

Understanding the demand for assets: Preference under uncertainty

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EE431

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Lecture 2

Goals

- How economists think about asset selection problem.
- Understand **demand for assets**. (multiple assets combined = **portfolio**)

Agenda

- Asset class
- Demand for asset

Assets

- Assets
 - Holder of an asset has the right to claim on cash-flow/pay-off/benefit of the asset (in future).
 - Financial (bond/stock) VS physical (house)
- Why holding (purchase) assets?
 - To gain returns from the investment
 - Saving vehicle against risks
 - Laid-off, Retired, Health

Asset

- Two important features of assets
 - Tradable / non-tradable
 - Certain / Uncertain / Contingent

Asset class

- Fixed-income instrument
- Equity instrument
- Derivative instrument
- Hybrid instrument

Assets class: EQUITY instrument

- Equity instrument
 - STOCK offers holders the right to claim all the residual earnings generated by the company issuing the STOCK.
 - Typically, cash-flow is delivered to holders of the STOCK in terms of DIVIDEND.
 - Return on STOCK = DIVIDEND + Price changes
 - DIVIDEND payment is **uncertain**, depending on two factors: **company's profit and dividend policy**
 - STOCK price is **highly** volatile, containing huge amount **PRICE risk**.

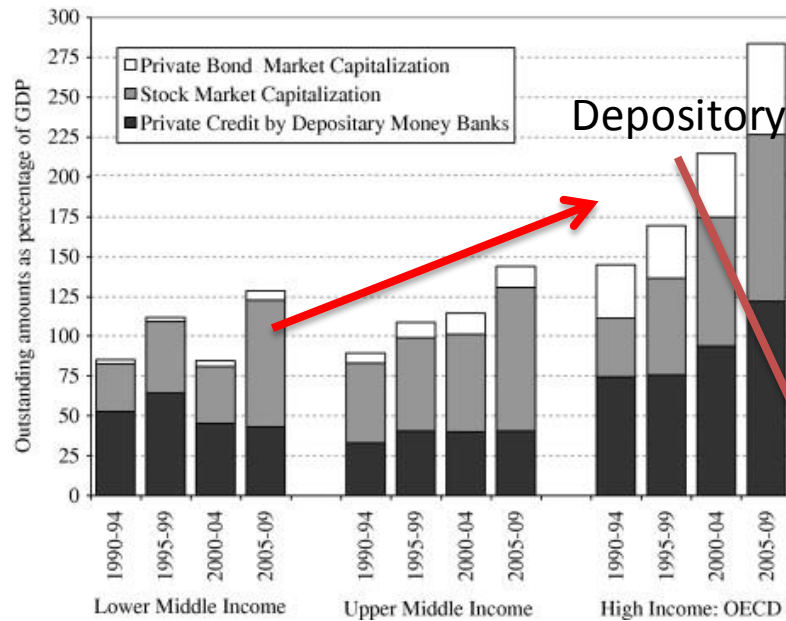
Assets class: Fixed income instrument

- Corporate bonds
 - Commit (promise) to pay %c of coupon, and Face value.
 - **Contingent** on the **financial conditions of the issuer**, at the time of redemption/payment → **uncertain**.
 - Not being able to service for the payment can arise due to the **bankruptcy** state. → **credit risk**.

Assets class: Fixed income instrument

- Government bonds
 - Coupon bond → %c of Face value, **certain** cash-flow → **credit risk-free**.
 - Inflation-indexed bond → %c of Face Value, paid back in full amount of face value/principal adjusted with compound rate of realized inflation, (payment is certain, but contingent.) → **no credit risk + no inflation risk**
 - Zero-coupon bond → no interim payment, paid back in full amount of face value/principal at the maturity date
 - Treasury Bill → short-term zero-coupon bond, less than a year → **no credit risk + no inflation risk + no price risk → benchmark for the “risk-free asset”**.

