# Cognitive Constraints on Valuing Annuities

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# Under a wide range of assumptions people should annuitize to guard against length-of-life uncertainty

- What are supply side barriers?
  - Adverse selection
  - Incomplete annuity markets (aggregate risk)
- What are demand-side limitations?
  - Bequest motives
  - Formal or informal substitutes (e.g. family)
  - Pretty much any explanation creates new puzzles:
    - E.g. if family provides risk sharing, annuity demand should go up after a spouse dies

# Behavioral aspects

- Decisions are complicated and there is little opportunity for learning

- If one does not understand an annuity product, then reluctant to buy it

- Presumably financially more literate individuals will be better at valuing annuities (and may be more willing to buy them).

# Data from American Life Panel

- At the time of our survey, the ALP included about 4,000 active panel members.

- Two waves (at least two weeks apart):
  - 1st wave 2478 observations (rr=83.9%)
  - 2nd wave  2355 observations (rr=95%)

- Calculated individual SS entitlements:
  - 4% said not be eligible for SS; asked to assume benefits equal to  their age/education/sex mean.

-  Our full sample included 2,112 complete responses for both waves 1 and 2.

# Our Experiment

- Use two waves of the American Life Panel and ask questions like the following (CV-SELL)

- *"In this question, we are going to ask you to make a choice between two money amounts.*

- *Please click on the option that you would prefer*

- *Suppose Social Security gave you a choice between:*

- *(1) Receiving your expected [current] Social Security benefit of $SSB per month.*

- *or*

- *(2) Receiving a Social Security benefit of $(SSB-X) per month and receiving a one-time payment of $LS at age Z [one year from now]."*

# Screen shot: CV-Sell

In this question, we are going to ask you to make a choice between two money amounts.

Please click on the option that you would prefer.

Suppose Social Security gave you a choice between:

- ○ Receiving a Social Security benefit of $1,500 per month <u>and</u> **receiving** a <u>one-time</u> payment of $20,000 one year from now.

- ○ Receiving your Social Security benefit of $1,600 per month.

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RAND
American Life
Panel

# Four versions of the annuity valuation tradeoff question

| | "SELL"-version | | "BUY"-version | |
|---|---|---|---|---|
| | Choice A | Choice B | Choice A | Choice B |
| Compensating Variation (CV) | [SSB-X] + LS | [SSB] | [SSB+X] - LS | [SSB] |
| Equivalent Variation (EV) | [SSB]+ LS | [SSB+X] | [SSB] - LS | [SSB-X] |

X is typically $100 per month; this seems a fairly modest amount so one would expect the CV and EV versions to be fairly similar.

# EV-Buy

In this question, we are going to ask you to make a choice between two money amounts.

Please click on the option that you would prefer.

Suppose Social Security gave you a choice between:

○ Receiving your Social Security benefit of $1,600 per month <u>and</u> **making** a <u>one-time</u> payment of $20,000 one year from now to Social Security.

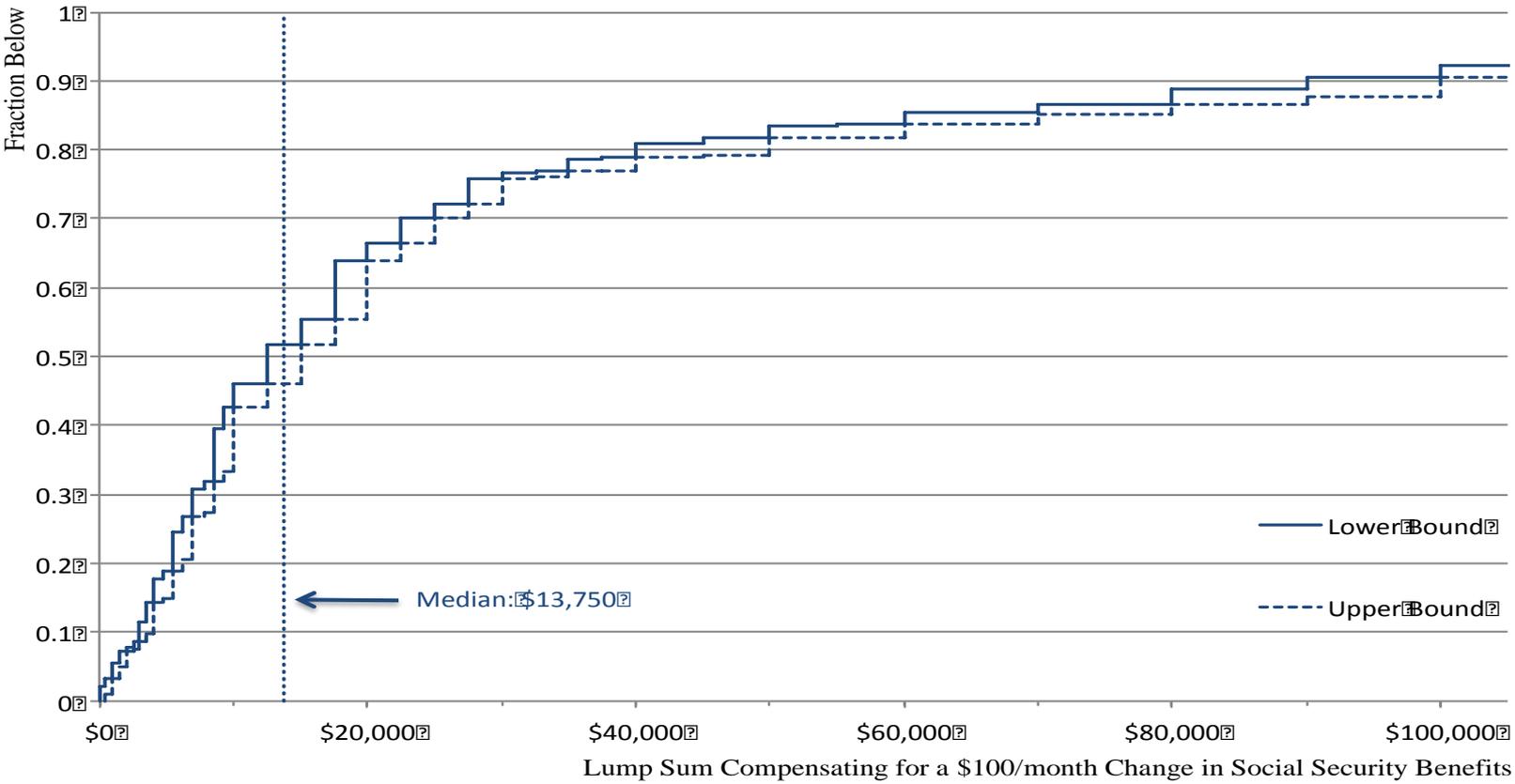○ Receiving a Social security benefit of $1,500 per month.

