FINANCIAL MANAGEMENT

Financial Management

Prescribed Text Book:

- Corporate Finance by Ross, S. A.−Westerfield, R. W. and Jaffe, J., The McGraw-Hill Companies, 2010.

Other Reference/Suggested Books:

- Corporate Finance by Ross, S. A.−Westerfield, R. W.-Jaffe, J. –Jordon, B. D and Kakani, R. K., The McGraw-Hill Education (India) Pvt. Ltd, 2017.
- Corporate Finance: A Focussed Approach by Brigham, E. and Ehrhardt, M. C., South Western Cengage Learning, 2013.
- Financial Management by Khan, M. Y. and Jain, P. K., McGraw-Hill Education (India) Pvt. Ltd, 2014.
- Principles of Corporate Finance by Brealey, R.-Myers, S. and Allen, F. The McGraw-Hill Companies, 2014.
- Corporate Financial Analysis with Microsoft Excel by Francis J. Clauss, The McGraw-Hill Companies, 2010.

FINANCIAL MANAGEMENT: AN OVERVIEW

Scope of Financial Management

Financial Management addresses the following questions:

1A. What long-term and short-term investments should the firm engage in?

1B. How should short-term operating cash flows be managed?

2. How can the firm raise the money for the required investments?

3. What proportion of net profits can be distributed to the shareholders in the form of dividends and what proportion can be retained in the business itself ?

Scope of Financial Management

The scope of financial management can be broken down into three major decisions as functions of finance:

(1) Investment Decision

The investment decision relates to the selection of assets in which funds will be invested by a firm. The assets which can be acquired fall into two broad groups: (a) fixed-assets/long-term assets (Capital Budgeting) (b) short-term /current assets (Working Capital);

(a) Capital Budgeting: Capital budgeting is probably the most crucial financial decision of a firm. It relates to the selection of an asset or investment proposal or course of action whose benefits are likely to be available in future over the lifetime of the project;

(b) Working Capital Management: Working capital management is concerned with the management of current assets. It is an important and integral part of financial management as short-term survival is a prerequisite for long-term success

(2) Financing Decision

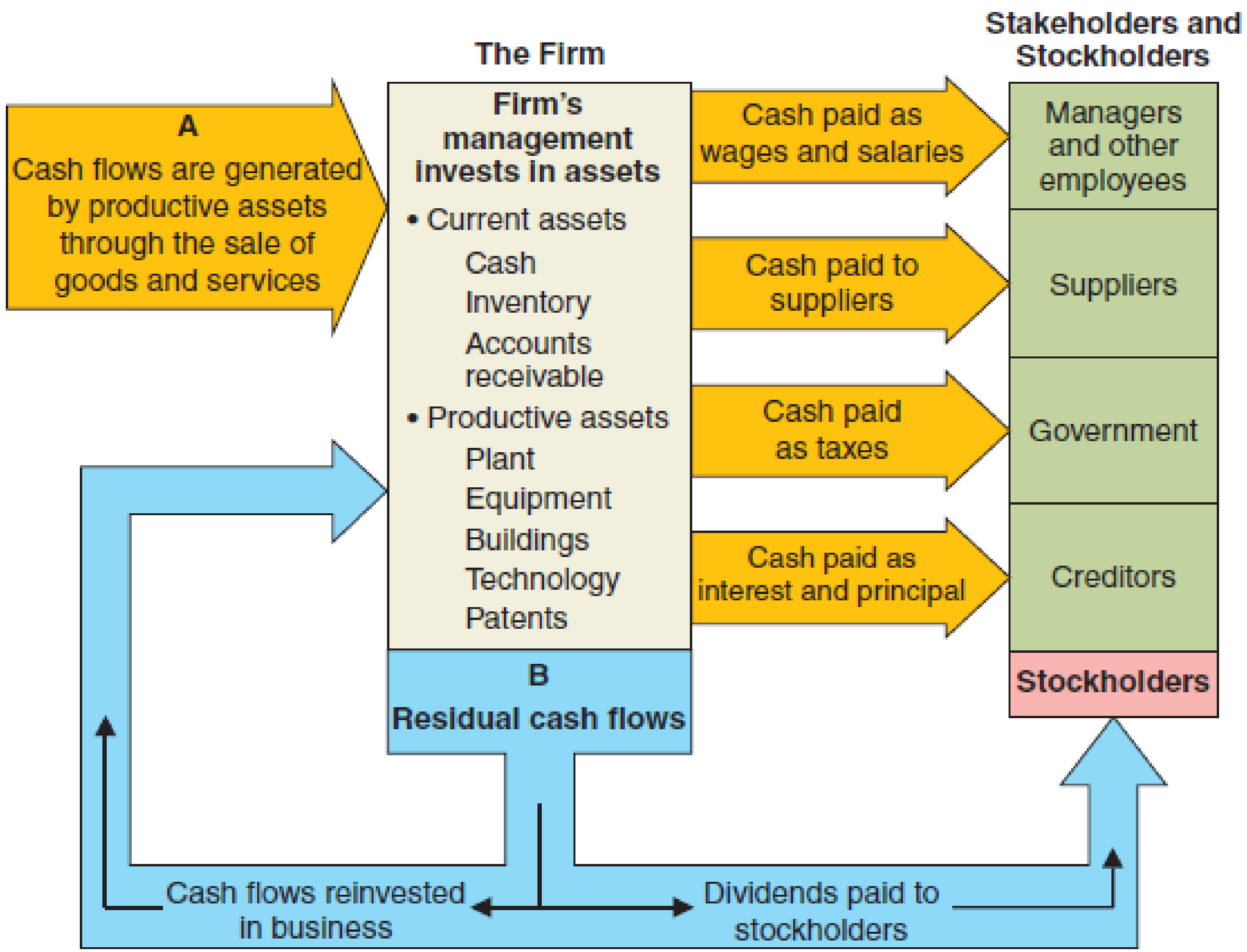
Financing decision relates to the choice of the proportion of debt and equity sources of financing. While the investment decision is broadly concerned with the asset-mix or the composition of the assets of a firm, the concern of the financing decision is with the financing-mix or capital structure or leverage. There is one major aspect of the financing decision, called the **optimum capital structure**

(3) Dividend Decision

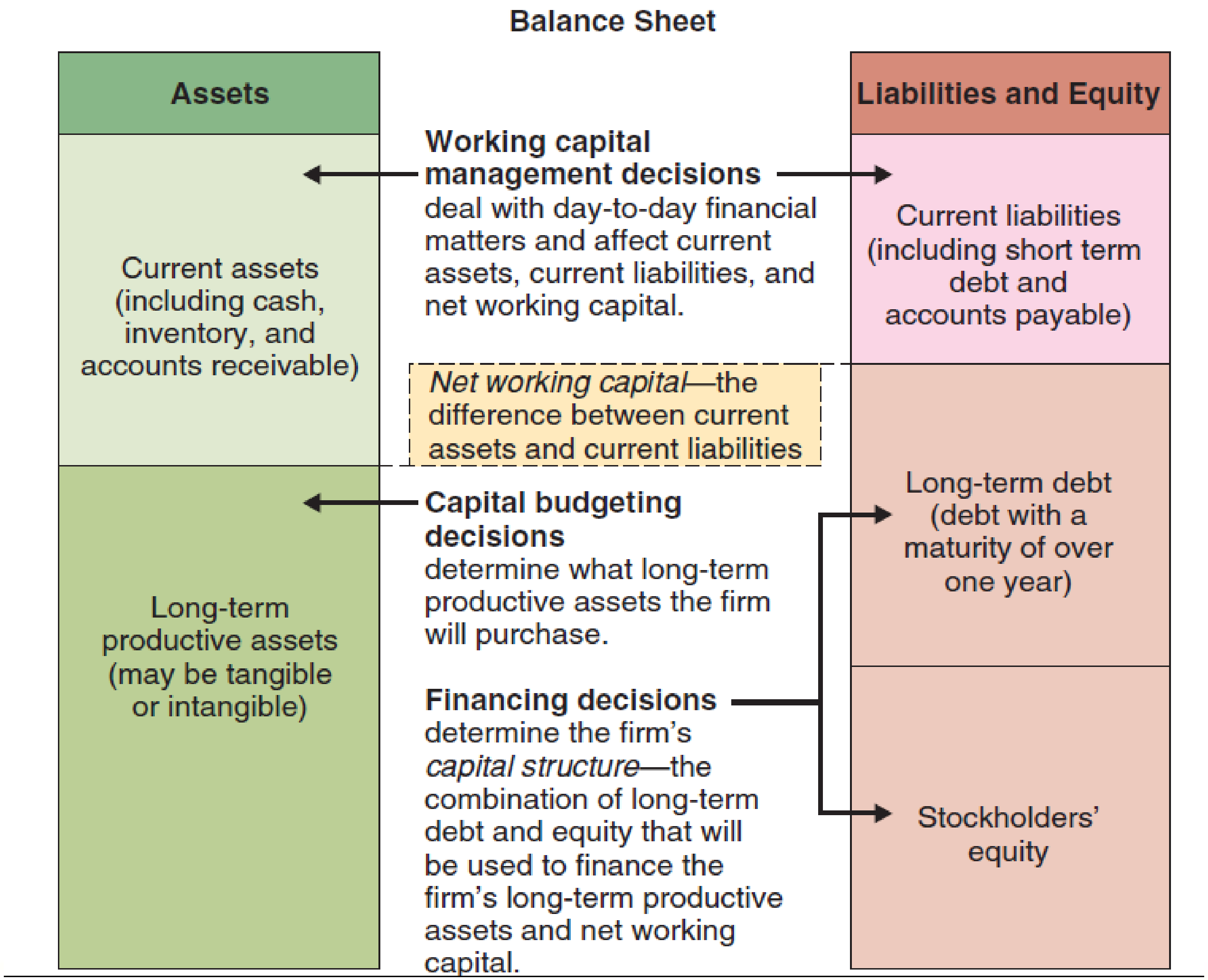
The dividend decision relates to the distribution and retention of net profits of a firm. The two alternatives available with the firm are:

(i) Net profits can be distributed to the shareholders in the form of dividends or (ii) they can be retained in the business itself. The decision as to which course should be followed depends largely on a significant element in the dividend decision, **the dividend-pay out ratio**, that is, what proportion of net profits should be paid out to the shareholders and what proportion should be retained in the business.

Cash Flows Between the Firm and Its Stakeholders and Owners (Stockholders)



Financial Decisions and its affect on the Balance Sheet of Firm

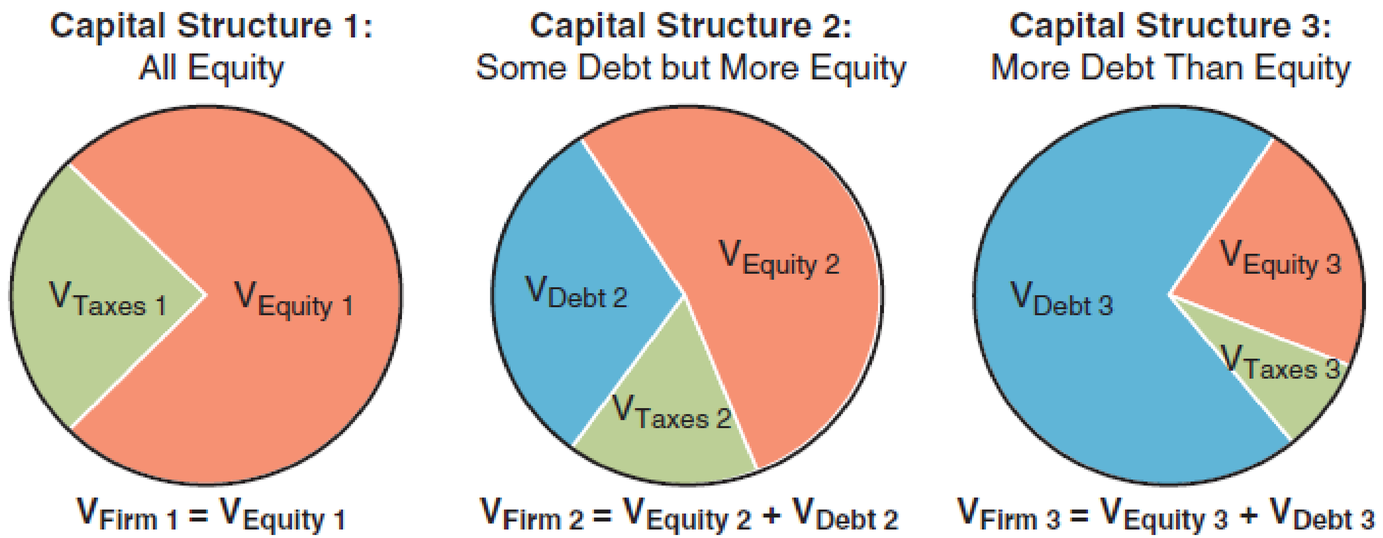


Trading on Equity/Financial Gearing:

Trading on equity (Financial leverage) is the use of borrowed funds in expectation of higher return to equity-holders:

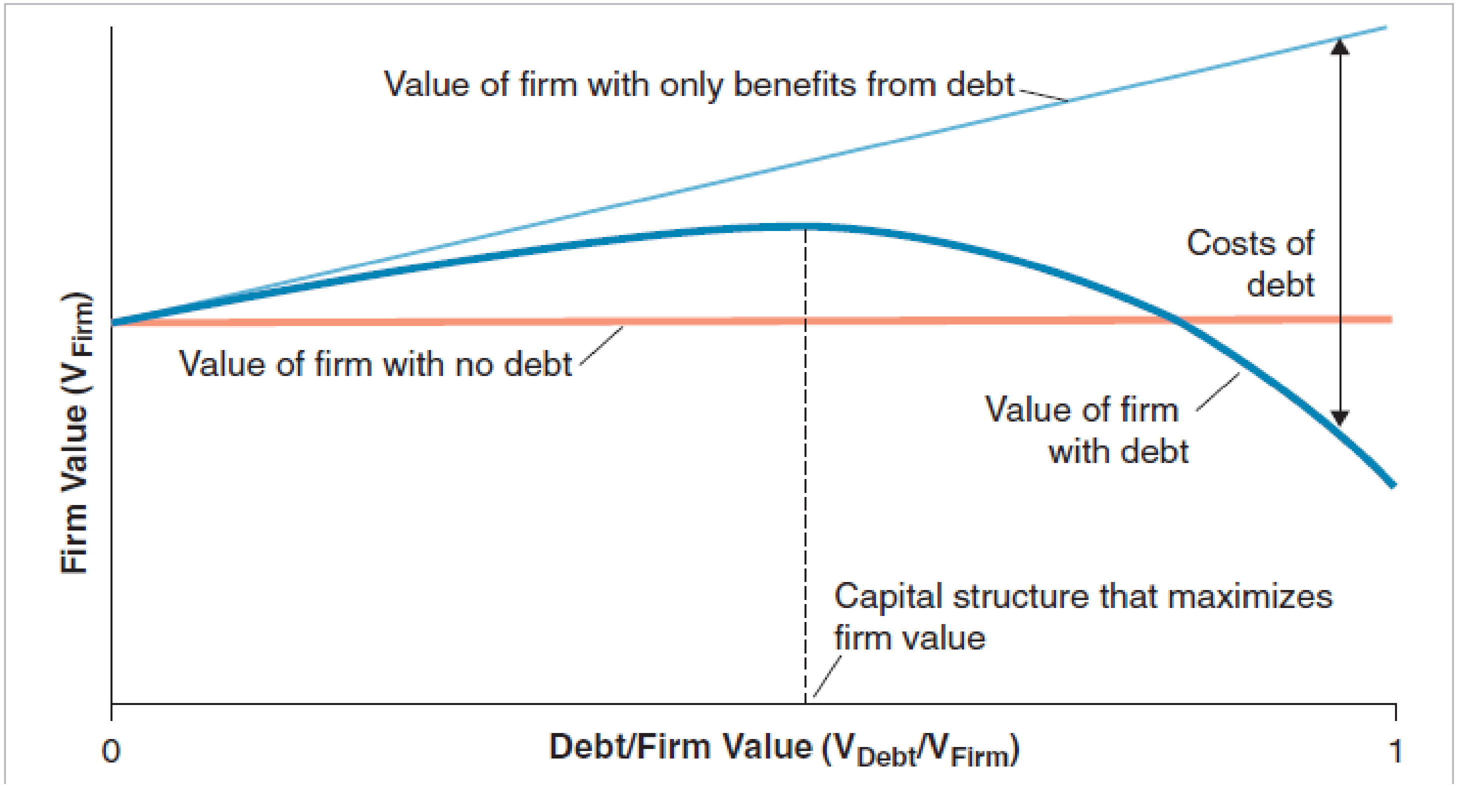
Trading on Equity	(Amount in $, thousand)			
Particular	**A**	**B**	**C**	**D**
(a) Total Assets	1,000	1,000	1,000	1,000
Financing Pattern:				
Equity Capital	1,000	800	600	200
Debt	—	200	400	800
(b) Operating Profit (EBIT)	300	300	300	300
Less: Interest (15%)	—	30	60	120
Earnings Before Taxes (EBT)	300	270	240	180
Less: Taxes (35%)	105	94.5	84	63
Earnings After Taxes (EAT)	195	175.5	156	117
Return on Equity [EAT/Equity](%)	19.5	21.9	26	58.5

