

The Role of Time Preferences and Exponential-Growth Bias in Retirement Savings

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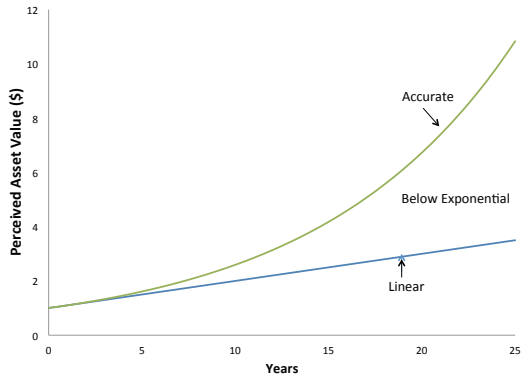
Motivation

Understanding retirement savings is important.

- Increased reliance on retirement savings accounts due to dramatic decline in traditional pensions
- Tremendous variation in retirement wealth after controlling for income, age, and education
- Complexity of problem increases likelihood that “behavioral” factors influence retirement wealth accumulation

Behavioral Factor 1: Exponential-Growth Bias (EGB)

- Individuals neglect compounding and view the value of assets as growing linearly.
- EGB affects perceptions of accumulation and decumulation of wealth



EGB Influences Budget Constraint

Let $p(\vec{v}, t; \alpha)$ be the agent's perception of the period- T value of one dollar invested at time t :

$$p(\vec{v}, t; \alpha) = \prod_{s=t}^{T-1} (1 + \alpha i_s) + \sum_{s=t}^{T-1} (1 - \alpha) i_s \quad (1)$$

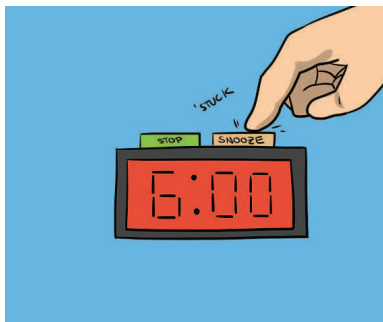
- $\alpha = 1$: individual correctly perceives growth to be exponential
- $\alpha = 0$: individual incorrectly perceives growth to be linear
- $\alpha \in [0, 1]$: individual perceptions inbetween

EGB affects intertemporal budget constraint:

$$\sum_{s=0}^T \hat{c}_s \cdot p(\vec{r}, s; \alpha_j) \leq \sum_{s=0}^T y_s \cdot p(\vec{r}, s; \alpha_j) \quad (2)$$

Behavioral Factor 2: Present Bias (PB)

- Individuals with PB underweight future utility relative to present utility in a dynamically *inconsistent* manner
- For retirement savings, may continually delay enrollment



PB Manifests in Preferences

We assume individual i has quasi-hyperbolic utility (Laibson, 1997) over a vector of consumption $x \in \mathbb{R}^{T-t+1}$ of the form:

$$U_{i,t}(x) \equiv u_i(x_t) + \beta_i \sum_{\tau=t+1}^T \delta_i^{\tau-t} u_i(x_\tau) \quad (3)$$

- δ_i is long-run discount factor (i.e. tradeoffs between future dates)
- Individual use $\beta_i \times \delta_i$ when considering tradeoffs involving today
- $1 - \beta_i$ is degree of present bias ($\beta = 1$ is not present biased)

EGB, Present bias and retirement savings

Theoretical predictions

- Retirement savings unambiguously increasing in δ
- Retirement savings generally increasing in β
- Prediction ambiguous for α

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Empirical evidence is limited

- Most past research has used proxies for time preferences; recent research relates parameter elicitation to presence of retirement savings (Heutel et al., 2014)
- EGB elicitation related to debt, total savings (Stango and Zinman 2009; Levy and Tasoff 2015); indirect evidence on link between EGB and retirement savings through field experiments (Goda et al., 2014; Song, 2012)
- Relative influence of these behavioral parameters on retirement savings is unknown

This Paper

Objective: Empirically evaluate influence of behavioral parameters on retirement savings