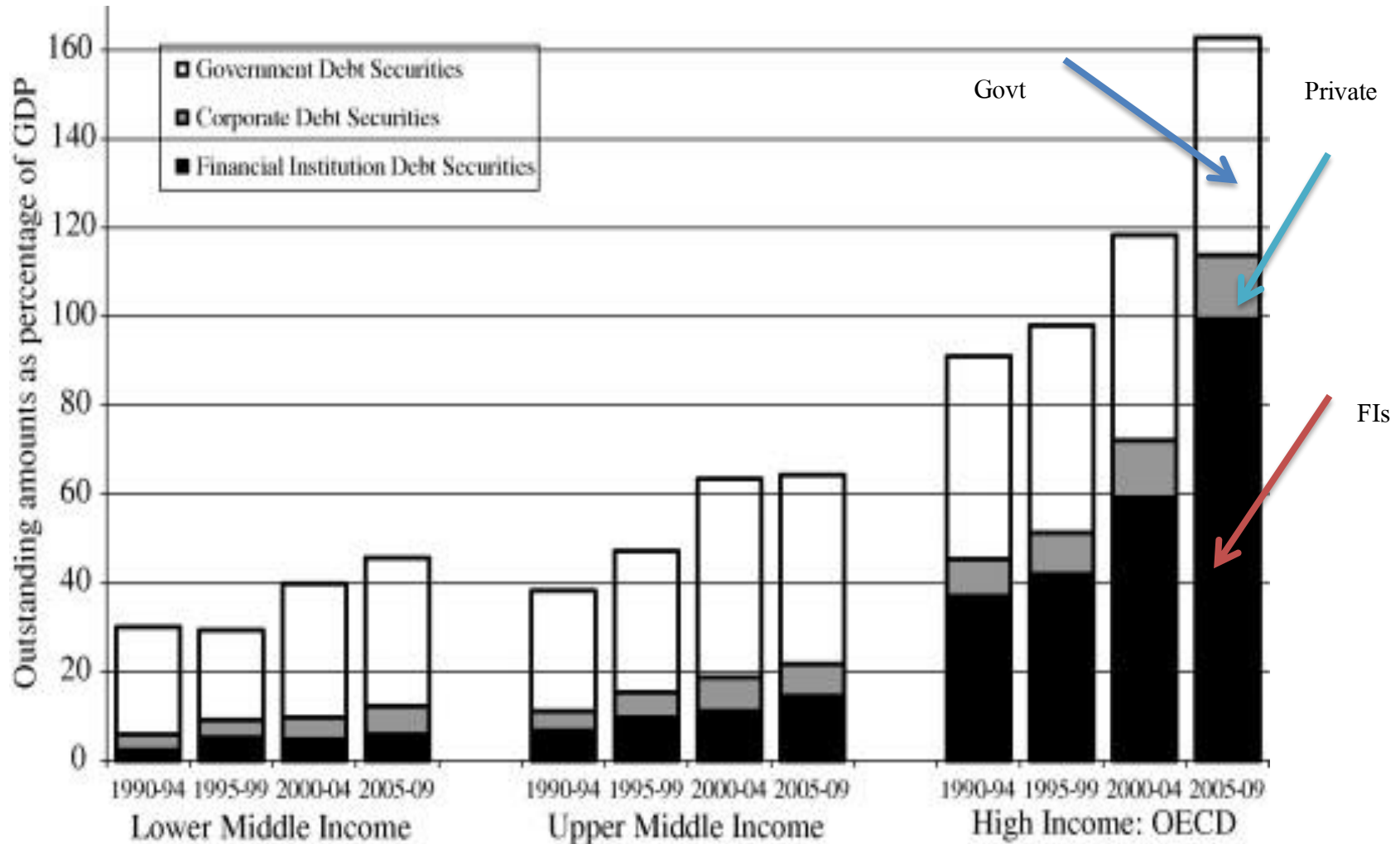
Financing structure around the world



Bonds

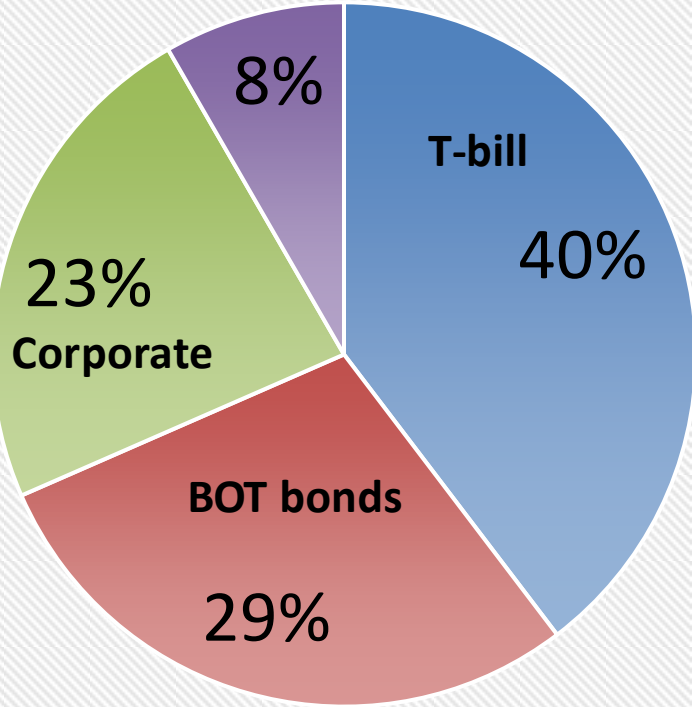
Stock

Debt instrument by issuers

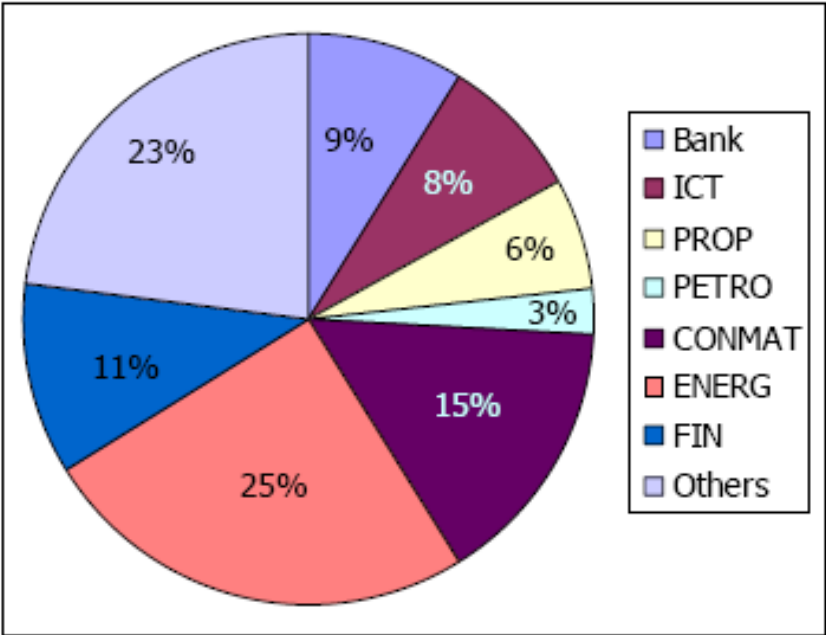


Bond market in Thailand

Chart Title



Corporate Bond Outstanding Value by sector



Assets class: DERIVATIVE instrument

- Risk-management assets (mitigating risk)
- OPTION
 - Right to buy (call) and sell (put) an underlying asset
 - At a pre-specified price: **exercise (strike) price**
 - Cash-flow receivable from an option is **contingent** on the price of the underlying asset.

Assets class: DERIVATIVE instrument

- CREDIT default SWAP (CDS)
 - **Non-tradable** derivative contract
 - Insurance contract.
 - Seller of CDS promises to pay to the buyer of CDS some amount of money under some conditions.
 - Eg. CDS on Greece Bond = In case of default,
 - SWAP cash-flow between issuer and holder of CDSs

Assets class: HYBRID instrument

- Convertible Preferred STOCK
 - Preferred STOCK + Convertible bond
 - An Option-embedded asset.
 - Initial issued as DEBT.
 - Convertible into STOCK an a pre-specified converting ratio.
- STRUCTURED products
 - BOND-liked asset
 - Proceeds raised from BOND are invested in other assets.
 - Might be designed to be principal protected.

