



Lecture 8

CAPM Model & Behavior Issues in Financial Markets

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Agenda

- Risk diversification via portfolio investment
- CAPM (Capital Asset Pricing Model)
- Critique of CAPM
- Behaviour issues in financial markets



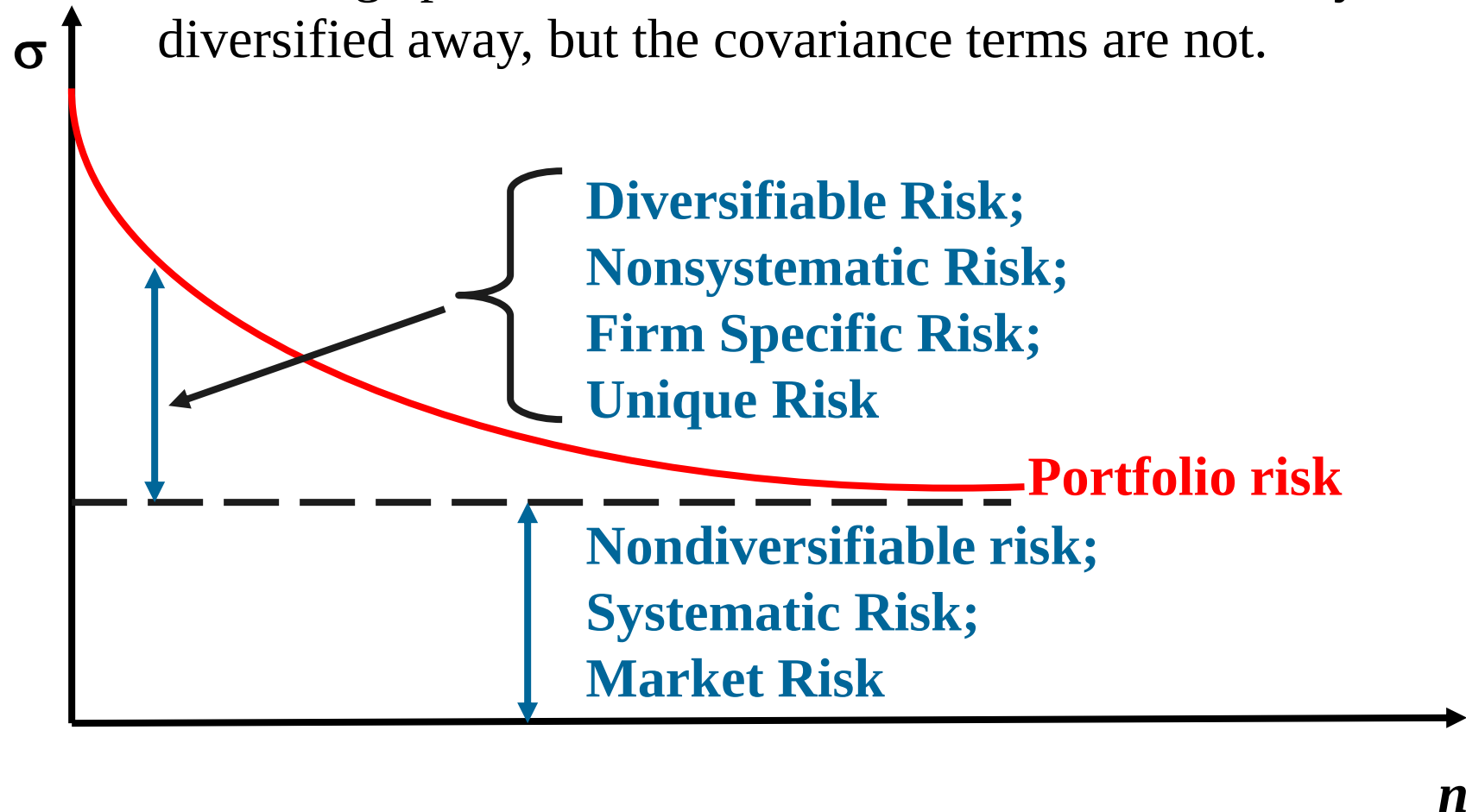
Expected Returns and Variances

- **For Individual Assets**
- Calculations based on *Expectations* of future;
$$E(R) = \sum (p_s \times R_s)$$
- *Variance (or Standard Deviation):*
 - a measure of variability;
 - a measure of the amount by which the returns might deviate from the average ($E(R)$)
$$\sigma^2 = \sum \{p_s \times [R_s - E(R)]^2\}$$



Portfolio Risk and Number of Stocks

* In a large portfolio the variance terms are effectively diversified away, but the covariance terms are not.





Systematic Risk

- Risk factors that affect a large number of assets
- Also known as non-diversifiable risk or market risk
- Includes such things as changes in GDP, inflation, interest rates, etc.



