Are Retirement Planning Tools Substitutes or Complements to Financial Capability?

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Motivation

- Employer-sponsored defined contribution (DC) plans play an increasingly important role in America. 73% participates in DC in 2019 (Munnell and Chen, 2020).
- Determining how much to save is a complex problem in DC plans
- Decision largely falls on the individuals
- Many are not well-equipped to solve such a complex problem
  - Low rate of understanding financial concepts (Lusardi and Mitchell, 2014)
  - Limited financial understanding can lead to the disproportionate reliance of defaults on participation and contribution decisions (Madrian and Shea, 2001; Beshears et al., 2009)
  - Low financial literacy and lack of exponential growth bias (EGB) are associated with lower retirement wealth accumulation among retirement-age individuals(Goda et al., 2019)
  - EGB, present bias, and financial illiteracy as attributes implicated in low retirement savings (Goda et al., 2014; Brown and Previtero, 2014; Goda et al., 2019; Lusardi and Mitchell, 2011a).

Research Question

- Information interventions are sought to improve employee decision making
- Successful intervention will address three key aspects:
    - Who selects into using them
    - How it affects contribution among users
    - How the intervention differentially affects financially more vulnerable populations
- **Research Question:**

    > Are information interventions effective at raising financial decision-making capacity across the board, or do the tools themselves require a sufficient understanding of financial concepts in order to be effective?

Experiment and Preview Results

Experiment among U.S. federal employees

- Randomly assign either a treatment or an active control tool
- Differing in how complete this projected income calculation is
- Our treatment is designed specifically to overcome EGB and present bias

Preview Findings:

- Selection into tool use
  - 48% of the employees select into using the tool
  - The selection is correlated with pre-intervention TSP contributions
- Treatment on the Treated (TOT)
  - The treatment increased average annual retirement contributions by $174 (2.3 percent) among tool users
  - The TOT effect is significantly greater for those with
    - A higher measure of financial literacy,
    - A college degree
    - A higher financial-capability factor.
- No effect for EGB, present bias, pre-intervention contributions, or other factors

Experimental Design and Data

Experiment Setting

- U.S. Office of Personnel Management (OPM) is an agency of the federal government
- The Thrift Savings Plan (TSP) is similar to 401(k)
- Employer makes a base contribution of 1% of pay and matches employee contributions up to 5% of pay
  - Up to the IRS maximum each year, which was $18,000 in 2017
- Employees are also covered by a defined benefit pension.
- Low contribution rate among federal employees
  - Half of federal employees were not contributing enough to TSP to maximize the agency match (OPM, 2015).
  - Full match rate is even lower for recent hires, who are covered by a 3 percent automatic enrollment provision introduced in 2010
- OPM leaders seeking to develop an effective online tool to improve TSP contribution decisions

Intervention

- We designed both a treatment and an active control version of the new online calculator tool
- Both provide employees with both a target retirement income and a projected retirement income
- The active control did not provide any information on how TSP balances and contributions translated into retirement income
- The additional information provided in the treatment removes the need to make exponential computation, therefore isolating the effect of EGB and present bias

Ballpark Savings Estimate
Are you saving enough for retirement?

More Info

Reset Data and
Start Again

Step 1 ▶ Step 2 ▶ Step 3 ▶ Step 4 ▶ Step 5 ▶ Step 6 ▶ View Your Plan ▶ Adjust Your Plan ▶ What to Do Next

Let's get started

What is your date of birth? Month: -- Year: --

When did you start working for the Federal government?
(Service Computation Date) Month: -- Year: --

Current Annual Salary $

Expected Retirement Age 62

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◀ ▶

Ballpark Savings Estimate
Are you saving enough for retirement?

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Reset Data and Start Again

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | View Your Plan | Adjust Your Plan | What to Do Next |

What lifestyle would you like in retirement?

Select your desired lifestyle in retirement. This will set your retirement income goal.

70% of Income

Expect to have **lower spending** in retirement as compared to today.

85% of Income

Expect to have **similar spending** in retirement as compared to today.

100% of Income

Expect to have **higher spending** in retirement as compared to today.

115% of Income

Or enter other amount [85] (%)

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Are you saving enough for retirement?

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Goal: $5,649/month

Here is your Retirement Income Goal

Your monthly retirement income goal is **$5,649** a month, which is 85% of your projected final salary before taxes.

Your projected final salary takes into account the expected increase in salary until retirement, based on a historical average.

Are you on target to meet this goal?

Proceed to the next steps to find out.

All estimates are in today's dollars

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Are you saving enough for retirement?

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What is your Retirement System?

◉ FERS
○ CSRS
○ CSRS Offset

As a Federal employee, you fall into one of three retirement systems: FERS, CSRS, CSRS Offset.
Most people hired after 1984 are in FERS, which represents over 90 percent of Federal employees.

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Are you saving enough for retirement?

More Info

Reset Data and Start Again

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | View Your Plan | Adjust Your Plan | What to Do Next |

What are your current retirement savings?

Federal employees can save additional income for retirement through the Thrift Savings Program (TSP).

Enter Current TSP Account Balance $ 0

Enter Your TSP Contribution ● Percent 0 %
○ Dollar $
Max: $18,500/year or $712/pay period

Annual TSP Catch-up Contribution

Min: 0

Max 6000

$ 0

Enter Additional Retirement Savings Balance $ 0

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Are you saving enough for retirement?

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Reset Data and Start Again

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Do you have other sources of retirement income?

☑ I expect to receive Social Security benefits.

Enter Expected Monthly Social Security Benefits $ 0
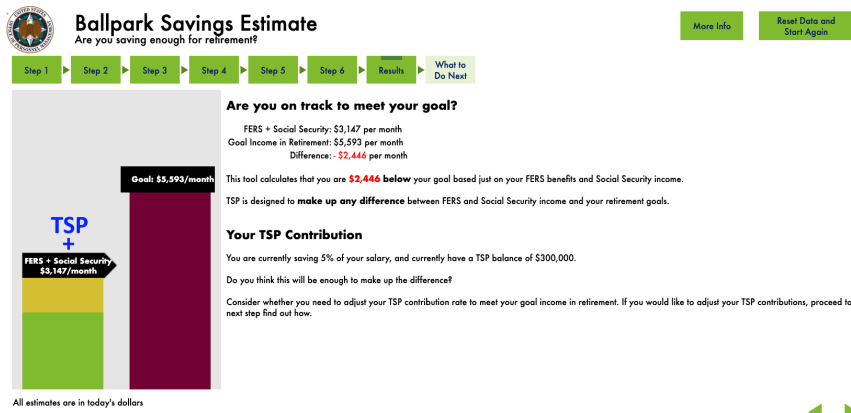
Need help? **Estimate my Social Security benefit**

☐ I expect to work after retirement.

☐ I expect an additional pension.

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Figure 1: Step 7 - Active Control

Ballpark Savings Estimate
Are you saving enough for retirement?

More Info | Reset Data and Start Again

Step 1 ▶ Step 2 ▶ Step 3 ▶ Step 4 ▶ Step 5 ▶ Step 6 ▶ Results ▶ What to Do Next

Are you on track to meet your goal?

FERS + Social Security: $3,147 per month
Goal Income in Retirement: $5,593 per month
Difference: - $2,446 per month

This tool calculates that you are **$2,446 below** your goal based just on your FERS benefits and Social Security income.

TSP is designed to **make up any difference** between FERS and Social Security income and your retirement goals.

Your TSP Contribution

You are currently saving 5% of your salary, and currently have a TSP balance of $300,000.

Do you think this will be enough to make up the difference?

Consider whether you need to adjust your TSP contribution rate to meet your goal income in retirement. If you would like to adjust your TSP contributions, proceed to next step find out how.

Goal: $5,593/month

TSP +

FERS + Social Security $3,147/month

All estimates are in today's dollars

Figure 2: Step 7 - Treatment

Ballpark Savings Estimate
Are you saving enough for retirement?

More Info | Reset Data and Start Again

Step 1 ▸ Step 2 ▸ Step 3 ▸ Step 4 ▸ Step 5 ▸ Step 6 ▸ View Your Plan ▸ Adjust Your Plan ▸ What to Do Next

Are you on track to meet your goal?

