Behavioral Finance

Lecture 16

Financial Economics

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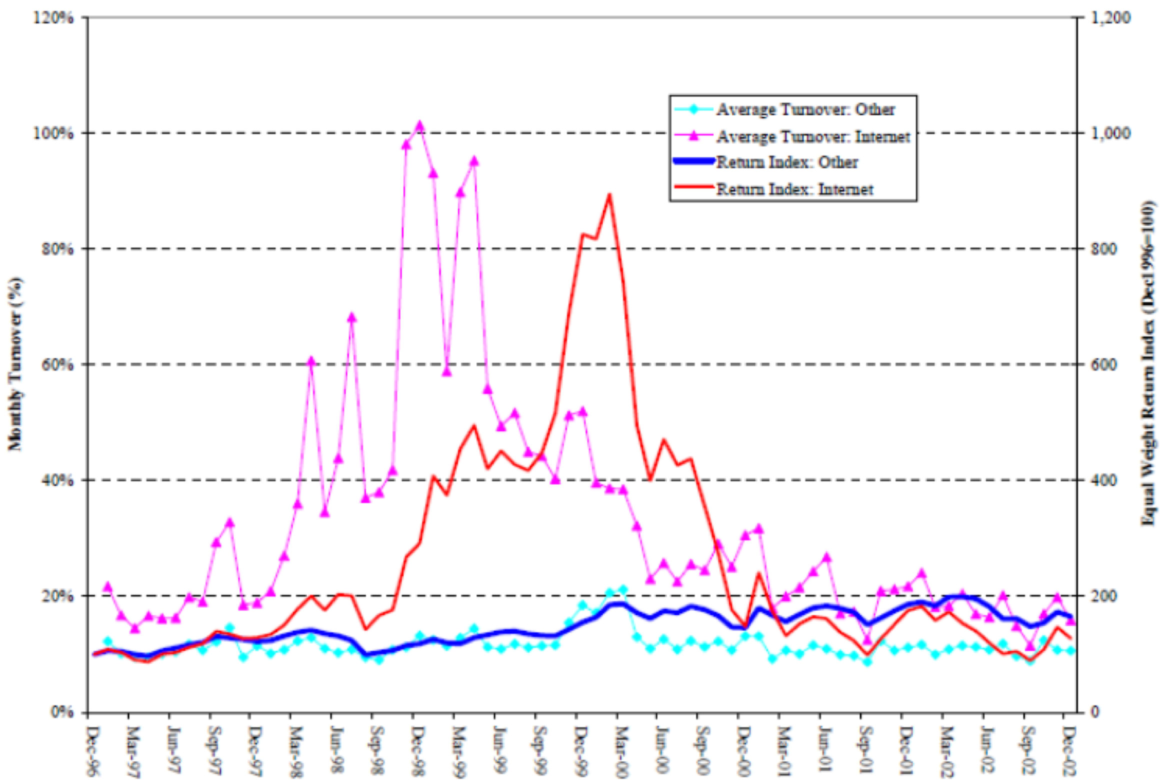
Roadmap

Canonical Finance Models	Behavioral Finance Models	Empirical Applications
Homogeneous Beliefs	1. Heterogeneous Beliefs / Disagreement	Financial bubbles; Excess trading volume
Geometric Discounting	2. Hyperbolic Discounting	Consumption-Saving
Forward-looking preferences (“sunk cost”)	Backward-looking preferences: 3. Disposition effect / 4. Loss-aversion (PT part 1)	Portfolio decisions
Unbiased expectations w.r.t. risks and returns	Biased expectations: 5. Prob. weighting (PT part 2) 6. Extrapolative expectations 7. Representativeness 8. Overconfidence	Insurance decisions; Portfolio decisions; Return predictability; Corporate decisions

Heterogeneous beliefs

Heterogeneous Beliefs and Disagreement

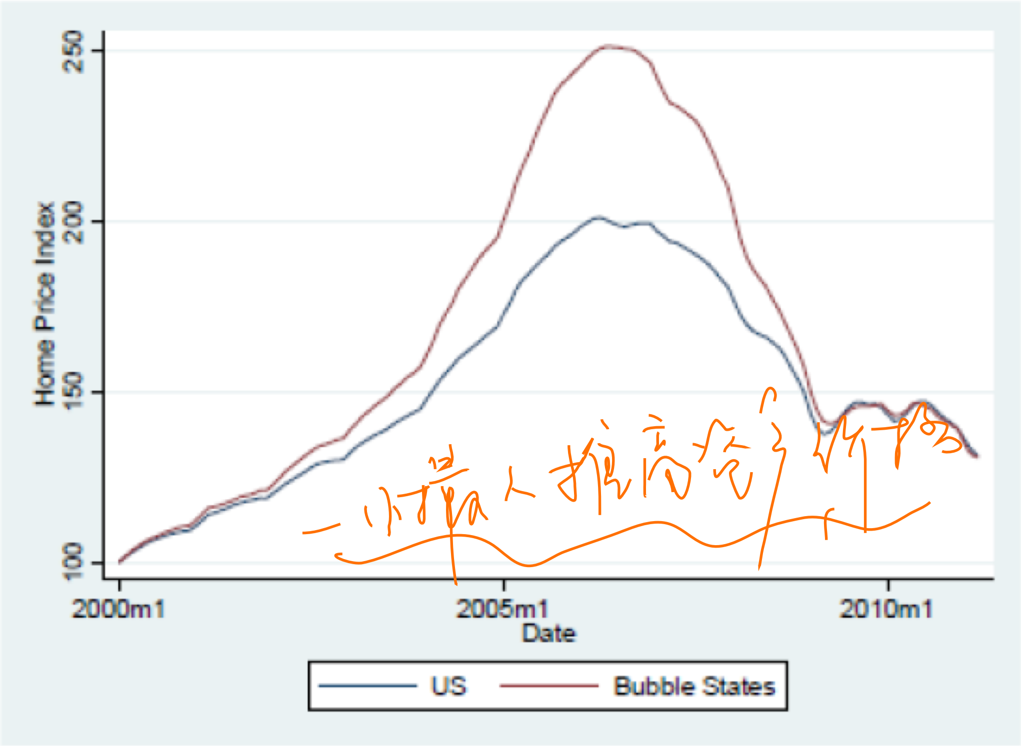
Figure 1: Prices and Turnover for Internet and Non-Internet Stocks, 1997-2002



