constant, the low-income group has monthly opt-out odds after the initial period (conditional on not having opted out previously) that are smaller than those of the high-

[8] Specifically, we assume that the low-income employees' opt-out odds in the initial few months after hire for a given target contribution rate are proportional to the high-income employees' opt-out odds in the initial few months after hire for the same target contribution rate, and that the ratio between the two is constant across all target contribution rates. We make an analogous proportionality assumption for the monthly opt-out odds (conditional on not having opted out previously) after the initial few months, but we allow the two proportionality factors to differ. We have experimented with relaxing these assumptions and obtained similar results.

[9] For example, imagine that we observe employees who opt out to the 5% contribution rate over a span of two months, over which we assume that the probability of opting out in each month is constant. If we observe 20 people opting out in the first month and 16 people opting out in the second month, we can infer that the monthly hazard rate is 20%. We can then combine the hazard rate with the absolute number of employees who opted out to conclude that we started with 100 people who have a target contribution rate of 5%.

income sub-group, with the odds ratio ranging from 0.32 to 0.95 across companies. These estimates are also statistically significantly different from one for nine of the ten cases.

To better interpret the magnitude of these effects, we conduct counterfactual exercises using the results from our statistical models. For each company, we assume that the opt-out probabilities of the low-income and high-income groups take the values that we estimated, but we assume that the target rate distributions for the low-income and high-income groups are both equal to the average of the estimated target rate distributions for the two groups. Under these assumptions, we calculate the probability that a low-income employee who has a target contribution rate different from the default nonetheless remains at the default two years after hire. We also calculate the same probability for a high-income employee. We find that the probability for the low-income employee is greater than the probability for the high-income employee, with the difference ranging from 3.1 to 20.6 percentage points across companies. The difference is statistically significant for eight out of ten companies. By construction, the difference is not due to the divergent target rate distributions of the low-income and high-income groups. 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 options that are selected as defaults.

Controlling for the target rate distributions in our counterfactual exercises is important, as the difference in target rate distributions contributes to the overall difference in the likelihood of remaining at the default in our sample. To document this point, we again calculate the difference between the low-income employee's probability and the high-income employee's probability of remaining at the default two years after hire despite having a different target rate, but we change the assumed target rate distributions to be the estimated low-income distribution and the estimated high-income distribution, respectively. The difference between the two probabilities is generally larger compared to the difference when we assume that the target rate distributions are identical.

We also conduct analyses that pool across all ten companies, weighting each company by the number of employees it contributes to the sample. When we control for the difference in target rate distributions, we find that low-income employees are 7.1

percentage points more likely than high-income employees to remain at the default two years after hire despite having a different target rate. The difference is 10.2 percentage points when we do not control for the difference in target rate distributions, indicating that the difference in target rate distributions accounts for approximately one-third of the overall effect.

These findings are important considerations for policymakers and managers who design retirement savings institutions. More broadly, our methodological approach can be applied to study other domains where choice architecture techniques are used and to study heterogeneity along dimensions other than income. To explore the application of our approach to other dimensions of heterogeneity, we use our statistical model to compare the savings plan contribution rate decisions of younger versus older and male versus female employees. The difference in the probability of remaining at the default two years after hire despite having a different target rate is smaller when comparing younger and older employees relative to when comparing low-income and high-income employees. However, the decomposition into the two different sources of heterogeneity is similar. Younger employees are less likely to opt out of the default than older employees, and approximately 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 the likelihood of opting out of the default.

As the final step in our analysis, we consider the possibility that contribution rate defaults differentially influence low-income and high-income employees' target rate distributions. In order to pursue this line of inquiry, we study two additional companies, both of which changed the default contribution rate in their plans, one from 0% to 3% and the other from 3% to 0%. For each company, we estimate our statistical model separately for the 0% default regime and for the 3% default regime, and we examine how the low-income and high-income groups' estimated target rate distributions shift as the default changes. The low-income employees exhibit a much larger shift in target rates than the high-income employees. At one company, the fraction of low-income employees who have the old default as their target rate decreases by 14 percentage points, while the fraction who have the new default increases by 21 percentage points. The comparable numbers for high-income employees at the same company are 8 and 11 percentage points. At the second company, the comparable numbers for low-income employees are 62 and 56 percentage points, and the comparable numbers for high-income employees are both 39 percentage points. The evidence is consistent with the possibility that low-income employees exhibit a stronger anchoring effect than high-income employees, leading low-income employees to adopt the default as their target rate more frequently (Tversky and Kahneman, 1974; Bernheim, Fradkin, and Popov, 2015), but the data are also consistent with alternative interpretations.

Our analysis focuses primarily on heterogeneity by income because income is likely to capture a rich set of factors that influence decision making. Low-income individuals might exhibit more responsiveness of their target contribution rates to the default and might be slower to opt out of the default conditional on their target contribution rates because they have higher cognition or action costs for opting out, a higher susceptibility to time-inconsistent procrastination, a lack of expertise or information about financial decisions, or a greater willingness to accept the default setter's implicit endorsement of the default option. In addition, a given deviation from the target contribution rate may have smaller utility consequences for a low-income individual because of the shape of the individual's utility function or because of the tax rates that the individual faces. It is important to note that we do not attempt to disentangle these correlated 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 in general more likely to opt out of defaults in employer-sponsored savings plans.

The paper proceeds as follows. In Section I, we explain our statistical model and empirical methodology. In Section II, we describe 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 by gender in Section V. In Section VI, we explore the influence of the default on the low-income and high-income groups' target rate distributions. We offer concluding remarks in Section VII.

I. Methodology

We follow the framework of Carroll et al. (2009) in assuming that each employee has an ideal 401(k) savings rate *s*. If an employee is compelled to make an active decision, he would select this target rate from a menu of all available contribution rates. Upon first joining the firm, the employee is automatically enrolled at a default savings rate *d*.[10] In the case that , he faces a flow utility loss in every period until he opts out of the default rate *d* and into *s*. At the beginning of every period, the employee draws a random transaction cost, and upon learning its realized value, chooses to either opt out of the default rate, at which point he incurs the realized value of the transaction cost, or remain at the default rate, at which point he incurs the period's flow utility loss.

The primary empirical challenge in this setting arises from the problem of disentangling underlying preferences from observable behavior. If we observe that an employee has been contributing at the default contribution rate since hire, one of three possibilities exists. It's possible that the employee prefers the default contribution rate over all possible contribution rates – that is, . It is also possible that the employee prefers a different contribution rate more, but the perceived benefits of switching to that contribution rate are so small that unless the employee is compelled by active decision, he will never willingly incur the transaction cost to switch. Finally, it's possible that the employee prefers a different contribution rate over the default, and he has yet to encounter a period in which his transaction costs are low enough to prompt him to switch to his desired contribution rate; however, he will switch if he is given a sufficiently long time horizon.

We define an employee as having a target rate *c* if *c* is the employee's most preferred contribution rate from the menu of all possible contribution rates ($c = s$), and if the employee will eventually switch from the default contribution rate to rate *c* given a

[10] Note that this applies whether or not the firm has an explicit automatic enrollment policy, since an opt-in savings plan is equivalent to $d = 0$.

sufficiently long time horizon. If an employee prefers the default contribution rate over all possible contribution rates, or if he is never willing to incur the transaction cost to switch from the default rate to his most preferred rate *s*, we define that employee as having the default rate as his target rate.

We make two key assumptions to identify the proportion of employees at a firm who have a non-default target rate. First, we assume that each employee has a constant target rate upon joining the firm, at least until he switches to that target rate.[11] Second, we assume that after the initial flurry of opt-out activity when employees first join a firm, the month-to-month probability of opt-out to a given target rate for employees in a similar income group is constant.[12] These two assumptions will allow us to use the observed distribution of switching over time to each non-default contribution rate to jointly estimate underlying target rate preferences and switching probabilities for each non-default target rate.

We divide the new hires at a firm into two groups for comparison along a dimension of heterogeneity. In this paper, we consider three relevant dimensions: income, age, and gender. For ease of exposition, we will develop our framework using low- and high-income employees, but our methods generalize to any arbitrary definition of groups. We separate the first *T* months of tenure for each employee into two ranges: the initial period, , and the later period, . We define a partition of the set of all possible non-default contribution rates at a firm as . While it is possible to define the partition so that each element contains only one contribution rate, in which case , etc., we define the setup generally here as to allow for the possibility of estimating a single set of parameters for a group of contribution rates. We also define as a singleton that always contains the default rate, so partitions the set of all possible contribution rates. We let be the probability that an employee from the high-income group has a target rate in c_i, and we

[11] This assumption is reasonable given that the longest time horizon that we consider here is two years.
[12] A constant hazard rate arises naturally from the Carroll et al. (2009) framework, where individuals independently draw opt-out costs from a common distribution at the beginning each period, and decide to opt out of the default if the perceived benefits to switching exceeds the realized opt-out cost. If there is unobserved heterogeneity within a group that is not captured by differences in target contribution rates, then hazard rates would decline over time instead of remaining constant. We check our constant hazard rate assumption as a robustness check in Section IV, and do not find any evidence that hazard rates change systematically over the first two years of employee tenure.

similarly let be the probability that an employee from the low-income group has a target rate in c_i.[13]

Over the duration of the initial period, an employee with a non-default target rate in c_i from the high-income group has a probability of switching from the default rate d to his target rate equal to , while an employee with the same target rate from the low-income group has a probability of switching equal to , where and is the logistic CDF.[14] In other words, the initial period switching odds ratio is constant across target rates.[15]

During each month in the later period, an employee with a non-default target rate in c_i from the high-income group (who is still at the default contribution rate d) has a monthly switching hazard rate equal to . That is, conditional on having a non-default target rate in c_i and staying at the default rate until month t in the later period, the employee has a probability of switching to his target rate during that month equal to . An analogous employee from the low-income group has a monthly switching hazard rate equal to .[16,17]

It follows that an employee in the high-income group switches from the default rate to his non-default target rate in c_i in month t of tenure with probability

[13] Notice that we allow for additional heterogeneity between individuals in a specific group (i.e. the low-income group) in two important ways. First, we allow the switching probabilities to vary by the employee's target rate. Second, we separate the observational period into two separate ranges to allow for differences in the propensity to opt out of the default within each group-target rate cell. Individuals who view the opt-out cost as negligible (i.e. dynamically consistent, pre-committed, or highly financially literature employees) will opt out during the initial period, while individuals prone to delay (i.e. due to procrastination, high learning costs, or generally high transaction costs) will opt out during the later period.

[14] For simplicity, we scale the logistic distribution parameters so that

[15] There are two practical reasons why we make this assumption. First, our estimation method is most precise when a large number of employees are switching to each contribution rate. By fixing one of the two component parameters across contribution rates, we can still preserve some heterogeneity across contribution rates while also increasing the precision of our parameter of focus. Second, the logistic CDF functional form naturally bounds the overall probability between 0 and 1. It also gives us a familiar interpretation for the parameter as a linearly additive term in log odds, which is analogous to the interpretation of the coefficient of a dummy variable for the low-income group in a logistic regression in which the dependent variable is the probability of switching during the initial period.

[16] We make the same assumption for the functional form of θ_2 as we did for θ_1 for the same reasons specified in the previous footnote. Note, however, that we do allow the odds ratio to vary across periods. We also perform a robustness check that allow both θ_1 and θ_2 to partially vary by target rate.

[17] In theory, it is possible to construct a richer functional form for θ in a way that allows for the simultaneous comparison of three or more groups, or even in a way that incorporates continuous covariates into the functional form. However, in our semi-parametric setup, such an approach would require many ad-hoc assumptions to ensure that we obtain enough degrees of freedom to estimate both the target rate probability and the hazard rate in a stable manner, while offering qualitatively similar results and more difficult to interpret parameters.

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

Meanwhile, an employee in the high-income group stays at the default rate *d* by 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 follows by substituting for , for , and for .