Projected Income in Retirement: $6,195 per month
Goal Income in Retirement: $5,593 per month
Difference: $602 per month

This tool calculates that you are **$602 above** your goal.

Proceed to the next step to see how adjusting your plan can get you closer to your goal.

Plan: $6,195/month

Goal: $5,593/month

Ballpark Savings Estimate
Are you saving enough for retirement?

More Info

Reset Data and Start Again

Get closer to your goal by adjusting your plan!

- Adjust plan inputs using the four tabs on the right.
- Move the slider and watch how your Plan and Goal bars adjust.
- When you are happy with your new Plan, proceed to the next step!

Plan: $5,504/month

Goal: $5,649/month

income in retirement.

New contribution 10%

Min: 0

Maximum: 25%

10 %

Current contribution 5%

New TSP Contribution

Retirement Age/ Lifestyle Goals

Other Income Sources

Assumptions

For instructions on **how to make this change,** go to the next page!

What if I delay changing my New TSP Contribution?

No delay

0 Never change

Years

All estimates are in today's dollars

Report Issue

Ballpark Savings Estimate
Are you saving enough for retirement?

More Info

Reset Data and Start Again

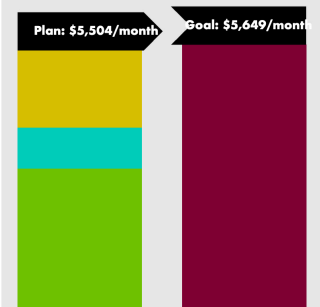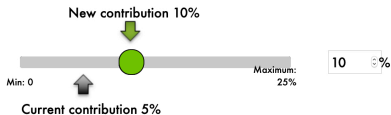Step 1 ▶ Step 2 ▶ Step 3 ▶ Step 4 ▶ Step 5 ▶ Step 6 ▶ View Your Plan ▶ Adjust Your Plan ▶ What to Do Next

Get closer to your goal by adjusting your plan!

- Adjust plan inputs using the four tabs on the right.
- Move the slider and watch how your Plan and Goal bars adjust.
- When you are happy with your new Plan, proceed to the next step!

Plan: $5,504/month

Goal: $5,649/month

Try adjusting your retirement age or lifestyle plans

Retirement Age

Min: 55

62

Max: 75

Retirement Goal

New TSP Contribution

Retirement Age/ Lifestyle Goals

Other Income Sources

Assumptions

All estimates are in today's dollars

Report Issue

Ballpark Savings Estimate
Are you saving enough for retirement?

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- Adjust plan inputs using the four tabs on the right.
- Move the slider and watch how your Plan and Goal bars adjust.
- When you are happy with your new Plan, proceed to the next step!

Plan: $5,504/month

Goal: $5,649/month

Try adjusting your income from other sources

Monthly Social Security - Calculate Social Security

Min: $0 $1,650   Max: $5,000

Post Retirement Yearly Income

Min: $0 $0   Max: $100,000

Years Working Post Retirement

Min: 0   0   Max: 22

New TSP Contribution

Retirement Age/ Lifestyle Goals

Other Income Sources

Assumptions

All estimates are in today's dollars

Report Issue

Ballpark Savings Estimate
Are you saving enough for retirement?

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Get closer to your goal by adjusting your plan!

- Adjust plan inputs using the four tabs on the right.
- Move the slider and watch how your Plan and Goal bars adjust.
- When you are happy with your new Plan, proceed to the next step!

Plan: $5,504/month ▶

Goal: $5,649/month

New TSP Contribution

Retirement Age/ Lifestyle Goals

Other Income Sources

Assumptions

Try adjusting assumptions used to calculate your projected retirement income

Annual Wage Growth Rate

Min: 0%   Max: 6%   3.2 %

Annual Pre-Retirement Investment Return

Min: 0%   Max: 10%   5 %

Annual Post-Retirement Investment Return

Min: 0%   Max: 10%   4 %

The Inflation Rate in the Ballpark Savings Estimate is set at 2.5%

All estimates are in today's dollars

Report Issue

Ballpark Savings Estimate
Are you saving enough for retirement?

More Info

Reset Data and Start Again

Step 1 ▶ Step 2 ▶ Step 3 ▶ Step 4 ▶ Step 5 ▶ Step 6 ▶ View Your Plan ▶ Adjust Your Plan ▶ What to Do Next

Here is a summary of your Current Saving Plan and your proposed New Saving Plan based on using this tool:

Current Saving Plan

Your Current TSP Contribution:	5% per pay period
Projected Income in Retirement:	$5,353 per month
Goal Income in Retirement:	$5,649 per month
Difference:	-$296 per month

This tool calculates that you are $296 below your goal with your Current Saving Plan.

New Saving Plan

|	
Your New TSP Contribution:	10% per pay period
Projected Income in Retirement:	$5,504 per month
Goal Income in Retirement:	$5,649 per month
Difference:	-$145 per month

This tool calculates that you are $145 below your goal with your New Saving Plan.

Print this plan to keep for your records   Print

Change your TSP contribution now! Here's how:

Sign into your agency's electronic payroll system and select the "Thrift Savings Plan" option. You can contribute a percentage of your salary or a

Timeline
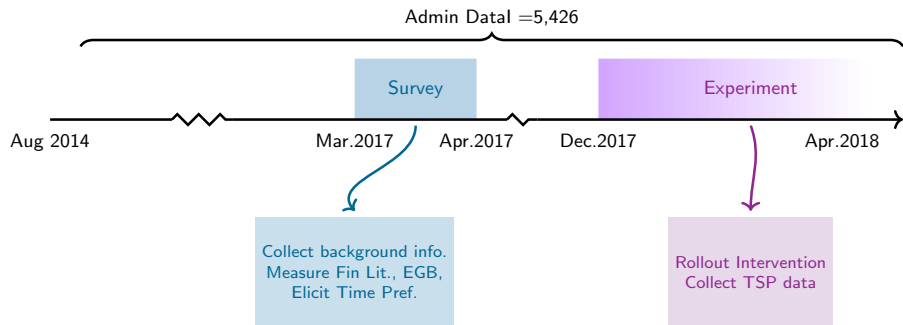
Survey

- Prior to the intervention, we surveyed the employees for background characteristics and elicit behavioral parameters
- 1,435 completed the survey ((26% completion rate)
- Measure financial capabilities, including EGB, financial literacy, and college degree completion.
- Elicit time preferences, including the long-term discount rate and present-biased preferences.

Treatment Assignment

- Rolled out intervention on December 1, 2017
- $I = 5,426$ unique individuals
- Equal probability of accessing either treatment or active control tool
- Stratified based on survey responses
- Within a survey-response group (completers/non-completers), we stratified on total pay, age, TSP total amount, and gender.
- Survey completers were also stratified on their mean response to the EGB elicitation and mean response to the time-preference elicitation.

