

Econ 211

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More Evidence for Prospect Theory

Overview

- ▶ Loss aversion is one of the most well-supported theories from the field
- ▶ We already saw how it could explain behavior of cab drivers
- ▶ We will see two more famous examples today
 - ▶ One additional real-world example, this time of professional golfers
 - ▶ A laboratory experiment where reference points come from expectations

Why Golf?

- ▶ Pope and Schweitzer examine observational data from professional golfers playing on the PGA tour
- ▶ Golf suggests a natural reference point for score on each hole: par
 - ▶ Par is the number of strokes a professional golfer typically takes to complete the hole

Why Golf?

- ▶ Pope and Schweitzer examine observational data from professional golfers playing on the PGA tour
- ▶ Golf suggests a natural reference point for score on each hole: par
 - ▶ Par is the number of strokes a professional golfer typically takes to complete the hole
 - ▶ Because object of game is *minimize* number of strokes, below par is the gain domain and above par is the loss domain
 - ▶ Terminology for going above or below par:
 - ▶ Eagle: two shots below par
 - ▶ Birdie: one shot below par
 - ▶ Bogey: one shot above par
 - ▶ Double bogey: two shots above par
- ▶ Stakes are very high: typical tournament pays out \$5 million in prizes to the top finishers

Connection to Prospect Theory

- ▶ Let Δx indicate the score relative to par
- ▶ Prospect theory value function (with no diminishing sensitivity):

$$v(\Delta x) = \begin{cases} \Delta x & \Delta x \geq 0 \\ \lambda \Delta x & \Delta x < 0 \end{cases}$$

- ▶ Focus on putting (usually last 1-2 shots of the hole)
 - ▶ Make the putt for score $\Delta x - 1$, or
 - ▶ Miss the putt for score Δx
- ▶ Prediction from prospect theory?

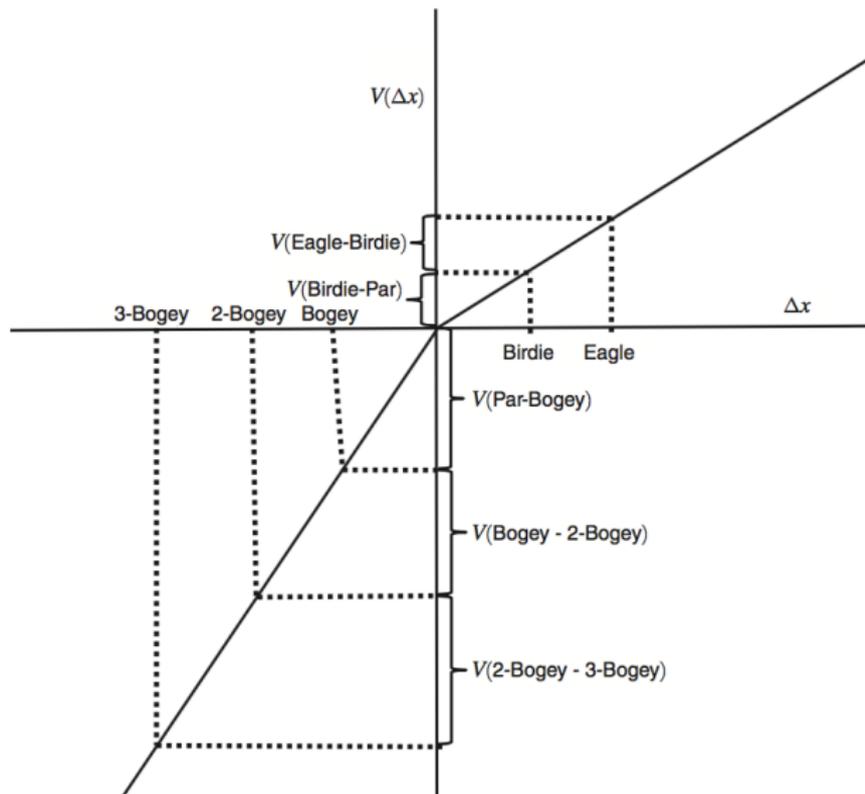
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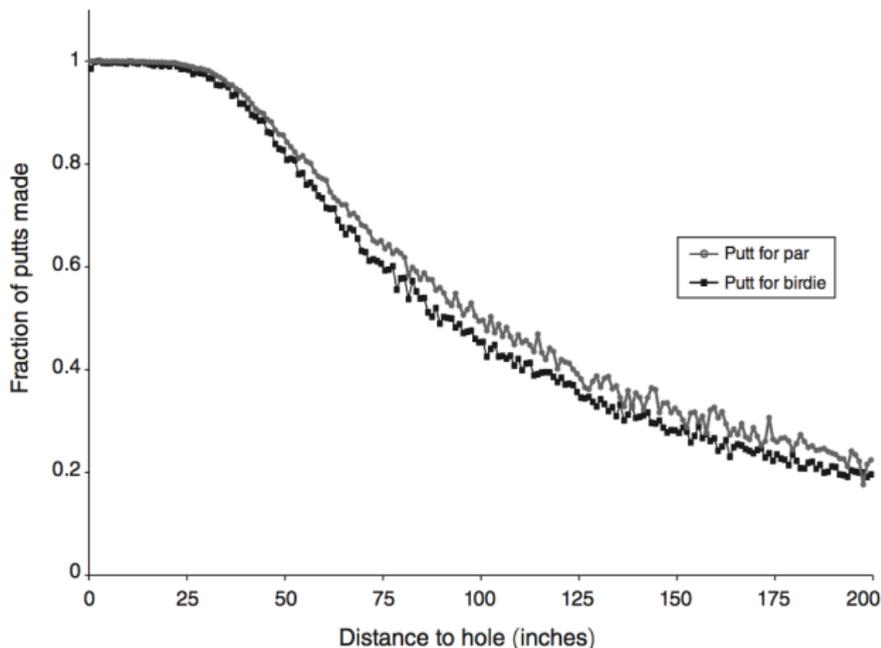
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- ▶ Focus on putting (usually last 1-2 shots of the hole)
 - ▶ Make the putt for score $\Delta x - 1$, or
 - ▶ Miss the putt for score Δx
- ▶ Prediction from prospect theory? Putts attempted for par, bogey, and double-bogey will be more accurate than putts attempted for birdie and eagle