We observe high (low) income employees who first switch from *d* to a rate in c_i in their month *t* of tenure, and high (low) income employees who remain at the default rate by 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:

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

To estimate our parameters, we maximize this total log-likelihood function with respect to and with the constraint that ,, , and . It follows that for each income group, the probability that an employee has the default contribution rate as the target rate is .

To study the accumulated differences in switching probabilities over a span of tenure, we consider the high-income rate preference adjusted sticking probability – the probability that a high-income employee with a non-default target rate remains stuck at the default rate by the end of month *T,* controlling for any differences in target rate preferences between the high- and low-income groups:

$$\Psi_H=\sum_{i=0}^{n}\frac{p_{Lc_i}+p_{Hc_i}}{2-p_{Lc_d}-p_{Hc_d}}\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{T+1-T_s} \tag{4}$$

as well as its analog for the low-income group. [18,19] We control for rate preferences here since different rate preferences may contribute to observed differences between income groups, independently of any differences in target rate conditional switching probabilities. Carroll et al. (2009), for example, provides evidence that employees make contribution election decisions more slowly when their target rates are closer to the

[18] Which follows by substituting for and for .

[19] We construct the weights here as to guarantee that we equally weight the target rate probability estimates for both groups.

default rate. Meanwhile, most firms that we study here have a default contribution of 3% 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 at the default due to differences in target rate preferences alone.

If employees from the low-income group do take longer to switch from the default rate to their target rates (even after controlling for underlying rate preferences), we should expect to see evidence of this through a few channels. We may expect that the initial period switching probability is lower for the low-income group, which is true if and only if . We may also expect that the later period monthly switching hazard is lower for the low-income group, which is true if and only if . Finally, we may expect that over the observation period.

While we explicitly control for heterogeneity in rate preferences between the two income groups, we recognize that rate preferences are, by themselves, a relevant factor in influencing opt-out behavior. Therefore, we separately consider the high-income overall sticking probability – the total probability that a high-income employee with a non-default target rate remains stuck at the default rate by the end of month *T*:

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

as well as its analog for the low-income group.[20] Again, if employees from the low-income group take longer to switch from the default rate to their target rates, we would expect that . In addition, if the effect of target rate differences stacks on top of any target rate-conditional switching probability differences, we would expect that .

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 the standard errors for our test statistics then follow from applying the multivariate delta method (while allowing for covariance between parameters). In some cases, our 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

[20] Which follows by substituting for , for , and for .

(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.[21]

II. Data

We aim to capture a wide variety of enrollment schemes and firm characteristics in our paper, so we use a systematic method to select ten candidate firms for analysis. We begin with the universe of data ranging from 2002 to 2013 from our data provider, Aon Hewitt, which contain annual snapshots of employee demographics, compensation, and 401(k) eligibility, as well as monthly snapshots of employee contributions for a number of firms. We separate these firms into two groups: automatic enrollment firms (firms with default rates > 0%) and standard enrollment firms (firms with default rates = 0%). Some firms switch enrollment design from standard enrollment to automatic enrollment (or vice versa), and we split those firms into the two groups according to their timelines under each enrollment design.

To maintain consistency during the two year observation period for all hires at a firm (and avoid some potential confounds to observed switching patterns), we exclude any firms' hires whose first two years of tenure are affected by automatic escalation, the offering of a Roth 401(k) plan, any quick enrollment campaigns, any changes in the default rate or match threshold, or substantial contributions in fractions of a percent or in dollar amounts. While automatic escalation can be incorporated as a tenure-dependent default rate, we are unable to observe the month of tenure when an employee opts out of an automatic escalation plan to stay at his current contribution rate. As a result, we're unable to study automatic escalation in this setting without being forced to make much stronger assumptions on the timing of opt-out choices. We therefore leave the role of automatic escalation to future research. Meanwhile, the introduction of a Roth 401(k)

[21] On rare occasions, we may obtain a resample where the initial or later period hazard parameter for an income group is unidentified or at a corner case. We then exclude that income group-rate combination from the maximum likelihood estimation procedure in that iteration, and assign the affected parameters as missing (in the unidentified case) or to their respective border case values. These special cases do not factor into our estimates for the odds ratios or sticking probabilities, since they have no weight on estimates of the odds ratios and their contribution to the sticking probability is zero in all possible cases. However, we acknowledge these outcomes during the calculation of parameter bootstrap standard errors by including any border case values and assuming the most pessimistic outcomes for the unidentified parameter cases.

plan, quick enrollment campaign, or changes to the default or match thresholds would sufficiently change the incentives for switching contribution rates to the point that our assumption of a constant month-to-month probability of switching in the later period would no longer be reasonable for employees whose first two years of tenure overlapped with these changes. We therefore exclude those firms from our analysis. Finally, we drop any firms that offer the option of contributing to the 401(k) plan in a flat dollar amount or in fractions of a percent. This practice is fairly rare, and these non-standard contribution rates make a firm difficult to compare with the majority of the firms that we study.

After applying the firm-based selection rules, we choose the 5 automatic enrollment firms and 5 largest standard enrollment firms remaining in the data. Within each selected firm, we restrict our sample to 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 observational period (which is 24 months long in the main specifications). We do not necessarily restrict our attention to full time workers as an explicit rule, although we do eliminate many part time workers indirectly by requiring that all included new hires have compensation data of at least $5,000 (in 2010 levels) from the year of hire, and become eligible to contribute in the 401(k) plan within 60 days of hire. [22] We also restrict our attention to contribution elections to tax-deferred plans, since they are the primary source of payroll deducted savings in the firms that we study.

Table 1 contains a summary of the main characteristics for the ten firms. By virtue of our selection criteria, all of the firms that we study are large. We do, however, observe substantial variation in firm characteristics. These 10 firms operate in 8 different industries, and their median compensation for new hires range from $27,800 to $86,000. At the five automatic enrollment firms, default contribution rates range from 2% to 6%. All ten firms provide matching employer contributions, and the match thresholds vary from 2% to 6% of contributions. All ten firms have maximum contribution limits that exceed 10%, and seven firms allow employees to contribute as little as 1% of income to participate in the 401(k) plan (three exceptions are Firm A, which requires employees to

[22] Since the hire dates in our sample range from 2002 to 2010, we adjust compensation data 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

contribute at least 3% to participate, and Firms B and D, which requires employees to contribute at least 2% to participate).

The median compensation across all observed new hires in the final sample is $62,470. We classify any new hires with income above the overall median income as high-income employees, and any new hires with income at or below the overall median income as low-income employees.[23] Since we observe employees' contribution rates as snapshots 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 d.

In general, we define the initial period to be 2 months long for each firm to cover any administrative delays in implementing rate elections from the time of hire as well as to allow for basic eligibility and auto-enrollment delays. However, for three firms, we define longer initial periods. At Firm B, we do not observe hires' auto-enrollment status in the data until the 3rd month of tenure, so we extend the initial period for the firm to 3 months. Meanwhile, Firm A's employees become eligible for employer matching contributions after a year of tenure, and we observe a corresponding bump in switching activity for up to two months after eligibility in the data. We therefore extend Firm A's initial period to 14 months to ensure that the initial period for the firm covers the matching eligibility change and the corresponding increase in switching. Similarly, Firm I's employees also become eligible for employer matching contributions after a year of tenure, but we do not observe any delays in rate elections after the eligibility change. We therefore extend Firm I's initial period to 12 months. [24]

We determine the partitioning 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%)

[23] We also run robustness checks that split employees into the high- and low-income groups using firm-level median income, income terciles, and income relative to peers with the same gender and age-range.
[24] For details about firm plan design and switching patterns, see the data appendix

at every firm to precisely estimate parameters in those scenarios.[25] So, we use a systematic rule to determine the partitioning of all possible contribution rates. 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. We then group together any remaining intervals of contribution rates, with the assumption that employees who are switching to neighboring, non-focal contribution rates tend to be similar. 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 the match threshold, which is consistent with the explanation that the kink in the intertemporal budget curve introduced by a matching contribution threshold provides a natural accumulation point for employees with different tastes for savings. A notable exception to this pattern is Firm H, where an estimated 70.5% of low-income hires and 39.4% of high-income hires have target rates below the 6% match threshold. This may not be surprising, since Firm H only matches 25% of employee contributions up to the match threshold, which is the lowest employer match percentage out of the ten firms that we study.

On the other hand, the default contribution rate appears to be remarkably unpopular with workers' underlying contribution rate preferences. At seven out of the eight firms that set the default contribution rate at a different rate than any match thresholds, we estimate that at least 85% of new hires in either income group will eventually choose to incur the transaction cost to opt out of the default rate to a more attractive contribution rate. Again, the only exception in this group is Firm H, where an estimated 34.7% of low-income hires and 19.9% of high-income hires have a target rate equal to the default contribution rate of 0%. Given that our empirical strategy considers

[25] We do, however, estimate specifications that consider contribution rates between 0% and 10% individually as robustness checks.

employees who are never willing to incur the transaction cost of switching away to their most desired contribution rate as having the default rate as their target rate, the actual proportion of employees who would select the default rate under active decision may be even lower than our default target rate probability estimates. We explore this topic further in Section VII by estimating the change in target rate probabilities at two firms that altered their default rates.

The popularity of the match threshold and the relative unpopularity of the default rate suggest that for at least seven of the ten firms that we study, the adopted default rate may be a poor choice if firms primarily choose the default rate to minimize opt-outs, a rule of thumb suggested by Thaler and Sunstein (2003). Alternatively, setting the default rate to the match threshold may eliminate opt-out costs from 16-60% of employees from both income groups who have the match threshold as their target rate. Our target rate results align with separate analysis by Bernheim, Fradkin, and Popov (2015), who show that when opt-out costs are the main welfare consideration, setting the default rate to the match threshold tends to maximize employee welfare.[26]

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

Figure 2 presents estimates by income group for 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 for some firms to correspond to different plan designs, we cannot directly compare the initial period switching probabilities across

[26] The author also provides conditions when setting the default rate as 0% may be desirable under some scenarios, but they robustly conclude that setting a default rate that is strictly greater than 0% and less than the match threshold is suboptimal.

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 switch more quickly from the default when their target contribution rates are far from the default.

Figure 3 presents estimates by income group for 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 estimates for the initial period switching probabilities, but we do observe the same general trend that employees from both income groups tend to switch more quickly away from the default rate when their target contribution rates are far from the default.

Our point estimates suggest that at all ten firms, for any target contribution rate, hires in the low-income group are less likely than hires in the high-income group to switch from the default rate to their target contribution rate during the initial period. Our point estimates also suggest that at nine out of ten firms, again for any target contribution rate, hires in the low-income group are less likely than their high-income peers to switch from the default rate to their target rate in any given month during the later period. By construction, the difference in switching probabilities or hazards is constant in log odds across all contribution rate groups at a firm, so it is unsurprising that the low-income switching probabilities or hazards differ from their high-income versions in the same direction for all target contribution rates at each firm. However, we explicitly allow this difference to vary across periods, so it is surprising that we find such consistent differences in switching behavior.

We formally test for differences in switching using odds ratios and sticking probabilities. Column 1 in Table 2 reports estimates for 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 different from one at the 1% level for nine out of ten firms. Our estimates for the later period switching odds ratios are less precise, but significantly different from one at the 1% level for six out of ten firms (one additional firm is significant at the 5% level, and another firm is significant at the 10% level). To aggregate any accumulated differences in switching probability, column 3 in Table 3 reports the rate preference adjusted sticking probability difference between the two income groups after the first two years of tenure. 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 still 3 to 21 percentage points more likely than their high-income peers to remain stuck at the default contribution rate.[27] The difference between the low-income group's and the high-income group's rate preference adjusted sticking probability is significantly different from zero at the 1% level for seven firms, and significant at the 5% level for one additional firm.