Unsystematic (Diversifiable) Risk

- Risk factors that affect a limited number of assets
- Also known as unique risk, asset-specific risk and idiosyncratic risk.
- Includes such things as labor strikes, part shortages, etc.
- The risk that can be eliminated by combining assets into a portfolio
- If we hold only one asset, or assets in the same industry, then we are exposing ourselves to risk that we could diversify away.



Total Risk

- Total risk = systematic risk + unsystematic risk
- The standard deviation of returns is a measure of total risk.
- For well-diversified portfolios, unsystematic risk is very small.
- Consequently, the total risk for a well-diversified portfolio is essentially equivalent to the systematic risk.



Capital Assets Pricing Model -CAPM

CAPM is also known as the **Security Market Line (SML)** equation.

$$R_i = R_f + \beta_i [R_m - R_f] + e_i$$

R_i - Rate of return on stock i

R_f - Risk-free rate of return

β - Beta coefficient (ratio)

R_m - Rate of return on portfolio of all stocks or rate of return on an average-risk stock.

e_i - Error term



Risk-free rate (R_f)

- Only the government can issue default-free bonds.
- Treasury bills are viewed as “the” risk-free asset
- Where to find the interest rates for UK Treasury Bills (3 Months)?

From Bank of England website, select Statistics -> Interest and Exchange Rates -> Wholesale interest and discount rates -> Treasury Bills (3 month) -> Sterling -> End month - IUMAJNB - Monthly