- Online survey using U.S. representative sample (American Life Panel + USC Understanding America Study, $n = 2,319$)
- Elicit α , β , δ as well as other drivers of retirement wealth (e.g., financial literacy, IQ, risk aversion)
- Relate parameters to accumulated retirement wealth

Robustness: Design addresses threats to validity

- Causality: Deliver treatments targeted to mitigate biases in a retirement savings scenario
- Measurement: Instrumental variables strategy for addressing classical measurement error

Sample Characteristics (n = 2,319)

	mean	st. dev.	min	max
Retirement Savings	132,835	275,951	0	1,700,000
Has Any Retirement Savings	0.70	0.46	0	1
Age	51.47	15.15	18	96
Female	0.55	0.50	0	1
Family Income	66,564	55,835	0	200,000
<i>Education</i>				
HS or Less	0.19	0.39	0	1
Some College	0.24	0.43	0	1
Assoc Degree	0.12	0.33	0	1
BA/BS Degree	0.27	0.44	0	1
Post BA/BS	0.18	0.39	0	1
<i>Marital Status</i>				
Married/Partnered	0.60	0.49	0	1
Separated	0.02	0.15	0	1
Divorced	0.14	0.35	0	1
Widowed	0.05	0.22	0	1
Never Married	0.18	0.38	0	1
Number of Children	0.73	1.18	0	9

Elicitation of Biases and Self-Awareness

Exponential Growth Bias (“Alpha”)

- 5 question, real-stakes elicitation (earn up to \$3 per question)
- “An asset has an initial value of \$100 and grows at an interest rate of 10% each period. What is the value after 20 periods?”
- Overconfidence: Assess self-awareness regarding α by asking subjects to choose between earnings based on performance, or random draw

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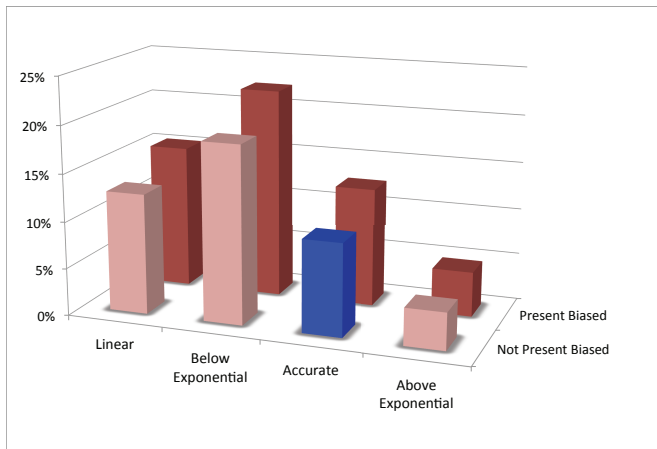
Time preference parameter elicitation (“Delta” and “Beta”)

- Use time-staircase procedure (Falk et al. 2014)
- *Present-Future staircase*: “Would you rather receive \$100 today or \$[X] in 12 months?”
- *Future-Future staircase*: “Would you rather receive \$110 in 12 months or \$[Y] in 24 months?”
- Sophistication: Assess self-awareness about present bias using *Prediction staircase* (i.e., “Suppose that 12 months from now, you are going to be given the choice between payment today and in 12 months.”)

Descriptive Statistics for Parameters

	mean	st. dev.	min	max
Alpha	0.571	0.488	0.000	3.000
Beta	1.028	0.208	0.468	2.135
Delta	0.708	0.172	0.461	0.985
Imputed Beta	0.140	0.347	0	1
Imputed Delta	0.097	0.295	0	1
Overconfidence (re: Alpha)	0.307	0.380	-1.000	1.000
Sophisticated (re: Beta)	0.320	0.466	0	1

Joint Distribution of Beta and Alpha



Other predictors of retirement wealth

Financial literacy and numeracy: Important determinants of financial decisions (e.g., van Rooij et al. 2012, Banks et al. 2010; Lusardi and Mitchell 2014)

Additional survey measures:

- 3-item financial literacy assessment (Lusardi and Mitchell 2011)
- 5-item cognitive ability assessment (Condon and Revelle 2014)
- Risk aversion assessment (incentivized choice over lotteries based on coin flip)

Other controls:

- Demographics, including state of residence
- Addition control set: education, income (17 bins) and age \times income bins

What is the relationship between the behavioral parameters and retirement savings?