Random Assignment

Table 1: Descriptive Statistics for ITT and TOT Sample

	Assignment				Tool Use				
	(1) All	(2) Partial	(3) Full	(4) Difference	(5) All Tool User	(6) Non-User	(7) Partial User	(8) Full User	(9) Difference
TSP Amount ($/year)	6274.8	6287.8	6262.0	25.803	7269.9	5382.0	7319.5	7219.2	100.357
	(5721.6)	(5783.8)	(5660.6)	(155.366)	(6037.8)	(5265.6)	(6190.1)	(5880.0)	(238.437)
SD Change in TSP Amount	1.107	1.109	1.105	0.005	1.282	0.949	1.291	1.273	0.018
	(1.009)	(1.020)	(0.998)	(0.027)	(1.065)	(0.929)	(1.092)	(1.037)	(0.042)
Final TSP Rate	6.899	6.899	6.898	0.000	7.852	6.043	7.870	7.833	0.037
	(5.467)	(5.611)	(5.323)	(0.148)	(5.869)	(4.927)	(6.114)	(5.610)	(0.232)
Mean Alpha	0.483	0.472	0.493	-0.021	0.516	0.417	0.480	0.550	-0.069
	(0.826)	(0.813)	(0.838)	(0.042)	(0.836)	(0.802)	(0.792)	(0.875)	(0.053)
Mean Beta	1.007	1.005	1.008	-0.003	1.007	1.006	1.005	1.008	-0.003
	(0.0865)	(0.0854)	(0.0875)	(0.004)	(0.0827)	(0.0935)	(0.0831)	(0.0823)	(0.005)
Std. Financial Literacy	-0.0753	-0.0844	-0.0664	-0.018	-0.0445	-0.138	-0.0400	-0.0487	0.009
	(1.019)	(1.023)	(1.015)	(0.053)	(0.995)	(1.065)	(1.008)	(0.984)	(0.064)
Total Pay (in Thousand)	85.99	86.08	85.90	0.180	88.61	83.64	88.71	88.51	0.195
	(31.62)	(31.74)	(31.50)	(0.859)	(31.77)	(31.30)	(32.48)	(31.04)	(1.255)
Age	45.73	45.80	45.65	0.144	46.72	44.83	46.75	46.69	0.058
	(10.70)	(10.69)	(10.70)	(0.290)	(10.43)	(10.86)	(10.53)	(10.33)	(0.412)
Gender	0.429	0.428	0.429	-0.001	0.443	0.416	0.444	0.441	0.003
	(0.495)	(0.495)	(0.495)	(0.013)	(0.497)	(0.493)	(0.497)	(0.497)	(0.020)
Bachelor or Higher	0.654	0.659	0.649	0.010	0.658	0.651	0.679	0.636	0.043*
	(0.476)	(0.474)	(0.477)	(0.013)	(0.475)	(0.477)	(0.467)	(0.481)	(0.019)
White	0.658	0.653	0.664	-0.011	0.684	0.635	0.688	0.680	0.008
	(0.474)	(0.476)	(0.473)	(0.013)	(0.465)	(0.481)	(0.464)	(0.467)	(0.018)
Observations	5,426	2,696	2,730	5,426	2,566	2,860	1,297	1,269	2,566
Chi-Squared				2.42					2.49
P-Value				0.97					0.96

Data

- Individual by month TSP contribution elections
- Administrative records from Aug 2014 to Apr 2018
- 2,625 (48%) unique employees who used the tool and their 152,198 total individual-by-month observations
- Also constructed survey samples by matching survey responses to the HR records
  - 1,435 unique individuals completed the survey
  - N = 85,974
- Sample Schematics Diagram ▶

Survey Sample

Table 2: Descriptive Statistics by Survey Participation

	(1) All	(2) Survey Non-Completers	(3) Survey Completer	(4) Difference
TSP Amount ($/year)	6274.0	5939.1	7205.4	-1266.219***
	(5724.1)	(5537.6)	(6119.9)	(175.365)
SD Change in TSP Amount	1.107	1.048	1.271	-0.223***
	(1.010)	(0.977)	(1.080)	(0.031)
Final TSP Rate	6.895	6.568	7.801	-1.233***
	(5.465)	(5.268)	(5.885)	(0.167)
Total Pay (in Thousand)	85.99	85.30	87.90	-2.598**
	(31.62)	(31.60)	(31.60)	(0.973)
Age	45.73	45.18	47.24	-2.052***
	(10.70)	(10.65)	(10.69)	(0.328)
Gender	0.429	0.424	0.442	-0.018
	(0.495)	(0.494)	(0.497)	(0.015)
Bachelor or Higher	0.654	0.651	0.663	-0.013
	(0.476)	(0.477)	(0.473)	(0.015)
White	0.658	0.642	0.704	-0.062***
	(0.474)	(0.479)	(0.457)	(0.015)
Observations	5,426	3,991	1,435	5,426
Chi-Sqaured				62.39
P-Value				0.00

Survey Measures - EGB

- EGB is the tendency to neglect compound interest (Stango and Zinman, 2009)
- We hypothesize that people with more EGB may exhibit larger treatment effects because the treatment tool explicitly computing the exponential growth of the user's savings
- We estimated EGB using the parametric model of (Levy and Tasoff, 2016)

$$p(\vec{r}, t; \alpha_i) = \prod_{s=t}^{T-1}(1 + \alpha_i r_s) + \sum_{s=t}^{T-1}(1 - \alpha_i)r_s \qquad (1)$$

- If $\alpha_i = 0$, individual fully compound interest
- if $\alpha_i = 1$, individual correctly perceives growth to be exponential
- Values of $\alpha_i \in (0, 1)$ generate perceptions between linear and exponential growth.
- Values $\alpha_i > 1$ reflect an overestimation of the returns to compounding.

Survey Measures - EGB

- We ask three hypothetical investment questions in our survey for the value of an asset after a certain amount of time.
- For example: "An asset has an initial value of $100 and grows at an interest rate of 10 percent each period. What is the value of the asset after 20 periods?"
- EGB is measured by minimizing the distance between the response and the correct answer informed by Equation (1) similarly to Godaetal:2019
- Between 29 and 33 percent of survey participants answered the questions within 10 percent of the correct value as compared to 23 to 31 percent in a representative U.S. sample (Goda et al., 2019)

Survey Measures - Time Preference

- We hypothesize that present-biased individuals are more likely to have gaps between their ideal and actual savings rates due to procrastination.
- Displaying the gap may be a cue that inspires them to make a change.
- Used "time-staircase" procedure developed by (Falk et al., 2016) to construct a simple measure of present bias("Beta'), as well as the long-run discount factor ("Delta")
- Staircases have these forms:

Present-Future Staircase: Would you rather receive \$100 today or \$[X] in 12 months?

Future-Future Staircase: Would you rather receive \$120 in 12 months or \$[Y] in 24 months?

Survey Measures - Time Preference

- Subjects begin with a common value of [X] or [Y]. If a subject indicates they prefer the money sooner (later), then the second dollar amount increases (decreases) on the next question.
- For each staircase, subjects answer five questions, gradually narrowing the interval that contains the indifference point.
- Participants were asked these questions for a 12-month (as shown above) and a 6-month time interval, for a total of four sets.
- We randomize the order of the staircases and use different base values for the different sets of questions to minimize the influence of mechanical responses
- From these staircases we construct measures of Beta and Delta from the implied indifference point.

Survey Measures - Financial Literacy

- We hypothesize that employees with low financial literacy would have bigger gaps between their ideal and actual savings rate
- The intervention will have larger treatment effects on those with low financial literacy if the savings tool serves as a substitute for financial capability.
- We measure basic financial literacy using the five-item battery of financial literacy questions (Lusardi and Mitchell, 2011b, 2014)
- These questions measure understanding of inflation, diversification, compound interest, mortgage payments, and bond prices using multiple choice questions.
- In our subsequent analysis, we use a z-score of financial literacy standardized within the sample.
- OPM employees performed well relative to the U.S. population
    - 39-95 percent correct, compared to 21 and 70 percent for a representative sample of the U.S. population (Lusardi and Mitchell, 2011b).
    - 30 percent of OPM employees answered all five questions correctly, relative to 10 percent to the U.S. population

Factor Analysis

- Aim to reduce the dimensionality of the heterogeneity using Principal Component Analysis
- Retained factors with the eigenvalue greater than 1 ▶ Parallel Analysis
- Examine the factor loads to give meaning to the latent factors

