THE UNIVERSITY OF QUEENSLAND
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FINM3407 – Behavioral Finance

Topic 1:

Introduction to Behavioral Finance and Traditional Finance Theories

Reference: AckertDeaves Chapters 1 & 2

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What we do this week

[Part One – Introduction to Behavioral Finance]

- **Overview of neoclassical economics**

(1) Preference Relation

(2) Utility Function and Expected Utility Theory

(3) Brief Introduction to Behavioural Finance

[Part Two – Foundations of Finance]

- **Foundations of Finance II: Asset Pricing, Market Efficiency and Agency Relationships**

(1) Risk and Return Relationship

(2) CAPM model and Fama and French

(3) Market Efficiency (brief introduction = > more details in Topic 3)

(4) Agency Relationships and Corporate Governance

Neoclassical economics - normative theory (versus positive)

1. People have **rational preferences** across possible outcomes or states of nature.
2. People **maximize utility** and **firms maximize profits**.
3. People make **independent decisions based on all "relevant" information**.

Behavioral Finance
Example:

(1) Preference Relation

- Economists use **preferences** to understand and analyse people's decision-making process
- In the most fundamental sense, the theory of rational choice specifies what types of preferences are considered to be rational in neoclassical economics

What is Preference?

= > Preference is a relation that ranks alternatives (typically, consumption bundles) according to their desirability

- **Weak Preference**

$x \succsim y$: "x is at least as good as y"

- **Strict Preference**

$x \succ y$: "x is strictly preferred to y"

$x \succ y \Leftrightarrow x \succsim y$ but not $y \succsim x$

- **Indifference**

$x \sim y$: "x is indifferent to y"

$x \sim y \Leftrightarrow x \succsim y$ and $y \succsim x$

Question? What kind of preference is a rational preference?

Recap:

*People have **rational preferences** across possible outcomes or states of nature.*

(1) Preference Relation – Rational Preference

The preference relation $\succsim$ is rational if it has the following two properties:

1) Completeness (Ordering)

for all x, y ∈ X, we have that x $\succsim$ y or y $\succsim$ x (or both if there is indifference)

e.g., My preference on fruit: Banana $\succsim$ Apple, Apple $\succsim$ Banana => *My preference is complete*

2) Transitivity

for all x, y, z ∈ X, if x $\succsim$ y and y $\succsim$ z, then x $\succsim$ z

e.g., My preference on fruit: Banana $\succsim$ Apple, Apple $\succsim$ Watermelon,
we can imply that Banana $\succsim$ Watermelon

$\Rightarrow$ My preference is transitive

To have transitive preferences, a person, group, or society that prefers choice option x to y and y to z must prefer x to z.

(1) Preference Relation – Rational Preference

Question Time: Are the following relations complete? Are they transitive?

“Lisa is in love with Alex”

“Ann is the mother of Lisa”

“George is an ancestor of Lisa”

(1) Preference Relation & Utility Function

Utility Function: measures the satisfaction an individual gained from a preference

Notation: u(x,y,z)

Utility over goods:

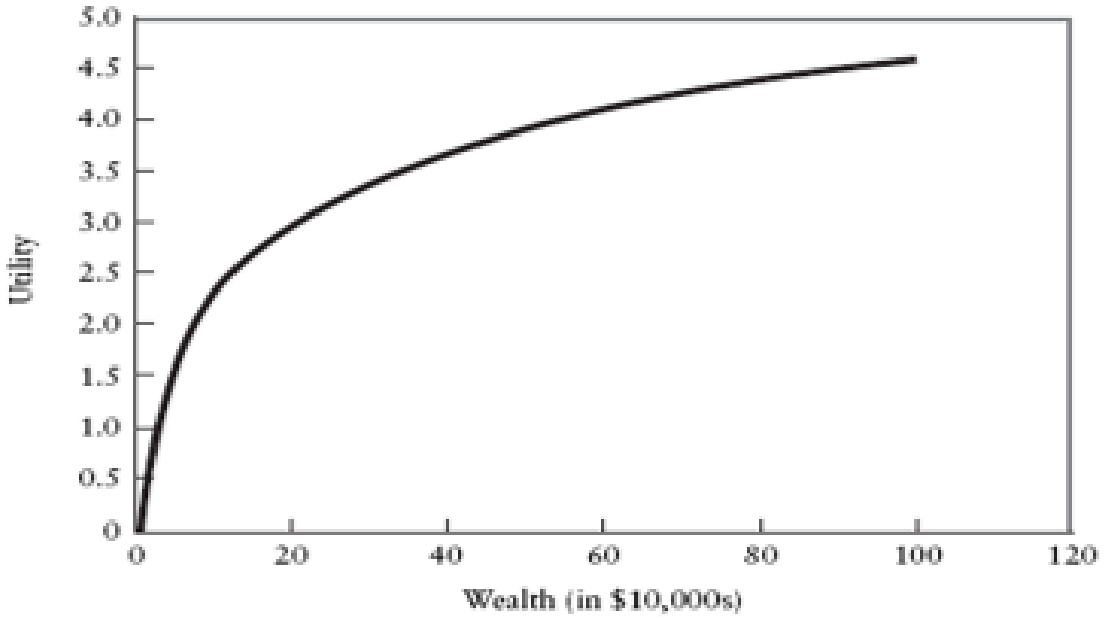
u(2 bread, 1 water) > u(1 bread, 2 water)

Utility over money:

u(w2) > u(w1) if w2 > w1

(1) Preference Relation & Utility Function

Utility function over wealth, u(w) = ln(w)



Diminishing marginal utility

TABLE 1.1 | LOGARITHMIC UTILITY OF WEALTH

Wealth (in $10,000s)	$u(w) = \ln(w)$
1	0
2	0.6931
5	1.6094
7	1.9459
10	2.3026
20	2.9957
30	3.4012
50	3.9120
100	4.6052

(2) Expected utility theory

Says that individuals should act when confronted with decision-making under uncertainty in a certain way.

- Theory is really set up to deal with **risk**, not uncertainty:
- Risk is when you know what the outcomes could be, and can assign probabilities
- Uncertainty is when you can’t assign probabilities; or you can’t come up with a list of possible outcomes

(2) Expected utility theory – Wealth Outcome & Prospects

Say there are a given number of states of the world:

- **A sunny and warm – 50%**
  - **$500/day**
- **B rainy and cold – 50%**
  - **$100/day**

Prospect

- P1(0.5, 500, 100)
  - Expected outcome = 300 (0.5x500+0.5x100)

Complete

Assume if it's rainy and cold, the ice cream truck makes no profit

- P2(0.5, 500)
  - Expected outcome = 250 (0.5x500)
- P3(0.7,800,1000)
  - Expected outcome = 860

An ordering of P1 vs. P2 and P1 vs. P3:

$P1 \succ P2$ and $P3 \succ P1$

Transitivity says: $P3 \succ P2$

(2) Expected utility of prospect

$$U(P) = pr_A * u(w_A) + pr_B * u(w_B) + pr_C * u(w_C)$$

Example

$$u(w) = w^{0.5}$$

Prospects:

- **P4(0.5, 1000, 500)** Exp outcome = 750
- **P5(0.6, 1200, 300)** Exp outcome = 840

For P4: $U(P4) = 0.5 * 1000^{0.5} + 0.5 * 500^{0.5} = 26.99$

For P5: $U(P5) = 0.6 * 1200^{0.5} + 0.4 * 300^{0.5} = 27.71$

So P5 $\succ$ P4

Based on assumptions such as ordering and transitivity (and others), it can be shown that when such choices over risky prospects are to be made, people should act *as if* they are **maximising** expected utility:

Properties of utility functions

- Certain properties of utility functions can be demonstrated:
  - Unique up to a positive linear transformation
  - Upward-sloping
  - Latter allows one to set u(lowest outcome)=0 and u(highest outcome)=1, which can be useful for proving certain things
- Other properties such as differentiability (implying continuity) are often assumed.