Capital Structure and Firm Value with Taxes

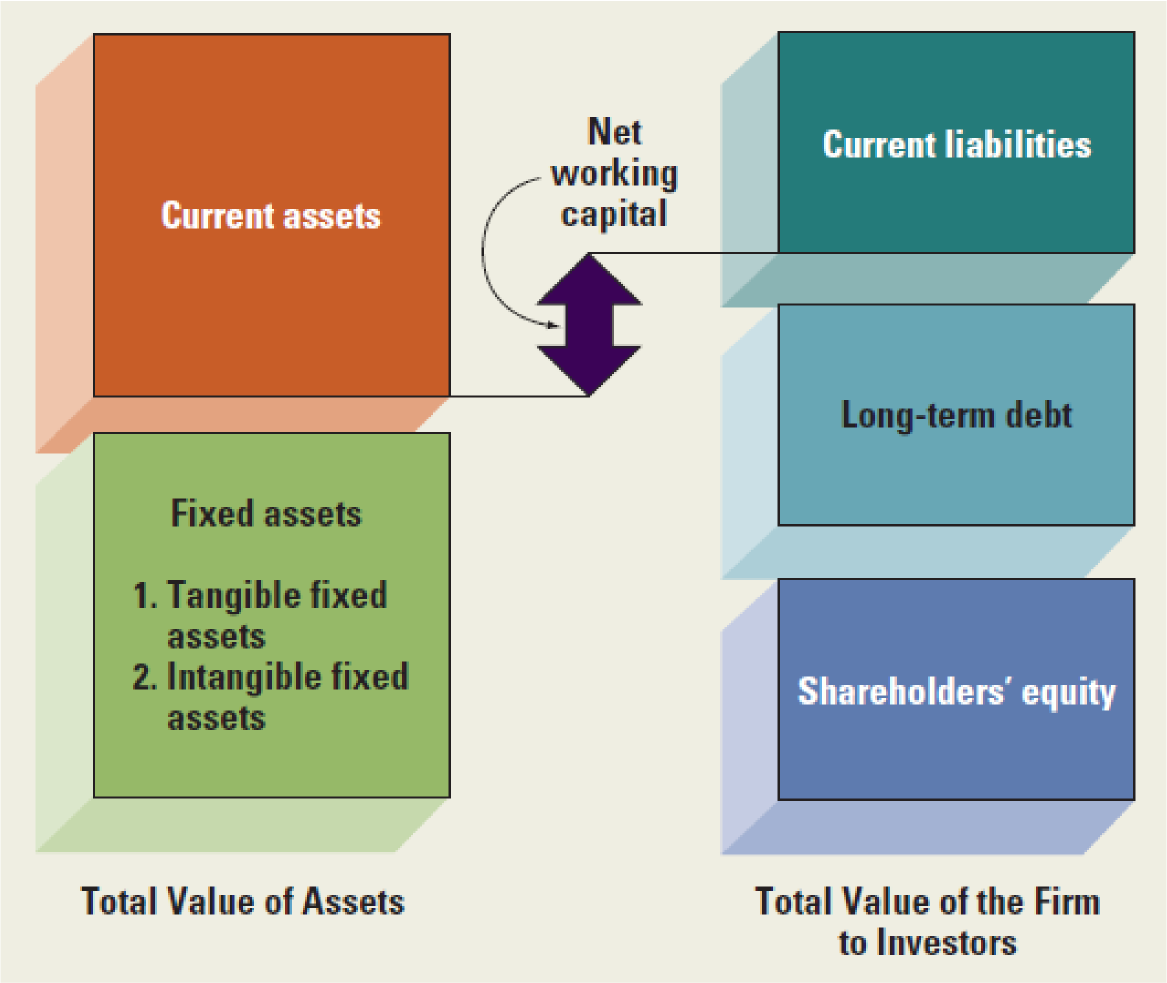


With taxes: $V_{Firm\ 1} < V_{Firm\ 2} < V_{Firm\ 3}$

Trade-Off of Capital Structure: The Benefits and Costs of Debt



The Balance-Sheet Model of the Firm



The Balance-Sheet Model of the Firm

Total Firm Value to Investors:

Shareholders' Equity

Long-Term Debt

Current Liabilities

Total Value of Assets:

Fixed Assets

1 Tangible

2 Intangible

Current Assets

The Balance-Sheet Model of the Firm

The Capital Budgeting and Working Capital Decision

Shareholders' Equity

Long-Term Debt

Current Liabilities

What Long-term investments should the firm engage in?

Fixed Assets

1 Tangible

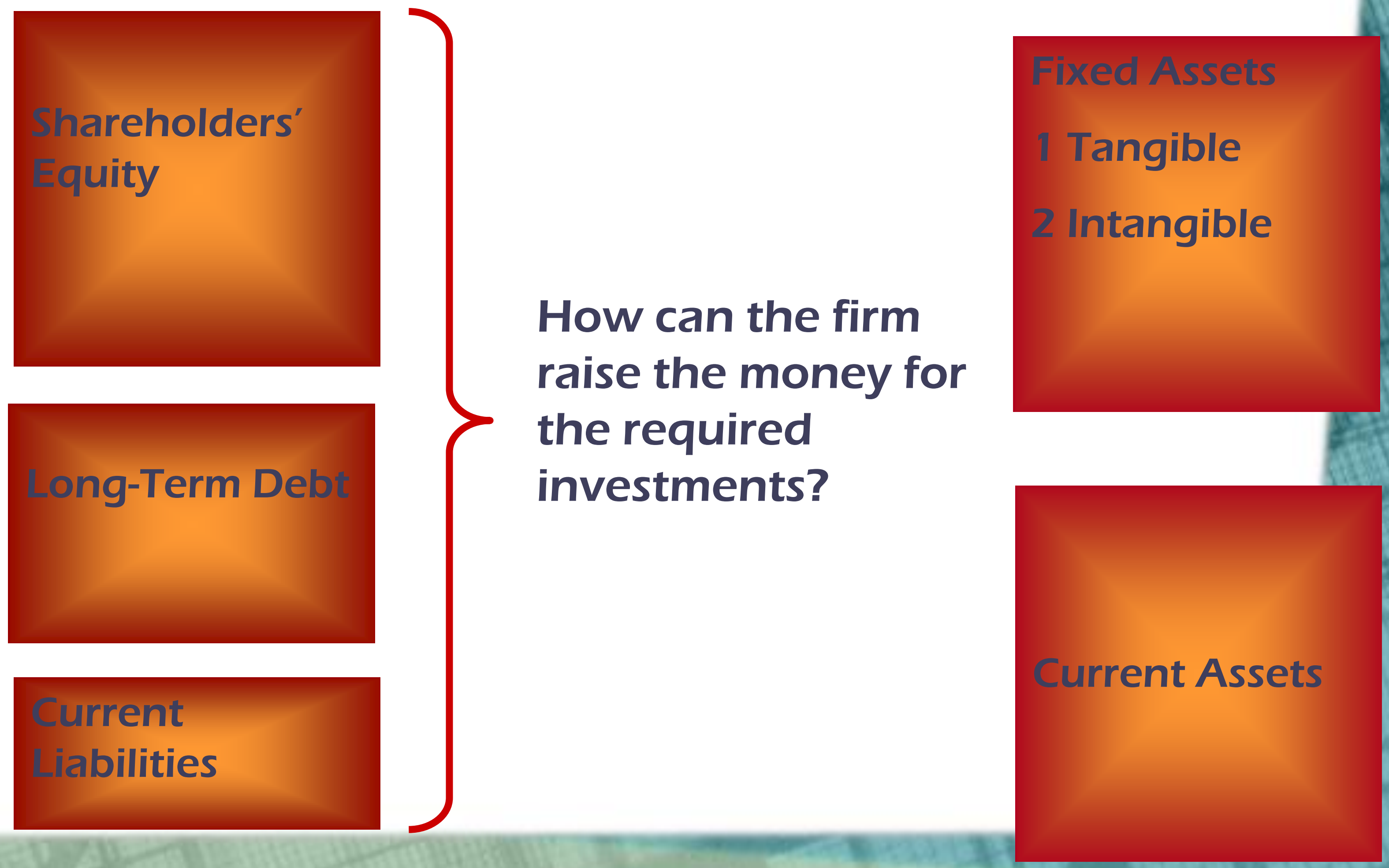
2 Intangible

What Short-term investments should the firm engage in?