Agenda

- Asset class
- Demand for assets

Framework for Demand for assets

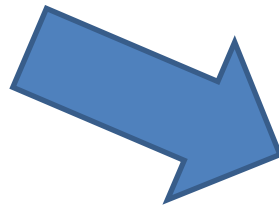
- Problem: how to allocate your wealth for the investment (under uncertainty)
- Approaches
 - Modern portfolio theory (FN311)
 - Traditional portfolio theory

Framework for Demand for assets

- Traditional portfolio theory \Leftrightarrow Modern portfolio theory when
 1. Return on assets are normally distributed.
 2. Utility function is quadratic in wealth.

Traditional portfolio theory

- Decision under uncertainty
- Portfolio selection as an optimization problem



- Demand for risky asset
- Determinants

Preference

- Assumption: Axiom of Rationality
 - Preference set: Complete ranking on the binary basis
 - Preference set: Transitivity, consistent preference

Preference set

- **Example:** Rational preference
 - Three options: A / B / C
 - # 1st respondent: $A > B$
 - # 2nd respondent: $B > C$
- # 3rd is to ask the preference relation between “A” and “C”
 - Rational if $A > C$ (transitive)
 - Irrational if stated otherwise

Preference set

- Preference set is a very abstract concept; hard to quantify in terms of level or numbers.
- Technically, rational preference set can be quantitatively constructed using the concept of **utility function**.
- Utility function is a mathematical function with the domain defined on sets of **consumption bundles**.

Preference set

- Example: $U(x,y)$
 - X is the amount of consumption on Pizza.
 - Y is the amount of consumption on Sushi.
 - $(X,Y) = (3,2)$ is called a consumption bundle
- Properties of utility function
 - Increasing: more prefer to less
 - Concave: prefer diversity/variety

Preference set under uncertainty

- How to define consumption sets under uncertainty:
 - Probabilistic outcome defined over different bundles
 - Probability assigned over each outcome under the bundle.
- Technically, this is called Lottery.

Preference set under uncertainty

- Lottery 1: An orange with a banana
- Lottery 2: Coin tossing
 - Head: an orange and two bananas
 - Tail: two oranges and a banana.
- Lottery 3: Card dealt
 - Black spade dealt: an orange and a banana
 - Heart dealt: ten oranges and ten bananas
 - Otherwise; nothing.

Preference set under uncertainty

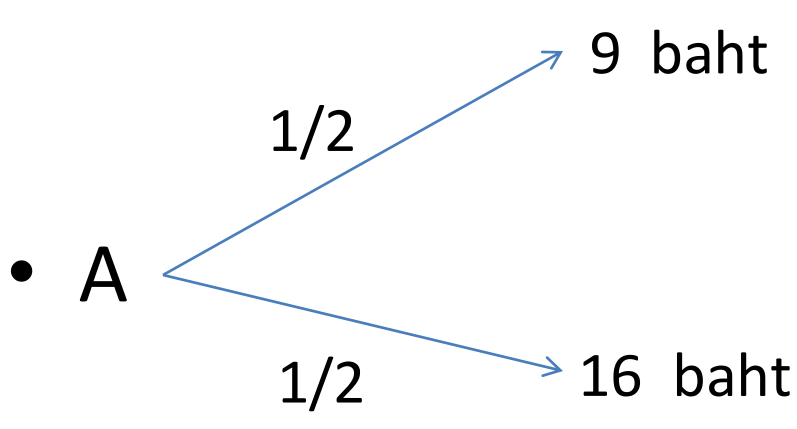
- How would you evaluate the desirability of alternative options given by the three lotteries?
- Adapted from the idea under deterministic outcome, one can rank the desirability of different lotteries using the “Von-Neuman Morgenstern (VNM) Expected utility”

Preference set under uncertainty

- VNM Expected utility
 - Weighted average of utility defined over different outcomes under the bundle/lottery
- Example