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# Experimental variations

- Order of choices

- LS first or X first

- For CV SELL, vary X: $100, $500, SSB, X random from {200, 300, 400, 600, 700, … SSB-100}

- Starting value of LS

  - Actuarially fair

  - 50% lower

  - 50% higher

- A variant where we explicitly exclude political risk
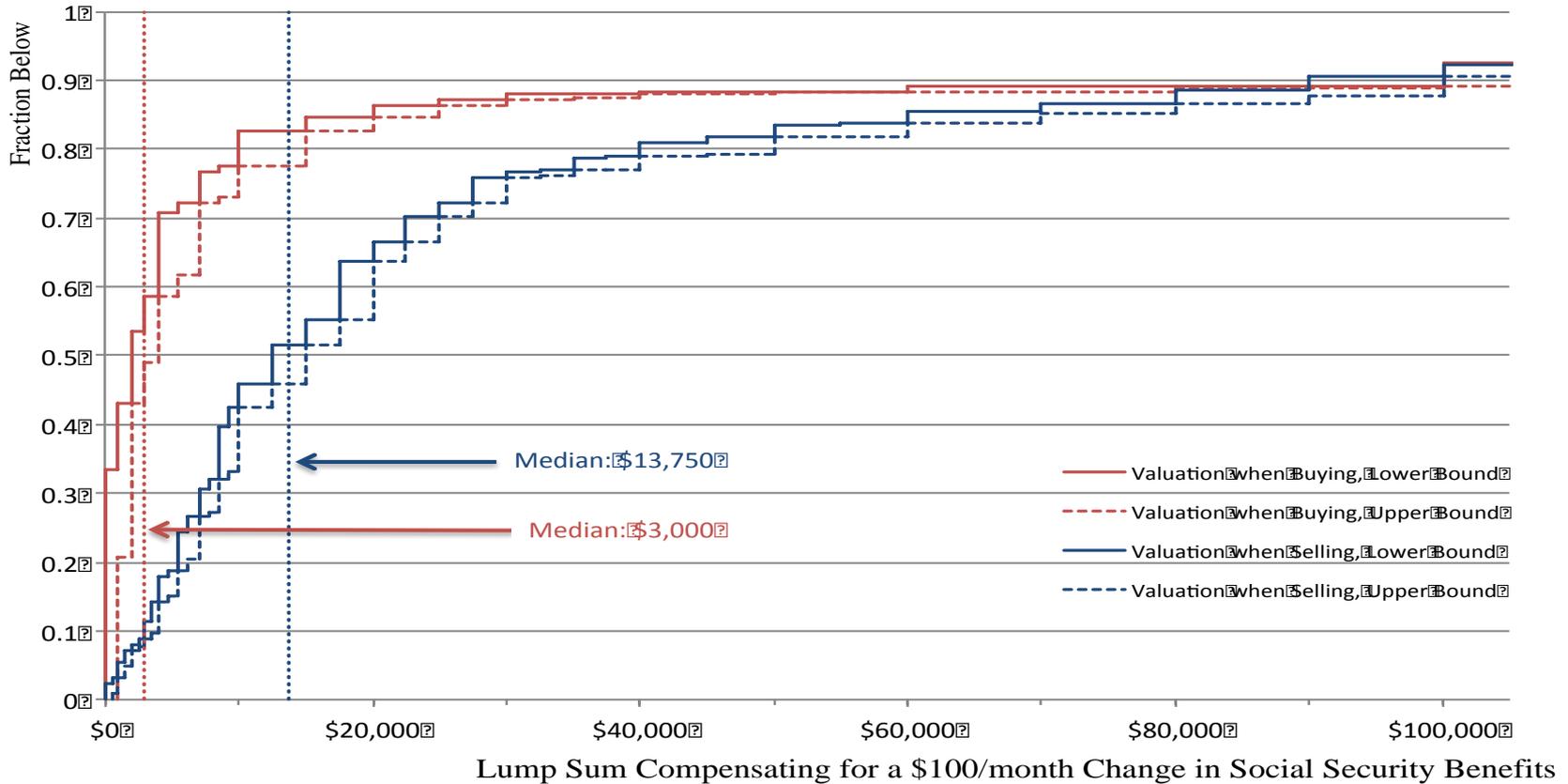
# CV-SELL (median is approximately act. fair)



Median: $13,750

Lower Bound

Upper Bound

Lump Sum Compensating for a $100/month Change in Social Security Benefits

# CV-SELL (continued)

- 6% reports a valuation of $1500 or lower
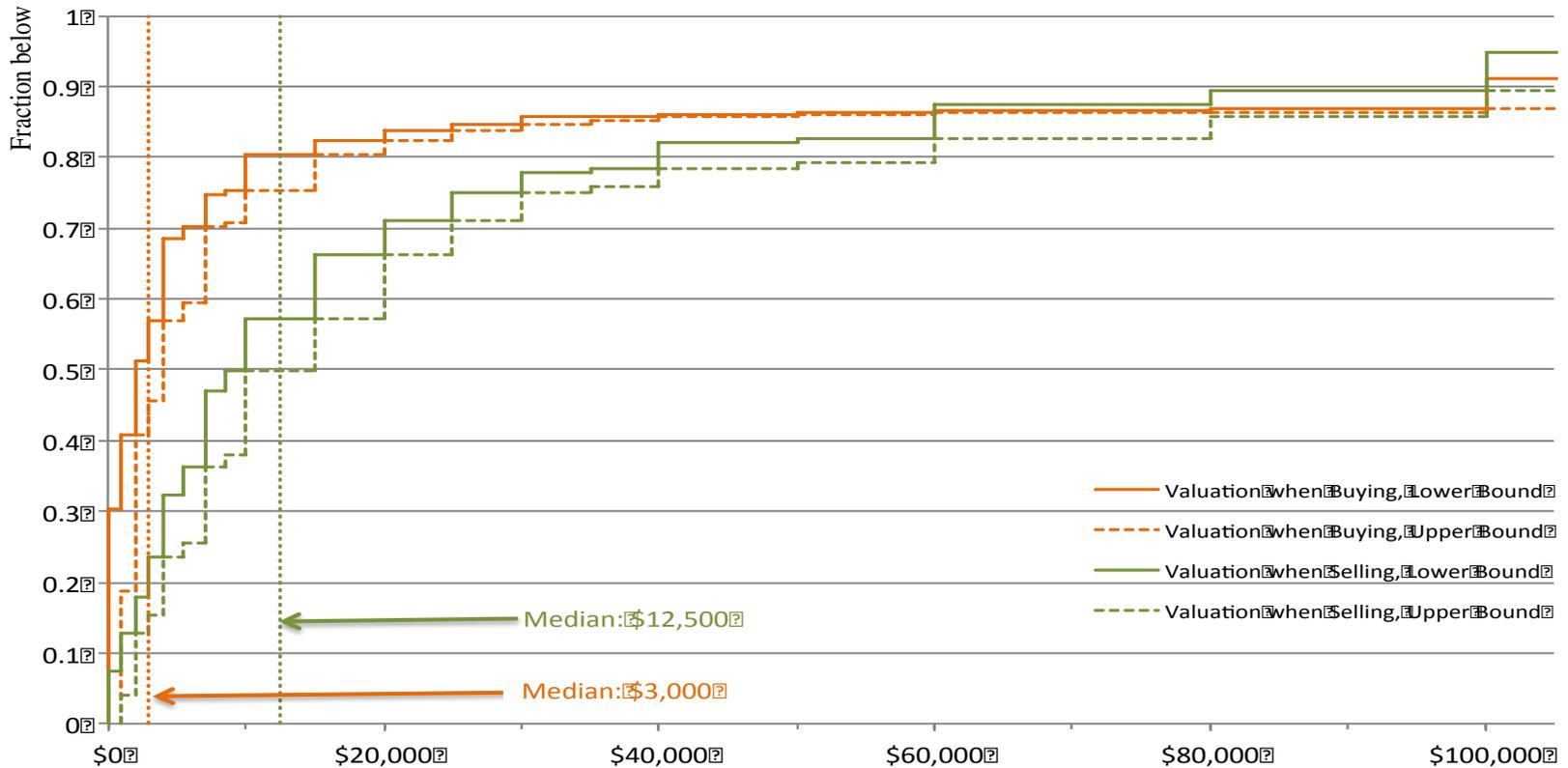
- 12% wants $200,000 or more

