Prospect Theory x Mental accounting

EE 434 Behavioral Finance, SEM1/2022

Sunsiree Kosindesha

Integration vs. Segregation

Integration vs. Segregation

- After one-shot gamble has played out, there has been gain or loss from accepting such gamble.
- This gain or loss is now considered as prior gain or loss, “prior” to the current decision.

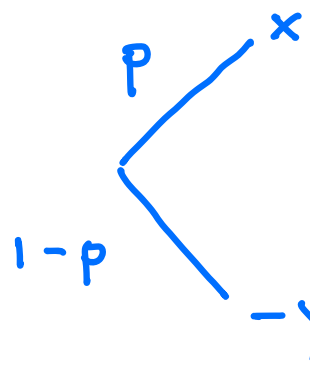
Integration vs. Segregation

- On the gain-loss axis, does individual go back to zero (segregation) or move along curve (integration)?
- Integration occurs when positions are lumped together.
- Segregation occurs when situations are viewed one at a time.

For ex, if prior loss is $-z$, $z > 0$

Our current decision is

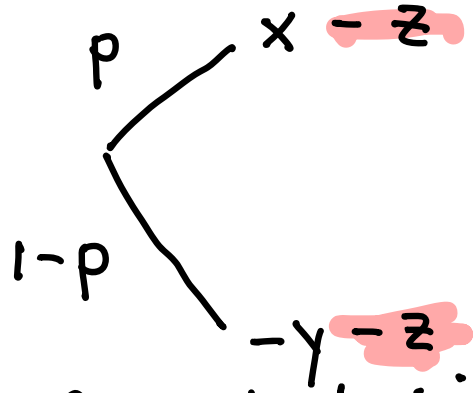
$\$0$ (not accepting risk) vs.



, $x, y > 0$

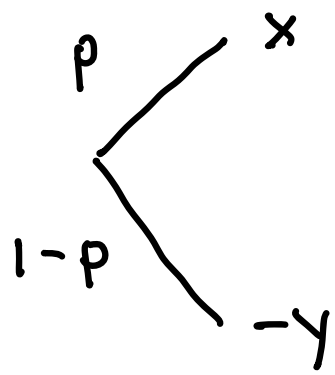
Integrate prior loss into current decision:

$-z$ vs.



Segregate prior loss from current decision:

$-z$ & [$\$0$ vs.



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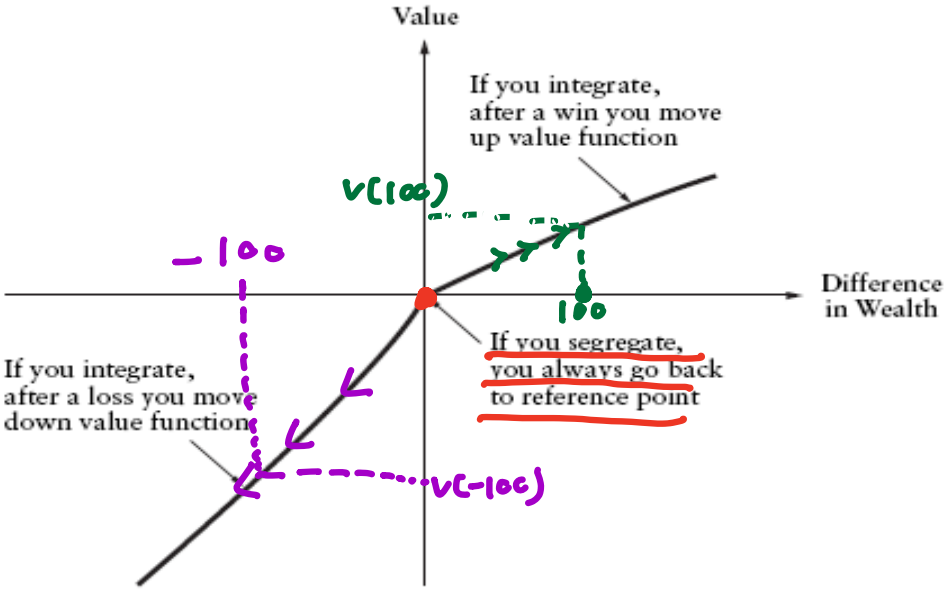
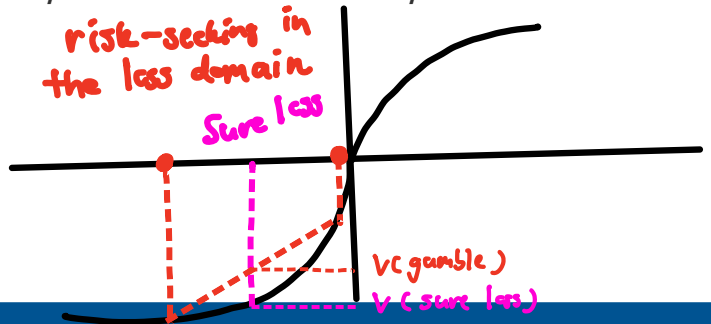
Integration vs. segregation



Integration vs. Segregation

- Kahneman and Tversky recognized that sometimes people adopt the frame of integration.