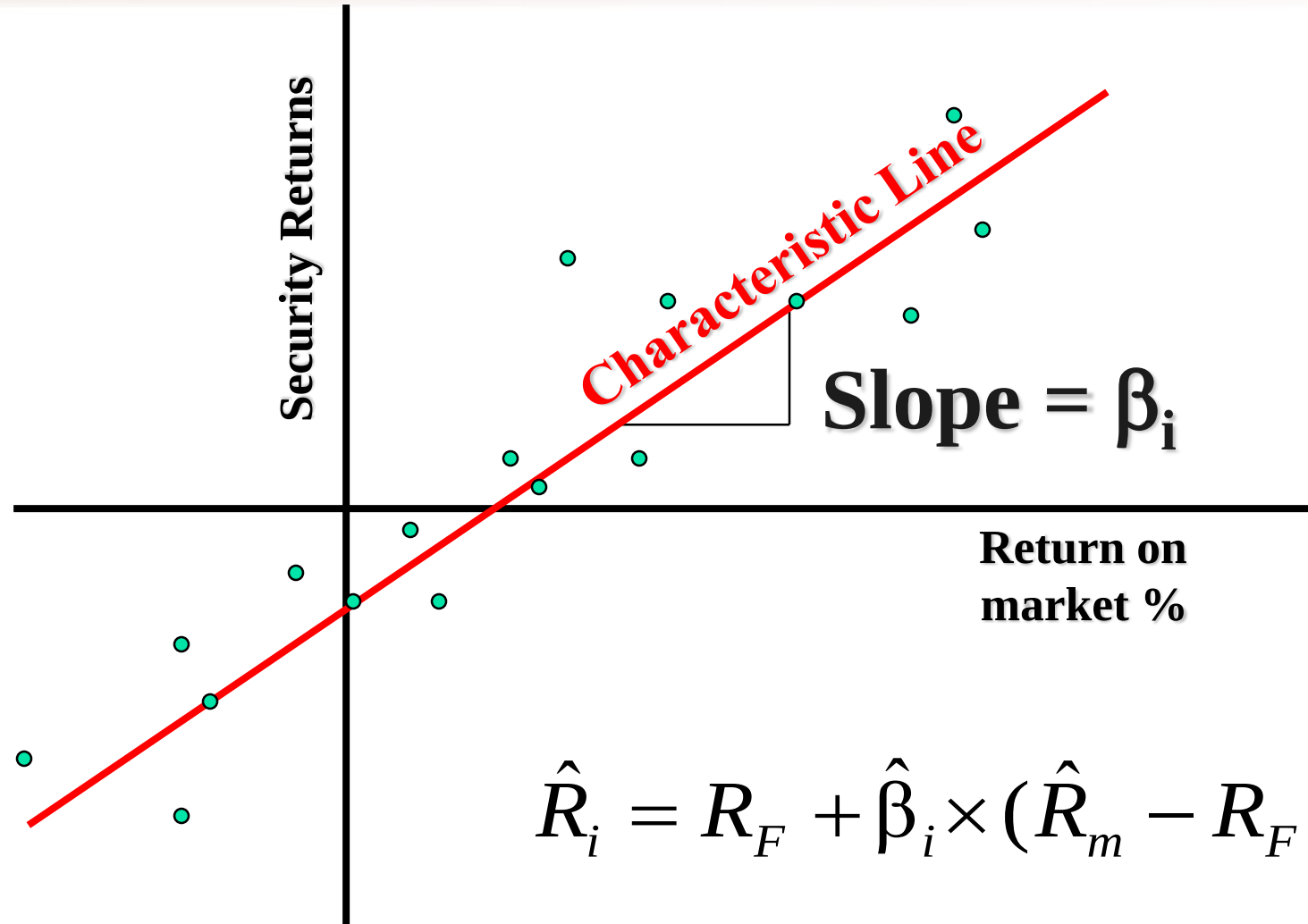


Beta and risk

- CAPM provides an expression which relates the expected return on an asset to its systematic risk.
- A good measure of the risk of a security in a large portfolio is the *beta* (β) of the security
- *Beta* (β) measures the responsiveness of a security to movements in the market portfolio (i.e., **systematic** risk)
- Error term (e_i) captures the **unsystematic** risk.



Estimating β with regression





The Formula for Beta

$$\beta_i = \frac{\text{Cov}(R_i, R_M)}{\sigma^2(R_M)} = \frac{\sigma_{i,M}}{\sigma_M^2}$$

Clearly, your estimate of beta will depend upon your choice of a proxy for the market portfolio



Example

<i>State</i>	<i>Type of Economy</i>	<i>Return on Market</i>	<i>Return on single stock</i>	<i>Type of Economy</i>	<i>Return on Market</i>	<i>Expected return on single stock</i>
<i>I</i>	Bull	15%	25%	Bull	15%	$25\% \cdot 1/2 + 15\% \cdot 1/2 = 20\%$
<i>II</i>	Bull	15%	15%	Bear	-5%	$(-5\%) \cdot 1/2 + (-15\%) \cdot 1/2 = -10\%$
<i>III</i>	Bear	-5%	-5%			
<i>IV</i>	Bear	-5%	-15%			

The market's return in a bullish economy is 20% ($=15\% - (-5\%)$) greater than the market's return in a bearish economy. However the stock's return in a bullish economy is 30% [$=20\% - (-10\%)$] higher than its return in a bearish economy. Thus the stock has a responsiveness coefficient of 1.5



Market Risk Premium

- Estimated return on an individual security:

$$\hat{R}_i = R_F + \hat{\beta}_i \times \underbrace{(\hat{R}_m - R_F)}$$

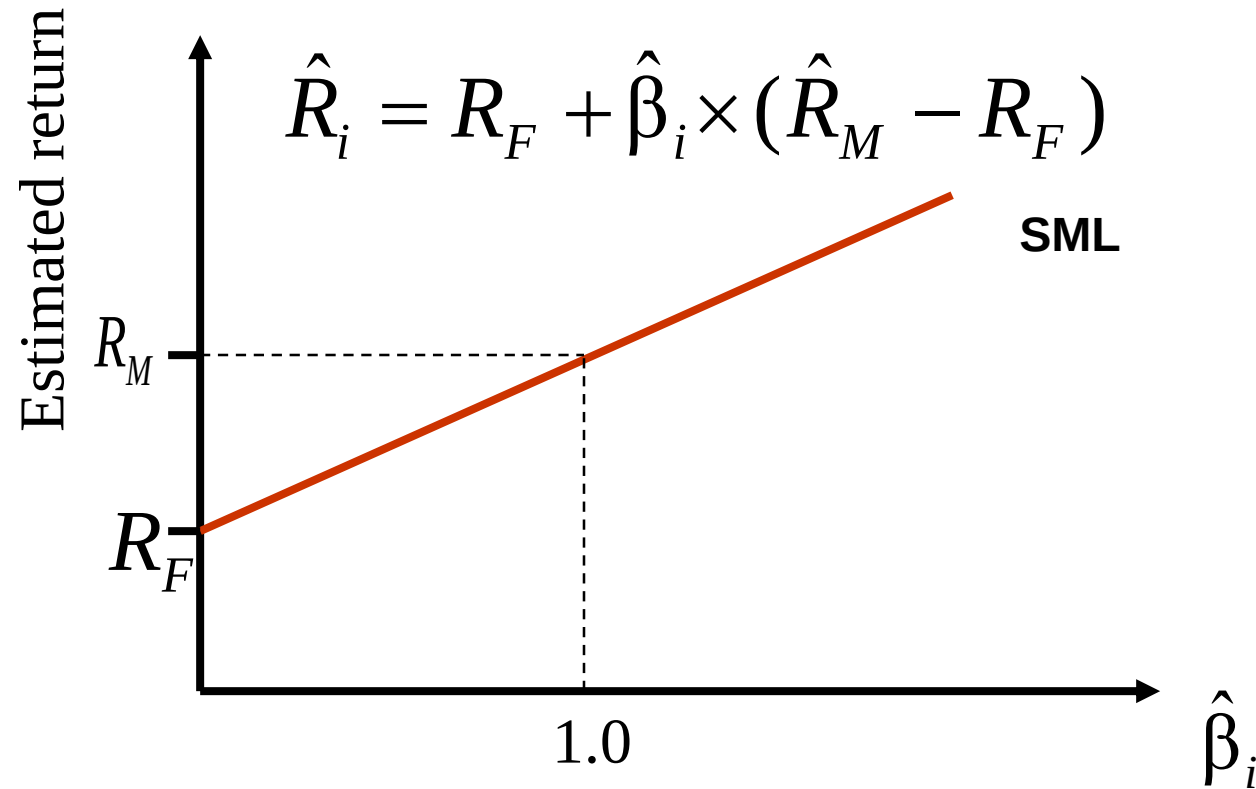
Market Risk Premium

This applies to individual securities held within well-diversified portfolios.

- Assume estimated $\beta_i = 0$, then the estimated return $\hat{R}_i = R_F$
- Assume estimated $\beta_i = 1$, then the estimated return $\hat{R}_i = \hat{R}_M$