# CV-SELL and CV-BUY

# CV-SELL and CV-BUY (continued)

- People place a much higher value on SS when asked to give up some of it than when asked their willingness to pay for some more

- This could be status quo bias/ endowment effect

- Liquidity constraints are an unlikely explanation (e.g. about 82 percent of respondents indicate that they could come up with the lowest lump-sum amount that they declined to pay. Of the 18 percent that indicated that they could not come up with this amount, half said that even if they had had the money, they would have declined to pay the lump sum)

# EV-SELL and EV-BUY



Median: $12,500

Median: $3,000

Lump Sum Equivalent to a $100/month Change in Social Security Benefits

Legend:
- Valuation when Buying, Lower Bound
- Valuation when Buying, Upper Bound
- Valuation when Selling, Lower Bound
- Valuation when Selling, Upper Bound

# EV-SELL and EV-BUY (continued)

- A similar shift as with CV, but slightly less dramatic

- Note that with EV, endowment effects are less likely (since none of the alternatives includes the status quo)

# Within Person Variation (correlations)

| Pairwise correlations | CV-Sell (in logs) | EV-Sell (in logs) | CV-Buy (in logs) | EV-Buy (in logs) |
|---|---|---|---|---|
| CV-Sell (in logs) | 1 | | | |
| EV-Sell (in logs) | 0.31*** | 1 | | |
| CV-Buy (in logs) | -0.11*** | -0.17*** | 1 | |
| EV-Buy (in logs) | -0.11*** | -0.15*** | 0.72*** | 1 |

# Financial Literacy Index (1)

- *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 $102,*
- *exactly $102,*
- *or less than $102?*
- *{Do not know; refuse to answer}*

# Financial Literacy Index (2)

- *Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year.*
- *After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?*
- *More*
- *The same*
- *Less*
- *{Do not know; refuse to answer}*

# Financial Literacy Index (3)

- *Do you think that the following statement is true or false?*

- *"Buying a single company stock usually provides a safer return than a stock mutual fund."*

- *True*

- *False*

- *{Do not know; refuse to answer}*

# Six Number Scoring Tests

Here is an example of a simple batch:

- Item　　　　　Answer

- 7 8 __ 10　　　Correct: 9
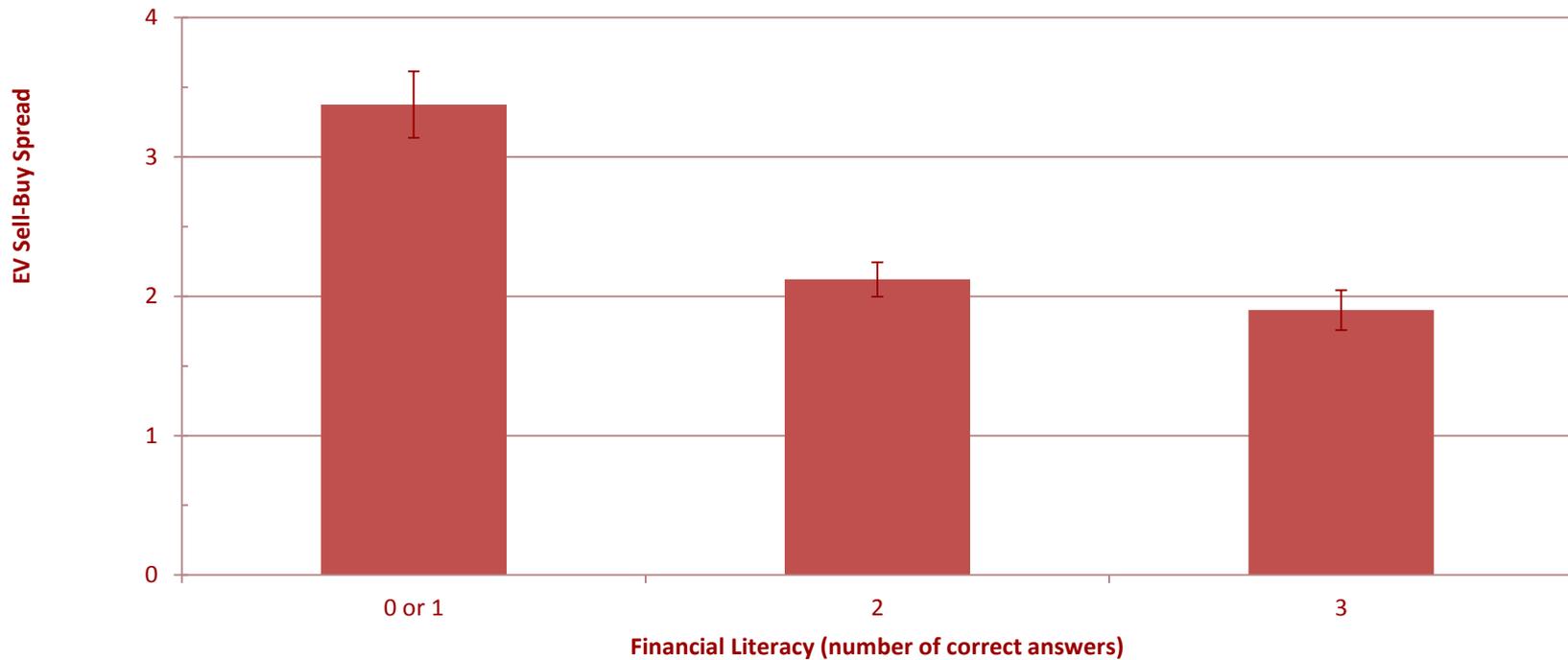
- 5 __ 3 2　　　Correct: 4

- 4 7 10 __　　　Correct: 13

Here is a more challenging one:

