Behavioral Finance

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EVROPSKÁ UNIE
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MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

KEY DISCUSSIONS IN BEHAVIORAL FINANCE

- Market efficiency
- Rationality of agents

=> 2 building blocks of Behavioral Finance

I. Limits to arbitrage
II. Psychology of decision making (cognitive psychology)

ASSUMPTIONS OVERVIEW*

	Behavioral Finance	Efficient Markets Hypothesis
Rationality of investor		
Expectations of investor		
Market efficiency		
Asset price development		

* Jindřich, T. (2008) Behavioral Finance, diploma thesis, VŠE, p.19-20

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*** Movements of the stock price have the same distribution and are independent on each other and thus from the past we cannot predict the future

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New information		
Abnormal returns		

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New information	Could cause overreaction, leading to overpricing	Included in asset pricing immediately and at the correct value
Abnormal returns	Possible if the behavior of the market is estimated correctly	Not possible in the long term

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Example: Ford

- The fundamental value of a share of Ford is $20. Imagine that a group of irrational traders becomes excessively pessimistic about Ford's future prospects and through its selling, pushes the price to $15. Is there space for riskless profits at no costs? What will arbitrageur do?

Example: Ford

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- Arbitrageur will **buy the security at its bargain price** + hedge their bet by **shorting a "substitute" security**, such as General Motors
- The buying pressure on Ford shares will then bring their price back to fundamental value.

Is free lunch really for free?

Behavioral finance: “still, there are some mispricings that remain unchallenged”

WHY?

Is free lunch really for free?

Behavioral finance: "still, there are mispricings that remain unchallenged"

WHY?

"Trading strategies designed to correct the mispricing can be both risky and costly"

I. LIMITS TO ARBITRAGE

- **Fundamental risk**

  - loss potential arising from situation affecting specific group of people or firms, changing the fundamental price

  -short position in substitute stock should cover the arbitrageur from adverse news to the whole sector, but not from the news related to specific stock

  - substitute stock can be also mispriced

- **Noise trader risk**

- the reason behind the mispricing (i.e. reaction to irrelevant information) may even worsen in short period, traders can get more pessimistic
- that can force arbitrageurs to close their positions earlier (risk of investors' decision to withdraw money from losing fund, etc.) facing huge losses

- **Implementation costs**

  - revealing mispricing is costly or the resources to exploit it are expensive (i.e fee for shorting, legal constraints, etc.)

Example: Ford and GM

Example – Japanese stock market in 1980s

- Mid 1987 – Arbitrageurs short Japanese stocks

  \+ buy long in US stock market

  -> turns out as right strategy in the long run

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- October 1987 – US Stock market crash is bigger than Japanese (due to Japanese government intervention)

- Why this might be a problem?

Example – Japanese stock market in 1980s

- If arbitrageurs trade on **limited funds**, at some point, they cannot hold on to the strategy for much longer – they have **limited time horizon**

- Situation later forced some **to liquidate their positions** (just when the relative mispricing was the greatest)

  - => Additional buying pressure for Japanese stocks at the moment when they were most overvalued*

* Ritter 2003: Behavioral finance, Pacific-Basin Finance Journal 11 (4), 429 - 437

Example: BIG SHORT

- Michael Burry bets against the housing markets:

https://www.youtube.com/watch?v=Cxjdj5_5yNM

- Michael Burry restricts the withdrawals:

https://www.youtube.com/watch?v=19hJCsc-F8Y

Michael Burry closes the fund:

https://www.youtube.com/watch?v=dlbG6G_iHLU

HOW ABOUT THE EVIDENCE?

- Any case of long-term mispricing could serve as evidence of limits of arbitrage

Criticism: If mispricing is defined as deviation from fundamental value, when testing the inefficiency we face "joint hypothesis problem"

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- Any case of long-term mispricing could serve as evidence of limits of arbitrage

  Criticism: If mispricing is defined as deviation from fundamental value, when testing the inefficiency we face "joint hypothesis problem"

  = observed value could reflect inefficiency, wrong asset pricing model, or both

  => market efficiency is near to impossible to be tested in reality

LIMITED EVIDENCE EXIST

- Several examples of financial markets phenomena that are almost certainly mispricing and persistent:
- Twin shares
- Index inclusions

1. Twin shares

- Example*:

  In 1907, Royal Dutch and Shell Transport agreed to merge their interests on a 60:40 basis while remaining separate entities.

