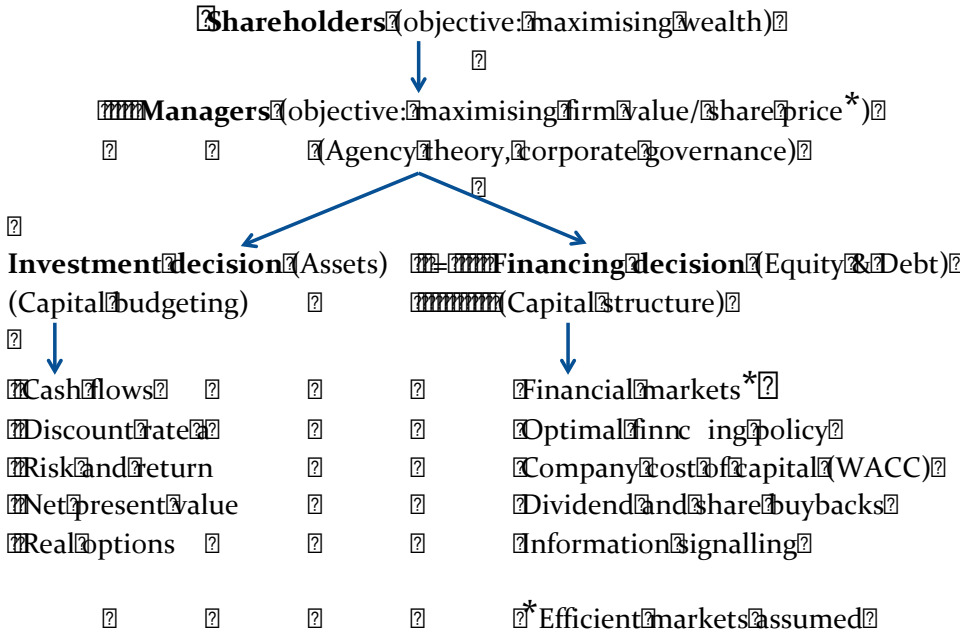
LECTURE 1 – Introduction To Corporate Projects, Investments, and Major Theories

Corporate Finance

- It is about how corporations make financial decisions.
- It is about money and markets, but also about people.
- It is also known as business finance or financial management.



Most Important Ideas In Finance

1. Net present value
2. Portfolio theory
3. Capital asset pricing theory
4. Efficient market theory
5. Agency theory
6. Capital structure theory
7. Signalling theory
8. Option theory

Net Present Value

– Investment Decision

- Investment decision – what real assets (tangible and intangible) should the firm purchase to produce goods and services?
  1. Identify an investment opportunity or 'project'.
  2. Evaluate whether the project is worth more than the capital required to undertake it (capital budgeting or capital expenditure decision).
  3. If the project has a positive net present value (NPV), then consider funding.
- NPV = – (Initial payment) + (Cash inflow/1 + r).
- Investment decisions involve spending money.

- **Financing Decision**

- Financing decision – how should the firm pay for those investments?
- To obtain the money, the firm sells claims on its real assets and on the cash flow those assets will generate.
- These claims are called financial assets or securities.
- For example, the bank provides the corporation with cash in exchange for a financial asset, which is the corporation's promise to repay the loan with interest.
- However an ordinary bank loan is not a security because it is not sold or traded in financial markets.
- Financing decisions involve raising money.

- **Financial Decisions**

- Financial decisions – the evaluation of risky cash flows over time.
- Broadly characterised by three factors:
  - Involve money or cash.
  - Cash flows may have a time dimension (money has time value; a dollar today is worth more than a dollar tomorrow).
  - Involve an element of risk or uncertainty.
- Future cash flows need to be discounted to their present values for proper comparison.

Portfolio Theory

- Portfolio theory – concerned with the measurement of risk; it suggests that investors should diversify their portfolio investments to reduce risk.
- Some cash flows may be more uncertain than others and a safe dollar is worth more than a risky one, so we need to take differences in risk into account in financial decisions.
- Risk in investment is measured by standard deviation (for single assets) or beta (for portfolios).

Capital Asset Pricing Theory

- Capital Asset Pricing Model or Security Market Line provides a simple linear relationship between expected return and beta (risk).
- An important issue is how the financial market prices or values risk.
- Generally the higher the risk on an investment the higher must be the expected return on the project for it to be undertaken.