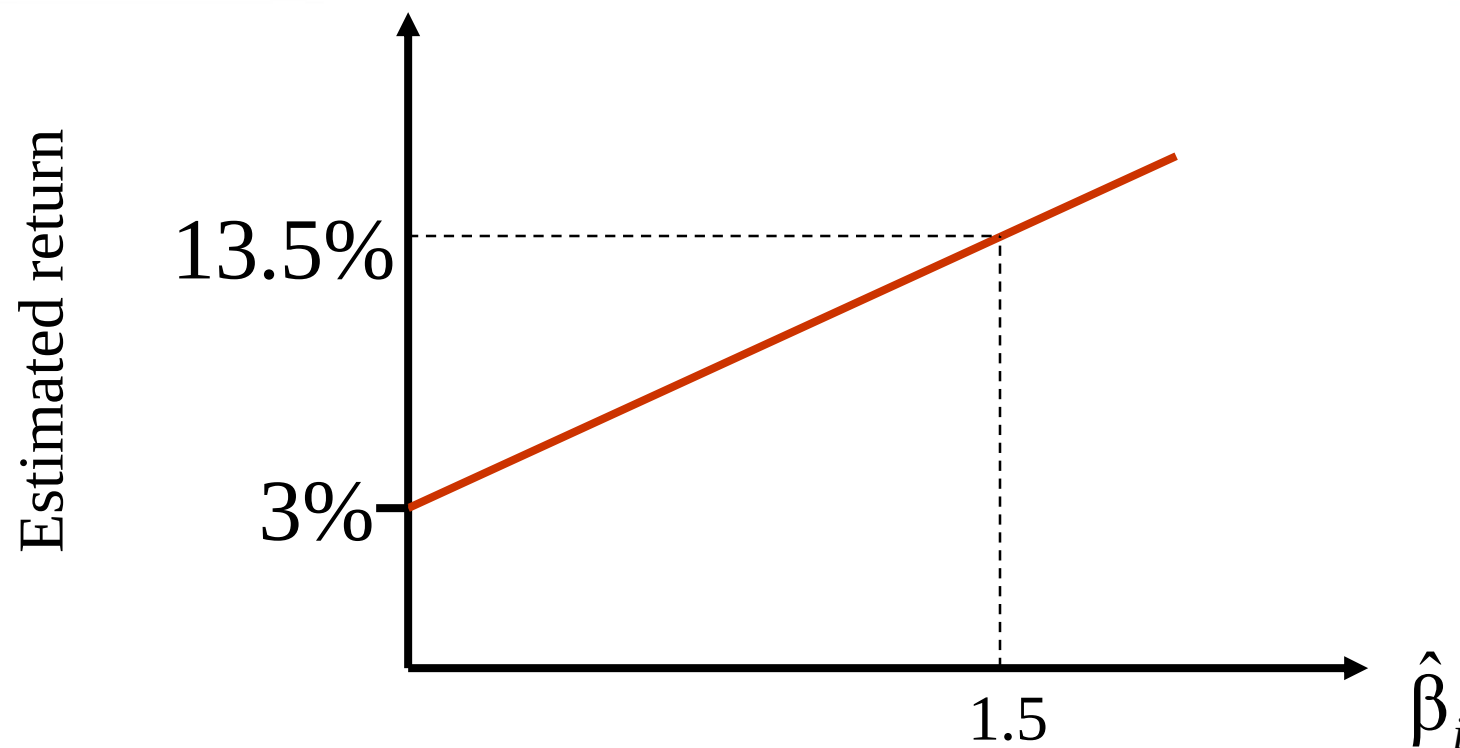


Relationship between risk & return





Relationship between risk & return: Example



$$\hat{\beta}_i = 1.5 \quad R_F = 3\% \quad \hat{R}_M = 10\%$$

$$\hat{R}_i = 3\% + 1.5 \times (10\% - 3\%) = 13.5\%$$



Roll's (1977) Critique of the CAPM

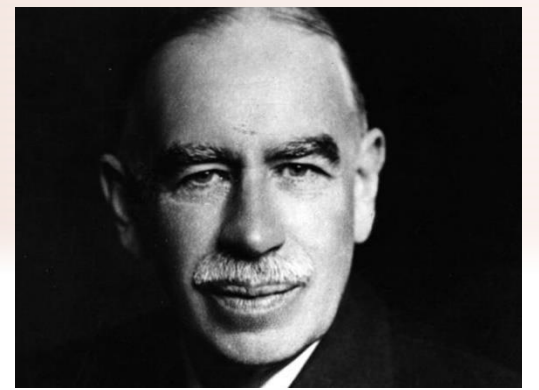
It is practically impossible to construct a portfolio that contains every single security (i.e. the true market portfolio), any test of the CAPM that uses a market index proxy (e.g. FTSE100, DAX30, S&P500, etc.) will be testing that specific portfolio, and not the true market portfolio.

This means that, for all intents and purposes, the CAPM is empirically untestable because the underlying market portfolio is unobservable.

Any tests of the CAPM that use market indices will be affected by this criticism.



A few quotes



- *It is hard to see how any rational man can ever invest*
(John Maynard Keynes)
- *The market can stay irrational longer than you can stay solvent*
(J.M. Keynes)
- *There is nothing so dangerous as the pursuit of a rational investment policy in an irrational world*
(Still...J.M. Keynes)



Theoretical challenges of EMH: Behavioral Finance

- The main opposition to EMH & the “rational markets” school has been, since the 1980s, the behavioral school
- Three arguments:
 - Rationality is not perfect / perfectly distributed
 - There are independent deviations from rationality
 - Arbitrage is risky and might not work



Behavioural Finance

- Recall the assumptions of EMH
 - Investors are rational
 - Any irrational trades are random and cancel out
 - Rational arbitrageurs will eliminate the influence of irrational traders
- Proponents of EMH argue that investors often behave irrationally, and push share prices away from the fundamental value for considerable periods of time.
- Behavioural finance is a descriptive not prescriptive area of finance
 - Explains a number of unsolved puzzles under rational finance



Rationality is not perfect

- People are not always rational
 - They trade and generally act on the basis of emotions / non-rational criteria
- In particular, many investors fail to diversify, trade too much, and seem to try to maximize taxes by selling winners and holding losers
- Herd behavior!



Arbitrage is not risk free

- Suppose that your superior, rational, analysis shows that company ABC is overpriced
- Arbitrage would suggest that you should short the ABC shares
- After the rest of the investors come to their senses, you make money because you were smart enough to “sell high and buy low”
- But what if the rest of the investors does not come to their senses in time for you to cover your short position?
 - This makes arbitrage risky