Current Assets

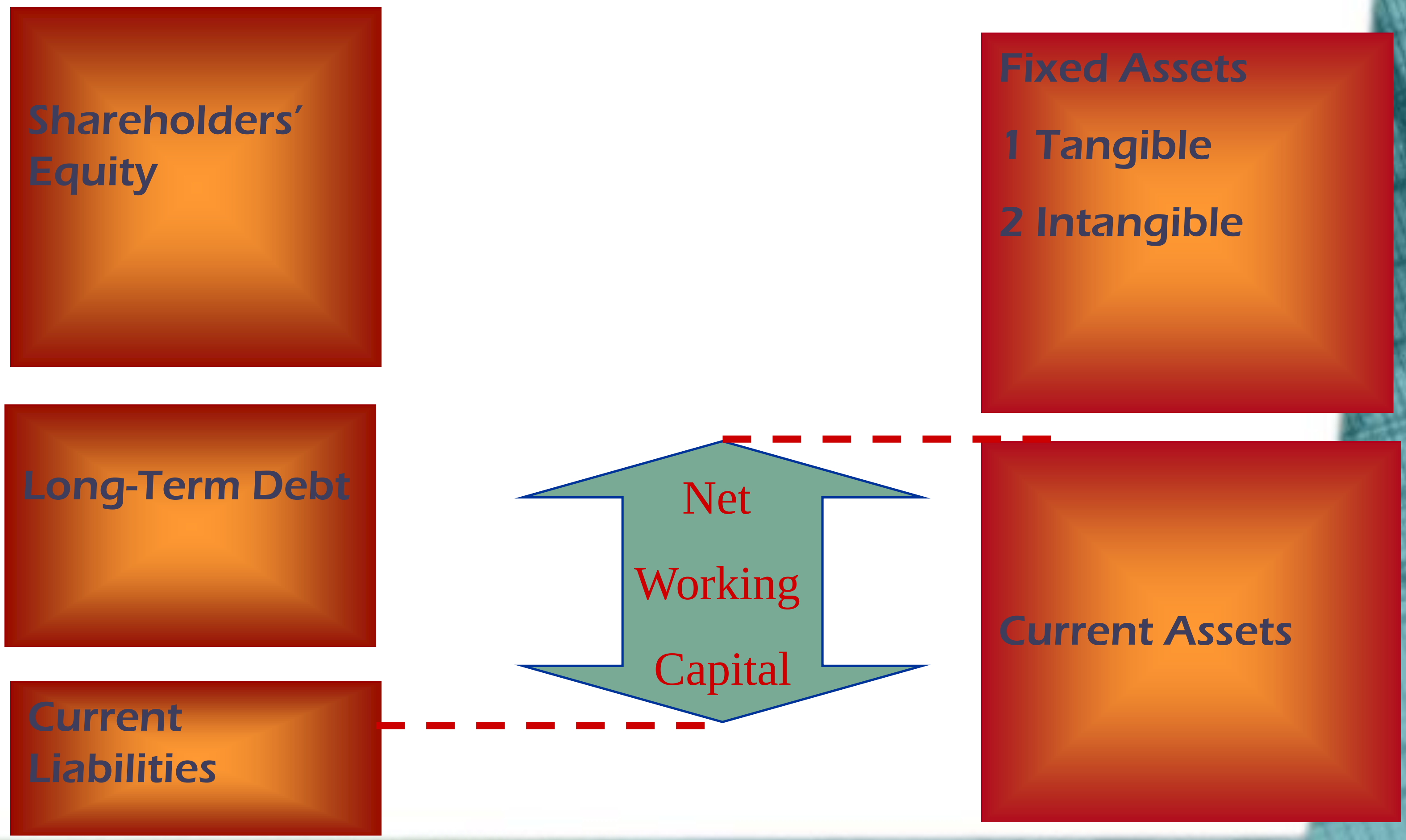
The Balance-Sheet Model of the Firm

The Financing Decision



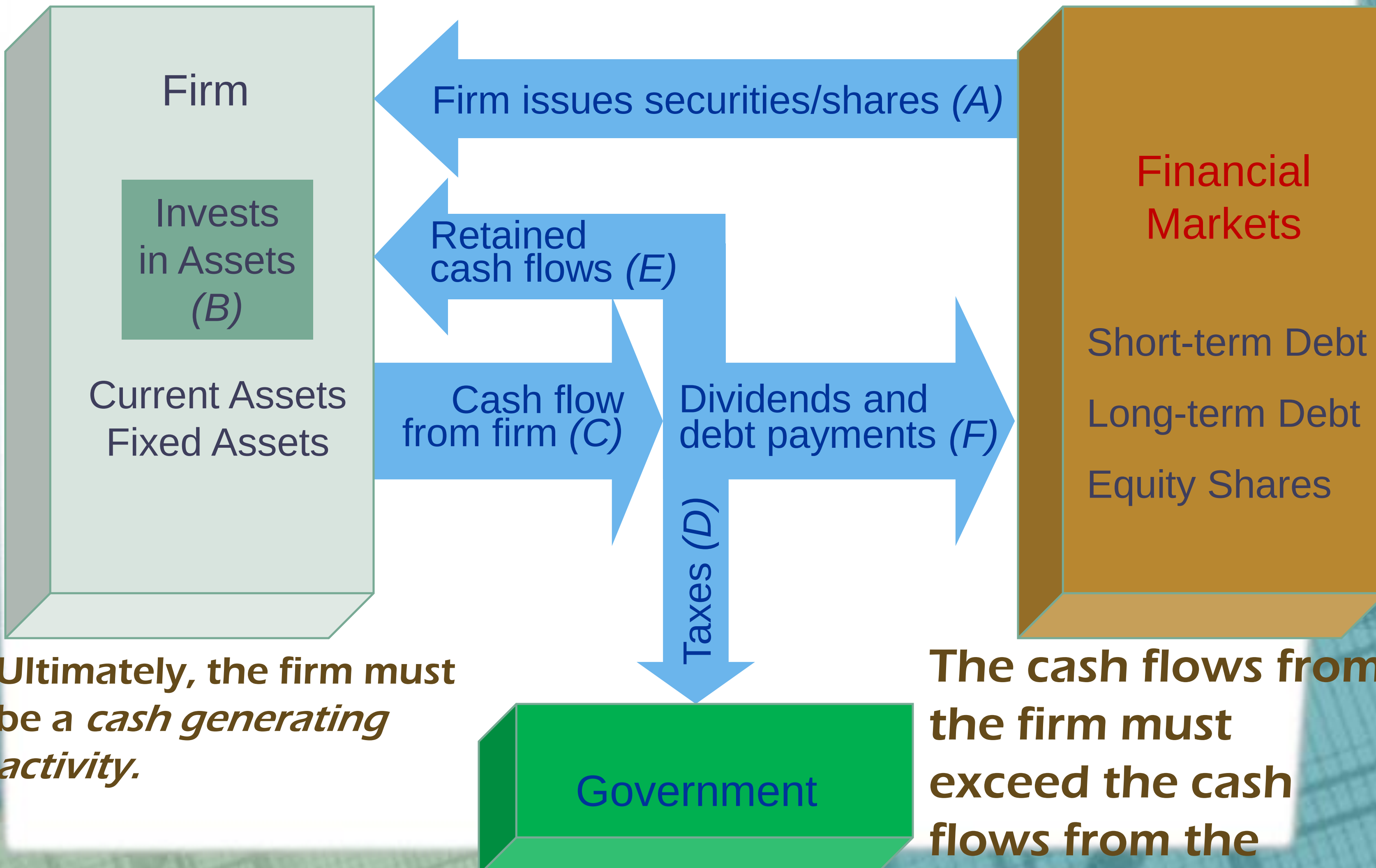
The Balance-Sheet Model of the Firm

The Net Working Capital Decision



The Firm and the Financial Markets

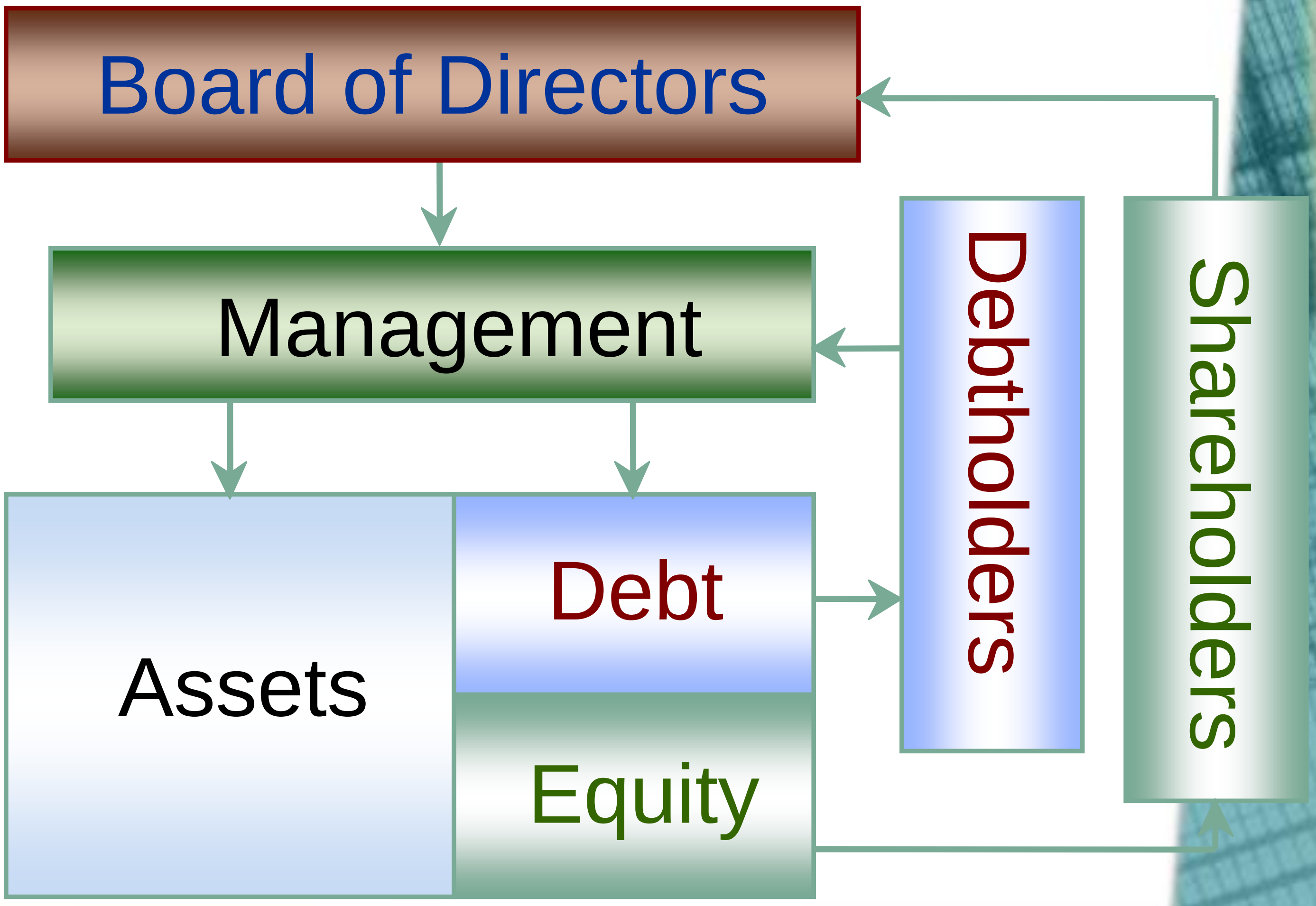
The Firm and the Financial Markets:



Ultimately, the firm must be a *cash generating activity.*

The cash flows from the firm must exceed the cash flows from the financial markets.

Separation of Ownership and Control: Agency Problem



Agency Problem

An agency problem results when managers as agents of owners (principal) place personal goals ahead of corporate goals.

Market forces and the threat of hostile takeover tend to act to prevent/minimise agency problems. In addition, firms incur agency costs in the form of monitoring and bonding expenditures, opportunity costs and structuring expenditures which involve both incentive and performance-based compensation plans to motivate management to act in the best interest of the shareholders.

VALUE AND CAPITAL BUDGETING

Time Value of Money

(Time Preference for Money)

Time value of money means that the value of a unit of money is different in different time periods. Money has time value.

A rupee/dollar today is more valuable than a rupee/dollar a year hence or a rupee/dollar a year hence has less value than a rupee/dollar today.

Money has, thus, a future value and a present value.

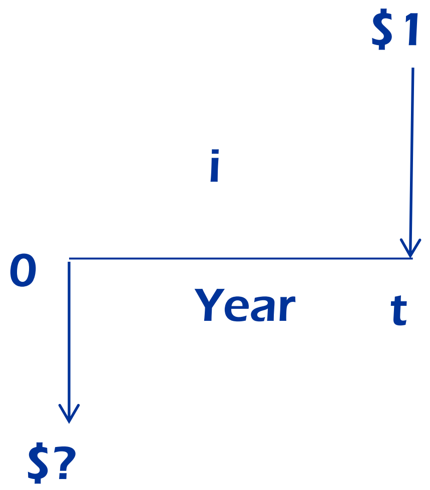
Time Preference for Money

Time preference for money is a preference for possession of a given amount of money now, rather than the same amount at some future time.

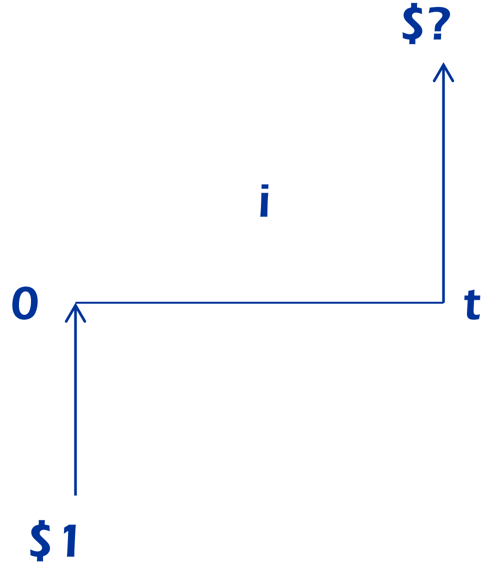
Three reasons may be attributed to the time preference for money:

- **Risk**
- **Preference for Consumption**
- **Investment Opportunities**

Discounting to calculate PV of an expected cash flow



Compounding to calculate FV of an expected cash flow



LEVEL CASH FLOWS:
ANNUITIES AND PERPETUITIES

Level Cash Flows: Some Simplifications

- Firms encounter contracts that call for the payment of ***equal*** amounts of cash over several time periods. For example, most business term loans and insurance policies require the holder to make a series of equal payments, usually monthly;
- Similarly, nearly all consumer loans, such as auto, personal, and home mortgage loans, call for equal monthly payments;
- Firms often need to compute the value of multiyear product or service contracts with cash flows that increase each year at a **constant rate**;
- Because many corporate finance problems are potentially time-consuming, some simplifications and simplifying formulas mainly classifying into four classes of cash flow streams are provided:
  - Annuity
  - Growing Annuity
  - Perpetuity
  - Growing Perpetuity

Level Cash Flows: Some Simplifications

- **Annuity:** Any financial contract that calls for equally spaced and level cash flows over a finite number of periods is called an annuity. Most annuities are structured so that cash payments are received at the end of each period. Because this is the most common structure, these annuities are often called ***ordinary annuities***;
- **Growing Annuity:** A stream of cash flows that grows at a ***constant*** rate for a fixed number of periods;
- **Perpetuity:** If the cash flow payments continue forever, the contract is called a perpetuity. Specifically, a perpetuity is a constant stream of cash flows that goes on forever;
- **Growing Perpetuity:** A stream of cash flows that grows at a ***constant*** rate forever.

Annuity: Calculations

- Calculating PV of Annuity;
- Calculating Monthly and Yearly Payments;
- Preparing a Loan Amortization Table;
- Finding Interest Rate;
- Calculating Delayed Annuity;
- Calculating Annuity Due (Advance);
- Calculating FV of Annuity;
- Calculating PV of Growing Annuity;

Preparing a Loan Amortization Schedule

Preparing a Loan Amortization Schedule

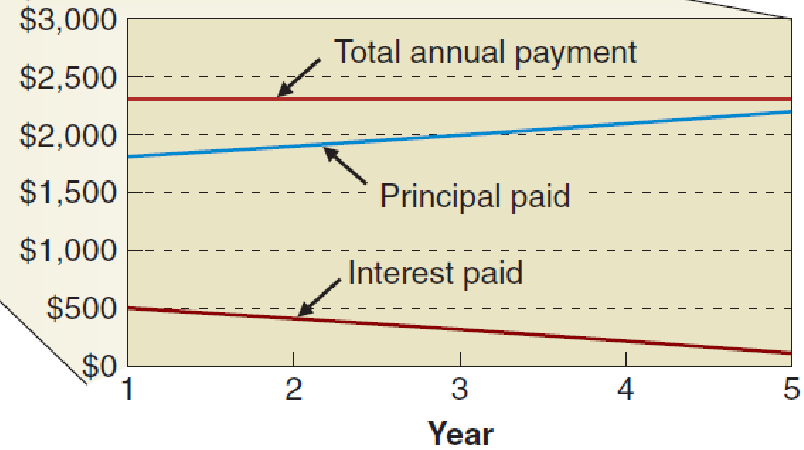
- **Amortization:** The term *amortization* describes the way in which the principal (the amount borrowed) is repaid over the life of a loan
  - With an amortizing loan, some portion of each month's loan payment goes to paying down the principal;
  - The other portion of each loan payment is interest, which is payment for the use of outstanding principal (the amount of money still owed);
  - When the final loan payment is made, the unpaid principal is reduced to zero and the loan is paid off;
  - Thus, with an amortizing loan, each loan payment contains some repayment of principal and an interest payment
- **Loan Amortization Schedule:** It is a table that shows the loan balance at the beginning and end of each period, the payment made during that period, and how much of that payment represents interest and how much represents repayment of principal

Preparing a Loan Amortization Schedule

Illustration: Suppose that a firm has borrowed $10,000 at a 5% interest rate from a bank to purchase a fixed asset. For simplicity, we will assume that the bank allows the firm to make annual payments and that the loan will be repaid over five years.

Amortization Table for a Five-Year, $10,000 Loan at 5% Interest

Year	(1) Beginning Principal Balance	(2) Total Annual Payment[a]	(3) Interest Paid[b]	(4) Principal Paid (2)–(3)	(5) Ending Principal Balance (1)–(4)
1	$10,000.00	$2,309.75	$500.00	$1,809.75	$8,190.25
2	8,190.25	2,309.75	409.51	1,900.24	6,290.02
3	6,290.02	2,309.75	314.50	1,995.25	4,294.77
4	4,294.77	2,309.75	214.74	2,095.01	2,199.76
5	2,199.76	2,309.75	109.99	2,199.76	0.00



[a]The total annual payment is calculated using the formula for the present value of an annuity, Equation 6.1. The total annual payment is CF in $PVA_n = CF \times PV$ annuity factor.

[b]Interest paid equals the beginning balance times the interest rate.

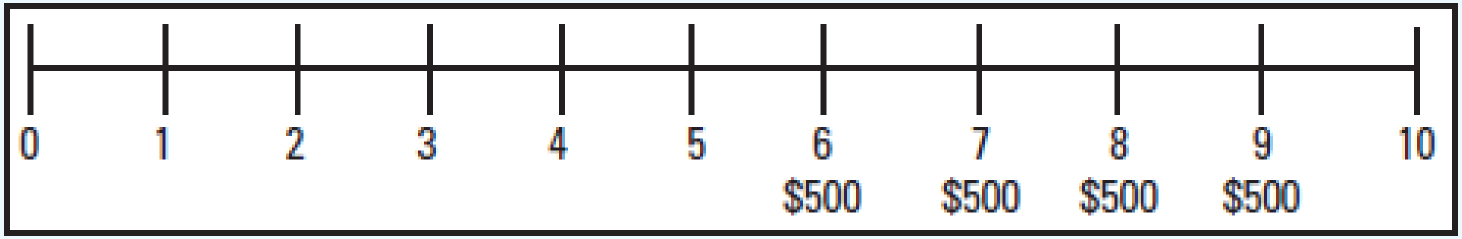
Notice that the interest paid declines with each payment, while the principal paid increases

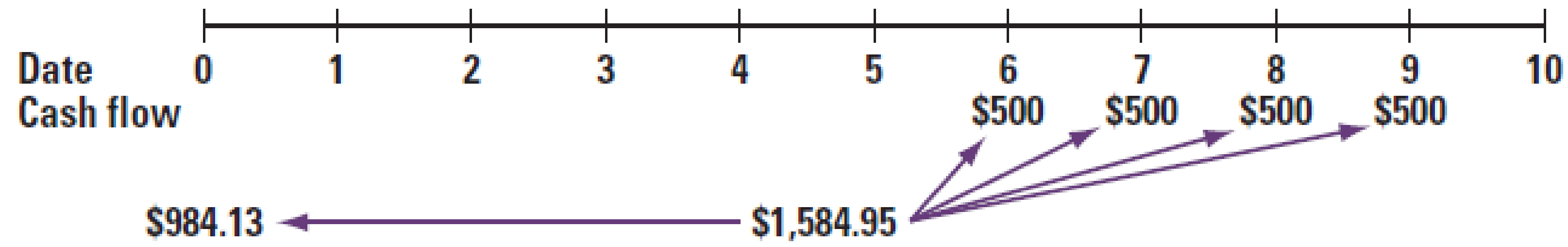
Finding the Interest Rate

A Delayed Annuity

A Delayed Annuity: A DELAYED annuity begins at a date many periods in the future

Example: Daniel will receive a four-year annuity of $500 per year, beginning at date 6. If the interest rate is 10%, what is the present value of his annuity?