Efficient Market Theory

- Efficient market theory – security prices accurately reflect available information and respond rapidly to new information as soon as it becomes available.
- It implies that competition in capital markets is very tough and security prices reflect intrinsic value of assets.
- Capital markets are assumed to be efficient throughout this course, however, real asset markets are imperfect and investment opportunities with positive NPV are available.

Agency Theory

- Agency theory – the possible conflicts of interest among stakeholders and the attempt to overcome such conflicts.
- A modern corporation involves managers, shareholders, employees, debtholders, government, and other constituencies "stakeholders".

– Separation of Ownership and Control

- The board is supposed to ensure that managers act in the shareholders' best interest.
- A manager who invests only in assets with positive net present values (the NPV rule) will increase the market value of the firm and the current price of its shares; this serves the best interests of each one of the firm's shareholders.
- Advantages:
  - Allows share ownership to change without interfering with the business operation.
  - Allows the firm to hire professional managers.
- Problems:
  - Managers' and shareholders' objectives may differ.
  - Managers may have their own nests to feather, such as seeking a luxurious working lifestyle or building an empire to satisfy their own ego.
  - This potential conflict of interest is termed a principal-agent problem.

– Agency Costs

- Agency costs – any loss of firm value that results from a conflict of interest.
- Agency costs are incurred when:
  - Managers do not attempt to maximise firm value.
  - Shareholders incur costs to monitor the managers, constrain their actions and align their interest with shareholders'.
- Agency costs can also arise when the firm gets into financial distress and the interests of the shareholders are in conflict with those of the debtholders.

– Corporate Governance

- Agency problems are mitigated by good systems of corporate governance:
  - Legal and regulatory requirements (e.g. financial statements).
  - Compensation plans (e.g. stock options).
  - Board of directors (holding managers to task).
  - Monitoring (by security analysts and banks).
  - Takeovers (a market mechanism of control).
  - Shareholder pressure (e.g. becoming directors or selling out).

Capital Structure Theory

- Two types of financing decisions to raise capital:
  - The issue of debt and equity capital.
  - The retention of profits vs. dividend decision.
- There are no simple answers to the capital structure or dividend decisions (e.g. more debt can be good or bad).
- Modigliani and Miller's capital structure theory provides a starting point for analysing the impact of financing decisions on firm value.

Signalling Theory

- Managers may use capital structure and dividend decisions to signal their view of the firm's prospects.
- An increase in the dividend could signal an expectation of improved earnings, and hence increased capacity to pay higher dividends.
- It becomes more difficult to resolve conflicts and agency problems when managers have more information than shareholders/debtholders.

  - **Information Asymmetry**
    - Managers, shareholders and lenders may all have different information about the value of a real or financial asset.
    - Managers typically have more information about the true prospects of the firm.
    - Financial managers need to recognise these information asymmetries and finds ways to reassure investors that there are no nasty surprises on the way.

Option Theory

- Firms regularly use derivative securities such as options and futures to reduce risk.
- The value of these derivatives depends on the value of some other assets.
- Many capital investments include an embedded option to expand or to bail out in the future; these are called real options in capital budgeting decisions.
- Option theories such as binomial tree model or Black-Scholes-Merton formula can be used to value these financial derivatives and real options.

LECTURE 2 – Estimating The Cash Flows and The NPV of A Project

What To Discount

- Wise investment decisions are based on the NPV rule.
- NPV depends on future cash flows.
- Cash flow is just the difference between dollars received and dollars paid out.
- Cash flows are different to accounting profits, which include income and expenses not yet received or paid as well as depreciation charges, which are not cash flows at all.

Estimate Cash Flows On An Incremental Basis

- The value of a project depends on all the incremental (additional) cash flows after-tax that follow from the project acceptance.
- Important to include all incidental effects on the remainder of the firm's business such as existing products sales.
- Recognise after-sales cash flows to come later such as downstream activities on service and spare parts.

Working Capital Requirements

- Firms generally use sales and COGS to estimate cash flow:
  - Cash inflow = Sales – Increase in Accounts Receivable (AR).
  - Cash outflow = COGS + Increase in Inventory (INV) – Increase in Accounts Payable (AP).
  - Net Cash Flow = Cash inflow – Cash outflow
    = [Sales – COGS] – [AR + INV – AP]
- The amount of [AR + INV – AP] is the additional investment in net working capital (often referred to simply as working capital).
- An increase in working capital should be treated as an outflow.
- Working capital is likely to increase in the early and middle years of a project.
- When the project comes to an end, all the investments in working capital over the life are recovered and treated as a cash inflow.
- If firms estimate cash flow directly by counting dollars in and dollars out, there is no need to keep track of changes in working capital at all.

