Projection bias

EE416 Sem2/2019

Announcement

- Final exam is now on Sunday 10th of May, 1.30pm-4.30pm
- Please complete student information sheet:

https://cornell.qualtrics.com/jfe/form/SV_6haBdllJUUfxu8l

- Office hour is now by appointment. Regular office hours on Wednesdays and Fridays will resume when final exams are approaching.

"At any moment our preferences are the result of a unique constellation of needs and desires that may never be repeated. Consequently, when we make choices that will not come into effect until later, we have to predict our future preferences (Kahneman & Snell, 1990; Kahneman, Wakker, & Sarin, 1997; March, 1978). The easiest way to do this is to take our current desires as a baseline and then to adjust them according to anticipated changes in circumstances. To the degree that our tastes are stable, this procedure will work faultlessly, but what happens when they are not?" Read and Van Leeuwen(1998)

"Loewenstein, Prelec, and Shatto (1998) argue that this occurs because it is difficult for us to imagine what it is like to be in a different visceral state than the one we are currently in….They refer to the inability that we have when in one state of arousal to "get in the shoes" of ourselves in a future state as an intrapersonal empathy gap.

PROJECTION BIAS IN PREDICTING FUTURE UTILITY*

George Loewenstein
Ted O'Donoghue
Matthew Rabin

People exaggerate the degree to which their future tastes will resemble their current tastes. We present evidence from a variety of domains which demonstrates the prevalence of such *projection bias*, develop a formal model of it, and use this model to demonstrate its importance in economic environments. We show that, when people exhibit habit formation, projection bias leads people to consume too much early in life, and to decide, as time passes, to consume more—and save less—than originally planned. Projection bias can also lead to misguided purchases of durable goods. We discuss a number of additional applications and implications.

> The great source of both the misery and disorders of human life, seems to arise from over-rating the difference between one permanent situation and another. Avarice over-rates the difference between poverty and riches: ambition, that between a private and a public station: vain-glory, that between obscurity and extensive reputation—Adam Smith, *The Theory of Moral Sentiments* [2002, p. 173; III,iii,31].

Loewenstein, ODonoghue, & Rabin (QJE 2003)

- Introduced the concept of “Projection Bias”:

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

Projection Bias: A Model

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".
- s_t is such as hunger, fear, fatigue, etc.

Projection Bias: A Model

Step 1: A Model of Changing Tastes

- 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:
  - $u(pie, hungry) > u(pie, full)$
  - $u(coat, cold) > u(coat, warm)$

Projection Bias: A Model

Step 2: Predictions of Future Tastes

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

- True taste vs. Current taste vs. Prediction:
  - True taste will be $u(c, s)$.
  - Current taste will be $u(c, s')$.
  - Prediction is denoted by $\tilde{u}(c, s|s')$.

Projection Bias: A Model

Step 2: Predictions of Future Tastes

- True taste vs. Current taste vs. Prediction:
  - True taste will be $u(c, s)$.
  - Current taste will be $u(c, s')$.
  - Prediction is denoted by $\tilde{u}(c, s|s')$.
- 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.

Projection Bias: A Model

Step 2: Predictions of Future Tastes

- True taste vs. Current taste vs. Prediction:
  - True taste will be $u(c, s)$.
  - Current taste will be $u(c, s')$.
  - Prediction is denoted by $\tilde{u}(c, s|s')$.
- True taste vs. Current taste vs. Prediction:
  - True taste will be $u(pie, full)$.
  - Current taste will be $u(pie, hungry)$.
  - Prediction is denoted by $\tilde{u}(pie, full|hungry)$.

Projection Bias: A Model

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

  - True taste = Prediction
  - $\tilde{u}(c, s|s') = u(c, s)$
  - $\tilde{u}(pie, full|hungry) = u(pie, full)$
  - $\tilde{u}(coat, warm|cold) = u(coat, warm)$

Projection Bias: A Model

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

Examples:

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

Projection Bias: A Model

Step 3: A simple formulation

A person has "simple projection bias":

$$\tilde{u}(c,s|s') = (1-\alpha)u(c,s) + \alpha u(c,s')$$

IF $\alpha \in (0,1)$.