Table 3: Factor Loading Matrix

Variable	Factor1 Demographics	Factor2 Seniority	Factor3 Financial Capability	Factor4 Time Preference	Factor5 Big Daddy	Factor6 Hispanic Factor	Uniqueness
Age	-0.0753	0.6838	0.0146	0.0648	-0.2091	-0.07	0.4738
Male	0.2269	-0.0046	0.3806	0.046	0.5064	0.0223	0.5446
Years of Schooling	-0.0993	-0.1911	0.7269	-0.0084	-0.1586	0.1145	0.3869
Race = White	0.925	-0.0198	-0.0022	0.0105	-0.0082	-0.2718	0.0699
Race = Hispanic	-0.0756	-0.0451	0.024	0.0178	-0.025	0.9097	0.1632
Race = Black	-0.9478	0.0585	-0.0297	-0.0367	-0.0067	-0.1584	0.071
Household Size	-0.0492	-0.0578	-0.0828	-0.0419	0.8686	-0.0349	0.2299
Tenure(in years)	-0.0802	0.8116	-0.131	0.0262	0.063	-0.0457	0.311
Is Supervisor	0.0577	0.4178	0.3047	-0.0493	0.2453	0.2889	0.5832
Tenure Description = Permanent	-0.0107	0.6444	-0.02	-0.0151	-0.0988	-0.012	0.5741
Std. Alpha	0.0448	0.1002	0.349	-0.0211	0.0972	-0.3106	0.7598
Std. Beta	0.0349	-0.0148	-0.0841	0.8349	-0.074	-0.0388	0.2875
Beta-Delta	0.0313	0.0673	0.1772	0.7921	0.0388	0.0725	0.3289
Financial Literacy	0.1299	0.0207	0.7042	0.1154	0.0648	-0.0656	0.4649
Eigenvalue	2.07686	1.75206	1.50360	1.31937	1.05755	1.04191	

Results

Selection into Tool Use

Table 4: Selection into TOT Sample

	Logit		
	(1) Tool Participation	(2) Tool Participation	(3) Tool Participation
Tool Participation			
Mean Alpha	0.111 (0.071)	0.107 (0.072)	0.085 (0.073)
Mean Beta	0.393 (0.683)	0.368 (0.699)	0.233 (0.697)
Std. Financial Literacy	0.078 (0.056)	0.044 (0.061)	-0.009 (0.063)
Age		-0.001 (0.006)	-0.009 (0.006)
Male		-0.031 (0.121)	-0.059 (0.125)
White		0.018 (0.292)	0.215 (0.307)
Hispanic		-0.323 (0.390)	-0.171 (0.408)
Black		-0.240 (0.312)	-0.015 (0.325)
Some College or Associate		0.282 (0.198)	0.191 (0.202)
Bachelor		0.240 (0.168)	0.008 (0.177)
Post-Bachelor		0.186 (0.182)	-0.108 (0.202)
Household Size		0.041 (0.045)	0.037 (0.045)
Total Pay			0.003 (0.003)
Tenure in Years			-0.006 (0.009)
Team Leader			0.222 (0.368)
Supervisor or Manager			0.415* (0.247)
Conditional - Tenure Group 2			0.577 (0.494)
Permanent - Tenure Group 1			0.657 (0.454)
Part-Time			0.845 (0.882)
TSP Amount Pre-Rollout ($1,000/year)			0.048*** (0.013)
Constant	0.252 (0.690)	0.096 (0.849)	-0.575 (1.007)

Treatment on the Treated

Table 5: Average Effects and Heterogeneous Effects by Single Dimensions of Heterogeneity (TOT)

	TOT Main		TOT Heterogeneity				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Overall Sample	Survey Sample	Std. Alpha	Std. Beta	Std. Financial Literacy	TSP Amount per year pre Rollout	Bachelor or Higher
Post × Full Tool	174.184**	120.979	114.466	118.969	132.774	308.069*	-210.650
	(75.621)	(129.646)	(129.537)	(129.367)	(129.607)	(174.319)	(195.251)
Post × Attribute			-63.461	120.159	-166.267	0.073***	-179.543
			(84.566)	(108.571)	(102.292)	(0.018)	(201.044)
Post × Full Tool × Attribute			122.769	-152.713	328.038**	-0.022	496.098*
			(106.152)	(131.581)	(130.793)	(0.024)	(257.274)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	7078.012	7577.489	7577.489	7577.489	7577.489	7577.489	7577.489
Permutation P Value	0.001	0.335					
R-squared	0.089	0.089	0.089	0.089	0.090	0.096	0.090
Observations	151,732	57,744	57,744	57,744	57,744	57,744	57,744

Table 6: Heterogeneous Effects by Factors (TOT)

	(1) TSP Amount ($/year)	(2) TSP Amount ($/year)	(3) TSP Amount ($/year)	(4) TSP Amount ($/year)	(5) TSP Amount ($/year)	(6) TSP Amount ($/year)	(7) TSP Amount ($/year)
Post × Full Tool	141.889 (130.840)	75.229 (130.527)	151.798 (131.326)	137.219 (130.473)	173.534 (135.362)	133.807 (131.544)	25.538 (134.771)
Post × Demographics	-105.760 (95.464)						-107.469 (96.001)
Post × Full Tool × Demographics	149.497 (128.685)						157.211 (126.854)
Post × Seniority		-293.914*** (99.988)					-288.275*** (99.769)
Post × Full Tool × Seniority		-38.885 (137.083)					-67.622 (133.333)
Post × Financial Capability			-126.354 (97.740)				-113.895 (96.591)
Post × Full Tool × Financial Capability			411.633*** (132.631)				364.711*** (128.438)
Post × Time Preference				164.910 (109.860)			176.523 (109.173)
Post × Full Tool × Time Preference				-180.815 (133.436)			-180.677 (132.239)
Post × Big Daddy					46.222 (104.020)		57.651 (102.362)
Post × Full Tool × Big Daddy					-101.637 (128.338)		-113.733 (125.478)
Post × Hispanic Factor						-81.289 (93.459)	-78.221 (84.823)
Post × Full Tool × Hispanic Factor						89.919 (108.988)	56.255 (103.873)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	7579.859	7579.859	7579.859	7579.859	7579.859	7579.859	7579.859
F-Statistic	1.350	0.080	9.632	1.836	0.627	0.681	
P-Value	0.246	0.777	0.002	0.176	0.429	0.410	
R-squared	0.089	0.094	0.093	0.092	0.092	0.092	0.107
Observations	56,131	56,131	56,131	56,131	56,131	56,131	56,131

Discussion

- Selection into tool use favors those who save more, and who are therefore less likely to need a TSP saving correction
- We do not find evidence that either of EGB or present bias were correlated with the treatment effect
- The complementarity between the treatment and Financial Capability implies that interventions like this one may be ineffective at helping employees who are most vulnerable.
- We speculate that a certain degree of Financial Capability is necessary to effectively use the online tool
- Online tools may require better automation that leads to fewer steps, less reliance on financial language, and less need for employee self-knowledge.
- It is also possible that more expensive forms of intervention, such as one-on-one sessions, may be necessary to help those with lower financial capability

Conclusion

- We conducted an RCT inviting federal employees to use the retirement saving calculator tool
- Selection into the tool favored those who already had higher TSP contributions.
- Participants who received projections of their retirement income from their DC plan saved $174 more annually than those who did not.
- The treatment effect was larger for the financially literate and those who were more "Financial Capable," a factor generated by our factor analysis.
- This complementarity between the tool and financial capability suggests that similar tools are less likely to help those who are relatively uninformed, less educated, and less financially literate.

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Additional Results

Select Into Survey Sample

Table 7: Selection into Survey Sample

	Logit	
	(1) In Survey Sample	(2) In Survey Sample
In Survey Sample		
Age	-0.003***	0.001
	(0.001)	(0.001)
Male	0.355***	0.356***
	(0.017)	(0.017)
White	0.351***	0.359***
	(0.037)	(0.037)
Hispanic	-0.106**	-0.077
	(0.048)	(0.049)
Black	0.202***	0.254***
	(0.039)	(0.040)
Some College or Associate	0.503***	0.492***
	(0.028)	(0.029)
Bachelor	0.105***	0.103***
	(0.021)	(0.023)
Post-Bachelor	0.315***	0.300***
	(0.024)	(0.027)
Household Size	0.054***	0.061***
	(0.006)	(0.007)
Total Pay		-0.002***
		(0.000)
Tenure in Years		-0.019***
		(0.001)
Team Leader		0.133***
		(0.047)
Supervisor or Manager		-0.001
		(0.031)
Conditional - Tenure Group 2		-0.459***
		(0.069)
Permanent - Tenure Group 1		-0.104*
		(0.063)
Part-Time		1.421***
		(0.186)
Full-Time		1.572***
		(0.169)
Constant	0.807***	-0.490***
	(0.059)	(0.188)