Opportunity Costs

- Should include the opportunity cost of a resource used in a project even when no cash changes hands.
- E.g. a new operation will use an already acquired land that could otherwise be sold.
- The opportunity cost of a resource is the cash it could generate for the company if the project were rejected and the resource were sold or put to some other productive use.
- Should judge projects on the basis of "with or without", not "before versus after".

Sunk Costs, Allocated Overhead Costs, Inflation, and Salvage Value

- Ignore past and irreversible sunk costs.
- Ignore the accountant's allocation of existing overheads and include only the extra overhead expenses generated by a project.
- Treat inflation consistently by discounting nominal cash flows at a nominal rate of return and real cash flows at a real rate.
- Remember salvage value (net of any taxes) when the project comes to an end (it can be negative when restoring land to suitable, environmental state).

Separate Investment and Financing Decisions

- Analyse the project as if it were all equity-financed, treating all cash flows as coming from and going to shareholders.
- If a project is partly financed by debt, we will not subtract the debt proceeds from the required investment cost nor will we recognise interest and principal payments as cash outflows.
- Financing costs are recognised in the discount rate instead.

Depreciation

- Depreciation is an allowable deduction against profit.
- It provides an annual tax shield:
  - Tax shield = (Depreciation $\times$ Tax rate).
- The tax shield is implicitly shown in the reduced amount of tax on operations recorded in the income statement.
- As depreciation is a noncash expense, it has to be added back to profit after-tax to arrive at the net cash flow.
- Straight-line depreciation is used for this subject.

Investment Timing

- Sometimes you have the ability to defer an investment and select a time that is more ideal to make the investment decision.
- A project might become more valuable if undertaken in the future. You can defer the receipt of the cash flow yet increase the cash flow.
- The optimal timing is when NPV maximised. You maximise the NPV of your investment if you invest as soon as the rate of increase in value drops below the cost of capital.

Equivalent Annual Cash Flows

- Sometimes in project analysis it is helpful to reverse the calculation of NPV, i.e. transforming an investment today into an equivalent stream of future cash flows.
- Equivalent Annual Annuity = $\frac{\text{Present value of cash flows}}{\text{Annuity factor}}$
- Note that the first annuity payment occurs in year 1, not at year 0.

Mutually Exclusive Projects With Unequal Lives

- A machine/project may have a lower present value of costs but it will have to be replaced a year earlier than the other machine/project.
- The rule is to select the asset with the lowest equivalent annual cost.

When To Replace An Existing Machine

- First calculate the EAA of the new machine.
- The optimal timing of replacement can be decided by comparing the NPVs achieved over an infinite period of replacement with the new machines.
- Select the year with the highest positive NPV or lowest negative NPV.

Cost of Excess Capacity

- Suppose a new investment project requires heavy use of an existing information system and will bring the purchase date of a replacement system forward from year 4 to year 3.
- The new system has a life of five years, and at a discount rate of 6% the present value of the cost of buying and operating it is $500,000.
- When the new system in turn wears out, we will replace it with another.
- We begin by converting the $500,000 present value to an EAA of $118,700 ($=500{,}000/[(1-1.06^{-5})/0.06]$).
- As the new system will be continuously replaced with another, we will have to pay $118,700 a year indefinitely.
- If we undertake the new project and buy the replacement system in year 3, the perpetual series of $118,700 begins in year 4; if we do not undertake the new investment, the series begins in year 5.
- The additional cost of $118,700 in year 4 has a present value of $118700/(1.06)^4$ = $94,020.
- This amount of $94,020 must be charged against the new project for the use of spare capacity.

Fluctuating Load Factors

- A manufacturer operates two machines, each of which has a capacity of 1,000 units a year.
- The machines have an indefinite life and no salvage value, and the only costs are the operating expenses of $2 per unit.
- Each machine currently produces 750 units a year in order to meet the combined demand of 1,500 units. The discount rate is 10%.

	Two Old Machines
Annual output per machine	750 units
Operating cost per machine	2 x 750 = $1,500
PV operating cost per machine	1,500 / .10 = $15,000
PV operating **cost** of 2 machines	2 x 15,000 = **$30,000**

	Two New Machines
Annual output per machine	750 units
Capital cost per machine	$6,000
Operating cost per machine	1 x 750 = $750
PV total cost per machine	6,000 + 750/.1 = $13,500
PV total cost of 2 machines	2 x 13,500 = **$27,000**

- A better alternative that saves $4000; to replace just one of the old machines and operate the new one with a lower operating cost at full capacity all year but the old one at half capacity.