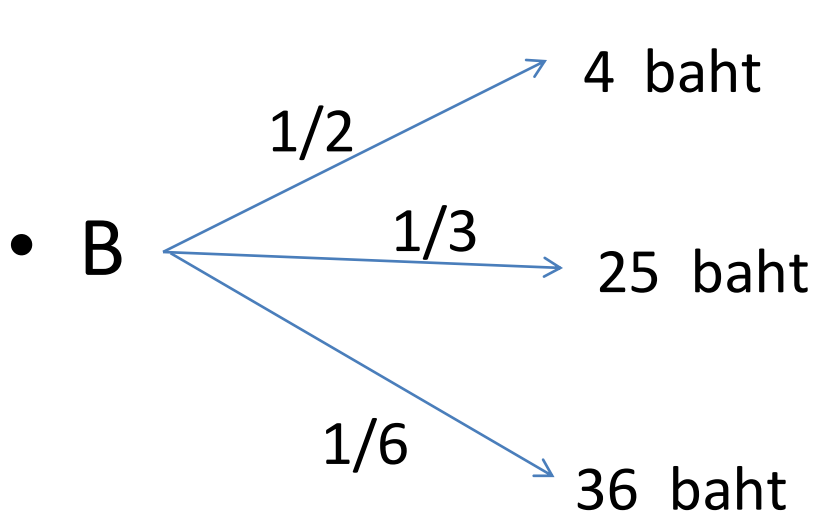
Preference under uncertainty for financial decision

- An asset does not directly benefit you in terms of utility attained from the consumption.
- The utility is derived from the return/pay-off of the asset measured in terms of monetary values.
- When accumulated over the investment horizon, returns increase/decrease your wealth.
- Mostly, we assume that investor's preference is defined on the level of wealth measured at the terminal period of the investment



Two lotteries with risky outcome measured in terms of pay-off/money

Suppose $U(W) = \sqrt{W}$



Which one would you choose? A or B?

Example

- Suppose that $U(W) = \sqrt{W}$
- Which option?
- The answer is _____

Attitude toward risks

- Risk-averse
- Risk-neutral
- Risk-Lover

Risk-averse: definition

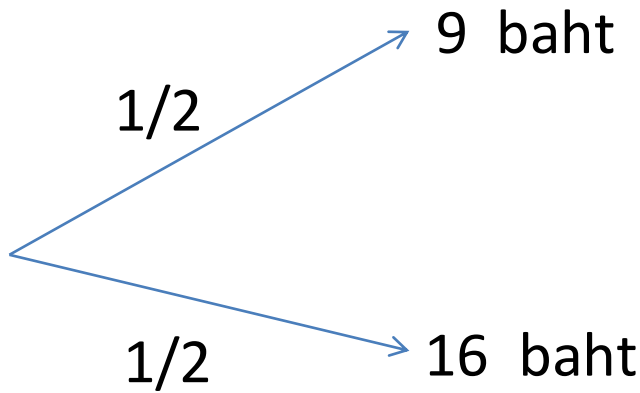
- Prefer riskless option, rather than risky option
- Back to risky choice “A”
- Alternative riskless option used to the comparison with “A”?
 - Giving “average” = 12.5
 - $\bar{W} = E(W)$ = expected pay-off (NOT, the same as expected utility!)

Risk-averse: definition

– Definition:

- If the level of utility under the certain pay-off (consuming expected pay-off) is greater than the expected utility under the risky choice in question, agent is classified as a risk averse agent.

– prefer safer option/choices

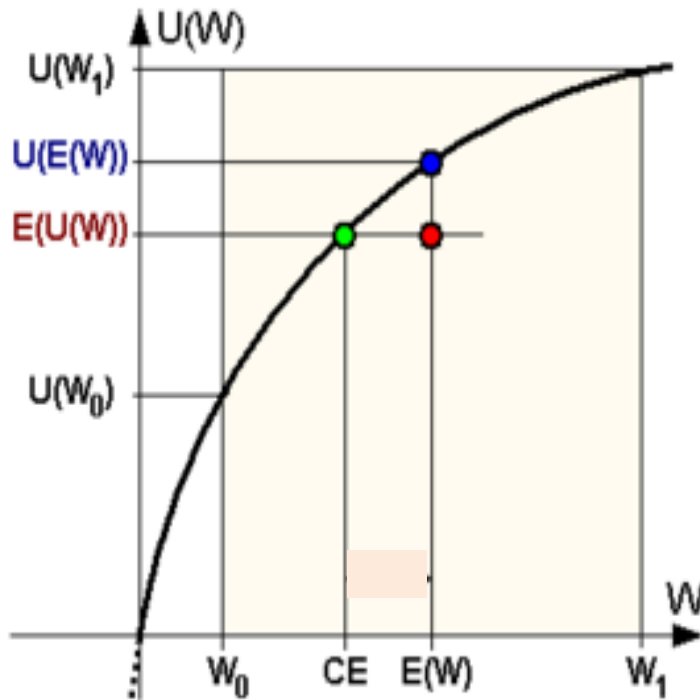


$$U(W) = \sqrt{W}$$

What do we know?