Value Function Applied to Golf



Results



- ▶ 2-4 percentage points more likely to make putts for par from same distance as putt for birdie

Expectations as Reference Point

- ▶ So far, we have mostly thought of reference point as fixed number, independent of the choice at hand
- ▶ However, possible that reference point is based on *expected* outcome
 - ▶ For example, equal chances of getting \$10, \$40, or \$50
 - ▶ Getting \$10 feels like a loss, while getting \$40 or \$50 feels like a gain
 - ▶ So a reasonable reference points might be the expected value:

$$\frac{\$10 + \$40 + \$50}{3} = \$33.33$$

Setup: Effort Task

- ▶ Abeler, Falk, and Goette (2011) perform lab experiment where they manipulate expected payment for a task
- ▶ Task: count the number of zeros in an array of 150 randomly ordered ones and zeros
 - ▶ This is *really annoying* ▶ Example

Setup: Effort Task

- ▶ Abeler, Falk, and Goette (2011) perform lab experiment where they manipulate expected payment for a task
- ▶ Task: count the number of zeros in an array of 150 randomly ordered ones and zeros
 - ▶ This is *really annoying* [▶ Example](#)
- ▶ Subjects performed as many of these tasks as they wanted, for up to 60 minutes
- ▶ One of two possible payment schemes
 - ▶ 50% probability: paid 10 cents per correct answer (piece rate)
 - ▶ 50% probability: paid fixed amount (either 3 Euros in LOW treatment or 7 Euros in HIGH treatment)
- ▶ Do not know which payment scheme will be used under *after* they have decided to stop working

Expected Results

- ▶ Assume that reference point for earnings is average of what subject will earn if paid piece rate and what subject will earn if paid fixed amount
- ▶ Which treatment should have higher effort?

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- ▶ Assume that reference point for earnings is average of what subject will earn if paid piece rate and what subject will earn if paid fixed amount
- ▶ Which treatment should have higher effort?
- ▶ Reference point should be higher for subjects in the HIGH treatment
- ▶ Earning less than the reference point feels like a loss, so subjects work harder to get to reference point
- ▶ Thus subjects in HIGH treatment are expected to work harder (ie complete more tasks) than subjects in LOW treatment

Formal Analysis

- ▶ Suppose if subject puts in effort e , they will finish e tasks
- ▶ Each task pays w (no fixed amount yet)
- ▶ Utility of money $4\sqrt{x}$
- ▶ Effort cost $c(e) = e$
- ▶ Thus utility is $u(e) = 4\sqrt{we} - e$