	One old machine	One new machine
Annual output per machine	500 units	1,000 units
Capital cost per machine	0	$6,000
Operating cost per machine	2 x 500 = $1,000	1 x 1,000 = $1,000
PV total cost per machine	1,000/.10 = $10,000	6,000 + 1,000/.10 = $16,000
PV total cost of both machines	**$26,000**	

LECTURE 3 – Evaluating and Mitigating The Risks of A Project, and Real Options

Sensitivity Analysis

- A project may appear to be worth going ahead with a positive NPV.
- The firm, however, needs to conduct a sensitivity analysis with respect to key variables.
- The project's NPV is recalculated as the underlying variables are set one at a time to their optimistic and pessimistic values, while leaving the remaining variables at their expected value.

		Range	
Variable	**Pessimistic**	**Expected**	**Optimistic**
Market size	0.9 million	1 million	1.1 million
Market share	0.04	0.1	0.16
Unit price	350,000 yen	375,000 yen	380,000 yen
Unit variable cost	**360,000 yen**	300,000 yen	275,000 yen
Fixed cost	4 billion yen	3 billion yen	2 billion yen
	NPV (billions of yen)		
Variable	**Pessimistic**	**Expected**	**Optimistic**
Market size	+1.1	+3.4	+5.7
Market share	-10.4	+3.4	+17.3
Unit price	-4.2	+3.4	+5.0
Unit variable cost	**-15.0**	+3.4	+11.1
Fixed cost	+0.4	+3.4	+6.5

NPV calculation for Pessimistic unit variable cost estimate			
		Year 0	Years 1-10
1	Investment	-15	
2	Revenue		37.5
3	**Variable cost**		**36.0**
4	Fixed cost		3.0
5	Depreciation (straight-line)		1.5
6	Pretax profit (2-3-4-5)		-3.0
7	Tax @50%		-1.5
8	Net profit after tax		-1.5
9	Operating cash flow (5+8)		0.0
10	Net cash flow	-15	0.0
11	NPV = -15 + (0)[(1 - 1.1^{-10})/0.1] = -15		

Value of Information

- Suppose that the pessimistic value for unit variable cost partly reflects the worry that a particular machine will not work as designed and that the operation will have to be performed at an extra cost of ¥20,000 per unit.
- If it does occur, the after-tax cash flow will be reduced by ¥1 billion a year and the NPV reduced by (1)[(1 - 1.1^{-10})/0.1] = ¥6.14 billion.
- The chance for the problem to occur is 10%.
- Suppose further that a ¥10 million pretest of the machine will reveal whether it will work and allow you to clear up the problem.
- The value of additional information about unit variable cost from the pretest is:
  - –$10M + (.10 × $6,140M) = +¥604 million.
- Should invest in the pretest.

Limits To Sensitivity Analysis

- Sensitivity analysis forces the manager to identify the underlying variables, indicate where additional information would be most useful, and helps to expose inappropriate forecasts.
- One drawback is what exactly optimistic or pessimistic means.
- Another problem is that the underlying variables are likely to be interrelated.

Scenario Analysis

- If the variables are interrelated, we may use scenario analysis to look at different but consistent combinations of variables.
- E.g. a scenario of higher oil prices and recession would result in the following:
  - Market size = 0.8 million.
  - Market share = 0.13.
  - Unit price = ¥431,000.
  - Unit variable cost = ¥345,000.
  - Fixed cost = ¥3.5 billion.
- Revenue = Market size × Market share × Unit price.

Break-even Analysis

- Analysis of the level of sales, Q, at which the project breaks-even with a zero NPV:
  - NPV = {[Revenue – Variable cost – Fixed cost – Depreciation] × (1 – tax rate) + Depreciation} × [annuity factor] – Investment
  - NPV = {[(Q(375,000) – Q(300,000) – $3B – $1.5B] × (1 – 0.5) + $1.5B} × $[(1 - 1.1^{-10})/0.1]$ – $15B = 0
  - Q = 85,098 units.
- Accounting break-even is different, yet wrong. It does not consider the time value of money. A lower break-even unit sales will be derived based on accounting profits.