- 1 __ 16 64　　　Correct: 4

- __ 19 25 37 61　Correct: 16

- 70 __ __ 84　　Correct: 72, 76 **or** 78, 82

- Based on six such batches and a scoring algorithm a respondent is assigned a score
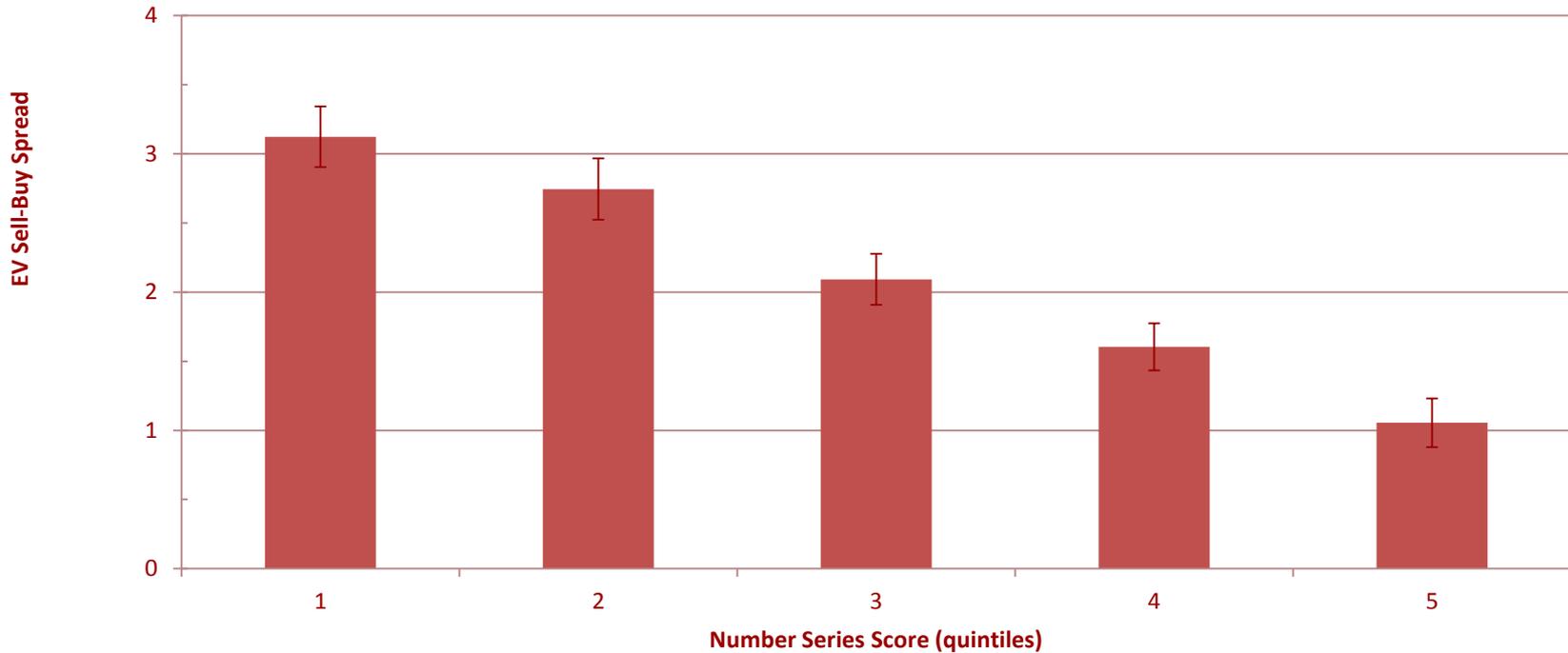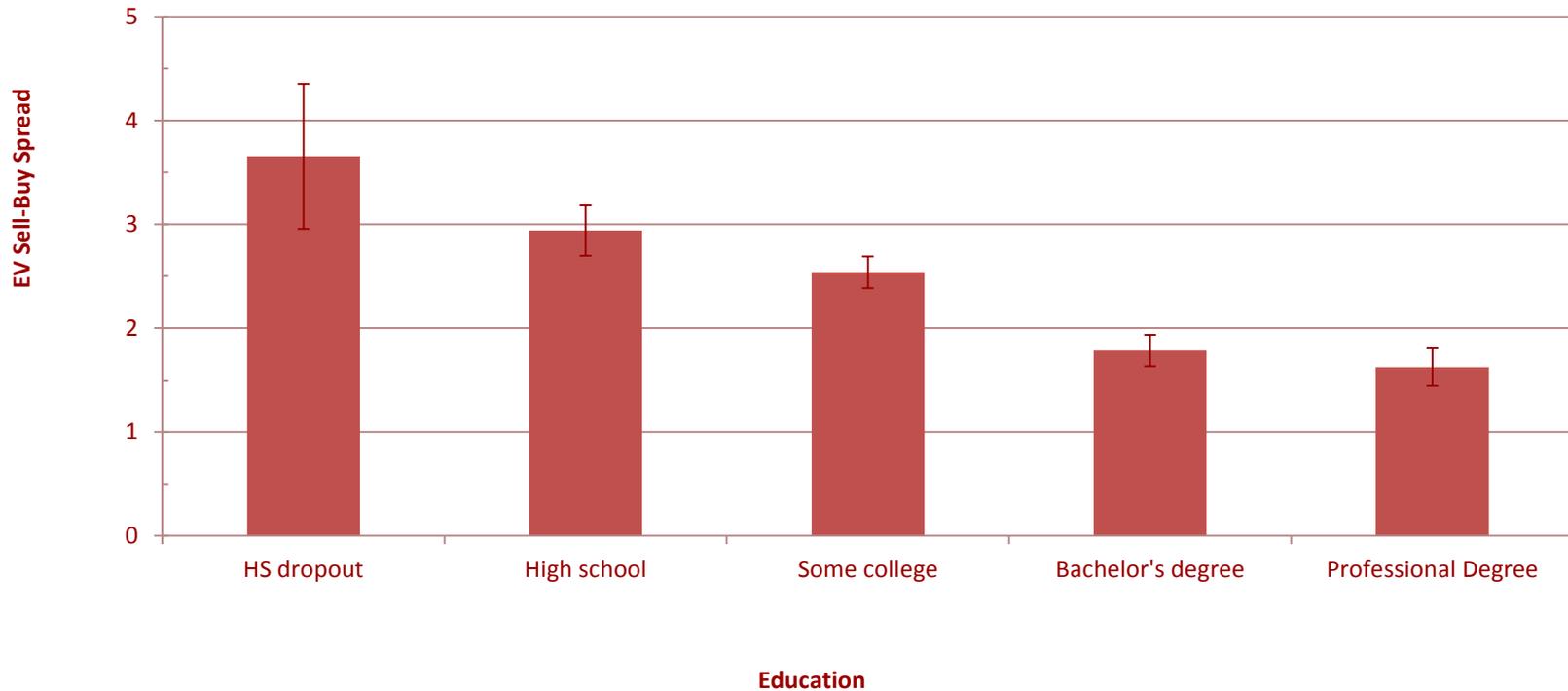
# EV Sell-Buy Spread by Financial Literacy



