Prospect Theory In The Wild: Evidence From The Field

Article · June 1998

Source: RePEc

1 author:

Colin Farrell Camerer
California Institute of Technology
458 PUBLICATIONS   **95,256** CITATIONS

CHAPTER 5

Prospect Theory in the Wild: Evidence from the Field

COLIN F. CAMERER

THE WORKHORSES of economic analysis are simple formal models that can explain naturally occurring phenomena. Reflecting this taste, economists often say they will incorporate more psychological ideas into economics if those ideas can parsimoniously account for field data better than standard theories do. Taking this statement seriously, this article describes ten regularities in naturally occurring data that are anomalies for expected utility theory but can all be explained by three simple elements of prospect theory: loss-aversion, reflection effects, and nonlinear weighting of probability; moreover, the assumption is made that people isolate decisions (or edit them) from others they might be grouped with (Read, Loewenstein, and Rabin 1999; cf. Thaler 1999). I hope to show how much success has already been had applying prospect theory to field data and to inspire economists and psychologists to spend more time in the wild.

The ten patterns are summarized in table 5.1. To keep the article brief, I sketch expected-utility and prospect theory very quickly. (Readers who want to know more should look elsewhere in this volume or in Camerer 1995 or Rabin 1998). In expected utility, gambles that yield risky outcomes x_i with probabilities p_i are valued according to $\Sigma\, p_i\, u(x_i)$, where $u(x)$ is the *utility* of outcome x. In prospect theory they are valued by $\Sigma\pi(p_i)v(x_i - r)$, where $\pi(p)$ is a function that weights probabilities nonlinearly, overweighting probabilities below .3 or so and underweighting larger probabilities.[1] The value function $v(x - r)$ exhibits diminishing marginal sensitivity to deviations from the reference point r, creating a "reflection effect" because $v(x - r)$ is convex for losses and concave for gains (i.e., $v''(x - r) > 0$ for $x < r$ and $v''(x - r) < 0$ for $x > r$). The value function also exhibits *loss aversion* if the value of a loss $-x$ is larger in magnitude than the value of an equal-sized gain (i.e., $-v(-x) > v(x)$ for $x > 0$).

[1] In rank-dependent approaches, the weights attached to outcomes are differences in weighted cumulative probabilities. For example, if the outcomes are ordered $x_1 > x_2 > \cdots > x_n$, the weight on outcome x_i is $\pi(p_i + p_2 + \cdots + p_i) - \pi(p_1 + p_2 + \cdots + p_{i-1})$. (Notice that if $\pi(p) = p$ this weight is just the probability p_i.) In cumulative prospect theory, gains and losses are ranked and weighted separately (by magnitude).

dels that can ex-
omists often say
f those ideas can
es do. Taking this
urally occurring
be explained by
tion effects, and
made that people
ped with (Read,
how much suc-
a and to inspire

le brief, I sketch
o want to know
Rabin 1998). In
ilities p_i are val-
In prospect the-
on that weights
r so and under-
bits diminishing
ng a "reflection
for gains (i.e.,
nction also ex-
e than the value

the Center for Ad-
Mellers gave help-

es in weighted cu-
x_n, the weight on
if $\pi(p) = p$ this
es are ranked and

TABLE 5.1
Ten Field Phenomena Inconsistent with EU and Consistent with Cumulative Prospect Theory

Domain	Phenomenon	Description	Type of Data	Isolated Decision	Ingredients	References
Stock market	Equity premium	Stock returns are too high relative to bond returns	NYSE stock, bond returns	Single yearly return (not long-run)	Loss-aversion	Benartzi and Thaler (1995)
Stock market	Disposition effect	Hold losing stocks too long, sell winners too early	Individual investor trades	Single stock (not portfolio)	Reflection effect	Odean (in press), Genesove and Mayer (in press)
Labor economics	Downward-sloping labor supply	NYC cabdrivers quit around daily income target	Cabdriver hours, earnings	Single day (not week or month)	Loss-aversion	Camerer et al. (1997)
Consumer goods	Asymmetric price elasticities	Purchases more sensitive to price increases than to cuts	Product purchases (scanner data)	Single product (not shopping cart)	Loss-aversion	Hardie, Johnson, Fader (1993)
Macroeconomics	Insensitivity to bad income news	Consumers do not cut consumption after bad income news	Teachers' earnings, savings	Single year	Loss-aversion, reflection effect	Shea (1995); Bowman, Minehar, and Rabin (1999)
Consumer choice	Status quo bias, Default bias	Consumers do not switch health plans, choose default insurance	Health plan, insurance choices	Single choice	Loss-aversion	Samuelson and Zeckhauser (1988), Johnson et al. (1993)
Horse race betting	Favorite-longshot bias	Favorites are underbet, longshots overbet	Track odds	Single race (not day)	Overweight low p(loss)	Jullien and Salanié (1997)
Horse race betting	End-of-the-day effect	Shift to longshots at the end of the day	Track odds	Single day	Reflection effect	McGlothlin (1956)
Insurance	Buying phone wire insurance	Consumers buy overpriced insurance	Phone wire insurance purchases	Single wire risk (not portfolio)	Overweight low p(loss)	Cicchetti and Dubin (1994)
Lottery betting	Demand for Lotto	More tickets sold as top prize rises	State lottery sales	Single lottery	Overweight low p(win)	Cook and Clotfelter (1993)