(2) Expected utility theory - Certainty equivalents

Consider prospect P6:

P6(0.4, 5, 100) **Expected outcome = 62**

Assume utility function **u(w) = ln(w)**

we have:

U(P6) = 0.40(1.6094) + 0.60(4.6052) = 3.41

Equivalent guaranteed expected wealth ($62)

u(E(w)) = ln(62) = 4.13

Risk-averse: U(E(w)) > U(P)

Prefers the expected value of a lottery to the lottery itself.

Certainty equivalent is defined as that wealth level that leads decision-maker to be indifferent between a particular prospect and a certain wealth level, implied by the expected utility of the prospect.

At what amount will make you just as happy?

U(P6) = 3.41 = u(w)=ln(w)

w=exp^(3.41)

w = 30.17

Problems with expected utility theory

- A number of violations of expected utility have been discovered.
- Most famous is Allais (French- pronounced Allay ☺) paradox = > we are going to cover in tutorials .
- Alternative theories have been developed which seek to account for these violations.
- Best-known is prospect theory of Daniel Kahneman and Amos Tversky.

(3) Introduction to Behavioural Finance

Behavioural economists believe that:

- the deviations from rationality are large enough, systematic enough, and consequently predictable enough, to warrant the development of new descriptive (aka Positive) theories

- in many cases normativity (normative) and adequate descriptivity (positive) cannot be embodied in the same theory

The key idea of behavioural finance:

Investors DO NOT always act RATIONAL (as per economics).

Investors suffer from heuristics and biases

Four main categories：

(1) Loss Aversion

(2) Representative

(3) Mental Accounting

(4) Fear of Regret

(3) Introduction to Behavioural Finance

Loss Aversion

Losses loom GREATER than gains.

Considering the following two cases:

A: Receiving $100 for sure. E(rA) = $100

B: 50% chance of winning $300 and 50% chance of losing $100. E(rB) = $100

Some real-life examples of loss aversion:

Not selling a stock when your current rational analysis of the stock clearly indicates that it should be abandoned as an investment.

Selling a stock that has gone slightly up in price just to realize a gain of any amount, when your analysis indicates that the stock should be held longer for a much larger profit [Diposition effect].

(3) Introduction to Behavioural Finance

Representative

- People frequently make the mistake of believing that two similar things or events are more closely correlated than they actually are.
- Judging the likelihood of things in terms of how well they seem to represent, or match, particular prototypes.

Considering Laura, she is 31, single, outspoken, and very bright. She majored in economics at university as a student, and she was passionate about the issues of equality and discrimination.
Which of the following is more likely true:

A. Laura works at a bank.

B. Laura woks at a bank and is active in the feminist movement.

(3) Introduction to Behavioural Finance

Mental Accounting

- Individuals classify money differently based on subject criteria.

Fear of Regret

- Make decisions based on minimising the possibility of experiencing regret in the future, even if it means avoiding potential opportunities or taking risks.

Some examples:

- You are a conservative investor and always invest in low-beta stocks. Recently, you noticed the “UQ Coin” craze is unfolding in the financial markets, and you saw your friend purchasing UQ Coins as well. You decided to buy some yourself, ignoring potential risks, to avoid the regret of not purchasing it if it runs up further.

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[Part Two: Foundations of Finance]

- **Foundations of Finance II: Asset Pricing, Market Efficiency and Agency Relationships**

(1) Portfolio Risk and Return

(2) CAPM model

(3) Market Efficiency (brief introduction = > more details is going to discuss on Topic 3)

(4) Agency Relationships and Corporate Governance

Reference Reading:
AckertDeaves Chapter 2: Foundations of Finance II: Asset Pricing, Market Efficiency and Agency Relationships

(1) Portfolio risk and return

- **Return is a weighted average of returns of individual securities.**

$$r_p = \sum_{i=1}^{k} r_i \omega_i$$

- **Total risk is measured as the standard deviation (volatility).**

$$\sigma_p = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2 w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2}$$

$$SD = \sqrt{\frac{\sum (r_i - r_{avg})^2}{n-1}}$$

- **Portfolio risk is less than a weighted average of risks of individual securities – if correlations are less than 1.**
- **The lower the correlations the lower the risk of a portfolio.**
- **Lower portfolio risk through Diversification.**
  - **Can't reduce risk to 0, can only diversify Unsystematic Risks, not Systematic Risks.**

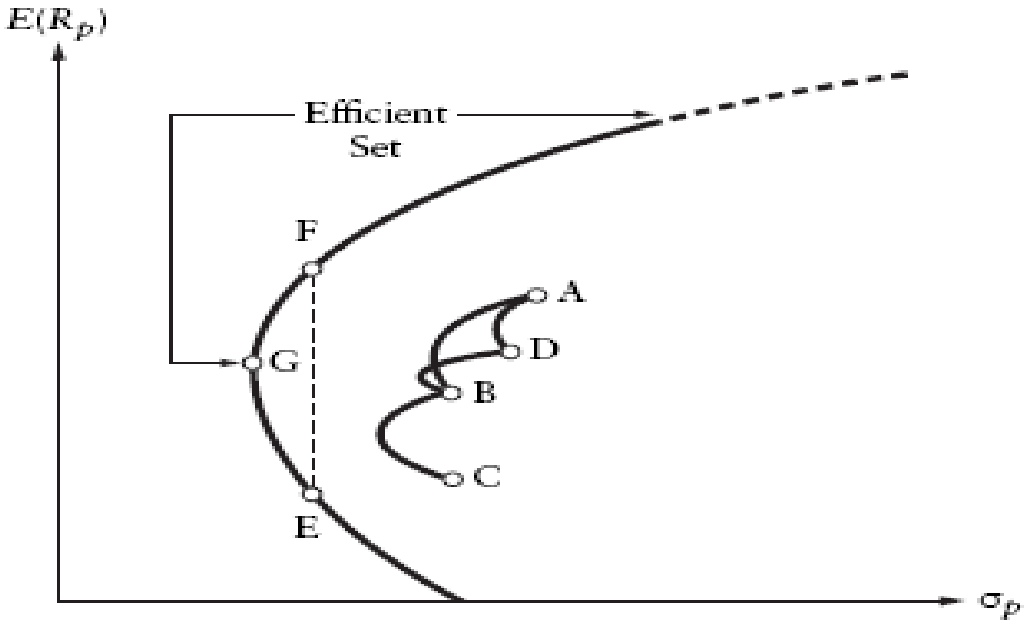
Investors get compensated for bearing SR.

The risk that is unique to a specific company or industry.

