TIAA-CREF institute

TRENDS AND ISSUES

DECEMBER 2015

THE ROLE OF TIME PREFERENCES AND EXPONENTIAL-GROWTH BIAS IN RETIREMENT SAVINGS

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EXECUTIVE SUMMARY

Understanding the drivers of retirement-wealth accumulation is critical given that changes in employer-provided retirement plans have shifted responsibility for retirement savings increasingly to individuals. This paper empirically investigates two factors – one cognitive and one motivational – that may lead to low levels of retirement wealth accumulation. Cognitively, individuals may underestimate the future value of saving today by neglecting compound interest when assessing returns to saving, which is known as exponential-growth bias (EG bias). The motivational factor is present bias, which is the tendency for individuals to act patient in the long term, but impatient in the near term such that they continually put off saving today.

Using an online survey of a broad sample of US households, we measure individuals' tendency for EG bias and present bias and relate them to individuals' retirement savings. We find that both biases are prevalent and are negatively related to levels of retirement savings. In particular, 78% of the sample exhibits EG bias and 55% is present biased. However, having one bias does not increase the likelihood of having the other. As for retirement savings, individuals who have accurate understanding of exponential growth have $27,300 more in retirement savings relative to those who neglect exponential growth, while those who value time consistently have $25,200 more in savings relative to individuals who have present bias. Overall, we find that eliminating both biases would be associated with 12% higher retirement savings or as much as 70% if we correct for error in our ability to measure these biases.

We also present our sample with a hypothetical retirement-savings scenario and ask respondents how they would save. We randomize the delivery of policy-relevant interventions designed to "undo" the biases and assess their overall effect on hypothetical saving decisions. Moreover, we test whether these interventions are more effective at influencing response for those with the most bias relative to those with the least bias, as would be expected if the biases affect savings rates.

Financial Services

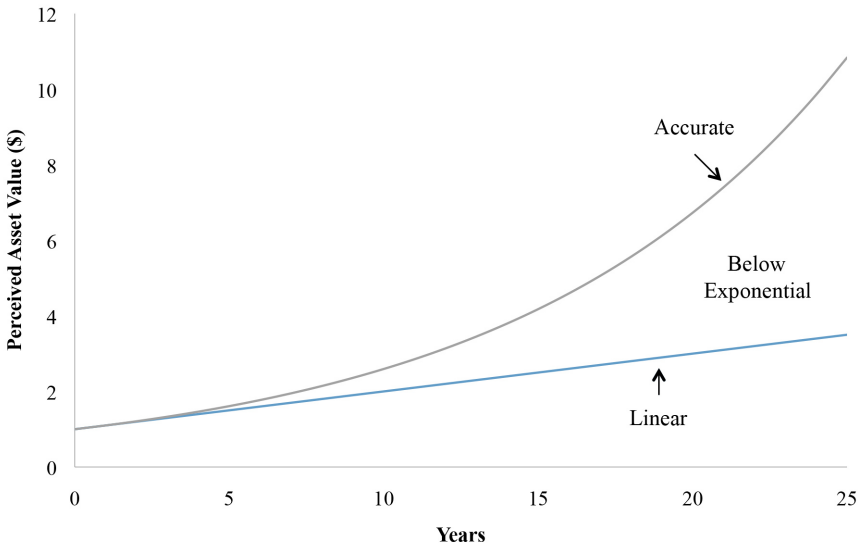
VARIATION IN RETIREMENT SAVINGS ACROSS US HOUSEHOLDS

In aggregate, individual retirement savings are reaching unprecedented levels, yet there is considerable variation in wealth accumulation even after taking into account background characteristics, such as age, income, and education. Because the change in employer-provided pension landscape requires millions of Americans to rely more on their individual savings to finance retirement, understanding what factors contribute to differences in retirement-wealth accumulation, and whether individuals are saving inadequately for retirement, is a critical policy concern.