1. FINANCE: THE EQUITY PREMIUM

Two important anomalies in finance can be explained by elements of prospect theory. One anomaly is called the *equity premium*. Stocks—or equities—tend to have more variable annual price changes (or "returns") than bonds do. As a result, the average return to stocks is higher as a way of compensating investors for the additional risk they bear. In most of this century, for example, stock returns were about 8% per year higher than bond returns. This was accepted as a reasonable return premium for equities until Mehra and Prescott (1985) asked how large a degree of risk-aversion is implied by this premium. The answer is surprising: under the standard assumptions of economic theory, investors must be absurdly risk averse to demand such a high premium. For example, a person with enough risk-aversion to explain the equity premium would be indifferent between a coin flip paying either $50,000 or $100,000 and a sure amount of $51,209.

Explaining why the equity premium is so high has preoccupied financial economists for the past 15 years (see Siegel and Thaler 1997). Benartzi and Thaler (1997) suggested a plausible answer based on prospect theory. In their theory, investors are not averse to the variability of returns; they are averse to loss (the chance that returns are negative). Because annual stock returns are negative much more frequently than annual bond returns are, loss-averse investors will demand a large equity premium to compensate them for the much higher chance of losing money in a year. Keep in mind that the higher average return to stocks means that the cumulative return to stocks over a longer horizon is increasingly likely to be positive as the horizon lengthens. Therefore, to explain the equity premium Benartzi and Thaler must assume that investors take a short horizon over which stocks are more likely to lose money than bonds. They compute the expected prospect values of stock and bond returns over various horizons, using estimates of investor utility functions from Kahneman and Tversky (1992) and including a loss-aversion coefficient of 2.25 (i.e., the disutility of a small loss is 2.25 times as large as the utility of an equal gain). Benartzi and Thaler show that over a 1-year horizon, the prospect values of stock and bond returns are about the same if stocks return 8% more than bonds, which explains the equity premium.

Barberis, Huang, and Santos (1999) include loss-aversion in a standard general equilibrium model of asset pricing. They show that loss-aversion and a strong "house money effect" (an increase in risk-preference after stocks have risen) are both necessary to explain the equity premium.

2. FINANCE: THE DISPOSITION EFFECT

Shefrin and Statman (1985) predicted that because people dislike incurring losses much more than they like incurring gains and are willing to gamble in the domain of losses, investors will hold on to stocks that have lost value (relative to their purchase price) too long and will be eager to sell stocks that have risen in value. They called this the *disposition effect*. The disposition effect is anomalous because the

ents of prospect
quities—tend to
nds do. As a re-
ng investors for
e, stock returns
ted as a reason-
sked how large
er is surprising:
ust be absurdly
on with enough
between a coin
09.

financial econ-
rtzi and Thaler
heir theory, in-
se to loss (the
negative much
will demand a
ance of losing
cks means that
ly likely to be
uity premium
on over which
the expected
sing estimates
d including a
2.25 times as
over a 1-year
t the same if
um.

ndard general
and a strong
ave risen) are

urring losses
n the domain
to their pur-
value. They
because the

purchase price of a stock should not matter much for whether you decided to sell it. If you think the stock will rise, you should keep it; if you think it will fall, you should sell it. In addition, tax laws encourage people to sell losers rather than winners because such sales generate losses that can be used to reduce the taxes owed on capital gains.

Disposition effects have been found in experiments by Weber and Camerer (1998).[2] On large exchanges, trading volume of stocks that have fallen in price is lower than for stocks that have risen. The best field study was done by Odean (in press). He obtained data from a brokerage firm about all the purchases and sales of a large sample of individual investors. He found that investors held losing stocks a median of 124 days and held winners only 104 days. Investors sometimes say they hold losers because they expect them to "bounce back" (or mean-revert), but in Odean's sample, the unsold losers returned only 5% in the subsequent year, whereas the winners that were sold later returned 11.6%. Interestingly, the winner-loser differences did disappear in December. In this month investors have their last chance to incur a tax advantage from selling losers (and selling winners generates a taxable capital gain), and thus their reluctance to incur losses is temporarily overwhelmed by their last chance to save on taxes.

Genovese and Meyer (in press) report a strong disposition effect in housing sales. Owners who may suffer a nominal loss (selling at a price below what they paid) set prices too high and, as a result, keep their houses too long before selling.

3. LABOR SUPPLY

Camerer, Babcock, Loewenstein, and Thaler (in this volume) talked to cab drivers in New York City about when they decide to quit driving each day. Most of the drivers lease their cabs for a fixed fee for up to 12 hours. Many said they set an income target for the day and quit when they reach that target. Although daily income targeting seems sensible, it implies that drivers will work long hours on bad days when the per-hour wage is low and will quit earlier on good high-wage days. The standard theory of the supply of labor predicts the opposite: Drivers will work the hours that are most profitable, quitting early on bad days and making up the shortfall by working longer on good days.