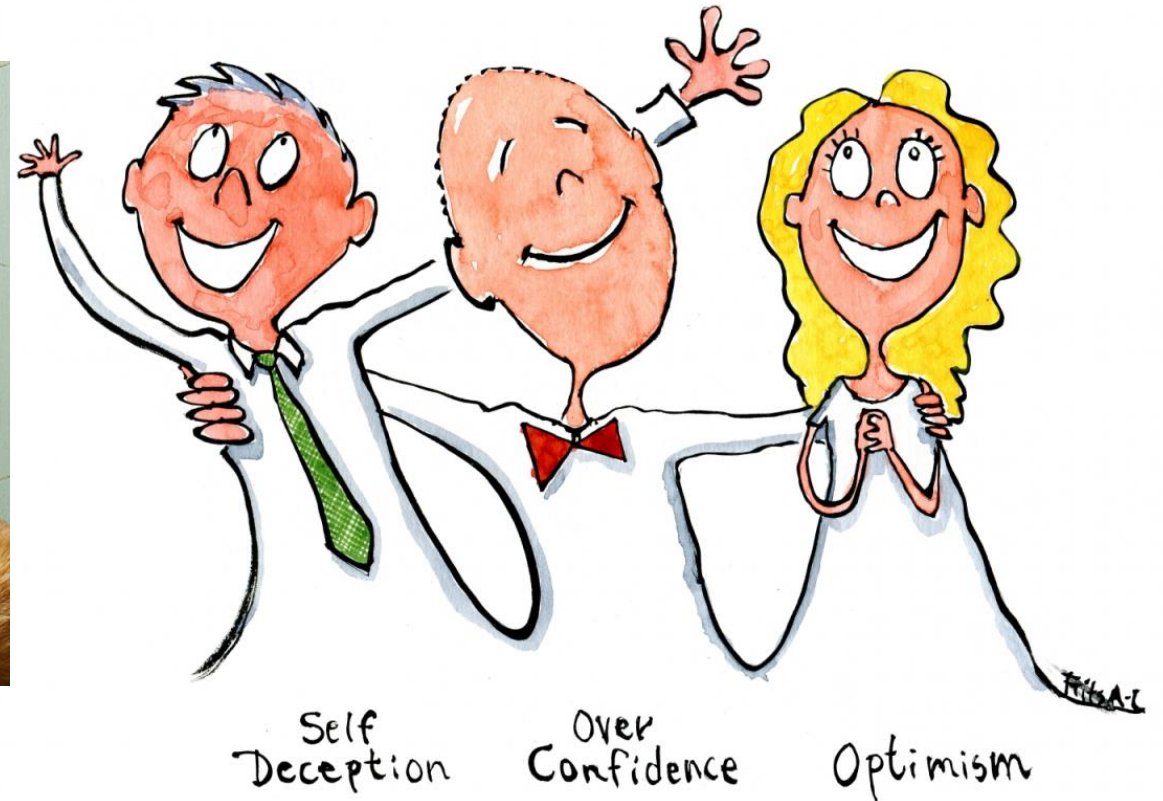
Deviations from rationality

- Psychologists argue that people deviate from rationality in predictable ways:
 - Over-optimism
 - Overconfidence
 - Conservatism bias
 - Cognitive dissonance
 - Confirmation
 - Anchoring
 - Representativeness Heuristic
 - Availability Heuristic
 - Ambiguity aversion
 - Narrow framing or mental accounting



Irrational Bias - Over-optimism

- Self attribution and illusion of control





Irrational biases: Overconfidence

- Overconfidence
 - Understate risk
 - Exaggerate ability to control or overestimate knowledge level
- *Examples in Trading*
 - High frequency of trades
 - Males trade more often than females, turnover leads to underperformance
 - Joint trading accounts owned by males and females generate higher returns on average



Irrational biases: Conservatism Bias

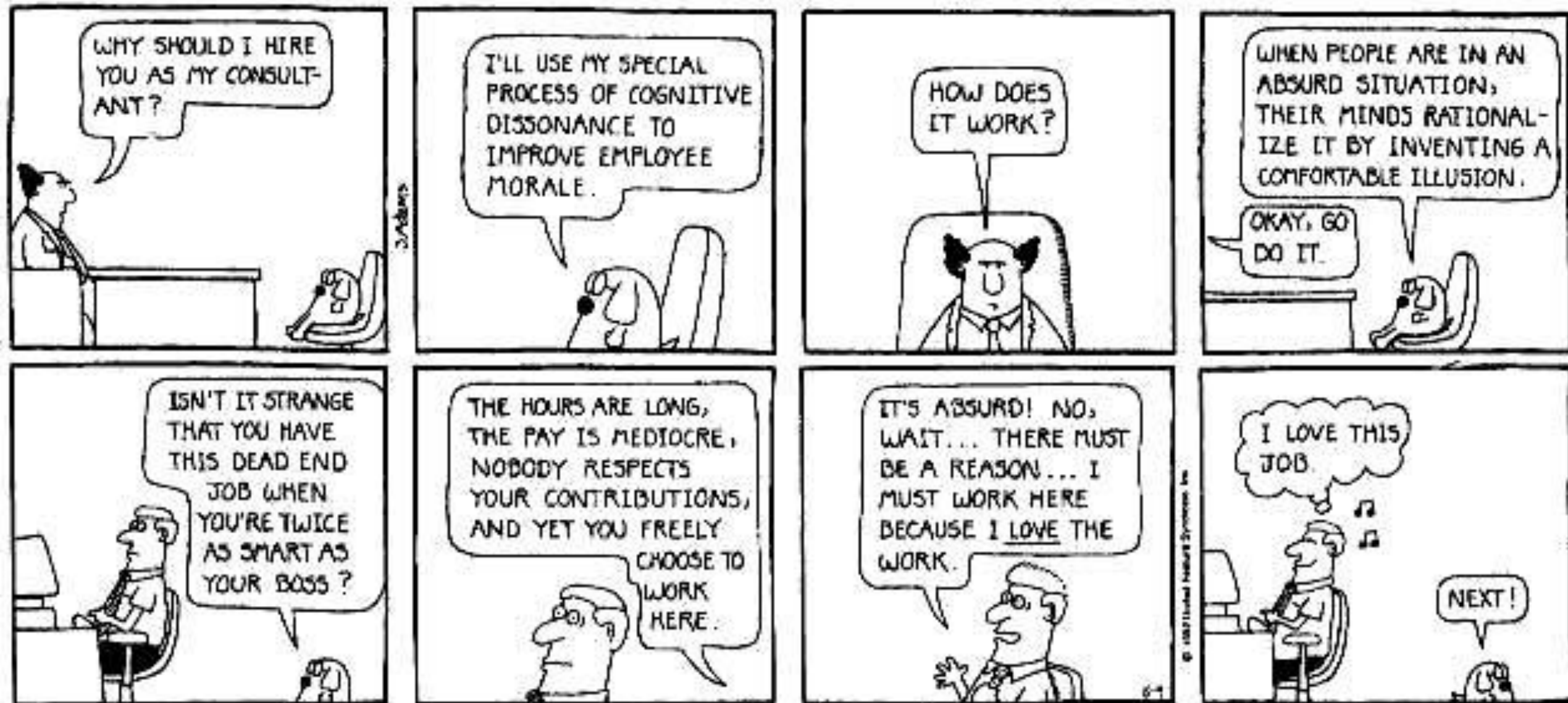
- In cognitive psychology and decision science, **conservatism bias** in human information processing refers to the tendency to revise one's belief insufficiently when presented with new evidence.
- Implication to investors in financial market:
 - Cling to their prior investment views for forecasts
 - Underreact to the new information
 - They act to new information but pretty slowly