Step one: Discount the four payments back to date 5 by using the annuity formula.
Step two: Discount the present value at date 5 ($1,584.95) back to present value at date 0.

Annuities Due (Advance)

Annuities Due (Advance): An annuity in which payments are made at the beginning of each period. Cash payments start immediately, at the beginning of the first period. For example, when you rent an apartment, the first rent payment is typically due immediately. The second rent payment is due the first of the second month, and so on. In this kind of payment pattern, you are effectively prepaying for the service. In other words, you will have to calculate the value of an annuity that begins today, at Date 0?

Annuity Transformation Method: An easier way to work annuity due problems is to transform the formula for the ***present value of an annuity (PVA)***, so that it will work for annuity due problems. ***To do this, we pretend that each cash flow occurs at the end of the period (although it actually occurs at the beginning of the period) and use PVA formula.*** Since PVA formula discounts each cash flow by one period too many, we then correct for the extra discounting by multiplying our answer by (1+i), where i is the discount rate or interest rate

The relation between an **ordinary annuity** and an **annuity due** can be formally expressed as: $\text{Annuity due value} = \text{Ordinary annuity value} \times (1 + i)$

Annuity Transformation Method: Three Steps

The value of an annuity due using PVA involves three steps:

1. Adjust the problem time line as if the cash flows were an ordinary annuity;

2. Calculate the present value of the annuity as if the cash flows are like an ordinary annuity;

3. Finally, multiply the answer by $(1+i)$

Future Value of an Annuity

- Future Value of an Annuity is the value of an annuity at some point in the future. Generally, when we are working with annuities, we are interested in computing their present value. On occasion, though, we need to compute the future value of an annuity (FVA)
- Such computations typically involve some type of saving activity, such as a monthly savings plan. Example-Sinking Fund
- **Sinking Fund:** A sinking fund is a fund created by a corporation by setting aside a fixed sum of revenue over a period of time to fund a future capital expenditure, or repayment of a long-term debt
  - Illustration: The CFO of Mahindra Company invests $10,000 at the end of each month into a sinking fund to accumulate capital for new equipment that will be purchased at the end of two years. The money invested will earn interest at a 5 percent annual rate, compounded monthly. How much will be available in the sinking fund at the end of two years?
- Another application is computing terminal values for retirement or pension plans with constant contributions.

Cash Flows that Grow at a Constant Rate: Growing Annuity

Growing Annuity: An annuity in which the cash flows increase at a constant rate. Financial managers often need to compute the value of multiyear product or service contracts with cash flows that increase each year at a constant rate. For example, the business firm may want to value the cost of a 25-year lease that adjusts annually for the expected rate of inflation over the life of the contract

The following formula is used to compute the present value of an annuity growing at a constant rate for a finite time period:

$$PVA_n = \frac{CF_1}{i-g} \times \left[1 - \left(\frac{1+g}{1+i}\right)^n\right]$$

where,

PVA_n = present value of a growing annuity with n periods

CF_1 cash flow one period in the future (t =1)

i = interest rate, or discount rate

g = constant growth rate per period

Calculation of Growing Annuity: Some important points

1. The cash flow (CF_1) used is not the cash flow for the current period (CF_0), but is the cash flow to be received in the next period (t=1). The relation between these two cash flows is $CF_1=CF_0(1+g)$.

2. A necessary condition for using growing annuity formula is that $i>g$. If this condition is not met ($i \leq g$) the calculations from the equation will be meaningless, as you will get a negative or infinite value for finite positive cash flows.

Perpetuity

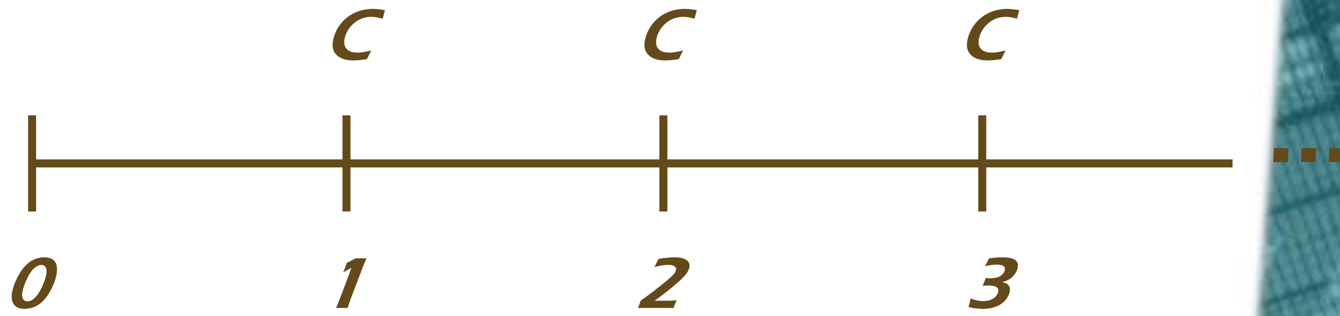
Perpetuity: A constant stream of cash flows that lasts forever without end. From PVA formula, one can calculate the present value of a perpetuity (PVP) by setting *n*, which is the number of periods, equal to infinity (∞). When that is done, the value of the term $\mathbf{1/(1+\mathit{i})^{\infty}}$ approaches 0, and thus the value of a perpetuity that begins NEXT period (PVP) equals:

$$\begin{aligned} \text{PVP} &= \frac{\text{CF}}{i} \times \left[1 - \frac{1}{(1+i)^{\infty}}\right] \\ &= \frac{\text{CF}}{i} \times [1 - 0] \\ &= \frac{\text{CF}}{i} \end{aligned}$$

Note: Conversely, we can derive the formula for the present value of an ordinary annuity from the formula for a perpetuity.

Perpetuity

A constant stream of cash flows that lasts forever without end.



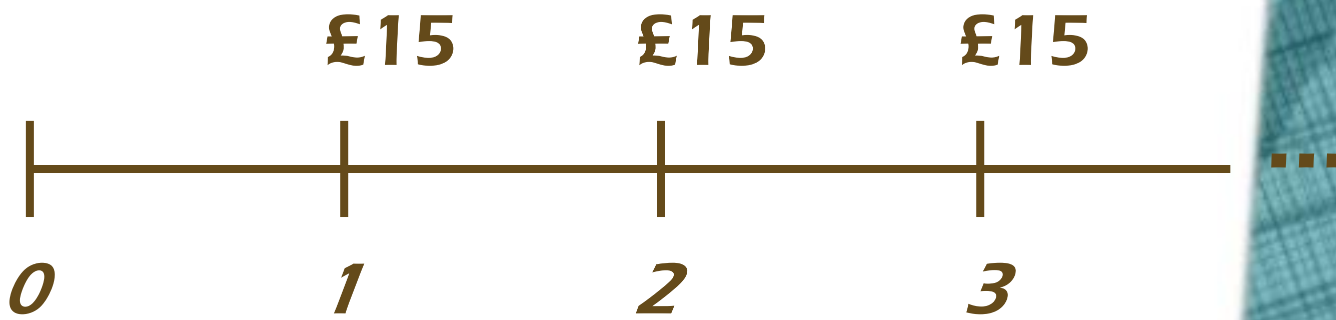
$$PV = \frac{C}{1+r} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \cdots$$

The formula to calculate the present value of a perpetuity that begins next period is:

$$PV = \frac{C}{r}$$

Perpetuity: Example

What is the value of a British Consol that promises to pay £15 each year, every year until the sun turns into a red giant and burns the planet to a crisp if the interest rate is 10-percent?



$$PV = \frac{£15}{0.10} = £150$$

Growing Perpetuity

- **Growing Perpetuity:** A cash flow that grows at a constant rate forever. Sometimes cash flows are expected to grow at a constant rate indefinitely. The formula to compute the present value for a growing perpetuity that begins next period (PVP) is as follows:

$$\text{PVP} = \frac{\text{CF}_1}{i - g}$$

- As before, CF_1 is the cash flow occurring at the end of the first period, i is the discount or interest rate, and g is the constant rate of growth of the cash flow (CF).

Growing Perpetuity: Example

Paying Dividends Popovich Corporation is *just about* to pay a dividend of $3.00 per share. Investors anticipate that the annual dividend will rise by 6 percent a year forever. The applicable discount rate is 11 percent. What is the price of the stock today?

The numerator in Equation 4.12 is the cash flow to be received next period. Since the growth rate is 6 percent, the dividend next year is $3.18 (=$3.00 × 1.06). The price of the stock today is:

$$\$66.60 = \underbrace{\$3.00}_{\text{Imminent dividend}} + \underbrace{\frac{\$3.18}{.11 - .06}}_{\text{Present value of all dividends beginning a year from now}}$$

The price of $66.60 includes both the dividend to be received immediately and the present value of all dividends beginning a year from now. Equation 4.12 makes it possible to calculate only the present value of all dividends beginning a year from now. Be sure you understand this example; test questions on this subject always seem to trip up a few of our students.

Growing Perpetuity: Example

To illustrate a growing perpetuity, we will consider an example. Suppose that you and a partner, after graduating from college, started a health and athletic club. Your concept included not only providing workout facilities, such as weights, treadmills, and elliptical trainers, but also promoting a healthy lifestyle through a focus on cooking and nutrition. The concept has proved popular, and after only five years, you have seven clubs in operation. Your accountant reports that the firm's cash flow last year was $450,000, and the appropriate discount rate for the club is 18 percent. You expect the firm's cash flows to increase by 5 percent per year, which includes 2 percent for expected inflation. Since the business is a corporation, you can assume it will continue operating indefinitely into the future. What is the value of the firm?

We can use Equation 6.6 to solve this problem. Although the equation is very easy to use, a common mistake is using the current period's cash flow (CF_0) and not the *next* period's cash flow (CF_1). Since the cash flow is growing at a constant growth rate, g, we simply multiply CF_0 by $(1 + g)$ to get the value of CF_1. Thus,

$$CF_1 = CF_0 \times (1 + g)$$

We can then substitute the result into Equation 6.6, which yields a helpful variant of this equation:

$$PVP = \frac{CF_1}{i - g} = \frac{CF_0 \times (1 + g)}{i - g}$$

Now we can insert the values for the health club into the equation and solve for PVP:

$$\begin{aligned} PVP &= \frac{CF_0 \times (1 + g)}{i - g} \\ &= \frac{\$450{,}000 \times (1 + 0.05)}{0.18 - 0.05} \\ &= \$3{,}634{,}615 \end{aligned}$$

The business is worth $3,634,615.

Growing Perpetuity: Example

- IBM is *just about* to pay a dividend of $3.00 per share. Investors anticipate that the annual dividend will rise by 6 percent a year forever. The applicable discount rate is 11 percent. What is the price of the stock today?

Growing Perpetuity: Example

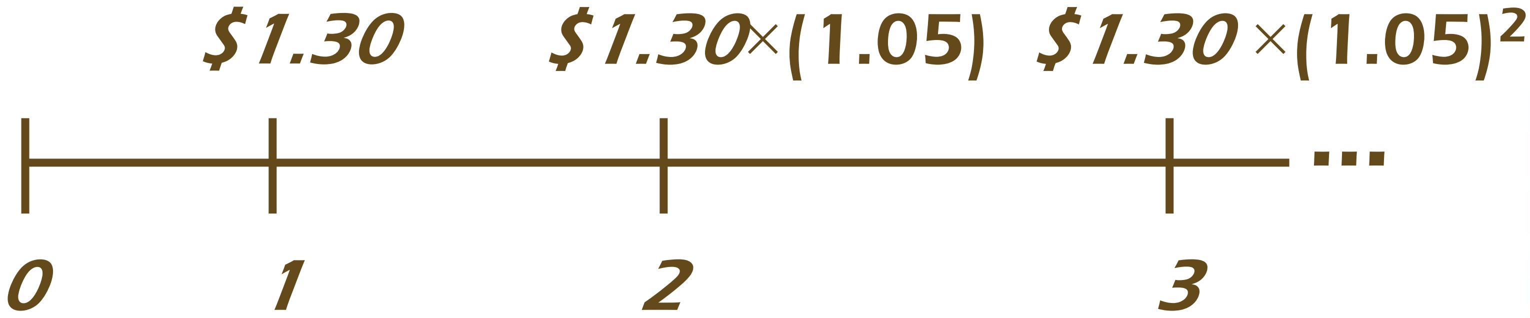
Ans. Since the growth rate is 6 percent, the dividend next year is \$3.18 (\$3.00*1.06). The price of the stock today is:

$$\underset{}{\$66.60} = \underbrace{\$3.00}_{\substack{\text{Imminent}\\ \text{dividend}}} + \underbrace{\frac{\$3.18}{.11 - .06}}_{\substack{\text{Present value of all}\\ \text{dividends beginning}\\ \text{a year from now}}}$$

- The price of \$66.60 includes both the dividend to be received immediately and the present value of all dividends beginning a year from now. The growing perpetuity formula makes it possible to calculate only the present value of all dividends (cash flows) beginning a year from now.

Growing Perpetuity: Example

The expected dividend next year is $1.30 and dividends are expected to grow at 5% forever. If the discount rate is 10%, what is the value of this promised dividend stream?



$$PV = \frac{\$1.30}{.10 - .05} = \$26.00$$

Excel Functions

Solving for	Formula
Present Value	= PV(RATE, NPER, PMT, FV)
Future Value	= FV(RATE, NPER, PMT, PV)
Discount Rate	= RATE(NPER, PMT, PV, FV)
Payment	= PMT(RATE, NPER, PV, FV)
Number of Periods	= NPER(RATE, PMT, PV, FV)

CAPITAL BUDGETING:
LONG-TERM INVESTMENT DECISIONS

CAPITAL BUDGETING

Capital Budgeting: Process of planning expenditures that give rise to revenues or returns over a number of years in future

Capital budgeting is generally used for the following:

- Purchase of Plant and machinery and equipment;
- Replacement of worn-out capital and equipment;
- Expansion of production facilities;
- Entering entirely new product lines;
- Planning major advertising campaigns;
- Employee training programs;
- Research and development;
- Decisions to purchase or rent production facilities, sites.

