Project Appraisal Techniques

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INTRODUCTION

The term 'project appraisal' embraces the techniques applied to determine the financial and/or economic viability of the creation of capital assets, so that decision-makers can identify and select those projects that offer the highest probability of adding to profitability and/or social welfare. The main issues that must be addressed are how to ensure that the information on revenues and expenditures (or on benefits and costs) attached to any such capital investment can be made commensurate, so as to allow decisions to be taken on a clear and consistent basis. Three basic problems complicate this task: the need to make allowances for project outlays and returns that occur over different time periods; the lack of reliable market prices for valuing some of these outlays and returns; and the need to allow for the possibility of multiple objectives in assessing alternative capital investments. This section will consider the three main techniques used to tackle these obstacles facing the consistent project appraisal of capital investments:

- *Discounted Cash Flow* (DCF) analysis takes account of the effects of different time periods when comparing projects where all resource values and opportunity costs are fully reflected in market prices (eg the commissioning of manufacturing plants operating within competitive factor and product markets);
- *Cost-Benefit Analysis* (CBA) tackles projects with significant impacts that are inadequately priced through the market (eg provision of new infrastructure with major externalities or public good characteristics);
- *Multi-Criteria Analysis* (MCA) is applied to projects designed to deliver a number of alternative objectives, the overall assessment of which requires the establishment of a specific preference ranking system to substitute for market forces (eg choosing between strategic options which involve health and safety issues, such as the storage of radioactive material).

BACKGROUND TO DCF

Traditional approaches for evaluating capital investments, such as pay-back periods, were superseded in the 1950s with the application of DCF techniques (Parker, 1968). DCF incorporates the price of borrowing directly into the decision-making rule for investment by discounting estimated future net income streams to their present value using a rate reflecting the interest on commercial loans (or the interest foregone by committing internal funds to the project).

MAIN FOCUS ON DCF

Table 1 sets out a simple example of the process. We assume an initial capital investment of £100m in the initial time period (normally taken to be a year), creating a negative cash flow of £100m in that year. The project becomes operational a year later, with recurrent (operational) costs of £4m in that period, bringing in revenue amounting to £44m, so the positive net cash flow for that period is £40m. The positive net cash flows in the subsequent two years of operation are £50m and £42m. The technique of DCF provides a way

DOI: 10.4018/978-1-4666-5202-6.ch172

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Table 1. Example of calculation of project cash flows (£000)

Time period	Expenditure		Revenue	Net cash flows	NPV conversion factor
	Capital	Recurrent			
t_0	100,000	0	0	-100,000	1
t_1	0	4,000	44,000	+40,000	$1/(1 + r)^1$
t_2	0	5,000	55,000	+50,000	$1/(1 + r)^2$
t_3	0	6,000	48,000	+42,000	$1/(1 + r)^3$

of comparing the present value of all these cash flows, by applying a discount rate reflecting the cost of borrowing (which also reflects the opportunity cost of using internal funds that could otherwise be placed on deposit to earn interest).

As indicated in the right-hand column, this discount rate *r* reflects the time period in which the net cash flow occurs. As the period before receipt increases, so the discount attached to the sum will rise, diminishing the current value of the cash flow. This simply reflects the fact that interest accrues with time: if the current rate of interest is 10% a year, then a sum of £100 received after three years is equivalent to depositing a sum of £75.13 in the bank now and waiting for three years for it to be worth £100. So £75.13 is the present value of £100 received three years later at such a rate of discount (which is what interest is termed when applied this way).

Table 2 demonstrates the process with a range of discount rates, to indicate how the cost of borrowing funds influences the profitability of the project. If funds are available at no cost and there are no alternative usages for project revenues that offer interest, then there is no need for discounting and the *net present value* (NPV) of all these cash flows is simply their arithmetic sum: £32m. As the interest rate rises from 5% to 10% and 15%, the NPV of the project falls successively to £19.7m, £9.3m and £0.2m. The latter sum indicates that a discount rate of 15% effectively reduces the NPV of the project to zero. This is termed the project's *internal rate of return* (IRR), indicating that if funds can be made available at a lower discount rate the project will have a positive NPV, but if they are only available at a higher rate it will have a negative NPV.

Table 3 demonstrates how the timing of cash flows can affect the relative profitability of alternative projects. Each of these has an initial capital cost of £100m, but project A takes only a year to produce a net cash flow of £165m (£300m revenue minus £135m recurrent costs), whereas project B has no returns in the first year after project construction, but a net cash flow of £182m (£300m revenue minus £118m recurrent costs) in the second year. To determine which has the greater NPV we must apply a discount rate reflecting the cost of borrowing funds. If we apply a discount rate of 10%, the NPV of both projects is £150m.

Table 2. Conversion of cash flows into net present value (NPV) at different discount rates

Time period	Net cash flows discounted to present value			
	at 0%	at 5%	at 10%	at 15%
t^0	-100000	-100000	-100000	-100000
t^1	1/1 = +40000	1/1.05= +38095	1/1.1 = +36364	1/1.15 = +34783
t^2	1/1 = +50000	1/1.102 = +45351	1/1.21 = +41322	1/1.322 = +37807
t^3	1/1 = +42000	1/1.157 = +36281	1/1.331= +31579	1/1.52 = +27616
NPV	+32,000	+19,727	+9,265	+206

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