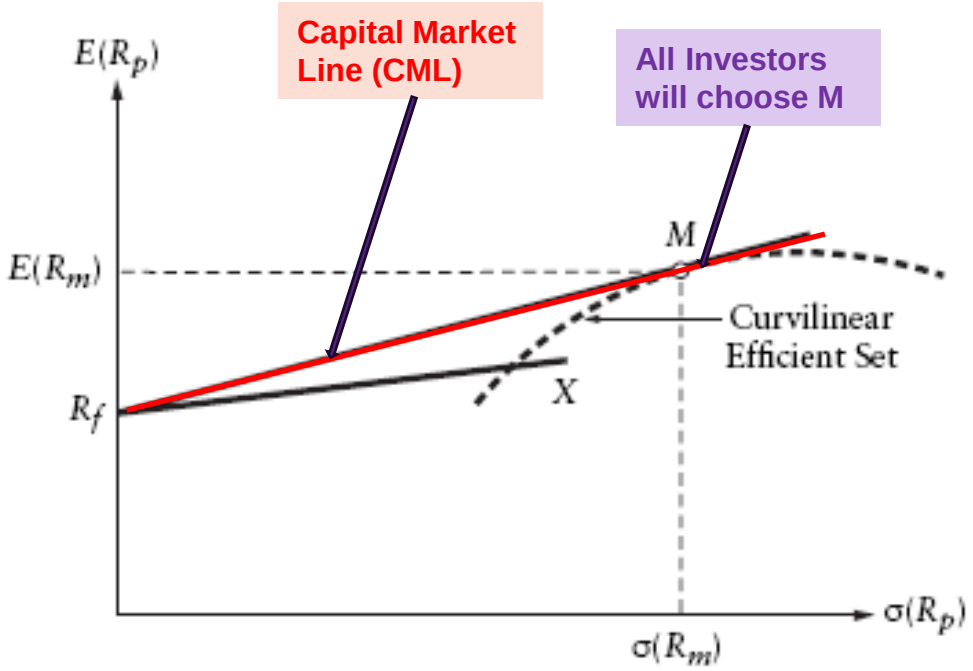
The risk that is inherent to the entire market or market segment

(1) Portfolio risk and return

Efficient Frontier



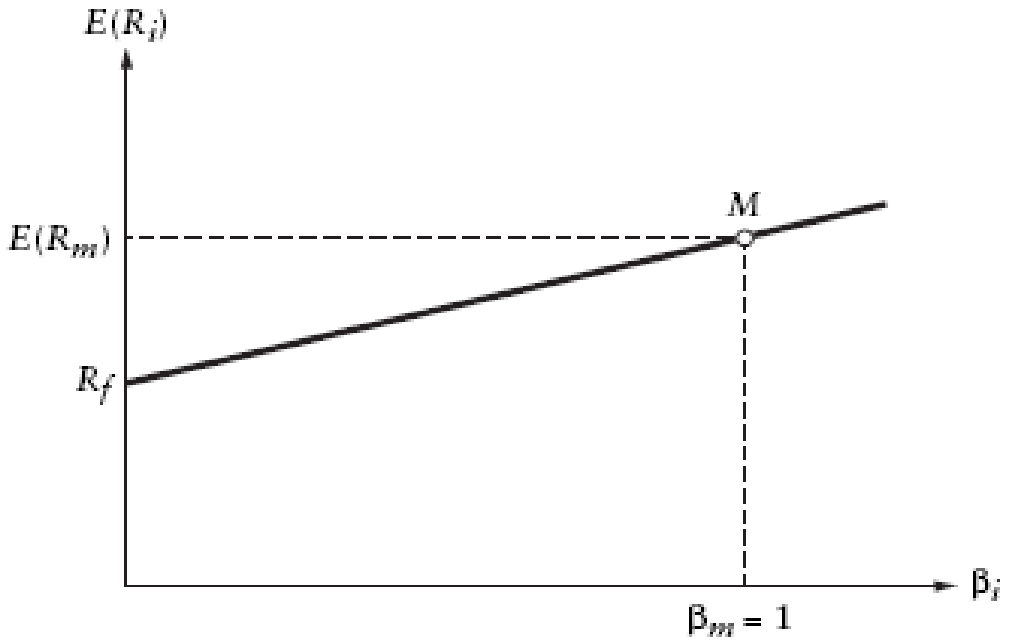
Efficient Frontier with CML (Capital Market Line)



(2) CAPM Model

CAPM equation

$$\mathbf{E(R) = R_f + \beta\,(R_m - R_f)}$$



SML (Security Market Line)

- CAPM is an equilibrium model: it brings all investors together.
- According to CAPM, only risk related to market movements (systematic risks) is priced by the market.
- Because all other risks can be diversified away (and they should be).
- SML is the graphical representation of CAPM.

(3) Market Efficiency

Operational definition:

- Financial markets are efficient if no one can consistently earn excess returns.
  - Security prices should respond quickly and accurately to new information
  - Professional investors should not outperform net of all fees
  - Simulated trading strategies should fail
  - Abnormal profits should not be consistently made.

Efficient Market Hypothesis (EMH)

- **Weak form**: Only past (historical prices & volume) information is available in the market
- **Semi-strong form**: Only past & public (e.g. financial statements) information is available in the market
- **Strong form**: All information (past, public & private) is available in the market

(4) Agency Relationships and Corporate Governance

Corporate Governance

Agency relationship and agency problem

- An agency relationship exists whenever the principal contracts with an agent to take action on their behalf and represent the principal's interests.
- In an agency relationship, the agent has the authority to make decisions for the principal.
- An agency problem arises when the agent's and principal's incentives are not aligned.

Agency Cost

- **Direct costs:** expenditures that benefit the managers but not the firms & costs arise from monitoring management actions

Example: the cost of hiring outside auditors, business trips using a private jet instead of commercial flights

- **Indirect costs:** results from lost opportunities

Example: managers of a firm that is an acquisition target may resist the takeover attempt because of concern about keeping their jobs, even if the shareholders would benefit from the merger.

Thank you!

See you next week.

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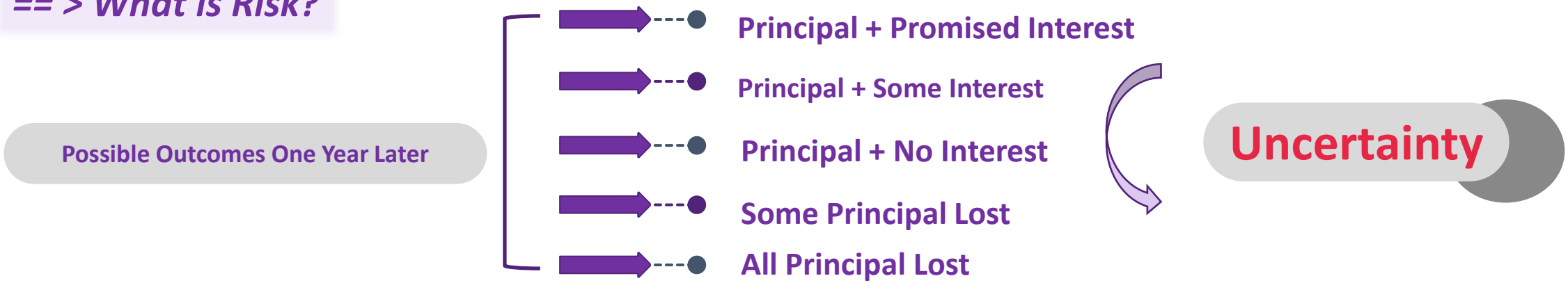
Topic 1 Appendix:

Extra Information on Traditional Finance Models

(1) Portfolio risk and return

== > What is Risk?



Risk is defined in financial terms as the chance that an investment outcome will differ from an expected outcome.

We use this because?

Source: the uncertainty of a future event

Mathematical measure: the standard deviation of all possible future outcomes.

(1) Portfolio risk and return

== > What is Expected Return?

Holding Period Return (HPR)

- Where:		
P_s	=	Sale Price
P_B	=	Buy Price
CF	=	Cash flow during the holding period

- HPR is expressed as a percentage of the initial buy price

Expected Return

Average return over states or scenarios which is weighted by probabilities of an investment's return outcomes.

$$E(R) = \sum_{i=1}^{n} P_i R_i = P_1 R_1 + P_2 R_2 + \cdots\cdots + P_n R_n$$

$$P_1 + P_2 + P_3 + \cdots\cdots + P_n = 1$$

(1) Portfolio risk and return

What is Expected Return?