Saving for retirement is a challenging task for many Americans. Making informed decisions requires understanding the complex calculations required to judge whether current saving decisions are likely to achieve a desired standard of living in retirement. A central piece of this calculation is compound interest, or the interest earned on previously earned interest that has been added to the principal. Exponential-growth bias (EG bias) is the tendency for individuals to underestimate the exponential growth of an asset's value over time due to neglecting compound interest. Misunderstanding this relationship creates a cognitive barrier to saving.

Figure 1 illustrates how individuals with different levels of EG bias perceive the expected growth of an asset with a given rate of return. Those without EG bias perceive accurately how the asset would grow with compound interest ("Accurate"). Individuals who perceive the asset's value as growing linearly completely neglect the effects of compound interest and are the most biased ("Linear"). Other individuals display some degree of negative bias, meaning they perceive the asset's value to be higher than that implied by no compound interest, but do not fully appreciate the ability of compound interest to increase the asset's value ("Below Exponential"). A growing body of literature suggests that EG bias is prevalent and is correlated with lower levels of wealth accumulation and higher levels of debt. However, prior research has not uncovered whether EG bias independently drives wealth, or whether both are driven by general cognitive ability or financial knowledge.

FIGURE 1: ILLUSTRATION OF EXPONENTIAL-GROWTH (EG) BIAS



Note: The figure shows the perceived asset value with a starting value of $1 at time zero growing at an annual interest rate of 10 percent for savers with varying levels of linearized exponential growth bias.

Saving for retirement also requires individuals to sacrifice consumption today. This applies both to spending today versus saving for the future and to completing the tedious task of enrolling in a savings plan that even well-intentioned people may continually choose to delay. In particular, individuals may exhibit "present bias," which is the tendency to exhibit patience when contemplating tradeoffs between future periods, but impatience when making tradeoffs between the present and the future. An individual who is present biased may intend to save more in the future but never does, due to continued procrastination of the enrollment process when "the future" becomes "the present." In contrast, individuals who are not present-biased follow through with intended actions because they consistently value benefits received today and those received in the future.

Table 1 illustrates the difference between individuals who are time consistent versus those who are present biased in the context of completing the necessary paperwork for enrolling in a retirement-savings plan. A time-consistent individual will make a plan and follow through. In contrast, a present-biased individual makes a plan but may continually push off action for a later date. Existing research shows how present bias is predicted to decrease savings, in theory, and that it is related to credit card debt, BMI, smoking, drinking, seatbelt use, and insurance purchase. However, there is a lack of empirical research relating present bias to retirement-saving behavior.

TABLE 1: ILLUSTRATION OF PRESENT BIAS

Employee Type	Planned Behavior	Actual Behavior
Not Present Biased	"I'll get it done tomorrow."	Tomorrow she clears her schedule for an hour to complete the paperwork.
Present Biased	"I'll get it done tomorrow."	Each day she delays doing the paperwork; she may never complete it.

Theoretically, EG bias affects desired savings levels and present bias affects motivation, and thus we may predict that they operate through separate channels. Understanding the prevalence and influence of these biases is critical for designing effective public policy in the context of retirement saving. We address this important gap in knowledge by estimating EG bias and present bias in a broad sample of the U.S. population. We measure their prevalence and relate these biases to accumulated retirement wealth, and assess how interventions designed to mitigate these biases are likely to influence an individual's response to retirement savings opportunities presented by employer-provided retirement savings plans.

DESCRIPTION OF STUDY

Our study collected data via online surveys administered to participants in two representative U.S. samples: the American Life Panel (ALP) hosted by RAND Corporation, and the Understanding America Study run by University of Southern California. Both provide computer and Internet services as needed to reach segments of the population without such access. In addition, each make available a host of previously collected background information on panelists, such as age, gender, employment status, and education.