The daily targeting theory and the standard theory of labor supply therefore predict opposite signs of the correlation between hours and the daily wage. To measure the correlation, we collected three samples of data on how many hours drivers worked on different days. The correlation between hours and wages was strongly negative for inexperienced drivers and close to zero for experienced drivers. This suggests that inexperienced drivers began using a daily income

---

[2] In the Weber and Camerer experiment, subjects whose shares were automatically sold every period (but could be bought back with no transaction cost) did not buy back the shares of losers more than winners. This shows they are not optimistic about the losers but simply reluctant to sell them and lock in a realized loss.

targeting heuristic, but those who did so either tended to quit or learned by experience to shift toward driving around the same number of hours every day.

Daily income targeting assumes loss aversion in an indirect way. To explain why the correlation between hours and wages for inexperienced drivers is so strongly negative, one needs to assume that drivers take a 1-day horizon and have a utility function for the day's income that bends sharply at the daily income target. This bend is an aversion to "losing" by falling short of an income reference point.

4. ASYMMETRIC PRICE ELASTICITIES OF CONSUMER GOODS

The price elasticity of a good is the change in quantity demanded, in percentage terms, divided by the percentage change in its price. Hundreds of studies estimate elasticities by looking at how much purchases change after prices change. Loss-averse consumers dislike price increases more than they like the windfall gain from price cuts and will cut back purchases more when prices rise compared with the extra amount they buy when prices fall. Loss-aversion therefore implies elasticities will be asymmetric, that is, elasticities will be larger in magnitude after price increases than after price decreases. Putler (1992) first looked for such an asymmetry in price elasticities in consumer purchases of eggs and found it.

Hardie, Johnson, and Fader (1993) replicated the study using a typical model of brand choice in which a consumer's utility for a brand is unobserved but can be estimated by observing purchases. They included the possibility that consumers compare a good's current price to a reference price (the last price they paid) and get more disutility from buying when prices have risen than the extra utility they get when prices have fallen. For orange juice, they estimate a coefficient of loss-aversion (the ratio of loss and gain disutilities) around 2.4.

Note that for loss-aversion to explain these results, consumers must be narrowly bracketing purchases of a specific good (e.g., eggs or orange juice). Otherwise, the loss from paying more for one good would be integrated with gains or losses from other goods in their shopping cart and would not loom so large.

5. SAVINGS AND CONSUMPTION: INSENSITIVITY
TO BAD INCOME NEWS

In economic models of lifetime savings and consumption decisions, people are assumed to have separate utilities for consumption in each period, denoted $u[c(t)]$, and discount factors that weight future consumption less than current consumption. These models are used to predict how much rational consumers will consume (or spend) now and how much they will save, depending on their current income, anticipations of future income, and their discount factors. The models make many predictions that seem to be empirically false. The central prediction is that people should plan ahead by anticipating future income to make a guess

about their "permanen
any one year. Because
their lives, this predic
when they are young-
spend when they are ol
to a fixed fraction of cu
as much as standard th
ment, which should r
enough for it.

Shea (1995) pointe(
Think of a group of w(
Shea's empirical analy
ated one-year ahead.]
good, then the teacher:
pointingly low, the tea
teachers in Shea's stud
rise, but they *did not* c(

Bowman, Minehart,
two-period consumptio
utility, $u(c(t) - r(t))$ (cl
in each period exhibits
to reach the reference
exceeding it) and a refl
point, the marginal utili
gin with some referenc
reference point in the s(
their first-period consu
workers get from consi
sumed in the first perio
reference point. If they
appointed if their stand

Bowman et al. (199!
havior of the teachers
reference point and ge
ution of possible wage
teachers may not cut
downward" for two rea
sumption means they
feels awful. (2) Owin
year's wages might no
they either consume fa
cept consumption that
make the teachers relt
news about future inc(

learned by expe-
every day.

y. To explain why
ers is so strongly
and have a utility
come target. This
erence point.

ed, in percentage
f studies estimate
es change. Loss-
he windfall gain
se compared with
ore implies elas-
magnitude after
oked for such an
d found it.

a typical model
served but can be
y that consumers
e they paid) and
extra utility they
efficient of loss-

ers must be nar-
ge juice). Other-
ed with gains or
m so large.

ions, people are
period, denoted
han current con-
consumers will
on their current
rs. The models
tral prediction is
o make a guess

about their "permanent income" and consume a constant fraction of that total in any one year. Because most workers earn larger and larger incomes throughout their lives, this prediction implies that people will spend more than they earn when they are young—borrowing if they can—and will earn more than they spend when they are older. But in fact, spending on consumption tends to be close to a fixed fraction of current income and does not vary across the life cycle nearly as much as standard theory predicts. Consumption also drops steeply after retirement, which should not be the case if people anticipate retirement and save enough for it.

Shea (1995) pointed out another prediction of the standard life-cycle theory. Think of a group of workers whose wages for the next year are set in advance. In Shea's empirical analysis, these are unionized teachers whose contract is negotiated one-year ahead. In the standard theory, if next year's wage is surprisingly good, then the teachers should spend more now, and if next year's wage is disappointingly low, the teachers should cut back on their spending now. In fact, the teachers in Shea's study did spend more when their future wages were expected to rise, but they *did not* cut back when their future wages were cut.