Panel A

# EV Sell-Buy Spread by Education

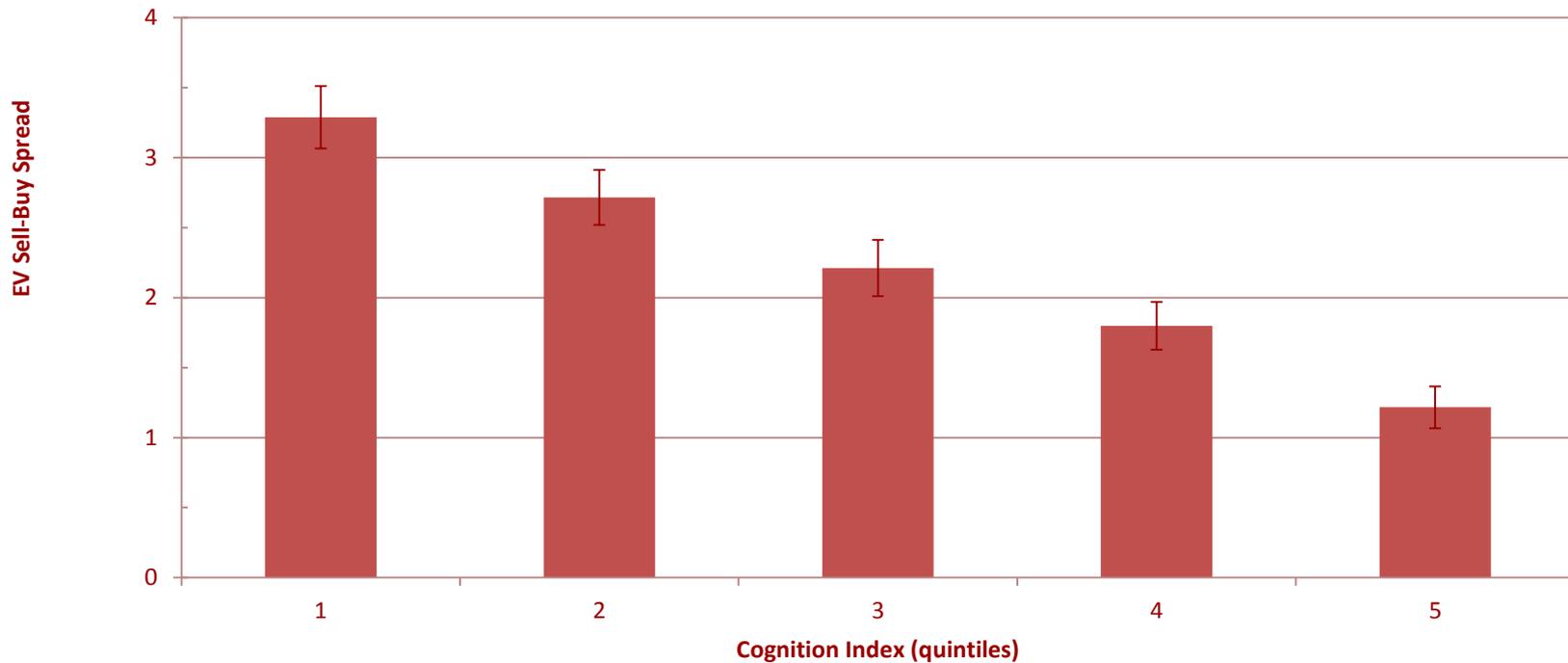## Panel C

# EV Sell-Buy Spread by Cognition Index



Panel D

# Explaining the Sell-Buy Spread

| Dependent Variable: |Log CV-Sell - Log CV-Buy| | | | |
|---|---|---|---|---|
| **Explanatory Variables** | **(1)** | **(2)** | **(3)** | **(4)** |
| **Age 35 to 49** | **-0.10** | **0.08** | **0.09** | **0.22** |
| | **(0.13)** | **(0.13)** | **(0.13)** | **(0.13)** |
| **Age 50 to 64** | **0.05** | **0.33***** | **0.34***** | **0.42***** |
| | **(0.12)** | **(0.12)** | **(0.12)** | **(0.13)** |
| **Age 65 and older** | **0.44***** | **0.66***** | **0.68***** | **0.66***** |
| | **(0.14)** | **(0.14)** | **(0.14)** | **(0.16)** |
| **Cognition index, standardized** | | | **-0.59***** | **-0.42***** |
| | | | **(0.04)** | **(0.07)** |
| **Financial literacy index, 0-3 scale** | | **-0.32***** | | |
| | | **(0.06)** | | |
| **Education index, 1-5 scale** | | **-0.24***** | | |
| | | **(0.04)** | | |
| **Number series score, standardized** | | **-0.31***** | | |
| | | **(0.05)** | | |
| **Controls for demographics** | **No** | **No** | **No** | **Yes** |
| **Controls for experimental** | **Yes** | **Yes** | **Yes** | **Yes** |
| **Adjusted R$^2$** | **0.0270** | **0.1230** | **0.1233** | **0.1677** |

# More Randomizations

| Explanatory Variables | Dependent Variable: log CV-Sell | | | |
|---|---|---|---|---|
| | **Entire sample** | **Top quintile of cognition index** | **Bottom quintile of cognition index** | **Entire sample** |
| **Log of starting value** | 0.37*** | 0.17 | 0.92*** | 0.39*** |
| | (0.07) | (0.13) | (0.21) | (0.07) |
| | | | | |
| **Asked after larger version** | 0.70*** | 0.70*** | 0.77*** | 0.69*** |
| | (0.07) | (0.12) | (0.19) | (0.07) |
| | | | | |
| **Asked in wave 1** | 0.04 | 0.01 | 0.38** | 0.05 |
| | (0.07) | (0.12) | (0.19) | (0.07) |
| | | | | |
| **Lump-sum option shown last** | 0.09 | 0.01 | -0.03 | 0.08 |
| | (0.07) | (0.12) | (0.19) | (0.07) |
| **Log of starting value ⨯ Cognition index** | | | | -0.20** |
| | | | | (0.08) |
| **Asked after larger version ⨯ Cognition index** | | | | -0.09 |
| | | | | (0.07) |
| **Asked in wave 1 ⨯ Cognition index** | | | | -0.03 |
| | | | | (0.07) |
| **Lump-sum option shown last ⨯ Cognition index** | | | | 0.03 |
| | | | | (0.07) |
| **Cognition index** | | | | -0.17*** |
| | | | | (0.04) |
| **Adjusted $R^2$** | 0.0600 | 0.0832 | 0.0827 | 0.0737 |

# Explanations

- Starting value:
  - Starting value of size of lump sum
- Asked in wave 1:
  - Whether questions were asked in first or second wave (the experiment was done over two waves)
- Lump sum option shown last
  - If that would show an effect, it would indicate "straight lining"
- Asked after larger version:
  - Order of increment sizes in CV_sell (Xs arranged in increasing order or Xs arranged in decreasing order)

# Political risk?

- One version of the annuity valuation question states: *"From now on, please assume that you are absolutely certain that Social Security will make payments as promised, and that there is no chance at all of any benefit changes in the future other than the trade-offs discussed in the question below."*

-  We find that the response to the no-political-risk question is a statistically significant 7 percent *lower* than the response to the baseline CV-Sell question.

- Our question may have had the unintended effect of making political risk more salient, rather than less.

# Explaining Annuity Valuations

| Explanatory Variables | Dependent Variable: Mean of CV-Sell and CV-Buy (in logs) | | | |
|---|---|---|---|---|
|  | (1) | (2) | (3) | (4) |
| Log actuarial value | 1.02*** (0.25) |  | 0.84*** (0.26) |  |
| Log theoretical utility-based annuity value |  | 0.04 (0.04) |  | 0.18 (0.13) |
|  | (0.13) | (0.13) | (0.12) | (0.13) |
| R-squared | 0.060 | 0.053 | 0.080 | 0.076 |
| Number of observations | 2065 | 2065 | 2065 | 2065 |

Columns (1) and (2): controls for age, sex, race, marital status, experimental variation; columns (3) and (4) additional controls for education, income, owns an annuity, home ownership, self-reported health, ever had kids, risk aversion, precaution, expects a return >3%.