- After entering the market, if prices reflect fundamental value, **the market value of Royal Dutch equity** should always be **1.5 times the market value of Shell equity.**

- Nevertheless…

*ARBERIS, THALER, 2003. A survey of behavioral finance

1. Twin shares

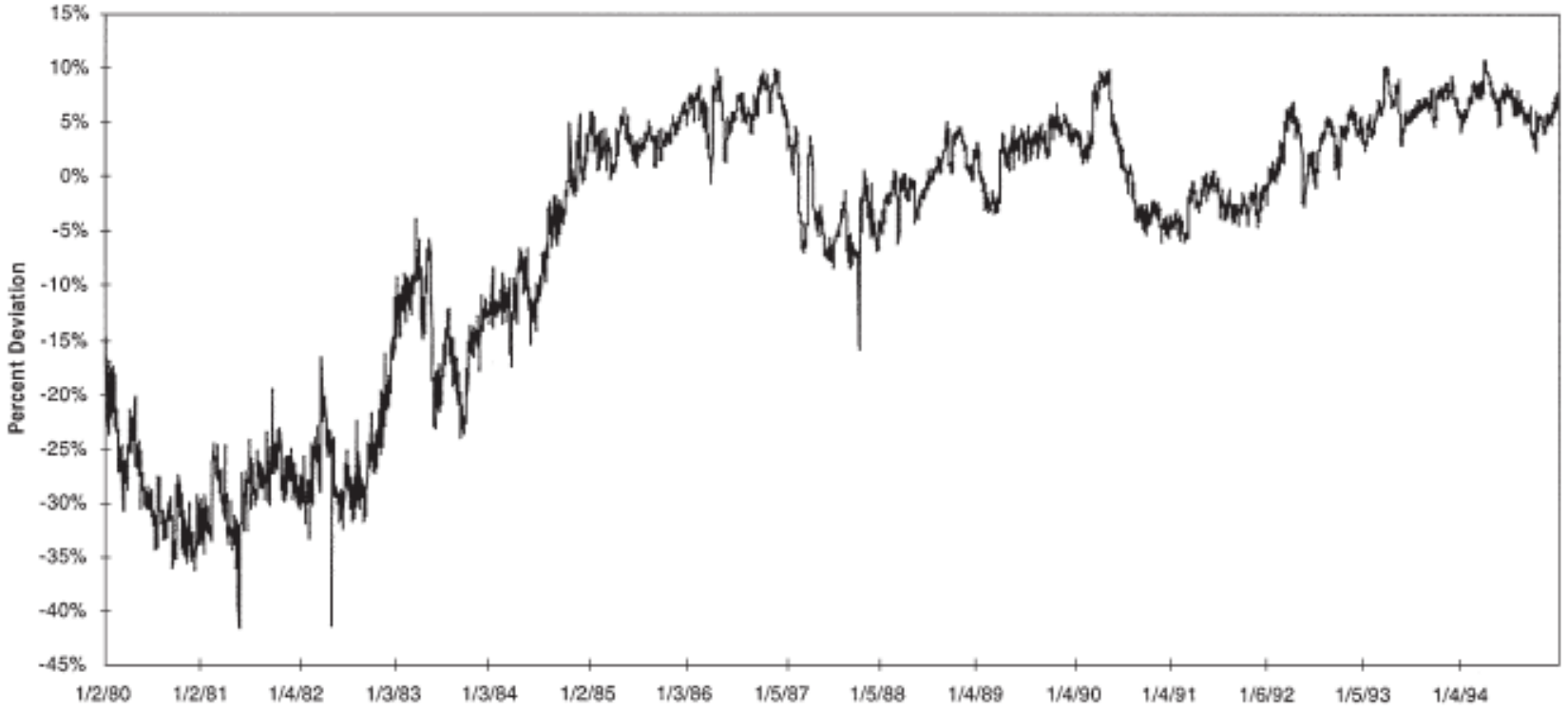


Fig. 1. Log deviations from Royal Dutch/Shell parity. Source: Froot and Dabora (1999).