Bowman, Minehart, and Rabin (1999) can explain this pattern with a stylized two-period consumption-savings model in which workers have reference dependent utility, $u(c(t) - r(t))$ (cf. Duesenberry 1949). The utility they get from consumption in each period exhibits loss aversion (the marginal utility of consuming just enough to reach the reference point is always strictly larger than the marginal utility from exceeding it) and a reflection effect (if people are consuming below their reference point, the marginal utility of consumption rises as they get closer to it). Workers begin with some reference point $r(t)$ and save and consume in the first period. Their reference point in the second period is an average of their initial reference point and their first-period consumption, and thus $r(2) = \alpha r(1) + (1 - \alpha)c(1)$. The pleasure workers get from consuming in the second period depends on how much they consumed in the first period through the effect of previous consumption on the current reference point. If they consumed a lot at first, $r(2)$ will be high and they will be disappointed if their standard of living is cut and $c(2) < r(2)$.

Bowman et al. (1999) show formally how this simple model can explain the behavior of the teachers in Shea's study. Suppose teachers are consuming at their reference point and get bad news about future wages (in the sense that the distribution of possible wages next year shifts downward). Bowman et al. show that the teachers may not cut their current consumption at all. Consumption is "sticky downward" for two reasons: (1) Because they are loss-averse, cutting current consumption means they will consume below their reference point this year, which feels awful. (2) Owing to reflection effects, they are willing to gamble that next year's wages might not be so low; thus, they would rather take a gamble in which they either consume far below their reference point or consume right at it than accept consumption that is modestly below the reference point. These two forces make the teachers reluctant to cut their current consumption after receiving bad news about future income prospects, which explains Shea's finding.

6. STATUS QUO BIAS, ENDOWMENT EFFECTS, AND BUYING–SELLING PRICE GAPS

Samuelson and Zeckhauser (1988) coined the term *status quo bias* to refer to an exaggerated preference for the status quo and showed such a bias in a series of experiments. They also reported several observations in field data that are consistent with status quo bias.

When Harvard University added new health-care plan options, older faculty members who were hired previously when the new options were not available were, of course, allowed to switch to the new options. If one assumes that the new and old faculty members have essentially the same preferences for health-care plans, then the distribution of plans elected by new and old faculty should be the same. However, Samuelson and Zeckhauser found that older faculty members tended to stick to their previous plans; compared with the newer faculty members, fewer of the old faculty elected new options.

In cases in which there is no status quo, people may have an exaggerated preference for whichever option is the default choice. Johnson, Hershey, Meszaros, and Kunreuther (1993) observed this phenomenon in decisions involving insurance purchases. At the time of their study, Pennsylvania and New Jersey legislators were considering various kinds of tort reform allowing firms to offer cheaper automobile insurance that limited the rights of the insured person to sue for damages from accidents. Both states adopted very similar forms of limited insurance, but they chose different default options, creating a natural experiment. All insurance companies mailed forms to their customers asking them whether they wanted the cheaper limited-rights insurance or the more expensive unlimited-rights insurance. One state made the limited-rights insurance the default (the insured person would get that if they did not respond), and the other made unlimited-rights the default. In fact, the percentage of people actively electing the limited-rights insurance was higher in the state where that was the default. An experiment replicated the effect.

A closely related body of research on endowment effects established that buying and selling prices for a good are often quite different. The paradigmatic experimental demonstration of this is the "mugs" experiments of Kahneman, Knetsch, and Thaler (1990). In their experiments, some subjects are endowed (randomly) with coffee mugs, and others are not. Those who are given the mugs demand a price about 2–3 times as large as the price that those without mugs are willing to pay, even though in economic theory these prices should be extremely close together. In fact, the mug experiments were inspired by field observations of large gaps in hypothetical buying and selling prices in "contingent valuations." Contingent valuations are measurements of the economic value of goods that are not normally traded—like clean air, environmental damage, and so forth. These money valuations are used for doing benefit-cost analysis and establishing economic damages in lawsuits. There is a huge literature establishing that selling prices are generally much larger than buying prices, although there is a heated

debate among psychologists and economists about what the price gap means and how to measure "true" valuations in the face of such a gap.

All three phenomena (status quo biases default preference, and endowment effects) are consistent with aversion to losses relative to a reference point. Making one option the status quo or default or endowing a person with a good (even hypothetically) seems to establish a reference point people move away from only reluctantly, or if they are paid a large sum.

7. RACETRACK BETTING: THE FAVORITE-LONGSHOT BIAS

In parimutuel betting on horse races, there is a pronounced bias toward betting on "longshots," which are horses with a relatively small chance of winning. That is, if one groups longshots with the same percentage of money bet on them into a class, the fraction of time horses in that class win is far smaller than the percentage of money bet on them. Longshot horses with 2% of the total money bet on them, for example, win only about 1% of the time (see Thaler and Ziemba 1988; Hausch and Ziemba 1995).

