R28 Uses of Capital

Version 1.0

1. Introduction

Capital allocation is the process that companies use for decision-making on capital investments i.e., investments with a life of a year or more.

Capital allocation is important because it helps decide the future of many corporations. Most capital investments require huge investments that are not easy to reverse.

The valuation principles used in capital budgeting are also used in security valuation and portfolio management. These principles deal with projecting and then discounting cash flows to determine if the project adds value.

This reading covers:

- A typical capital allocation process – steps, assumptions, and types of projects
- Basic investment decision criteria – NPV and IRR
- Real options – timing, sizing, flexibility, and fundamental options
- Common capital allocation pitfalls

2. The Capital Allocation Process

Steps in Capital Allocation Process

The steps in the capital allocation process are as follows:

Step 1 – Idea generation: Most important step in the process. Investment ideas can come from anywhere within the organization, or outside (customers, vendors, etc.). What projects can add value to the company in the long term?

Step 2 – Investment analysis: Gathering information to forecast cash flows for each project and then computing the project's profitability. Output of this step: A list of profitable projects.

Step 3 – Capital allocation planning: Do the profitable projects fit in with the company's long-term strategy? Is the timing appropriate? Some projects may be profitable in isolation but not so much when considered along with the other projects. Scheduling and prioritizing of projects are important.

Step 4 - Monitoring and post-audit: Post-audit helps in assessing how effective the capital budgeting process was. How do the actual revenues, expenses, and cash flows compare against the predictions? Post-auditing is useful in three ways:

- If the predictions were optimistic or too conservative, then it becomes evident here.
- Helps improve business operations. Puts the focus on out-of-line sales and costs.
- Helps in identifying profitable areas for fresh investments in the future, or scale down in non-profitable ones.

Types of Capital Projects

Capital allocation projects may be divided into the following categories:

- Replacement projects: Analyzing whether the replacement of existing equipment would be profitable.
- Expansion projects: Constructing a new plant or expanding capacity of the existing one.
- New products and services: Diversifying current business operations to maintain a competitive edge.
- Regulatory, safety, and environmental projects: Regulatory safety and environmental laws, mandated by a governmental agency or an insurance company.
- Other projects: Pet projects of senior management or high-uncertainty projects like R&D projects that are difficult to analyze using the traditional methods.

Capital Allocation Assumptions

The following are the six key principles of capital allocation:

1. Decisions are based on cash flows:
   - Use incremental cash flows: Cash flow with the decision minus the cash flow without the decision.
   - Exclude sunk costs: For example, already incurred costs like preliminary consulting fees should not be included in the analysis.
   - Include externalities - Both positive/negative externalities should be considered in the analysis. For example, negative impact of a new diet soda product launch on the sales of existing soda products.
   - A project has conventional cash flows if the sign of cash flows changes only once during the life of the project, while an unconventional cash flow project has more than one sign change.
2. Cash flows are not accounting net income or operating income: Decisions are not based on accounting concepts like net income or operating income because these measures are accrual based and exclude non-cash expenses such as depreciation.
3. Cash flows are based on opportunity cost: For example, if you plan to use an existing office space rather than renting it out, then rental income from an office space is an opportunity cost.
4. Cash flows are analyzed on an after-tax basis: Shareholder value increases only on the cash that they have earned. Hence, any tax expenses must be deducted from the cash flows.
5. Timing of cash flows is vital: Due to the time value of money, cash flows received earlier are more valuable than cash flows received later.
6. Financial costs are ignored: Financial costs are already included in the cost of capital (discount rates) used to discount cash flows to arrive at the present value. Hence, to avoid double counting, they must not be deducted from the cash flows.

Independent projects vs. mutually exclusive projects: Independent projects are unrelated projects that can be analyzed separately, while mutually exclusive projects compete with each other. Two independent projects can both be executed if they individually meet the criteria. If two projects are mutually exclusive, then either of the two can be undertaken, not both.

Project sequencing: Certain projects are linked through time, i.e. completion of one project creates an opportunity to invest in another project later based on its profitability.

Unlimited funds vs. capital rationing: A firm can undertake all profitable projects if it has access to unlimited funds. A company having limited capital however, must prioritize and allocate funds to projects that maximize shareholder value.

3. Investment Decision Criteria

3.1 Net Present Value

Net present value is the present value of the future after tax cash flows minus the investment outlay.

$$\text{NPV} = \text{CF0} + \left[\frac{\text{CF1}}{(1+\text{r})^1}\right] + \left[\frac{\text{CF2}}{(1+\text{r})^2}\right] + \left[\frac{\text{CF3}}{(1+\text{r})^3}\right]$$

Decision rule:

For independent projects:

If NPV > 0, accept.
If NPV < 0, reject.