- the ratio of Royal Dutch equity value to Shell equity value relative to the efficient markets benchmark of 1.5.

1. Twin shares – limits to arbitrage?

- Fundamental risk:
- Noise trader risk:
- Implementation costs:

1. Twin shares – limits to arbitrage?

- Fundamental risk: NO

(one stock good substitute for another, well hedged)

- Noise trader risk: YES

(Whatever investor sentiment is causing one share to be undervalued relative to the other could also cause that share to become *even more undervalued in the short term)*

- Implementation costs: NO

(mispricing visible, shorting one or another should not be complicated)

2. Index inclusions

- When stock is included in key stock market index (as replacement of another), it tends to jump in price
- Harris and Gurel (1986)* and Shleifer (1986)**: when a stock is added to the index, it jumps in price by an average of 3.5%, and much of this jump is permanent.
- AOL rose 18% on the news of its inclusion in the index, Yahoo +24 % by single day

•Harris, Gurel (1986), "Price and volume effects associated with changes in the S&P 500:new evidence for the existence of price pressure", Journal of Finance 41:851–860.
* * Shleifer, A. (1986), "Do demand curves for stocks slope down?", Journal of Finance 41:579–90.

2. Index inclusions – limits to arbitrage?

- Fundamental risk:
- Noise trader risk:
- Implementation costs:

2. Index inclusions – limits to arbitrage?

- Fundamental risk: YES
  (hard to find perfect substitute stock)

- Noise trader risk: YES
  (whatever caused the initial jump in price – in all likelihood, buying by S&P 500 index funds – may continue in short run– i.e. Yahoo from $115 prior to its S&P inclusion announcement to $210 a month later)

- Implementation costs: NO

(shorting considered easy)

Just a short review…

2 building blocks of Behavioral Finance

I. Limits to arbitrage

- The theory of limited arbitrage shows that if irrational traders cause deviations from fundamental value, there are cases rational traders are powerless
- To know more about the structure of these deviations – it is important to know, what the specific forms of irrationality are

=> II. Psychology of decision making (cognitive psychology)

II. PSYCHOLOGY OF DECISION MAKING

- Gives explanations to systematic biases that arise when individuals form **beliefs**

- And what are the biases stemming from people's **preferences**

II. PSYCHOLOGY OF DECISION MAKING

Biases that arise when individuals form **beliefs:**

Overconfidence
Confirmation bias
Optimism and wishful thinking
Representativeness
Conservatism
Belief perseverance
Anchoring
Availability biases

Biases stemming from people's **preferences:**

Prospect Theory (Framing, Loss Aversion)
Ambiguity aversion

1. Beliefs - overconfidence

- People are overconfident in their judgments:
  - confidence intervals people assign to their estimates of quantities are too narrow
  - Poor judgment about probabilities

1. Beliefs – confirmation bias

- Tendency of an individual to actually seek out, interpret or recall evidence to support a predisposed belief.

1. Beliefs - other

Optimism and wishful thinking

- Tendency to display unrealistically rosy views of one's abilities and prospects

Representativeness

- When determing probability that i.e. A belongs to a class B, individuals are influenced by stereotypes (i.e. a degree to which A reflects the essential characteristics of B)
- tendency to neglect base case (Linda)
- + sample size neglect
  - in case individuals do not know the data generating process, they will infer it only on few data points – „law of small numbers"*
  - In case of knowing the data generating process (i.e. toss of a coin), the law of small numbers leads to a gambler's fallacy effect („tails are due")

Belief preseverence

- Holding on too tightly and too long to previously formed opinion

•Rabin, M. (2002), "Inference by believers in the law of small numbers", Quarterly Journal of Economics

1. Beliefs - other

Conservatism

- Unlike representativeness, base rates are over-emphasized relative to sample evidence
- Tendency to maintain prior view without properly reflecting new information

Anchoring

- Tendency to rely too heavily on first piece of information offered or to “anchor” too much on initial value when making estimates or decisions

Availability biases

- When judging probability of an event, individuals tend to search for available relevant information in their memory –> tendency to overweight most recent or striking events
- i.e. probability of a plane crash

How to deal with these biases?