dot com bubble

Heterogeneous Beliefs and Disagreement

Figure 5: Housing Prices in US and Four Bubble States (AZ, CA, FL, and NV)



一小撮人推高房子价格

房地产

Heterogeneous Beliefs and Disagreement

inflation

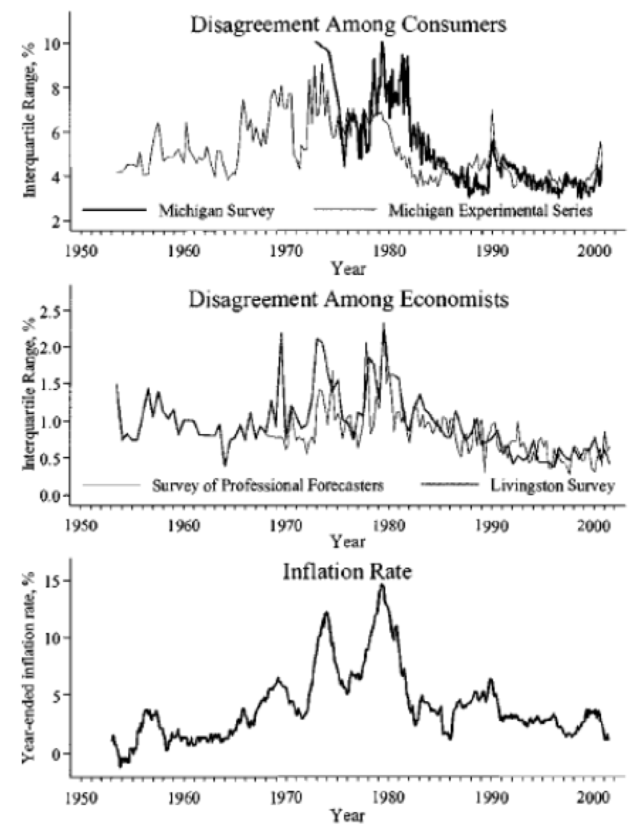
- Heterogeneous beliefs:
- Current price/m2 in 华清嘉园： 110,000 RMB
- Price in 2017: 120,000 RMB
- Price in 2007: 11,000 RMB
- What will the price be in 2019? 2020?

普遍

市场参与者不同观点

1. private info
2. past experience
3. personality

Figure 6: Disagreement over Inflation Expectations Through Time



Date reflects when the forecast is made.

Bubble: Disagreement and short-sale constraint

→ def ?

- What explains bubbles?
- One influential theory: Short-sale constraints and Disagreement (heterogeneous beliefs)
  - Disagreement: optimists and pessimists
  - Short-sale constraints:
    Harder to short-sell assets than to long assets
  - With short-sale constraints and disagreement, market price over-represent the opinion of optimists
- Simplest model: two date binomial tree (100, 0) with an optimist (0.8, 0.2) and a pessimist (0.5, 0.5). Can hold 1 or 0.

two risk-neutral investor: A & B

$\pi_A^g = 0.8$ $\pi_A^b = 0.2$

$\pi_B^g = 0.5$ $\pi_B^b = 0.5$

乐观者的期望 $\Leftarrow$ 不能卖空 (can only choose 买 or 不买)