We also find some evidence that income-based differences in the distribution of target rates lead to a greater proportion of low-income employees to be stuck at the default rate, independently of differences in target-rate specific switching probabilities. At firms where the default contribution rate is low, employees from the low-income group should be more likely to be stuck at the default when we allow their target rate preferences to vary from the firm's average target rate distribution. Column 6 in Table 3 reports the difference in sticking probabilities when we use each income group's own target rate distribution, instead of the firm average target rate distribution used in columns 1-3.[28] 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 increased the difference in the estimated proportion of employees stuck at the default contribution rate. The difference between the low-income group's and the high-income group's overall sticking probabilities is also significantly different from zero at the 1% level for seven out of the ten firms.

IV. Robustness

We vary a series of inputs to ensure that our results are robust to changes in specification. These nine robustness checks can be broadly separated into three categories. Three rate group-related checks change our method for treating unpopular contribution rates to ensure that our results do not rely on any special grouping of the rates. Three pay-related checks explore results under alternative definitions of high- and

[27] For a formal definition of the rate preference adjusted sticking probability, see equation 4.
[28] For a formal definition of the overall sticking probability, see equation 5.

low-income employees. Three mechanics-related checks test for the sensitivity of our results to changes in our underlying identifying assumptions.

Although we use a systematic procedure to partition available contribution rates into rate groups, we want to verify that our grouping does not generate results in some special way. So, we apply a series of alternate procedures to determine rate groups. Our baseline for these checks is the most simple rate grouping possible; we separately estimate any 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, we add an additional specification check in which we assume that any employee with a target rate of 11% or greater will have switched to that contribution rate by the end of two years, and we do not estimate switching parameters for that rate group. Our odds ratio results remain unchanged under these specifications (see Table A1, columns 2, 3, 6, and 7).

Meanwhile, although our rate preference adjusted and overall sticking probability differences are qualitatively similar under the new specification, 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 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 effects of the low hazard rates and high target rate probabilities stack with each other during the calculation of the sticking probability. To eliminate the issue of unpopular contribution rates from our individual rate groups specification, we assume that any employee with an unpopular rate[29] as his target rate will have switched within his first two years of tenure, and we exclude those rates from the maximum likelihood estimation procedure. Columns 4 and 8 in Tables A1 and A2 report the results from this additional specification check, and we verify that our results are in line with our main estimates.

[29] defined as a rate with an estimated later period hazard rate of 0.01 or less

We also use three alternative definitions for income to ensure that our results are not sensitive to the definition of low- and high-income employees: income terciles, income relative to age and gender, and income relative to others at the same firm. For income terciles, we assign an employee into the low-income group if his income is at or below $48,516, the 1/3 quantile income for the overall sample across firms, and we assign the hire into the high-income group if his income is at or above $80,395, the 2/3 quantile income. Columns 2 and 6 in Tables A3 and A4 report the results from this robustness check, and as expected, our results are generally unaffected or stronger when we use this more strict division rule. To verify that we are not simply picking up proxies for age or gender effects, we subtract from each employee's income the corresponding 5-year age and gender group's cross firm average income, and then we allocate employees into low- and high-income groups by the median demeaned income of -$4491. Our results remain largely unchanged after controlling for age and gender (see columns 3 and 7 in Tables A3 and A4). To address any potential issues around separating employees at each firm into income groups by the cross-firm median income (for example, due to industry or firm level differences in benefits that compensates for differences in pay), we also estimate a version of our model that use each firm's median income for new hires as the cutoff rule. While the effect of this change from the main specification varies by firm (due to differences in firms' median pay for new hires), our results also remain large unchanged under this rule (see columns 4 and 8 in Tables A3 and A4).

Finally, we run three checks for the sensitivity of our results to our specification of the maximum likelihood model. For the five automatic enrollment firms, we estimate separate odds ratios for contributions rate groups above and below the default rate. A possible explanation for slower opt-outs from the low-income group is that employees from the low-income group may have fewer tax advantages from contributing in the tax-deferred 401(k) plans that we study here, and they therefore face lower costs for delaying any desired increases to their savings rates. While this is a possible channel, it is unlikely to be the main factor that explains the slower opt-out rates. For eight out of the ten firms in our sample that set their default contribution rate below the match threshold, the employer match on the marginal dollar of contributions above the default rate clearly outweigh most tax advantages that employees may expect. Nevertheless, 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. 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 do 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 while we select employees for whom key plan characteristics remain constant during the first two years of tenure, we may pick up anticipatory effects from upcoming rule changes. If there is a behavioral response to anticipatory effects, our assumption that the later period switching hazard is constant will not hold for those hires. We therefore drop 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).[30]

We run a final test for the sensitivity of our results by relaxing the assumption that the month to month hazard rate in the later period is constant for each target rate and income group. We expand our original model by dividing the later period evenly into two. Employees in the high-income group with a target rate in c_i have a monthly switching hazard of in the first later period , and a monthly switching hazard of in the second later period . It follows that the overall probability of observing an employee in the high-income group switching to a contribution rate in c_i in month t is then:

$$Pr\left(I_{Hc_it}|T_s,T_a,d\right)=\begin{cases} p_{Hc_i}F\left(x_{c_i}\right) & t<T_s \\ p_{Hc_i}F\left(y_{c_i}\right)\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{t-T_s} & T_s\leq t<T_a \\ p_{Hc_i}F\left(z_{c_i}\right)\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{T_a-T_s}\left(1-F\left(z_{c_i}\right)\right)^{t-T_a} & T_a\leq t\leq T \end{cases} \quad (6)$$

Meanwhile, we observe an employee in the high-income group staying at the default rate d by the end of month T with probability

$$Pr\left(I_{Hd}|T_s,T_a,d\right)=\sum_{i=0}^{n}p_{Hc_i}\left(1-F\left(x_{c_i}\right)\right)\left(1-F\left(y_{c_i}\right)\right)^{T_a-T_s}\left(1-F\left(z_{c_i}\right)\right)^{T+1-T_a}+1-\sum_{i=0}^{n}p_{Hc_i} \quad (7)$$

The corresponding probabilities for an employee in the low-income group follows by substituting for , for , for , and for . While we lose substantial precision by splitting the

[30] Incidentally, this approach also dropped any employees whose later period overlapped with the start of the Great Recession, so we are also able to verify though this robustness check that our results are not driven by asymmetric responses to the Recession.

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 also extend naturally along dimensions of heterogeneity other than income. In this section, we examine two other sources of differences between new hires, age and gender, and explore the extent to which responses to defaults vary along these two dimensions. Our empirical framework under this section ports directly from Section I, and we consider the same set of new hires that is studied in Sections II-IV. The primary change in this section arises from a new division of employees along the relevant dimension of heterogeneity. Remaining consistent with our income approach, we define younger employees as employees who are at most 33 years old at the time of hire, the across firm 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 for the target rate probabilities of younger versus older employees. Mirroring our results from the main income-related estimates, 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. Meanwhile, our estimates are less precise in the later period. The switching hazard odds ratios are less than one at five out of the ten firms (and statistically significant for four out of five firms), approximately one at four firms, and greater than one at one firm (but not statistically significantly so).

Columns 3 and 6 of Table 5 aggregate switching probabilities into 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 that we study. 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 across firm average sticking probability differences are both statistically significant from zero at the 1% level.

Given that income and age are positively correlated, one concern with our age-related results is that we are simply capturing income effects. To address this, we adjust each employee's age by the cross firm average age of employees whose income is in the same $5000 income range, and separate employees into either the younger or older group by their relative age compared to other employees with similar incomes. Our odds ratio results under this check 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 two firms. However, our sticking probability results actually become stronger – sticking probability differences are statistically significant for Firm C as well after controlling for the average age of each income group. 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 for the target rate probabilities of female employees compared to male employees. We find few systematic gender-based differences in the distribution of target contribution rates across the ten firms in our sample. Two possible exceptions are Firms G and H, where female employees are more likely than male employees to target contribution rates that are below the match threshold whereas male employees are more likely than female employees to target contribution rates above the match threshold.

Column 1 of Table 6 presents the estimates for 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 switch more slowly from the default contribution rate in the initial period. The point estimates for the odds ratios are less than 1 for eight firms, statistically significant at the 1% level for three firms, and statistically significant at the 5% level for one other firm. Meanwhile, our estimates are generally imprecise in the later period and widely distributed around 1; only one point estimate is marginally significantly different from one at the 10% level.

Columns 3 and 6 of Table 7 compile any differences in switching rates during the initial and later periods. We find no systematic evidence that female and male employees have different probabilities of being stuck at the default contribution rate after two years. The cross firm differences in average sticking probabilities are reasonably precisely estimated for both sticking probabilities, but they are insignificant both in magnitude and statistical significance.

VI. Target Rate Probabilities Under Different Default Rates

Our work so far has focused on examining the rate of opt-out from the default rate to an employee's target contribution rate, while taking the target contribution rate as given. However, given that an important channel for plan design is through the choice of the default contribution rate, a separate, but interesting question is how a change in the default contribution rate affects the distribution of target rates. There are two separate, but not mutually exclusive channels through which we expect the choice of default rates to affect target rates. First, if the default contribution rate has an anchoring effect, then we would expect that an individual's ideal contribution rate will shift from the previous default towards the new default rate.[31] In addition, recall that under our framework, two types of individuals have the default rate as their target contribution rate: people whose ideal contribution rate is the default contribution rate, and people whose ideal rate is

[31] This anchoring effect can have a classical explanation as the rational response to a signal from management about the optimal savings rate, or it can be a psychological bias. For more discussion, see Tversky and Kahneman (1974), Green et al. (1998), or Ariely, Loewenstein, and Prelec (2003).

different than the default, but perceive the benefits to switching as sufficiently small that they will never voluntarily incur the cost to opt out of the default into their ideal rate. If there is a positive mass of the second type, then we would expect target rates to move with the default contribution rate, even after holding ideal contribution rates fixed.

To identify the relationship between target rate probabilities and default rates, we focus on firms in our data 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 the selection of firms in this section are more relaxed than the criteria used in the main specifications. For example, we allow firms to offer a Roth 401(k) plan concurrently with a tax-deferred plan, although we do drop any hires whose observed tenure overlapped with the introduction of the Roth plan. Among the set of firms that switched default contribution rates at some point in our dataset, we identified two firms that have full contributions panel data for employees hired both before and after the change in the default.[32] Both firms have nonstandard rules that make an employee eligible for matching contributions anywhere from 12 months to at least 18 months after hire, depending on the calendar month when the employee joined the firm. A change in the match eligibility status may violate our assumption that the hazard rate is constant if it takes place during the later period, and data availability constraints render an 18 month initial period infeasible to implement. Therefore, we truncate the observational period to the first ten months of tenure, and define the later period as the 3rd or 4th month of tenure to the 10th month of tenure.[33]

Table 8 summarizes the main characteristics of the two firms that we study in this section. Firm K introduced automatic enrollment for new hires on 6/1/2008 and also

[32] One of the firms, Firm K, is missing one month of contribution elections data. We interpolated the elections data accordingly using the employee's contribution elections immediately before and after the missing month, as well as the average rate of switching for each contribution rate at each month of tenure. For more information, see the data appendix.

[33] One may be concerned that this is a misrepresentation of the later period, since we know that the plan in place during the first 10 months of tenure will change in future months. However, notice that as long as the plan design remains constant during the first ten months, then our identifying assumptions still hold. The interpretation of target rates is more complicated with the delayed match eligibility, since an individual who would not save in a 401(k) plan in the absence of a match would only opt out of a 0% default rate in order to save on future opt-out costs when the match becomes relevant. So, that individual would actually have a different target rate if the plan setup in the later period is extended to be infinitely long. However, one can consider the benefit of saving future opt-out costs to be equivalent to a different, less generous matching regime that's in place throughout the entire later period, and the target rates estimated in this specification are what an employee would choose if that equivalent match regime is in place indefinitely.

enrolled any past hires who are not participating in the plan, so the standard enrollment cohort is truncated to ensure that their observational period does not overlap with any retroactive automatic enrollment. The firm differs from the firms in our main sample in that it offers a Roth 401(k) option concurrently alongside the tax-deferred plan for both cohorts of hires included in the sample. Meanwhile, Firm L removed automatic enrollment for new hires on 11/1/2003, but did not actively remove any previously auto-enrolled hires from the savings plan. We are therefore able to include employees hired as late as 10/31/2003 in the standard enrollment cohort. Employees at this firm only become eligible to participate in the plan after 60-90 days of tenure, so we include any employees who become eligible within 90 days (instead of 60 days for other firms), and we define the initial period for the firm to be 3 months long.