# Predictive Power of Actuarial Value by Quintile of the Cognition Index

| Dependent Variable: Mean of log CV-Sell and log CV-Buy | Coefficient on log actuarial value | p-value on coefficient=1 | Root MSE | Adjusted $R^2$ | N |
|---|---|---|---|---|---|
| 1. *Bottom quintile* | **0.46** | **0.483** | **1.488** | **0.0922** | **404** |
| | **(0.77)** | | | | |
| 2. *Second quintile* | **0.76** | **0.686** | **1.246** | **0.0259** | **451** |
| | **(0.59)** | | | | |
| 3. *Third quintile* | **1.24**** | **0.618** | **1.163** | **0.0204** | **392** |
| | **(0.49)** | | | | |
| 4. *Fourth quintile* | **0.77** | **0.650** | **1.034** | **0.0498** | **433** |
| | **(0.50)** | | | | |
| 5. *Fifth quintile* | **1.49***** | **0.340** | **0.889** | **0.0677** | **385** |
| | **(0.51)** | | | | |

# Correlations between buy and sell become more negative for lower values of the cognition index

**Panel B: Sell vs. Buy**



*Correlation between Sell Valuations and Buy Valuations* (y-axis)

*Cognition Index (quintiles)* (x-axis)
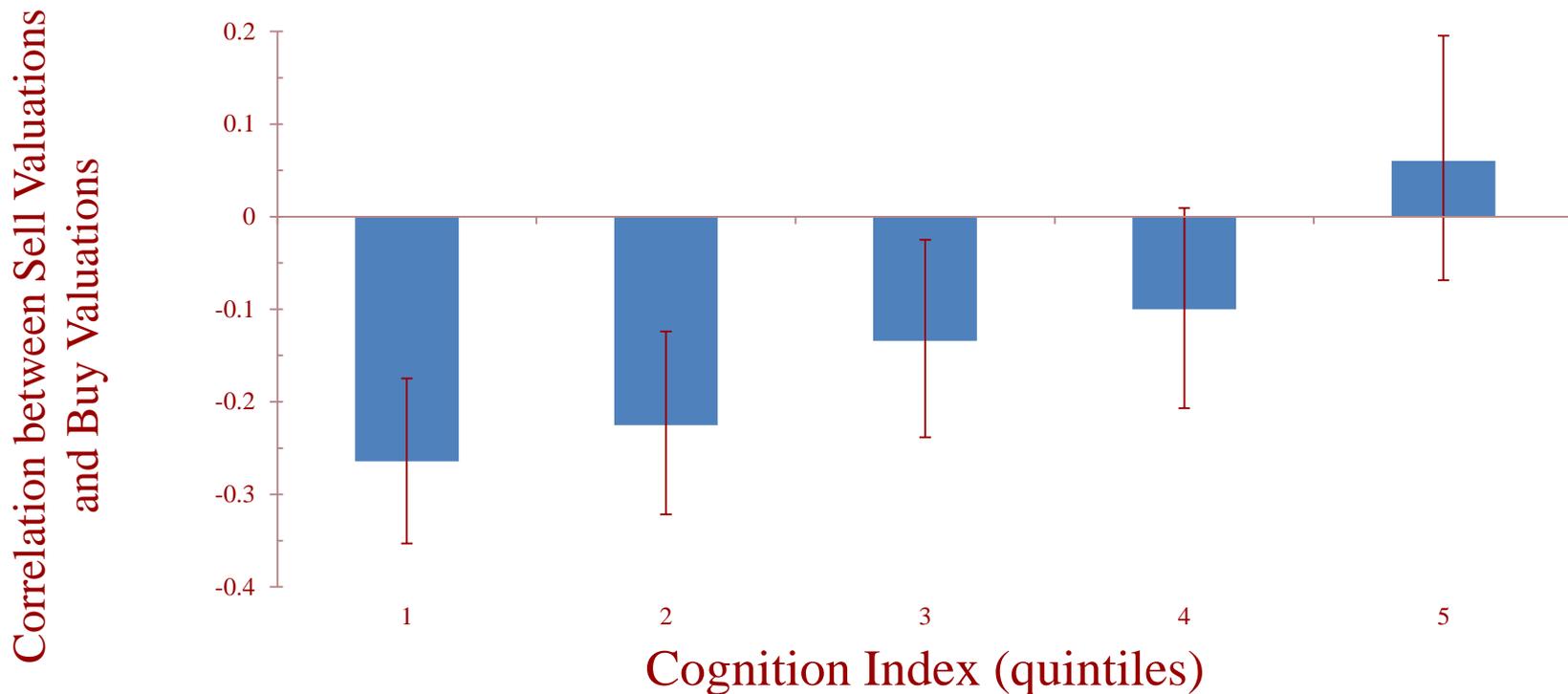
# Robustness

# Compare results with and without 148 outliers

- We have repeated the analyses omitting 148 extreme values:

  – Results change very little; In particular the negative correlation between buy and sell does not go away
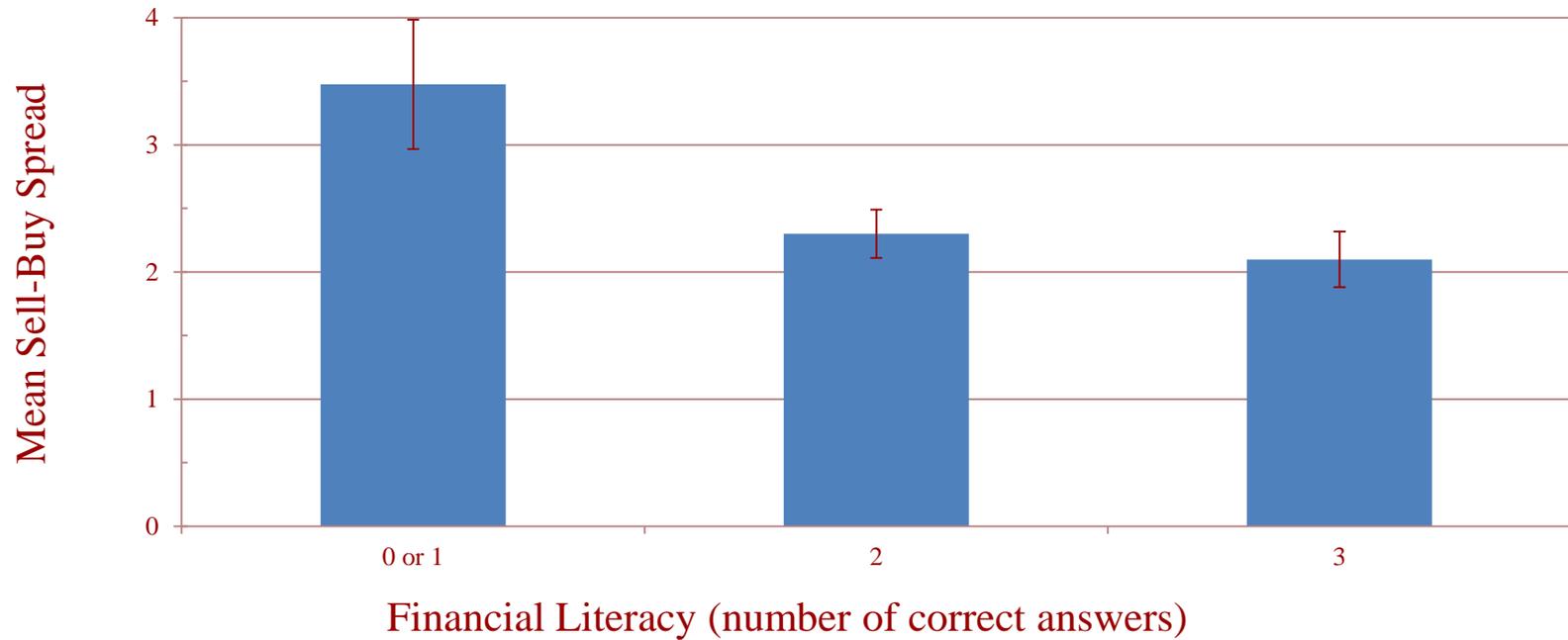
# Correlations for 50+

| Pairwise correlations | CV-Sell (in logs) | EV-Sell (in logs) | CV-Buy (in logs) | EV-Buy (in logs) |
|---|---|---|---|---|
| CV-Sell (in logs) | 1 | | | |
| EV-Sell (in logs) | 0.29*** | 1 | | |
| CV-Buy (in logs) | -0.11*** | -0.17*** | 1 | |
| EV-Buy (in logs) | -0.11*** | -0.17*** | 0.72*** | 1 |