80时，A买

低于80的价格，不是均衡，A会不停地买

p — $\pi_A^g = 0.8,\ \pi_B^g = 0.5$ — g 100

p — $\pi_A^b = 0.2,\ \pi_B^b = 0.5$ — b 0

资产价格 80

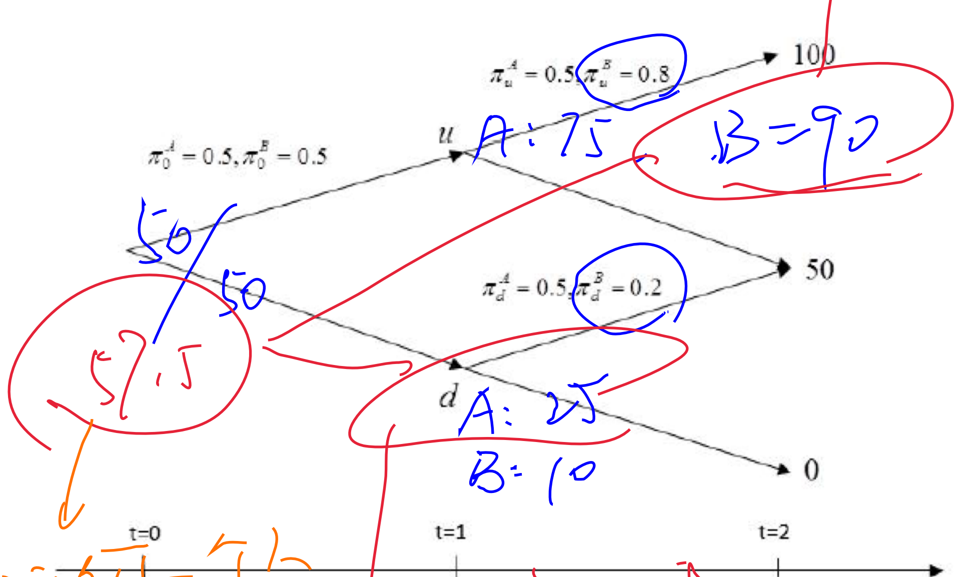
反映了乐观者的期望

Resale-option theory of bubble

A认为B是接盘侠

- Two periods, three dates: t = 0, 1, 2
- Two risk-neutral investors, A and B, trade a risky asset
- Final payoff on date 2: 100, 50, 0
- u: A -> optimistic
- d: B -> optimistic
- Unconditionally (t=0), A and B both neutral (neither opti. nor pessi.)
- The option to sell to the "greater fool" at t=0 makes asset overvalued at t=1
- Pu = 80. Pd = 50. P = 65.
- E_A[payoff] = E_B[payoff] = 50

Figure 7: An Illustration of the Resale Option Theory of Bubbles



高于对任何一个人预期

B认为A是接盘侠

1、反映乐观者的预期（无法 short-sale）

2、就算没有乐观者（on average），也会产生更高的价格 due to heterogeneous belief

Hyperbolic discounting

Geometric Discounting

- How do economists typically model time preference and intertemporal choice?
- Discounted Utility model (Samuelson, 1937)

$$U_t(c_t, c_{t+1}, \ldots, c_T) = \sum_{k=0}^{T-t} \delta^k u(c_{t+k})$$

差一年，就是δ

- Utility is independent across time (hence we can sum them up after applying discounting)
- Instantaneous utility (u) is the same function of consumption each period
- The discount rate is a constant δ between any two time periods k and k+1.

今年和明年：impatient

但判断明年和更远：多1的元(多一点)

Note, δ is often expressed as $\frac{1}{1+\rho}$ where δ is the discount "factor" and ρ is the discount "rate"

Motivating violations

- "smaller-sooner vs. larger-later" questions
- Find out how much subject values future money

- I can give you \$100 now, or wait until tomorrow and give you \$100 + \$x
  - Find out what is the x that subject is willing to accept for waiting one more day
  - The percentage increase required to wait, is then our estimate for the discount rate ρ

- I can give you \$100 one month from now, or wait until one month and one day from now and give you \$100 + \$y
  - Find out what is the y that subject is willing to accept for waiting one more day
  - In Discounted Utility, y should be the same as x.

- **However, x is typically much more than y**

Motivating violations

- This suggests that the "present" matters more

- Thaler (1981) asks subjects what amount of money in various time intervals from now, would make them indifferent to receiving $15 now.
  - One month from now: estimated annualized discount rate is 345%
  - One year from now: estimated annualized discount rate is 120%
  - 10 years from now: estimated annualized discount rate is 19%

- Preference reversals:
  - A person may prefer $110 in 31 days over $100 in 30 days, but prefers $100 now over $110 tomorrow.

From Frederick, Loewenstein, O"Donoghue, "Time Discounting and Time Preference: A Critical Review", Journal of Economic Literature, June 2002

Present-bias / hyperbolic discounting

- Laibson (1997)
- Also known as "quasi-hyperbolic" discounting or "present-biased time" preference

$$U_t(c_t, c_{t+1}, \ldots, c_T) = u(c_t) + \beta \sum_{k=1}^{T-t} \delta^k \mathrm{u}(\mathrm{c}_{t+k})$$

- β is the present-bias parameter ≤ 1
- Only the "present" (or current period) is discounted by β, but all future periods are not
- Unlike the δ discounting component, β applies equally to all "future" time periods going forward
- Introduces time inconsistency