Categories of Investment Projects: Firms

1. Replacement: Investments to replace equipment that is worn-out in the production process;

2. Cost Reduction: Investments to replace working but obsolete equipment with new and more efficient equipment, expenditures for training programs aimed at reducing labor costs and expenditures to move production facilities to areas where labor and other inputs are cheaper;

3. Output Expansion to accommodate Demand Increases: Investments to expand production facilities in response to increased demand for the firm's traditional products and in traditional or existing markets;

4. Output Expansion for New Products and New Markets: Investments to develop, produce and sell new products and/or enter new markets;

5. Government Regulation: Investments made to comply with government regulations. These include investment projects required to meet government health and safety regulations, pollution control, and to satisfy other legal requirements.

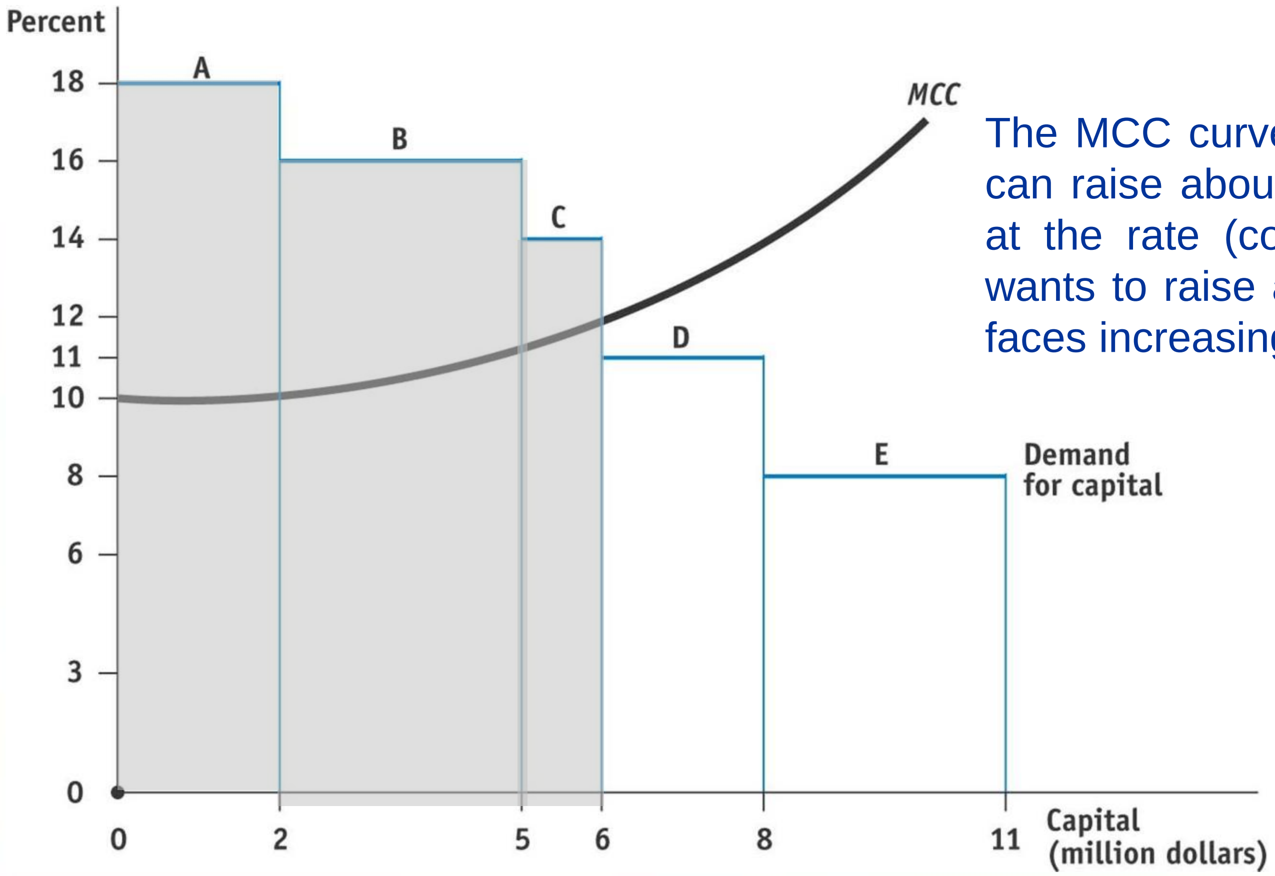
Capital Budgeting Process: General Principle

- **General Principle:** Capital budgeting is essentially an application of the general principle that a firm should produce the output or undertake an activity until the marginal revenue from the output or activity is equal to its marginal cost. Specifically, this principle implies that the firm should undertake additional investment projects until the marginal return from the investment is equal to its marginal cost;
- **Demand for Capital:** The schedule of investment projects open to the firm, arranged from the one with the highest to lowest return, represents the firm's demand for capital;
- **Supply of Capital:** The marginal cost of capital (MCC) schedule, gives the cost that the firm faces in obtaining additional amounts of capital for investment purposes. The MCC increases as the firm wants to raise the additional amount of capital as it faces increasingly higher costs.

Capital Budgeting Process: General Principle

The top of each bar represents the firm's demand for capital

Firm will undertake projects A, B, and C



The MCC curve shows that the firm can raise about $2 million of capital at the rate (cost) of 10%, but if it wants to raise additional amounts, it faces increasingly higher costs.

Capital Budgeting: A Summary

1. **Initial Capital Outlay:** A typical project involves making an initial CAPITAL OUTLAY (expenditures like cost of purchasing and installing new equipment, reorganizing the firm's production processes, and providing additional working capital for inventory and other associated labor costs) which is expected to generate a series of net cash inflows over the life of the project;
2. **Cash Inflows:** The cash inflows are the *incremental sales revenues* generated by the project plus the salvage value of the equipment at the end of its economic life (if any) and recovery of working capital at the end of the project;
3. **Cash Outflows:** The cash outflows are the *incremental variable costs*, *fixed costs and taxes* resulting from the project;
4. **Net Cash Flows (*after-tax free cash flows*):** Net Cash Flows is equal to CASH INFLOWS minus CASH OUTFLOWS in each year during the life of the project

Guidelines in Estimating the Net Cash Flows

Projecting Net Cash Flows: It is the difference between cash inflows (receipts) and cash outflows (expenditures) over the life of the project. Since cash flows occur in the future, a great deal of uncertainty is involved in their estimation. Generally, the following guidelines must be followed in estimating cash flows:

-Incremental After-Tax (free) Cash Flows: The term incremental refers to the fact that these cash flows reflect how much the firm's ***total after-tax free cash flows*** will change if the project is adopted. Thus, the incremental after-tax free cash flows (FCF) for a project is defined as the ***total after-tax free cash flows the firm would produce with the project, LESS the total after-tax free cash flows the firm would produce without the project*** (The difference between a firm's future cash flows with a project and those without the project)

$$\mathbf{FCF_{project} = FCF_{Firm\ with\ project} - FCF_{Firm\ without\ project}}$$

-After-tax Basis: Incremental Net Cash flows must be estimated on an after-tax basis using the firm's marginal tax rate

-Depreciation: Depreciation expenses should be added since it is a non-cash expense that affects cash flows through its effect on taxes

Guidelines in Estimating the Net Cash Flows

THE STAND-ALONE PRINCIPLE

The Stand-alone Principle: It would be cumbersome to actually calculate the total future total after-tax cash flows to the firm with and without a project, especially for a large firm. Fortunately, it is not really necessary to do so. Once we identify the effect of undertaking the proposed project on the firm's cash flows, we need to focus only on the project's resulting incremental cash flows. This is called the ***stand-alone principle***. The principle that allows us to treat each project as a standalone firm during capital budgeting analysis

What the stand-alone principle says is that once we have determined the incremental cash flows from undertaking a project, we can view that project as a kind of "minifirm" with its own future revenues and costs, its own assets, and, of course, its own cash flows. We will then be primarily interested in comparing the cash flows from this minifirm to the cost of acquiring it. An important consequence of this approach is that we will be evaluating the proposed project purely on its own merits, in isolation from any other activities or projects.

Guidelines in Estimating the Net Cash Flows

The Free Cash Flow Calculation

Explanation	Calculation	Formula
The change in the firm's cash income, excluding interest expense, resulting from the project.	Revenue	Revenue
	−Cash operating expenses	−Op Ex
	Earnings before interest, taxes, depreciation, and amortization	EBITDA
	−Depreciation and amortization	−D&A
	Operating profit	EBIT
	× (1 − Firm's marginal tax rate)	$\times(1 - t)$
	Net operating profit after tax	NOPAT
Adjustments for the impact of depreciation and amortization and investments on FCF.	+ Depreciation and amortization	+D&A
	Cash flow from operations	CF Opns
	− Capital expenditures	−Cap Exp
	− Additions to working capital	−Add WC
	Free cash flow	FCF

The formula for the FCF calculation can also be written as:

$$FCF = [(\text{Revenue} - \text{Op Ex} - \text{D\&A}) \times (1 - t)] + \text{D\&A} - \text{Cap Exp} - \text{Add WC}$$

where Revenue is the incremental revenue (net sales) associated with the project, D&A is the incremental depreciation and amortization associated with the project, and t is the firm's marginal tax rate

Capital Budgeting (Evaluation) Techniques

Capital Budgeting Techniques

Discounted Cash Flow (DCF) Techniques

1. NPV Method
2. IRR Method
3. Profitability Index Method
4. Discounted payback period Method

Traditional Techniques

1. The Payback Period Method
2. The Average Accounting Return

DCF TECHNIQUES

I. Net Present Value

- One way of deciding whether the firm should accept or reject an investment project is to determine the *Net Present Value (NPV)* of the project
- NPV of a project is the difference between the present value of expected net cash inflows and the present value of cash outflows (initial cost)

Decision (NPV) Rule:

Accept	Reject
Accept if the NPV of a project is positive or is greater than zero	**Reject if the NPV of a project is negative or is less than zero**

Net Present Value

$$NPV = -C_0 + \sum_{t=1}^{n} \frac{C_t}{(1+i)^t}$$

where

C_0 = Initial Cash Outflow of the project;

C_t = Estimated Net Free Cash Inflow at time 't' from the project;

i = Discount Rate

II. Internal Rate of Return (IRR)

- Another method of determining whether a firm should accept an investment project is to calculate the internal rate of return on the project
- The IRR on a project is the discount rate that *equates the present values of the expected net cash flows from the project to the initial cost of the project*

Internal Rate of Return (IRR)

$$C_0 = \sum_{t=1}^{n} \frac{C_t}{(1+i)^t}$$

where C_0 = Initial Cash Outflow of the project;
C_t = Estimated Net Free Cash Inflow at time ‘t’ of the project
i = IRR

In general, the IRR is the rate that causes the NPV of the project to be zero suggesting that the firm should be equally willing to accept or reject the project. The firm should accept the project if the discount rate is below IRR. The firm should reject the project if the discount rate is above IRR

Basic (IRR) Rule:

Accept	Reject
Accept if the IRR of a project is greater than or is equal to the discount rate	**Reject if the IRR of a project is less than the discount rate**

Note: IRR does not depend on the interest rate prevailing in the capital market. It solely depends on the expected net cash flows from the project given an initial investment outlay. Therefore, known as internal rate of return; the number is internal or intrinsic to the given project.

Calculation of Internal Rate of Return (IRR): Trail and Error Method

1. Begin by using an arbitrary discount rate to calculate the PV of the net cash inflows from the project;
2. If the PV of the net cash inflows *EXCEEDS* the initial cost outlay of the project, INCREASE the discount rate and repeat the process;
3. If the PV of the net cash flows from the project is *SMALLER* than the initial cost outlay of the project, DECREASE the discount rate and repeat the process;
4. This process is continued until the rate of discount is found that equates the PV of the net cash flows from the project to the initial cost of the project
5. The discount rate found is the IRR on the project

CAPITAL BUDGETING

An Example (using NPV and IRR)

1. Suppose that a firm estimates that it needs to make an initial investment of $1 million in order to introduce a new product. The marketing division of the firm expects the life of the product to be 5 years. Incremental sales revenues are estimated to be $1 million during the first year of operation and to rise by 10% per year until the fifth year when the product will be replaced. The production department projects that the incremental variable costs of producing the product will be 50% of incremental sales revenues and that the firm would also incur additional fixed cost of $1,50,000 per year. The finance department of the firm anticipates a marginal tax rate of 40% and depreciation of $2,00,000 per year for 5 years for the firm. The salvage vale of the initial equipment is estimated to be $2,50,000 and the firm also expects to recover $1,00,000 of its working capital at the end of the fifth year. The risk adjusted cost of capital is 12%. Should the Firm undertake the project? Evaluate the project using NPV and IRR methods and accordingly advice the firm.

Solution: Estimated Cash Flow from Project

	Year				
	1	2	3	4	5
Sales	$1000,000	$1,100,000	$1,210,000	$1,331,000	$1,46,4100
Less: 1. Variable Cost 2. Fixed Costs 3. Depreciation	5,00,000 1,50,000 2,00,000	5,50,000 1,50,000 2,00,000	6,05,000 1,50,000 2,00,000	6,65,500 1,50,000 2,00,000	7,32,050 1,50,000 2,00,000
Profit Before Taxes	**1,50,000**	**2,00,000**	**2,55,000**	**3,15,500**	**3,82,050**
Less: Income Tax	60,000	80,000	1,02,000	1,26,200	1,52,820
Profit After Tax	**90,000**	**1,20,000**	**1,53,000**	**1,89,300**	**2,29,230**
Plus: Depreciation	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
Net Cash Flow	**2,90,000**	**3,20,000**	**3,53,000**	**3,89,300**	**4,29,230**
	1. Salvage Value of Equipment in year 5 2. Recovery of Working Capital in year 5				**2,50,000** **1,00,000**
	Net Cash Flow in Year 5				**$7,79,230**

Trail and Error Method			
Using PVIF at 24%			
Year end (1)	Net Cash flows ($) (2)	Present value factor (3)	Present value ($) (2) × (3)
1	2,90,000	0.8065	233885
2	3,20,000	0.6504	208128
3	3,53,000	0.5245	185149
4	3,89,300	0.4230	164674
5	7,79,230	0.3411	265795

			1057631
PV of net cash flows ($1057631) is greater than initial cost ($1000000): Increase the discount rate			

Trail and Error Method			
Using PVIF at 28%			
Year end (1)	Cash flows ($) (2)	Present value factor (3)	Present value ($) (2) × (3)
1	2,90,000	0.7813	226577
2	3,20,000	0.6104	195328
3	3,53,000	0.4768	168310
4	3,89,300	0.3725	145014
5	7,79,230	0.2910	226756

			961986
PV of net cash flows ($961986) is smaller than initial cost ($1000000): Decrease the discount rate			

Trail and Error Method			
Using PVIF at 26.5%			
Year end (1)	Cash flows ($) (2)	Present value factor (3)	Present value ($) (2) × (3)
1	2,90,000	0.7905	229245
2	3,20,000	0.625	200000
3	3,53,000	0.494	174382
4	3,89,300	0.3905	152022
5	7,79,230	0.309	240782

			996431

PV of net cash flows ($996431) is smaller ($3569) than initial cost ($1000000): Decrease the discount rate

Precisely, in this case the discount rate will be 26.34% that equates the present values of the expected net cash flows from the project to the initial cost of the project.