Although sample sizes for both firms are large, our estimates here are less stable than estimates from our main specifications for two reasons. First, the observation period here is substantially shorter. Second, we focus on precisely estimating the default target rate probabilities, which are the most sensitive parameters in our model to small samples (as discussed in Section IV). As a result, we maximize the sample size in both income groups by dividing employees in each firm by the firm-specific (but not cohort-specific) median income, rather than the cross firm median income. Our basic rate grouping algorithm described in Section II is also insufficient for the limited data available here, so we group remaining low precision contribution rate estimates with other nearby estimates. For Firm K, we combine the 7-9% rate group with the 10% rate group. Meanwhile, for Firm L, we combine the 1-2% rate group with the 4-5% rate group, and we combine the 10% rate group with the 11%+ rate group.

Figure 6 presents the estimated target rate probability distributions for the two enrollment cohorts at Firm K, and Table 9 reports the changes to target rate probabilities after the introduction of automatic enrollment. Low-income employees are 21.0 percentage points more likely to have a target contribution rate of 3% when it is the default contribution rate, whereas high-income employees are 10.6 percentage points more likely to do the same. On the other hand, low-income employees are 14.1 percentage points less likely to have a target contribution rate of 0% when is it no longer the default, and high-income employees are 8.4 percentage points less likely to do the same. Both sets of differences are statistically significant, as well as both differences between the two income groups' responses to automatic enrollment. In addition, we find statistically significant decreases in the 1-2% and 4-5% rate group target rate probability.

Some caution is warranted when interpreting the changes to target rate preferences at 0% or at higher contribution rates at Firm K, since the introduction of automatic enrollment overlaps with the onset of the Great Recession. While it's unlikely that many employees converged towards 3% as an ideal savings rate due to the Recession, it is possible that a non-negligible proportion of employees reduced their ideal contribution rate from high contribution rates to either 0%, the lower bound for 401(k) contributions, or 6% the match threshold.

Figure 7 presents the estimated target rate probability distributions for the two enrollment cohorts at Firm L, and Table 10 reports the changes to target rate probabilities from implementing automatic enrollment. The sample here does not overlap with the recession, and we verify the main qualitative findings from Firm K. Notably, low-income employees are 61.7 percentage points more likely to have a target contribution rate of 3% when it is the default rate, while high-income employees are 39.3 percentage points more likely to do the same. Meanwhile, nearly symmetrically, low-income employees are 55.8 percentage points less likely to have a target contribution rate of 0% when it is not the default, and high-income employees are 38.7 percentage points less likely to do the same. Again, both sets of differences are statistically significant, as well as both differences between income groups. We also find evidence that setting the default rate at 3% reduces the probability that employees will choose rates of 1-2% or 4-5% as their target rate, which matches our findings from Firm K and corroborates the theory that placing a default rate near, but not at an employee's ideal rate may induce the employee to shift his target rate from the ideal rate to the default rate, since the perceived gains to switching become much smaller.

VII. Conclusion

This paper develops and estimates a statistical model to study the propensity for low-income and high-income employees to opt out of the default contribution rate in a savings plan. Low-income employees, relative to high-income employees, are slower to opt out of the default, holding fixed the target contribution rate that would be selected upon opting out. Also, low-income employees' target rates are more influenced when the default changes. Applying the methodology to other dimensions of heterogeneity, we find that younger employees are slower to opt out of the default than older employees, controlling for the target contribution rate, but this effect is smaller than the effect for income. We do not find heterogeneity by gender.

These results have implications for the design of defined contribution retirement savings plans. Given the powerful influence of the default contribution rate on savings outcomes, a policymaker or manager who desires to increase savings might set a default that is higher than the defaults of 0%–6% of income currently observed. Our methodological approach is not designed to address whether such a default would improve employees' welfare, but our evidence suggests that such a default would increase overall contribution rates because low-income employees would not quickly opt out to lower contribution rates. Future research should address the optimal design of savings plans in the face of heterogeneous populations. More generally, heterogeneity in responsiveness to choice architecture is a topic with important policy implications that should be examined more extensively.

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Table 1: Summary of characteristics for firms in the main specifications

Firm	Industry	Hire Dates Covered	Sample Size	Median Income (2010 levels)	Initial Period (months)	Default Contrib. Rate	Match Structure
A	Pharmaceutical/ Healthcare	01/01/2002 - 12/31/2005	14,753	$68,026	14	3%	$.75 per $1 on the first 6%
B	Medical Equipment/ Technology	01/01/2002 - 11/01/2003	5,444	$60,635	3	3%	Varies between $.50 to $.75 per $1 on the first 6%
C	Diversified Manufacturing	10/02/2008 - 12/31/2010	1,931	$37,167	2	6%	$1 per $1 on the first 6%
D	Diversified Manufacturing	01/01/2002 - 12/31/2006	5,193	$50,942	2	6%	Varies between $.35 to $.50 per $1 on the first 6%
E	Electronics	01/01/2004 - 12/31/2006	2,416	$80,692	2	2%	$1 per $1 on the first 4%
F	Computer Hardware	01/01/2002 - 12/31/2002	1,872	$40,828	2	0%	$1 per $1 on the first 3%
G	Insurance	08/02/2003 - 12/31/2006	5,819	$40,666	2	0%	Varies between $.50 to $1.50 per $1 on the first 5%
H	IT Services	03/02/2002 - 12/31/2004	8,289	$66,124	2	0%	$.25 per $1 on the first 6%
I	Pharmaceutical/ Healthcare	01/01/2002 - 12/31/2004	5,453	$86,044	12	0%	$1 per $1 on the first 4%
J	Telecom Services	01/01/2002 - 12/31/2003	2,169	$27,802	2	0%	$1 per $1 on the first 2%, $.40 per $1 on the next 4%

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*** **
CI	(0.021)	(0.069)
B	**0.476*** **	**0.936**
CI	(0.022)	(0.118)
C	**0.363*** **	**0.385*** **
CI	(0.027)	(0.041)
D	**0.519*** **	**0.954**
CI	(0.029)	(0.136)
E	**0.408*** **	**0.650** **
CI	(0.069)	(0.158)
F	**0.338*** **	**0.318*** **
CI	(0.052)	(0.076)
G	**0.625*** **	**0.630*** **
CI	(0.042)	(0.065)
H	**0.512*** **	**0.534*** **
CI	(0.025)	(0.039)
I	**0.899**	**0.689* **
CI	(0.189)	(0.175)
J	**0.410*** **	**0.531*** **
CI	(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 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	**Median or below**	**Above median**	**Difference**	**Median or below**	**Above median**	**Difference**
A	**0.056**	**0.017**	**0.039*****	**0.064**	**0.015**	**0.049*****
CI	(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**
CI	(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*****
CI	(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**
CI	(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*****
CI	(0.017)	(0.015)	(0.022)	(0.019)	(0.014)	(0.024)
AE Avg	**0.125**	**0.068**	**0.057*****	**0.135**	**0.062**	**0.073*****
CI	(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*****
CI	(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*****
CI	(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*****
CI	(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**
CI	(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*****
CI	(0.055)	(0.047)	(0.046)	(0.073)	(0.033)	(0.065)
SE Avg	**0.146**	**0.057**	**0.089*****	**0.180**	**0.042**	**0.139*****
CI	(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*****
CI	(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**
CI	(0.072)	(0.183)
B	**0.739*****	**1.066**
CI	(0.052)	(0.146)
C	**0.931**	**0.550*****
CI	(0.181)	(0.089)
D	**0.785*****	**1.024**
CI	(0.060)	(0.143)
E	**0.689*****	**1.259**
CI	(0.111)	(0.549)
F	**0.723*****	**1.079**
CI	(0.095)	(0.292)
G	**0.804*****	**0.882**
CI	(0.060)	(0.114)
H	**0.663*****	**0.718*****
CI	(0.037)	(0.062)
I	**0.743*****	**0.775***
CI	(0.068)	(0.124)
J	**0.547*****	**0.487*****
CI	(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 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	**0.030**	**0.026**	**0.004**	**0.032**	**0.024**	**0.008**
CI	(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**
CI	(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**
CI	(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**
CI	(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**
CI	(0.036)	(0.038)	(0.034)	(0.036)	(0.038)	(0.034)
AE Avg	**0.105**	**0.090**	**0.014**	**0.109**	**0.086**	**0.023***
CI	(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**
CI	(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***
CI	(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*****
CI	(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**
CI	(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*****
CI	(0.012)	(0.028)	(0.028)	(0.013)	(0.027)	(0.029)
SE Avg	**0.131**	**0.080**	**0.051*****	**0.144**	**0.071**	**0.073*****
CI	(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*****
CI	(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**
CI	(0.067)	(0.121)
B	**0.821** **	**0.840**
CI	(0.071)	(0.100)
C	**0.977**	**1.384**
CI	(0.190)	(0.532)
D	**1.161**	**1.052**
CI	(0.137)	(0.158)
E	**0.897**	**1.446**
CI	(0.169)	(0.458)
F	**1.041**	**1.654**
CI	(0.175)	(0.444)
G	**0.657*** **	**1.013**
CI	(0.040)	(0.152)
H	**0.902**	**0.944**
CI	(0.062)	(0.098)
I	**0.663*** **	**0.777* **
CI	(0.054)	(0.124)
J	**0.871**	**1.100**
CI	(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 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	**Female**	**Male**	**Difference**	**Female**	**Male**	**Difference**
A	**0.036**	**0.025**	**0.011**	**0.037**	**0.025**	**0.012**
CI	(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**
CI	(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**
CI	(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**
CI	(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**
CI	(0.023)	(0.015)	(0.028)	(0.023)	(0.015)	(0.029)
AE Avg	**0.096**	**0.094**	**0.003**	**0.095**	**0.095**	**0.000**
CI	(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***
CI	(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**
CI	(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**
CI	(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***
CI	(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**
CI	(0.077)	(0.082)	(0.054)	(0.085)	(0.082)	(0.077)
SE Avg	**0.112**	**0.104**	**0.008**	**0.117**	**0.099**	**0.018**
CI	(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**
CI	(0.013)	(0.012)	(0.008)	(0.014)	(0.012)	(0.010)

Table 8: Summary of characteristics for 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	Business Services	01/01/2006 - 06/01/2007	6,851	$67,243	2	0%	Varies between $.33 to $1 per $1 on the first 6%
K	Business Services	06/01/2008 - 12/31/2012	18,324	$73,111	2	3%	Varies between $.33 to $1 per $1 on the first 6%
L	Healthcare	11/01/2003 - 12/31/2007	18,453	$30,407	3	0%	$.50 per $1 on the first 3%
L	Healthcare	01/01/2002 - 10/31/2003	7,519	$29,517	3	3%	$.50 per $1 on the first 3%

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% and the target rate probability when Firm K has a default contribution rate of 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	Above median	Difference
0%	**-0.141*** **	**-0.084*** **	**-0.057** **
CI	(0.028)	(0.026)	(0.027)
1-2, 4-5%	**-0.033*** **	**-0.022** **	**-0.011**
CI	(0.012)	(0.011)	(0.013)
3%	**0.210*** **	**0.106*** **	**0.104*** **
CI	(0.020)	(0.026)	(0.020)
6%	**0.031**	**0.061** **	**-0.030**
CI	(0.028)	(0.030)	(0.018)
7-10%	**-0.042*** **	**-0.016**	**-0.026** **
CI	(0.007)	(0.012)	(0.012)
11%+	**-0.025*** **	**-0.045*** **	**0.021** **
CI	(0.005)	(0.009)	(0.010)

Table 10: 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% and the target rate probability when Firm L has a default contribution rate of 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	Above median	Difference
0%	**-0.558*** **	**-0.387*** **	**-0.171*** **
CI	(0.026)	(0.026)	(0.030)
1-2, 4-5%	**-0.053*** **	**-0.077*** **	**0.024**
CI	(0.019)	(0.025)	(0.019)
3%	**0.617*** **	**0.393*** **	**0.224** **
CI	(0.023)	(0.129)	(0.111)
6-9%	**0.000**	**0.049**	**-0.049**
CI	(0.017)	(0.113)	(0.097)
10%+	**-0.005**	**0.023**	**-0.027**
CI	(0.010)	(0.058)	(0.050)

Figure 1: Income based target rate probabilities

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.