Irrational Biases: Cognitive dissonance

- Cognitive dissonance
 - Self-denial and conflict when evidence shows you're wrong
- *Examples in Investment appraisal*
 - Indefinitely postpone project because waiting has value
 - Abandonment and escalation of commitment

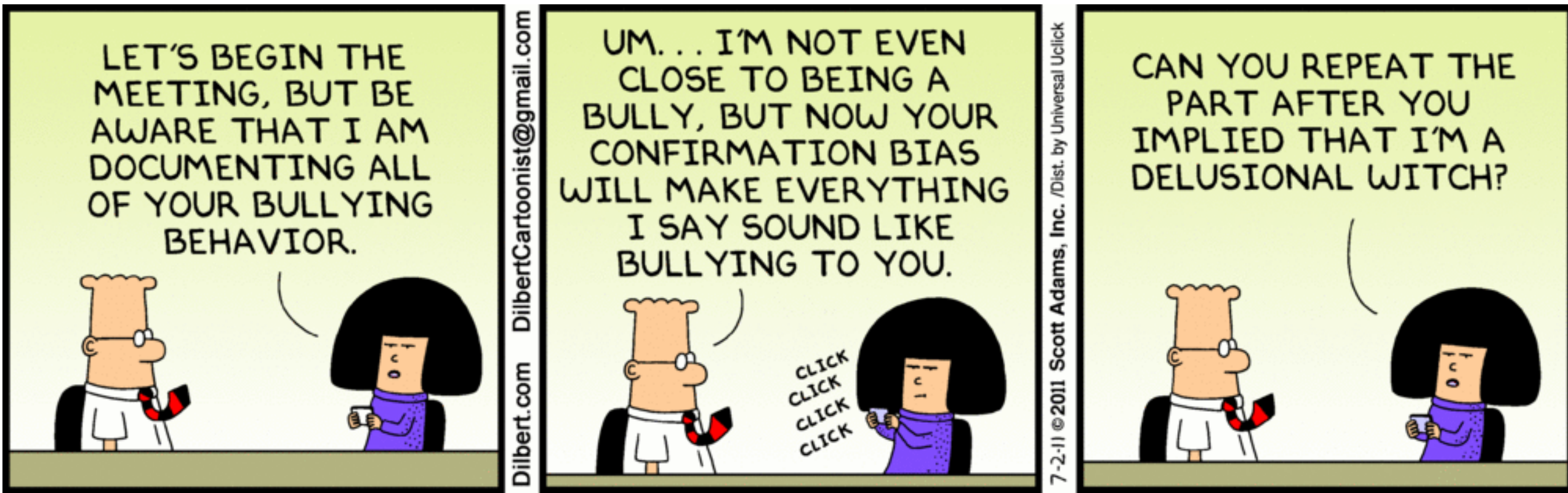
Example from Dogbert





Irrational Bias: Confirmation Bias

- Confirmation bias
 - Finding any information that supports your view and rejecting everything else





Irrational biases: Anchoring

- Anchoring
 - Influenced by other views or suggestions when making an assessment
- Examples
 - Asking house prices are not representative of market value, they depend on information provided by real estate agents in ads and brochures



Anchoring

<https://www.youtube.com/watch?v=eqTLPtPMKL>





Irrational biases: Representativeness Heuristic

- Representativeness heuristic
 - Rule of thumb without considering probabilistic outcomes or facts
- Example:
 - Flip a coin 6 times: which sequence occurs more often?