- For example, more bets are placed on long shots at the end of a horse racing day, suggesting that at least some bettors are integrating the outcomes of races and taking risks they would not ordinarily take in order to try to break even.



Mental Accounting

Mental accounting

- Accounting is process of categorizing money, spending and financial events.
- Mental accounting is a description of way people intuitively do these things and is one method people use to make financial decision-making manageable.

Mental accounting

- Richard Thaler, "mental accounting is the set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities."

- In general, Thaler wished to use the term 'mental accounting' to describe the entire process of coding, categorizing, and evaluating events.

See: Thaler, R. H., 1999, "Mental accounting matters," Journal of Behavioral Decision Making 12, 183–206.

Mental accounting

- Many people nominally place their money in silos:
  - expenditures (food, housing, entertainment, vacation),
  - wealth (checking account, retirement savings), and
  - income (salary, bonus).
- It is important to note that often these "accounts" are mental constructs rather than actual accounts.
  - For example, most of us have not explicitly set up a bank account (or piggy bank) for entertainment.

Mental accounting

- Traditionally, economists have assumed that funds are fungible (substitutable), but because of the silo approach created by mental accounting, this may not be so.

Mental accounting

- Two salient properties of mental accounts:

1. Money is not fungible across mental accounts.

2. The individual does not exclusively focus on maximizing overall financial wealth. For instance, the objective might also be to limit the size of losses in individual accounts.

- That is, often, tendency to use mental accounting leads to odd and suboptimal decisions.

Theater ticket problems

- Imagine you have decided to see a play where admission is $20.
- As you enter theater you discover that you have lost a $20 bill.
- Would you still pay $20 for a ticket to the play?

Theater ticket problems

- Imagine that you have decided to see a play and paid the admission price of $20 per ticket.
- As you enter the theater you discover that you have lost the ticket. The seat was not marked, and the ticket cannot be recovered.
- Would you pay $20 for another ticket?

Theater ticket problems

- Of respondents given first question, 88% said they would buy a ticket.
- Of respondents given second question, 54% said they would *not* buy a ticket.

Theater ticket problems

- Nothing is really different between the questions.
- A certain amount of money ($20) has been irretrievably lost, and the only decision you have to make is whether or not the theater experience is worth $20 to you.
- Whether or not the $20 was lost in the form of cash or in the form of a theater ticket is truly irrelevant.

1st scenario

ticket mental account

mb $30

MC −$20

2nd scenario

ticket mental account

mb $30

MC −$20 −$20 = −$40

note:
rational benchmark: doesn't care about sunk cost

Theater ticket problems

- When the ticket was originally purchased, a “ticket purchase account” was set up.
- If all had gone as planned, the play would have been attended using the original ticket, the pleasure of witnessing the play would have offset the cost of the ticket, and the “ticket purchase account” would have been closed.

Theater ticket problems

- In the 1st scenario, the lost $20 bill is not directly linked to the ticket, so people are willing to purchase a new ticket. While not happy about losing $20, absent budget constraints, there is no reason to connect this loss to the ticket purchase decision. Segregation is used.

- In 2nd question, integration is more likely because both lost ticket and new ticket would be from same “ticket purchase account.” Integration might suggest that $20 is too much for the ticket.

Prospect theory & Mental Accounting

"disposition effect"

- ***When does a person close a mental account?***

- Prospect theory tells us that people feel losses more severely than gains, which implies that when there is discretion as to when to close an account,
  - they may choose to avoid doing so if losses will be realized.
  - If gains, on the other hand, will be realized, they may be quite ready to close an account.

Integration ⇒ Combining outcome together

Segregation ⇒ not combining

Prospect theory & Mental Accounting

- In the context of a stock portfolio, consider a stock investor who has witnessed one of his picks drop in price.
- As long as he holds it, he can view it as a "paper loss," in a remaining open account.
- Selling the stock is equivalent to closing the account—and closing the account is a painful experience because of loss aversion.

Still holding stock ⇒ paper gain, paper loss in open mental account

Sell the stock ⇒ realized gain & mental account is close.
realized loss

Prospect theory & Mental Accounting

- The tendency to sell winners too soon and hold losers too long is called the disposition effect.