- Considering A and supposed that \bar{W} = the average pay-off under the risky option = _____.
- $U(\bar{W}) =$ _____.
- Note that $E(U(W)) =$ _____ $U(\bar{W}) =$ _____
- Therefore, preference is _____.
- Note further for the shape of the utility function: Is it convex or concave?

Risk aversion and concavity



- Certainty Equivalent
- Risk premium

Certainty Equivalent

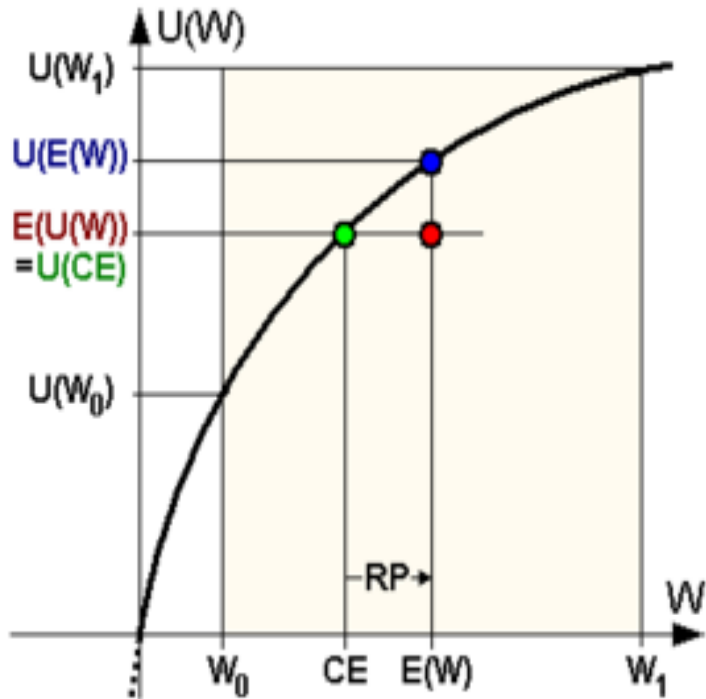
- From the risky option A, suppose a person is offering you an option with secured pay-off.
- How much money would it be needed to ensure that you are feeling indifferent between “accepting A” and “accepting the secured pay-off”
- The level of secured pay-off minimally needed is called the Certainty equivalence.

$$U(\text{CE}) = E(U(W))$$

$$U(W) = \sqrt{W}$$

- CE = _____.
- Comparing with pay-off \bar{W} we will find that \bar{W} _____ CE
- $\bar{W} - CE =$ _____

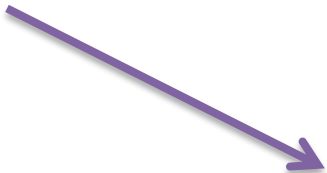
Risk aversion: summary



- $E(U(W))$ _____ $U(\bar{W})$
Utility function is _____.
Certainty equivalent is _____ than \bar{W} .
Risk premium is _____.