We measure the presence of EG bias using individuals' responses to five questions about the future value of an asset given various assumptions on the interest rate and time horizon. For example, individuals were asked: "An asset has an initial value of $100 and grows at an interest rate of 10% each period. What is the value of the asset after 20 periods?" EG bias is assessed based on the accuracy of the respondents' answers.[1]

Our measure of present bias uses individuals' reports of how they value receiving various amounts of money over different time horizons. For example, they were asked, "Would you rather receive $100 today or $125.40 in 12 months?" and "Would you rather receive $120.00 in 12 months or $150.50 in 24 months?" Individuals who indicate that they value payments

1 Calculators and other forms of help were neither explicitly forbidden nor overtly suggested. Respondents were told they could use whatever approaches they preferred to answer the questions.

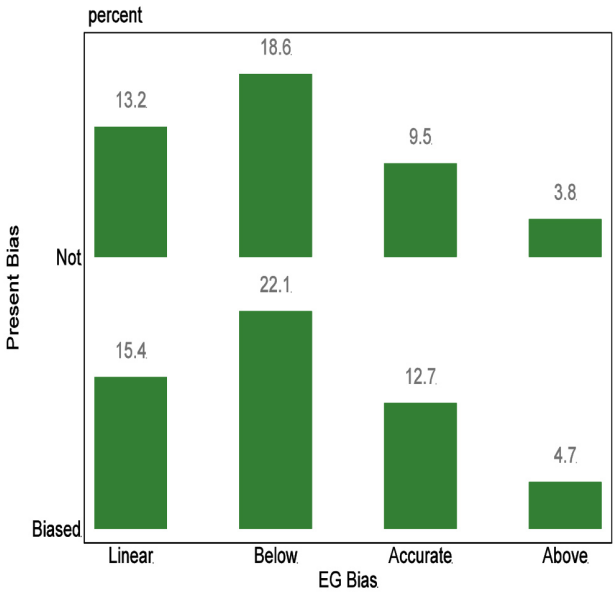
received today relative to payments received in 12 months *more than* they value payments received in 12 months relative to 24 months display characteristics of present bias.

The next two sections report the results of our study. First, we discuss results on the prevalence of EG bias and present bias in the U.S. population, and the relationship between these biases and retirement savings. Second, we report how response to a hypothetical retirement saving opportunity is affected by treatments designed to mitigate these biases. Complete description of study and results can be found in Goda, Levy, Manchester, Sojourner, & Tasoff (2015).

FINDINGS ON BIASES AND RETIREMENT SAVINGS

A key contribution of this study is providing descriptive information on the prevalence of present bias and EG bias in the U.S. population. We classify individuals into one of four categories of EG bias and one of two categories of present bias, for a total of eight possible combinations of EG bias and present bias. Figure 2 shows the distribution of our sample across these groups. We find that both biases are prevalent in the sample: 55% of the sample is present biased and 69% of the sample either underestimates ("Below") or neglects ("Linear") compound interest. Approximately 22% correctly perceive exponential growth ("Accurate"). A small portion (9%) of the sample perceive returns to be greater than exponential ("Above"). Importantly, having one bias is not related to having the other bias, as shown by the similar pattern of EG bias across those with and without present bias.

FIGURE 2: PREVALENCE OF EG BIAS AND PRESENT BIAS



Notes: N=2,317.

