What To Do About Fuzzy Math and Red Ink?

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Behavioral Finance and “Undersaving”

Standard Explanations:

• *Biased heuristics (Benartzi and Thaler 2007 JEP)
  – “Stick with the default”
  – “Love company stock”
  – “Diversify 1/n”

• *Present-biased preferences
  – Time-inconsistent (Laibsonian) preference always favors consuming today
  – Self-control problem: always prefer to start saving tomorrow rather than today

• (Present-)biased expectations
  – E.g., over-optimism about future income, ability to work when elderly
A “New” Behavioral Explanation for Undersaving: Fuzzy Math

Take your typical (potential) client.

How would they answer the following?

• How much would you end up with if you invested $10,000 and left it in a mutual fund that earns a 7% average annual return for 30 years? $76,000

• If you were borrowing $10,000 to buy a car and had quotes from two lenders, one for an interest rate of 8% and one for 48 monthly payments of $299, which would you prefer? Many choose $299, even though = 20% APR
A “New” Behavioral Explanation for Undersaving: Fuzzy Math

• People underestimate compound interest
  – You knew that already

• What’s new:
  – The same “cognitive bug” that makes savings yields unattractive also makes installment debt deceptively cheap
  – So double-whammy: undersaving and overborrowing
  – We pull together evidence that:
    • Documents these biased perceptions
    • Shows their common cognitive source: exponential growth bias
    • “Shows” that these perceptions influence actual real-world behavior
What is Fuzzy Math?

Present-biased perceptions of the price of the consumption vs. savings tradeoff.

People systematically underestimate the return to saving
• Especially over long horizons
• Especially at high annual yields

People systematically underestimate the cost of installment borrowing
• Especially at short/medium maturities

So people systematically underestimate the price of not saving
The Evidence on Fuzzy Math: People Underestimate Compound Yields

What does this look like mathematically?

\[ FV = PV (1 + i)^t \]

• Given \( i \), consumer underestimates \((1+i)^t\)
• Hence given \( PV, i, \) and \( t \), underestimates \( FV \)
• Best evidence on this: Eisenstein and Hoch (2005)
• Key point: biased underestimation.
  – Not mean-zero errors
  – Not case that some folks underestimate, others overestimate
  – Not case that any individual sometimes under, other times over
  – Always under.

What does this look like economically?....
Underestimating Compound Yields
when i = 4% 
(higher “theta” means worse underestimation)
Underestimating Compound Yields when i = 11%  
(higher “theta” means worse underestimation)
Another Look (with $i = 7\%$)
Take-Aways on the Compounding Problem

- Almost everyone underestimates
- Underestimation gets worse
  - Over long horizons
  - As annual (expected) yield increases
- This is what we’d expect in theory
  - Based on the underlying math of compounding
- And this is what we find in practice
  - Evidence not airtight yet though
  - No nationally representative evidence yet
The Evidence on Fuzzy Math: Underestimating Installment Borrowing Costs

What does this look like mathematically?

\[ m = Li + \frac{Li}{(1 + i)^t - 1} \]

Given monthly payment \( m \), maturity \( t \), and principal amount \( L \)...

- **consumer underestimates \( i \)**
- Best evidence on this: Stango and Zinman (2007)
- Again key point: *biased underestimation.*
  - Not mean-zero errors
  - Not case that some folks underestimate, others overestimate
  - Not case that any individual sometimes under, other times over
  - *Always under.*
- This is why lenders “shroud” (hide) and distort interest rates

What does this look like economically?....
Perception of Loan Interest Rates, as Degree of Bias and Maturity Change
Take-Aways on the Borrowing Cost Problem

• Almost everyone underestimates
  – When interest rate is shrouded

• Underestimation gets worse
  – As maturities shorten

• This is what we’d expect in theory
  – Based on the underlying math
  – (More complicated for borrowing than saving problem)

• And this is what we find in practice
  – Again evidence not yet airtight
  – Based on old data
Fuzzy Math in Perceptions of the Price of Borrowing and Saving

• A single “cognitive bug” can explain all of the stylized facts above

• Borrowing cost problem:
  \[ m = Li + \frac{Li}{(1 + i)^t - 1} \]

• Savings yield problem:
  \[ FV = PV(1 + i)^t \]

• Link is “Exponential growth bias”: Wagenaar and Sagaria (1975) sparked literature in cognitive psychology. Given:
  \[ f(i, t) = (1 + i)^t \]

• People always dramatically underestimate when asked to extrapolate an exponentially growing series because they perceive:
  \[ f(i, t, \theta) < (1 + i)^t \]
Neuromechanics of Exponential Growth Bias

\[ f(i, t, \theta) < (1 + i)^t \]

• Brain works linearly
  – Exponential growth brand-new in evolutionary history of human brain
  – “What Have You Learned in the Last Two Seconds?”
  – Brain wants to linearize

• People anchor on linear approximation and don’t adjust upward sufficiently
Where Does Fuzzy Math Come From?