Irrational biases: Availability Heuristic

- Availability Heuristic
 - Relying on nearby and not complete information

Examples:

- Stock selection, under diversification and home bias



Guess the occupation of the ladies in the picture





Irrational biases: Ambiguity aversion

- Ambiguity aversion
 - People are exceptionally afraid of (financial) situations they don't know
 - Not knowing distribution of events
- Example:
 - Underinvestment and economic behaviour during crises

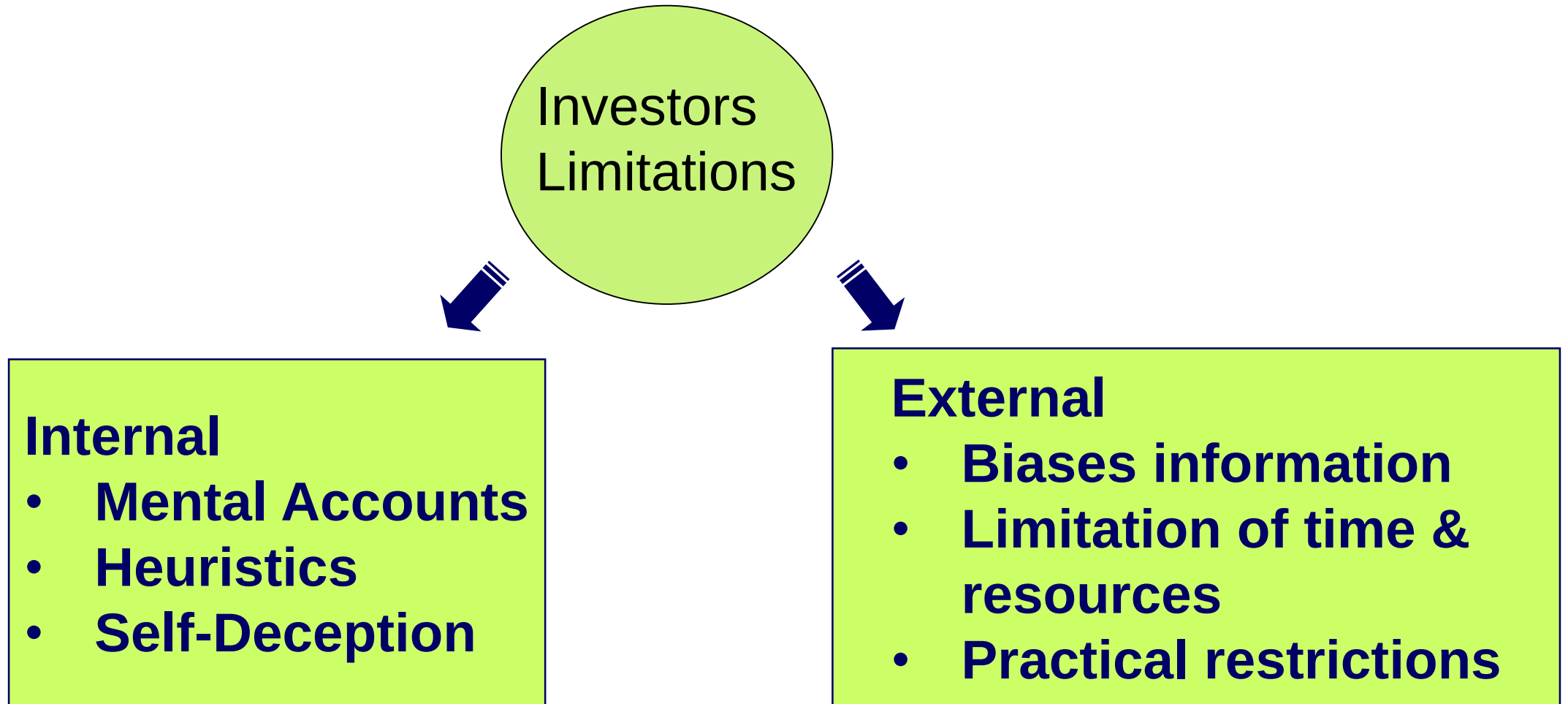


Irrational biases: Narrow framing or mental accounting

- Narrow framing or mental accounting
 - Sensitivity to the context
- Example:
 - 1st Choose between:
 - A) Sure gain of 2400 or B) 25% of 10000 gain and 75% of nothing
 - Then 2nd choose between:
 - C) Sure loss of 7400 or D) 75% of 10000 loss and 25% of nothing
- Loss avoidance more important than loss minimisation



Applying Behavioral Finance





What lessons does Behavioral Finance teach us?

Investor

1. Be aware of information biases: seek and screen information actively
2. Avoid narrow framing, anchoring, overconfidence
3. Follow rules of decision making under uncertainty



Market

1. Market and people are imperfect
2. There are systematic and recurring market inefficiencies
Anomalies are consistent and can't be ignored
3. Sensible implementation of irrational human behavior into asset pricing models necessary



Next Topic

- The Role of Central Banks
- Mishkin and Eakins (2015) Chapter 7