R_i P_i

Scenario	States	Return	Probabilities
1	Principal + Full Int.	10%	0.5
2	Principal + Partial Int.	5%	0.3
3	Principal + No Int.	0	0.1
4	Some Principal Lost	-20%	0.05
5	All Principal lost	-100%	0.05

$$E(R) = \sum_{i=1}^{n} P_i R_i = P_1 R_1 + P_2 R_2 + \cdots\cdots + P_n R_n$$

$$= 0.5 \times 0.1 + 0.3 \times 0.05 + 0.1 \times 0 + 0.05 \times (-0.2) + 0.05 \times (-1)$$

$$= 0.005 = \underline{\mathbf{0.5\%}}$$

Decision?

One Year Australian Government Bond Yield = 1.354%

(1) Portfolio risk and return

Stocks need to be randomly selected

Risk and Expected Return == > Diversification

Let's rethink about risk.

Even the largest stocks, tend to have higher risk and lower returns than large portfolios

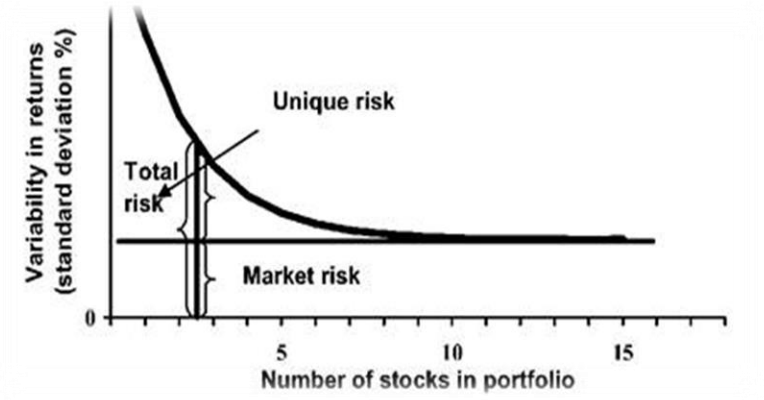
→ There must be some benefits of combining stocks into portfolios.

Diversification:
A risk management strategy that averages out or reduces risk by creating a portfolio that includes multiple investments.

- **You can't reduce risk to ZERO**

→ There must be some risk that you can't reduce.

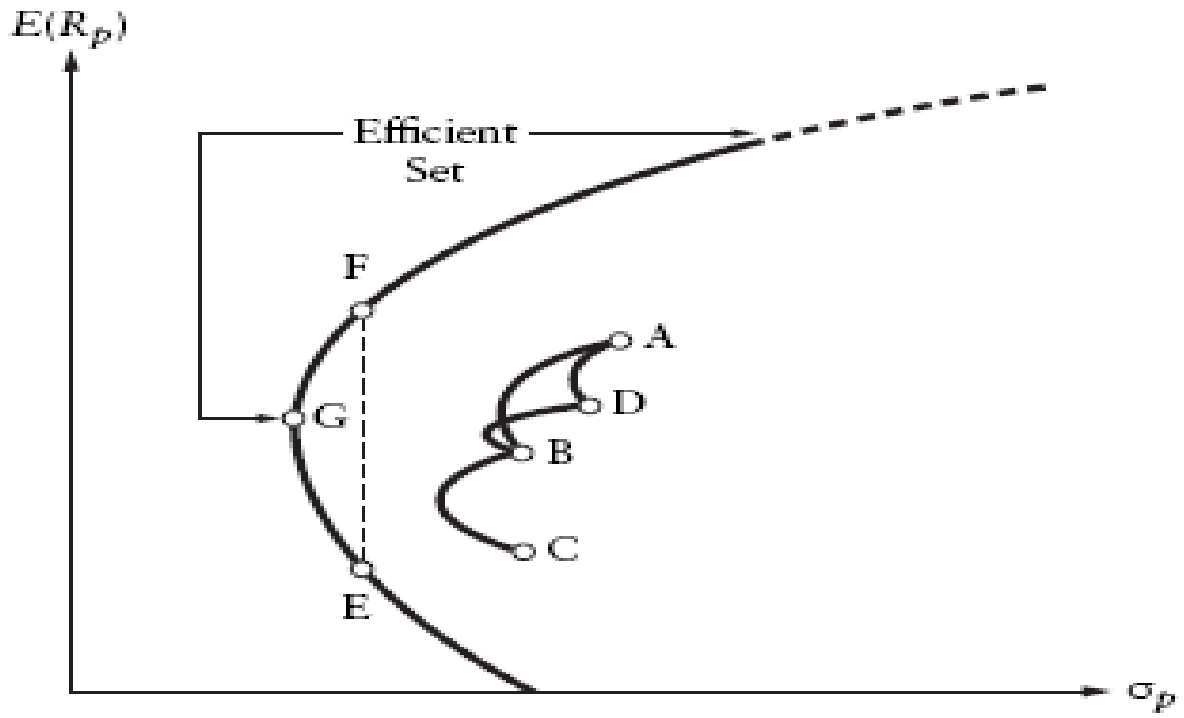
- **What RISK can/can't be reduced by diversification?**



Diversification benefits are affected by two factors:
- Correlations between the stocks;
- Number of stocks in the portfolio (has a limit)

(1) Portfolio risk and return

Efficient Frontier



The Effect of Correlation

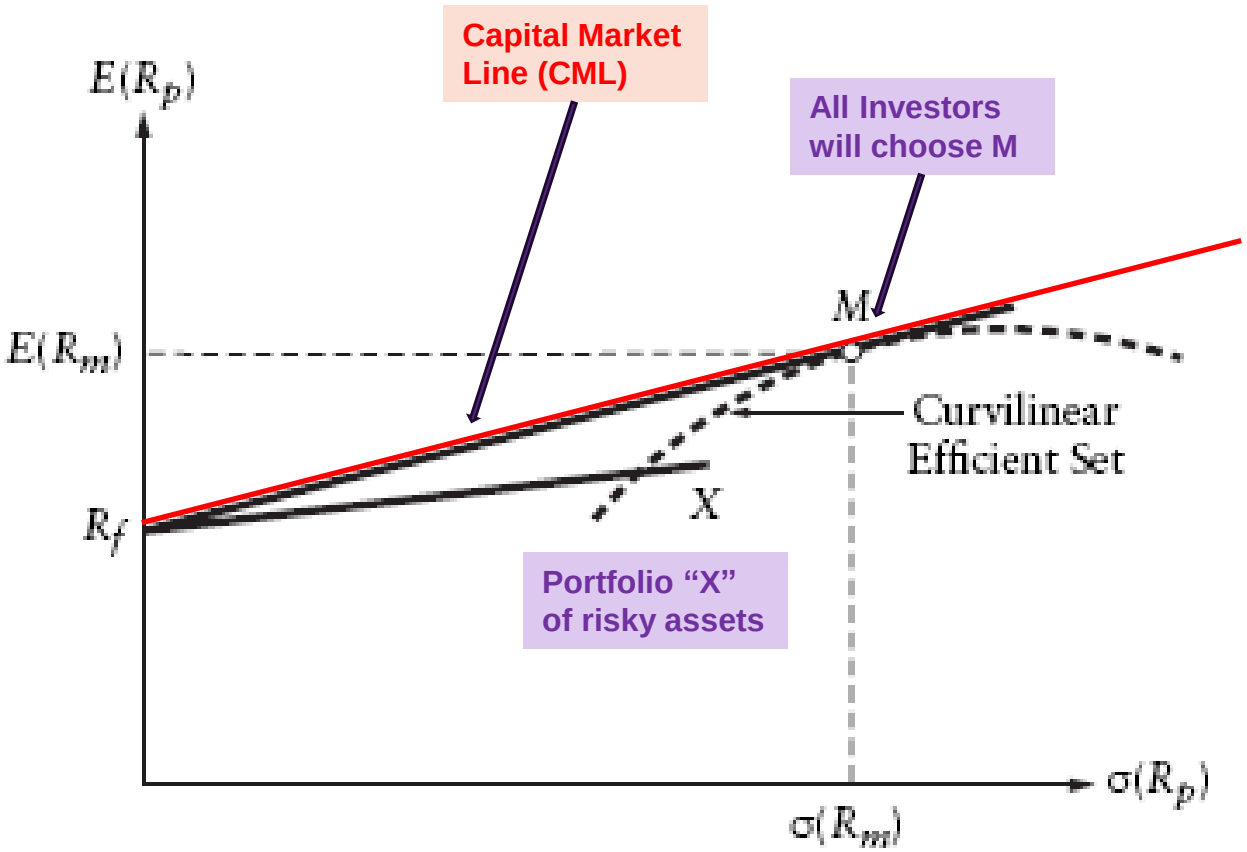
- **Correlation** does not affect expected return, yet it does affect risk.
- The lower the correlation, the lower the volatility we can obtain. As the correlation decreases, the volatility of the portfolio falls → More diversification.
- Efficient frontier is normally a concave curve, the only case it is a straight line is when the correlation = 1 (perfectly positively correlated)