Impact of Exponential Growth Bias easy to see on savings. Directly impacts perception of future values.

Harder to see on borrowing side. Again: 

$$m = Li + \frac{Li}{(1 + i)^t - 1}$$

Intuition: bias prevents proper adjustment for declining principal balance

- You don’t get to borrow full amount for full maturity
- Paying back principal as you go
- This has bigger effect on $i$ at shorter maturities
  - Interest payments front-loaded

Another way to see it: interest only = infinite maturity (perpetuity)

- No exponentiation required
- Linear inference about rate gets you the right answer!
Why Don’t People Learn (to Debias Themselves)?

• Deep cognitive bug (maladaptation)
  – Work by Kahneman, Stanovich, and others: biases persist in abstract domains like math and finance

• Low frequency feedback
  – Installment borrowing decisions made infrequently
    • Vs. credit card borrowing, spending more generally
  – Long-run savings decisions made infrequently

• Debiasing “architecture” only partially effective
  – Truth-in-Lending doesn’t bite for many lenders
  – Costly to enforce (Stango and Zinman 2007b)
Why Don’t People Debias Themselves?

- Because learning is hard
- And lenders have incentive to exploit/exacerbate bias
- So we find only partial awareness by consumers:
  - Of their biased strategies
  - Of cost-effective strategies for mitigation:
    - Decision aids (financial calculators)
    - Accurate heuristics (to cut through misleading product presentation)
    - Expert advice
Fuzzy Math and Real-World Decisions: Some Evidence

Our approach:

• Measure exponential growth bias
• Measure financial decisions
• Measure and control for other (more standard) decision inputs (preferences, expectations, demographic, available resources, sophistication/education, etc.)
• Estimate conditional correlations between decisions and bias
Fuzzy Math and Real-World Decisions: From Theory to Evidence

The mathematics of EG bias leads to specific predictions that we can test in the data.

Data support the theory. More biased consumers:

• Borrow more on short-term installment debt.
  – But no more on long-term

• Invest less in stocks
  – But no less in CDs

• Save less and hold less wealth
  – But effects dampened when they are credit constrained

• Be more likely to use advice
  – And benefit more when they do use advice
  – In fact advice seems to eliminate the effects of bias

• Magnitudes are large. E.g.:
  – Most-biased hold 12-28% less wealth than least-biased
  – Most biased hold 30-50% less wealth in stocks
Caveat on this Evidence

• Old data (only 1983 has everything we need)
• Evolution of retail financial markets could cut either way
• Bias and its effects weaker?
  – Decision aids and advice cheaper now than in 1983
  – More generally: information more readily available
• Bias and its effects stronger?
  – Evidence on underestimation of compound yields is contemporary
  – Marketing and product menus more sophisticated now: lenders better at exploiting any underlying bias(es)
  – More choices in hands of consumers
    • DC vs. DB
    • Many more consumer loan options
How is Fuzzy Math Distinct from other Behavioral Biases?

• Has distinct effects on behavior:
  – Tilts portfolios
  – Motivates delegation (big role for unbiased advice)

• More “treatable” in important ways:
  – Strong normative basis (vs. trying to change preferences)
  – Easy to measure (vs. preferences, expectations)
    • Can identify who’s biased in 2 or 3 questions
    • May be useful for target marketing
  – Highly specific (vs. “financial literacy”, cognitive ability)
    • Grounds for optimism that “debiasing” can work
So What to do About Fuzzy Math?

Marketing
- Content
- Target markets
- Frequency
- “Social” marketing (and regulation)

Workplace Plan Design

Product Development
Marketing Content in a Fuzzy Math World

*What* do we market?

**General lessons from behavioral finance**

- Content have big effect on financial decisions
  - Zinman and co-authors: direct mail experiment
- Tailor offers and make menus small
  - Avoid “choice overload”
- Subtle “priming” can be particularly effective for decisions that are not highly salient
  - Zinman and co-authors: several new experiments on this, building on psych/marketing and voting (push-polling)
Marketing Content in a Fuzzy Math World

*What* do we market?