- Holding on the loser stocks is to integrate the current decision and the past performance of the stock.

See: SHEFRIN, H. and STATMAN, M. (1985), The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence. The Journal of Finance, 40: 777-790. https://doi.org/10.1111/j.1540-6261.1985.tb05002.x

Think about the behavior that "investors hold losers for too long":

① mental account & loss aversion

⇒ if close mental account,
we feel the pain from realized loss

② integrate prior loss into an open mental account

⇒ risk-seeking in the loss

⇒ try to go with the chance to break-even

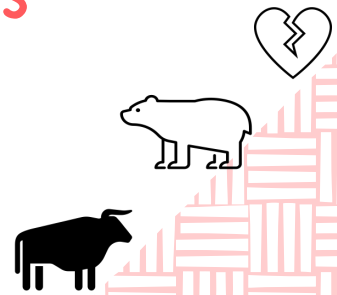
"break-even effect"

Prospect theory & Mental Accounting

- The type of investor, who looks at a stock, notices that it has dropped, realizes that this event is history, resets his new reference point to the current stock price, is using segregation.

- Such an approach helps prevent a disposition effect from happening.

Loss Aversion & Financial Insights



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Are Investors Reluctant to Realize Their Losses?

TERRANCE ODEAN*

ABSTRACT

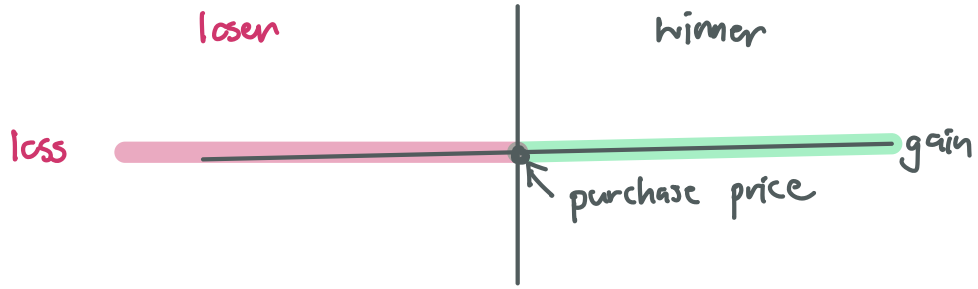
I test the disposition effect, the tendency of investors to hold losing investments too long and sell winning investments too soon, by analyzing trading records for 10,000 accounts at a large discount brokerage house. These investors demonstrate a strong preference for realizing winners rather than losers. Their behavior does not appear to be motivated by a desire to rebalance portfolios, or to avoid the higher trading costs of low priced stocks. Nor is it justified by subsequent portfolio performance. For taxable investments, it is suboptimal and leads to lower after-tax returns. Tax-motivated selling is most evident in December.

Odean (Journal of Finance 1998)

Are Investors Reluctant to Realize Their Losses?

- Use a database that included trading records for 10,000 accounts at a large discount brokerage house with almost 100,000 transactions during 1987–1993

- Reference point: nominal purchase price of each stock (or average purchase price in the case of multiple transactions)



Odean (Journal of Finance 1998)

Are Investors Reluctant to Realize Their Losses?

- A stock is a winner if its current price is above its purchase price, and it is a loser if its current price is below its purchase price.
- Odean calculated the proportion of gains realized (PGR) and the proportion of losses realized (PLR).

how much of the winners/gain is investor realizing?

$$PGR = \frac{Realized\ gains}{Realized\ gains + Paper\ gains}$$

Paper gains include any sales that could have been made at a gain

how much of the losers/losses is investor realizing?

$$PLR = \frac{Realized\ losses}{Realized\ losses + Paper\ losses}$$

Paper losses include any sales that could have been made at a loss

H_0: no disposition effect
PGR = PLR

H_a: have disposition effect
PGR > PLR

Are Investors Reluctant to Realize Their Losses?

- To provide insight into the tendency of these individual investors to sell winners while holding losers, Odean tested the hypothesis that the proportion of gains realized exceeded the proportion of losses realized.

TABLE 10.1 | AGGREGATE PROPORTION OF GAINS (PGR) AND LOSSES (PLR) REALIZED

	Entire Year	December	January–November
PLR	0.098	0.128	0.094
PGR	0.148	0.108	0.152
Difference in proportions	−0.050	0.020	−0.058
t-statistic	−35	4.3	−38

PLR − PGR < 0 ↑ disposition effect

Source: Odean, T., 1998, "Are investors reluctant to realize their losses?" in *Journal of Finance* 53(5), 1775–1798.

