The Effect of Financial Education on the Quality of Decision Making

Sandro Ambuehl, B. Douglas Bernheim
Department of Economics, Stanford University
Annamaria Lusardi
School of Business, George Washington University

Cherry Blossom Financial Education Institute
The George Washington School of Business
April 15, 2016
Motivation

Studying financial education is important

- Financial literacy around the world is low.
  - Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? (more than/less than/exactly $102)

Only 30% of Americans can answer all of three such questions about basic financial concepts correctly.
Motivation

Studying financial education is important

- Financial literacy around the world is low.
  - Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? (more than/less than/exactly $102)

  Only 30% of Americans can answer all of three such questions about basic financial concepts correctly.

- Widespread attempts at providing financial education to citizens (high school, workplace)
Motivation

Studying financial education is important

- Financial literacy around the world is low.
  - Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? (more than/less than/exactly $102)

  Only 30% of Americans can answer all of three such questions about basic financial concepts correctly.

- Widespread attempts at providing financial education to citizens (high school, workplace)

- (Mixed) evidence that financial education impacts financial choices (Reviews by Hastings, Madrian, Skimmyhorn, 2013 and Lusardi & Mitchell, 2014)
Motivation

Studying financial education is important

• Financial literacy around the world is low.
  • Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow? (more than/less than/exactly $102)

  Only 30% of Americans can answer all of three such questions about basic financial concepts correctly.

• Widespread attempts at providing financial education to citizens (high school, workplace)

• (Mixed) evidence that financial education impacts financial choices (Reviews by Hastings, Madrian, Skimmyhorn, 2013 and Lusardi & Mitchell, 2014)

Are the effects of financial education beneficial?
Are the effects of financial education beneficial?

Discussions sometimes colored by preconceptions and paternalistic judgments

- Saving more is good
- Balanced portfolios are good
- Education affects financial choices because it improves understanding
Are the effects of financial education beneficial?

Discussions sometimes colored by preconceptions and paternalistic judgments

- Saving more is good
- Balanced portfolios are good
- Education affects financial choices because it improves understanding

But education may influence behavior because it involves

- Advertising, indoctrination
- Social pressure, brow-beating, shame
- Psychological anchors
This study

1. Introduces the concept of Financial Competence
   Non-paternalistic conception of what it means to make “good” financial choices
This study

1. Introduces the concept of *Financial Competence*
   *Non-paternalistic* conception of what it means to make “good” financial choices

2. Evaluation of example financial education intervention
   - Conventional measures
     - Intervention has all the right effects for all the right reasons
   - Our measure
     - Intervention leaves welfare unchanged, and we can tell you why
Simple and Complex Framing

Simple Framing
Choose amongst goods that you intrinsically value.
• E.g. standard of living before and after retirement
Simple and Complex Framing

Simple Framing
Choose amongst goods that you intrinsically value.
  • E.g. standard of living before and after retirement

Complex Framing
Choose amongst goods that merely have implications for the goods you intrinsically value (*consumption instruments*).
  • E.g. choose how much of your current income to invest in retirement savings account at APR 5%, compounded yearly.
Our Measure: Financial Competence

Based on Bernheim & Rangel, 2004, 2009
Our Measure: Financial Competence
Based on Bernheim & Rangel, 2004, 2009

Definition
A decision maker is more financially competent the less her choices differ across different framings of the same choice problem.

Welfare interpretation
• Simple frame: subjects understand opportunity set
• Complex frame: subjects may misconstrue opportunity set
Use choice made in simple frame to assess welfare loss from choices in complex frame
Our Measure: Financial Competence
Based on Bernheim & Rangel, 2004, 2009

Definition
A decision maker is more financially competent the less her choices differ across different framings of the same choice problem.

Welfare interpretation
- Simple frame: subjects understand opportunity set
- Complex frame: subjects may misconstrue opportunity set
Our Measure: Financial Competence
Based on Bernheim & Rangel, 2004, 2009

Definition
A decision maker is more financially competent the less her choices differ across different framings of the same choice problem.