For mutually exclusive projects:

Accept the project with higher and positive NPV.

Example

Compute NPV for projects A and B given the following data:

Cost of capital = 10%		
Expected Net after Tax cash flows		
Year	**Project A (in $)**	**Project B (in $)**
0	-1,000	-1,000
1	500	100
2	400	300
3	300	400
4	100	600

Solution:

Project A:

$$\text{NPV} = -1000 + \frac{500}{1.1} + \frac{400}{1.1^2} + \frac{300}{1.1^3} + \frac{100}{1.1^4} = 78.82$$

On the exam, you can save time by using the calculator to solve for NPV instead of using the

above formula. The key strokes are given below:

Key strokes	Display
[CF][2nd][CLR WORK]	CF0 = 0
1000 [+|-] [ENTER]	CF0 = -1000
[↓] 500 [ENTER]	C01 = 500
[↓]	F01 = 1
[↓] 400 [ENTER]	C02 = 400
[↓]	F02 = 1
[↓] 300 [ENTER]	C03 = 300
[↓]	F03 = 1
[↓] 100 [ENTER]	C04 = 100
[↓]	F04 = 1
[NPV] 10 [ENTER]	I = 10
[↓] CPT	NPV = 78.82

Project B:

$$NPV = -1000 + \frac{100}{1.1} + \frac{300}{1.1^2} + \frac{400}{1.1^3} + \frac{600}{1.1^4} = 49.18$$

3.2 Internal Rate of Return (IRR)

IRR is the discount rate that makes the present value of future cash flows equal to the investment outlay. We can also say that IRR is the discount rate which makes NPV equal to 0.

Decision rule:

For independent projects:

If IRR > required rate of return (usually firms cost of capital adjusted for projects riskiness), accept the project.

If IRR < required rate of return, reject the project.

The required rate of return is also called hurdle rate.

For mutually exclusive projects:

Accept the project with higher IRR (as long as IRR > cost of capital).

Example

Compute IRR for projects A and B given the following data.

Cost of Capital = 10%; Expected Net After Tax Cash Flows		
Year	**Project A (in $)**	**Project B (in $)**
0	-1,000	-1,000
1	500	100
2	400	300
3	300	400
4	100	600

Solution:

Project A:

A very tedious method is to set up the equation below and solve for r using trial and error.

$1000 = \frac{500}{1+r} + \frac{400}{(1+r)^2} + \frac{300}{(1+r)^3} + \frac{100}{(1+r)^4}$ r = 14.49%

A much faster method is to use the calculator:

Key strokes	Display
[CF][2nd][CLR WORK]	CF0 = 0
1000[+|-] [ENTER]	CF0 = -1000
[↓] 500 [ENTER]	C01 = 500
[↓]	F01 = 1
[↓] 400 [ENTER]	C02 = 400
[↓]	F02 = 1
[↓] 300 [ENTER]	C03 = 300
[↓]	F03 = 1
[↓] 100 [ENTER]	C04 = 100
[↓]	F04 = 1
[IRR][CPT]	14.49

Project B:

$1000 = \frac{100}{1+r} + \frac{300}{(1+r)^2} + \frac{400}{(1+r)^3} + \frac{600}{(1+r)^4}$ r = 11.79%

Ranking conflicts between NPV and IRR

For single and independent projects with conventional cash flows, there is no conflict between NPV and IRR decision rules. However, for mutually exclusive projects the two criteria may give conflicting results. The reason for conflict is due to differences in cash flow patterns and differences in project scale.

For example, consider two projects one with an initial outlay of $1 million and another project with an initial outlay of $1 billion. It is possible that the smaller project has a higher IRR, but the increase in firm value (NPV) is small as compared to the increase in firm value (NPV) of the larger project.

In case of a conflict, we should always go with the NPV criterion because:

- The NPV is a direct measure of expected increase in value of the firm.
- The NPV assumes reinvestment of cash flows at the required rate of return (more realistic), whereas the IRR assumes reinvestment of cash flows at the IRR rate (less realistic).
- IRR is not useful for projects with non-conventional cash flows as such projects can have multiple IRRs , i.e., there are more than one discount rates that will produce an NPV equal to zero.

Comparison between NPV and IRR

NPV	IRR
Advantages	**Advantages**
Direct measure of expected increase in value of the firm.	Shows the return on each dollar invested.
Theoretically the best method.	Allows us to compare return with the required rate.
Disadvantages	**Disadvantages**
Does not consider project size.	Incorrectly assumes that cash flows are reinvested at IRR rate. The correct assumption is that intermediate cash flows are reinvested at the required rate.
	Might conflict with NPV analysis.
	Possibility of multiple IRRs.