ITT on TSP Amount

Table 8: Effect of the Treatment (ITT) on TSP Amount

	ITT Main		ITT Heterogeneity				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Overall Sample	Survey Sample	Std. Alpha	Std. Beta	Std. Financial Literacy	TSP Amount per year pre Rollout	Bachelor or Higher
Post × Full Tool	61.055	134.103	131.192	134.080	151.680	285.584**	-89.439
	(48.990)	(100.994)	(100.774)	(100.901)	(101.817)	(135.674)	(148.638)
Post × Attribute			41.775	30.028	-125.891*	0.081***	
			(74.787)	(73.575)	(75.388)	(0.014)	
Post × Full Tool × Attribute			80.896	21.494	238.383**	-0.021	
			(92.855)	(92.759)	(99.264)	(0.020)	
Post × Attribute=1							-90.545
							(147.613)
Post × Attribute=1 × Full Tool							337.035*
							(198.862)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	6188.494	7016.741	7016.741	7016.741	7016.741	7016.741	7016.741
F-Statistic			0.759	0.054	5.767	1.089	2.872
P-Value			0.384	0.817	0.016	0.297	0.090
R-squared	0.069	0.072	0.073	0.072	0.073	0.081	0.073
Observations	318,873	85,974	85,974	85,974	85,974	85,974	85,974

TOT on SD Change in TSP Amount

Table 9: Effect of the Treatment (TOT) on SD Change in TSP Amount

| | TOT Main | | TOT Heterogeneity | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
	Overall Sample	Survey Sample	Std. Alpha	Std. Beta	Std. Financial Literacy	TSP Amount per year pre Rollout	Bachelor or Higher
Post × Full Tool	0.031**	0.021	0.020	0.021	0.023	0.054*	-0.037
	(0.013)	(0.023)	(0.023)	(0.023)	(0.023)	(0.031)	(0.034)
Post × Attribute			-0.011	0.021	-0.029	0.000***	-0.032
			(0.015)	(0.019)	(0.018)	(0.000)	(0.035)
Post × Full Tool × Attribute			0.022	-0.027	0.058**	-0.000	0.088*
			(0.019)	(0.023)	(0.023)	(0.000)	(0.045)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	1.248533	1.336639	1.336639	1.336639	1.336639	1.336639	1.336639
Permutation P Value	0.000	0.348					
R-squared	0.089	0.089	0.089	0.089	0.090	0.096	0.090
Observations	151,732	57,744	57,744	57,744	57,744	57,744	57,744

Table 10: Heterogeneous Effects by Factors (TOT) on SD Change in TSP Amount

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	SD Change in TSP Amount	SD Change in TSP Amount	SD Change in TSP Amount	SD Change in TSP Amount	SD Change in TSP Amount	SD Change in TSP Amount	SD Change in TSP Amount
Post × Full Tool	0.025 (0.023)	0.013 (0.023)	0.027 (0.023)	0.024 (0.023)	0.031 (0.024)	0.024 (0.023)	0.005 (0.024)
Post × Demographics	-0.019 (0.017)						-0.019 (0.017)
Post × Full Tool × Demographics	0.026 (0.023)						0.028 (0.022)
Post × Seniority		-0.052*** (0.018)					-0.051*** (0.018)
Post × Full Tool × Seniority		-0.007 (0.024)					-0.012 (0.024)
Post × Financial Capability			-0.022 (0.017)				-0.020 (0.017)
Post × Full Tool × Financial Capability			0.073*** (0.023)				0.064*** (0.023)
Post × Time Preference				0.029 (0.019)			0.031 (0.019)
Post × Full Tool × Time Preference				-0.032 (0.024)			-0.032 (0.023)
Post × Big Daddy					0.008 (0.018)		0.010 (0.018)
Post × Full Tool × Big Daddy					-0.018 (0.023)		-0.020 (0.022)
Post × Hispanic Factor						-0.014 (0.016)	-0.014 (0.015)
Post × Full Tool × Hispanic Factor						0.016 (0.019)	0.010 (0.018)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	1.337	1.337	1.337	1.337	1.337	1.337	1.337
F-Statistic	1.350	0.080	9.632	1.836	0.627	0.681	
P-Value	0.246	0.777	0.002	0.176	0.429	0.410	
R-squared	0.089	0.094	0.093	0.092	0.092	0.092	0.107
Observations	56,131	56,131	56,131	56,131	56,131	56,131	56,131

Table 11: Effect of the Treatment (ITT) on SD Change in TSP Amount

| | ITT Main | | ITT Heterogeneity | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
	Overall Sample	Survey Sample	Std. Alpha	Std. Beta	Std. Financial Literacy	TSP Amount per year pre Rollout	Bachelor or Higher
Post × Full Tool	0.011	0.024	0.023	0.024	0.027	0.050**	-0.016
	(0.009)	(0.018)	(0.018)	(0.018)	(0.018)	(0.024)	(0.026)
Post × Attribute			0.007	0.005	-0.022*	0.000***	
			(0.013)	(0.013)	(0.013)	(0.000)	
Post × Full Tool × Attribute			0.014	0.004	0.042**	-0.000	
			(0.016)	(0.016)	(0.018)	(0.000)	
Post × Attribute=1							-0.016
							(0.026)
Post × Attribute=1 × Full Tool							0.059*
							(0.035)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	1.092	1.238	1.238	1.238	1.238	1.238	1.238
F-Statistic			0.759	0.054	5.767	1.089	2.872
P-Value			0.384	0.817	0.016	0.297	0.090
R-squared	0.069	0.072	0.073	0.072	0.073	0.081	0.073
Observations	318,873	85,974	85,974	85,974	85,974	85,974	85,974

Table 12: Effect of the Treatment (TOT) on TSP Rate

	TOT Main		TOT Heterogeneity				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Overall Sample	Survey Sample	Std. Alpha	Std. Beta	Std. Financial Literacy	TSP Amount per year pre Rollout	Bachelor or Higher
Post × Full Tool	0.145	0.119	0.112	0.116	0.130	0.453*	-0.372
	(0.088)	(0.162)	(0.163)	(0.163)	(0.162)	(0.233)	(0.289)
Post × Attribute			-0.061	0.130	-0.325**	0.000**	-0.667**
			(0.106)	(0.157)	(0.136)	(0.000)	(0.291)
Post × Full Tool × Attribute			0.125	-0.175	0.412**	-0.000	0.727**
			(0.128)	(0.175)	(0.171)	(0.000)	(0.349)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	7.687612	8.166443	8.166443	8.166443	8.166443	8.166443	8.166443
Permutation P Value	0.051	0.452					
R-squared	0.023	0.024	0.024	0.024	0.025	0.026	0.025
Observations	151,732	57,744	57,744	57,744	57,744	57,744	57,744

TOT by Factor on TSP Rate

Table 13: Heterogeneous Effects by Factors (TOT) on TSP Rate

	(1) Final TSP Rate	(2) Final TSP Rate	(3) Final TSP Rate	(4) Final TSP Rate	(5) Final TSP Rate	(6) Final TSP Rate	(7) Final TSP Rate
Post × Full Tool	0.148 (0.164)	0.010 (0.167)	0.136 (0.167)	0.133 (0.164)	0.166 (0.166)	0.145 (0.165)	-0.070 (0.181)
Post × Demographics	-0.075 (0.102)						-0.079 (0.100)
Post × Full Tool × Demographics	0.147 (0.142)						0.163 (0.141)
Post × Seniority		-0.456*** (0.149)					-0.428*** (0.146)
Post × Full Tool × Seniority		0.078 (0.190)					0.025 (0.186)
Post × Financial Capability			-0.375** (0.148)				-0.357** (0.145)
Post × Full Tool × Financial Capability			0.517*** (0.187)				0.465** (0.180)
Post × Time Preference				0.178 (0.151)			0.203 (0.151)
Post × Full Tool × Time Preference				-0.183 (0.171)			-0.202 (0.172)
Post × Big Daddy					0.153 (0.119)		0.152 (0.114)
Post × Full Tool × Big Daddy					-0.200 (0.147)		-0.190 (0.142)
Post × Hispanic Factor						-0.097 (0.096)	-0.083 (0.084)