Welfare interpretation
- Simple frame: subjects understand opportunity set
- Complex frame: subjects may misconstrue opportunity set

Use choice made in simple frame to assess welfare loss from choices in complex frame
Conventional Measures

Financial Literacy (performance in knowledge tests)

Assumptions required for welfare statements:

- Education affects behavior only through understanding of financial concepts.
- Better understanding leads to better decision making
Conventional Measures

Financial Literacy (performance in knowledge tests)

Assumptions required for welfare statements:

- Education affects behavior \textit{only} through understanding of financial concepts.
- Better understanding leads to better decision making

Observed behavior

E.g. compare average saving rate with and without education intervention

Assumption required for welfare statements:

- Behavior is \textit{directionally} biased.
Evaluation of Example Education Intervention

Goal

1. Contrast our measure with conventional measures
   - Conventional measures: Intervention works great, for the right reasons
   - Our measure: Intervention does not work at all

2. Trace mechanisms for divergence
Experiment Structure
(Web-based experiment)

1. Education intervention about compound interest
Experiment Structure
(Web-based experiment)

1. Education intervention about compound interest
2. Choice problems
Experiment Structure
(Web-based experiment)

1. Education intervention about compound interest
2. Choice problems
3. Incentivized test on compound interest
Stage 1: Education Intervention

Education intervention

- Section on compound interest of Malkiel and Ellis, *The Elements of Investing: Easy Lessons for Every Investor* (popular text on investing)
Stage 1: Education Intervention

Education intervention

- Section on compound interest of Malkiel and Ellis, *The Elements of Investing: Easy Lessons for Every Investor* (popular text on investing)
- Presented as video (narrated slides like Khan academy)
Stage 1: Education Intervention

Education intervention

- Section on compound interest of Malkiel and Ellis, *The Elements of Investing: Easy Lessons for Every Investor* (popular text on investing)
- Presented as video (narrated slides like Khan academy)
- Subjects know they might be paid for performance on test on the material
Stage 1: Education Intervention

Starts with simple explanation of compound interest using an example (iterative calculation). Then:

1. Substance
   - Explanation and application of the Rule of 72
     \[ \text{% interest rate} \times \text{doubling period} = 72 \]
     - 5 example calculations

2. Rhetoric
   - Quotes, e.g. “Albert Einstein is said to have described compound interest as the most powerful force in the universe”
   - Examples in which relatively small initial investments grow to millions of dollars, but no calculations are done
Stage 1: Education Intervention

Starts with simple explanation of compound interest using an example (iterative calculation). Then:

1. **Substance**: Explanation and application of the Rule of 72
   - \((\% \text{ interest rate}) \times (\text{doubling period}) = 72\)
   - 5 example calculations
Stage 1: Education Intervention

Starts with simple explanation of compound interest using an example (iterative calculation). Then:

1. **Substance**: Explanation and application of the Rule of 72
   - \((\% \text{ interest rate}) \times (\text{doubling period}) = 72\)
   - 5 example calculations

2. **Rhetoric**
   - Quotes, e.g. “Albert Einstein is said to have described compound interest as the most powerful force in the universe”
   - Examples in which relatively small initial investments grow to millions of dollars, but no calculations are done
Treatment interventions: $2 \times 2$ across subjects design

Each subject is in one of 4 treatments

- Full intervention
- Substance-only (no rhetoric)
- Rhetoric-only (no rule of 72 – introductory example retained)
- Control (unrelated material from same book)
Paired Choice Problems (*within subjects*)

- Elicit present value (PV) for 10 future rewards
- Each subject sees each future reward twice
  - Simple framing: “We will pay you $20 in 72 days.”
  - Complex framing: “We will invest $10 at an interest rate of 1% per day. Interest is compounded daily. We will pay you the proceeds in 72 days.”
Stage 2: Paired Choice Problems

Paired Choice Problems (within subjects)

- Elicit present value (PV) for 10 future rewards
- Each subject sees each future reward twice
  - Simple framing: “We will pay you $20 in 72 days.”
  - Complex framing: “We will invest $10 at an interest rate of 1% per day. Interest is compounded daily. We will pay you the proceeds in 72 days.”