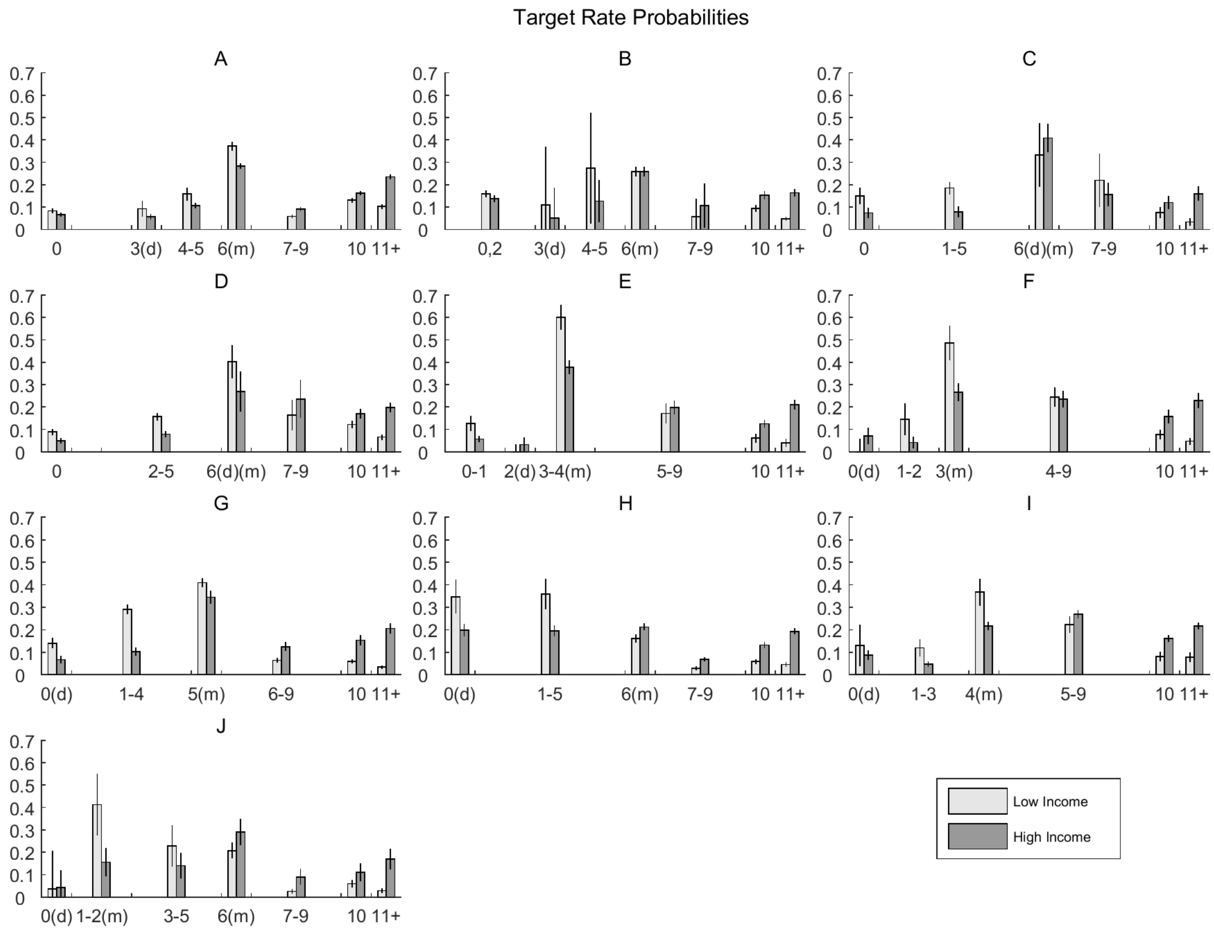

Figure 2: Income based initial period switching probabilities

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). Tick marks on the x axis indicate the end points of each rate group, and line segments on each bar indicate 95% confidence intervals.

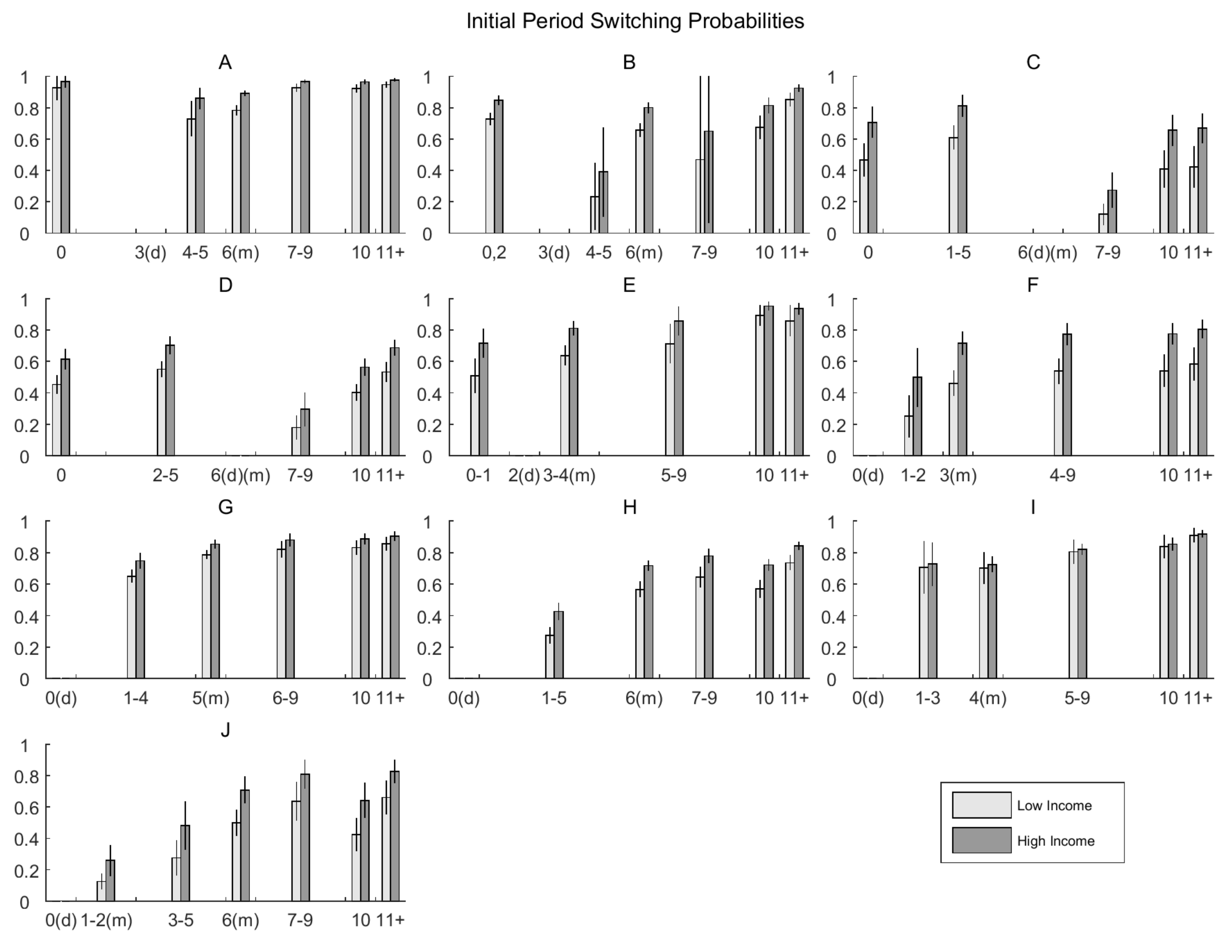

Figure 3: Income based later period switching hazards

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 rate up to that month. 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.

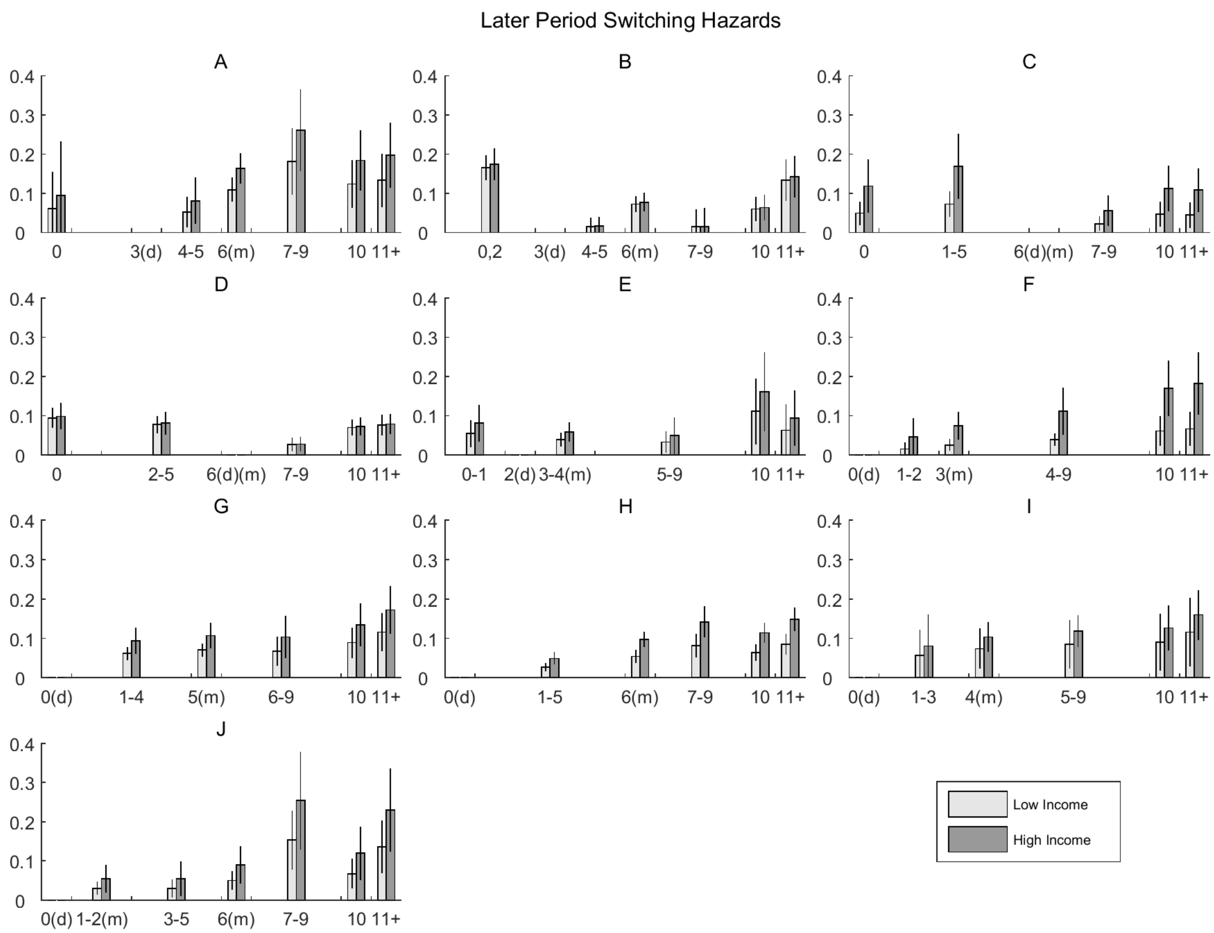

Figure 4: Aged based target rate probabilities

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.