Operating Leverage and The Break-Even Point

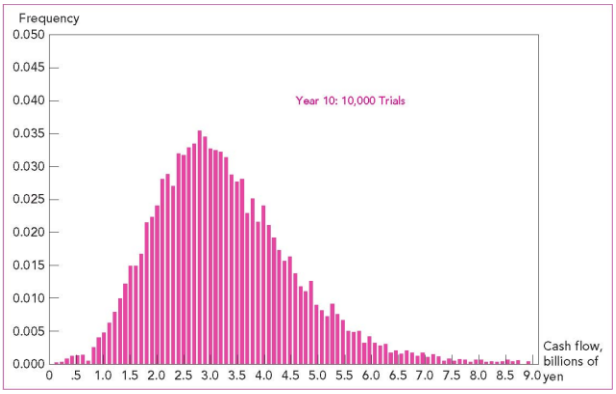
- A project's break-even point depends on the extent to which its costs vary with the level of sales.
- A business with high fixed costs is said to have high operating leverage and high business risk, and will have a high break-even sales.
- Operating leverage is usually defined in terms of accounting profits rather than cash flows.
- Degree of operating leverage (DOL):
  - $\text{DOL} = \frac{\%\text{ change in profits}}{\%\text{ change in sales}}$

    OR
  - $\text{DOL} = 1 + \frac{\text{fixed costs including depreciation}}{\text{before tax profits}}$

Monte Carlo Simulation

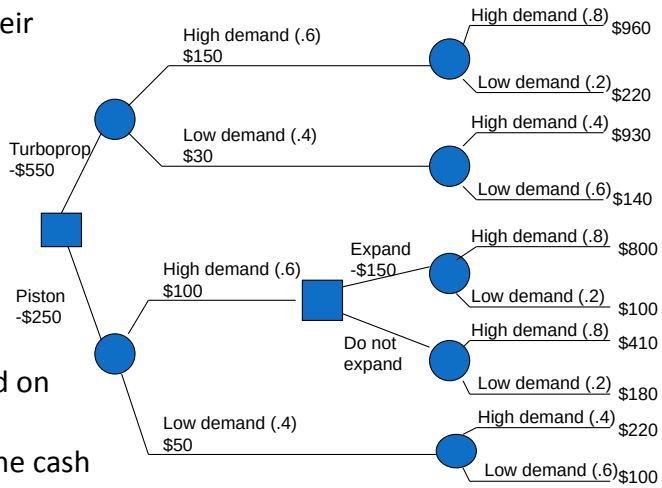
- Simulation is a tool for considering all possible combinations of variables.

1. Modeling the project by giving the computer a set of equations to specify the interdependence between different variables and between different periods.
2. Specifying the probabilities of possible forecast errors for each of the variables that are in the model.
3. Select at random a value from the distribution of each variable and calculate the net cash flow for each period, repeat the process a thousand times to get probability distributions of the project's cash flows in each period (which reflect project risk).
4. Calculate the expected cash flows from the distributions of project cash flows to find their present values.



Flexibility and Real Options

- In practice, companies do not sit back and watch the cash flows unfold; they are constantly modifying their operations.
- If cash flows are better than anticipated, the project may be expanded. If they are worse, it may be contracted or abandoned altogether.
- Options to modify projects are known as real options:
  - Option to expand.
  - Option to abandon (to cut losses).
  - Timing options (to postpone investments).
  - Production options (to provide flexibility in production).
- Such options do not show up in the assets in the balance sheet but are reflected in the market value of shares.
- Decision trees help companies determine their options by showing the timing of sequential decisions and possible cash flow outcomes.
- The two decisions/actions are marked by a square.
- Each circle represents an outcome revealed by fate.
- The probability of high and low demand are in parentheses.
- The probabilities for the second year depend on the first year outcomes.
- The payoff figures in year 2 are the sum of the cash flow that year plus the year-2 value of any subsequent cash flows (so the project can be treated as a 2-year investment).
- Always consider the square in the most distant future when first calculating.
- Investment in the Piston:



$$\text{NPV}_{t=0} = -250 + \frac{.6(100+450)+.4(50+135)}{1.10} = 117$$

- Investment in the Turboprop:

$$\text{NPV}_{t=0} = -550 + \frac{.6(150)+.4(30)}{1.10} + \frac{.6[.8(960)+.2(220)]+.4[.4(930)+.6(140)]}{(1.10)^2} = 96$$

- The company should buy a piston plane now and expand to buy a second piston if demand turns out to be high in year 1.