If $\alpha = 0$, there is no projection bias.

Examples:

- $\tilde{u}(pie, full|hungry) = \alpha u(pie, hungry) + (1-\alpha)u(pie, full)$
- $\tilde{u}(coat, warm|cold) = \alpha u(coat, cold) + (1-\alpha)u(coat, warm)$

Projection Bias in Economic Applications

- In order to apply projection bias in an economic environment, the starting point MUST be a standard, dynamic economic model with changing tastes (i.e., with state-dependent utility).

- Projection bias does NOT create changes in tastes, rather it creates bias in how people react to underlying changes in tastes.

Projection Bias in Economic Applications

- Person is not aware of the bias (otherwise could just correct for it).
- Except for these mispredictions, intertemporal preferences are as in the DU Model.

- Instead of maximizing:

$$U^t = u_t + \delta u_{t+1} + \delta^2 u_{t+2} \ldots$$

- Person maximizes

$$\widetilde{U}^t = u_t + \delta \tilde{u}_{t+1} + \delta^2 \tilde{u}_{t+2} + \cdots$$

Projection bias: underappreciation of adaptation

- Evidence on underappreciation of adaptation:
  - There exists a lot of evidence that people adapt to major changes in life circumstances (winning the lottery, acquiring serious medical conditions, imprisonment etc.).
  - There also exists evidence that people underappreciate the extent of such adaptation, and thus overestimate the impact of major changes.

Projection bias: underappreciation of adaptation

- Let $s_0 \equiv accustomed\ to\ being\ healthy$

  $s_1 \equiv accustomed\ to\ being\ sick$
- Adaptation means:

$$u(sick, s_1) > u(sick, s_0).$$

- Underappreciation of adaptation means:

$$u(sick, s_1) > \tilde{u}(sick, s_1 | s_0) > \ u(sick, s_0).$$

Predicting Hunger: The Effects of Appetite and Delay on Choice

Daniel Read

Leeds University Business School and Rotterdam Institute for Business Economic Studies

and

Barbara van Leeuwen

Leeds University Business School

Preferences often fluctuate as a result of transient changes in hunger and other visceral states. When current decisions have delayed consequences, the preferences that should be relevant are those that will prevail when the consequences occur. However, consistent with the notion of an intrapersonal empathy gap (Loewenstein, 1996) we find that an individual's current state of appetite has a significant effect on choices that apply to the future. Participants in our study made advance choices between healthy and unhealthy snacks (i.e., fruit and junk food) that they would receive in 1 week when they were either hungry (late in the afternoon) or satisfied (immediately after lunch). In 1 week, at the appointed time, they made an immediate choice, an opportunity to change their advance choice. Our main predictions were strongly confirmed. First, advance choices were influenced by current hunger as well as future hunger: hungry participants chose more unhealthy snacks than did satisfied ones. Second, participants were dynamically inconsistent: they chose far more unhealthy snacks for immediate choice than for advance choice.

Application 1: Predicting hunger

- Evidence on 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.

Application 1: Predicting hunger

- Procedure:
  - The hunger state of the participants was manipulated by varying the time of day when they made their choices: choices were either made when most participants would be hungry (late afternoon) or when they would be satisfied (immediately after lunch).
  - 13 snacks: including 5 pieces of fruit(e.g. apples, banana), 5 chocolate bars(e.g. Mars, Snickers), and 3 salty snacks.

Application 1: Predicting hunger

- Results: % of Subjects Choosing Unhealthy Snack

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

Application 2: Durable goods

- A durable good yields a utility stream:

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

- Suppose $\mu_t \sim iid, E(\mu_t) = \bar{\mu}$.
- Suppose in period 0 a person decides whether to purchase a durable good that will yield utility in periods 1 to T.
- Assume $\delta = 1$.