Independent (Single Project) v/s Mutually Exclusive Projects

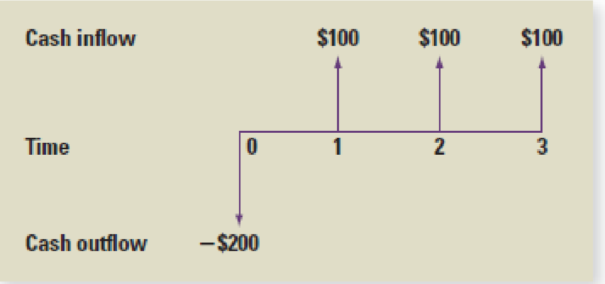
Independent Project: An independent project is one whose acceptance or rejection is independent of the acceptance or rejection of other projects

Mutually Exclusive Projects: When only one of two or more projects can be undertaken. What does it mean for two projects, A and B, to be mutually exclusive? You can accept A or you can accept B or you can reject both of them, but you cannot accept both of them.

Comparison of NPV and IRR: Independent Projects

1. Evaluating a single or independent project, the NPV and IRR methods tend to lead to the ***same accept-reject decisions***. Because *NPV will be positive only if the IRR on the project exceeds discount rate used by the firm and vice- versa.*

Example: Project = (-\$200, \$100, \$100, \$100)



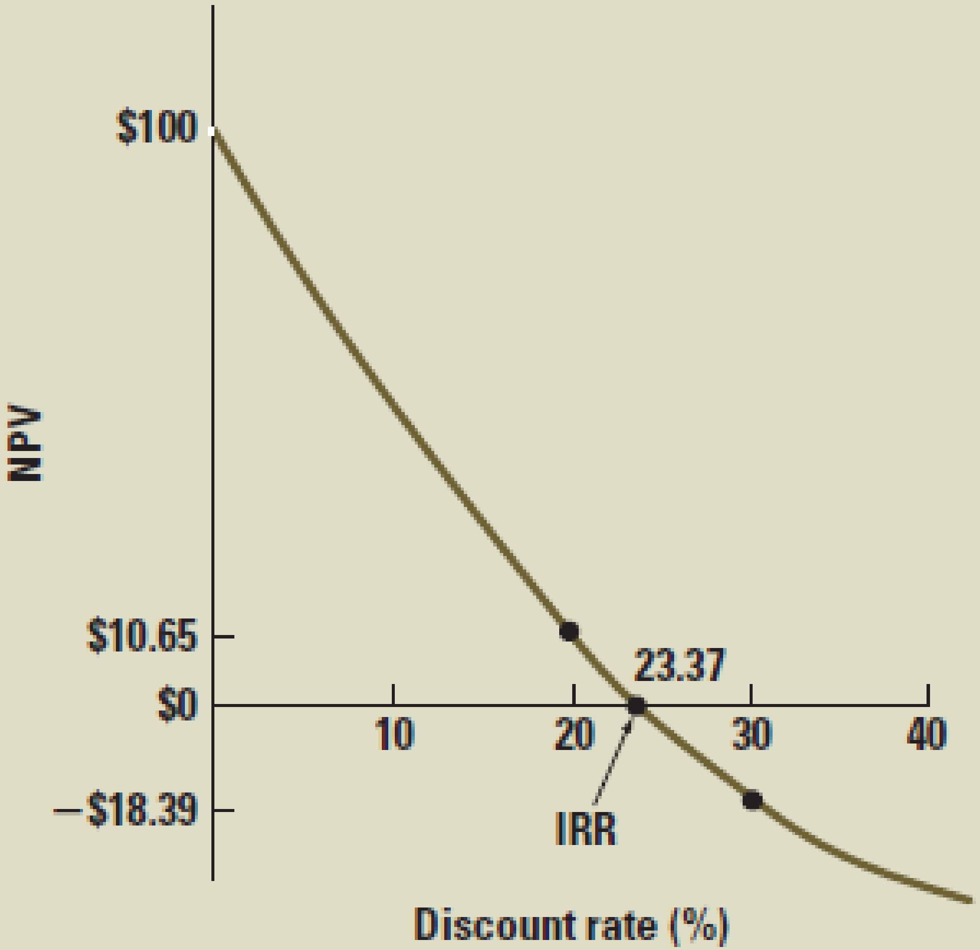
Algebraically, IRR is the unknown in the following equation:

$$C_0 = \sum_{t=1}^{n} \frac{C_t}{(1+i)^t}$$

$$0 = -\$200 + \frac{\$100}{1 + \text{IRR}} + \frac{\$100}{(1 + \text{IRR})^2} + \frac{\$100}{(1 + \text{IRR})^3}$$

- After much more trial and error, we find that the NPV of the project is zero when the discount rate is 23.37 percent. Thus, the IRR is 23.37 percent.

Comparison of NPV and IRR:



The NPV is positive for discount rates below the IRR and negative for discount rates above the IRR.

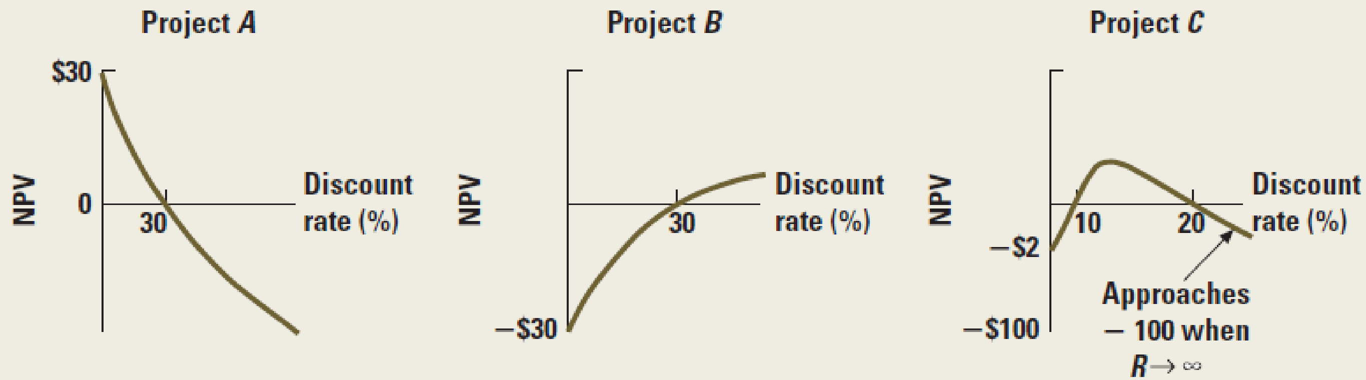
If we accept projects like this one when the discount rate is less than the IRR, we will be ***accepting positive NPV projects***. Thus, the IRR rule coincides exactly with the NPV rule

Discount Rate	NPV
20%	$10.65
30	−18.39

Two General Problems with IRR Affecting Both Independent and Mutually Exclusive Projects

Problems with the IRR Approach: Problem 1

	Project A			Project B			Project C		
Dates:	0	1	2	0	1	2	0	1	2
Cash flows	–$100	$130		$100	–$130		–$100	$230	–$132
IRR	30%			30%			10% and 20%		
NPV @10%	$ 18.2			–$ 18.2			0		
Accept if market rate	<30%			>30%			>10% but <20%		
Financing or investing	Investing			Financing			Mixture		



Project A has a cash outflow at Date 0 followed by a cash inflow at Date 1. Its NPV is negatively related to the discount rate. Project B has a cash inflow at Date 0 followed by a cash outflow at Date 1. Its NPV is positively related to the discount rate. Project C has two changes of sign in its cash flows. It has an outflow at Date 0, an inflow at Date 1, and an outflow at Date 2. Projects with more than one change of sign can have multiple rates of return.

Problems with the IRR Approach: Problem 1

- **Project B:** As with Project *A*, the internal rate of return is 30%. However, the net present value is *negative* when the discount rate is *below IRR of* 30%. Conversely, the net present value is positive when the discount rate is above IRR of 30%. The decision rule is exactly the opposite of our previous result.
- For this type of project, the following Decision Rule applies:

Accept	Reject
Accept the project if the IRR is LESS than the discount rate	**Reject the project if the IRR is GREATER than the discount rate**

Investing Type Project v/s Financing Type Project:

Case of Project B: ($100, -$130)

Suppose the firm wants to obtain $100 immediately: It has two options

(1) Accept Project *B* or (2) Borrow $100 from a bank

NOTE: The project B is actually a substitute for borrowing. In fact, because the IRR is 30%, taking on Project *B* is equivalent to borrowing at 30%. If the firm can borrow from a bank at, say, only 25%, it should REJECT the project. However, if a firm can borrow from a bank only at, say, 35%, it should ACCEPT the project. Thus, Project *B* will be accepted if and only if the discount rate is *ABOVE* the IRR

Case of Project A: (-$100, $130)

Suppose the firm wants to invest $100 immediately: It has two options

(1) Accept Project *A* or (2) Lend $100 to the bank

NOTE: The project is actually a substitute for lending. In fact, because the IRR is 30%, taking on Project *A* is tantamount to lending at 30%. The firm should ACCEPT Project *A* if the lending rate is BELOW 30%. Conversely, the firm should REJECT Project *A* if the lending rate is above 30%

Investing v/s Financing: Because the firm initially pays out money with Project *A* but initially receives money with Project *B* , Project *A is referred to* as an *investing type project* and Project *B* as a *financing type project*

Problems with the IRR Approach: Problem 2

Multiple Rates of Return: Suppose the cash flows from a project (project C) are **(-$100, $230, -$132)** [The project's cash flows exhibit two changes of sign, or "flip-flops]. It is easy to verify that this project has not one but two IRRs, 10% and 20%. In a case like this, the IRR DOES NOT make any sense.

Calculation of multiple rates:

$$-\$100 + \frac{\$230}{1.1} - \frac{\$132}{(1.1)^2}$$

$$-\$100 + 209.09 - 109.09 = 0$$

and

$$-\$100 + \frac{\$230}{1.2} - \frac{\$132}{(1.2)^2}$$

$$-\$100 + 191.67 - 91.67 = 0$$

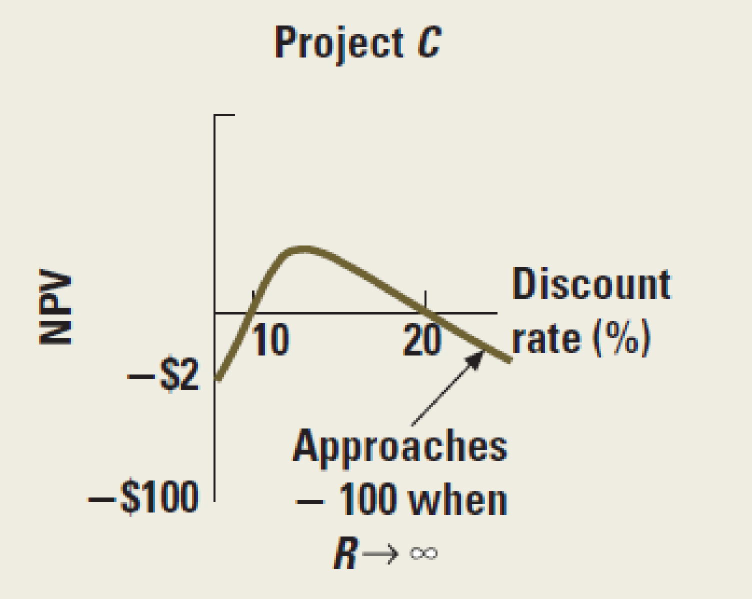
Thus, we have multiple rates of return.

- Why does this project have multiple rates of return? Project *C* generates multiple internal rates of return because both an inflow and an outflow occur after the initial investment. In general, these flip-flops or changes in sign produce multiple IRRs.
- In theory, a cash flow stream with *K* changes in sign can have up to *K* sensible internal rates of return. Therefore, because Project *C* has two changes in sign, it can have as many as two IRRs.

Problems with the IRR Approach: Problem 2

Multiple Rates of Return: NPV Rule

- **NPV Rule** Of course, one should not be too worried about multiple rates of return. After all, one can always fall back on the NPV rule. Figure below plots the NPV of Project *C* (−\$100, \$230, −\$132) as a function of the discount rate. As the figure shows, the NPV is zero at both 10 percent and 20 percent and negative outside the range. Thus, the NPV rule tells us to accept the project if the appropriate discount rate is between 10 percent and 20 percent. The project should be rejected if the discount rate lies outside this range.



Modified IRR (MIRR): Alternative to NPV

Modified IRR (MIRR): As an alternative NPV, MIRR handles the multiple IRR problem by combining cash flows until only one change in sign remains. How it works: Project C (−\$100, \$230, −\$132)

With a discount rate of, say, 14%, the present value of the last cash flow, −\$132, as of Date 1 is:

$$-\$132/1.14 = -\$115.79$$

Because \$230 is already received at Date 1, the "adjusted" cash flow at Date 1 is \$114.21 (=\$230−\$115.79). Thus, the MIRR approach produces the following two cash flows for the project:

$$(-\$100, \$114.21)$$

Note: By discounting and then combining cash flows, one is left with only one change in sign. The IRR rule can now be applied. The IRR of these two cash flows is 14.21 percent, implying that the project should be accepted given our assumed discount rate of 14 percent.

GENERAL RULES

Flows	Number of IRRs	IRR Criterion	NPV Criterion
First cash flow is negative and all remaining cash flows are positive.	1	Accept if IRR > *R*. Reject if IRR < *R*.	Accept if NPV > 0. Reject if NPV < 0.
First cash flow is positive and all remaining cash flows are negative.	1	Accept if IRR < *R*. Reject if IRR > *R*.	Accept if NPV > 0. Reject if NPV < 0.
Some cash flows after first are positive and some cash flows after first are negative.	May be more than 1.	No valid IRR.	Accept if NPV > 0. Reject if NPV < 0.

Two General Problems with IRR Affecting Mutually Exclusive Projects Only

Comparison of NPV and IRR: Mutually Exclusive Projects

2. For mutually exclusive projects (when only one of two or more projects can be undertaken), the NPV and IRR methods may provide contradictory signals as to which project will add more value to the firm. (A project with higher NPV may have a lower IRR than an alternative project and vice-versa)

Example: NPV and IRR on two Mutually Exclusive Investment Projects

	Project A (-$1000000, -$100000, $0, $500000, $500000, $14,00000)	**Project B** (-$1000000, $3,50,000, $3,50,000, $3,50,000, $3,50,000, $3,50,000)
Initial Cost	$1000,000	$1000,000
NPV@12% discount rate	$3,78,761	$2,61,671
IRR	20.3%	22.1%
Life, Years	5	5

Comparison of NPV and IRR : Mutually Exclusive Projects

Reason:

----Under NPV method, the net cash inflows generated from the project are implicitly assumed to be reinvested at the firm's cost of capital or risk-adjusted DISCOUNT RATE used by the firm;

---Under IRR method, the net cash inflows generated from the project are implicitly assumed to be reinvested at the same HIGHER IRR earned on the project

Decision Rule (NPV v/s IRR): Since there is no certainty that the firm can reinvest the net cash inflows generated by a project at the same HIGHER IRR earned on a given project, it is generally better to USE **NPV** method in deciding which of the two mutually exclusive projects to undertake. Accept the project with HIGHER NPV rather than the one with higher IRR

Comparison of NPV and IRR : Mutually Exclusive Projects

Scale Problem: Stanley Jaffe and Sherry Lansing have just purchased the rights to Corporate Finance: The Motion Picture. They will produce this major motion picture on either a small budget or a big budget. Here are the estimated cash flows:

	Cash Flow at Date 0	Cash Flow at Date 1	NPV @25%	IRR
Small budget	−\$10 million	\$40 million	\$22 million	300%
Large budget	− 25 million	65 million	27 million	160

Because of high risk, a 25 percent discount rate is considered appropriate. Sherry wants to adopt the large budget because the NPV is higher. Stanley wants to adopt the small budget because the IRR is higher. Who is right?