3.3 Corporate Usage of Capital Allocation Methods

Analysts and corporate managers should understand the logic and practicalities of different capital allocation methods.

If a company can invest in a project that earns more than its opportunity costs of funds, then the investment creates value and will increase shareholder wealth. Conversely, if the project earns less than the company's opportunity cost of funds, then the investment decreases value and will reduce shareholder wealth. The return on invested capital (ROIC) is a measure that is often used to make these comparisons.

Relationship between NPV and Stock Price

- The value of a company can be measured as the existing value plus the present value of its future investments. NPV is a direct measure of the expected change in the firm's value from undertaking a capital project.
- A positive NPV project should cause a proportionate increase in a company's stock price. But, if the project's profitability is less than expectations, then the stock price may be negatively impacted.

Example

A company is undertaking a project with an NPV of $500 million. The company currently has 100 million shares outstanding and each share has a price of $50. What is the likely impact of the project on the stock price?

Solution:

NPV of the project = $500 million. The overall value of company should increase by $500 million because of the project. Since there are 100 million shares outstanding, each share should go up by 500/100 = $5. The share price should increase from $50 to $55.

Effects of Inflation on Capital Allocation process

Capital allocation analysis can be done either in 'nominal' terms or 'real' terms. Nominal cash flows include the effects of inflation. Whereas, real cash flows are adjusted downward to remove the effect of inflation. Nominal cash flows should be discounted at a nominal discount rate, and real cash flows should be discounted at a real rate. In general, the relationship between real and nominal rates is:

(1 + Nominal rate) = (1 + Real rate) (1 + Inflation rate).

Inflation reduces the value of depreciation tax savings. This is because the depreciation charge is based on the asset's original purchase price and it is not adjusted to match the current inflated price. Higher-than-expected inflation increases the corporation's real taxes and shifts wealth from the corporation to the government.

Inflation does not affect all revenues and costs uniformly. The company's after-tax cash flows will be better or worse than expected depending on how particular sales outputs or cost inputs are affected.

Inflation complicates the capital allocation process.

4. Real Options

Real options are options that allow managers to make decisions in the future that change the value of capital investment decisions made today. As with financial options, real options are contingent on future events. The difference is that real options deal with real assets.

Types of real options include:

- Timing options: A company can delay investing until it has better information.
- Sizing options: If a company can invest in a project and then abandon it if its financial results are weak, it has an abandonment option. Conversely, if the company can make additional investments when financial results are strong, it has a growth option.
- Flexibility options: Once an investment is made, operational flexibilities such as changing the price (price setting option), or increasing production (production flexibility option) may be available.
- Fundamental options: In this case, the whole investment is an option. For example, the value of an oil well or refinery depends on the price of oil. If oil prices are low, a company may not drill a well. If oil prices are high, the company may pursue drilling.

There are several approaches to evaluating capital allocation projects with real options. Four common sense approaches to real options analysis are presented below:

1. Use DCF analysis without considering options. If the NPV of the project without considering options is positive, then we can go ahead and make the investment. The presence of real options will simply add even more value. Therefore, it is not

necessary to determine the value of the options separately.

2. If NPV is negative without considering options, then calculate project NPV as: Project NPV = NPV (based on DCF alone) – Cost of options + Value of options. Check if the project NPV turns positive after the options are considered.
3. Use decision trees. They can help in many sequential decision-making problems.
4. Use option pricing models. These models are complex and the company may need the help of special consultants.

Example: Production-flexibility option
(*This is Example 3 from the curriculum.*)

Sackley AquaFarms estimated the NPV of the expected cash flows from a new processing plant to be –$0.40 million. Sackley is evaluating an incremental investment of $0.30 million that would give management the flexibility to switch between coal, natural gas, and oil as an energy source. The original plant relied only on coal. The option to switch to cheaper sources of energy when they are available has an estimated value of $1.20 million. What is the value of the new processing plant including this real option to use alternative energy sources?

Solution:

NPV, including the real option = NPV based on DCF alone – Cost of options + Value of options = -0.40 million – 0.30 million + 1.20 million = 0.50 million.
Without the flexibility offered by the real option, the plant is unprofitable. The real option to adapt to cheaper energy sources adds enough to the value of this investment to give it a positive NPV.