# EV Sell-Buy Spread by Financial Literacy, 50+

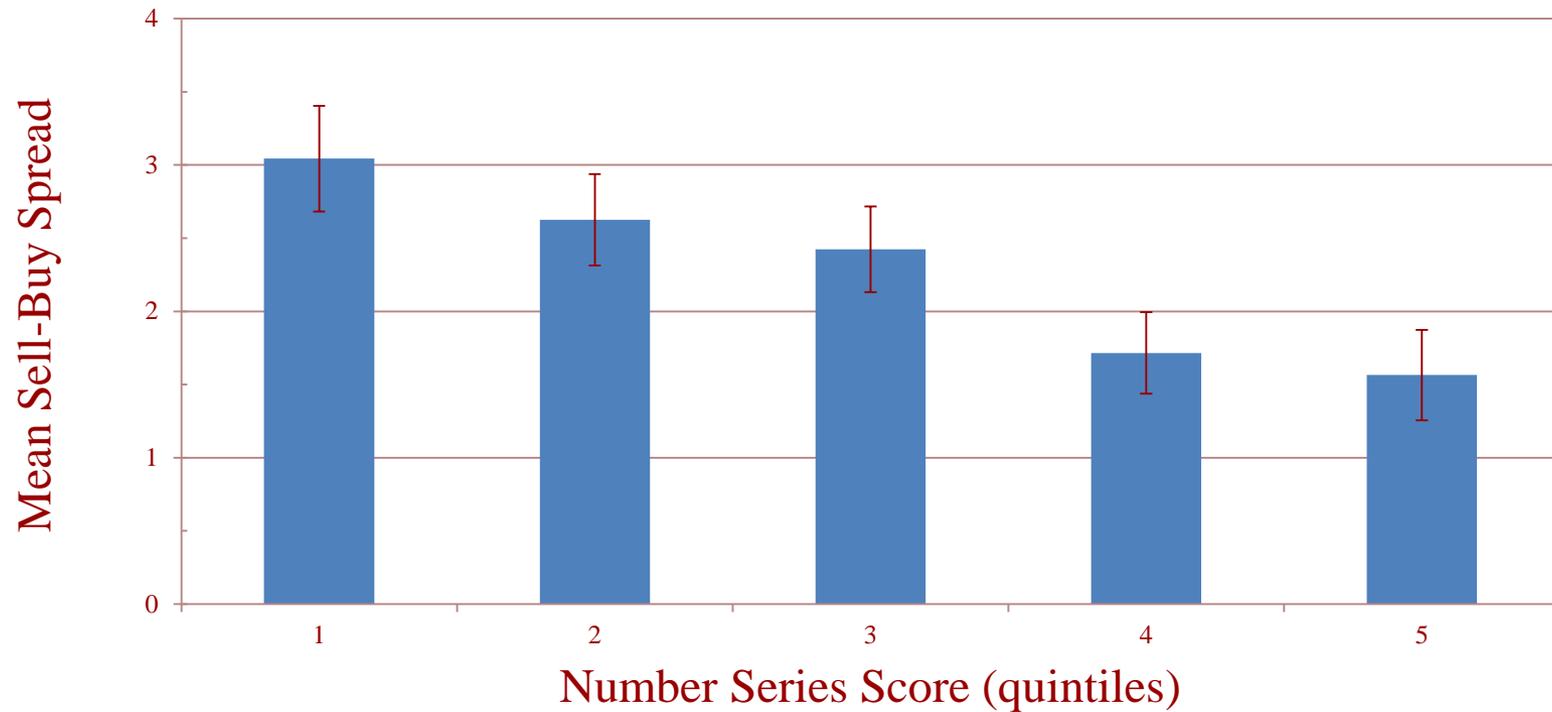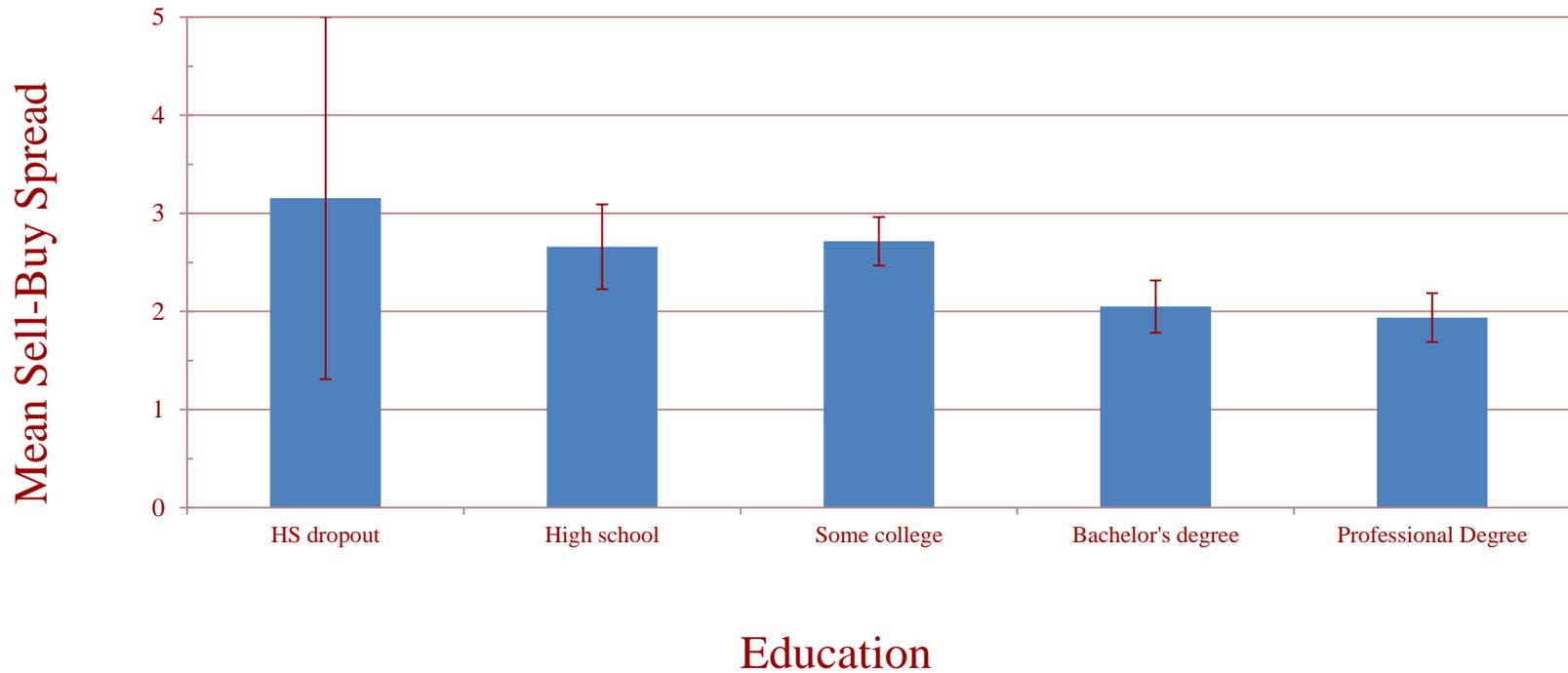**Panel A**