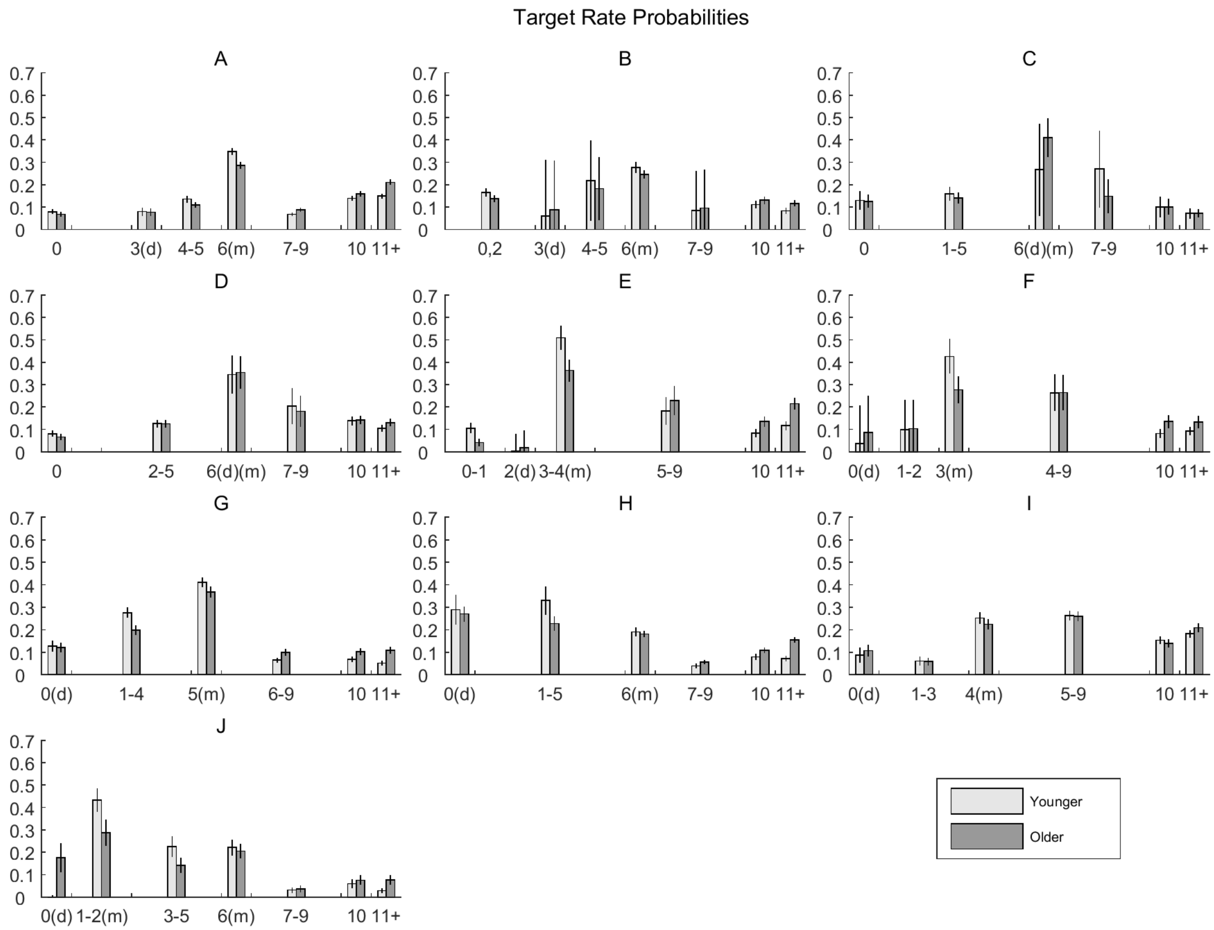

Figure 5: Gender based target rate probabilities

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.