5. Common Capital Allocation Pitfalls

Common mistakes that managers make when analyzing capital allocation projects are:

- *Not incorporating economic responses into the investment analysis*: For example, if a project is successful, competitors can enter and reduce the project's profitability.
- *Misusing capital budgeting templates*: Many companies have standard capital budgeting templates. The manger may select a template that is not suitable for the project.
- *Pet projects*: Pet projects are projects backed by senior management. They may contain overly optimistic projections that overstate the project's profitability.
- *Basing investment decisions on EPS, net income, or return on equity*: The compensation of mangers is sometimes tied to EPS, net income, or ROE. They may therefore reject even strong positive NPV projects that reduce these accounting numbers in the short run.
- *Using IRR to make investment decisions*: For mutually exclusive projects, the NPV and IRR criteria may give conflicting results. Since the NPV criterion is more economically sound than IRR, in case of conflicts decisions should be based on NPV.

- *Bad accounting for cash flows*: For a complex project, it is easy to make mistakes such as omitting relevant cash flows, double counting cash flows, etc.
- *Overhead costs*: Overhead costs such as management time, information technology support, financial systems etc. may be over or underestimated.
- *Not using the appropriate risk-adjusted discount rate.*
- *Spending all of the investment budget just because it is available.*
- *Failure to consider investment alternatives.*
- *Handling sunk costs and opportunity costs incorrectly.*

Summary

LO.a: Describe the capital allocation process and basic principles of capital allocation.

Capital allocation is the process that companies use for decision-making on capital investments i.e., investments with a life of a year or more.

The steps in the capital allocation process are:

- Idea generation
- Investment analysis
- Capital allocation planning
- Monitoring and post-audit

Basic principles of capital allocation are:

1. Decisions are based on cash flows.
2. Cash flows are not accounting net income or operating income.
3. Cash flows are based on opportunity cost
4. Cash flows are analyzed on an after-tax basis
5. Timing of cash flows is vital
6. Financial costs are ignored

LO.b: Demonstrate the use of net present value (NPV) and internal rate of return (IRR) in allocating capital and describe the advantages and disadvantages of each method.

Net present value (NPV) is the present value of the future after-tax cash flows, minus the investment outlay (cost of the project). For independent projects, accept all projects with positive NPV. For mutually exclusive projects, accept the project with the higher NPV.

Internal rate of return (IRR) is the discount rate which makes NPV equal to 0. For independent projects, if IRR is greater than opportunity cost (required rate of return), accept the project, otherwise reject the project. For mutually exclusive projects, accept the project with the higher IRR as long as the IRR is greater than the opportunity cost.

Comparison between NPV and IRR:

NPV	IRR
Advantages	Advantages
Direct measure of expected increase in value of the firm.	Shows the return on each dollar invested.
Theoretically the best method.	Allows us to compare return with the required rate.
Disadvantages	Disadvantages

Does not consider project size.	Incorrectly assumes that cash flows are reinvested at IRR rate. The correct assumption is that intermediate cash flows are reinvested at the required rate.
	Might conflict with NPV analysis.
	Possibility of multiple IRRs.

LO.c: Describe expected relations among a company's investments, company value, and share price.

NPV is a direct measure of the expected change in the firm's value from undertaking a capital project. A positive NPV project should cause a proportionate increase in a company's stock price. But if the project's profitability is less than expectations, then the stock price might be negatively impacted.

LO.d: Describe types of real options relevant to capital investment.

The types of real options include:

1. Timing options
2. Sizing options - abandonment options or growth options
3. Flexibility options - price-setting options or production-flexibility options
4. Fundamental options

If NPV is positive without considering options, go ahead and make the investment.

If NPV is negative without considering options, calculate NPV (based on DCF alone) – Cost of options + Value of options.

Simple options can be evaluated with decision trees; for more complex options, the analyst should use option pricing models.

LO.e: Describe common capital allocation pitfalls.

Some of the common capital allocation pitfalls are listed below:

- Not incorporating economic responses into the investment analysis
- Misusing capital budgeting templates
- Pet projects
- Basing investment decisions on EPS, net income, or return on equity
- Using IRR to make investment decisions
- Bad accounting for cash flows
- Overhead costs
- Not using the appropriate risk-adjusted discount rate
- Spending all of the investment budget just because it is available
- Failure to consider investment alternatives
- Handling sunk costs and opportunity costs incorrectly

Practice Questions

1. Helix Corporation is evaluating an investment to enhance the safety at its manufacturing facility to meet the new government standards. The project is *most likely* a:
   A. new product or market development.
   B. mandatory project.
   C. replacement project.

2. Which of the following statements regarding capital allocation is *most likely* to be true:
   A. Opportunity costs must be factored in the cash flows.
   B. Interest costs must be factored in the cash flows.
   C. Cash flows should not factor in taxes.