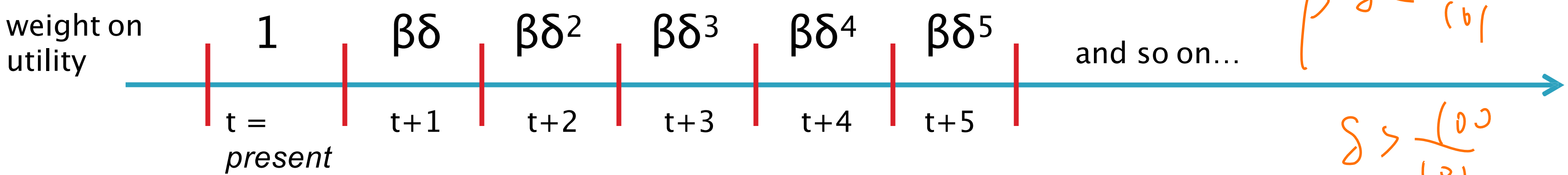
The βδ model

$10000 > \beta\delta\, 10100$

$\beta\delta\, 10100 < \beta\delta^{2}\, 10100$

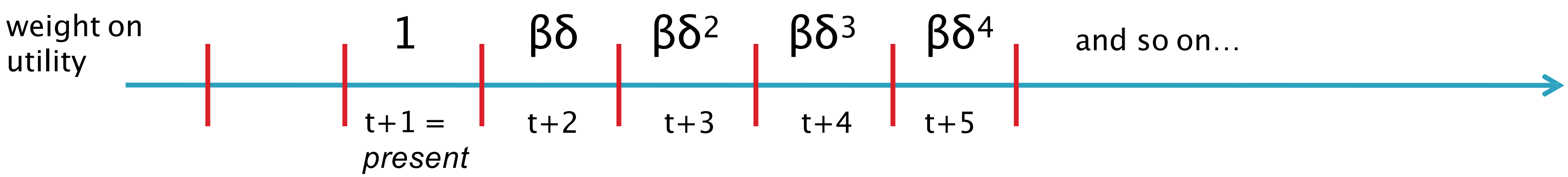
$$U_t(c_t, c_{t+1}, \ldots, c_T) = u(c_t) + \beta \sum_{k=1}^{T-t} \delta^k u(c_{t+k})$$

$\beta\delta < \frac{100}{101}$



$\delta > \frac{100}{101}$

What happens tomorrow?



- Benefits: captures the observed discounting patterns from studies, also it is fairly tractable
  - note there are other proposed discounting formulas which capture the pattern but they are not as easy to work with

time inconsistency

Naive and sophisticated

- Naïve:
  - believes tomorrow-self will use geometric discounting
  - wake up the next day to the surprise that ”today” once again matters more than future
  - Study the day before exam (-10, -9, …, -2, -1, Exam!)
- Sophisticated:
  - Aware that tomorrow-self will again use hyperbolic discounting
  - Commitment devices:
    Savings accounts, illiquid assets
    Gym memberships (higher avg. cost v.s. lower marginal cost)

Loss aversion

Disposition effect

不愿意割肉

- Investors are more reluctant to realize portfolio losses than profits (i.e. a type of history-dependence)
- This suggests preferences are asymmetric to gains and losses

Are Investors Reluctant to Realize Their Losses? 1783

Table I

PGR and PLR for the Entire Data Set

This table compares the aggregate Proportion of Gains Realized (PGR) to the aggregate Proportion of Losses Realized (PLR), where PGR is the number of realized gains divided by the number of realized gains plus the number of paper (unrealized) gains, and PLR is the number of realized losses divided by the number of realized losses plus the number of paper (unrealized) losses. Realized gains, paper gains, losses, and paper losses are aggregated over time (1987–1993) and across all accounts in the data set. PGR and PLR are reported for the entire year, for December only, and for January through November. For the entire year there are 13,883 realized gains, 79,658 paper gains, 11,930 realized losses, and 110,348 paper losses. For December there are 866 realized gains, 7,131 paper gains, 1,555 realized losses, and 10,604 paper losses. The *t*-statistics test the null hypotheses that the differences in proportions are equal to zero assuming that all realized gains, paper gains, realized losses, and paper losses result from independent decisions.

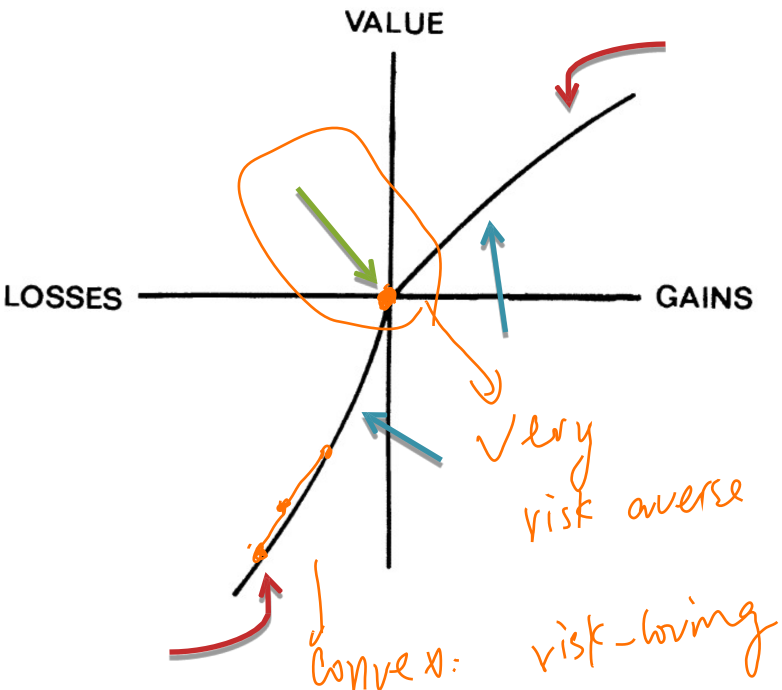
→十二月割肉

	Entire Year	December	Jan.–Nov.
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

