Lecture 2g: Choice over Time
Projection Bias

EC 404: Behavioral Economics

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March 22, 2024

“Projection Bias”

Introduced by Loewenstein, O’Donoghue, & Rabin (*QJE* 2003)

“Projection Bias”:

- People understand qualitatively the directions in which their tastes change, but they systematically underappreciate the magnitudes of these changes.

A Model of Projection Bias

Step 1: A Model of Changing Tastes

To describe changes in tastes, we use "state-dependent utility":

- The instantaneous utility in period t is $u(c_t, s_t)$, where c_t is period-t consumption and s_t is the period-t "state".

Two examples:

- $u(\text{pie,hungry}) > u(\text{pie,full})$
- $u(\text{coat,cold}) > u(\text{coat,warm})$

A Model of Projection Bias

Step 2: Predictions of Future Tastes

Suppose you're predicting tastes given future state s, but this prediction is potentially contaminated by your current state s'.

- True tastes will be $u(c, s)$.
- Current tastes are $u(c, s')$.
- Let $\tilde{u}(c, s|s')$ denote the prediction.

Example: Suppose you're predicting what your utility from a slice of pie will be when you're full, but this prediction is potentially contaminated by the fact that you're currently hungry.

- True tastes will be $u(\text{pie, full})$.
- Current tastes are $u(\text{pie, hungry})$.
- $\tilde{u}(\text{pie, full}|\text{hungry})$ denotes your prediction.

A Model of Projection Bias

Step 2: Predictions of Future Tastes (cont)

Standard model: $\tilde{u}(c, s|s') = u(c, s)$.

- The standard economic assumption is that people's predictions are accurate.

Two examples:

- $\tilde{u}(\text{pie, full}|\text{hungry}) = u(\text{pie, full})$
- $\tilde{u}(\text{coat}, \text{warm}|\text{cold}) = u(\text{coat}, \text{warm})$

"Projection bias" means $\tilde{u}(c, s|s')$ in between $u(c, s)$ & $u(c, s')$.

Two examples:

- $u(\text{pie, full}) < \tilde{u}(\text{pie, full}|\text{hungry}) < u(\text{pie, hungry})$
- $u(\text{coat}, \text{warm}) < \tilde{u}(\text{coat}, \text{warm}|\text{cold}) < u(\text{coat}, \text{cold})$

A Model of Projection Bias

Step 3: A Simple Formulation

A person has "simple projection bias" if

$$\tilde{u}\left(c, s|s'\right) \;=\; (1-\alpha) * u\left(c, s\right) \;+\; \alpha * u\left(c, s'\right).$$

- $\alpha = 0 \iff$ No Projection Bias
- $\alpha \in (0,1) \iff$ Projection Bias

Examples:

$$\tilde{u}\left(\text{pie}, \text{full}|\text{hungry}\right) = (1-\alpha) * u\left(\text{pie}, \text{full}\right) + \alpha * u\left(\text{pie}, \text{hungry}\right)$$

$$\tilde{u}\left(\text{coat}, \text{warm}|\text{cold}\right) = (1-\alpha) * u\left(\text{coat}, \text{warm}\right) + \alpha * u\left(\text{coat}, \text{cold}\right)$$

A Model of Projection Bias

Two other issues:

- The person is not aware of the bias (otherwise she could just correct for it).
- Except for these mispredictions, the person's intertemporal preferences are as in discounted utility model (for ease, think δ^x.)

Evidence of Projection Bias

A first type of evidence: underappreciation of the endowment effect.

Loewenstein & Adler (*EJ* 1995)

Subjects: 27 CMU undergrads & 39 Pittsburgh MBA's.

Procedure:

- All subjects shown a mug, told they'll get one and have the opportunity to sell it for money.
- Half of the subjects predict how much they'd sell it for.
- After a delay, all subjects are given a mug and an opportunity to sell

Evidence of Projection Bias

Loewenstein & Adler (*EJ* 1995)

Results:

		Prediction	Actual
CMU:	Prediction	\$3.73	\$5.40
	Control	——	\$6.46
Pittsburgh:	Prediction	\$3.27	\$4.56
	Control	——	\$4.98

Evidence of Projection Bias

VanBoven, Dunning, & Loewenstein (*JPSP* 2000)

Study 2: Subjects were 43 Cornell undergraduates.

19 subjects randomly chosen to be "sellers".
24 subjects randomly chosen to be "buyers".

Each seller given a coffee mug.
Each buyer shown a coffee mug.

Two tasks:

- Elicit people's reservation prices.
- Ask buyers to predict average reservation price of sellers, and ask sellers to predict average reservation price of buyers.

Evidence of Projection Bias

VanBoven, Dunning, & Loewenstein (*JPSP* 2000)

Results:

	Reservation Price	Prediction for Other Group
Sellers:	$6.37	$3.93 Buyers:
$1.85	$4.39	

Evidence of Projection Bias

A second type of evidence: underappreciation of the effects of hunger.

Read & van Leeuwen (*OBHDP* 1998)

Subjects were 200 employees at several firms in Amsterdam.

Procedure:

- Each subject asked to choose between a healthy vs. unhealthy snack to be received in one week.
- They varied subjects' expected future hunger and their current hunger.