Application 2: Durable goods

- Optimal WTP from standard model is:

$$WTP = T\bar{\mu}.$$

- With projection bias,

$$WTP = T[(1-\alpha)\bar{\mu} + \alpha\mu_0]$$
$$WTP = T\bar{\mu} + \alpha T(\mu_0 - \bar{\mu})$$

- If $\mu_0 > \bar{\mu}$, then overprone to buy.
- If $\mu_0 < \bar{\mu}$, then underprone to buy.

Application 2: Durable goods

- Hence, for once-and-for-all decisions whether to buy a durable good, projection bias can lead to over-buying or under-buying, depending on whether one's current valuation is high or low.

Projection bias vs. Present bias

- Consider a once-and-for-all decision to purchase a durable good, but now suppose that you can use the good immediately.
- Optimal behavior:

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

Projection bias vs. Present bias

- Optimal behavior:

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

- Projection bias:

$$WTP_{pro} = \mu_1 + (T-1)[\alpha\mu_1 + (1-\alpha)\bar{\mu}]$$
$$WTP_{pro} = \mu_1 + (T-1)\bar{\mu} + \alpha(T-1)(\mu_1 - \bar{\mu})$$

- Present bias:

$$\mu_1 + \beta(T-1)\bar{\mu} - \beta p \geq 0$$

$$WTP_{pre} = \mu_1 + (T-1)\bar{\mu} + \frac{1-\beta}{\beta}\mu_1$$

Projection bias vs. Present bias

- Optimal behavior:

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

- Projection bias:

$$WTP_{pro} = \mu_1 + (T-1)\bar{\mu} + \alpha(T-1)(\mu_1 - \bar{\mu})$$

- Present bias:

$$WTP_{pre} = \mu_1 + (T-1)\bar{\mu} + \frac{1-\beta}{\beta}\mu_1$$

Projection bias vs. Present bias

- Present bias:

$$WTP_{pre} = \mu_1 + (T-1)\bar{\mu} + \frac{1-\beta}{\beta}\mu_1$$

- Present bias can create a small distortion, but cannot be very large unless very large self-control problem.

Projection bias vs. Present bias

- Projection bias:

$$WTP_{pro} = \mu_1 + (T-1)\bar{\mu} + \alpha(T-1)(\mu_1 - \bar{\mu})$$

Projection bias can create a large distortion, because a high μ_1 can lead you to overestimate value in ALL future periods, hence even if α is small, the distortion can be large.

You are deciding whether to commit to a long-term consumption stream- exactly the type of environment in which projection bias can be a big problem while present bias typically is not.

Testing for Projection Bias in Field Data

Projection Bias in Catalog Orders

By Michael Conlin, Ted O'Donoghue, and Timothy J. Vogelsang*

Evidence suggests that people understand qualitatively how tastes change over time, but underestimate the magnitudes. This evidence is limited, however, to laboratory evidence or surveys of reported happiness. We test for such projection bias *in field data. Using data on catalog orders of cold-weather items, we find evidence of projection bias over the weather—specifically, people's decisions are overinfluenced by the current weather. Our estimates suggest that if the order-date temperature declines by 30°F, the return probability increases by 3.95 percent. We also estimate a structural model to measure the magnitude of the bias.* (*JEL* D12, L81)