Prospect theory 1: loss aversion

- Kahneman and Tversky's value function (1979)

对于赚钱的股票 risk averse



•The loss segment of the value function is steeper than the gains segment

亏 — — — risk loving

•This creates a kink at the "reference point" (at zero gains and losses)

•Gains and loss segments have diminishing sensitivity

- concave over gains – risk averse
- convex over losses – risk loving

- Barberis and Xiong (2006): a particular form of loss aversion robustly predicts the disposition effect

Prospect theory 1: loss aversion

- Example of a Prospect Theory value function for wealth x, given reference point r:

  (utility function)

- $$V(x|r) = \begin{cases} (x-r)^{\alpha} & \text{for } x \geq r \\ -\lambda(r-x)^{\alpha} & \text{for } x < r \end{cases}$$

  reference point

- Where λ is the "loss aversion parameter", typically estimated at $\lambda \approx 2$

- α is curvature parameter of segments, typically estimated at $\alpha \approx 0.8$

- Is the Prospect Theory value function "rational"?

Probability weighting

Prospect theory 2: prob. weighting

Consider the gamble $(x,\ p; y,\ q)$

小概率事件，除非确定是0，否则 odds 很难确定（可能会放大）

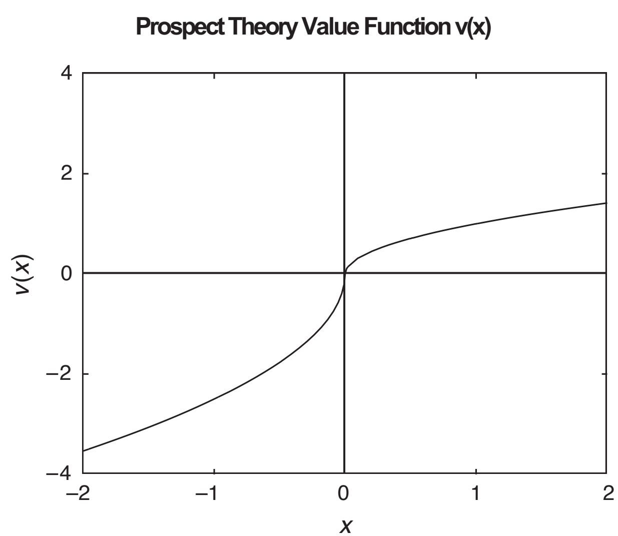
- under EU, it is assigned the value

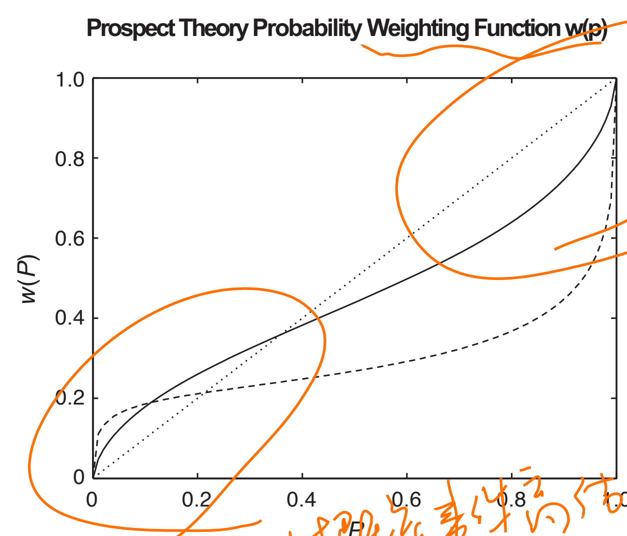
$$pU(W + x) + qU(W + y)$$

- under prospect theory, it is assigned the value

$$w(p)v(x) + w(q)v(y)$$

where v(y) is the value function in the previous part





对大概率事件低估

对小概率事件高估

Prospect theory 2: prob. weighting

- Prospect theory and the **cross-section** of stock returns
  - new prediction: the pricing of skewness
  - **probability weighting** plays the most critical role
  - ”lottery-like” stocks in high-demand and will be over-valued
    - ” a stock whose past return distribution has a high (low) prospect theory value earns a low (high) subsequent return, on average” – Barberis, Mukherjee, Wang (2016)