- Researchers believe in:
  - Learning process – biases can be limited through repetition and expertise
  - Incentives

Nevertheless:

„No replicated study has made rationality violations disappear purely by raising incentives.”*

*Camerer, C., and R. Hogarth (1999), “The effects of financial incentives in experiments: a review and capital-labor production framework”, Journal of Risk and Uncertainty 19:7–42.

2. Preferences – Prospect theory*

- **Expected utility framework** – systematically violated when individuals choose among risky gambles

  -> **Prospect Theory** (Kahneman and Tversky, 1979) seems to be most promising alternative for financial application

- For gambles with at most 2 non-zero outcomes:

  $(x, p; y, q)$ - *outcome x with probability p, outcome y with probability q,* where $x < 0 < y$ *or* $y < 0 < x$, people assign it a value of:

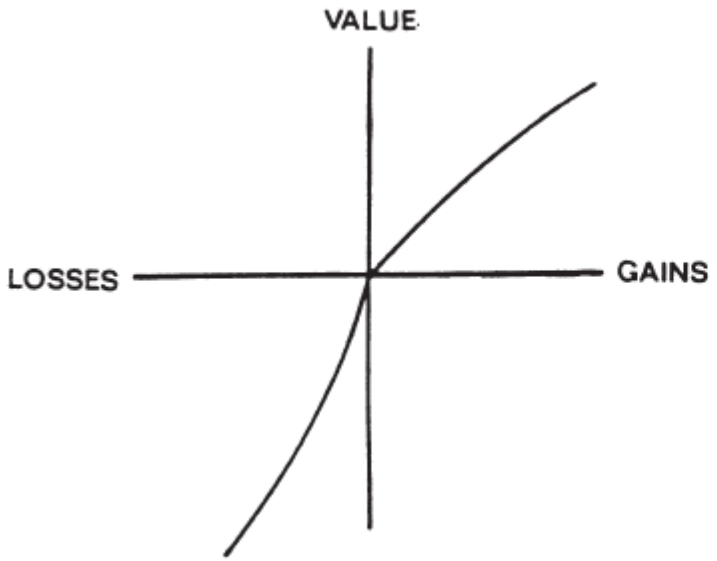
$$\pi(p)\, v(x) + \pi(q)\, v(y)$$

  $\pi(p)$ .....*decision weight*
  $v(x)$ .....*value function*

  ...and when choosing between different gambles, they pick the one with the highest value.

* Kahneman, D., and A. Tversky (1979), "Prospect theory: an analysis of decision under risk", Econometrica 47:263–291

2. Preferences – Prospect theory



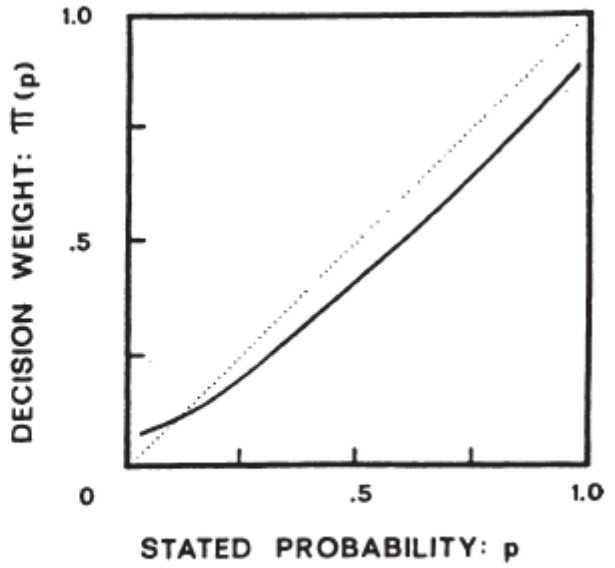


Fig. 2. Kahneman and Tversky's (1979) proposed value function v and probability weighting function π.