Overbetting longshots implies favorites are underbet. Indeed, some horses are so heavily favored that up to 70% of the win money is wagered on them. For these heavy favorites, the return for a dollar bet is very low if the horse wins. (Because the track keeps about 15% of the money bet for expenses and profit, bettors who bet on such a heavy favorite share only 85% of the money with 70% of the people, which results in a payoff of only about $2.40 for a $2 bet.) People dislike these bets so much that, in fact, if one makes those bets it is possible to earn a small positive profit (even accounting for the track's 15% take).

There are many explanations for the favorite-longshot bias, each of which probably contributes to the phenomenon. Horses that have lost many races in a row tend to be longshots, and thus a gambler's fallacious belief that such horses are due for a win may contribute to overbetting on them. Prospect-theoretic overweighting of low probabilities of winning will also lead to overbetting of longshots.

Within standard expected utility theory, the favorite-longshot bias can only be explained by assuming that people have convex utility functions for money outcomes. The most careful study comparing expected utility and prospect theory was done by Jullien and Salanié (1997). Their study used a huge sample of all the flat races run in England for ten years (34,443 races). They assumed that bettors value bets on horses by using either expected-utility theory, rank-dependent utility theory, or cumulative prospect theory (see Kahneman and Tversky 1992). If the marginal bettor is indifferent among bets on all the horses at the odds established when the race is run, then indifference conditions can be used to infer the parameters of that bettor's utility and probability weighting functions.

Jullien and Salanié found that cumulative prospect theory fits much better than rank-dependent theory and expected utility theory. They estimated that the utility function for small money amounts is convex. Their estimate of the probability

weighting function $\pi(p)$ for probabilities of gain is almost linear, but the weighting function for loss probabilities severely overweights low probabilities of loss (e.g., $\pi(.1) = .45$ and $\pi(.3) = .65$). These estimates imply a surprising new explanation for the favorite-longshot bias: Bettors like longshots because they have convex utility and weight their high chances of losing and small chances of winning roughly linearly. They hate favorites, however, because they like to gamble ($u(x)$ is convex) but are disproportionately afraid of the small chance of losing when they bet on a heavy favorite. (In my personal experience as a betting researcher, I have found that losing on a heavy favorite is particularly disappointing—an emotional effect the Jullien-Salanié estimates capture.)

8. RACETRACK BETTING: THE END-OF-THE-DAY EFFECT

McGlothlin (1956) and Ali (1977) established another racetrack anomaly that points to the central role of reference points. They found that bettors tend to shift their bets toward longshots, and away from favorites, later in the racing day. Because the track takes a hefty bite out of each dollar, most bettors are behind by the last race of the day. These bettors really prefer longshots because a small longshot bet can generate a large enough profit to cover their earlier losses, enabling them to break even. The movement toward longshots, and away from favorites, is so pronounced that some studies show that conservatively betting on the favorite to show (to finish first, second, or third) in the last race is a profitable bet despite the track's take.

    The end-of-the-day effect is consistent with using zero daily profit as a reference point and gambling in the domain of losses to break even. Expected-utility theory cannot gracefully explain the shift in risk preferences across the day if bettors integrate their wealth because the last race on a Saturday is not fundamentally different than the first race on the bettor's next outing. Cumulative prospect theory can explain the shift by assuming people open a mental account at the beginning of the day, close it at the end, and hate closing an account in the red.

9. TELEPHONE WIRE REPAIR INSURANCE

Ciccheti and Dubin (1994) conducted an interesting study of whether people purchase insurance against damage to their telephone wiring. The phone companies they studied either required customers to pay for the cost of wiring repair, about $60, or to buy insurance for $.45 per month. Given phone company estimates of the frequency of wire damage, the expected cost of wire damage is only $.26.

    Ciccheti and Dubin looked across geographical areas with different probabilities of wire damage rates to see whether cross-area variation in the tendency to buy insurance was related to different probabilities. They did find a relation and exploited this to estimate parameters of an expected-utility model. They found

some evidence that peop
some evidence of statu
when a new insurance (
customers were.)

    More importantly, C
purchase insurance aga
who is averse to very 1
averse to large risks. R.
the implications of loc
formally that a mildly
down a coin flip (at all
$11 or lose $10 should
less of how much he or
small-stakes flip implie
function. Turning down
ity function is slightly c
dramatic degree of glok

    Rabin's proof sugge
buy wire repair insurar
according to expected
more plausible explanat
are overweighting the 1
not explain their purch
spending the $.45 per r
they overestimate the p
required: consumers m
probability of a modes:
downs and weighted m

10. STATE LOTTERIES

Lotto is a special kind (
bers from a set of 40–:
match six numbers tha
numbers correctly, the j
several weeks of rollov
large jackpots have m
American states in 19:
sales by 1989.