Prospect theory 2: prob. weighting

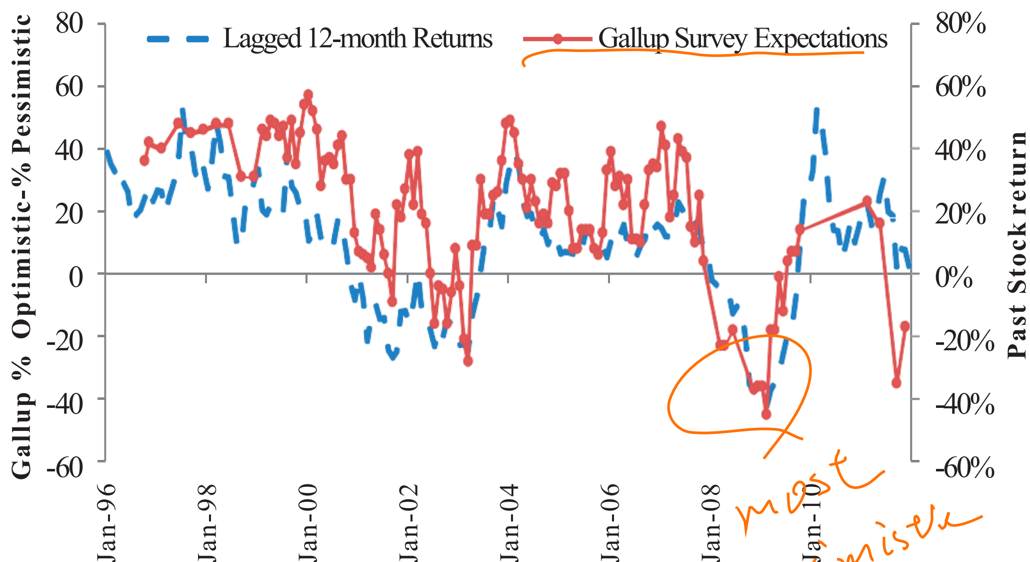
- Over-insurance of small risks
- Sydnor (2009)
  - Homeowner's insurance – covering damage due to theft, accidents and weather, but excluding floods and earthquakes. Also covers expenses in case home becomes uninhabitable.
  - When fitting a neoclassical model of risk aversion to homeowners' (deductible, premium) choices, get implausibly high levels of risk aversion
  - Customers choose from menu of deductibles: {$1000, $500, $250, $100}
  - $500 deductible was chosen most frequently, and customers paid $100 to
  - reduce the deductible from $1000 to $500
  - Given the claim rates, the additional coverage was only worth less than $25 in expectation

Extrapolative expectations

Extrapolative expectations

- investor expectations of future stock market returns are a positive function of past returns
  - Greenwood and Shleifer (2014), Koijen, Schmeling, Vrugt (2015)

盖洛普



most pessimistic

过去和表现与将来的观点一致

- the data point to *over* -extrapolation
  - –investor expectations are *negatively* correlated with subsequent realized returns

Extrapolative expectations

- Several important applications:
  - aggregate stock market
    – excess volatility, predictability
  - bubbles
    – high prices *and* high volume
  - cross-section of stock returns

– momentum, long-term reversals, value premium Note:

the above patterns are present in many asset classes, suggesting a single underlying mechanism

–return extrapolation is a simple candidate mechanism

Bubbles and extrapolative expectations

- Bubble has many definitions, we visit one here:

- a bubble is an episode in which:
  - the price of an asset rises sharply over some period of time and then collapses
  - during the price rise, there is much talk of overval- uation in the media and among investors
- also, some of the following are observed:
  - very high trading volume
  - extrapolative expectations
  - sophisticated investors “riding the bubble”
  - good fundamental news near the start of the bub- ble