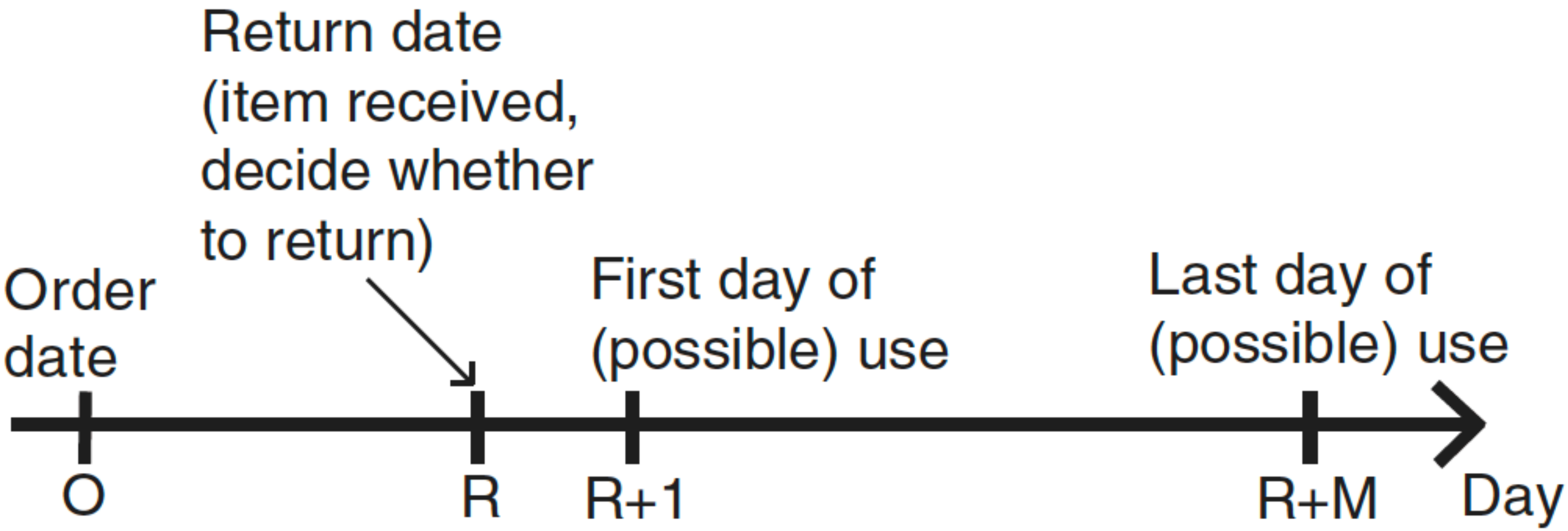
Testing for Projection Bias in Field Data

- Evidence that the state variable impacts current choice for future outcomes in a way consistent with projection bias.
- Identify projection bias using data on catalog orders.
- Basic logic: According to the standard economic model, for the most part, people's decisions of whether to order and whether to return clothing items should be independent of the weather conditions on the days they make these decisions.

Testing for Projection Bias in Field Data

- Projection bias implies that the more valuable an item is to you now, the more valuable you think it will be in the future.
- For cold-weather items, items for which the colder the temperature the higher the value- this means that a person's expected future value for an item is higher the lower is the current temperature.

Testing for Projection Bias in Field Data



Testing for Projection Bias in Field Data

- Ceteris paribus, the colder the temperature on the order date, the more likely people are to order cold-weather items.
- Ceteris paribus, the colder the temperature on the order date, the more likely people are to return cold-weather items.
- Ceteris paribus, the colder the temperature on the return date, the more likely people are to keep cold-weather items.

Note: For the most part, standard agents should not be influenced by the weather on a specific day.

Testing for Projection Bias in Field Data

- Two main predictions: Pr [return|order] is decreasing in order-date temperature but increasing in return-date temperature.
- Consider a category-by-category probit estimation:
- The paper found strong support for the order-date prediction: In all seven categories, the marginal effect associated with temperature on the order day is indeed negative, and it is statistically significant at 5% level for four of the seven categories.