Time Preferences & EGB Predict Retirement Savings

	(1)	(2)	(3)	(4)	(5)
Alpha	54,706*** (11,812)	30,209*** (10,508)		27,186** (10,554)	18,135** (8,709)
ln(Beta)	130,250*** (28,572)	68,497*** (25,742)		69,797*** (26,080)	45,884* (24,745)
ln(Delta)	185,009*** (30,931)	83,596*** (28,223)	64,745*** (25,054)	81,266*** (27,962)	49,632* (26,123)
Fin Lit (Std.)			2,813 (4,436)	1,728 (4,503)	-855 (6,303)
IQ Measure (Std.)			11,503** (5,064)	9,128* (5,067)	5,634 (4,677)
Demog Controls	Yes	Yes	Yes	Yes	Yes
Add'l Controls	No	Yes	Yes	Yes	Yes
Mean of Dep Var	132,835	132,835	132,835	132,835	97,283
Adj R ²	0.178	0.367	0.365	0.368	0.375
N	2,319	2,319	2,319	2,319	2,319

Notes: Dependent variable is winsorized retirement wealth. Demographic controls include indicator variables for female, marital status, number of household members, number of children, race, ethnicity, state of residence, risk aversion category, and 10-year age groups. Additional controls include indicator variables for highest level of education, 17 income categories, and 10-year age groups X income category interactions.

How does self-awareness of each bias relate to retirement savings?

Self-Awareness: Overconfidence & Sophistication

	(1)	(2)	(3)	(4)
Alpha	21,416*	27,243**	27,324**	21,490*
	(11,050)	(10,614)	(10,619)	(11,090)
Overconfidence	-23,453*			-23,893**
	(12,107)			(12,105)
ln(Beta)	69,145***	71,983***	59,091**	55,025*
	(26,419)	(26,332)	(27,926)	(28,142)
Sophisticated		2,132	1,279	1,065
		(10,364)	(10,169)	(10,166)
Sophisticated × ln(Beta)			41,268	45,321
			(51,094)	(51,078)
ln(Delta)	78,583***	81,458***	81,602***	79,131***
	(28,012)	(28,080)	(28,074)	(28,097)
Fin Lit (Std.)	1,314	1,598	1,440	1,101
	(4,544)	(4,584)	(4,614)	(4,589)
IQ Measure (Std.)	8,887*	9,539*	9,594*	9,006*
	(5,114)	(5,107)	(5,107)	(5,106)
Controls	Yes	Yes	Yes	Yes
Mean of Dep Var	132,835	132,835	132,835	132,835
Adj R ²	0.368	0.367	0.367	0.368
N	2,319	2,319	2,319	2,319

Notes: Dependent variable is winsorized retirement wealth. Demographic controls include

Mechanisms through which Biases May Operate

	(1)	(2)	(3)	(4)	(5)
	Ret Plan	Enrolled	Cont Amt	Inv in Equity	Housing Share
Alpha	.111 (.0913)	-.0375 (.033)	-5.36 (426)	.0271 (.0213)	-.0129 (.014)
Overconfidence	-.0154 (.116)	-.0224 (.0401)	-1,286** (576)	.0208 (.0317)	.0106 (.0182)
ln(Beta)	.637** (.32)	-.146 (.11)	2,271* (1,236)	.00053 (.0828)	-.155*** (.0479)
Sophisticated	.0563 (.0823)	.00875 (.0301)	182 (440)	-.0173 (.022)	.0161 (.0147)
Sophisticated × ln(Beta)	-.869 (.605)	.145 (.171)	1,380 (2,400)	-.0115 (.135)	.0515 (.0799)
ln(Delta)	.0664 (.211)	.0626 (.0712)	4,123*** (1,061)	.0384 (.053)	-.097*** (.0348)
Fin Lit (Std.)	.108** (.0523)	.0225 (.0202)	-254 (263)	.0314** (.0148)	-.0122 (.009)
IQ Measure (Std.)	-.0111 (.0454)	.0084 (.015)	334 (212)	.0155 (.0114)	-.00922 (.00779)
Controls	Yes	Yes	Yes	Yes	Yes
Mean of Dep Var	3.16	.766	4,375	.813	.661
Adj R ²	0.212	0.063	0.179	0.159	0.321
N	693	1,147	1,145	1,611	1,544

Are these relationships causal?