Table 14: Effect of the Treatment (ITT) on TSP Rate

	ITT Main		ITT Heterogeneity				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Overall Sample	Survey Sample	Std. Alpha	Std. Beta	Std. Financial Literacy	TSP Amount per year pre Rollout	Bachelor or Higher
Post × Full Tool	0.033	0.103	0.101	0.103	0.126	0.402**	-0.238
	(0.055)	(0.122)	(0.122)	(0.123)	(0.122)	(0.173)	(0.206)
Post × Attribute			0.051	0.037	-0.266***	0.000***	
			(0.089)	(0.104)	(0.098)	(0.000)	
Post × Full Tool × Attribute			0.073	0.018	0.319***	-0.000	
			(0.108)	(0.120)	(0.123)	(0.000)	
Post × Attribute=1							-0.499**
							(0.203)
Post × Attribute=1 × Full Tool							0.515**
							(0.256)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean DV	6.848	7.707	7.707	7.707	7.707	7.707	7.707
F-Statistic			0.454	0.023	6.723	2.399	4.055
P-Value			0.501	0.879	0.010	0.122	0.044
R-squared	0.014	0.016	0.016	0.016	0.017	0.019	0.017
Observations	318,873	85,974	85,974	85,974	85,974	85,974	85,974

Sample Schematics

All Admin Data
I = 5,426
N = 316,036

Survey Completer
I = 1,435
N = 85,974

Survey Non-Completer
I = 3,991
N = 230,062

Tool Assignment

Tool Assignment

Active Control
I = 708
N = 42,100

Treatment
I = 727
N = 43,874

Active Control
I = 1,988
N = 114,017

Treatment
I = 2,003
N = 116,045

Tool Use

Tool Use

Tool Use

Tool Use

YES

NO

YES

NO

YES

NO

YES

NO

I = 463
N = 27,865

I = 245
N = 14,235

I = 494
N = 29,879

I = 233
N = 13,995

I = 834
N = 48,287

I = 1,154
N = 65,730

I = 775
N = 45,701

I = 1,228
N = 70,344

Distribution of Coefficients from Randomization Inference
High Std. Alpha Sample
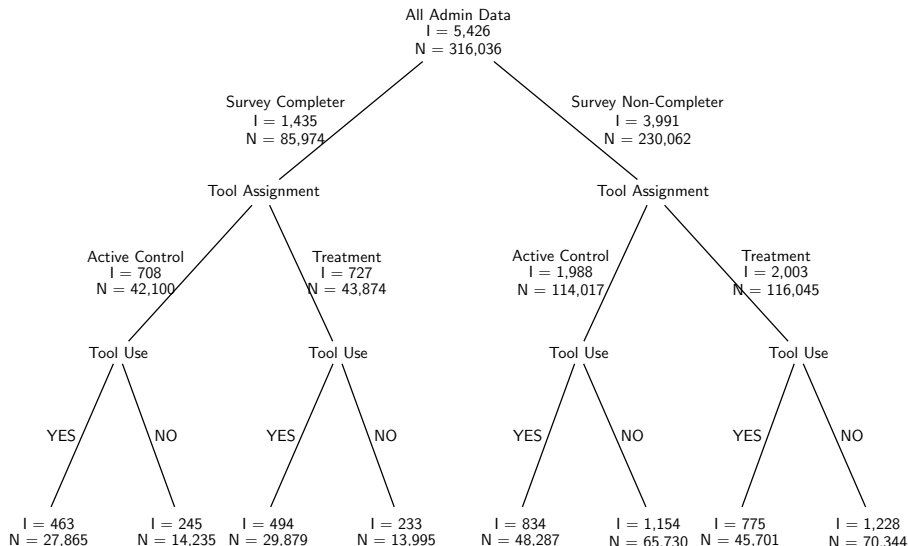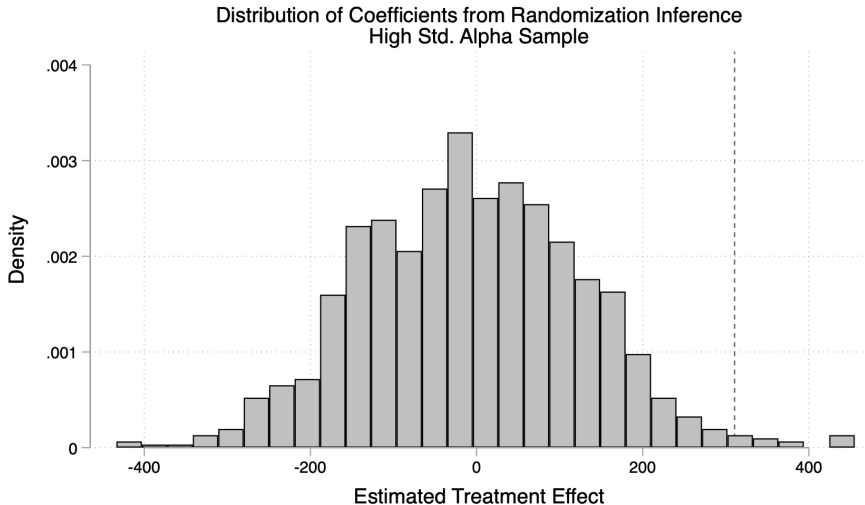
Randomization Inference of TOT for High Std. Alpha Sample.
DV: TSP Amount ($/year); True Effect: 310.54

Distribution of Coefficients from Randomization Inference
Low Std. Alpha Sample

Randomization Inference of TOT for Low Std. Alpha Sample.
DV: TSP Amount ($/year); True Effect: -38.69

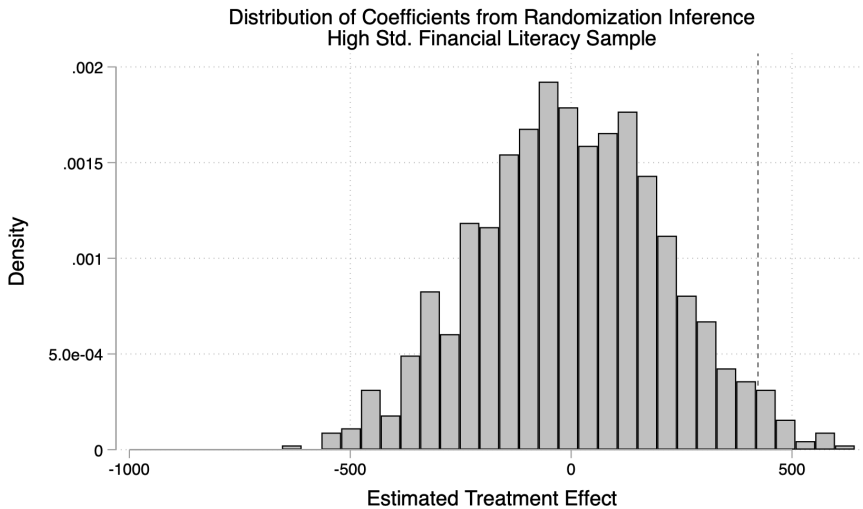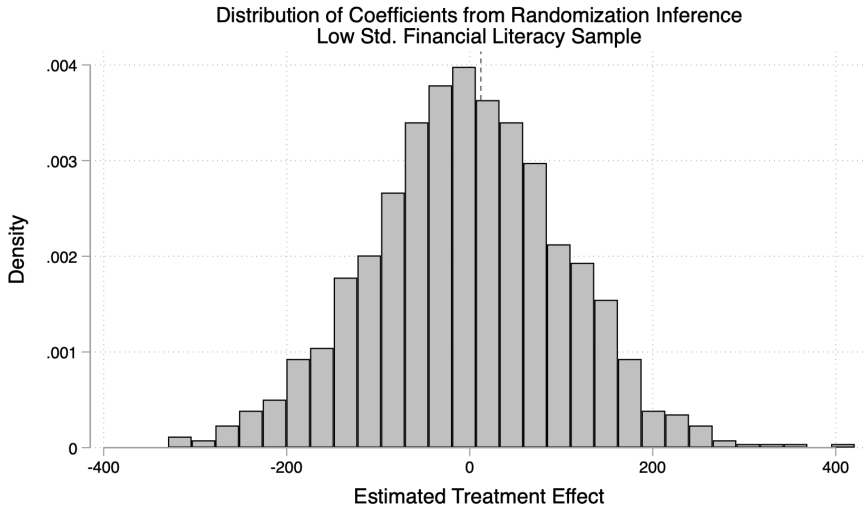**Figure 5:** Randomization Inference Histogram of TOT effect on TSP Amount for High Std. Beta Sample