Odean (Journal of Finance 1998)

Are Investors Reluctant to Realize Their Losses?

- Figures in the table uses all investor accounts.
- There is a clear tendency to sell winners over losers (PGR > PLR) over the entire year.
- It is important to note that for tax reasons investors should prefer to sell losers, not winners.
- An investor with a positive tax rate should put off realizing gains on winners because of the tax liability generated, but should recognize losses sooner in order to reduce current tax liability.

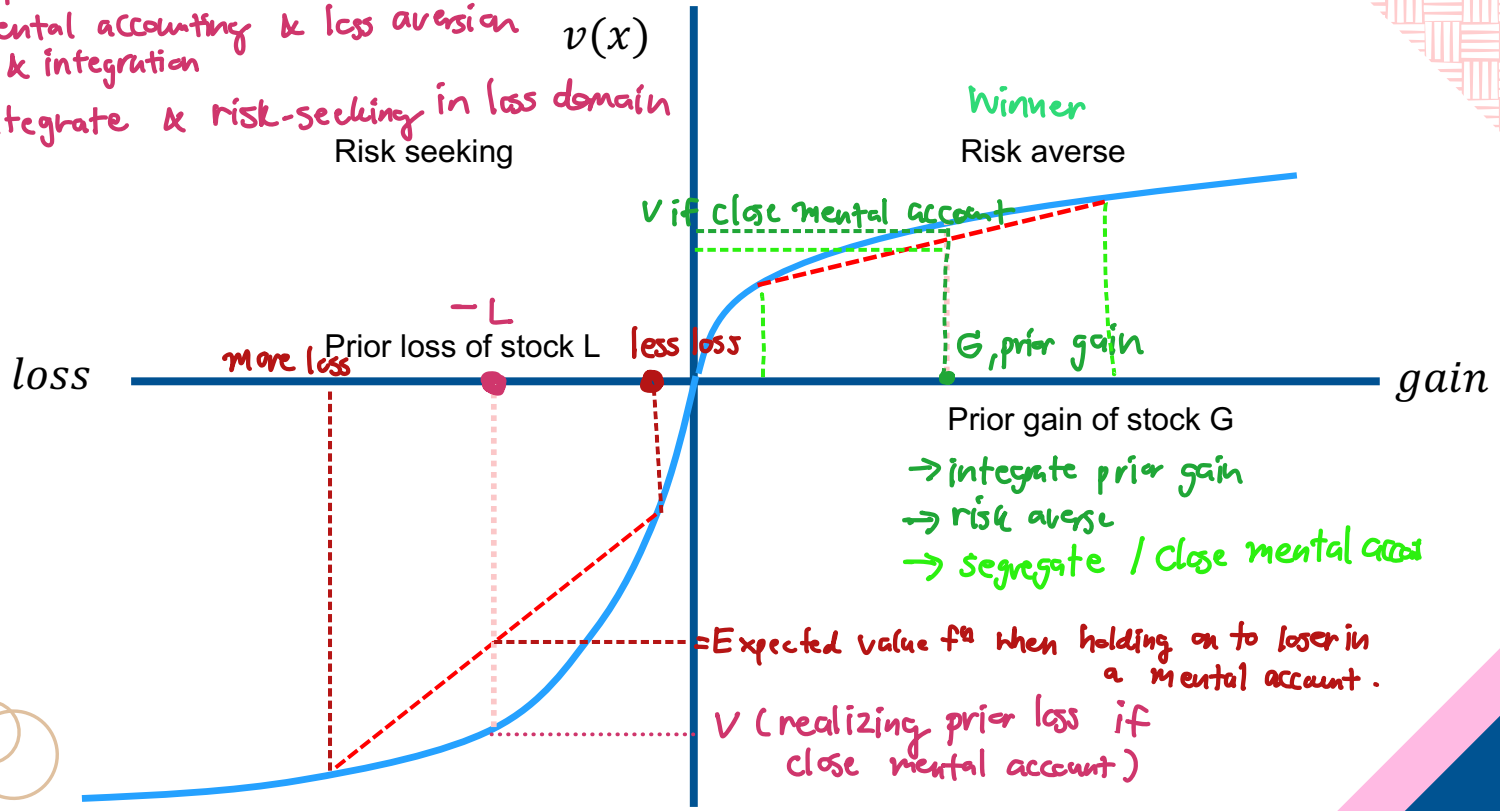
Odean (Journal of Finance 1998)

Are Investors Reluctant to Realize Their Losses?