Comparison of NPV and IRR : Mutually Exclusive Projects

Scale Problem: NPV is correct. Hence Sherry is right. However, Stanley is very stubborn where IRR is concerned. How can Sherry justify the large budget to Stanley using the IRR approach? This is where ***incremental IRR*** comes in. Sherry calculates the incremental cash flows from choosing the large budget instead of the small budget as follows:

	Cash Flow at Date 0 (in $ millions)	Cash Flow at Date 1 (in $ millions)
Incremental cash flows from choosing large budget instead of small budget	−$25 − (−10) = −$15	$65 − 40 = $25

The above table shows that the incremental cash flows are -$15 million at date 0 and $25 million at date 1.

Comparison of NPV and IRR : Mutually Exclusive Projects

Scale Problem: Sherry calculates incremental IRR and NPV as follows:

Formula for Calculating the Incremental IRR:

$$0 = -\$15 \text{ million} + \frac{\$25 \text{ million}}{1 + \text{IRR}}$$

IRR equals 66.67 percent in this equation, implying that the incremental IRR is 66.67 percent. Incremental IRR is the IRR on the incremental investment from choosing the large project instead of the small project

NPV of Incremental Cash Flows:

$$-\$15 \text{ million} + \frac{\$25 \text{ million}}{1.25} = \$5 \text{ million}$$

Comparison of NPV and IRR : Mutually Exclusive Projects

Scale Problem: We know the small-budget picture would be acceptable as an independent project because its NPV is positive. We want to know whether it is beneficial to invest an additional $15 million to make the large-budget picture instead of the small-budget picture. In other words, is it beneficial to invest an additional $15 million to receive an additional $25 million next year?

First, our calculations show the NPV on the incremental investment to be positive ($5 million). Second, the incremental IRR of 66.67 percent is higher than the discount rate of 25 percent. For both reasons, the incremental investment can be justified, so the large-budget movie should be made. The second reason is what Stanley needed to hear to be convinced.

Comparison of NPV and IRR : Mutually Exclusive Projects

Decision: In review, we can handle this example (or any mutually exclusive example) in one of three ways:

1. Compare the NPVs of the two choices. The NPV of the large-budget picture is greater than the NPV of the small-budget picture. That is, $27 million is greater than $22 million;

2. Calculate the incremental NPV from making the large-budget picture instead of the small-budget picture. Because the incremental NPV equals $5 million, we choose the large-budget picture;

3. Compare the incremental IRR to the discount rate. Because the incremental IRR is 66.67 percent and the discount rate is 25 percent, we take the large-budget picture

Comparison of NPV and IRR : Mutually Exclusive Projects

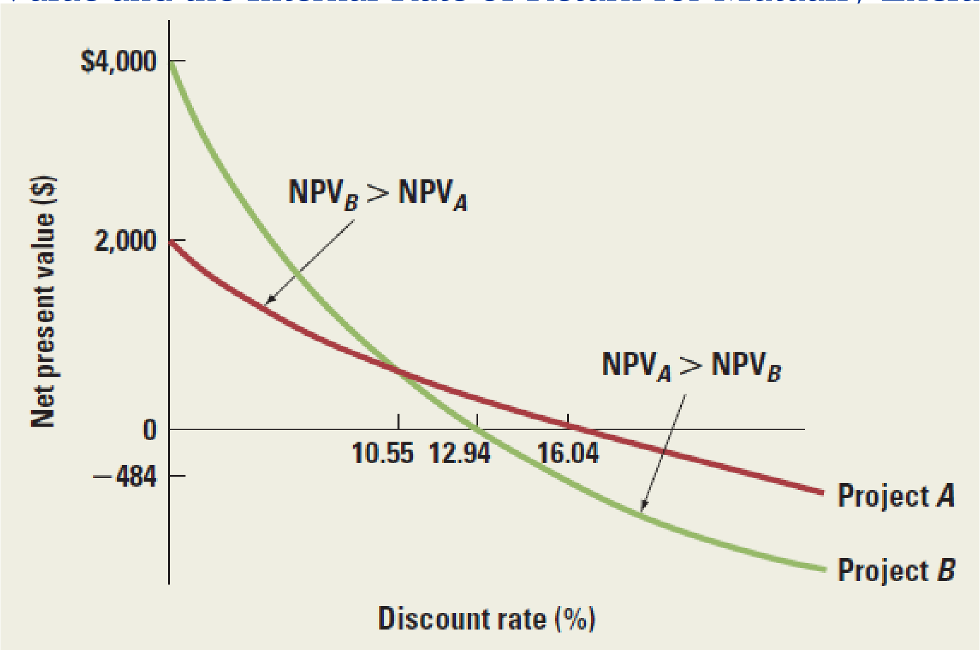
The Timing Problem: Suppose that the Kaufold Corporation has two alternative uses for a warehouse. It can store toxic waste containers (investment A) or electronic equipment (investment B). The cash flows are as follows:

	Cash Flow at Year				NPV			
Year:	0	1	2	3	@0%	@10%	@15%	IRR
Investment *A*	−$10,000	$10,000	$1,000	$ 1,000	$2,000	$669	$109	16.04%
Investment *B*	−10,000	1,000	1,000	12,000	4,000	751	−484	12.94

Note: The NPV of investment B is higher with low discount rates, and the NPV of investment A is higher with high discount rates. The cash flows of A occur early, whereas the cash flows of B occur later. If we assume a high discount rate, we favor investment A because we are implicitly assuming that the early cash flow (for example, $10,000 in year 1) can be reinvested at that rate. Because most of investment B's cash flows occur in year 3, B's value is relatively high with low discount rates.

Comparison of NPV and IRR : Mutually Exclusive Projects

Net Present Value and the Internal Rate of Return for Mutually Exclusive Projects



Observations: 1. Project A has an NPV of $2,000 at a discount rate of zero. Project B has an NPV of $4,000 at the zero rate;

2. The NPV of project B declines more rapidly as the discount rate increases than does the NPV of project A because the cash flows of B occur later;

3. Because the NPV of B declines more rapidly, B actually has a lower IRR;

4. Both projects have the same NPV at a discount rate of 10.55 percent.

Comparison of NPV and IRR : Mutually Exclusive Projects

Decision Rule: One can select the better project with one of three different methods:

1. **Compare NPVs of the two projects**. If the discount rate is below 10.55 percent, we should choose project B because B has a higher NPV. If the rate is above 10.55 percent, we should choose project A because A has a higher NPV;

2. **Compare incremental IRR to discount rate.** Another way of determining that B is a better project is to subtract the cash flows of A from the cash flows of B and then to calculate the IRR:

						NPV of Incremental Cash Flows		
Year:	0	1	2	3	Incremental IRR	@0%	@10%	@15%
B − A	0	−$9,000	0	$11,000	10.55%	$2,000	$83	−$593

This chart shows that the incremental IRR is 10.55 percent. In other words, the NPV on the incremental investment is zero when the discount rate is 10.55 percent. Thus, if the relevant discount rate is below 10.55 percent, project B is preferred to project A. If the relevant discount rate is above 10.55 percent, project A is preferred to project B.

Comparison of NPV and IRR : Mutually Exclusive Projects

Decision Rule: One can select the better project with one of three different methods:

3. **Calculate NPV on incremental cash flows.** Finally, we could calculate the NPV on the incremental cash flows. We find that the incremental NPV is positive when the discount rate is either 0 percent or 10 percent. The incremental NPV is negative if the discount rate is 15 percent. If the NPV is positive on the incremental flows, we should choose B. If the NPV is negative on the incremental flows, we should choose A.

						NPV of Incremental Cash Flows		
Year:	0	1	2	3	Incremental IRR	@0%	@10%	@15%
B − *A*	0	−$9,000	0	$11,000	10.55%	$2,000	$83	−$593

III. The Profitability Index (PI)

Profitability Index: The basic principle that the firm follow in choosing the set of projects that creates the greatest value in a given period is to select the projects that yield the ***largest value per dollar invested***. PI is a measure of the value a project generates for each dollar invested in that project

PI: It is ***the ratio of the present value of the future expected net cash flows after initial investment divided by the amount of the initial investment*** The profitability index can be represented as:

$$\text{Profitability Index} = \frac{\text{Total Present value Net cash inflows}}{\text{Initial Investment}}$$

$$PI = \frac{\text{Benefits}}{\text{Costs}} = \frac{\text{Present value of future free cash flows}}{\text{Initial investment}} = \frac{\text{NPV} + \text{Initial investment}}{\text{Initial investment}}$$

where initial investment is the up-front investment required to fund the project

$$PI = \frac{\sum_{t=1}^{n} [R_t / (1+i)^t]}{C_0}$$

Where, C_0 = Initial Cash Outflow of the project
R_t = Estimated Net Cash Inflow at time 't' of the project
i = Discount rate

Decision (PI) Rule:

Accept	Reject
Accept if PI of a project is greater than 1 (PI>1)	**Reject if PI of a project is less than the 1 (PI<1)**

Ranking Criteria: Select alternative with highest PI in case of capital/credit rationing. Note: In the absence of capital rationing, the firm will undertake all the projects with a positive NPV and profitability index greater than 1

Application of the Profitability Index: Three Situations

1. Capital Rationing: The first two situations implicitly assumed that the firm could always attract enough capital to make any profitable investments. Now consider the case when the firm does not have enough capital to fund all positive NPV projects. This is the case of capital rationing. NPV investment rule may lead to difficulties especially where the firm may not have enough capital to fund all positive NPV projects

A smaller project may lead to a LOWER NPV than an alternative larger project, but the ratio of PV of the net cash inflows to the initial cost of the project (profitability per dollar of investment) may be HIGHER on the smaller project than on the larger project

Therefore, in cases of capital rationing (when the firm cannot undertake all the projects with positive NPV due to shortage of funds), the firm should RANK projects according to the profitability index and choose the projects with the HIGHEST profitability indexes rather than those with the highest NPVs

Capital Rationing

Example: A company has the following three independent projects. Assume that the company has only $20 million dollars for the proposed investment. All the three projects have a life of two years--Project A, Project B and Project C. The company applies a 12% discount rate. The cash flows from the project are as follows:

	Initial Investment ($,m)	**Net Cash Inflow ($, m)**
Project A	20	C_1 = 70; C_2 = 10
Project B	10	C_1 = 15; C_2 = 40
Project C	10	C_1 = -5; C_2 = 60

Capital Rationing

	Initial Investment ($,m)	PV Net Cash Inflow ($, m)	PI	NPV ($, m)
Project A (Larger)	20	= $\$70/(1.12)^1+\$10/(1.12)^2$ =$70.5	=$70.5/20 =3.53	**50.3**
Project B (Smaller)	10	= $\$15/(1.12)^1 +\$40/(1.12)^2$ =$45.3	=$45.3/10 =4.53	**35.3**
Project C (Smaller)	10	= $\$-5/(1.12)^1 +\$60/(1.12)^2$ =$43.4	=$43.4/10 =4.34	**33.4**

Important Observations:

1. The PI of project B (4.53) is greater than PI of project C (4.34) and A (3.53) respectively;
2. The NPV of project A ($50.3 million) is greater than the NPV of project B ($35.3 million) and C ($33.4 million);
3. Since project A has an initial investment of $20 million, the firm cannot select both project A and another one. However, projects B and C both can be selected which have an initial investment of $10 million each

Decision: Individually, projects B and C have lower NPVs than project A. However, when the NPVs of projects B and C are added together, the sum is higher than the NPV of project A. Thus, the projects B and C should be accepted

Important: Jointly, projects B and C increase the value of the firm, BUT they would not be undertaken if the firm followed the NPV rule and could invest only $20 million.

Capital Rationing: NPV v/s PI

In the case of (capital rationing) limited funds, one cannot rank projects according to their NPVs. Instead one should rank them according to the ratio of present value to initial investment (PI Index). This is the PI rule. Both project B and project C have higher PI ratios than does project A. Thus, they should be ranked ahead of project A when capital is rationed

Capital Rationing

Positive NPV Investments This Year

Now consider the case in which we have several projects to choose from in a given year but do not have enough money to invest in all of them. For example, suppose that we have identified the four positive NPV projects listed in following Exhibit and have only $10,000 to invest. How do we choose from among the four projects when we cannot afford to invest in all of them?

Project	Year 0	Year 1	Year 2	NPV @ 10%	PI
A	−$5,000	$5,500	$6,050	$5,000	2.000
B	−$3,000	$2,000	$3,850	$2,000	1.667
C	−$3,000	$4,400	$0	$1,000	1.333
D	−$2,000	$1,500	$1,375	$500	1.250

Capital Rationing

The exhibit shows the yearly free cash flows, NPV, and profitability index (PI) for the projects. The PI values indicate the value of the expected future free cash flows per dollar invested in each project

Project	Year 0	Year 1	Year 2	NPV @ 10%	PI
A	−$5,000	$5,500	$6,050	$5,000	2.000
B	−$3,000	$2,000	$3,850	$2,000	1.667
C	−$3,000	$4,400	$0	$1,000	1.333
D	−$2,000	$1,500	$1,375	$500	1.250

Our objective in a case such as this is to identify the bundle or combination of positive NPV projects that creates the greatest total value for stockholders. The PI is helpful in such a situation because it helps us choose the projects that create the most value per dollar invested: **We use the PI to do this by following a four-step procedure:**

1. Calculate the PI for each project;

2. Rank the projects from highest PI to lowest PI;

3. Starting at the top of the list (the project with the highest PI) and working your way down (to the project with the lowest PI), select the projects that the firm can afford;

4. Repeat the third step by starting with the second project on the list, the third project on the list, and so on to make sure that a more valuable bundle cannot be identified

Capital Rationing

Applying this process to the projects in Exhibit, we would choose to accept projects **A, B, and D**.

We would begin by choosing projects A and B because they have the largest PIs and we have enough money to invest in both.

Since choosing projects A and B means we would no longer have enough money to invest in project C, we would skip C and choose D, for which we do have enough money.

Projects A, B, and D would generate a total of $7,500 in total value for stockholders. Following the fourth step reveals that no other combination of projects has a larger total NPV than projects A, B, and D, so we would select these projects.

Capital Rationing

PROBLEM: You have identified the following seven positive NPV investments for your in-home computer-support business. If you have $50,000 to invest this year, which projects should you accept?

Project	Investment	NPV @10%
Buy new notebook computer	$ 3,000	$ 500
Buy employee training program	8,000	4,000
Buy new tool set	500	1,000
Buy office condo	40,000	5,000
Buy used car	12,000	4,000
Paint existing cars	4,000	2,000
Buy new test equipment	10,000	2,000

APPROACH: Use the four-step procedure presented in the text to determine which projects you should accept.