❑ The portfolio frontier depends on the **correlation** between the assets.
❑ The less correlated the assets' returns, the more diversification benefits.

(1) Portfolio risk and return – Can we do better?

Two-fund separation = > maximize per unit risk's return

?What we can do better



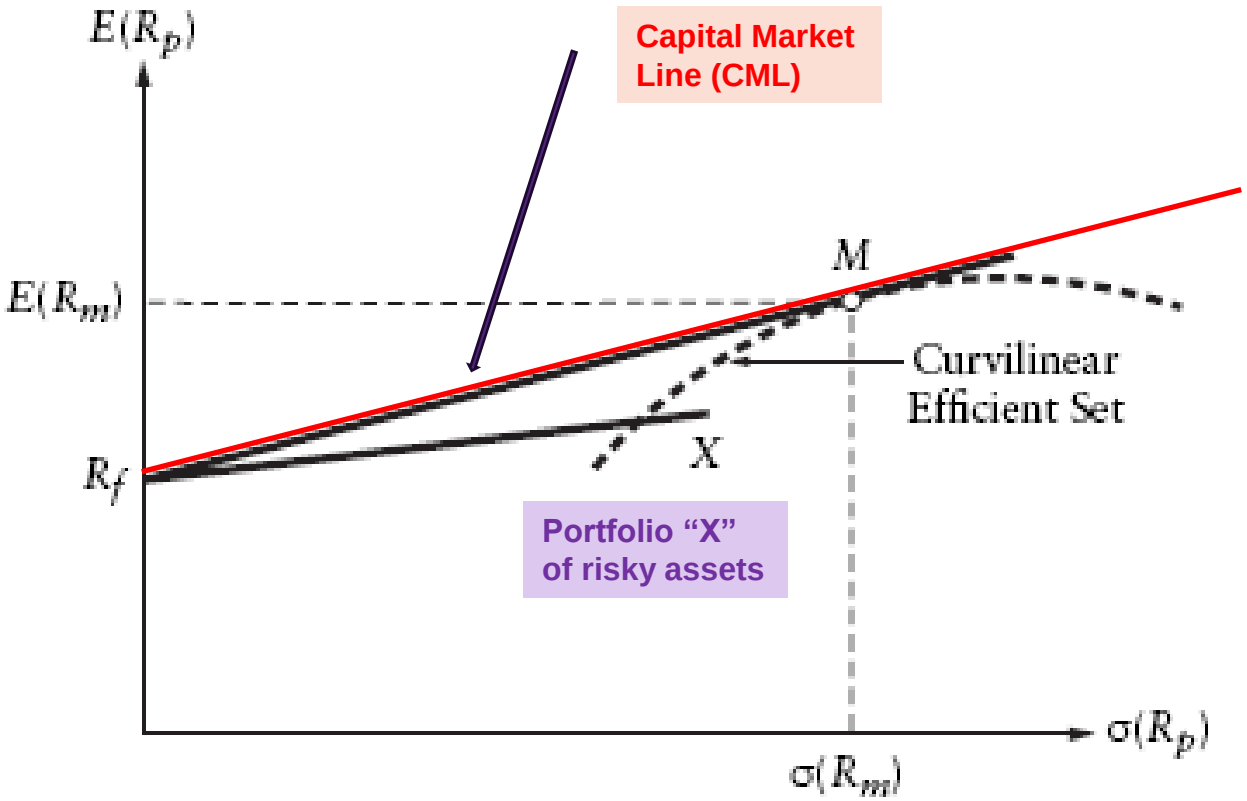
- By combining M and the risk-free rate, we can create a range of portfolios yielding the best risk and return trade-off → the highest Sharpe ratio (highest slope).
- The line connecting r_f and M is the Capital Market Line (CML).
- M is the tangency portfolio or the market portfolio.
- ALL INVESTORS, regardless of their risk preferences, will choose M.

To achieve the desired risk-return profile, they will change the weights invested in M and r_f

(1) Portfolio risk and return – Can we do better? (continue)

Two-fund separation = > maximize per unit risk's return

?Any Mathematical Interpretations
? What we can do better = > risk preference



Why a straight line?

Recall the equation of a line: $Y = a + b * X$

$Y = E(r_p)$ and $X = \sigma_p$

$$E[r_p] = r_f + \left[\frac{E[r_M] - r_f}{\sigma_M}\right]\sigma_P$$

= > Slope: $\left[\frac{E[r_M]-r_f}{\sigma_M}\right]$? Per unit risk's return = > Sharp Ratio