Object of Interest

Subject $i$’s distance between $PV_i^{simple}$ and $PV_i^{complex}$
## Multiple price list

(Complex framing)

<table>
<thead>
<tr>
<th>Amount</th>
<th>You will get the specified dollar amount within two days from today</th>
<th>We will invest $2 in an account with 5% interest per day. Interest is compounded daily. We will pay you the proceeds in 36 days.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20</td>
<td><img src="#" alt="Blue" /></td>
<td><img src="#" alt="White" /></td>
</tr>
<tr>
<td>$18</td>
<td><img src="#" alt="Blue" /></td>
<td><img src="#" alt="White" /></td>
</tr>
<tr>
<td>$16</td>
<td><img src="#" alt="White" /></td>
<td><img src="#" alt="Blue" /></td>
</tr>
<tr>
<td>$14</td>
<td><img src="#" alt="White" /></td>
<td><img src="#" alt="Blue" /></td>
</tr>
</tbody>
</table>
Details

- Elicited using (iterated) multiple price list
- Time horizon 36 or 72 days (easy application of rule of 72)
Stage 3: Financial Literacy

Incentivized test about compound interest

- 5 questions, e.g.
  - If an investment grows at 8 percent per year (interest is compounded yearly), by how much has it grown after 4 years?
  - If somebody tells you an investment should double in four years, what rate of return (per year) is he promising?

- 5 additional questions on contents of control intervention
Incentivized test about compound interest

- 5 questions, e.g.
  - If an investment grows at 8 percent per year (interest is compounded yearly), by how much has it grown after 4 years?
  - If somebody tells you an investment should double in four years, what rate of return (per year) is he promising?

- 5 additional questions on contents of control intervention

Self reports about decision process

[later]
Data

- Subjects recruited and paid through Amazon Mechanical Turk (online labor platform)
  - usually earn about $5 per hour
  - mean completion time 1 hour
  - average incentive payment $15, completion payment $10
- 106 - 128 subjects per treatment ($N = 455$)
  - Negligible attrition
- Demographics relative to US population
  - Lower income
  - More highly educated, higher financial literacy
  - Younger, whites and males overrepresented
Subjects recruited and paid through Amazon Mechanical Turk (online labor platform)
- usually earn about $5 per hour
- mean completion time 1 hour
- average incentive payment $15, completion payment $10

106 - 128 subjects per treatment ($N = 455$)
- Negligible attrition

Demographics relative to US population
- Lower income
- More highly educated, higher financial literacy
- Younger, whites and males overrepresented
Conventional Measure 1: Financial Literacy

Score on knowledge test by treatment
Conventional Measure 1: Financial Literacy

Score on knowledge test by treatment
Conventional Measure 1: Financial Literacy

Score on knowledge test by treatment

- Control
- Full Treatment
- Substance only
- Rhetoric only
Conventional Measure 1: Financial Literacy

Score on knowledge test by treatment
Conventional Measure 2: Observed Behavior

How does the intervention affect choices?

- Absent education, valuations in the complex framing will be too low.
- If valuations in the complex framing increase with education, this suggests the intervention improved welfare.
Conventional Measure 2: Observed Behavior

How does the intervention affect choices?

- Absent education, valuations in the complex framing will be too low.
- If valuations in the complex framing increase with education, this suggests the intervention improved welfare.

Normalizations

- We look at \( V_i^{\text{complex}} - V_i^{\text{simple}} \)
- All future values normed to $100.
Difference $V_i^{\text{complex}} - V_i^{\text{simple}}$
Difference $V_{i}^{complex} - V_{i}^{simple}$

(pooled over time horizons)
Difference $V_i^{\text{complex}} - V_i^{\text{simple}}$

(pooled over time horizons)
Effects of financial education intervention:

- Improves financial literacy, and subjects report operationalizing the knowledge
Pause to consider results so far

Effects of financial education intervention:

- Improves financial literacy, and subjects report operationalizing the knowledge
- Results are due to substantive content, not due to rhetoric
Pause to consider results so far

Effects of financial education intervention:

- Improves financial literacy, and subjects report operationalizing the knowledge
- Results are due to substantive content, not due to rhetoric
- Intervention seems to effectively counteract exponential growth bias.
Effects of financial education intervention:

- Improves financial literacy, and subjects report operationalizing the knowledge
- Results are due to substantive content, not due to rhetoric
- Intervention seems to effectively counteract exponential growth bias.