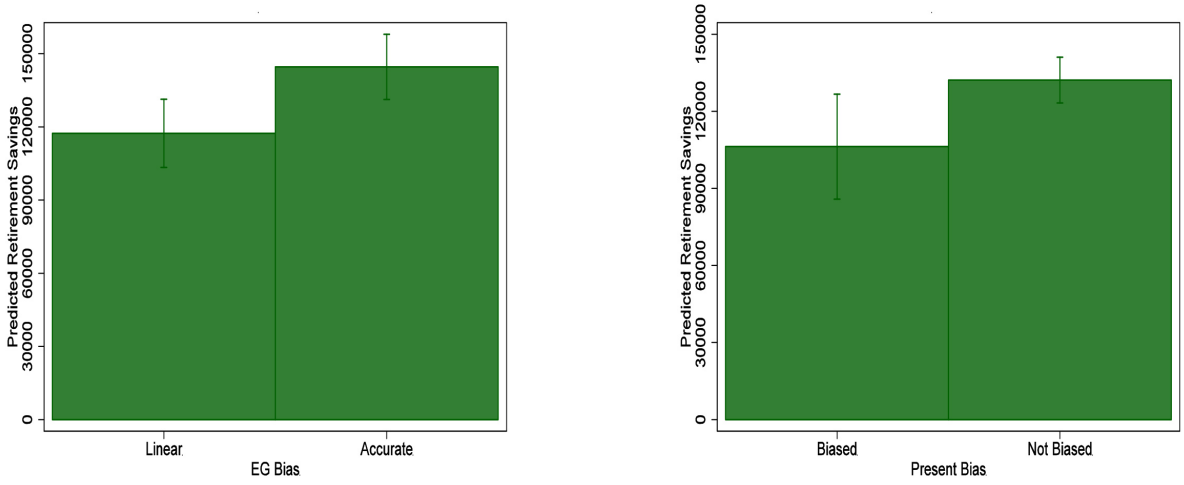
We relate these biases to individuals' report of their accumulated retirement savings. Because one's level of retirement savings also depends on factors other than biases, such as age, gender, ethnicity, and income, we control for these factors when isolating how retirement savings differs for those with EG bias and/or present bias. We also control for differences in financial literacy (measured by a battery of three questions about risk diversification, inflation, and interest rates), cognitive ability (measured by five questions from an IQ exam), risk preferences (measured using respondent's choice of coin-flip lotteries) and one's general preference for making tradeoffs in future dates.[2] We then use our model to predict retirement wealth based on differences in EG bias and present bias to determine the role of these biases in retirement saving decisions.[3]

2 The full set of control variables includes one's general time preference, age, gender, number of children, marital status, race/ethnicity, state of residence, educational attainment, income, interactions between age and income, employment status, risk aversion, cognitive ability, and standard measures of financial literacy.

3 These results implicitly assume that our measures of these biases are not correlated with other factors that affect retirement savings that are not included in our analysis.

Figure 3 shows the predicted retirement wealth based on the presence and absence of EG bias (left panel) and present bias (right panel). We also indicate the range of estimates based on a 95% level of confidence that assesses whether the difference in retirement wealth by the level of bias is likely to be driven by chance alone. For EG bias, we find that those with accurate understanding (Accurate) have $27,300 more in predicted retirement wealth relative to those who neglect it (Linear), which is equivalent to 20.5% of average savings.[4] Being present bias leads to $25,200 less in predicted retirement wealth relative to someone who makes consistent tradeoffs, which is approximately 19% of average retirement savings.[5] By way of comparison, the predicted effect of each bias is slightly larger than the effect of cognitive ability as captured by our IQ measure. When predicting retirement savings, our findings do not reveal evidence of any interaction between present bias and EG bias; instead, each bias appears to separately relate to retirement savings.

FIGURE 3: PRESENT BIAS, EG BIAS AND RETIREMENT SAVINGS



Notes: N=2,317. Height of bars represent the average predicted retirement wealth for our sample assuming level of present bias and EG bias is as shown.

RESPONSE TO HYPOTHETICAL RETIREMENT-SAVING SCENARIO

We also administer a hypothetical retirement-saving scenario to evaluate how individuals in our sample would respond in terms of saving behavior depending on whether they receive an intervention meant to "undo" each bias. To do this, we construct a hypothetical scenario based on an employer introducing a match component to its employer-provided retirement plan, and we randomize receipt of two sets of interventions in our sample: Projections to address EG bias and Incentives to address present bias.