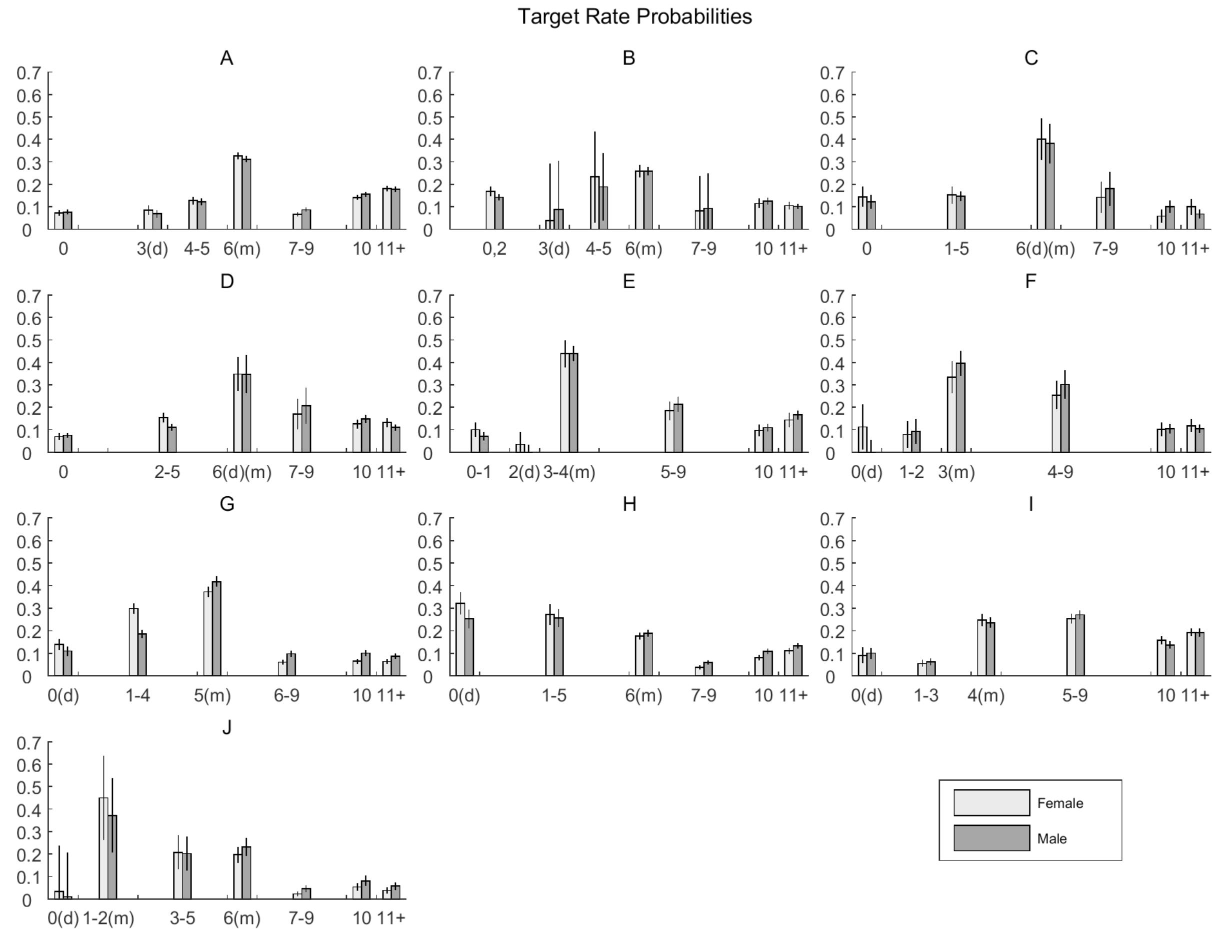

Figure 6: Target rate probabilities for Firm K

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

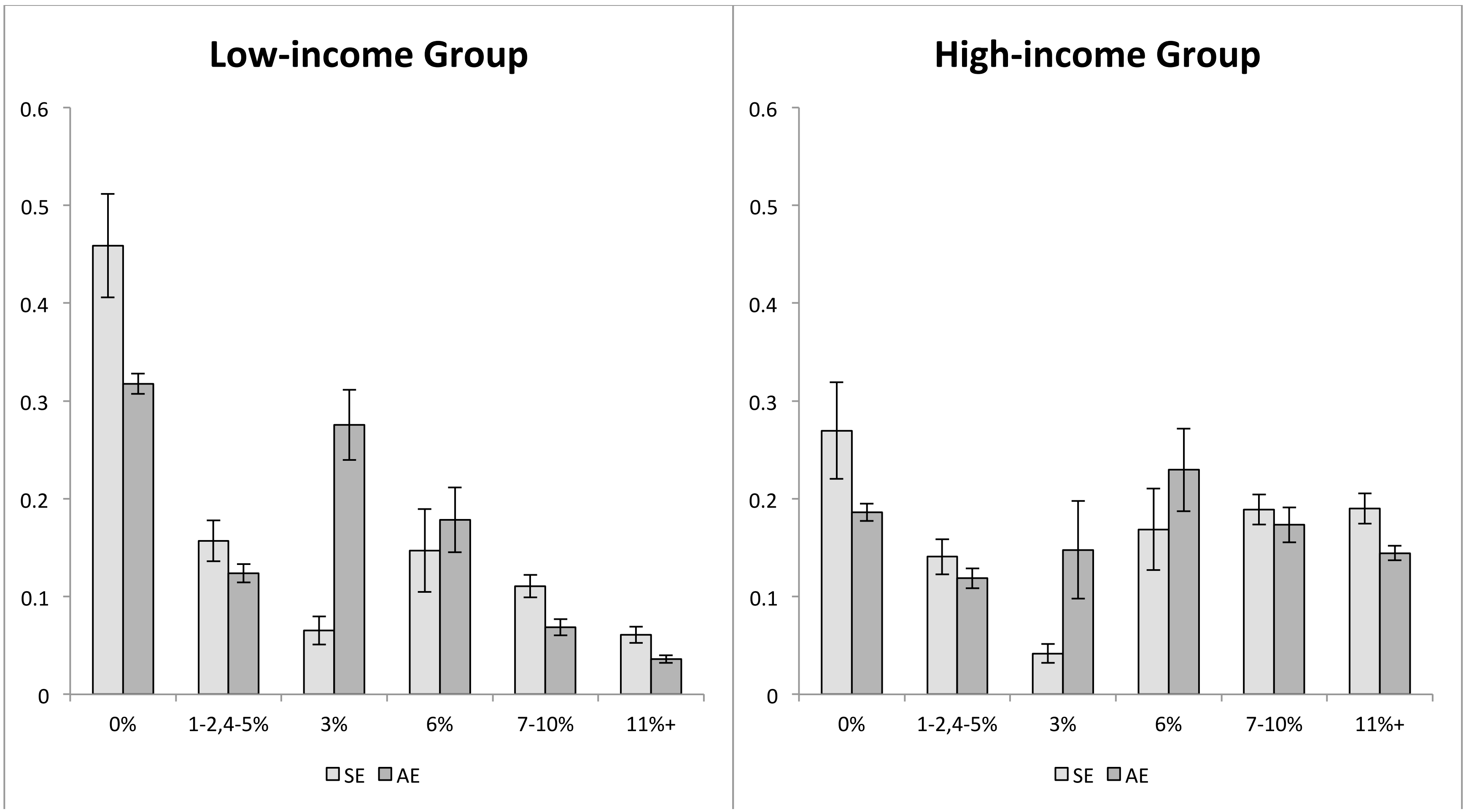

Figure 7: Target rate probabilities for Firm L

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

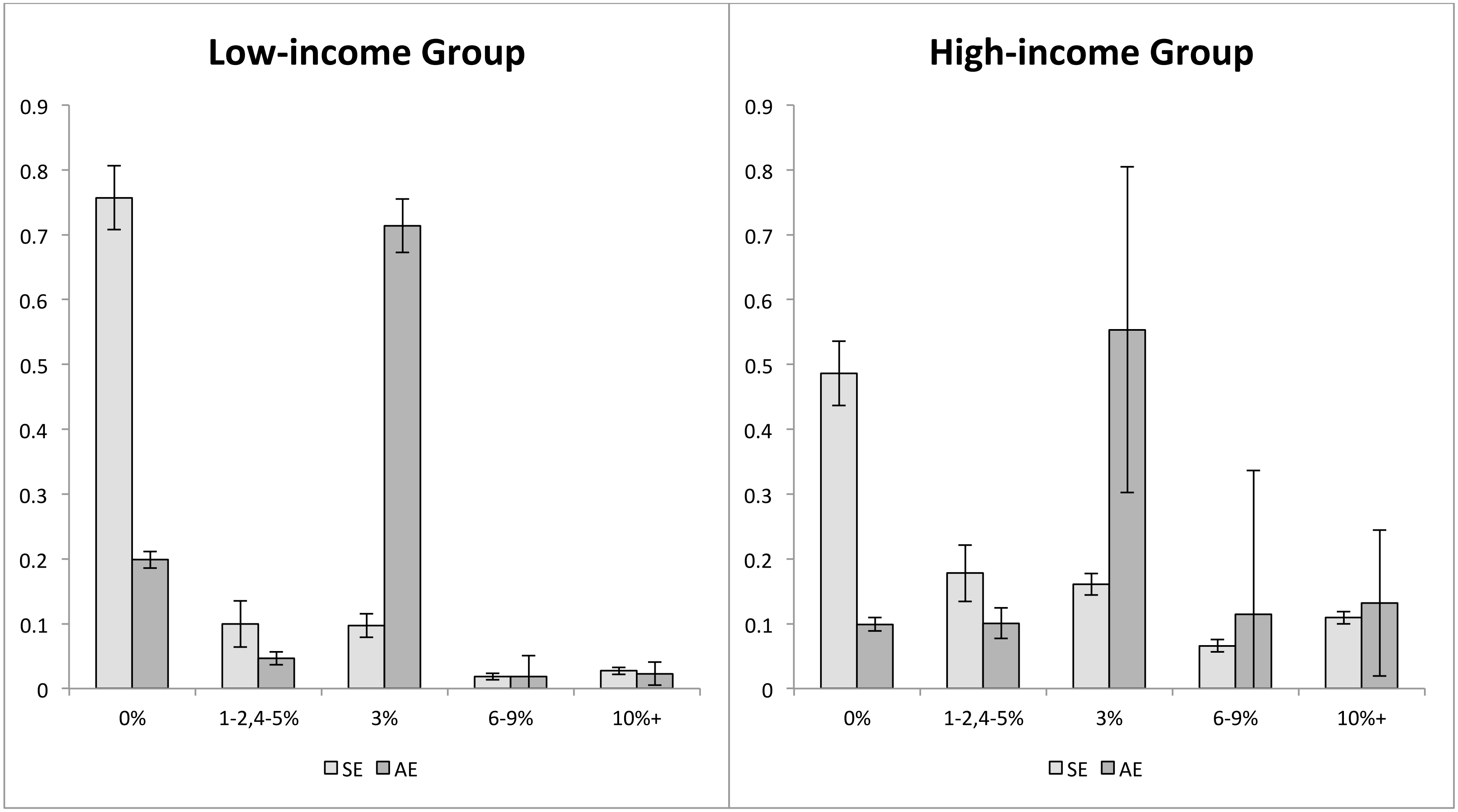

Table A1: Robustness of odds ratios to various rate groupings

Firm	Initial Period Odds Ratios: Base Estimates	Initial: Individual Target Rates	Initial: Individual, Excluding 11%+ Rates	Initial: Indiv., Excl. 11%+ & Unpopular	Later Period Odds Ratios: Base Estimates	Later: Individual Target Rates	Later: Individual, Excluding 11%+ Rates	Later: Indiv., Excl. 11%+ & Unpopular
A	**0.440*** **	**0.441*** **	**0.473*** **	**0.473*** **	**0.626*** **	**0.635** **	**0.649** **	**0.649** **
CI	(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**
CI	(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*** **
CI	(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**
CI	(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**
CI	(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*** **
CI	(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*** **
CI	(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*** **
CI	(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**
CI	(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** **
CI	(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*** **	**0.038***	**0.033***	**0.033***	**0.049*** **	**0.049**	**0.044**	**0.044**
CI	(0.012)	(0.021)	(0.019)	(0.019)	(0.015)	(0.032)	(0.031)	(0.031)
B	**0.055** **	**0.052** **	**0.058*** **	**0.041**	**0.122**	**0.166*** **	**0.175*** **	**0.064**
CI	(0.023)	(0.022)	(0.022)	(0.032)	(0.074)	(0.043)	(0.042)	(0.062)
C	**0.199*** **	**0.259*** **	**0.231*** **	**0.205*** **	**0.202*** **	**0.384*** **	**0.349*** **	**0.239** **
CI	(0.064)	(0.073)	(0.071)	(0.075)	(0.077)	(0.088)	(0.095)	(0.097)
D	**0.045**	**0.048**	**0.035**	**0.035**	**0.025**	**0.037**	**0.032**	**0.032**
CI	(0.028)	(0.032)	(0.034)	(0.034)	(0.035)	(0.087)	(0.091)	(0.091)
E	**0.081*** **	**0.047** **	**0.043** **	**0.061*** **	**0.102*** **	**0.071*** **	**0.071*** **	**0.099*** **
CI	(0.022)	(0.019)	(0.019)	(0.022)	(0.024)	(0.020)	(0.020)	(0.023)
F	**0.206*** **	**0.203*** **	**0.193*** **	**0.193*** **	**0.261*** **	**0.261*** **	**0.260*** **	**0.260*** **
CI	(0.034)	(0.027)	(0.028)	(0.028)	(0.029)	(0.019)	(0.022)	(0.022)
G	**0.032*** **	**0.108*** **	**0.108*** **	**0.040** **	**0.044*** **	**0.174*** **	**0.176*** **	**0.051***
CI	(0.009)	(0.031)	(0.030)	(0.020)	(0.010)	(0.055)	(0.054)	(0.030)
H	**0.123*** **	**0.090*** **	**0.068*** **	**0.059***	**0.205*** **	**0.344*** **	**0.325*** **	**0.088**
CI	(0.028)	(0.024)	(0.021)	(0.035)	(0.039)	(0.028)	(0.030)	(0.064)
I	**0.031**	**0.029**	**0.047**	**0.032**	**0.052**	**0.130** **	**0.142** **	**0.052**
CI	(0.041)	(0.045)	(0.046)	(0.052)	(0.048)	(0.065)	(0.063)	(0.071)
J	**0.156*** **	**0.158*** **	**0.133** **	**0.133** **	**0.254*** **	**0.257*** **	**0.239*** **	**0.239*** **
CI	(0.046)	(0.047)	(0.056)	(0.056)	(0.065)	(0.068)	(0.044)	(0.044)