- For the entire year, the disposition effect operates despite the fact that some investors understand this tax issue and act accordingly.
- In the month of December, when investors are most likely to transact for tax reasons, there is actually a greater tendency to sell losers rather than winners.
- It is in the other 11 months where the disposition effect dominates.
- Investors were selling long-term winners and holding on to long-term losers. Odean found that winners sold outperform losers held by 3.41% on a risk-adjusted basis.

Disposition:

- mental accounting & loss aversion & integration
- integrate & risk-seeking in loss domain



Odean (Journal of Finance 1998)

Are Investors Reluctant to Realize Their Losses?

- Besides the possible reason that closing an account at a loss is difficult because of mental accounting and loss aversion (or regret aversion, TBD), integration also play a role for disposition effect.
- Stock L has suffered losses, while stock G has experienced gains.
- After a large gain (G), you have moved to the risk averse segment of the value function.
- On the other hand, after a large loss (L) you have moved to the risk-seeking segment of the value function.
- The implication is that since you are less risk averse for losers, you are more likely to hold on to them.

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"excess volatility"

GAMBLING WITH THE HOUSE MONEY AND TRYING TO BREAK EVEN: THE EFFECTS OF PRIOR OUTCOMES ON RISKY CHOICE*

Hedonic editing

k snake-bit effect

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How is risk-taking affected by prior gains and losses? While normative theory implores decision makers to only consider incremental outcomes, real decision makers are influenced by prior outcomes. We first consider how prior outcomes are combined with the potential payoffs offered by current choices. We propose an editing rule to describe how decision makers frame such problems. We also present data from real money experiments supporting a "house money effect" (increased risk seeking in the presence of a prior gain) and "break-even effects" (in the presence of prior losses, outcomes which offer a chance to break even are especially attractive).
(DECISION MAKING; PROSPECT THEORY; SUNK COSTS; MENTAL ACCOUNTING)

1. Introduction

Imagine that you are attending a convention in Las Vegas, and you walk into a casino. While passing the slot machines, you put a quarter into one machine and, surprisingly, you win $100. Now what? Will your gambling behavior for the rest of the evening be altered? Might you make a few more serious wagers, even if you usually abstain? Suppose

Hedonic Editing

People edit the gambles in a way that would make the prospects appear most pleasant or least unpleasant.

(x, p ; y, q)

The signs and magnitudes of x and y determine whether hedonic editing calls for segregation or integration.

The rules for hedonic editing follow from four principles:

- Segregate gains.
- Integrate losses. ⇒ break-even effect
- Segregate small gains from larger losses (The "silver lining" principle).
- Integrate (cancel) smaller losses with larger gains. ⇒ House money effect

The hedonic editing hypothesis assumes that these four principles are applied whenever possible.

TABLE 1

Experiment 1, *From Thaler* (1985)

Instructions: Below you will find four pairs of scenarios. In each case two events occur in Mr. A's life and one event occurs in Mr. B's life. You are asked to judge whether Mr. A or Mr. B is happier. Would most people rather be A or B? If you think the scenarios are emotionally equivalent, check "no difference." In all cases the events are intended to be financially equivalent.

(1) Mr. A was given tickets to two lotteries involving the World Series. He won $50 in one lottery and $25 in the other. Mr. B was given a ticket to a single, larger World Series lottery. He won $75. Who was happier?

A: 64% B: 18% No difference: 17% $N = 87$.

⇒ segregate gain

(2) Mr. A received a letter from the IRS saying that he made a minor arithmetical mistake on his tax return and owed $100. He received a similar letter the same day from his state income tax authority saying he owed $50. There were no other repercussions from either mistake. Mr. B received a letter from the IRS saying that he made a minor arithmetical mistake on his tax return and owed $150. There were no other repercussions from his mistake. Who was more upset?

A: 75% B: 16% No difference: 8% $N = 87$.

(3) Mr. A's car was damaged in a parking lot. He had to spend $200 to repair the damage. The same day the car was damaged, he won $25 in the office football pool. Mr. B's car was damaged in a parking lot. He had to spend $175 to repair the damage. Who was more upset?

A: 25% B: 70% No difference: 5% $N = 87$.

⇒ Seg. gain from larger loss

(4) Mr. A bought his first New York State lottery ticket and won $100. Also, in a freak accident, he damaged the rug in his apartment and had to pay the landlord $80. Mr. B bought his first New York State lottery ticket and won $20. Who was happier?

A: 29% B: 72% No difference: 6% $N = 87$.

⇒ Cancelling small loss with larger gain

Hedonic Editing

Hedonic editing permits combining and separating. That is, when there are two events x and y, assume that people either integrate the two and code the joint event as $v(x + y)$, or they segregate the events and code them as $v(x) + v(y)$.

