

NPV and Capital Budgeting: A Short Note on Estimation of Project Cash Flows (Relevant to AAT Examination Paper 4 – Business Economics and Financial Mathematics)

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The most important value-driving decisions for a firm (and its shareholders) are investment decisions. While it is possible for a firm to get into trouble if it keeps making poor financing and working capital management decisions, its value is mainly determined by the prospects of its long-term investments.

Investments by firms can take one of two forms: the purchase of external, already-existing assets (mergers and acquisitions, i.e. M&As) and internally generated investment projects. Capital budgeting is the process of analyzing (more precisely, identifying and valuing¹) potential investment projects. There are three major inputs into capital budgeting that determine the usefulness of the analysis:

- 1) Investment decision rules (e.g., NPV, IRR and Payback Period methods)
- 2) Project cash flows
- 3) Project cost of capital (the interest rate used to discount the project's cash flows to determine its value²)

It follows that investment decisions made with appropriate investment decision rules, but with poor estimations on project cash flows and the discount rate, could still destroy shareholders' value.

This short note discusses a framework that can be used to identify and estimate the cash flows (NOT accounting income) arising from a capital budgeting project. An example, together with detailed answers, is provided to help AAT Examination Paper 4 candidates to gain hands-on experience in handling this topic in the examination.

How will the firm's total after-tax cash flows change if the new project is accepted?

The key to a new project's cash flows (CFs) is to think incrementally.

Basic economics informs us that a correct decision can only be made if all marginal benefits and marginal costs of an action (including investment activities) are considered in the decision-making process. In the context of capital budgeting, this can be captured by the following relationship:

$$\text{CFs (Project)} = \text{CFs (Firm with the project)} - \text{CFs (Firm without the project)}$$

¹ Valuing is done by estimating the present value of the expected cash flows from the project.

² Project cost of capital is also commonly known as the required rate of return of the project, which essentially is determined by the risk of the project.

These project-related cash flows are known as **incremental cash flows (cash flows arising from the project)**. Incremental cash inflows (outflows) should show up as a positive (negative) value on the left-hand side of the equation above. If the cash flows occur regardless of whether the project is undertaken (non-incremental), then CFs (Project) will be equal to zero.

In determining the project's incremental cash flows, it would be helpful to keep the following principles in mind:

- i) **Do NOT include sunk costs:** Costs that have already been incurred or money that has already been committed are irrelevant; only cash flows that are incurred now and/or in the future matter.

Examples of sunk costs:

- Consultation fee for a feasibility study of the project
- Past research and development expenditures.

To see how the equation above can be used to determine the incremental cash flows for the project, assume that the consultation fee for the feasibility study above is \$0.5m. It follows that

$$\text{CFs (Project)} = 0 = [-\$0.5\text{m (cash flows to the firm with the project judged as } \textit{feasible})] - [-\$0.5\text{m (cash flows to the firm with the project judged as } \textit{infeasible})]$$

- ii) **Include opportunity costs:** Any asset used for a project might have a higher value in some alternative use.

Example:

Let the relevant market interest rate r be 10%. A piece of land owned by the firm is to be used to build a new plant on. The piece of land could be sold for \$10m now (if the project is not undertaken) or \$15m at the end of the project period, in 10 years.

$$\text{NPV of foregone opportunity} = -\$10\text{m} + \frac{\$15\text{m}}{(1 + 0.1)^{10}} = -\$4.22\text{m}$$

The above calculations show that, by going ahead with the project, although the firm retains the ownership of the piece of land and reaps the benefits from the rise in the land value during the project, it has incurred an opportunity cost of 10% per year (the return it could have earned by investing the \$10m in financial assets of similar risk to the project). It follows that the “opportunity land cost” for the project is \$4.22m in today's dollars.

- iii) **Include all side effects:** The project may harm or enhance existing businesses (in terms of cash flows) of the firm.
- iv) **Do NOT include financing costs:** The costs of financing the project (such as interest payments on debt and dividend payments) have already been embodied in the project cost

of capital (r). To avoid double counting, financing costs should not be included as part of the project's incremental cash outflows.

- v) **Future inflation (or deflation)** must be taken into account when estimating future cash flows of the project, as it would affect not only the incremental cash inflows and outflows, but also the project cost of capital, k . [In this note, inflation will not be considered.]

