7. Investment Projects. Criteria for Capital Budgeting. Special Issues

1.1 Criteria for Capital Budgeting

1.1.1 An Overview

In making capital budgeting decisions, managers must use both strategic qualitative evaluation and quantitative analysis to determine whether the project is wealth increasing. The process of determining exactly which assets to invest in and how much to invest is called **capital budgeting**. The cash outlays, called **capital expenditures**, are usually incurred to obtain **capital assets**.

The capital budgeting is a complex process that includes several activities:

- the search for new profitable investment,
- marketing and production analyses,
- financial forecasts (cash flow estimation),
- economic analysis,
- evaluation of proposals,
- control and monitoring of past projects.

Cash Flows Relevant to Capital Budgeting

Not all cash flows are relevant to capital budgeting.

- Capital budgeting does not focus on all of the firm's operating cash flows, but only on the **incremental cash flows after taxes**, denoted as CFATs, which occur if and only if an investment project is accepted.
- **Only future cash flows are relevant**. A common mistake is to include historical or sunk costs in the analysis.

Classification of Cash Flows After Tax (CFAT)

- Initial CFAT
- Operating CFAT
- Terminal CFAT

Initial cash flows

Direct cash flows	Indirect cash flows
Capital expenditures	After-tax proceeds of old assets sold
Operating expenditures	Change in net working capital

Operating cash flows

(1) $\Delta CFAT = (\Delta S - \Delta C - \Delta D)(1-T) + \Delta D$
     T is tax rate.

Terminal cash flows

- Salvage (scrap) value of the assets.

- Recovery of net working capital.

1.1.2 Basic Criteria

A criterion or rule is needed as the basis for deciding whether a particular project should be adopted. The conceptually sound criteria are following:

- net present value (NPV)
- internal rate of return (IRR)
- profitability index (PI).

Net Present Value Criterion

Formally,

(2) $NPV = PV_{inflows} - Pv_{outflows}$

It is implicitly assumed that the intermediate cash flows from a project are reinvested at the opportunity cost of capital. If the NPV is positive, it earns more than RRR and produces excess returns. NPV measures the economic profit created by accepting the project. Accepting a project with a positive NPV increases the company's market value by that amount. The NPV is superior to all other criteria for making correct capital budgeting decisions.

Internal Rate of Return Criterion

The IRR is the discount rate that makes the excess market value (NPV) of a project 0. Alternatively, the IRR is the discount rate that makes the present value of an investment's cash inflows equal to the present value of its cash outflows. **The IRR rule is accept a project if IRR > RRR and to reject the project if IRR < RRR.**

Profitability Index Criterion

The profitability index (PI) is simply a different way of presenting the same information that the NPV provides. The PI is the ratio of these two values:

(3) $PI = \dfrac{PV_{inflows}}{PV_{outflows}}$

The PI rule accepts projects if PI > 1 and rejects projects if PI < 1.

Payback Period Criterion

The payback period for a project measures the number of years required to recover the initial investment.

(4) $Payback\ period = \dfrac{initial\ investment\ outlay}{annual\ cash\ inflows}$

The discounted payback period is the number of years it takes for the discounted cash flows to yield the initial investment. It still ignores all cash flows beyond the discounted payback period.

Accounting Rate of Return Criterion

The **accounting rate of return criterion** (AROR) relates the profits provided by a project to its average investment:

(5) $AROR = \dfrac{annual\ profit}{average\ investment}$

1.2 Special Issues in Capital Budgeting

1.2.1 Non-conventional projects

An investment project with the cash flow pattern (-,…,-,+,+,…,+) is called a **conventional project**; a project with any other cash flow pattern is referred to as a **non-conventional project**. Non-conventional projects may cause IRR problems.

Multiple IRRs

Non-conventional cash flows and multiple IRRs may occur in oil and gas development projects, mineral recovery projects, some financial or insurance projects. Non-conventional projects may have multiple IRRs. Finding IRR is equivalent mathematically to solving a polynomial of the *n*th degree, so there can be *n* possible solutions or real roots. There can be as many IRRs as there are sign changes in the cash flow pattern.

1.2.2 Conflicts Between Capital Budgeting Criteria

Mutually exclusive projects

When mutually exclusive projects exist we can select either project A or project B, or we can reject both, but we cannot accept both projects. Conflicts between NPV and IRR may arise. The acceptance of any one project rules out the others. In such a situation NPV is a superior criterion, because it maximizes the wealth of shareholders.

1.2.3 Special Capital Budgeting Situations

Project ranking

Project ranking refers to identifying various projects in order of decreasing effectiveness. It is argued that project ranking is important when a company has limited financing sources. The rankings based on IRRs or PI may differ from the rankings based on the NPVs. The NPV and IRR or PI (profitability index) can lead to ranking conflicts and different project selections. To resolve the conflict, the manager should use the superior NPV criterion, simply because the NPV is consistent with the manager's objective of maximizing the wealth of shareholders.

Mutually Exclusive Projects with Different Lives

Mutually exclusive projects with different lives require special approach. This is an extraordinary situation when basic criteria are not used directly to select a project. The manager may use the **replacement chain method** or the **uniform annual series** (UAS) method. Both methods use the same philosophy and give the same results. The UAS method is preferable because it does not require an inconvenient replacement assumption.

The replacement chain method assumes replacement with an identical asset that has the same operating cash flows. Using this method we have to find common useful life for alternative projects. The lowest common life determines the horizon for the several replaced projects and then NPV criterion may be used. The UAS method converts project NPVs of alternative projects into uniform annual equivalent cash flows that then are compared. The UAS is more practical when the lowest common multiple of the projects' lives is a big number.

Optimal Replacement Decisions for Existing Assets

The UAS method is especially useful to determine the life of an asset (how long an asset should be used). We compute the UAS for each possible life of an asset and choose the highest UAS to find the optimal life.

Capital Rationing

Capital rationing refers to situation in which, the company attempts to select the combination of projects that will provide the greatest increment to firm value, **subject to some budget constraints**. Managers should accept all attractive investment opportunities, but some objective or subjective reasons cause the choice of only the best projects.

It is important to understand that this approach is inconsistent with the goal of value maximization. Regardless of how high the opportunity cost of capital may be, the firm should accept all the projects if their NPVs are positive. That it makes no sense to say that capital rationing exists because financing becomes to much expensive.

In selecting investment projects under capital rationing, it is necessary to understand that some projects are **divisible** and others are **indivisible**. Projects that should be accepted or rejected in their entirety are indivisible. The company should choose the combination of indivisible projects that maximizes the sum of their NPVs without exceeding the budget constraints. On the other hand, projects may be divisible. When projects are divisible, the profitability index criterion is appropriate to make the right decision. Projects may be ranked using PI values from highest to lowest, and then the highest-ranked projects that do not exceed the imposed capital budget may be selected.