$$\text{slope} = \frac{E[R_p] - r_f}{\sigma_p} = \text{Sharpe Ratio}$$

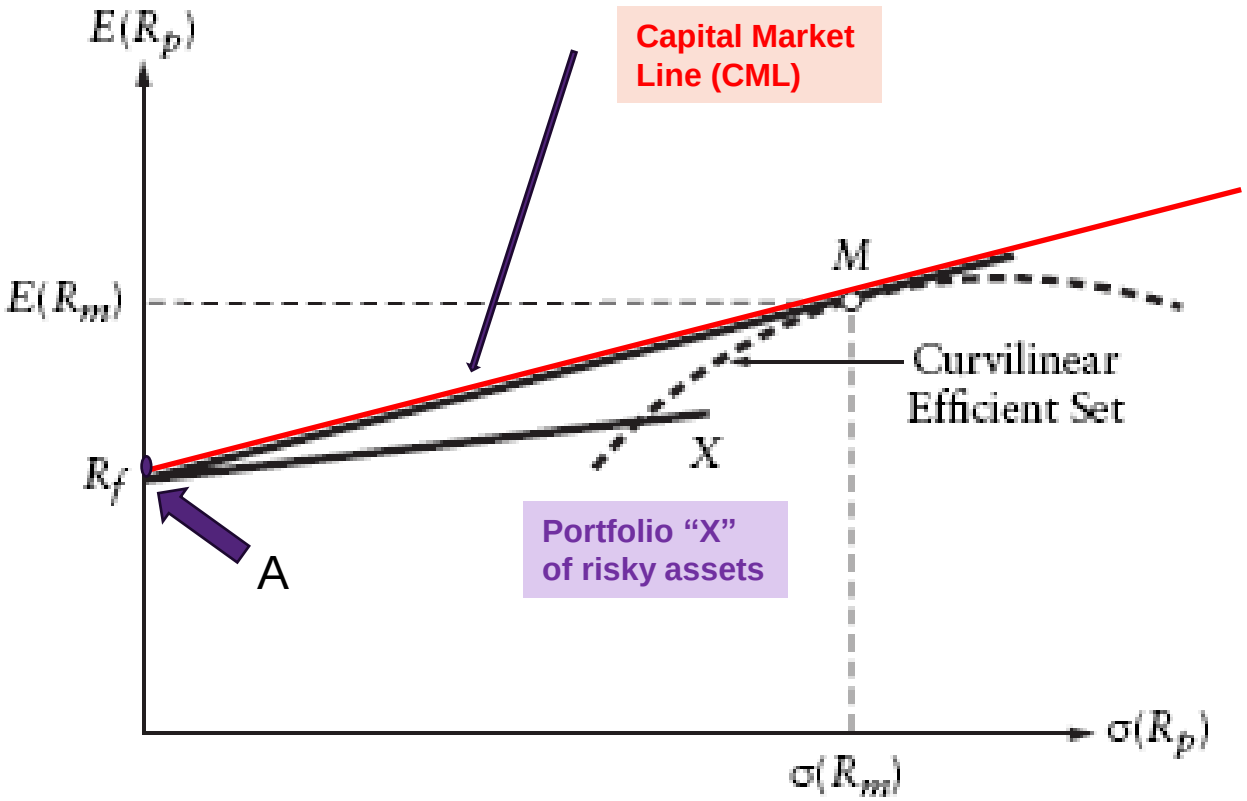
Purpose maximize the sharp ratio

= > Intercept: Risk-free Rate

(1) Portfolio risk and return – Can we do better? (continue)

Two-fund separation = > maximize per unit risk's return

?Any Mathematical Interpretations
? What we can do better = > risk preference



$$\text{slope} = \frac{E[R_p] - r_f}{\sigma_p} = \text{Sharpe Ratio}$$

Point A:

100% Risk-free Assets

Between Point A and M:

Combination between risk-free assets and risky-assets

Point M:

100% Risky Assets

Above Point M:

Borrowing money and investing more in M: negative weight on the risk-free asset : Buy on margin or leverage.

Risk & Return Exercise

- You hold a portfolio with expected return of 10% and volatility of 13%.
- The tangent portfolio (the combination with the highest Sharpe Ratio) has expected return of 21% and volatility of 18%. The risk-free rate is 3%.
- What is the highest return you can get with the same risk as your current portfolio?

Risk & Return Exercise – Solution

Volatility is usually regarded as standard deviation of returns

- You hold a portfolio with expected return of 10% and volatility of 13%.
- The tangent portfolio (the combination with the highest Sharpe Ratio) has expected return of 21% and volatility of 18%. The risk-free rate is 3%.
- What is the highest return you can get with the same risk as your current portfolio?

Solution:

- The tangent portfolio has the highest Sharpe Ratio, so you can improve your return by combining the tangent portfolio with the risk free asset.
- $Slope = \frac{21\%-3\%}{18\%} = 1 = \frac{E(R_A)-3\%}{\sigma_A} = \frac{E(R_A)-3\%}{13\%}$
- $\frac{E(R_A)-3\%}{13\%} = 1$, *so solve for* $E(R_A)$
- $E(R_A) = 3\% + 13\% * 1 = 16\%$ (so sell your portfolio and invest in a combo of market and risk free) Weights: 16%= Wm(21)+Wrf(3). Wm=72% and Wrf=28%

(2) CAPM Model

CAPM equation

$$E(R) = R_f + \beta\,(R_m - R_f)$$

$\beta_i = \sigma(R_i, R_m) / \sigma^2(R_m)$

Market Risk Premium
$= (R_m - R_f)$

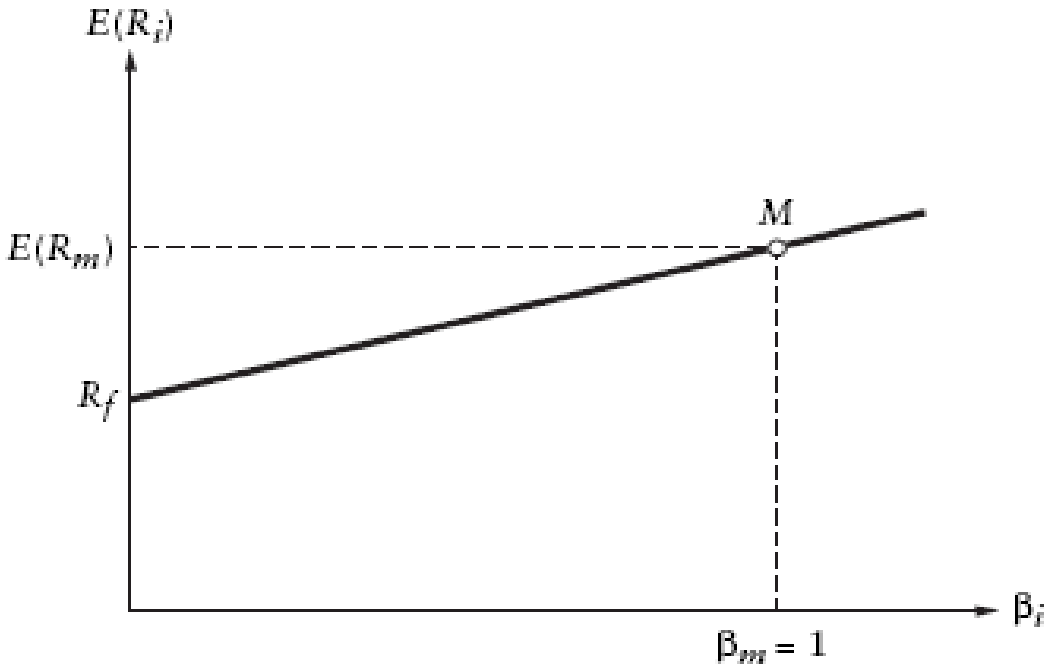
- Where		
$E(R)$	=	The Expected Return
R_f	=	The Risk-free Rate
β	=	Sensitivity; The Beta of the Investment
R_m	=	The Expected Return of the Market

- CAPM is an equilibrium model: it brings all investors together.
- According to CAPM only risk related to market movements is priced by market.
- This is because all other risks can be diversified away.
- Beta is a measure of non-diversifiable risks (systematic risks) for a security.