All the right effects for all the right reasons!
Effects of financial education intervention:

- Improves financial literacy, and subjects report operationalizing the knowledge
- Results are due to substantive content, not due to rhetoric
- Intervention seems to effectively counteract exponential growth bias.

All the right effects for all the right reasons!

... right?
Financial Competence (Welfare)

Use choices in simple frame to assess welfare loss due to complex framing.

Example

• For the same future reward, state: \( V_{\text{simple}} = \$10 \), \( V_{\text{complex}} = \$15 \).

• Offered future reward in complex framing at present price $12.

• Hence, buy at $12 although only valued at $10. Lose $2.

Given uniform distribution of price in our experiment, expected welfare loss proportional to \( (V_{\text{complex}} - V_{\text{simple}})^2 \).
Use choices in simple frame to assess welfare loss due to complex framing.

Example

• For the same future reward, state: $ V^{simple} = $10, $ V^{complex} = $15.

• Offered future reward in complex framing at present price $12.

• Hence, buy at $12 although only valued at $10. Lose $2.
Financial Competence (Welfare)

Use choices in simple frame to assess welfare loss due to complex framing.

Example

- For the *same* future reward, state: \( V^{\text{simple}} = $10, \ V^{\text{complex}} = $15. \)
- Offered future reward in complex framing at present price $12.
- Hence, buy at $12 although only valued at $10. Lose $2.

Given uniform distribution of price in our experiment, expected welfare loss proportional to

\[
(V^{\text{complex}} - V^{\text{simple}})^2
\]
Effect of intervention on welfare

\[-(V_{\text{complex}} - V_{\text{simple}})^2\]
Effect of intervention on welfare

$-(V_{\text{complex}} - V_{\text{simple}})^2$
WHAT ???
Another look at $V_i^{\text{complex}} - V_i^{\text{simple}}$
Another look at $V_i^{\text{complex}} - V_i^{\text{simple}}$
Another look at $V^\text{complex}_i - V^\text{simple}_i$
C.D.F. of $V_{\text{complex}} - V_{\text{simple}}$
C.D.F. of $V^{\text{complex}} - V^{\text{simple}}$

What good education should do:
C.D.F. of $V^{\text{complex}} - V^{\text{simple}}$

What the education intervention actually does:

![Graph showing the C.D.F. of $V^{\text{complex}} - V^{\text{simple}}$ with control, substance only, rhetoric only, and full intervention lines.](image)
C.D.F. of $V^{\text{complex}} - V^{\text{simple}}$

What the education intervention actually does:

![Graph showing the cumulative distribution function of complex - simple variables for different intervention groups: Control, Full, Substance only, and Rhetoric only. The x-axis represents the differences in scores, and the y-axis represents the cumulative distribution.](image-url)
Analyzing financial competence shows:

- This particular education intervention does not help people better achieve their own goals.
Analyzing financial competence shows:

- This particular education intervention does not help people better achieve their own goals
- It merely shifts behavior indiscriminately of initial bias
Analyzing financial competence shows:

- This particular education intervention does not help people better achieve their own goals
- It merely shifts behavior indiscriminately of initial bias
- Due to heterogeneity in bias, this is good for some, bad for others
Analyzing financial competence shows:

- This particular education intervention does not help people better achieve their own goals
- It merely shifts behavior indiscriminately of initial bias
- Due to heterogeneity in bias, this is good for some, bad for others

... in spite of improvement in financial literacy, and elimination of exponential growth bias!
Financial Competence

Non-paternalistic conception of what it means to make “good” financial choices
Financial Competence

*Non-paternalistic* conception of what it means to make “good” financial choices

Evaluation of example intervention

- Conventional measures: Intervention has all the right effects for all the right reasons
- Financial Competence: Intervention has no effect on mean welfare, and we know why
Financial Competence

*Non-paternalistic* conception of what it means to make “good” financial choices

**Evaluation of example intervention**

- Conventional measures: Intervention has all the right effects for all the right reasons
- Financial Competence: Intervention has no effect on mean welfare, and we know why

**Effects of the example intervention**

- Intervention increases financial literacy, but subjects do not implement it when making choices
- Rhetoric can be very effective in changing behavior
Discussion