The Projections dimension provides information on the value of the employer match as a projected account balance at retirement (Balance Treatment) or as projected annual income in retirement (Income Treatment), based on the contribution amount entered by the respondent using an embedded, online planning tool. By providing information about the relationship between current contributions and future values, these treatments were designed to address EG bias as a barrier to saving by helping individuals accurately understand the connection between current saving and future payoffs (Goda, Manchester, & Sojourner, 2014). We compare how individuals in the two treatment groups would respond to the match in terms of contribution rates relative to those in the control group who were presented only the year-end value of the match.

The Incentive dimension provides a hypothetical, immediate $50 bonus to individuals if they complete the necessary paperwork within one week (Incentive + Deadline Treatment) or anytime in the future (Incentive).[6] This dimension is

4 Average retirement savings for the sample is $132,926.

5 For this comparison, having present bias is defined as having a short term discount factor of 0.7, while someone who is not present biased has a value of 1.0.

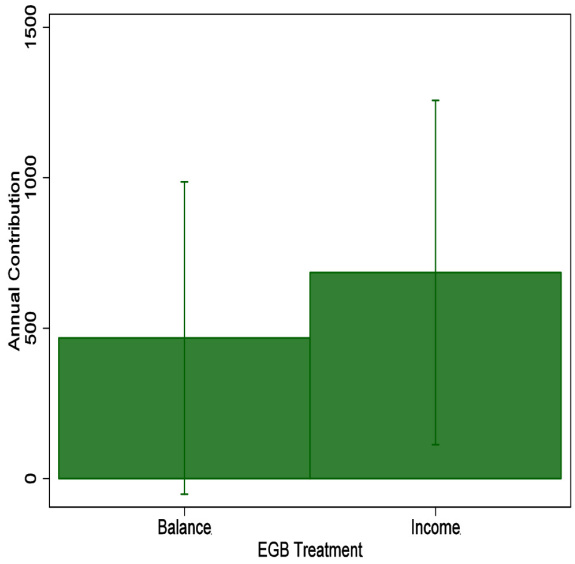
6 Per ERISA guidelines, we communicate to individuals that they may elect not to change their contributions on the paperwork. This ensures we are not directly incentivizing contributions with our treatments.

meant to address present bias as a barrier to saving by providing immediate incentives to perform tasks sooner rather than delaying them. We compare reports on the timing of when individuals' would complete the paperwork required for the change in the two treatments with individuals in the control condition, which provided no monetary incentive.[7] While one could imagine other interventions that may have a greater effect on response, our intent here was to generate a plausible treatment that would also be diagnostic for present bias independent of other factors.

THE EFFECT OF PROJECTION TREATMENTS ON CONTRIBUTION AMOUNT

Figure 4 reports the effect, along with the 95% confidence interval, of the two Projection Treatments, Balance and Income, on the hypothetical retirement contributions after introduction of an employer match. The results are compared to the control group, which had an average annual post-match contribution of $4,790. The results show that the Balance Treatment increased the response to the match by approximately $467 annually; however, the effect is not statistically different from the control group with 95% confidence as the interval plotted on the figure includes zero.[8] In contrast, the Income Treatment increased the response to the match by approximately $685 per year, and this effect is statistically different from the control group. Similar to Goda, Manchester, & Sojourner (2014), we do not find evidence that the effect of the Income Treatment was statistically different from that of the Balance Treatment.