(2) CAPM Model

CAPM relationship and beta = > Security Market Line

? Again, Any Mathematical Interpretations



β is defined as: $\beta_i = \left[\frac{\rho_{i,m}\sigma_i}{\sigma_m}\right]$

β is the systematic risk. Then: $E(r_i) = r_f + \beta_i\left[E(r_m) - r_f\right]$

This is known as the **Security Market Line**

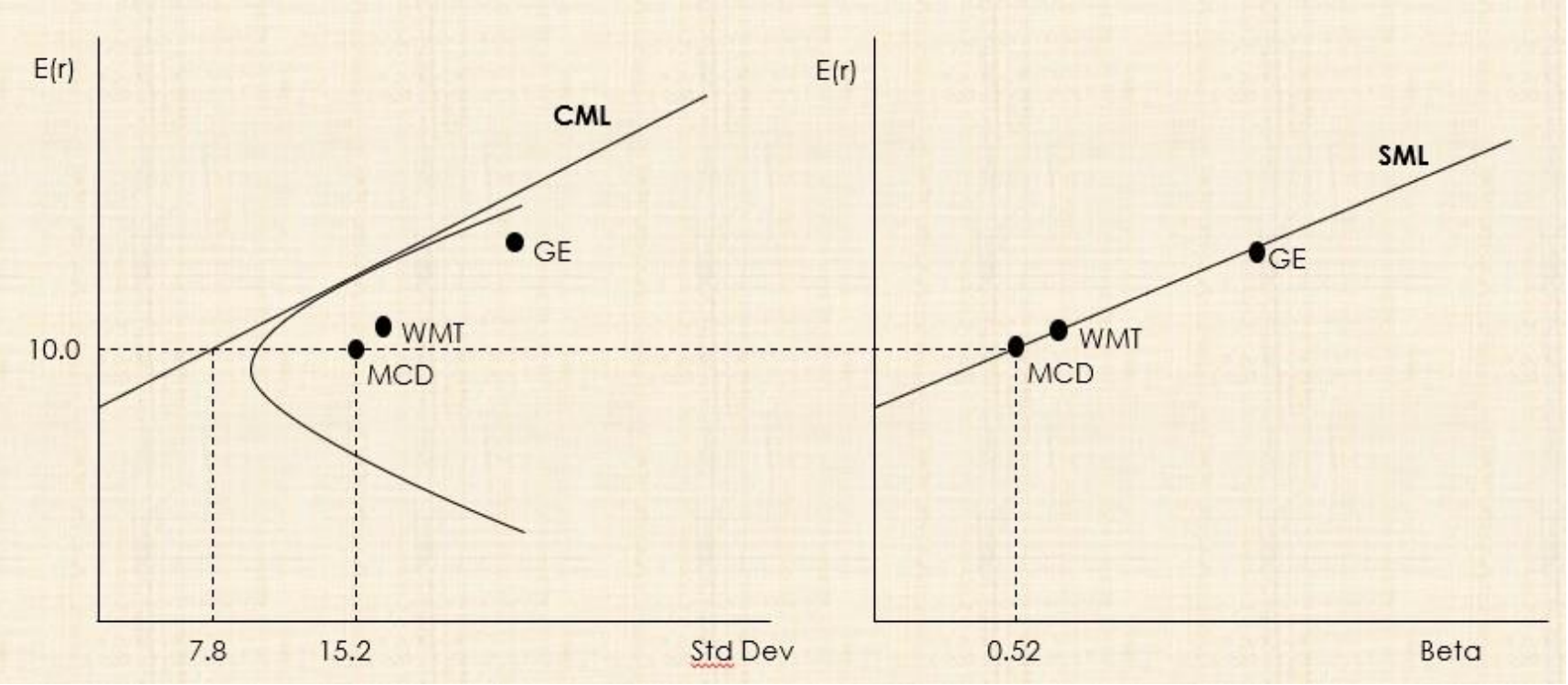
and as the **Capital Asset Pricing Model.**

= > Slope of SML = $\frac{\boldsymbol{E(R_m) - r_f}}{\boldsymbol{\beta_m - 0}}$ **=** $\boldsymbol{E(R_m) - r_f}$ *= Market Premium*

(note: beta for market portfolio equals to 1)

CML versus SML

From CML to SML:



(3) Market Efficiency (EMH)

- Value is what a security should be worth based on careful analysis.
- Price is what the market says it is worth.
- What is relationship between value and price if markets are efficient?

- Older version of market efficiency says value and price are always identical.
- More subtle and realistic version says they can sometimes differ a little.

(3) Market Efficiency

Operational definition of market efficiency

- Financial markets are efficient if no one can consistently earn excess returns.

Excess means…

- After risk is factored in
- And after costs are factored in

- What sort of costs?
  - Transaction costs
  - Analysis costs

(3) Market Efficiency

What should be true if markets are efficient?

- Security prices should respond quickly and accurately to new information.
- Professional investors should not outperform net of all fees.
- Simulated trading strategies should fail.
- Abnormal profits should not be consistently made.

(3) Market Efficiency

Simulated trading strategies

- We can look at possible strategies using historical data and see if they would have earned excess returns.
- These strategies must be based on information that was available.
- If a strategy succeeds in generating excess returns, this is preliminary evidence against market efficiency.
- But we need:
  - Statistical significance.
  - Consistency.
  - *Beware of data mining!*

(3) Efficient Market Hypothesis_answer

(3-1) Weak Form Efficiency

Price accurately reflects past market trading information such as:

e.g. Past stock price, trading volume etc.

➔(or any analysis based on historical data) is ***USELESS;*** ***technical* analysis *is USELESS***.

➔ public available & private information is ***USEFUL***, fundamental analysis is ***USEFUL***.

e.g. Stock price of a company XYZ increased in November in the past five years.

so you want to purchase the stock in Oct this year and sell it for profit. ⟶ Abnormal profit

[Conclusion: CAN NOT follow the strategy, Trading in the past information (weak)]

All past price data is incorporated into the current price such that consistent abnormal profits cannot be consistently made.

(3) Efficient Market Hypothesis_answer

(3-2) Semi-Strong Form Efficiency

Price reflects both historical and publicly available information in addition to past price such as:

e.g., past stock price and all fundamental data on a firm's product line

financial and accounting data and analysts/managers' earnings forecast.

➔Both technical analysis and fundamental analysis are ***USELESS***.

➔ Only private information is ***USEFUL***.

e.g., Morningstar just released a recommendation report on company ABC, in which it recommends a strong buy on this company, you want to profit following the recommendation.

[Conclusion: CAN NOT follow the strategy, Trading in the public available information (semi-strong form)]

(3) Efficient Market Hypothesis_Answer

(3-3) Strong Form Efficiency

Price reflects ALL Relevant information includes both public information and private information (information only available for insiders)

Remember consistent and abnormal profits must be made

➔Any form of information is ***USELESS***.