Example:

A feasibility study costing \$800,000 commissioned by UShale Mining Inc. (UMI) has concluded that production capacity constraints will be the major hindrance to the firm's development over the next few years. The company's board has decided to build a new production facility to increase the firm's production capacity. The project is expected to last for 10 years. The following cash flows are estimated for the project:

- 1) The land which the facility will be built on is estimated to cost \$150 million to acquire and is expected to be worth \$350 million at the end of the project.
- 2) The construction cost of the production facility is estimated to be \$20 million. For tax purposes, the facility will be fully depreciated on a straight line basis over its estimated economic life of 10 years and is expected to be sold for \$4 million at the end of the project.
- 3) Machinery will have to be purchased for the production facility at a cost of \$10 million. For tax purposes, machinery will be depreciated at its full cost on a straight-line basis over its estimated economic life of 10 years. The machines are expected to be sold for \$1 million at the end of the project.
- 4) An initial increase in working capital of \$500,000 is required today and another \$750,000 at the end of Year 4 and Year 7, respectively. The working capital will be fully recovered at the end of the project.
- 5) To fund the project, UMI has borrowed \$100 million from the bank and the yearly interest charge is 5%.

The management of UMI estimates that the project will increase revenues and operating expenses (before depreciation and amortization) by \$8 million and \$3 million respectively in its first three years of operation and \$12 million and \$5 million respectively in the remaining seven years.

UMI's corporate income tax rate is 20% and its cost of capital (required rate of return of the project, given its risk) is 10%.

Based on the net present method, should the project be undertaken?

How to handle the cash flows from the project to arrive at an NPV estimate for the project:

This framework is based on the *cash flows timeline* of the project:

- a) Initial Investments (Investment outlays at the beginning of the project, $t = 0$)
e.g. Investments on land, machinery, equipment, production facility and change in net working capital.
- b) Present Value (PV) of the Net Cash Flows over the life of the project
 - i) PV of yearly after-tax cash flows from operations (assuming cash flows are the same every year)
= Yearly after-tax operating CFs \times PVIFA_(m,k) where m is the economic life of the project and k is the project cost of capital

Note: If there is no corporate income tax, there is no difference between before-tax and after-tax cash flows.

- ii) PV of yearly tax savings from depreciation of the assets (based on the straight-line depreciation method and the asset being fully depreciated)
= Yearly depreciation expense $(D = \frac{\text{Initial Cost}}{n}) \times \text{tax rate (T)} \times \text{PVIFA}_{(m, k)}$
where n is the economic life of the asset

Note: If there is no corporate income tax, T is equal to zero, and there will be no tax savings from depreciation of the assets. This item can be ignored completely.

- iii) PV of after-tax salvage value of the assets received at the end of the project
= After-tax salvage value \times PVIF_(m,k)
 - 1) After-tax (AT) salvage value of *Depreciable Asset i*
= Resale Price – Corporate Income Tax owed (if any)
= Resale Price – (Resale Price – Remaining Book Value $t = m$) \times Tax Rate (T)
= Resale Price – (Resale Price – (Initial Cost – Accumulated Depreciation at the end of the project)) \times T
= Resale Price – [Resale Price – (Initial Cost – $\frac{\text{Initial Cost}}{n} \times m$)] \times T

Note: If the economic life of the project is the same as that of the asset (i.e., $m = n$), the formula above could be simplified to the following:

AT salvage value of Depreciable Asset $i = \text{Resale Price} (1 - T)$

- 2) After-tax (AT) salvage value of *Non-Depreciable Asset i* (e.g. land) *
 = Resale Price – Capital Gains Tax (if any)
 = Resale Price – (Resale Price – Purchase Price) x T

Note: If there is no capital gains tax,

AT salvage value of Non-Depreciable Asset i = Resale Price

- iv) PV of the recovered net working capital
 = **The amount of NWC recovered** × $PVIF_{(m,k)}$
- v) PV of any other *one-off* cash flows expected to be received/paid at the end of the project (e.g., the *after-tax* “clean-up” cost of a coal mine incurred at the end of the project)

Note: As mentioned earlier, financing costs such as interest payments and dividends should NOT be included as part of the incremental cash flows in the calculation of the NPV of the project.