Example of hedonic editing

Denote wealth by y, and the reference point by r.
Define $x = y - r$ as the increment in wealth relative to the reference point.

The value function takes the form:

$$v(x) = \begin{cases} x^{\beta} & , if\ x \geq 0 \\ -2.25(-x)^{\beta} & , if\ x < 0 \end{cases}$$

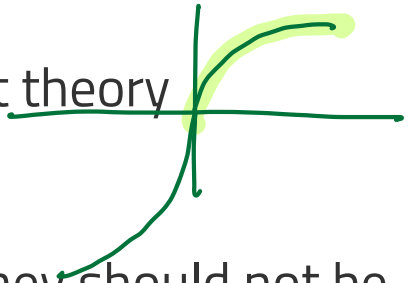
gain

loss

Example of hedonic editing

- **Multiple gains are segregated:**

The value function for gains under prospect theory is strictly concave.



Hence, if there are several positive gains, they should not be combined (because the marginal value function of a larger amount is smaller).

Instead gains should be segregated, perhaps temporally.

Example of hedonic editing

- **Multiple gains are segregated:**

If x = 100, then one prefers to split it up into two equal gains of 50 each.

integrating segregation

$$(100)^{0.88} < (50)^{0.88} + (50)^{0.88}, \beta = 0.88$$

$$57.5 < 62.5$$

Example of hedonic editing

- **Multiple gains are segregated:**

The strict concavity of $v(.)$ in gains implies that, for $a, b > 0$

$$v(b + a) - v(a) < v(b) - v(0)$$

which can be rewritten as

$$v(b + a) < v(b) + v(a)$$

Example of hedonic editing

- **Multiple losses are integrated:**

If x = -100, then one prefers to integrate two equal losses of 50 each.

integrating segregating

$$-2.25(100)^{0.88} > -2.25(50)^{0.88} - 2.25(50)^{0.88}, \beta = 0.88$$

$$-129.5 > -140.7$$

For $a, b > 0$,

$$v(-(b+a)) > v(-b) + v(-a)$$

Example of hedonic editing

❑ **Mixed net losses and the silver lining principle**

Consider an outcome pair (40, -6000) .

$$(40)^{0.75} + (-2.25(6000)^{0.75}) > -2.25(5960)^{0.75}$$
$$-1{,}517 > -1{,}526$$

One should **segregate small gains from larger losses**. This is known as the silver lining principle: something good that can be found in a bad situation.

Example of hedonic editing

- **Mixed net gains: Integrate (cancel) smaller losses with larger gains**

Consider an outcome pair (-5, 12.565)

net gain

$$(7.565)^{0.88} > -2.25(5)^{0.88} + (12.565)^{0.88}$$

$$5.93 > 0$$

Example of hedonic editing

- **Mixed net gains: Integrate (cancel) smaller losses with larger gains**

Consider an outcome pair $(b, -a), 0 < a < b, b - a > 0$

$$v(b) + v(-a) < v(b - a)$$

Path-dependent behavior: house money effect

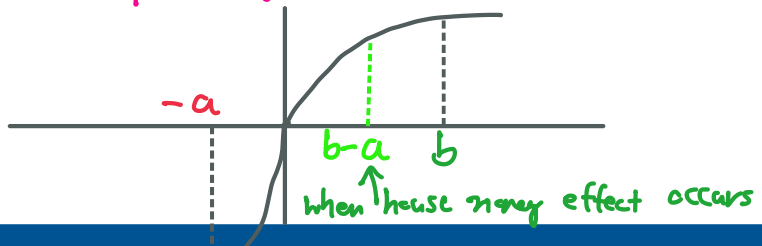
- After a prior gain, people become more open to assuming risk. This observed behavior is referred to as the house money effect, alluding to casino gamblers who are more willing to risk money that was recently won.

- If one integrates after a large gain, one has moved safely away from the value function loss aversion kink, serving to lessen risk aversion.