Distribution of Coefficients from Randomization Inference
High Std. Beta Sample
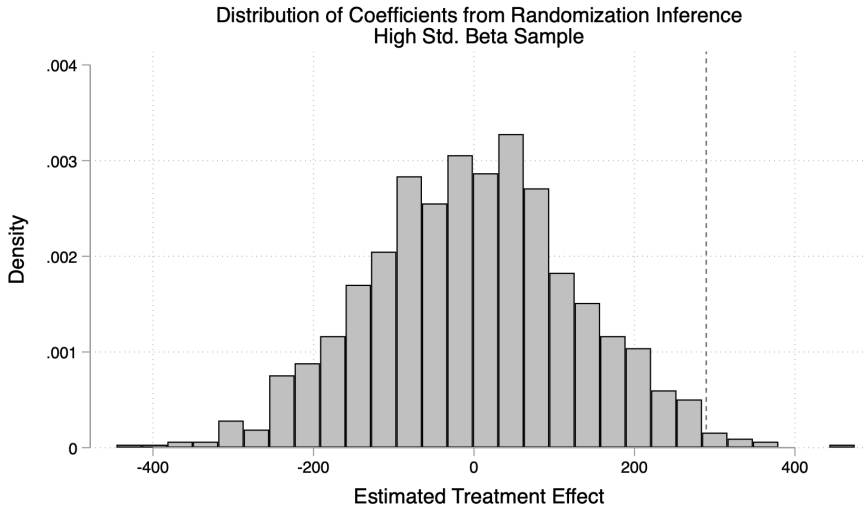
Randomization Inference of TOT for High Std. Beta Sample.
DV: TSP Amount ($/year); True Effect: 289.47

Distribution of Coefficients from Randomization Inference
Low Std. Beta Sample
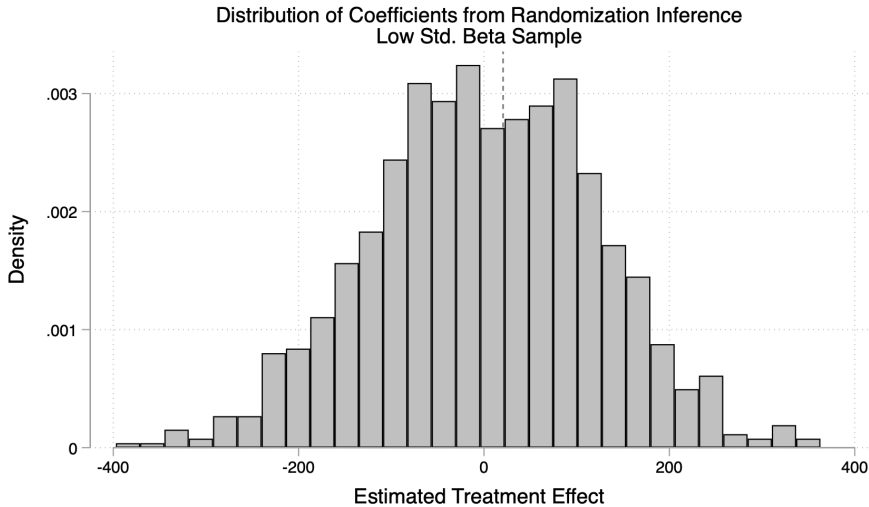
Randomization Inference of TOT for Low Std. Beta Sample.
DV: TSP Amount ($/year); True Effect: 20.59

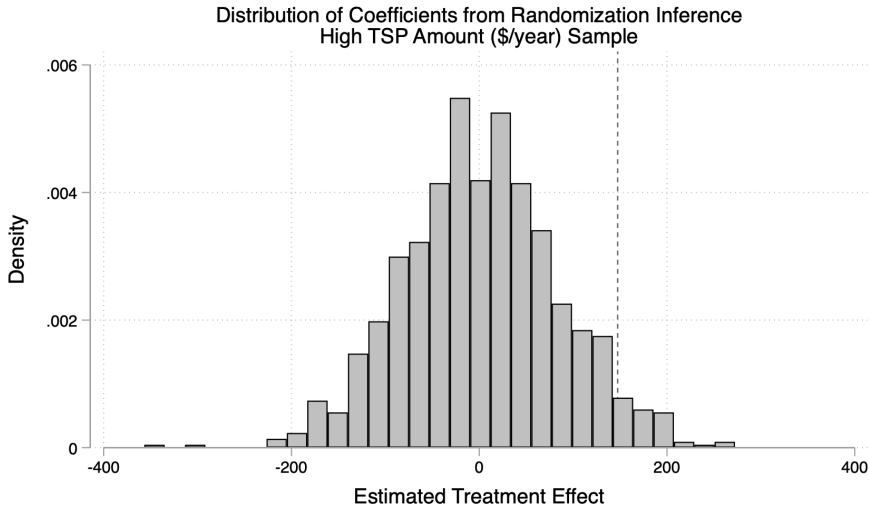Figure 7: Randomization Inference Histogram of TOT effect on TSP Amount for High Financial Literacy Sample

Distribution of Coefficients from Randomization Inference
High Std. Financial Literacy Sample

Randomization Inference of TOT for High Std. Financial Literacy Sample.
DV: TSP Amount ($/year); True Effect: 422.98

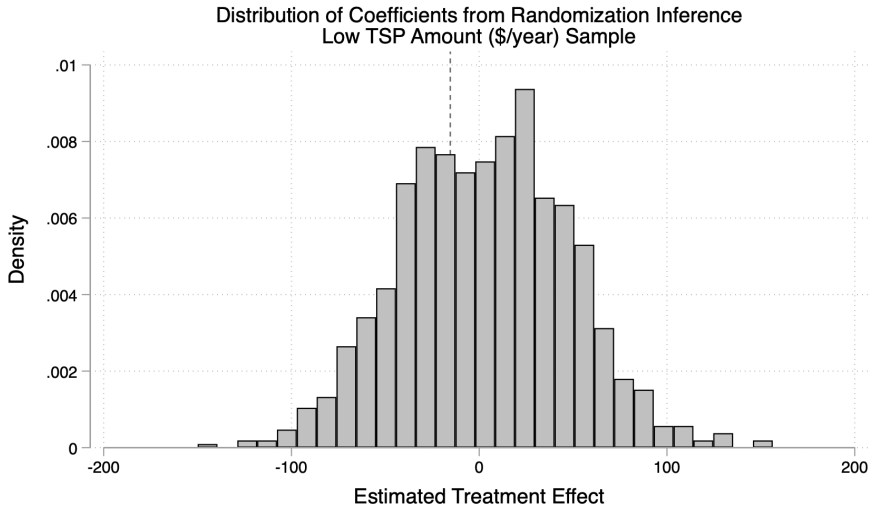Figure 8: Randomization Inference Histogram of TOT effect on TSP Amount for Low Financial Literacy Sample

Distribution of Coefficients from Randomization Inference
Low Std. Financial Literacy Sample

Randomization Inference of TOT for Low Std. Financial Literacy Sample.
DV: TSP Amount ($/year); True Effect: 12.15