---

[3] A similar bet, the "pick
bettors must choose the winn
curs if nobody has picked all
counts for a large fraction of

ar, but the weighting
bilities of loss (e.g.,
rising new explana-
ause they have con-
chances of winning
ike to gamble ($u(x)$
nce of losing when
betting researcher, I
ppointing—an emo-

track anomaly that
bettors tend to shift
the racing day. Be-
rs are behind by the
se a small longshot
ses, enabling them
om favorites, is so
g on the favorite to
able bet despite the

y profit as a refer-
n. Expected-utility
ross the day if bet-
not fundamentally
mulative prospect
tal account at the
count in the red.

hether people pur-
phone companies
iring repair, about
pany estimates of
e is only $.26.
ifferent probabili-
n the tendency to
ind a relation and
odel. They found

some evidence that people were weighting damage probabilities nonlinearly and also some evidence of status quo bias. (People who had previously been uninsured, when a new insurance option was introduced, were less likely to buy it than new customers were.)

More importantly, Ciccheti and Dubin never asked whether it is reasonable to purchase insurance against such a tiny risk. In standard expected utility, a person who is averse to very modest risks at all levels of wealth should be more risk-averse to large risks. Rabin (in press) was the first to demonstrate how dramatic the implications of local risk-aversion are for global risk-aversion. He showed formally that a mildly risk-averse expected-utility maximizer who would turn down a coin flip (at all wealth levels) in which he or she is equally likely to win $11 or lose $10 should not accept a coin flip in which $100, could be lost, *regardless of how much he or she could win*. In expected utility terms, turning down the small-stakes flip implies a little bit of curvature in a $21 range of a concave utility function. Turning down the small-stakes flip for all wealth levels implies the utility function is slightly curved at all wealth levels, which mathematically implies a dramatic degree of global curvature.

Rabin's proof suggests a rejection of the joint hypotheses that consumers who buy wire repair insurance are integrating their wealth and valuing the insurance according to expected utility (and know the correct probabilities of damage). A more plausible explanation comes immediately from prospect theory—consumers are overweighting the probability of damage. (Loss-aversion and reflection cannot explain their purchases because, if they are loss averse, they should dislike spending the $.45 per month, and reflection implies they will never insure unless they overestimate the probability of loss.) Once again, narrow bracketing is also required: consumers must be focusing only on wire repair risk; otherwise, the tiny probability of a modest loss would be absorbed into a portfolio of life's ups and downs and weighted more reasonably.

10. STATE LOTTERIES

Lotto is a special kind of lottery game in which players choose six different numbers from a set of 40–50 numbers. They win a large jackpot if their six choices match six numbers that are randomly drawn in public. If no player picks all six numbers correctly, the jackpot is rolled over and added to the next week's jackpot; several weeks of rollovers can build up jackpots up to $350 million or more. The large jackpots have made lotto very popular.[3] Lotto was introduced in several American states in 1980 and accounted for about half of all state lottery ticket sales by 1989.

---

[3] A similar bet, the "pick six," was introduced at horse-racing tracks in the 1980s. In the pick six, bettors must choose the winners of six races. This is extremely hard to do, and thus a large rollover occurs if nobody has picked all six winners several days in a row, just like lotto. Pick-six betting now accounts for a large fraction of overall betting.

Cook and Clotfelter (1993) suggest that the popularity of Lotto results from players' being more sensitive to the large jackpot than to the correspondingly probability of winning. They write,

> If players tend to judge the likelihood of winning based on the frequency with which someone wins, then a larger state can offer a game at longer odds but with the same perceived probability of winning as a smaller state. The larger population base in effect conceals the smaller probability of winning the jackpot, while the larger jackpot is highly visible. This interpretation is congruent with prospect theory. (p. 634)

Their regressions show that across states, ticket sales are strongly correlated with the size of a state's population (which is correlated with jackpot size). Within a state, ticket sales each week are strongly correlated with the size of the rollover. In expected utility, this can be explained only by utility functions for money that are convex. Prospect theory easily explains the demand for high jackpots, as Cook and Clotfelter suggest, by overweighting of, and insensitivity toward, very low probabilities.

CONCLUSIONS

Economists value (1) mathematical formalism and econometric parsimony, and (2) the ability of theory to explain naturally occurring data. I share these tastes. This article has demonstrated that prospect theory is valuable in both ways because it can explain ten patterns observed in a wide variety of economic domains with a small number of modeling features. Different features of prospect theory help explain different patterns. *Loss-aversion* can explain the extra return on stocks compared with bonds (the equity premium), the tendency of cab drivers to work longer hours on low-wage days, asymmetries in consumer reactions to price increases and decreases, the insensitivity of consumption to bad news about income, and status quo and endowment effects. *Reflection effects*—gambling in the domain of a perceived loss—can explain holding losing stocks longer than winners and refusing to sell your house at a loss (disposition effects), insensitivity of consumption to bad income news, and the shift toward longshot betting at the end of a racetrack day. *Nonlinear weighting of probabilities* can explain the favorite-longshot bias in horse-race betting, the popularity of lotto lotteries with large jackpots, and the purchase of telephone wire repair insurance. In addition, note that the disposition effect and downward-sloping labor supply of cab drivers were not simply observed but were also predicted in advance based on prospect theory.

In all these examples it is also necessary to assume people are isolating or narrowly bracketing the relevant decisions. Bracketing narrowly focuses attention most dramatically on the possibility of a loss or extreme outcome, or a low probability. With broader bracketing, outcomes are mingled with other gains and losses, diluting the psychological influence of any single outcome and making these phenomena hard to explain as a result of prospect theory valuation.