Attitude toward risks

- Risk-averse
- Risk-neutral
- Risk-Lover

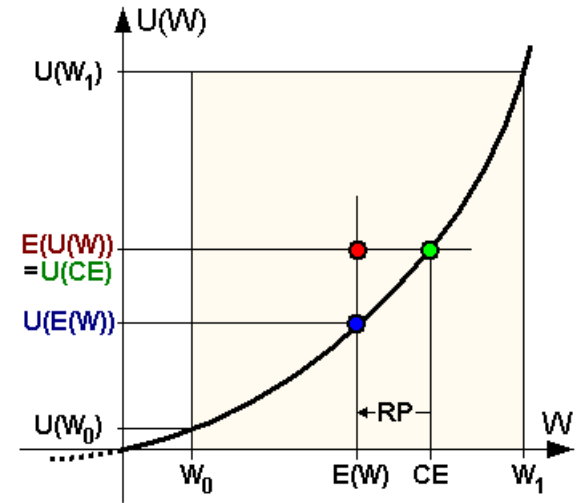
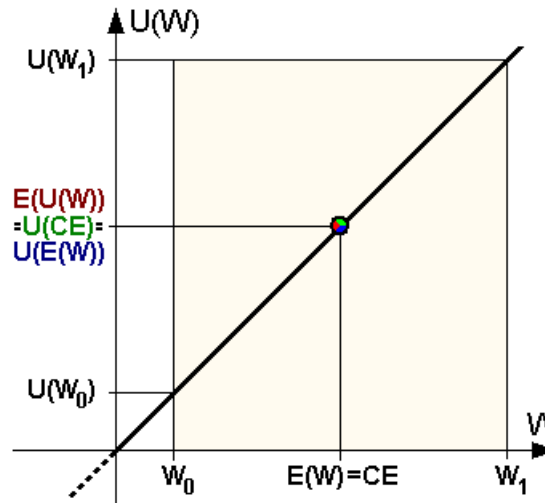
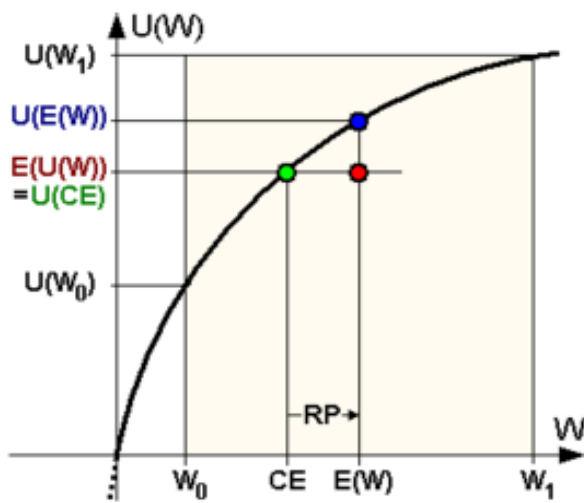


Utility formed under
expected pay-off = $E[U]$
expected utility



Utility formed under expected
pay-off $< E[U]$ expected utility

Attitude toward risks



Measuring risk aversions

- Most investment theory would assume that investors are risk averse.
- But, people are heterogeneity in the way they view the danger of risk, i.e. differences in the level of risk tolerance
- How to measure the **degree** of risk aversion?

Measuring risk aversions: **risk premium**

- Common sense:

Consider the same risky option:

Highly risk averse would tend to accept
_____ CE , and therefore require
_____ risk premium

Measuring risk aversions: **risk premium**

- Brute force approach:
 - If we know the form of the utility function, we can do the experiment, asking the agent and measure the level of risk premium.

Measuring risk aversions: **risk premium**

- Risk premium can be calculated using the approximation method.
- A key indicator measuring the extent to which people can accept the risk is calculate **Arrow-Pratt Coefficient of risk aversion**

Measuring risk aversions: **coefficient of risk aversion**

- Coefficient of Absolute Risk Aversion

$$R_A(W) = -\frac{u''(W)}{u'(W)}$$

- Coefficient of Relative Risk Aversion

$$R_R(W) = -W * \frac{u''(W)}{u'(W)}$$

$$R_R(W) = W * R_A(W)$$

Measuring risk aversions: **calculating** **example**

- $U(W) = \sqrt{W}$

- $R_A(W) =$

- $R_R(W) =$

- $U(W) = \ln W$

- $R_A(W) =$

- $R_R(W) =$

Measuring risk aversions: **types of risk aversion**

- Increasing/decreasing/constant **absolute** risk aversion if $R_A(W)$ is increasing/decreasing/constant over W
- Increasing/decreasing/constant **relative** risk aversion if $R_R(W)$ is increasing/decreasing/constant ตามระดับ W

Measuring risk aversions: **what type are they, empirically?**

- Absolute Risk aversion decreases as Wealth increases!
- Relative risk aversion is constant!
- <http://people.stern.nyu.edu/adamodar/pdfiles/valrisk/ch3.pdf>