3. Ecosense Industries is analyzing three projects for investment. The initial investments are $60 million, $50 million, and $40 million for projects A, B, and C, respectively. All three projects generate profits that are twice the initial investment. However, the company can select a maximum of two investments as the investment amount is capped at $100 million. The restriction is *most likely* a result of:
   A. project sequencing.
   B. capital rationing.
   C. mutually exclusive projects.

4. A capital project with an initial investment of $200 generates after-tax cash flows of $50, $100, and $150 in years 1, 2 and 3 respectively. The required rate of return is 8 percent. The net present value is *closest* to:
   A. $51.11.
   B. $62.11.
   C. $40.80.

5. A capital project with an initial investment of $100,000 generates after-tax cash flows of $50,000, $0, and $150,000 in years 1, 2, and 3 respectively. The cost of capital is 15 percent. The internal rate of return is *closest* to:
   A. 32.97 percent.
   B. 33.79 percent.
   C. 34.13 percent.

6. Which of the following is *most likely* correct statement?
   A. For independent projects, all projects with positive NPV should be accepted.
   B. For mutually exclusive projects, all projects with positive NPV should be accepted.

C. For mutually exclusive projects, all projects having IRR greater than opportunity cost should be accepted.

7. Apex Industries is investing in $500 million in a new capital project. The present value of the future after-tax cash flows resulting from the project is $600 million. Apex currently has 40 million outstanding shares trading at a market price of $82 per share. What is the theoretical effect of the new capital project on Apex's stock price *most likely* to be:
   A. Increase to $81.5.
   B. Decrease to $79.5.
   C. Increase to $84.5.

8. Two mutually exclusive projects have conventional cash flows, but one project has a larger NPV while the other has a higher IRR. Which of the following *most likely* explains this conflict?
   A. The size of the two projects is different.
   B. Both projects have similar cash flow patterns.
   C. The opportunity cost is different for both projects.

9. The NPV and IRR for two mutually exclusive projects are as shown below:

Year	**NPV**	**IRR (%)**
Project A	60	30
Project B	80	20

   If the required rate of return for both the projects is 10 percent, the appropriate investment decision would be?
   A. Invest in Project B because it has higher NPV.
   B. Invest in Project A because it has higher IRR.
   C. Invest in both projects.

Solutions

1. B is correct. Mandatory projects are required to address safety or environment related concerns. New product or market development would involve entering new market places. Replacement projects can be undertaken to replace obsolete machinery or reduce costs.

2. A is correct. Opportunity costs must be included in the incremental cash flows, as the decision to make the investment should factor in the next best use of the capital employed. Financing or interest costs are built into the discount rates or cost of capital that is used to discount the cash flows. Including interest costs in the cash flows would result in double counting. Taxes should be factored in the capital allocation decision.

3. B is correct. Capital rationing limits the total amount that can be invested. Hence, if the total amount of all the possible projects exceeds this limit, certain projects have to be shelved.

4. A is correct. (On the exam, use the CF function of your calculator)
   $\text{NPV} = -200 + \frac{50}{1.08} + \frac{100}{1.08^2} + \frac{150}{1.08^3} = \$51.11$

5. B is correct.
   The IRR calculated using the financial calculator is 33.79%

6. A is correct. Net present value (NPV) is the present value of the future after-tax cash flows, minus the investment outlay (cost of the project). For independent projects, accept all projects with positive NPV. For mutually exclusive projects, accept the project with the higher NPV. Internal rate of return (IRR) is the discount rate which makes NPV equal to 0. For independent projects, if IRR is greater than opportunity cost (required rate of return), accept the project, otherwise reject the project. For mutually exclusive projects, accept the project with the higher IRR as long as the IRR is greater than the opportunity cost.

7. C is correct. In theory, the stock price must increase by the NPV of the new capital project divided by the outstanding share base.
   NPV of the new capital project =$600 million - $500 million = $100 million.
   On a per-share basis, the addition adds value of = $100 million / 40 million = $2.5.
   Therefore, the new share price should be = $82 + $2.5 = $84.5.

8. A is correct. Conflicts between the NPV decision and IRR are due to differences in the scale/size of the project or the different cash flows pattern.

9. A is correct. While investing in mutually exclusive projects, the decision should be based on the NPV method as it uses the opportunity cost of funds as the discount rate. NPV correctly assumes that the intermediate cash flows are reinvested at the cost of capital or the opportunity cost of funds. IRR wrongly assumes that the intermediate cash flows for Project A are invested at 30%, while that for Project B are invested at 20%.