Hypothetical Saving Experiment

Approach for Assessing Causal Link:

- Randomize delivery of treatments designed to counteract each bias
- Assess if response to treatment is greater among those who have *more* bias relative to those with *less* bias

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Scenario: Introduction of match to employer-provided retirement plan

- Elicit annual contribution for each participant
 - Baseline policy: No employer match
 - New policy: Employer matches \$0.50 (\$1.00) per dollar of contribution
- Elicit timing for making a change to contribution amount under new policy (told it takes 1 hour to complete)

Description of Treatments

Exponential-Growth Bias Intervention: “Projection” Treatments

- **Balance Projection:** Value of employer match stated as account balance at retirement
- **Income Projection:** Value of employer match stated as annual income in retirement
- **Control:** Year-end value of employer match
- *Outcome:* Annual contribution under employer match policy

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Present Bias Intervention: “Incentive” Treatments

- **Incentive:** \$50 to fill out paperwork
- **Incentive + Deadline:** \$50 if fill out paperwork within 1 week
- **Control:** No incentive for completing paperwork
- *Outcome:* Timing (whether will make change within 1 week)

New Retirement Savings Plan with Matching

Now suppose your employer just changed the policy and is offering to **match** your regular contributions. For each \$1.00 you contribute, your employer will **contribute an additional \$0.50** to your retirement account. This money will be invested along with your regular contributions.



What is the value of this employer match?

Below you can see how much your regular contribution plus the employer match would be worth **for the year** and the **projected balance at retirement**. Enter a regular contribution amount, frequency of contribution, projected retirement age, and projected rate of investment return and click Calculate. Try as many times as you like!

Contribution Amount	Every year	Every month	Every two weeks	Every week
\$ <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please choose a projected retirement age between 50 and 80.

65

Please choose a projected rate of investment return.

7 %

Calculate



Contribution Calculator Output

	Annual Value	Projected Balance at Retirement
Your regular contribution	\$ <input type="text"/>	\$ <input type="text"/>
Employer match contribution	\$ <input type="text"/>	\$ <input type="text"/>
Total contribution	\$ <input type="text"/>	\$ <input type="text"/>

The projections are calculated using the contribution amount, projected rate of investment return, projected retirement age you select, and your current age. The values assume contributions are made annually at the end of each year and grow at a constant rate with no inflation and no withdrawals from the account prior to the assumed retirement age. All values are rounded to the

New Retirement Savings Plan with Matching

Under your employer's prior plan (i.e. no match), you stated you would contribute \$1000 every year.

You may wish to respond to the new **matching** contribution from your employer by changing your contributions. In order to enroll or change your contribution, you must contact an HR administrator and fill out several forms. You will specify an amount to contribute each year and designate how your contributions will be divided among investment options, including lifecycle funds that target a specific retirement date, index funds that track major asset classes, or mutual funds that pursue various investment strategies.

This entire paperwork process will take approximately **60 minutes** of your time. At the end of completing the paperwork, you can elect to make a change in your contributions, or elect to continue with your prior contribution amount by selecting, "no change."



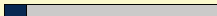
Your employer's new policy includes an **additional bonus**: if you complete the paperwork, you will get an immediate **\$50 in cash** to help compensate you for the hassle of completing the paperwork.

When answering the following questions, please consider the actual constraints you face in your life, including financial (i.e. income, savings, debt obligations) and time (i.e. all the things you have to do at work that take time).