Lenders know what to market....
Lenders Exploit EG Bias: Shroud APRs & Market “Low Payments”
Lenders Use Menus to Price Discriminate: Payments vs. APR Marketing
Marketing Content for Investment Products in a Fuzzy Math World

Recall that when you give people an estimated annual yield (on their initial investment), they underestimate the future value.

So why not market future values?
• Use pictures as well as (instead of?) numbers

Lack of visuals puzzling. Google “how will my money grow?” and here’s what you get:
• http://cgi.money.cnn.com/tools/savingscalc/savingscalc.html
• http://www.whitneybank.com/calcs/wif1.asp
• http://www.kiplinger.com/tools/fig401k.html
Marketing Content in a Fuzzy Math World

These strategies have *not* yet been tested
  – (or maybe they have, in-house)

But easy and cheap to test in direct mail experiments

Payoffs for optimizing content potentially enormous
  – Bertrand et al: effective content has same impact on loan demand as big price change
Target Marketing in a Fuzzy Math World

Who are we pitching?

Fuzzy math highlights three segments in particular:
1) Low-yield savers
2) Short-term savers, e.g.:
   • Not in retirement plan
   • CD holders
   • Active traders
3) Discretionary (installment) borrowers
   • Home equity
   • 2\textsuperscript{nd}/3\textsuperscript{rd} (luxury) car
Client Communication Strategy in a Fuzzy Math World

*How* do we communicate the pitch to our targets?

Learning works best with *high-frequency feedback*

- Need to be careful here: probably don’t want to give regular feedback on returns
  - Inefficient (fuzzy math)
  - Myopic loss aversion (Benartzi and Thaler)

- But giving feedback on *goal progress* is promising
  - Need to elicit goal with a baseline communication
    - Explicitly
    - Or subtly, via a priming communication
“Social” Marketing in a Fuzzy Math World

“Social” marketing should deliver bottom-line benefits for retailers of savings products

Need to counter consumer lenders that prey on fuzzy math and other behavioral biases
“Social” Marketing in a Fuzzy Math World

Social marketing what? **Financial survival skills:**

- How to interpret loan disclosures
  - E.g., double the simple interest rate to get the APR on short-term loans
- How to interpret annual yields
  - Rule of 72 tells you how quickly your money will double
- How to use decision aids
  - Getting started on planning
  - Financial calculators that help evaluate offers

In same vein, **effective loan disclosure regulation** key

- Content
- Enforcement
Product Development in a Fuzzy Math World

Big opportunity in retailing expert advice
• Our finding that advice eliminates effects of bias suggests big value proposition for consumer

Also:
• Cross-selling saving products
• Steering away from borrowing
Expert Advice in a Fuzzy Math World

Our finding that more biased consumers more likely to get advice is also encouraging
• Partial awareness of bias problems
• (Social) marketing strategies detailed above can increase awareness

Not clear yet how to skin the cat re: content, delivery costs
• Research suggests content can be simple
• And thus that costs can be low (e.g., can train and monitor relatively low-paid personnel to be “experts”)
• Critical and feasible to optimize through research
• Workplace approaches play a (limited?) role
Workplace Plan Design in a Fuzzy Math World

Strong motivation for more aggressive defaults
• Riskier (higher-yielding) asset allocation
• Higher savings rates

Greater role for advice
Summing Up:
The Effects of Fuzzy Math

Fuzzy math = exponential growth bias. This bias produces:
• Underestimation of compound yields » undersaving
• Underestimation of borrowing costs » overborrowing

Fuzzy math:
• Is exacerbated by lenders that shroud interest rates
• Tilts portfolios away from long-term saving, toward short-term borrowing
• Reduces savings rate and wealth levels
• Increases the value of “expert” advice
Summing Up:
What to do about Fuzzy Math

Marketing
• Content: future values
• Target markets: new segments
• Frequency: provide regular feedback
• “Social” marketing: survival skills and loan disclosure

Workplace Plan Design
• More aggressive defaults

Product Development
• Retailing advice
Suggestions for Further Reading

On Fuzzy Math:
• academic version: http://www.dartmouth.edu/~jzinman/Papers/Stango&Zinman_FuzzyMath_nov07.pdf
• Eisenstein and Hoch (2005): “Intuitive Compounding…."

On other drivers of undersaving:

On direct mail marketing content experiments:
Bertrand, Karlan, Mullainathan, Shafir, and Zinman (2007). “What’s Advertising Content Worth?....”
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