# EV Sell-Buy Spread by Number Series Score, 50+



Panel B

EV Sell-Buy Spread by Education, 50+
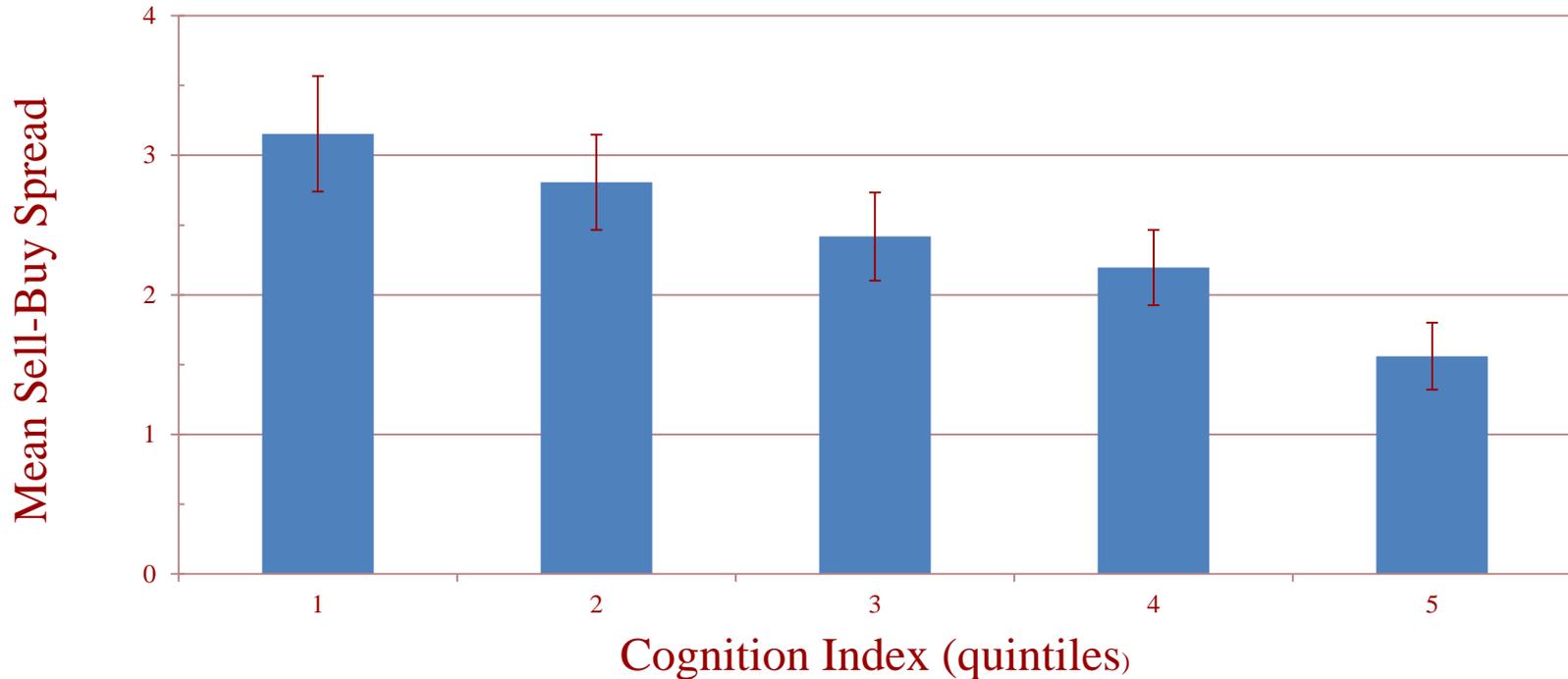
Panel C

Mean Sell-Buy Spread vs Education (HS dropout, High school, Some college, Bachelor's degree, Professional Degree)

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# EV Sell-Buy Spread by Cognition Index, 50+



**Panel D**

*Mean Sell-Buy Spread* (y-axis)

Cognition Index (quintiles)

# Logits indicating that respondent has at least one extreme value at the 80, 85, 90 and 95th percentile

# Extreme values are more likely for

- Older respondents

- Lower educated

- Minorities

- Women

- Non-home owners

- Respondents with lower incomes

- Respondents with lower wealth

- Lower financial literacy

# How About Endowment Effects?

A typical utility function would be:

$$U(Y) = \alpha Y - \beta(Y\text{-}Ref)\mathbf{1}(Y>Ref)$$

$\alpha>0$ denotes the marginal utility of SS benefits below the reference level and $0<\beta<\alpha$ denotes the decrease in marginal utility of Social Security that occurs at the reference point.

$0<\beta<\alpha<0$ denotes the case where marginal utility falls discontinuously at the kind but remains positive.

# Apply this to our setting

|  | "Sell" Version | | "Buy" Version | |
|---|---|---|---|---|
|  | **Choice A** | **Choice B** | **Choice A** | **Choice B** |
| CV | *[Ref-100]+13,000* | *[Ref]* | *[Ref+100]–3,000* | *[Ref]* |
| EV | *[Ref]+13,000* | *[Ref+100]* | *[Ref] – 3,000* | *[Ref-100]* |

# The Utility Function can Rationalize CV

$$U(Y) = \alpha Y - \beta(Y\text{-}Ref)1(Y>Ref),$$

**CV-Sell:** $U(Ref\text{-}100) + 13{,}000 = U(Ref)$ , or

$\alpha(Ref\text{-}100) + 13000 = \alpha\,Ref$          $\rightarrow$    $\alpha = 130$

**CV-Buy:** $U(Ref+100) - 3{,}000 = U(Ref)$, or

$\alpha(Ref+100)\text{-}100\beta - 3000 = \alpha\,Ref$       $\rightarrow$    $\beta = 100$

# But not EV

$$\alpha \, Ref + 13000 = \alpha(Ref+100)-100\beta \;\rightarrow\; 13000 = 100(\alpha-\beta)$$

$$\alpha \, Ref - 3000 = \alpha(Ref-100) \qquad\qquad \rightarrow \quad 3000 = 100\alpha$$

Hence: $\alpha = 30$, $\beta = -100$

Recall, for CV we had $\alpha = 130$, $\beta = 100$

Moreover, for EV marginal utility increases above the reference point: 30-(-100) =130

# Discussion

- The task of valuing annuities is very challenging, even for individuals with high cognition and financial literacy.

- Nevertheless, there is a very robust and strong effect of cognitive measures on capability to value annuities at least somewhat coherently

- It appears that an "unwillingness to trade" is strongly related to inability to value the alternatives.

- This phenomenon may explain several "anomalies" in the literature

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*Thank You*