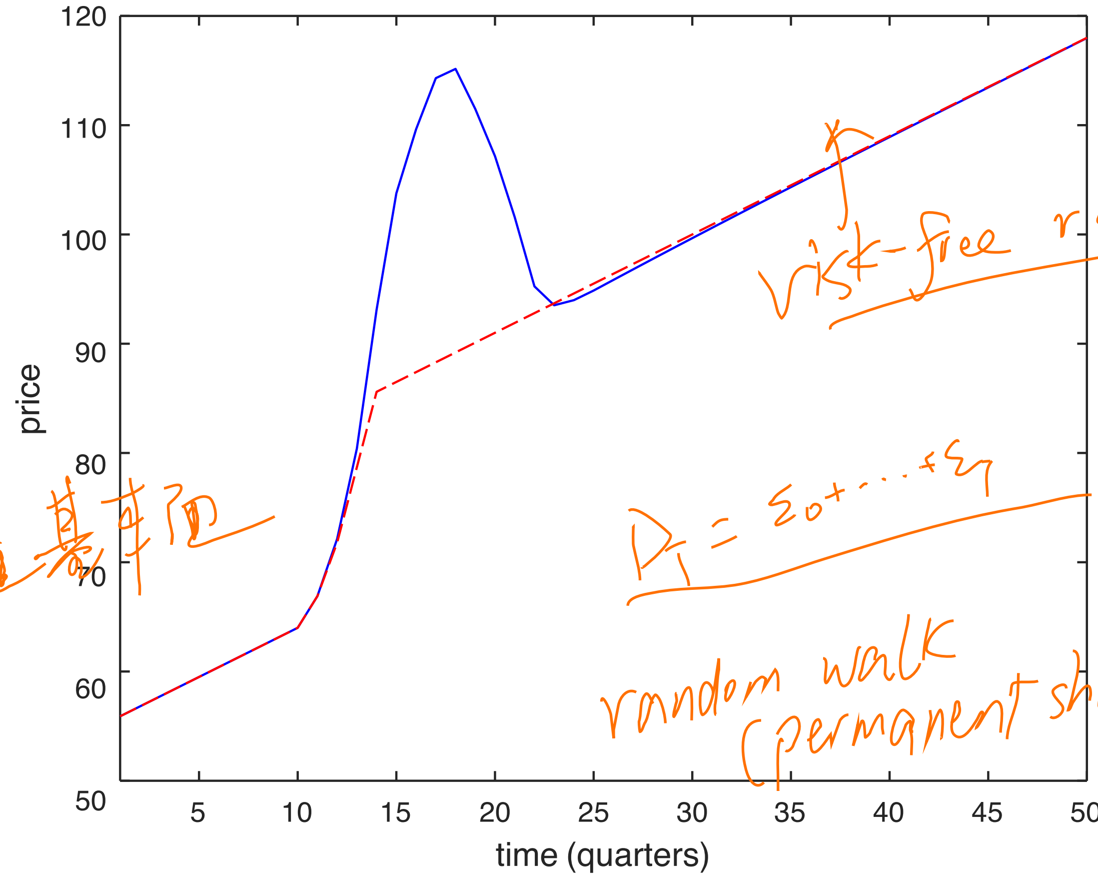
Bubbles and extrapolative expectations

Barberis, Greenwood, Jin, Shleifer (2016), "Extrapolation and Bubbles"

- A model with both rational traders and extrapolators ⇒ 不懂基本面 can generate bubble-like behaviors

specific sequence of cash-flow shocks to D_T

$$\{\varepsilon_1, \dots, \varepsilon_{10}\} = \{0, \dots, 0\}$$
$$\{\varepsilon_{11}, \dots, \varepsilon_{14}\} = \{2, 4, 6, 6\}$$
$$\{\varepsilon_{15}, \dots, \varepsilon_{50}\} = \{0, \dots, 0\}$$



Law of Small Numbers (Representativeness)

Kahneman and Tversky's observations

- "We submit that people view a sample randomly drawn from a population as highly **representative**, that is, similar to the population in all essential characteristics. Consequently, they expect any two samples drawn from a particular population to be **more** similar to one another and to the population than sampling theory predicts, at least for small samples."

- "Subjects act as if *every* segment of the random sequence must reflect the true proportion: if the sequence has strayed from the population proportion, a corrective bias in the other direction is expected."
  - Example: Subjects instructed to generate a finite random sequence of fair coin toss outcomes. The proportion of heads tends to stay very close to ½.

Law of Small Numbers

- Example: Subjects asked to predict events in a randomly generated series.

?

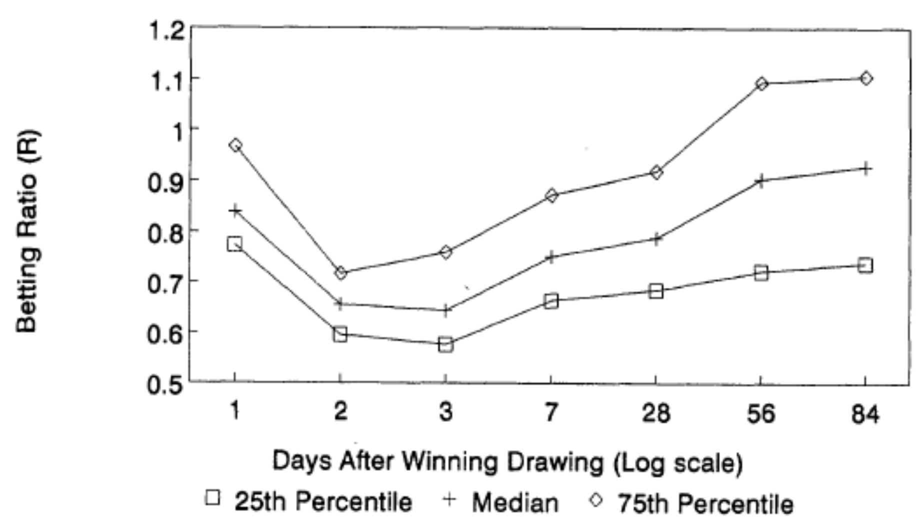
- Known as the Gambler's Fallacy: "The gambler feels that the fairness of the coin entitles him to expect that any deviation in one direction will soon be cancelled by a corresponding deviation in the other."

- For example, an activity where chance is involved is going very well for you. You feel that any minute now your luck will "run out".
- Or, you are doing terribly in an activity where chance is involved and you feel that any minute now your luck has to turn around.

In the Field: Lotteries

- Clotfelter and Cook (1993)
  - Look for evidence of the "gambler's fallacy" in lottery play – Maryland daily numbers game
  - The amount of money bet on a specific number falls sharply right after it is drawn, and recovers over the course of several months

Figure 1 **Betting on Previous Winners**



Clotfelter and Cook, "The „Gamber"s Fallacy" in Lottery Play", Management Science, Dec 1993.