• How to engage and motivate subjects without triggering simplistic heuristic reactions that overpower knowledge-based responses?
• More generally, how to use these findings to improve financial decision making and financial education?
• Other interpretations?
• Experiment does not show that financial education generally fails to improve welfare
• Shows that raising financial literacy and counteracting known biases does not necessarily increase welfare
Financial competence

Principle

• Different opportunity sets of financial instruments sometimes lead to same opportunity sets of intrinsically valued consumption

• Call these opportunity sets *equivalent*

• **Person is financially competent if she makes equivalent choices from equivalent opportunity sets**

Advantage

• Non-paternalistic, no need to make assumptions about “true preferences”, due to focus on internal consistency

• Based on behavior rather than questionnaires or tests

• Accounts for individual differences

• But: Researcher must take stand on what is intrinsically valuable to consumer
Implementation

- Study whether choices lead to the same time and state dependent *income* streams
  - Implies that the same intrinsically valued goods will be chosen if there are no *persistent framing effects*
  - Lack of financial competence equivalent to *contemporaneous* framing effects
- Instrument $i_c$ is *complexly framed* if a financial principle needs to be applied to infer the income stream it implies. Define that income stream as $i_s$, the simple framing of the same instrument.
- Elicit WTPs $V_c$ and $V_s$ to be given instruments $i_c$ and $i_s$, respectively.
- Define financial competence as
  \[ C = |V_c - V_s| \]
Welfare interpretation

If individual misconstrues opportunity set in complex, but not simple framing:

- $|V_c - V_s|$ is the maximal possible welfare loss due to having to make a choice in the complex framing from decisions of the form: Choose either $i_C$ or certain immediate amount of money $d$.

If individual reduces complexly framed choices to simply framed choices before making a decision:

- $|V_c - V_s|$ is a measure of how much the misunderstanding of a financial concept contributes to the overall welfare loss.

With other behavioral anomalies:

# Choice Pairs

<table>
<thead>
<tr>
<th>Final amount</th>
<th>Invested amount</th>
<th>Daily interest rate</th>
<th>#Doublings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20</td>
<td>$10</td>
<td>1 %</td>
<td>1</td>
</tr>
<tr>
<td>$18</td>
<td>$4.5</td>
<td>2 %</td>
<td>2</td>
</tr>
<tr>
<td>$16</td>
<td>$2</td>
<td>3 %</td>
<td>3</td>
</tr>
<tr>
<td>$14</td>
<td>$0.9</td>
<td>4 %</td>
<td>4</td>
</tr>
<tr>
<td>$12</td>
<td>$2</td>
<td>2.5 %</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Duration: 72 days

<table>
<thead>
<tr>
<th>Final amount</th>
<th>Invested amount</th>
<th>Daily interest rate</th>
<th>#Doublings</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20</td>
<td>$10</td>
<td>2 %</td>
<td>1</td>
</tr>
<tr>
<td>$18</td>
<td>$4.5</td>
<td>4 %</td>
<td>2</td>
</tr>
<tr>
<td>$16</td>
<td>$2</td>
<td>6 %</td>
<td>3</td>
</tr>
<tr>
<td>$14</td>
<td>$0.9</td>
<td>8 %</td>
<td>4</td>
</tr>
<tr>
<td>$12</td>
<td>$2</td>
<td>5 %</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Duration: 36 days

Rationale: (i) # doublings (ii) variety of decision problems
Financial Literacy

FL1. Suppose you had $100 in a savings account and the interest rate was 2 percent per year. After 5 years, how much do you think you would have in the account if you left the money to grow?

More than $102 (92.86%), Exactly $102 (3.37%), Less than $102 (1.98%), Do not know (1.79%)

FL2. Suppose you had $100 in a savings account and the interest rate is 20 percent per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total?

More than $200 (72.62%), Exactly $200 (22.62%), Less than $200 (2.98%), Do not know (1.79%)

FL3. Imagine that the interest rate on your savings account was 1 percent per year and inflation was 2 percent per year. After 1 year, how much would you be able to buy with the money in this account?

More than today (8.33%), exactly the same (6.94%), less than today (1.15%), do not know (3.57%)