I have two final com
several studies, or one
that cannot be easily
regularities can be exp
these extras are truly a
tion. Worse, an extra as
another. For example, a
for money) can explair
sumption predicts stock
can explain why cab dr
not borrow (they are liq
ers who get good incor
who get bad news can c

Second, prospect the
can explain anomalies l
phenomena expected ut
financial assets discuss
which appears in every
ance by people. The ex
unfair insurance is that
amounts of money disp
insurance premiums.

In fact, many people
quire automobile insura
the expected utility exp
(because the disutility
surance, people are pr
weight (the prospect th
concave utility functior

A crucial kind of evi
experiments on probab
claim, if an accident oc
ity theory, if *r* is small.
for probabilistic insura
Tversky 1997). But ex
insurance; they pay a
pay 80% as much whe
theory can explain the
the probability of loss
overweighted. Prospec
ance *and* why they do i
both.

Because prospect the
most fruitfully applied
also explain field anon

y of Lotto results from
to the correspondingly

the frequency with which
lds but with the same per-
population base in effect
hile the larger jackpot is
heory. (p. 634)

are strongly correlated
th jackpot size). Within
the size of the rollover.
nctions for money that
high jackpots, as Cook
ivity toward, very low

netric parsimony, and
a. I share these tastes.
able in both ways be-
of economic domains
res of prospect theory
n the extra return on
lency of cab drivers to
imer reactions to price
o bad news about in-
ects—gambling in the
ocks longer than win-
fects), insensitivity of
shot betting at the end
explain the favorite-
o lotteries with large
ice. In addition, note
ly of cab drivers were
ed on prospect theory.
e are isolating or nar-
vly focuses attention
come, or a low prob-
vith other gains and
outcome and making
ry valuation.

I have two final comments. First, I have chosen examples in which there are several studies, or one very conclusive one, showing regularities in field data that cannot be easily reconciled with expected utility theory. However, these regularities can be explained by adding extra assumptions. The problem is that these extras are truly ad hoc because each regularity requires a special assumption. Worse, an extra assumption that helps explain one regularity may contradict another. For example, assuming people are risk-preferring (or have convex utility for money) can explain the popularity of longshot horses and lotto, but that assumption predicts stocks should return *less* than bonds, which is wildly false. You can explain why cab drivers drive long hours on bad days by assuming they cannot borrow (they are liquidity constrained), but liquidity constraint implies teachers who get good income news should not be able to spend more, whereas those who get bad news can cut back, which is exactly the opposite of what they do.

Second, prospect theory is a suitable replacement for expected utility because it can explain anomalies like those listed above and can *also* explain the most basic phenomena expected utility is used to explain. A prominent example is pricing of financial assets discussed above in sections 1 and 2. Another prominent example, which appears in every economics textbook, is the voluntary purchase of insurance by people. The expected utility explanation for why people buy actuarially unfair insurance is that they have concave utility, and thus they hate losing large amounts of money disproportionally compared with spending small amounts on insurance premiums.

In fact, many people *do not* purchase insurance voluntarily (e.g., most states require automobile insurance by law). The failure to purchase is inconsistent with the expected utility explanation and more easy to reconcile with prospect theory (because the disutility of loss is assumed to be convex). When people *do* buy insurance, people are probably avoiding low-probability disasters that they overweight (the prospect theory explanation) rather than avoiding a steep drop in a concave utility function (the expected utility theory explanation).

A crucial kind of evidence that distinguishes the two explanations comes from experiments on probabilistic insurance, which is insurance that does *not* pay a claim, if an accident occurs, with some probability r. According to expected utility theory, if r is small, people should pay approximately $(1 - r)$ times as much for probabilistic insurance as they pay for full insurance (Wakker, Thaler, and Tversky 1997). But experimental responses show that people hate probabilistic insurance; they pay a multiple much less than $1 - r$ for it (for example, they pay 80% as much when $r = .01$ when they should pay 99% as much). Prospect theory can explain their hatred easily: probabilistic insurance does not reduce the probability of loss all the way toward zero, and the low probability r is still overweighted. Prospect theory can therefore explain why people buy full insurance *and* why they do not buy probabilistic insurance. Expected utility cannot do both.

Because prospect theory can explain the basic phenomena expected utility was most fruitfully applied to, like asset pricing and insurance purchase, and can also explain field anomalies like the ten listed in table 5.1 (two of which were

predicted), there is no good scientific reason why it should not be used alongside expected utility in current research and be given prominent space in economics textbooks.

REFERENCES

Ali, Muhktar. 1977. "Probability and Utility Estimates for Racetrack Bettors." *Journal of Political Economy*, 85: 803–15.

Benartzi, Shlomo, and Richard Thaler. 1995. "Myopic Loss Aversion and the Equity Premium Puzzle." *Quarterly Journal of Economics*, 110: 73–92.

Bowman, David, Debby Minehart, and Matthew Rabin. 1997. "Loss Aversion in a Savings Model." Working paper, University of California, Berkeley.