- c) NPV of the project
 = (b) – (a)
 NPV > 0 ⇒ Accept the project
 NPV < 0 ⇒ Reject the project

Suggested answers

(a) Initial costs of investment:

	\$
Land	150m
Production facility	20m
Machinery	10m
PV of working capital	1.3972m ($\$0.5m + \$0.75m \times PVIF_{(n=4, k=10\%)} + \$0.75m \times PVIF_{(n=7, k=10\%)}$)
Total	\$181.3972m

(b) PV of yearly after-tax cash operating income

$$= (\$8m - \$3m)(1 - 0.2) \times PVIFA_{(m=3, k=10\%)} + (\$12m - \$5m)(1 - 0.2) \times PVIFA_{(m=7, k=10\%)} \times PVIF_{(m=3, k=10\%)}^3$$

$$= \$9.9474m + \$20.4832m$$

$$= \mathbf{\$30.4306m}$$

(b_{ii}) PV of yearly tax savings from the depreciation⁴ of

$$\text{Production facility} = (\$20m/10 \times 0.2) \times PVIFA_{(m=10, k=10\%)} = \$2.4578m$$

$$\text{Machinery} = (\$10m/10 \times 0.2) \times PVIFA_{(m=10, k=10\%)} = \$1.2289m$$

$$\mathbf{\text{Sub-total} = \$3.6867m}$$

(b_{iii}) PV of after-tax salvage value of

$$\text{Land} = \$350m \times PVIF_{(m=10, k=10\%)} = \$134.9402m^*$$

$$\text{Production facility} = \$4m \times (1 - 0.2) \times PVIF_{(m=10, k=10\%)} = \$1.2337m^5$$

$$\begin{aligned} \text{Machinery} &= \$1m \times (1 - 0.2) \times PVIF_{(m=10, k=10\%)} \\ &= \$0.3084m^6 \end{aligned}$$

$$\mathbf{\text{Sub-total} = \$136.4823m}$$

Note: Although it is likely that all or some of the assets may be kept by the firm for other uses, project analysis (NPV analysis, in this case) requires that they be treated as sold at the market value at the end of the project.

³ If there is no corporate income tax, PV of cash operating income = $(\$8m - \$3m) \times PVIFA_{(m=3, k=10\%)} + (\$12m - \$5m) \times PVIFA_{(m=7, k=10\%)} \times PVIF_{(m=3, k=10\%)}$

⁴ If there is no corporate income tax, there will be no tax savings from depreciation of the assets. The calculations in (b_{ii}) could be ignored completely.

⁵ With no corporate income tax, the PV of the salvage value of the production facility = $\$4m \times PVIF_{(m=10, k=10\%)}$

⁶ With no corporate income tax, the PV of the salvage value of the machinery = $\$1m \times PVIF_{(m=10, k=10\%)}$

* Combined with the \$150m purchase price in (a), the opportunity land cost in today's dollar
= $-\$150\text{m} + \$111.8076\text{m} = (\$38.1924\text{m})$ (as explained on p.2)

(biv) PV of the fully recovered net working capital
= $(\$0.5\text{m} + \$0.75\text{m} + \$0.75\text{m}) \times \text{PVIF}_{(m=10, k=10\%)} = \mathbf{\$0.7710\text{m}^{**}}$

** Combined with the \$1.3972m working capital cost in (a), the opportunity cost of the working capital for the project

= $-\$1.3972 + \$0.7710\text{m} = (\$0.6262\text{m})$

Total [(b_i) + (b_{ii}) + (b_{iii}) + (b_{iv})] = \$171.3706m

Note: The 5% yearly interest on the \$100m loan (item (5) in the question) should be ignored since, as a financing cost of the project, it has been already been incorporated in the 10% project cost of capital given in the question.

(c) NPV = (b) – (a)
= $\$171.3706\text{m} - \181.3972m
= $(\$10.0266\text{m}) < 0$

Since the project's NPV is less than zero, reject the project.

Conclusion

This teaching note on estimating capital budgeting project cash flows has made several simplifying assumptions that are worth explicitly mentioning at the end of this article. The assumptions include the following:

- 1) Operating cash flows are assumed to be fixed every year, and thus can be treated as an ordinary annuity.
- 2) The straight-line depreciation method is adopted even though most firms would tend to use some sort of accelerating methods to reap the greatest tax saving benefits from the depreciation of the assets.
- 3) In estimating the opportunity land cost of the project, it was assumed that the piece of land is not yet owned by the firm. This assumption made the calculation of the after-tax salvage value of land and the underlying concepts much easier to handle.