FIGURE 4: EFFECT OF PROJECTIONS TREATMENTS ON CONTRIBUTION RESPONSE TO NEW EMPLOYER MATCH



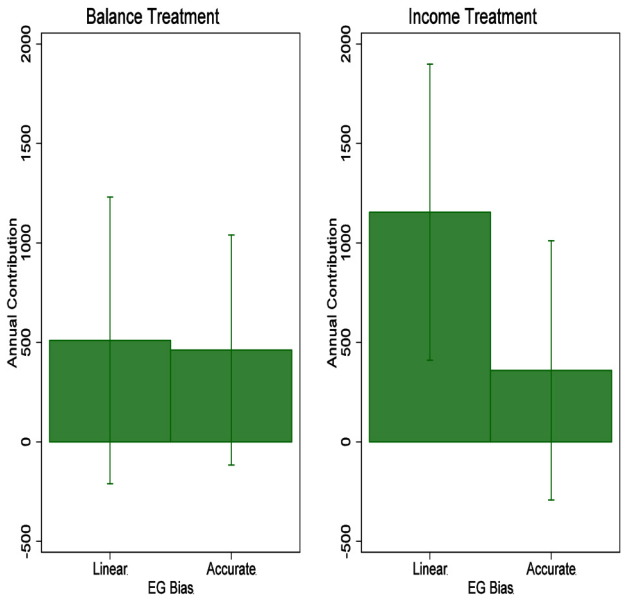
Notes: N=2,317. Height of bars represent the average effect of Balance and Income treatment relative to the control treatment for our sample.

We also look at differences in the effect of the Projections treatments by the level of bias (Figure 5). While the effect of the Balance Treatment (left panel) is not statistically different between those who neglect compound interest (Linear) and those who have accurate understanding (Accurate), we do find evidence that the Income Treatment (right panel) had significantly larger effects among those with the most EG bias (Linear) relative to those who are not biased (Accurate). Finding that individuals with greater bias respond more to this intervention meant to mitigate EG bias provides further support to the conclusion that EG bias affects retirement savings.

7 While one could imagine other interventions that may have a greater effect on response, our intent here was to generate a plausible treatment that would also be diagnostic for present bias independent of other factors.

8 Effect relative to control group is significantly different with 90% confidence.

FIGURE 5: EFFECT OF PROJECTIONS TREATMENTS ON CONTRIBUTION RESPONSE TO NEW EMPLOYER MATCH BY EG BIAS

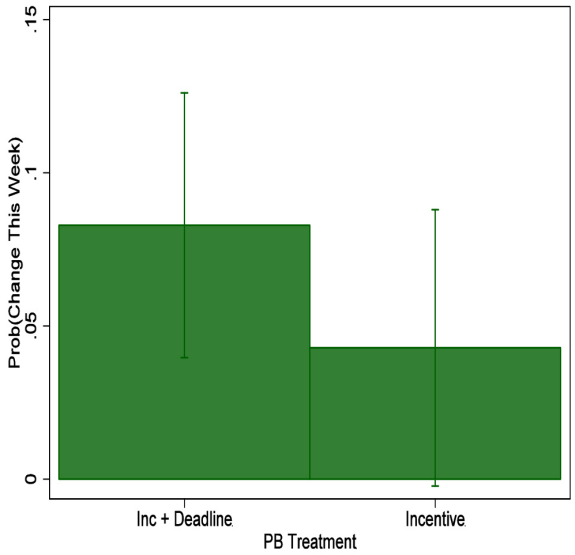


Notes: N=2,317. Height of bars represent the average effect of Balance and Income treatment relative to the control treatment for our sample.

The Effect of Incentive Treatments on Timing

Figure 6 shows the effects of the Incentive Treatments, Incentive and Incentive + Deadline, on the likelihood of completing the required paperwork within one week. Each panel reports the effect of the treatment on the individual's likelihood of indicating they would make a change within the week, along with a 95% confidence interval to assess whether the effect is statistically meaningful. The results are shown relative to the control group, for which 77% indicated they would complete the paperwork within one week. The results indicate that the Incentive Treatment resulted in a 4.3 percentage point increase in the number of individuals who reported they would respond within one week, which is significantly different from the control group with 95% confidence intervals (right bar). The response was larger in the Incentive + Deadline Treatment: individuals in this group were 8.3 percentage points more likely to indicate they would complete the paperwork within one week, which is also statistically different from the control group (left bar).