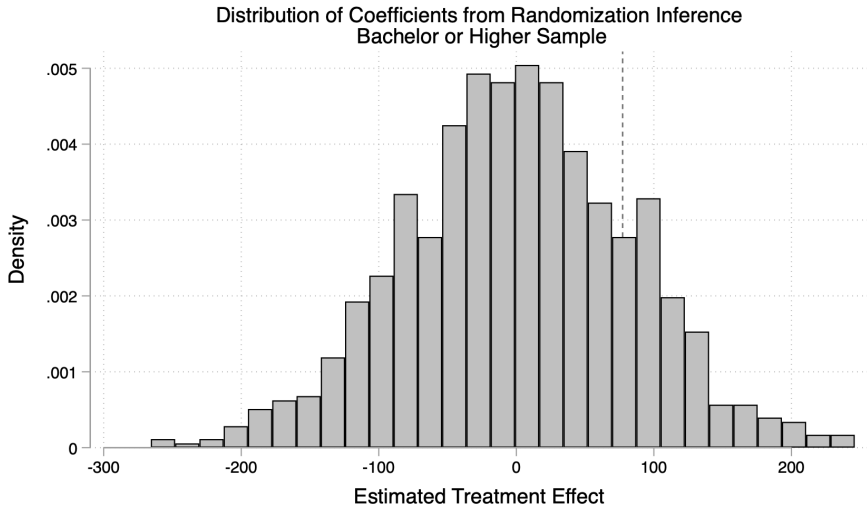Figure 9: Randomization Inference Histogram of TOT effect on TSP Amount for High TSP Amount Pre Rollout Sample

Distribution of Coefficients from Randomization Inference
High TSP Amount ($/year) Sample

Randomization Inference of TOT for High TSP Amount ($/year) Sample.
DV: TSP Amount ($/year); True Effect: 147.44

Figure 10: Randomization Inference Histogram of TOT effect on TSP Amount for Low TSP Amount Pre Rollout Sample

Randomization Inference of TOT for Low TSP Amount ($/year) Sample.
DV: TSP Amount ($/year); True Effect: -15.4

Figure 11: Randomization Inference Histogram of TOT effect on TSP Amount for High Education Sample

Distribution of Coefficients from Randomization Inference
Bachelor or Higher Sample

Randomization Inference of TOT for Bachelor or Higher Sample.
DV: TSP Amount ($/year); True Effect: 77.29000000000001

Figure 12: Randomization Inference Histogram of TOT effect on TSP Amount for Low Education Sample

Distribution of Coefficients from Randomization Inference
Less than Bachelor Sample
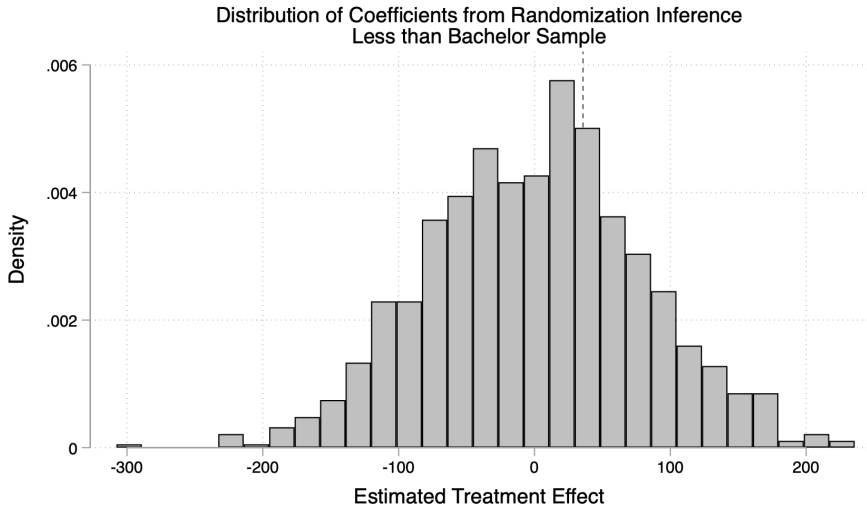
Randomization Inference of TOT for Less than Bachelor Sample.
DV: TSP Amount ($/year); True Effect: 35.76

TOT Effects by Assumptions: TSP Amount

Table 15: Heterogeneous Effects by Assumptions (TOT) on TSP Amount

	(1) TSP Amount ($/year)	(2) TSP Amount ($/year)	(3) TSP Amount ($/year)	(4) TSP Amount ($/year)	(5) TSP Amount ($/year)
Post × LR-HL Full Tool	287.964** (131.179)				
Post × HR-HL Full Tool	3.149 (104.879)				
Post × LR-LL Full Tool	211.459* (118.889)				
Post × HR-LL Full Tool	211.512 (129.502)				
Post × LR-HL Partial Tool		50.926 (105.181)			
Post × LR-HL Full Tool		314.025** (142.692)			
Post × HR-HL Full Tool		29.210 (118.974)			
Post × LR-LL Full Tool		237.520* (131.488)			
Post × HR-LL Full Tool		237.573* (141.156)			
Post × Full Tool			248.594*** (95.801)	211.489** (95.195)	280.937*** (107.046)
Post × Full Tool × High Return			-147.862 (108.815)		-144.777 (109.623)
Post × Full Tool × High Lifestyle				-73.336 (108.891)	-66.632 (109.658)
Year F.E.	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes
Omitted	All Partial	LR-LL Partial	All Partial	LL Partial	LR-LL Partial
Assumptions Type	Separating	Separating	Pooling	Pooling	Pooling
Mean DV	7078.012	7078.012	7078.012	7078.012	7078.012
R-squared	0.090	0.090	0.089	0.089	0.090
Observations	151,732	151,732	151,732	151,732	151,732

Table 16: Heterogeneous Effects by Assumptions (TOT) on SD change in TSP Amount

	(1) SD Change in TSP Amount	(2) SD Change in TSP Amount	(3) SD Change in TSP Amount	(4) SD Change in TSP Amount	(5) SD Change in TSP Amount
Post × LR-HL Full Tool	0.051** (0.023)				
Post × HR-HL Full Tool	0.001 (0.019)				
Post × LR-LL Full Tool	0.037* (0.021)				
Post × HR-LL Full Tool	0.037 (0.023)				
Post × LR-HL Partial Tool		0.009 (0.019)			
Post × LR-HL Full Tool		0.055** (0.025)			
Post × HR-HL Full Tool		0.005 (0.021)			
Post × LR-LL Full Tool		0.042* (0.023)			
Post × HR-LL Full Tool		0.042* (0.025)			
Post × Full Tool			0.044*** (0.017)	0.037** (0.017)	0.050*** (0.019)
Post × Full Tool × High Return			-0.026 (0.019)		-0.026 (0.019)
Post × Full Tool × High Lifestyle				-0.013 (0.019)	-0.012 (0.019)
Year F.E.	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	Yes	Yes	Yes
Individual F.E.	Yes	Yes	Yes	Yes	Yes
Omitted	All Partial	LR-LL Partial	All Partial	LL Partial	LR-LL Partial
Assumptions Type	Separating	Separating	Pooling	Pooling	Pooling
Mean DV	1.249	1.249	1.249	1.249	1.249
R-squared	0.090	0.090	0.089	0.089	0.090
Observations	151,732	151,732	151,732	151,732	151,732

TOT by Assumptions: TSP Rate

Table 17: Heterogeneous Effects by Assumptions (TOT) on TSP Rate

	(1) Final TSP Rate	(2) Final TSP Rate	(3) Final TSP Rate	(4) Final TSP Rate	(5) Final TSP Rate
Post × LR-HL Full Tool	0.300* (0.159)				
Post × HR-HL Full Tool	-0.060 (0.119)				
Post × LR-LL Full Tool	0.218* (0.128)				
Post × HR-LL Full Tool	0.139 (0.139)				
Post × LR-HL Partial Tool		0.010 (0.131)			
Post × LR-HL Full Tool		0.305* (0.172)			
Post × HR-HL Full Tool		-0.055 (0.136)			
Post × LR-LL Full Tool		0.223 (0.144)			
Post × HR-LL Full Tool		0.144 (0.154)			
Post × Full Tool			0.258** (0.112)	0.180* (0.105)	0.286** (0.118)
Post × Full Tool × High Return			-0.225* (0.119)		-0.222* (0.121)

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Figure 13: Parallel Analysis for Factors