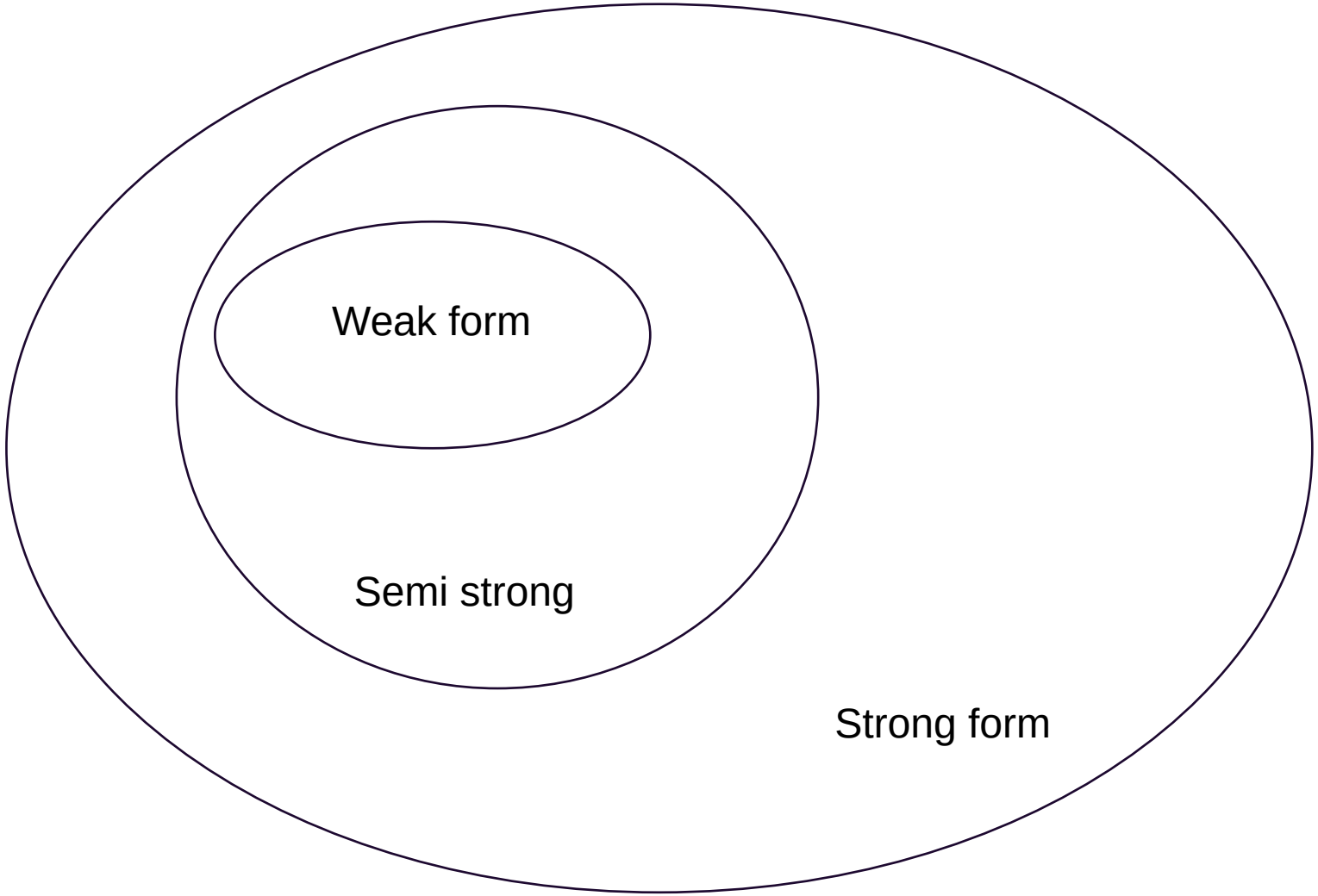
➔ NO investor can win.

e.g., your uncle works on company Q and he told you that their company launched a positive npv project, so the share price will increase shortly, you want to profit from buying shares from company Q.

But when you go to buy the shares you find they've already gone up

[Conclusion: The market is so efficient as soon as the information gets created the stock price reflects the new information.]

Each level encompasses the previous level



(3) Efficient Market Hypothesis

Joint hypothesis problem

All tests of market efficiency have two maintained hypotheses:

- Markets are efficient.
- A fair return on a security or portfolio is from a particular model (in early tests this model was usually CAPM).

Rejection means:

- Markets are not efficient.
- Method for calculating fair returns is faulty.
- Or both.

But which? Joint hypothesis problem!

(4) Agency Relationships and Corporate Governance

Sole Traders
Partnership
Corporation

Different Structure ← **Corporation** → **Different Stakeholders**

Stockholders,
Bondholders,
managers, et al.

The separation of ownership and control

Ownership (Shareholders)

Control (Managers)

Why separate the ownership and control?

Answers;
Managers are specialized in management

Conflicts of interests
(both parties seek to maximize their own interests)

Agency Problems

Agency Costs
(Impact the value of firm)

Agency cost of equity: These costs are incurred when managers' and shareholders' interests diverge. Managers might not always act in the best interest of shareholders, creating potential costs.
(for example: Excessive Perquisites, Empire-Building, Earnings Manipulation and Insufficient Effort)

Agency cost of debt: These costs arise when the interests of shareholders (equity holders) and debt holders diverge
(for example: Asset Substitution Effect, Underinvestment Problem, and Debt Overhang)

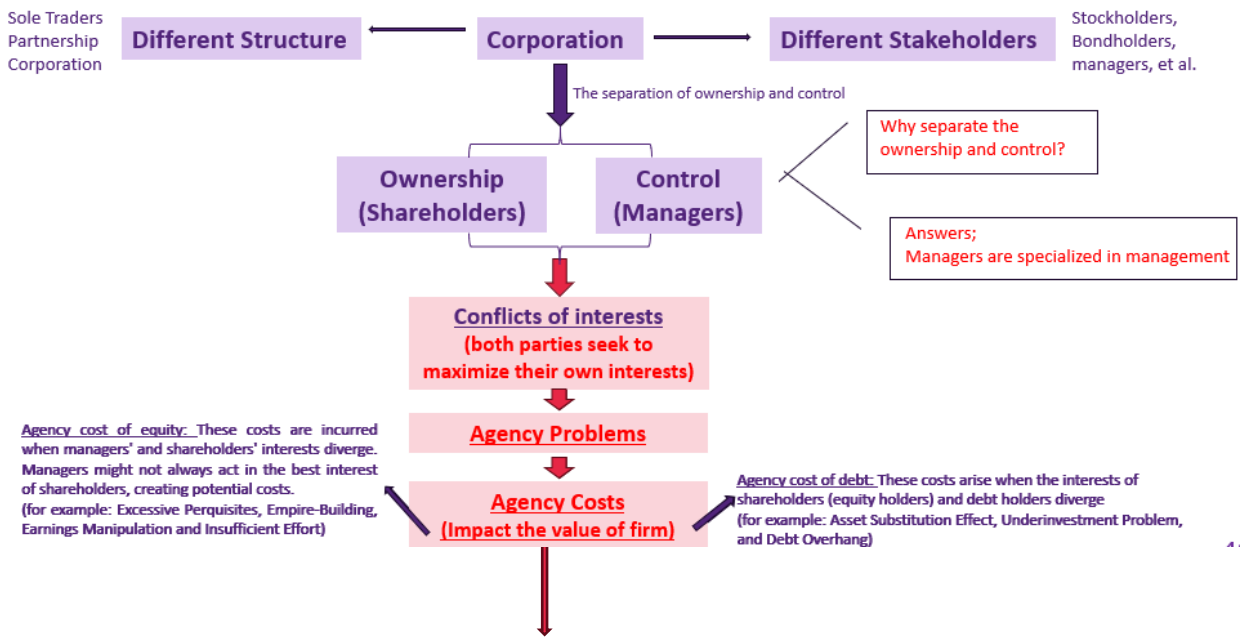
(4) Agency Relationships and Corporate Governance

Agency costs

- **Agency costs are incurred because managers' incentives are not consistent with maximizing value of firm.**
- **Direct costs:**
  - Example: need to monitor managers, including the cost of hiring outside auditors
- **Indirect costs:**
  - Example: managers of a firm that is an acquisition target may resist the takeover attempt because of concern about keeping their jobs, even if the shareholders would benefit from merger

Note: additional readings available via BB – Learning Resources – Lecture 1

(4) Agency Relationships and Corporate Governance



Corporate Governance
(mitigate the agency problems)

⇒ **Monitoring**

⇒ **Align the interests of two parties together**

Corporate Governance

- The system of controls, regulations, and incentives designed to minimize agency costs between managers and investors and prevent corporate fraud

- The role of the corporate governance system is to mitigate the conflict of interest that results from the separation of ownership and control without unduly burdening managers with the risk of the firm.

Implements two alternative strategies to mitigate moral hazard:

- Monitoring: usually imposed by controls and regulations
- Incentives: set by contract to reward desirable outcomes (e.g., stock options)