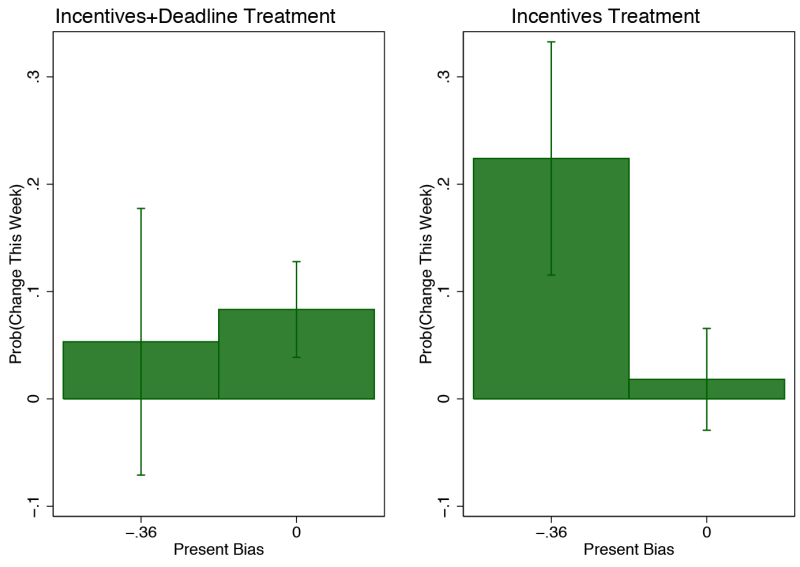
FIGURE 6: EFFECT OF INCENTIVE TREATMENTS ON TIMING RESPONSE TO NEW EMPLOYER MATCH



Notes: N=2,317. Height of bars represent the average effect of Incentive + Deadline and Incentive treatment relative to the control treatment for our sample.

However, when we look at the response to the Incentive Treatments by levels of present bias, we find some expected and some unexpected results. We find evidence that the Incentive Treatment was more effective among individuals who exhibit present bias relative to those who do not (Figure 7, right panel); however, we do not find such pattern among the Incentive + Deadline Treatment despite it being the stronger treatment (Figure 7, left panel). This finding warrants caution when designing interventions aimed at mitigating present bias as providing focal points, such as a one week response may induce behavior otherwise not considered.

FIGURE 7: EFFECT OF INCENTIVE TREATMENTS ON TIMING RESPONSE TO NEW EMPLOYER MATCH BY PRESENT BIAS



Notes: N=2,317. Height of bars represent the average effect of Incentive + Deadline and Incentive treatment relative to the control treatment for our sample.

CONCLUSIONS

This study provides important insights as to the prevalence and influence of cognitive and motivational barriers to retirement savings. In particular, we measure the presence of EG bias and present bias, relate them to retirement savings, and use interventions designed to mitigate these biases to provide further evidence for the relationship.

These biases are pervasive: 90% of the sample demonstrated one or both biases. Our evidence reveals that these biases are distinct in that having one does not increase one's likelihood of having the other. Based on our findings, eliminating both biases would be associated with 12% higher retirement savings; this figure increases to 70% when we correct for error in the ability to measure these biases.

In addition, each bias has an important, and independent, relationship to retirement savings. Findings from our hypothetical scenario suggest that these biases have a causal link to retirement saving behavior. In particular, we find that efforts to target those with EG bias through timely information are effective. These findings suggest that the recently proposed Lifetime Income Disclosure Act (113th Congress, H.R. 2171), which would require plan administers to distribute income disclosures that project the annual income supported by an individual's current savings and contribution rate, may mitigate EG bias to some extent. Alternatively, the findings from our present bias interventions warrant caution in designing incentives to target those with the greatest tendencies for present bias.

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The research reported herein was performed pursuant to grants from TIAA-CREF Institute to the Pension Research Council at the Wharton School, University of Pennsylvania, the Social Security Administration to the NBER, as part of the Retirement Research Consortium, and the National Institute on Aging. Opinions and errors are solely those of the authors and not of the institutions with whom the authors are affiliated.