In the Field: Stockmarket

- How might we observe the over-inference effect in the stock market?
- Benartzi (2001)
  - Examines rates of employee investment in their own company's stock using an estimated sample of 2/3 of US total employee holdings of company stock
  - (at this time 1/3 of large retirement savings plans were invested in own company stock, consensus is largely that this is too much – we will come back to this in a later topic)
  - Testing for 'excessive extrapolation' aka. overinference; "seeing trends and patterns even when the sequence is random"

In the Field: Stockmarket

- Benartzi (2001), continued
  - Employees whose firms experienced the best past stock performance allocated 39.7% of their 401k contributions to the company stock
  - Whereas employees whose firms experienced the worst past stock performance allocated just 10.4%
  - Accompanied by surveys to gauge investors' beliefs
  - The difference in returns over the subsequent years do not point to an informational explanation (ie. It was not that the employees had correct information about future stock performance)
- Over-inference provides an somewhat deeper explanation for return extrapolation

In the Field: Stockmarket

- Return reversal and LoSN
- De Bondt and Thaler (1985)
  - Do investors overreact to unexpected news events in a way that affects stock prices?

  - Hypothesis: Extreme movements in the stock price (overshooting) will be followed by price movements in the opposite direction – the more extreme the initial price movement, the more the price must eventually adjust in the opposite direction

In the Field: Stockmarket

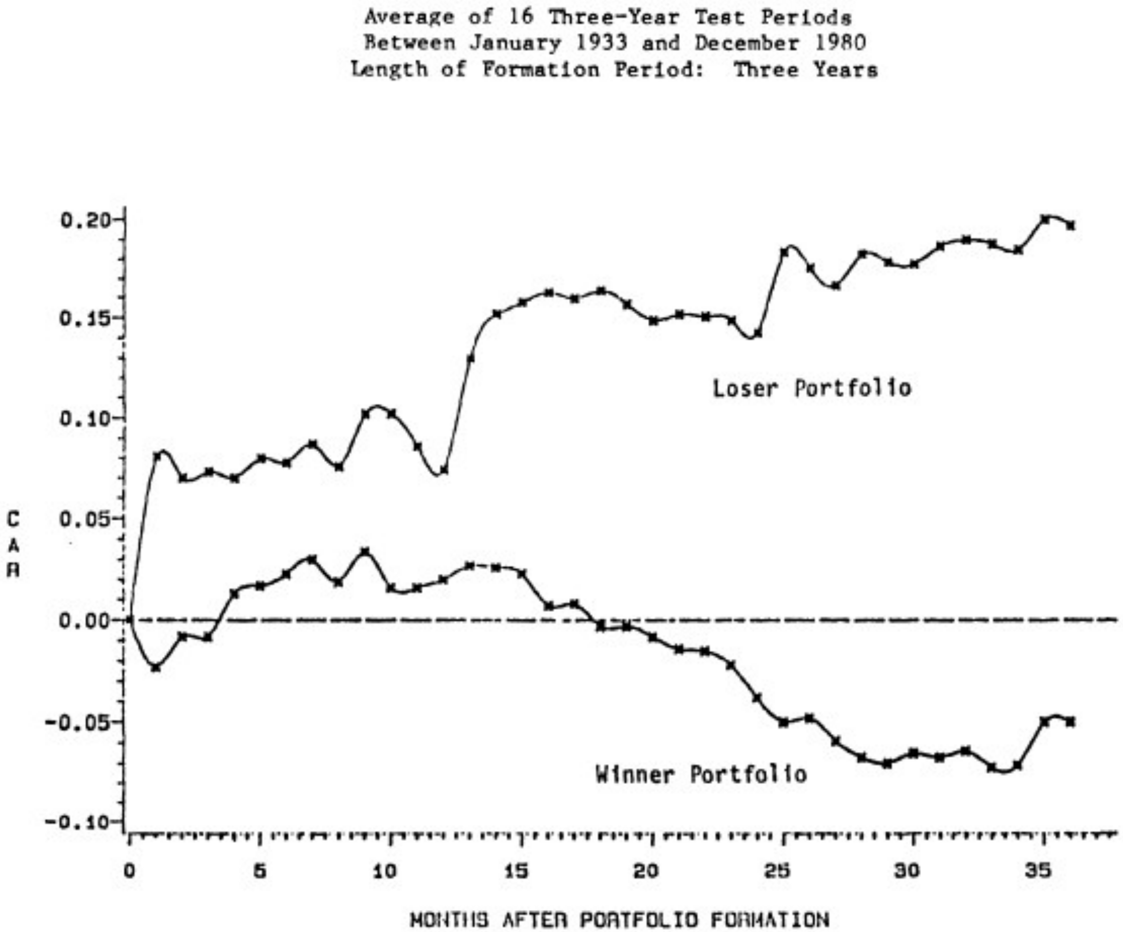


Figure 1. Cumulative Average Residuals for Winner and Loser Portfolios of 35 Stocks (1–36 months into the test period)

- Create portfolios of Winner and Loser stocks early performance, and see if residual price movements drift the other way
- LoSN provides one natural explanation for reversal
- Other potential explanations exist: reversal can also be caused by a correction of beliefs over time

Overconfidence

Overconfidence

- Will not go into details
  - Closely related to heterogeneous beliefs, LoSN, and other departures from canonical finance models in the belief dimension
- From Robert Shiller's October, 1987 Investor Survey:

"Did you think at any point on October 19, 1987 that you had a pretty good idea when the market would rebound?"

- Institutional: 29% yes, Individual 28% yes
- Among buyers: 47%, 48%

"If yes, what made you think you knew when a rebound would occur?

- Answers: "intuition," "gut feeling," "common sense"

Thank you and good luck!