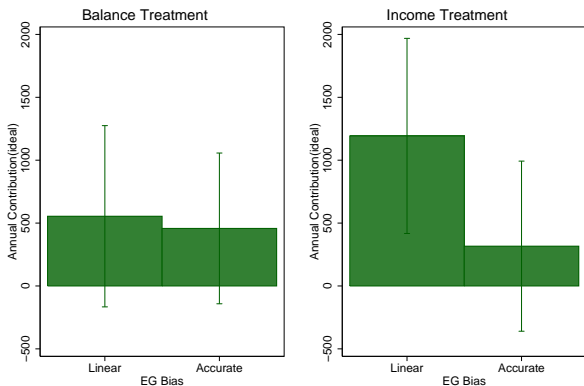
Based on the change to your employer's match policy, would you choose to go through the paperwork process? If so, when would you do so?

- No
- Yes. I'd do it today.
- Yes. Not today, but within a week.
- Yes. Not within a week, but some time in the future.

<<Back Next>>

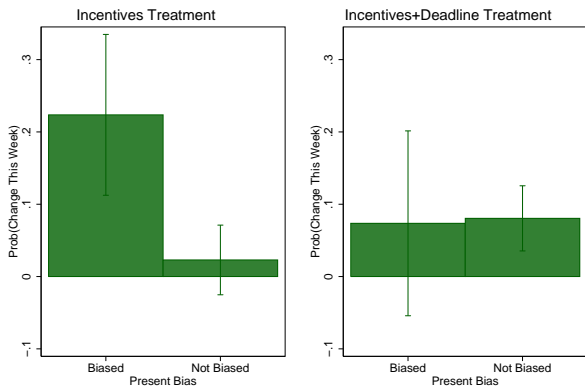


Effect of EGB Treatments by Alpha



Results relative to control group, for linear ($\text{Alpha} = 0$) and accurate ($\text{Alpha} = 1$)

Effect of PB Treatments by Beta



Result relative to control group, for biased ($\text{Beta} = 0.7$) and not biased ($\text{Beta} = 1$)

What about the noise in our parameter measures?

Measurement Error for EGB and Time Preferences

EGB

- Reliability: Test-retest correlation is 0.15 (p -value = 0.08) for $n = 150$
- Instrumental variables strategy: Tool use for Alpha (calculator, spreadsheet, pencil, other; help from others)

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Time Preference

- Test-retest correlation for $\text{Beta} \times \text{Delta}$ is 0.45 (p -value = 0.000) for $n = 150$
- Instrumental variables strategy: simple psychological questions on time preferences (e.g., "I do things when I originally plan to do them.")

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Measurement error in financial literacy and IQ

- *Financial Literacy*: Use first elicitation of 3-item battery (ALP)
- *IQ*: Use prior elicitation of cognitive ability (ALP)

Instrumental Variables for Measurement Error (ME)

	(1)	(2)	(3)	(4)	(5)
Alpha	27,322*** (10,586)	175,972** (74,701)	21,279** (10,643)	142,097** (66,749)	190,509* (107,798)
ln(Beta × Delta)	77,827*** (23,159)	62,884** (24,668)	404,483*** (89,294)	397,782*** (93,294)	426,968*** (121,508)
Fin Lit (Std.)	1,529 (4,486)	1,430 (4,683)	-1,073 (4,738)	-1,197 (4,980)	21,630 (35,214)
IQ Measure (Std.)	9,587* (5,130)	-4,529 (8,464)	6,223 (5,248)	-5,316 (8,078)	-23,689 (40,128)
Controls	Yes	Yes	Yes	Yes	Yes
Mean of Dep Var	132,835	132,835	132,835	132,835	136,259
F-Stat (Alpha)		12.284		4.667	3.489
F-Stat (ln (Beta × Delta))			10.854	7.582	3.872
F-Stat (Fin Lit)					7.901
F-Stat (IQ)					9.646
Over ID p-value		.884	.96	.992	.772
Adj R ²	.368	.302	.31	.269	.248
N	2,319	2,319	2,319	2,319	1,287

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Conclusions

Take-away from research

- Exponential-growth bias and present bias are prevalent in U.S. and significantly related to lower levels of retirement wealth
- Experimental evidence suggests the relationship may be causal.
- If causal, eliminating the bias may increase retirement savings by 12%, or as high as 70% using estimates that address classical measurement error.

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Limitations

- Experiment used hypothetical scenario
- Measurement of behavioral parameters