2. Preferences – Prospect theory

- Important features:

- utility is defined over **gains and losses** rather than over final wealth positions

- people are **risk averse over gains**, and **risk-seeking over losses** (shape of value function)

- greater sensitivity to losses than to gains (**=loss aversion**, captured by kink at the origin of value function)

- **nonlinear probability transformation** (small probabilities are overweighted, so that $\pi(p) > p$)

  => in case of gambles offering huge gain with small probability individuals are risk seeking, in case of huge losses with small probability risk averse

2. Preferences – Prospect theory – generalization*

- For gambles with more than 2 outcomes
- Gamble value for x_i with p_i:

$$\sum_i \pi_i \upsilon(x_i),$$

where

$$\upsilon = \begin{cases} x^{\alpha} & \text{if} \quad x \geqslant 0 \\ -\lambda(-x)^{\alpha} & \text{if} \quad x < 0 \end{cases}$$

and

$$\pi_i = w(P_i) - w(P_i^*),$$

$$w(P) = \frac{P^{\gamma}}{(P^{\gamma} + (1-P)^{\gamma})^{1/\gamma}}.$$

By experiments it was set:
$\alpha = 0.88$
$\lambda = 2.25$ … *"coefficient of loss aversion"*
$\gamma = 0.65$

* Tversky, A., and D. Kahneman (1992), "Advances in prospect theory: cumulative representation of uncertainty", Journal of Risk and Uncertainty 5:297–323

Example (prospect theory, framing)*

- Imagine you are richer by $300.

  Consider a choice between:
  - a sure gain of $100
  - a 50% chance to gain $200, a 50% chance to gain $0.

*TVERSKY & KAHNEMAN, 1981. The framing of decisions and the psychology of choice. Science, 211(4481), 453–458

Example (prospect theory, framing)*

- Imagine you are richer by $300.

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- Imagine you are richer by $500.

  Consider a choice between:
  - a sure loss of $100
  - a 50% chance to lose $200, a 50% chance to lose $0

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Example (prospect theory, framing)*

- Imagine you are richer by $300.
  Consider a choice between:
  - a sure gain of $100 (72%)
  - a 50% chance to gain $200, a 50% chance to gain $0 (28%)

- Imagine you are richer by $500.
  Consider a choice between:
  - a sure loss of $100 (36 %)
  - a 50% chance to lose $200, a 50% chance to lose $0 (64%)

Reversal in choice

- Case 1: 72% chose option 1, 28% chose option 2.
- Case 2: 36% chose option 1, 64% chose option 2.

  ⇒ A reversal in choice

  Although the **two problems are essentially identical**:
- Problem framed as a gain: majority choice is risk averse.
- Problem framed as a loss: majority choice is risk seeking.

-> Based on experiments, there **are 30 – 40 % preference shift** based on the **wording of a problem**

- **Mental accounting** (R.Thaler) – process how people formulate and categorize economic outcomes into "accounts"
  - + narrow framing – tendency to separate individual gambles from other wealth

2. Preferences – Ambiguity aversion

- In reality, it is rare to objectively know the probabilities of outcomes
- Ambiguity aversion suggests that people **are averse to situations where they are uncertain about the probability distribution** of a gamble

-> prefer bet where they feel more competent about relevant distribution

Example*:

Urn 1 : 100 blue and red balls, unknown proportion

Urn 2 : 100 blue and red balls, 50:50

- *a1 : a ball is drawn from Urn 1, $100 if red, $0 if blue,*
- *a2 : a ball is drawn from Urn 2, $100 if red, $0 if blue.*

- *b1 : a ball is drawn from Urn 1, $100 if blue, $0 if red,*
- *b2 : a ball is drawn from Urn 2, $100 if blue, $0 if red.*

  => outcome: a2 (b2) typically preferred to a1 (b1)

*Ellsberg, D. (1961), "Risk, ambiguity, and the savage axioms", Quarterly Journal of Economics 75: 643–69.

Coming next

- Equity premium puzzle and volatility puzzle