a pair of outcome $(b, -a)$, $b > a > 0$

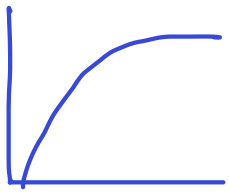
prior big gain ↑ possible small loss

if separate b, $-a$, house money will not happen

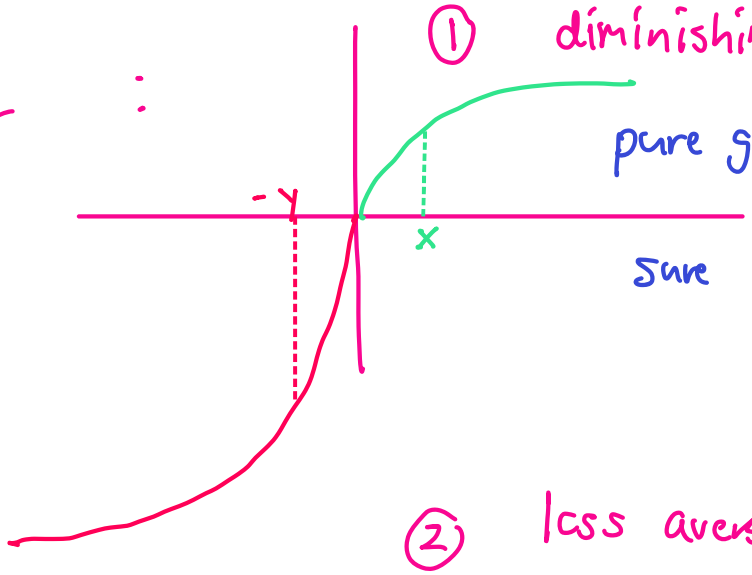


" risk-averse behavior "

EUT :



Prospect theory :



① diminishing sensitivity

pure gain gamble (x, p)

$x > 0$

vs.

sure money

vs.

px

② loss aversion

mixed gamble

(x, p ; -y, 1-p)

x, y > 0

vs.

0

Path-dependent behavior: : house money effect

- The essence of the idea is that until the winnings are completely depleted, losses are coded as reductions in a gain, as if losing some of "their money" doesn't hurt as much as losing one's own cash.

- In sum, the house money effect is used to label an event when a prior gain can increase subjects' willingness to accept gambles.

Path-dependent behavior: break-even effect

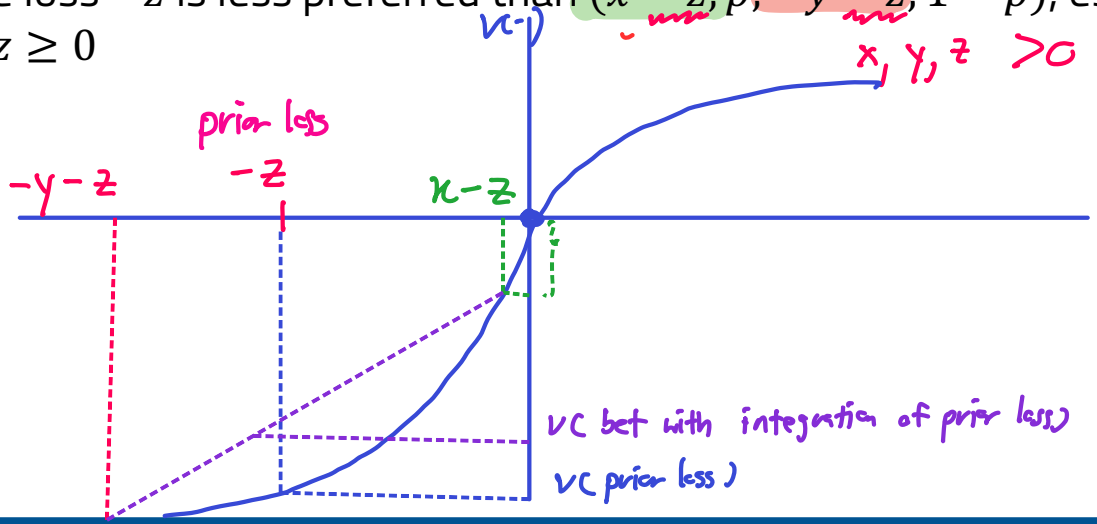
- After a prior loss, on the one hand, people seem to value breaking even, so a person with a prior loss may take a risky gamble in order to try to break even. This observed behavior is referred to as the break-even effect.

- When there is incomplete adaptation to recent losses, break-even effect is used to label an event when outcomes which offer the opportunity to "break even" after prior losses are especially attractive.

Path-dependent behavior: break-even effect

prior loss → risk seeking

- When breaking even is possible, integration is facilitated; thus, risk seeking in the domain of losses should occur.
- A prior sure loss $-z$ is less preferred than $(x - z, p; -y - z, 1 - p)$, especially when $x - z \geq 0$



Path-dependent behavior: snake-bit effect

- On the other hand, an initial loss can cause an increase in risk aversion in what has been called the snake-bit effect, especially when the new opportunity does not offer the opportunity to break even.

- This is when possible subsequent losses are not integrated with the prior outcome.