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$$EU = \frac{1}{2}(4\sqrt{we} - e) + \frac{1}{2}(4\sqrt{F} - e) = 2\sqrt{we} + 2\sqrt{F} - e$$

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 - ▶ FOC of EU gives $e = w$
 - ▶ Note that effort does not change if F increases

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- ▶ What is prospect theory value as function of e ?
 - ▶ Assume $\lambda = 2$
 - ▶ Assume reference point only affects money part of utility function, not effort cost part
 - ▶ Assume $F > we$ for all possible effort levels

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$$PT = \frac{1}{2}(-2) \left(4\sqrt{\left| we - \left(\frac{1}{2}F + \frac{1}{2}we \right) \right|} - e \right) \\ + \frac{1}{2} \left(4\sqrt{\left| F - \left(\frac{1}{2}F + \frac{1}{2}we \right) \right|} - e \right)$$

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- ▶ What level of e maximizes PT?
 - ▶ FOC of PT gives $e = \frac{F}{w} - \frac{1}{2}w$
 - ▶ Note that effort increases with F

Results

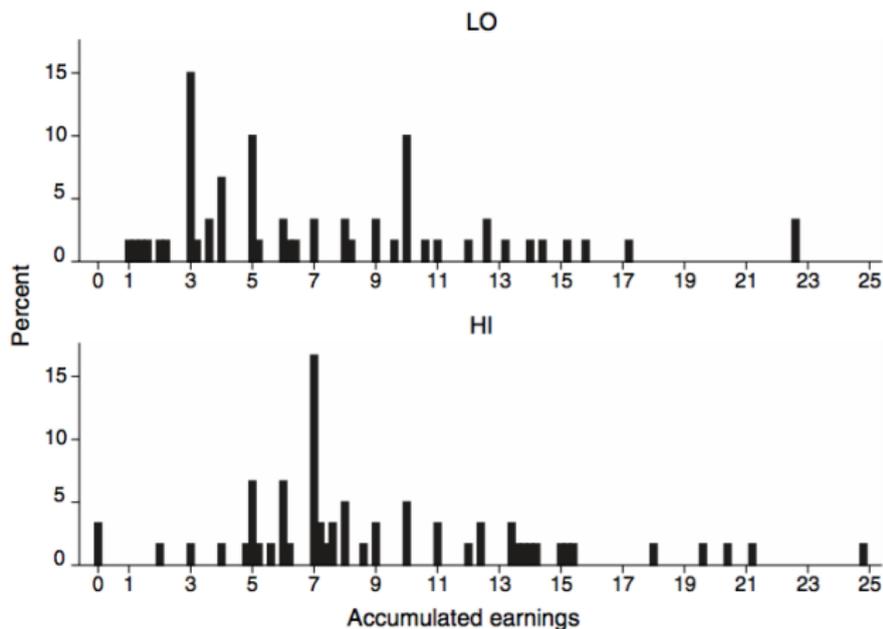


FIGURE 1. HISTOGRAM OF ACCUMULATED EARNINGS (IN EUROS)
AT WHICH A SUBJECT STOPPED

► Averages:

- LOW: 7.27 Euro
- HIGH: 9.22 Euro

Formation of Risk Preferences

Motivation

- ▶ Standard theory
 - ▶ You are born knowing exactly how you will respond to risk
 - ▶ Risk preferences are stable over your entire lifetime
 - ▶ Your risk preferences do not depend on outside factors or information
- ▶ However, it is clear intuitively that your experiences can shape your tolerance for risk

Setup

- ▶ Malmendier and Nagel (2011) examine this question with observational data
 - ▶ Data from the Survey of Consumer Finances, 1960-2007
 - ▶ Respondents report own risk tolerance, as well as their stock and bond holdings
 - ▶ Authors also collect data on annual average returns for stock market

Setup

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 - ▶ Data from the Survey of Consumer Finances, 1960-2007
 - ▶ Respondents report own risk tolerance, as well as their stock and bond holdings
 - ▶ Authors also collect data on annual average returns for stock market
- ▶ Hypothesis: individuals who have experienced higher returns on the stock market during their lifetime are more likely to take risks and invest in stocks

Results

- ▶ Individuals who experienced better-performing stock markets . . .
 - ▶ more likely to categorize themselves as financial risk-takers
 - ▶ Risk tolerance self-assessed on 4-point scale
 - ▶ Going from 10th to 90th percentile of returns experienced makes 10 percentage points less likely to be in lowest-risk-tolerance group