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

Firm	Initial Period Odds Ratios				Later Period Odds Ratios			
	Base Estimates	Terciles	Residual Pay	Firm Median Pay	Base Estimates	Terciles	Residual Pay	Firm Median Pay
A	**0.440*** **	**0.183*** **	**0.445*** **	**0.417*** **	**0.626*** **	**0.283*** **	**0.577*** **	**0.643*** **
CI	(0.021)	(0.042)	(0.023)	(0.018)	(0.069)	(0.098)	(0.063)	(0.072)
B	**0.476*** **	**0.256*** **	**0.479*** **	**0.454*** **	**0.936**	**0.399*** **	**0.755*** **	**0.862**
CI	(0.022)	(0.038)	(0.023)	(0.020)	(0.118)	(0.099)	(0.078)	(0.099)
C	**0.363*** **	**0.394*** **	**0.557*** **	**0.550*** **	**0.385*** **	**0.408*** **	**0.545*** **	**0.586*** **
CI	(0.027)	(0.046)	(0.066)	(0.064)	(0.041)	(0.065)	(0.087)	(0.102)
D	**0.519*** **	**0.383*** **	**0.527*** **	**0.554*** **	**0.954**	**1.056**	**0.922**	**1.044**
CI	(0.029)	(0.020)	(0.029)	(0.032)	(0.136)	(0.220)	(0.126)	(0.158)
E	**0.408*** **	**0.245*** **	**0.445*** **	**0.303*** **	**0.650** **	**0.464*** **	**0.594*** **	**0.462*** **
CI	(0.069)	(0.051)	(0.072)	(0.056)	(0.158)	(0.156)	(0.142)	(0.154)
F	**0.338*** **	**0.244*** **	**0.295*** **	**0.274*** **	**0.318*** **	**0.260*** **	**0.332*** **	**0.325*** **
CI	(0.052)	(0.045)	(0.049)	(0.040)	(0.076)	(0.076)	(0.094)	(0.065)
G	**0.625*** **	**0.477*** **	**0.580*** **	**0.599*** **	**0.630*** **	**0.545*** **	**0.461*** **	**0.641*** **
CI	(0.042)	(0.033)	(0.036)	(0.036)	(0.065)	(0.064)	(0.033)	(0.065)
H	**0.512*** **	**0.395*** **	**0.644*** **	**0.539*** **	**0.534*** **	**0.423*** **	**0.569*** **	**0.552*** **
CI	(0.025)	(0.020)	(0.035)	(0.026)	(0.039)	(0.033)	(0.039)	(0.039)
I	**0.899**	**0.800**	**0.979**	**0.682*** **	**0.689* **	**0.973**	**0.761**	**0.725** **
CI	(0.189)	(0.294)	(0.211)	(0.059)	(0.175)	(0.596)	(0.206)	(0.111)
J	**0.410*** **	**0.334*** **	**0.408*** **	**0.337*** **	**0.531*** **	**0.459*** **	**0.584*** **	**0.556*** **
CI	(0.031)	(0.076)	(0.031)	(0.048)	(0.069)	(0.132)	(0.087)	(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*** **	**0.146*** **	**0.045*** **	**0.034*** **	**0.049*** **	**0.192*** **	**0.054*** **	**0.043*** **
CI	(0.012)	(0.033)	(0.014)	(0.010)	(0.015)	(0.041)	(0.017)	(0.012)
B	**0.055** **	**0.169*** **	**0.067*** **	**0.064*** **	**0.122**	**0.312*** **	**0.138* **	**0.135* **
CI	(0.023)	(0.033)	(0.020)	(0.022)	(0.074)	(0.045)	(0.071)	(0.075)
C	**0.199*** **	**0.186** **	**0.129** **	**0.126* **	**0.202*** **	**0.194** **	**0.100**	**0.100**
CI	(0.064)	(0.081)	(0.059)	(0.067)	(0.077)	(0.095)	(0.063)	(0.076)
D	**0.045**	**0.046**	**0.050* **	**0.027**	**0.025**	**0.030**	**0.032**	**0.006**
CI	(0.028)	(0.034)	(0.028)	(0.028)	(0.035)	(0.042)	(0.034)	(0.035)
E	**0.081*** **	**0.112*** **	**0.087*** **	**0.088*** **	**0.102*** **	**0.140*** **	**0.108*** **	**0.106*** **
CI	(0.022)	(0.024)	(0.024)	(0.019)	(0.024)	(0.027)	(0.026)	(0.020)
F	**0.206*** **	**0.240*** **	**0.210*** **	**0.240*** **	**0.261*** **	**0.296*** **	**0.260*** **	**0.293*** **
CI	(0.034)	(0.037)	(0.038)	(0.029)	(0.029)	(0.029)	(0.033)	(0.022)
G	**0.032*** **	**0.044*** **	**0.045*** **	**0.044*** **	**0.044*** **	**0.062*** **	**0.056*** **	**0.060*** **
CI	(0.009)	(0.011)	(0.009)	(0.014)	(0.010)	(0.013)	(0.011)	(0.016)
H	**0.123*** **	**0.170*** **	**0.093*** **	**0.112*** **	**0.205*** **	**0.272*** **	**0.155*** **	**0.192*** **
CI	(0.028)	(0.043)	(0.022)	(0.025)	(0.039)	(0.059)	(0.030)	(0.036)
I	**0.031**	**0.009**	**0.019**	**0.033* **	**0.052**	**0.026**	**0.036**	**0.045** **
CI	(0.041)	(0.069)	(0.035)	(0.018)	(0.048)	(0.092)	(0.040)	(0.020)
J	**0.156*** **	**0.174*** **	**0.139*** **	**0.199*** **	**0.254*** **	**0.318*** **	**0.246*** **	**0.257*** **
CI	(0.046)	(0.042)	(0.046)	(0.043)	(0.065)	(0.033)	(0.066)	(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*** **	**0.022*** **	**0.447*** **	**0.429*** **	**0.304*** **	**0.626*** **	**0.010*** **	**0.662* **	**0.622*** **	**0.427*** **	**0.303*** **
CI	(0.021)	(0.029)	(0.069)	(0.021)	(0.057)	(0.069)	(0.015)	(0.181)	(0.072)	(0.110)	(0.117)
B	**0.476*** **	**0.505*** **	**0.470*** **	**0.337*** **	**0.500*** **	**0.936**	**0.899**	**0.940**	**0.515*** **	**0.940**	**1.178**
CI	(0.022)	(0.092)	(0.091)	(0.015)	(0.082)	(0.118)	(0.235)	(0.322)	(0.046)	(0.244)	(0.519)
C	**0.363*** **	**0.558*** **	**0.192*** **	**0.317*** **	**0.361*** **	**0.385*** **	**0.417*** **	**0.215*** **	**0.817**	**0.344*** **	**0.555**
CI	(0.027)	(0.167)	(0.074)	(0.143)	(0.132)	(0.041)	(0.194)	(0.105)	(0.555)	(0.172)	(0.444)
D	**0.519*** **	**0.835**	**0.395*** **	**0.523*** **	**0.531*** **	**0.954**	**1.022**	**0.803**	**1.012**	**0.974**	**1.035**
CI	(0.029)	(0.162)	(0.057)	(0.039)	(0.099)	(0.136)	(0.341)	(0.165)	(0.204)	(0.261)	(0.460)
E	**0.408*** **	**0.472** **	**0.392*** **	**0.360*** **	**0.359*** **	**0.650** **	**1.055**	**0.588*** **	**0.743**	**0.564*** **	**0.360*** **
CI	(0.069)	(0.225)	(0.074)	(0.066)	(0.069)	(0.158)	(0.697)	(0.156)	(0.184)	(0.147)	(0.188)
F	**0.338*** **				**0.325*** **	**0.318*** **				**0.295*** **	**0.262*** **
CI	(0.052)				(0.071)	(0.076)				(0.091)	(0.180)
G	**0.625*** **			**0.477*** **	**0.636*** **	**0.630*** **			**0.581*** **	**0.641** **	**0.715**
CI	(0.042)			(0.034)	(0.095)	(0.065)			(0.077)	(0.155)	(0.335)
H	**0.512*** **			**0.514*** **	**0.546*** **	**0.534*** **			**0.495*** **	**0.577** **	**0.669**
CI	(0.025)			(0.031)	(0.137)	(0.039)			(0.042)	(0.185)	(0.358)
I	**0.899**			**0.952**	**1.058**	**0.689* **			**0.698**	**0.807**	**1.175**
CI	(0.189)			(0.274)	(0.382)	(0.175)			(0.229)	(0.410)	(0.877)
J	**0.410*** **			**0.572*** **	**0.562*** **	**0.531*** **			**0.724**	**0.784**	**1.692**
CI	(0.031)			(0.152)	(0.139)	(0.069)			(0.206)	(0.278)	(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*** **	**0.101*** **	**0.037*** **	**0.104*** **	**0.049*** **	**0.137*** **	**0.046*** **	**0.131*** **
CI	(0.012)	(0.027)	(0.012)	(0.022)	(0.015)	(0.036)	(0.015)	(0.024)
B	**0.055** **	**0.056**	**0.125*** **	**0.046**	**0.122**	**0.123** **	**0.217* **	**0.161*** **
CI	(0.023)	(0.037)	(0.035)	(0.041)	(0.074)	(0.062)	(0.129)	(0.061)
C	**0.199*** **	**0.316*** **	**0.073**	**0.200**	**0.202*** **	**0.340*** **	**0.188**	**0.240**
CI	(0.064)	(0.091)	(0.117)	(0.134)	(0.077)	(0.111)	(0.156)	(0.171)
D	**0.045**	**0.075** **	**0.042**	**0.028**	**0.025**	**0.062**	**0.013**	**0.015**
CI	(0.028)	(0.036)	(0.043)	(0.068)	(0.035)	(0.044)	(0.056)	(0.081)
E	**0.081*** **	**0.084*** **	**0.092*** **	**0.097*** **	**0.102*** **	**0.104*** **	**0.112*** **	**0.120*** **
CI	(0.022)	(0.023)	(0.026)	(0.029)	(0.024)	(0.023)	(0.026)	(0.028)
F	**0.206*** **			**0.219*** **	**0.261*** **			**0.257*** **
CI	(0.034)			(0.063)	(0.029)			(0.065)
G	**0.032*** **		**0.044*** **	**0.028**	**0.044*** **		**0.058*** **	**0.038**
CI	(0.009)		(0.013)	(0.024)	(0.010)		(0.015)	(0.027)
H	**0.123*** **		**0.137*** **	**0.100**	**0.205*** **		**0.213*** **	**0.193** **
CI	(0.028)		(0.037)	(0.093)	(0.039)		(0.050)	(0.095)
I	**0.031**		**0.029**	**0.002**	**0.052**		**0.049**	**0.025**
CI	(0.041)		(0.054)	(0.070)	(0.048)		(0.062)	(0.087)
J	**0.156*** **		**0.079**	**0.000**	**0.254*** **		**0.248*** **	**0.054**
CI	(0.046)		(0.053)	(0.086)	(0.065)		(0.042)	(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</td><td></td><td></td><td></td><td colspan="2">0.007</td><td>0.008</td><td colspan="3">-0.132</td><td>0.000</td><td>0.013</td></tr>
<tr><td>CI</td><td>(0.125)</td><td></td><td></td><td></td><td colspan="2">(0.013)</td><td>(0.018)</td><td colspan="3">(0.138)</td><td>(0.046)</td><td>(0.060)</td></tr>
<tr><td>B</td><td>0.053</td><td></td><td rowspan="2">See Caption</td><td></td><td colspan="2">0.004</td><td>0.014</td><td colspan="3">0.000</td><td>0.015</td><td>0.037</td></tr>
<tr><td>CI</td><td>(0.062)</td><td></td><td></td><td colspan="2">(0.003)</td><td>(0.015)</td><td colspan="3">(0.037)</td><td>(0.016)</td><td>(0.114)</td></tr>
<tr><td>C</td><td>0.051</td><td colspan="5">0.080</td><td></td><td colspan="3">0.015</td><td>-0.010</td><td>-0.007</td></tr>
<tr><td>CI</td><td>(0.039)</td><td colspan="5">(0.060)</td><td></td><td colspan="3">(0.014)</td><td>(0.091)</td><td>(0.077)</td></tr>
<tr><td>D</td><td>0.002</td><td></td><td colspan="4">0.009</td><td></td><td colspan="3">-0.016</td><td>-0.022</td><td>0.012</td></tr>
<tr><td>CI</td><td>(0.025)</td><td></td><td colspan="4">(0.012)</td><td></td><td colspan="3">(0.014)</td><td>(0.026)</td><td>(0.013)</td></tr>
<tr><td>E</td><td colspan="2">0.013</td><td></td><td>-0.062</td><td></td><td colspan="5">-0.037</td><td>-0.110</td><td>-0.023</td></tr>
<tr><td>CI</td><td colspan="2">(0.028)</td><td></td><td>(0.040)</td><td></td><td colspan="5">(0.037)</td><td>(0.343)</td><td>(0.069)</td></tr>
<tr><td>F</td><td></td><td colspan="2">-0.066</td><td>-0.001</td><td colspan="6">-0.059</td><td>-0.052</td><td>0.075</td></tr>
<tr><td>CI</td><td></td><td colspan="2">(0.080)</td><td>(0.031)</td><td colspan="6">(0.108)</td><td>(0.233)</td><td>(0.108)</td></tr>
<tr><td>G</td><td></td><td colspan="4">0.002</td><td>0.007</td><td colspan="4">0.018</td><td>0.020</td><td>0.042</td></tr>
<tr><td>CI</td><td></td><td colspan="4">(0.027)</td><td>(0.030)</td><td colspan="4">(0.031)</td><td>(0.107)</td><td>(0.143)</td></tr>
<tr><td>H</td><td></td><td colspan="5">0.006</td><td>0.004</td><td colspan="3">-0.031</td><td>0.018</td><td>0.028</td></tr>
<tr><td>CI</td><td></td><td colspan="5">(0.007)</td><td>(0.017)</td><td colspan="3">(0.047)</td><td>(0.014)</td><td>(0.028)</td></tr>
<tr><td>I</td><td></td><td colspan="3">-0.025</td><td>0.024**</td><td colspan="5">0.002</td><td>-0.007</td><td>-0.047</td></tr>
<tr><td>CI</td><td></td><td colspan="3">(0.044)</td><td>(0.009)</td><td colspan="5">(0.025)</td><td>(0.058)</td><td>(0.052)</td></tr>
<tr><td>J</td><td></td><td>0.015</td><td></td><td colspan="3">0.017</td><td>0.017</td><td colspan="3">0.022</td><td>0.039</td><td>0.125</td></tr>
<tr><td>CI</td><td></td><td>(0.052)</td><td></td><td colspan="3">(0.029)</td><td>(0.062)</td><td colspan="3">(0.398)</td><td>(0.058)</td><td>(0.174)</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**				**0.010**		**0.022****	**-0.032**			**0.024**	**0.034**
CI	(0.042)				(0.006)		(0.009)	(0.064)			(0.023)	(0.027)
B	**0.025**		See Caption		**0.002**		**0.000**	**-0.005**			**0.004**	**0.013**
CI	(0.029)				(0.003)		(0.010)	(0.024)			(0.028)	(0.076)
C	**0.007**	**0.020**						**0.000**			**-0.032**	**-0.028**
CI	(0.010)	(0.025)						(0.013)			(0.024)	(0.039)
D	**-0.004**		**0.004**					**-0.019**			**-0.028**	**0.008**
CI	(0.018)		(0.013)					(0.019)			(0.023)	(0.013)
E	**0.018**			**-0.011**		**-0.002**					**-0.020**	**0.011**
CI	(0.013)			(0.024)		(0.017)					(0.078)	(0.401)
F		**-0.018**		**0.002**	**-0.015**						**-0.013**	**0.031**
CI		(0.057)		(0.009)	(0.015)						(0.054)	(0.030)
G		**-0.005**				**-0.002**	**0.006**				**0.006**	**0.021**
CI		(0.015)				(0.013)	(0.030)				(0.043)	(0.117)
H		**0.000**					**-0.006**	**-0.035**			**0.003**	**0.008**
CI		(0.004)					(0.026)	(0.041)			(0.012)	(0.015)
I		**-0.062**			**0.000**	**-0.036**					**-0.048**	**0.134**
CI		(0.094)			(0.021)	(0.048)					(0.072)	(0.255)
J		**-0.020**		**-0.018**			**-0.041**	**-0.115**			**-0.005**	**0.056**
CI		(0.013)		(0.014)			(0.029)	(0.112)			(0.024)	(0.264)