Table 2—Baseline Probit Regressions

	Gloves/ mittens	Winter boots	Hats	Sports equipment	Parkas/ coats	Vests	Jackets	All seven categories
Order-date temperature	−0.00013**	−0.00026**	−0.00020**	−0.00011*	−0.00009	−0.00048**	−0.00014	−0.00019**
	(0.00005)	(0.00009)	(0.00005)	(0.00006)	(0.00007)	(0.00011)	(0.00013)	(0.00003)
Receiving-date temperature	0.00005	0.00018*	−0.00005	−0.00008	0.00007	−0.00010	0.00010	0.00003
	(0.00006)	(0.00009)	(0.00006)	(0.00007)	(0.00008)	(0.00011)	(0.00014)	(0.00003)
Average winter temperature, 1990–1994	0.00029**	0.00055**	0.00038**	0.00042**	0.00056**	0.00098**	0.00035	0.00049**
	(0.00010)	(0.00016)	(0.00010)	(0.00012)	(0.00013)	(0.00018)	(0.00022)	(0.00005)
Days between order and shipment	−0.00189**	−0.00075	−0.00136**	−0.00032	−0.00179**	0.00141*	−0.00173*	−0.00105**
	(0.00048)	(0.00072)	(0.00044)	(0.00052)	(0.00060)	(0.00086)	(0.00101)	(0.00023)
Days between order and receipt	0.00065	−0.00008	0.00029	0.00035	0.00069	−0.00213**	0.00082	0.00029
	(0.00043)	(0.00069)	(0.00041)	(0.00050)	(0.00058)	(0.00082)	(0.00096)	(0.00022)
Ordered through Internet	−0.01083**	−0.01357**	−0.00965**	−0.00796**	−0.01556**	−0.00466	−0.01391**	−0.01153**
	(0.00246)	(0.00440)	(0.00262)	(0.00296)	(0.00311)	(0.00572)	(0.00478)	(0.00129)
Ordered by female	0.00435**	0.01197**	0.00823**	0.00590**	0.01259**	0.00146	0.00180	0.00781**
	(0.00101)	(0.00155)	(0.00095)	(0.00116)	(0.00126)	(0.00193)	(0.00216)	(0.00051)
First-time buyer	0.01570**	0.01531**	0.01065**	0.00202	0.01535**	0.01587**	0.02448**	0.01394**
	(0.00149)	(0.00213)	(0.00144)	(0.00177)	(0.00159)	(0.00261)	(0.00312)	(0.00070)
Number of prior purchases	0.00013**	0.00026**	0.00017**	0.00005**	0.00020**	0.00014**	0.00013**	0.00016**
	(0.00001)	(0.00002)	(0.00001)	(0.00001)	(0.00002)	(0.00003)	(0.00003)	(0.00001)
Percent of prior purchases returned	0.19922**	0.24204**	0.19078**	0.06806**	0.30153**	0.20275**	0.30637**	0.22252**
	(0.00364)	(0.00646)	(0.00558)	(0.00498)	(0.00446)	(0.00679)	(0.01016)	(0.00216)
Price of item	0.00075**	0.00005	0.00145**	0.00033**	0.00019**	0.00166**	0.00016	0.00023**
	(0.00024)	(0.00013)	(0.00025)	(0.00008)	(0.00004)	(0.00024)	(0.00018)	(0.00003)
Purchased with credit card	0.02042**	0.04337**	0.02876**	0.02395**	0.05893**	0.02294**	0.05312**	0.03531**
	(0.00250)	(0.00418)	(0.00244)	(0.00191)	(0.00405)	(0.00535)	(0.00568)	(0.00137)
Items in order	−0.00157**	0.00012	−0.00035	−0.00078**	0.00196**	−0.00177**	0.00141**	−0.00028**
	(0.00022)	(0.00039)	(0.00022)	(0.00028)	(0.00033)	(0.00045)	(0.00058)	(0.00012)
Clothing-type fixed effects	YES	YES	YES	NO[a]	YES	YES	YES	YES
Item fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Month-region fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year-region fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	484,067	262,610	484,085	146,403	524,831	151,958	145,910	2,199,950
R-squared	0.04	0.05	0.07	0.13	0.03	0.03	0.04	0.07

Notes: For each column, the dependent variable is whether an item is returned (= 1 if item returned, and 0 otherwise), and the table presents the estimated marginal effects calculated at the sample means of the regressors. Standard errors are in parentheses—the standard errors are robust to arbitrary heteroskedasticity and correlation within a household.

* Significant at the 10 percent level.

** Significant at the 5 percent level.

[a] Clothing-type information was not provided for sports equipment items.