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 - ▶ more likely to participate in financial markets at all
 - ▶ Participation as many as 7 percentage points lower than expected for some cohorts
 - ▶ hold more of their risky assets as stocks (as opposed to bonds)
 - ▶ Going from 10th to 90th percentile of returns experienced predicts 7.9 percentage points more assets as stocks

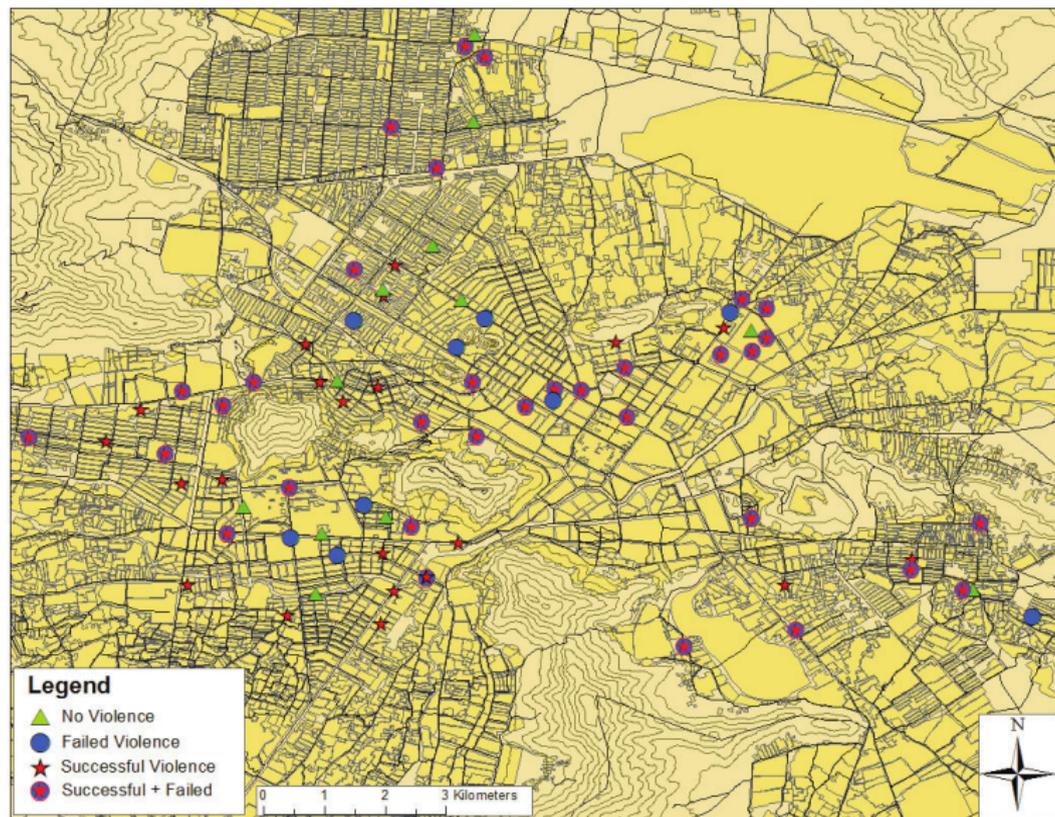
Subject Population

- ▶ Callen et al (2014) conducted field experiment in Afghanistan in December 2010
- ▶ Subjects were asked questions about their risk preferences, and some were also given a psychological prime
- ▶ Conducted near polling centers, three months after major election in September of that year
- ▶ Surveys conducted in homes
 - ▶ Hypothetical risk elicitation used for safety issues
- ▶ 1127 respondents in 12 provinces
 - ▶ Major attrition issues

Violence Data

- ▶ Afghanistan has experienced widespread violence for last 30+ years
- ▶ Focus on 2002-2010, ie leading up to election in 2010
- ▶ Geo-coded data on violence incidents during this time
 - ▶ Successful attacks: direct fire, explosions
 - ▶ Unsuccessful attacks: explosive devices found and cleared, hoaxes
- ▶ Main variable used: whether there were any successful attacks within one kilometer of polling station
- ▶ Placebo test: use failed attacks as main indicator instead
 - ▶ If assume success/failure is random, this allows us to tell whether it is threat or violence or actual violent outcomes that affect behavior