- A prior loss might even sensitize people to subsequent losses of a similar magnitude. This increase in loss aversion would tend to produce risk aversion for gambles that risk additional losses.

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House money effect
Snake-bit effect
" excess volatility "

PROSPECT THEORY AND ASSET PRICES*

NICHOLAS BARBERIS
MING HUANG
TANO SANTOS

We study asset prices in an economy where investors derive direct utility not only from consumption but also from fluctuations in the value of their financial wealth. They are loss averse over these fluctuations, and the degree of loss aversion depends on their prior investment performance. We find that our framework can help explain the high mean, excess volatility, and predictability of stock returns, as well as their low correlation with consumption growth. The design of our model is influenced by prospect theory and by experimental evidence on how prior outcomes affect risky choice.

Investor preference

- The investor derives direct utility not only from consumption but also from changes in the value of his financial wealth.

- When deciding how much to invest in the stock market, he takes both types of utility into account: the objective function he maximizes includes an extra term reflecting a direct concern about financial wealth fluctuations.

Utility from gain and loss

- How loss averse the investor is, depends on his prior investment performance.
- With prior gains, he becomes less loss averse: the prior gains will cushion any subsequent loss, making it more bearable.
- Conversely, after a prior loss, he becomes more loss averse: after being burned by the initial loss, he is more sensitive to additional setbacks.

House money effect

$\lambda_t \downarrow$

$\lambda_t \uparrow$

Snake-bit effect

Investor Preference

- Agents choose a consumption level C_t and an allocation to the risky asset S_t to maximize:

$$\max_{C_t, S_t} E\left[\sum_{t=0}^{\infty}\left(\rho^t \frac{C_t^{1-\gamma}}{1-\gamma} + b_t \rho^{t+1} v(X_{t+1}, S_t, z_t)\right)\right]$$

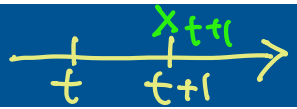
standard component $\Rightarrow$ EUT component

extended from Prospect theory Behavioral finance component

exponential discounting

- $\frac{C_t^{1-\gamma}}{1-\gamma}$: utility over consumption C_t
  - This is a standard feature of asset pricing models.
- $v(X_{t+1}, S_t, z_t)$: utility from fluctuations in the value of financial wealth

Utility from gain and loss



$$v(X_{t+1}, S_t, z_t) = \begin{cases} X_{t+1} & , X_{t+1} \geq 0 \\ \lambda(z_t) X_{t+1} & , X_{t+1} < 0 \end{cases}$$

$$\lambda(z_t) = \lambda + [k(z_t - 1)] \quad , k > 0$$

$\lambda(z_t)$: a function of the size of prior gain/loss, measured by z_t, $k > 0$

S_t : the time t value of the investor's holdings of the risky asset.

X_{t+1} : the gain or loss between period t and period $t+1$, $X_{t+1} = S_t R_{t+1} - S_t$

z_t : a state variable measuring the investor's gains or losses prior to time t as a fraction of S_t

Utility from gain and loss

$$v(X_{t+1}, S_t, z_t) = \begin{cases} X_{t+1} & , X_{t+1} \geq 0 \\ \lambda(z_t) X_{t+1} & , X_{t+1} < 0 \end{cases}$$

$$\lambda(z_t) = \lambda + k(z_t - 1)$$

z_t : a state variable measuring the investor's gains or losses prior to time t as a fraction of S_t.

own historical benchmark

$$z_t = \frac{Z_t}{S_t}$$

Z_t: Investor's own historical benchmark level for the value of the risky asset.

Utility from gain and loss

$$v(X_{t+1}, S_t, z_t) = \begin{cases} X_{t+1} & , X_{t+1} \geq 0 \\ \lambda(z_t) X_{t+1} & , X_{t+1} < 0 \end{cases}$$

$$\lambda(z_t) = \lambda + k(z_t - 1), k > 0$$

$z_t = S_t \Rightarrow \lambda(z_t) = \lambda$

$z_t = Z_t/S_t = 1$: the investor perceives neither prior gains nor prior losses on his investments.

$S_t > z_t \Rightarrow \lambda(z_t) < \lambda \Rightarrow$ House money

$z_t = Z_t/S_t < 1$: the investor perceives prior gains on his investments.

$S_t < z_t \Rightarrow \lambda(z_t) > \lambda \Rightarrow$ Snake-bit effect

$z_t = Z_t/S_t > 1$: the investor perceives prior losses on his investments.

House money effect and excess volatility

Barberis, Huang, and Santos's model predicts that the existence of the house money effect in financial markets leads to greater volatility in stock prices.

DANKE!

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