Evidence of Projection Bias

Read & van Leeuwen (*OBHDP* 1998)

Results: % of Subjects Choosing Unhealthy Snack

		Future Hunger: Hungry	Future Hunger: Satiated
Current Hunger	Hungry	78%	42%
	Satiated	56%	26%

Application: Projection Bias & The Endowment Effect

Let's use the model of the endowment effect that we used earlier this semester (based on loss aversion).

- (Total Utility) = (Mug Utility) + (Money Utility)
- (Total Utility) = $u(c, r)$ + m

Mug utility is $u(c, r) = w(c) + v(c - r)$, where

$$w(c) = \mu * c \qquad \text{and} \qquad v(x) = \begin{cases} \phi x & \text{if } x \geq 0 \\ \lambda \phi x & \text{if } x \leq 0. \end{cases}$$

Application: Projection Bias & The Endowment Effect

Suppose buy/sell the mug in period 1, and (possibly) consume the mug in periods 1 & 2.

Consumption is:

- $c_1 = c_2 = 1$ if buy or keep.
- $c_1 = c_2 = 0$ if don't buy or sell.

Initial reference point is exogenous:

- $r_1 = 0 \iff$ unendowed (buyers).
- $r_1 = 1 \iff$ endowed (sellers).

Assume $r_2 = c_1$

Application: Projection Bias & The Endowment Effect

One can show:

- Sellers should sell iff $P \geq P_S^* \equiv$
- Sellers actually sell iff $P \geq P_S^A \equiv$
- Buyers should buy iff $P \leq P_B^* \equiv$
- Buyers actually buy iff $P \leq P_B^A \equiv$

Application: Projection Bias & The Endowment Effect

<u>Some Results:</u>

(1) $p_S^A > p_S^*$ & $p_B^A > p_B^*$.

- People are over-prone to consume goods to which they become accustomed because they underappreciate how they'll adapt — and more generally can lead to incorrect intertemporal utility maximization.

(2) $p_S^A - p_B^A > p_S^* - p_B^*$.

- Projection bias magnifies the endowment effect — and more generally can magnify features of true tastes.

Application: Projection Bias & The Endowment Effect

(3) $\hat{p}_S^A < p_S^A$ & $\hat{p}_B^A > p_B^A$, where

$$\begin{aligned} \hat{p}_S^A &\equiv \text{unendowed person's predicted selling price} \\ \hat{p}_B^A &\equiv \text{endowed person's predicted buying price} \end{aligned}$$

- Consistent with the evidence on underappreciation of the endowment effect — and more generally can lead people to make plans that they don't carry out.

Application: Projection Bias and Durable Goods

(Discussion courtesy of O'Donoghue)

Underlying environment:

- A durable good — e.g., a winter coat — yields a utility stream

$$\mu_1, \mu_2, ..., \mu_T.$$

- These μ's typically vary from day to day in a somewhat random way — for simplicity, let's assume that for all days the expected value of μ_t is $\bar{\mu}$.

Application: Projection Bias and Durable Goods

On Day 1, when a person knows μ_1 but not the future μ_t's, how much is the person willing to pay for this durable good (assuming no discounting)?

- Optimal:

$$WTP = \mu_1 + (T-1)\bar{\mu}$$

- With Projection bias:

$$\begin{aligned} WTP &= \mu_1 + (T-1)[(1-\alpha)\bar{\mu} + \alpha\mu_1] \\ &= \mu_1 + (T-1)[\bar{\mu} + \alpha(\mu_1 - \bar{\mu})] \end{aligned}$$

Hence:
If $\mu_1 > \bar{\mu}$ then overprone to buy. If $\mu_1 < \bar{\mu}$ then underprone to buy.

Application: Projection Bias and Durable Goods

Recall: If $\mu_1 > \bar{\mu}$ then overprone to buy.
If $\mu_1 < \bar{\mu}$ then underprone to buy.

One extension: Suppose that you have multiple opportunities to buy the durable good (and suppose that there are limits on your ability to return the good).

Case 1: Suppose $P < T\bar{\mu}$, so you SHOULD buy the good.

- You end up buying it as long as $\mu_t \geq \bar{\mu}$ on at least one occasion, which is quite likely.
  $\Longrightarrow$ Under-buying is very unlikely.

Case 2: Suppose $P > T\bar{\mu}$, so you should NOT buy the good.

- Again, you end up buying it as long as $\mu_t \geq \bar{\mu}$ on at least one occasion, which is quite likely.
  $\Longrightarrow$ Over-buying is very LIKELY.

Application: Projection Bias and Durable Goods

Recall: If $\mu_1 > \bar{\mu}$ then overprone to buy.
If $\mu_1 < \bar{\mu}$ then underprone to buy.

Second extension: Suppose returns are easy — perhaps we can use returns to test for projection bias in field data.

- If μ_t is large, more "over-buying", thus many returns.
- If μ_t is small, more "under-buying", thus few returns.

Application: Projection Bias and Durable Goods

Conlin, O'Donoghue & Vogelsang (*AER* 2007)

Look at catalog orders — very easy to return!

Prediction: More returns for orders made on high-valuation days than for orders made on low-valuation days.

Big question: How can we assess whether a person orders on a high-valuation day vs. a low-valuation day?

Our answer: look at orders of winter-clothing items as a function of the weather.

- If order on a cold day, it's likely a high-valuation day.
- If order on a warm day, it's likely a low-valuation day.

Authors conduct precisely this test, and indeed find that the colder the temperature on the day a person orders a winter-clothing item, the more likely the person is to return that item.