Polling Centers in Kabul



Risk Elicitation Task: Monetary Payoffs

€	Option B	Option A
<i>Task 1</i>		
q'		
[0, 0.1]	10% chance of 450 Afs, 90% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.1, 0.2]	20% chance of 450 Afs, 80% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.2, 0.3]	30% chance of 450 Afs, 70% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.3, 0.4]	40% chance of 450 Afs, 60% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.4, 0.5]	50% chance of 450 Afs, 50% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.5, 0.6]	60% chance of 450 Afs, 40% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.6, 0.7]	70% chance of 450 Afs, 30% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.7, 0.8]	80% chance of 450 Afs, 20% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.8, 0.9]	90% chance of 450 Afs, 10% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
[0.9, 1]	100% chance of 450 Afs, 0% chance of 0 Afs	50% chance of 450 Afs, 50% chance of 150 Afs
€		
<i>Task 2</i>		
q		
[0, 0.1]	10% chance of 450 Afs, 90% chance of 0 Afs	150 Afghanis
[0.1, 0.2]	20% chance of 450 Afs, 80% chance of 0 Afs	150 Afghanis
[0.2, 0.3]	30% chance of 450 Afs, 70% chance of 0 Afs	150 Afghanis
[0.3, 0.4]	40% chance of 450 Afs, 60% chance of 0 Afs	150 Afghanis
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[0.8, 0.9]	90% chance of 450 Afs, 10% chance of 0 Afs	150 Afghanis
[0.9, 1]	100% chance of 450 Afs, 0% chance of 0 Afs	150 Afghanis

Note: 150 Afghanis equivalent to about 1 day's wage. Recall that stakes are hypothetical.

Theoretical Predictions

- ▶ Consider Task 1
 - ▶ EU decision-makers should switch from A to B at q' such that

$$\underbrace{q' \cdot v(450) + (1 - q') \cdot v(0)}_{\text{option B}} = \underbrace{0.5 \cdot v(450) + 0.5 \cdot v(150)}_{\text{option A}}$$

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- ▶ We can choose scale of $v(\cdot)$ so that $v(0) = 0$ and $v(450) = 1$
 - ▶ Solve to find

$$v(150) = \frac{q' - 0.5}{0.5}$$

Theoretical Predictions

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- ▶ Solve to find

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▶ Now consider Task 2

- ▶ EU decision-makers should switch from A to B at q' such that s

$$\underbrace{q \cdot v(450) + (1 - q) \cdot v(0)}_{\text{option B}} = \underbrace{v(150)}_{\text{option A}}$$

- ▶ Solve to find

$$v(150) = q$$

Theoretical Predictions, cont

- ▶ So expected utility theory says there should be a connection between Task 1 switch point q' and Task 2 switch point q :

$$q = \frac{q' - 0.5}{0.5}$$

- ▶ For example, if you switch at row 8 of Task 1, ie $q' \in [0.7, 0.8]$, you should switch at row 5 or 6 of Task 2, ie $q \in [0.4, 0.6]$
- ▶ If you switch earlier or later than this in Task 2, we can take this as evidence against Expected Utility, and in favor of Prospect Theory

Psychological Prime

- ▶ Prior to risk elicitations, subjects are asked one of three (randomly selected) questions:
 - ▶ “We are interested in understanding your daily experiences that may make you fearful or anxious. This could be anything, for example getting sick, experiencing violence, losing a job, etc. Could you describe one event in the past year that caused you fear or anxiety?” (FEAR)

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 - ▶ “We are interested in understanding your general daily experiences. This could be anything. Could you describe an event from the past year” (NEUTRAL)

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 - ▶ “We are interested in understanding your general daily experiences. This could be anything. Could you describe an event from the past year” (NEUTRAL)
- ▶ Prior evidence that being primed for fear makes individuals think bad events are more likely (Lerner et al 2003)

Results

- ▶ Evidence of strong violations of EU predictions among subjects who received FEAR prime and had violence near their polling center
 - ▶ Placebo test indicates that is it successful attacks, and not intended violence, that causes response
- ▶ All other groups consistent with EU predictions

Example of Counting Zeros Task

001111001011101
101011101011101
010111100110010
101011111101000
001110010111100
010001110011011
001010001000011
010111010011110
111111000001101
110100110000000

How many zeros are in the table?

OK

You have counted 0 tables correctly, your acquired earnings are thus **0.00 euros**.

Depending on the card in your envelope, you will receive your acquired earnings of **0.00 euros** or an amount of **3 euros**.

Stop working

▶ Back