Camerer, Colin F. 1995. "Individual Decision Making." In *Handbook of Experimental Economics*, edited by A. E. Roth and J. Kagel. Princeton: Princeton University Press.

Ciccheti, Charles, and Jeff Dubin. 1994. "A Microeconometric Analysis of Risk-Aversion and the Decision to Self-insure." *Journal of Political Economy*, 102: 169–86.

Cook, Philip I., and Charles T. Clotfelter. 1993. "The Peculiar Scale Economies of Lotto." *American Economic Review*, 83 (June): 634–43.

Hardie, Bruce G. S., Eric J. Johnson, and Peter S. Fader. 1993. "Modeling Loss Aversion and Reference Dependence Effects on Brand Choice." *Marketing Science*.

Hausch, Donald B., and William T. Ziemba. 1995. "Efficiency in Sports and Lottery Betting Markets." In *Handbook of Finance*, edited by R. A. Jarrow, V. Maksimovic, and W. T. Ziemba. Amsterdam: North-Holland.

Johnson, Eric, Jack Hershey, Jacqueline Meszaros, and Howard Kunreuther. 1993. "Framing, Probability Distortions, and Insurance Decisions." *Journal of Risk and Uncertainty*, 7: 35–51.

Jullien, Bruno, and Bernard Salanié. 1997. "Estimating Preferences under Risk: The Case of Racetrack Bettors. IDEI and GREMAQ Toulouse University working paper.

Kahneman, Daniel, Jack L. Knetsch, and Richard Thaler. 1990. "Experimental Tests of the Endowment Effect and the Coase Theorem." *Journal of Political Economy*, 98: 1325–48.

Kahneman, Daniel, and Amos Tversky. 1992. "Advances in Prospect Theory: Cumulative Representation of Uncertainty." *Journal of Risk and Uncertainty*, 5 (October): 297–324.

McGlothlin, William H. 1956. "Stability of Choices among Uncertain Alternatives." *American Journal of Psychology*, 69: 604–15.

Mehra, Rajneesh, and Edward Prescott. 1985. "The Equity Premium Puzzle." *Journal of Monetary Economics*, 15: 145–61.

Odean, Terrance. 1998. "Are Investors Reluctant to Realize Their Losses?" *Journal of Finance* 53(5): 1775–98.

Putler, Daniel S. 1992. "Incorporating Reference Price Effects into a Theory of Consumer Choice." *Marketing Science*, 11(3): 287–309.

Rabin, Matthew. 1998. "Psychology and Economics." *Journal of Economic Literature*, 36: 11–46.

Rabin, Matthew. 2000. "Risk-aversion and expected utility: A calibration theorem." *Econometrica*, 68: 1281–92.

Read, Daniel, George Loewenstein, and Matthew Rabin. 1998. "Choice bracketing." Work-

ing paper, Departm

Samuelson, William,
ing." *Journal of R*

Shea, John. 1995. "L
American Econom

Shefrin, Hersh, and N
Ride Losers too L(

Siegel, Jeremy, and
Economic Perspec

Thaler, Richard, and
and Lotteries." *Jou*

Wakker, Peter P., Ric
Journal of Risk an

Weber, Martin, and C
ing." *Journal of E(*

The left margin contains partial text from the facing page:

be used alongside
pace in economics

Bettors." *Journal of*

n and the Equity Pre-

Aversion in a Savings

ook of Experimental
n University Press.
ysis of Risk-Aversion
02: 169–86.
Economies of Lotto."

odeling Loss Aversion
Science.
orts and Lottery Bet-
, V. Maksimovic, and

reuther. 1993. "Fram-
Risk and Uncertainty,

under Risk: The Case
orking paper.
perimental Tests of the
olitical Economy, 98:

ct Theory: Cumulative
5 (October): 297–324.
ncertain Alternatives."

m Puzzle." *Journal of*

r Losses?" *Journal of*

a Theory of Consumer

conomic Literature, 36:

calibration theorem,"

oice bracketing." Work

ing paper, Department of Social and Decision Sciences, Carnegie-Mellon University.

Samuelson, William, and Richard Zeckhauser. 1988. "Status Quo Bias in Decision Making." *Journal of Risk and Uncertainty*, 1: 7–59.

Shea, John. 1995. "Union Contracts and the Life-Cycle/Permanent-Income Hypothesis." *American Economic Review*, 85: 186–200.

Shefrin, Hersh, and Meier Statman. 1985. "The Disposition to Sell Winners too Early and Ride Losers too Long." *Journal of Finance*, 40: 777–90.

Siegel, Jeremy, and Richard Thaler. 1997. "The Equity Premium Puzzle." *Journal of Economic Perspectives*, 11(Winter): 191–200.

Thaler, Richard, and William T. Ziemba. 1988. "Parimutuel Betting Markets: Racetracks and Lotteries." *Journal of Economic Perspectives*, 2: 161–74.

Wakker, Peter P., Richard H. Thaler, and Amos Tversky. 1997. "Probabilistic Insurance." *Journal of Risk and Uncertainty*, 15: 5–26.

Weber, Martin, and Colin Camerer. In press. "The Disposition Effect in Securities Trading." *Journal of Economic Behavior and Organization*.