SOLUTION: Calculating the PI and ranking the projects from highest to lowest PI yields the following:

Project	Investment	NPV @10%	PI
Buy new tool set	$ 500	$1,000	$1,500/$500 = 3.000
Buy employee training program	8,000	4,000	$12,000/$8,000 = 1.500
Paint existing cars	4,000	2,000	$6,000/$4,000 = 1.500
Buy used car	12,000	4,000	$16,000/$12,000 = 1.333
Buy new test equipment	10,000	2,000	$12,000/$10,000 = 1.200
Buy new notebook computer	3,000	500	$3,500/$3,000 = 1.167
Buy office condo	40,000	5,000	$45,000/$40,000 = 1.125

With $50,000 to invest, you should invest in all projects except the office condo. This strategy will require $37,500 and is expected to result in a total NPV of $13,500. The $12,500 that you have left over, which is not enough to buy the office condo, can be held in the business until an appropriate use for the money is identified, or it can be distributed to the stockholder (you).

2. Independent Projects and 3. Mutually Exclusive Projects

Example: A company applies a 12% discount rate to two investment opportunities which have the following cash flows:

	Initial Investment ($,m)	Net Cash Inflow ($, m)
Project A	20	$C_1 = 70$; $C_2 = 10$
Project B	10	$C_1 = 15$; $C_2 = 40$

	Initial Investment ($,m)	PV @ 12% Net Cash Inflow ($, m)	PI	NPV ($, m)
Project A (Larger)	20	$= \$70/(1.12)^1 + \$10/(1.12)^2 = \$70.5$	=$70.5/20 =3.53	50.3
Project B (Smaller)	10	$= \$15/(1.12)^1 + \$40/(1.12)^2 = \$45.3$	=$45.3/10 =4.53	35.3

2. Independent Projects: According to the NPV rule, both projects should be accepted because NPV is positive in each case. The profitability index (PI) is greater than 1 whenever the NPV is positive. Thus, the PI decision rule is: Accept an independent project if PI > 1 and Reject it if PI < 1;

3. Mutually Exclusive Projects: Let us now assume that the firm can only accept one of its two projects. NPV analysis says accept Project A because this project has the HIGHER NPV. Because Project B has the higher PI, the profitability index **MAY** lead to the wrong selection;

Reason: For mutually exclusive projects, the PI suffers from the *scale problem*. Project B is smaller than Project A. Because the PI is a ratio, it ignores Project A's larger investment. Thus, PI ignores *differences of scale* for mutually exclusive projects

Adjustment Mutually Exclusive Projects: Incremental Analysis

The flaw with the PI approach can be corrected by calculating the incremental cash flows after subtracting Project B from project A (Project A-Project B) as follows:

Project	Cash Flows ($000,000) C_0	C_1	C_2	PV @ 12% of Cash Flows Subsequent to Initial Investment ($000,000)	Profit-ability Index	NPV @12% ($000,000)
1–2	−$10	$55	−$30	$25.2	2.52	$15.2

Since, the PI on the incremental cash flows is greater than 1, the firm should choose the bigger project—that is, Project A which is the same decision with the NPV approach

IV. The Discounted Payback Period (DPBP) Rule

- **Payback Period** is the number of years it takes for the cash flows from a project to recover the project's initial investment. With the payback method for evaluating projects, a project is accepted if its payback period is below some specified threshold
- Under this approach first the net cash inflows are discounted to calculate their PV and then payback period is determined

Computing the Payback Period

$$\text{PB} = \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}}$$

Decision (DPBP) Rule:

Accept	Reject
Accept if DPBP of a project is LESS than the maximum payback period set by management (DPBP < Maximum PBP)	Reject if DPBP of a project is MORE than the maximum payback period set by management (DPBP>Maximum PBP)

Ranking Criteria: Highest ranking to the project which has the shortest DPBP and lowest ranking to the project with has the highest DPBP

Example

1. The exhibit shows the net and cumulative net cash flows for a proposed capital project with an initial cost of $70,000. The cash flow data are used to compute the payback period, which is 2.5 years:

Time line	0	1	2	3	4 Year
Net cash flow (NCF)	−$70,000	$30,000	$30,000	$20,000	$15,000
Cumulative NCF	−$70,000	−$40,000	−$10,000	$10,000	$25,000

$$
\begin{aligned}
\text{PB} &= \text{Years before cost recovery} + \frac{\text{Remaining cost to recover}}{\text{Cash flow during the year}} \\
&= 2 \text{ years} + \frac{\$70{,}000 - \$60{,}000}{\$20{,}000} \\
&= 2 \text{ years} + \frac{\$10{,}000}{\$20{,}000} \\
&= 2 \text{ years} + 0.5 \\
&= 2.5 \text{ years}
\end{aligned}
$$

Example: Discounted Payback Period Cash Flows and Calculations

2. The exhibit shows the net and cumulative net cash flows for a proposed capital project with an initial cost of $40,000. The cash flow data are used to compute the discounted payback period for a 10 percent cost of capital, which is 2.35 Years:

Time line	0	1	2	3 Year
Net cash flow (NCF)	−$40,000	$20,000	$20,000	$20,000
Cumulative NCF	−$40,000	−$20,000	$0	$20,000
Discounted NCF (at 10%)	−$40,000	$18,182	$16,529	$15,026
Cumulative discounted NCF	−$40,000	−$21,818	−$5,289	$9,737

Payback period = 2 years + $0/$20,000 = 2 years

Discounted payback period = 2 years + $5,289/$15,026 = 2.35 years

Cost of capital = 10%

Example

3. Projects P and Q involve the same outlay of $4000 each. The risk adjusted cost of capital is 10%. The cash flows from Project P and Q are given below:

	C_0	C_1	C_2	C_3	C_4
Project P	-4000	3000	1000	1000	1000
Project Q	-4000	0	4000	1000	2000

Example

Present Value of cash inflows from Project P using PVIF
Initial Investment = $4000

Year	Cash flows ($)
1	3000
2	1000
3	1000
4	1000

Present Value of Cash Inflows			
Year end	Cash flows ($)	Present value factor (2) × (3)	Present value ($)
1	2	3	4
1	3000	0.909	2727
2	1000	0.826	826
3	1000	0.751	751
4	1000	0.683	683
Simple PBP = 2 Years ($3000+$1000)			
DPBP = 2.7 Years ($2727+$826+$447) ($751/12 = $62.58)			

Example

Present Value of cash inflows from Project Q using PVIF
Initial Investment =$4000

Year	Cash flows ($)
1	0
2	4000
3	1000
4	2000

Present Value of Cash Inflows			
Year end	Cash flows ($)	Present value factor (2) × (3)	Present value ($)
1	2	3	4
1	0	0.909	0
2	4000	0.826	3304
3	1000	0.751	751
4	2000	0.683	1366
Simple PBP = 2 Years ($0+$4000)			
DPBP = 2.11 Years ($0+$3304+$696) ($751/12 = $62.58)			

Ranking:

	Simple PBP	DPBP
Project P	2 Years	**2.7 Years**
Project Q	2 Years	2.11 Years

If the estimated DPBP of 2.7 Years is less than the Maximum DPBP set by the management, the project P will be accepted.

TRADITIONAL TECHNIQUES

I. The Payback Period Rule

- Payback period (PBP) is the number of years required to recover the original cash outlay (outflow) invested in a given project.
- **Unequal Cash Net Inflows:** PBP is calculated by adding up the cash net inflows until the total is equal to the initial cash outlay.
- **Equal Cash Net Inflows:** A project generating constant (equal) cash inflows, the PBP is computed using:

Payback Period : Initial Investment/Annual Net Cash Inflows

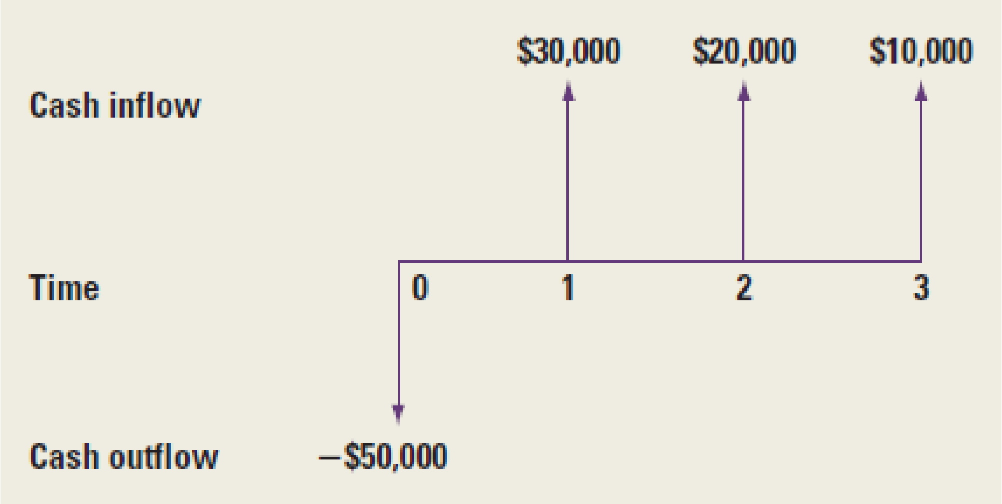
OR

Payback Period (PBP): C_0 /C

where C_0 = Initial Investment and C = Equal stream of Net Cash Flows (Annuity)

Consider a project with an initial investment of $50,000. Cash flows are $30,000, $20,000, and $10,000 in the first three years, respectively.

(-$50,000, $30,000, $20,000, $10,000)



The firm receives cash flows of $30,000 and $20,000 in the first two years, which add up to the $50,000 original investment. This means that the firm has recovered its investment in two years. In this case TWO YEARS is the *payback period* of the investment.

Decision (PBP) Rule:

Accept	Reject
Accept if PBP of a project is less than the maximum payback period set by management- (PBP< Maximum PBP)	Reject if PBP of a project is more than the maximum payback period set by management- (PBP>Maximum PBP)

Ranking Criteria: Highest ranking to the project which has the shortest PBP and lowest ranking to the project with has the highest PBP.

Example: Equal Cash Net Inflows

1. Assume that a project requires an outlay of $50,000 and yields annual cash inflow of $12,500 for 7 years. Calculate the payback period of the project.

Solution: PBP = $50,000/$12,500 = 4 Years

If the estimated PBP of 4 Years is less than the Maximum PBP set by the management, the project will be accepted.

2. Suppose that a project requires a cash outlay of $20,000 and generates cash inflows of $8000; $7000; $4000; and $3000 during next 4 years. What is the project's payback period?

Solution: (-$20,000, $8000, $7000, $4000, $3000)

1. When we add up the first three years cash inflows, ($8000+$7000+$4000) *$19000* of the original outlay is recovered.
2. In the fourth year cash inflow generated is $3000 and only $1000 of the original outlay remains to be recovered. Assuming that the cash inflows occur evenly during the year, the time required to recover $1000 will be 4 months ($3000/12=$250 ($250*4=$1000)
3. PBP = 3 Years and 4 Months (3.4 Years)

   Decision: Accept if 3.4 Years<Max PBP

- Disadvantages:
  - Ignores the time value of money
  - Requires an arbitrary acceptance criteria
  - A project accepted based on the payback criteria may not have a positive NPV

II. The Average Accounting Return Rule

$$\text{AAR} = \frac{\text{Average Net Income}}{\text{Average Investment}} * 100$$

Decision (AAR) Rule:

Accept	Reject
Accept if AAR of a project is higher than the minimum rate established by the management. (AAR>Minimum Rate).	**Reject if AAR of a project is lower than the minimum rate established by the management. (AAR<Minimum Rate).**

Ranking Criteria: Rank a project as number one if it has highest AAR and lowest rank would be assigned to the project with lowest AAR.

Steps:

1. **Determining Average Net Income:** Net Income in any year is net cash inflows minus depreciation and taxes. The average of all net cash inflows from a project is then calculated.
2. **Determining Average Investment:** Averaging process of investment assumes that the firm is using *straight line depreciation method* in which case the book value of the asset declines at a constant rate from its purchase price to zero at the end of its depreciable life. Therefore, the average investment would be equal to half (1/2) of the book value of original investment (I_0) plus book value of investment at the end of the project (which will be zero) (I_n) if it is depreciated constantly $(I_0+I_n)/2$.
3. **Determining AAR:** AAR=Average Net Income/Average Investment

II. The Average Accounting Return Rule

- Disadvantages:
  - Ignores the time value of money
  - Uses an arbitrary benchmark cutoff rate
  - Based on book values, not cash flows and market values

RISK ANALYSIS

Risk Analysis

- Uncertainty of unit sales, the price of a product, operating expenses, capital expenditures, and additions to working capital;
- Uncertainty about future economic conditions;
- Often resort to ***sensitivity analysis, scenario analysis, and simulation analysis*** to obtain a better understanding of how errors in forecasting these factors affect the attractiveness of a project.

Calculation of the yearly incremental pretax free cash flows (FCF) and the NPV of the automated production in the hammock-manufacturing assuming the project has a four year life:

Assumptions:

Opportunity cost of capital	10%	Initial investment	$40,000
Unit sales	10,000	D&A	$10,000
Unit price	$25	Annual Cap Exp	$8,000
Unit VC	$16	Add WC	$2,000
FC	$35,000	Tax Rate	35%

	Year				
	0	1	2	3	4
Revenue		$250,000	$250,000	$250,000	$250,000
− VC		160,000	160,000	160,000	160,000
− FC		35,000	35,000	35,000	35,000
EBITDA		$ 55,000	$ 55,000	$ 55,000	$ 55,000
− D&A		10,000	10,000	10,000	10,000
EBIT		$ 45,000	$ 45,000	$ 45,000	$ 45,000
− Taxes		15,750	15,750	15,750	15,750
NOPAT		$ 29,250	$ 29,250	$ 29,250	$ 29,250
+ D&A		10,000	10,000	10,000	10,000
CF Opns		$ 39,250	$ 39,250	$ 39,250	$ 39,250
− Cap Exp	$40,000	8,000	8,000	8,000	8,000
− Add WC		2,000	2,000	2,000	2,000
FCF	($40,000)	$ 29,250	$ 29,250	$ 29,250	$ 29,250
NPV	$52,719				

Sensitivity Analysis

Sensitivity Analysis: Examination of the sensitivity of the results to changes in individual assumptions. Specifically, it involves examining the sensitivity of the output from an analysis, such as the NPV estimate to changes in individual assumptions.

Example, how NPV of the project changes if there is a decrease in the value of individual cash flows assumptions or an increase in the value of individual cash flow assumptions.

Scenario Analysis

Scenario Analysis: Examination of how the results from a financial analysis will change under alternative scenarios. The individual assumptions in a financial analysis are often related to each other. Their values do not tend to change one at a time. Example, financial analysis of the project is conducted in alternative scenarios such as expected, weaker or stronger economic conditions.

NPV Values for the Automated Hammock Production Alternative for Three Scenarios

Economic Conditions	Unit Sales	Unit Price	Unit Variable Costs	NPV
Strong	12,000	$28	$17	$139,256
Expected	10,000	$25	$16	$52,719
Weak	8,000	$22	$15	($17,335)

Different economic scenarios result in different NPV estimates for the automated production alternative in the hammock-manufacturing example. The expected unit sales, unit prices, and unit variable costs vary depending on economic conditions.

Simulation Analysis

Simulation Analysis: Simulation analysis is like scenario analysis except that in simulation analysis an analyst uses a computer to examine a large number of scenarios in a short period of time. Specifically, **Simulation Analysis** uses a computer to quickly examine a large number of scenarios and obtain probability estimates for various values in a financial analysis.

Rather than selecting individual values for each of the assumptions—such as unit sales, unit price, and unit variable costs—the analyst assumes that those assumptions can be represented by statistical distributions.