Lecture

INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

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Chapter: Unit 4 Chapter 2

Chapter Name: Project assessment

Today's Agenda

1. Capital project
    1. Initial appraisal
    2. Evaluation of cashflows

2. Methods of project evaluation

2. Results of evaluation
    1. Simulation
    2. Results of analysis
    3. A note about tax

1 Capital project

Any project where there is initial expenditure and then, once the project comes into operation, a stream of revenues less running costs.

1.1 Initial appraisal

Initial appraisal means a new appraisal of the Borrower's inventory performed by an independent appraiser.

The main purpose of the initial appraisal of a proposed capital project is to decide whether the project will satisfy the criteria set by the sponsoring organisation that authorises the project.

These criteria will describe the financial results expected and (sometimes) the risk that these results may not be achieved. However, there may be many additional criteria in practice, including:

1. achieving synergy or compatibility with other projects undertaken by the sponsor
2. satisfying 'political constraints', both within and without the sponsoring organisation.
3. having sufficient upside potential
4. using scarce investment funds or management resources in the best way.

1.1 Initial appraisal

- During the appraisal process it will be necessary to investigate the main risks involved in the project and come to a view on the best course of risk mitigation, having regard to the costs involved.

- The remaining risks will need to be listed for the benefit of sponsors, lenders and investors, so that they can be considered in the decision-making process.

1.2 Evaluation of cash flows

There should then be an evaluation of the most likely cashflows for:

1. capital expenditure
2. running costs
3. revenues
4. termination costs.

These cashflows should be expressed in terms of present day money values and should exclude financing costs such as interest, depreciation, effects of price inflation, etc.

The cashflows should allow for any effects on the sponsor's other activities or costs.

Accurate definition and evaluation of the most likely cashflows is crucial to the success of the subsequent work, as these constitute a baseline.

2 Methods of Project evaluation

1. Net present value (NPV)

The NPV method models all the cashflows of a project until completion and discounts these back to the present day using the cost of capital.

- **If the result is positive then the project will improve shareholder returns.**
- Risk is best allowed for in the model explicitly so that the company will look at the weighted average NPV of a range of scenarios.
- The company would need to bear in mind its risk tolerance in deciding how to finance the project. The discount rate used could be different for different types of project.

Question

A retailer is considering opening a new store as a business venture. The purchase price of the store will be £2 million and there will be a further investment required of £0.5 million 6 months after purchase.

The store will open 12 months after purchase. Revenues less running costs are expected to occur continuously and will be £0.2 million in the first year of operation, £0.25 million in the second year of operation and thereafter increasing at yearly intervals by 4% per annum compound.

Eight years after purchase, a major refit costing £0.8 million will be required. Fifteen years after purchase, it is assumed that the store will be closed and sold for £6.4million.

The retailer requires a rate of return on its investment of 10% per annum effective.

(i) Calculate the net present value of the venture.

Solution

Present value of initial outlay $= 2 + 0.5\, v^{1/2} = 2.4767$

PV of 1st year's net revenue $= 0.2\, v\, \bar{a}_{\overline{1}|} = 0.2\, v^2\, i/\delta$

$= 0.2 \times 0.82645 \times 1.049206$

$= 0.1734$

PV of 2nd to 14th year of net revenue

$= 0.25\, v^2\, \bar{a}_{\overline{1}|} + 0.25 \times 1.04\, v^3\, \bar{a}_{\overline{1}|} + \ldots\ldots + 0.25 \times 1.04^{12} v^{14}\, \bar{a}_{\overline{1}|}$

$= 0.25 v^2\, \bar{a}_{\overline{1}|} \left(1 + 1.04\, v + \ldots + 1.04^{12}\, v^{12}\right)$

$= 0.25 v^3 \frac{i}{\delta} \left[\frac{1 - \left(1.04/1.10\right)^{13}}{1 - 1.04/1.10} \right]$

Solution

$= 0.25 \times 0.75131 \times 1.049206 \times 9.49094$

$= 1.8704$

PV of refit $= 0.8\,v^{8} = 0.3732$

PV of sale proceeds $= 6.4\,v^{15}$

$= 1.5321$

$\Rightarrow$ NPV $= 0.1734 + 1.8704 + 1.5321 - 2.4767 - 0.3732$

$=$ £0.726m

2 Methods of Project evaluation

2. Internal rate of return (IRR)

This is essentially the same in method of calculation as the NPV, the difference being that rather than discounting at the cost of capital, a solution is found for the interest rate that gives the project a zero NPV.

- **If this is higher than the cost of capital then the project may proceed.**

- However there are practical problems with the IRR approach.

1. Nonsense results can be obtained if the initial capital is small, giving very high positive (or negative) solutions, two solutions or no solution at all.
2. While the average net present value of a range of scenarios can be found simply by summing the value multiplied by the probability of the scenario, this is not the case for the internal rate of return.
3. It should be noted that the IRR equation can sometimes have multiple solutions, especially if there are net negative cashflows at some points during the operating life of the project or at completion. This has helped to make it less popular than the NPV as a measure of project worth.

2 Methods of Project evaluation

3. Annual capital charge

This method expresses the capital outlay as an annual charge, writing off the capital steadily over a period of years. This charge may then be offset against the benefits, and if the net result is positive, the project or capital expenditure can be approved.

- It shows the impact on the company's profit stream of an investment. The short-term impact on earnings may be highly sensitive, as it is very visible.

2 Methods of Project evaluation

4. Shareholder value approach

Shareholder value represents the present value of all expected current and future cashflows available to shareholders.

- The shareholder value method is based on but extends the NPV approach.
- The method has the important distinction that it is looking at the company from the point of the external shareholder and less on the internal issues governing the attractiveness of a project.
- The difference in rating is the value being placed by the market on the management's ability to grow the business profitably. If they have high confidence then the capitalisation of the company will be high in relation to its peers.
- The value-added approach then adds in the new project or company purchase and looks at all the valuation issues above to see what the impact is.

2 Methods of Project evaluation

4. Shareholder value approach

The important element of the value-added process now comes into action, for it has to look at the impact of the new project on the rating of the company.

Issues to be evaluated would include:

- impact on ranking versus competitors
- possible competitor reactions and change in level of competition
- impact on perception of management
- impact on analyst perceptions
- impact on debt rating
- enhancement or dilution of earnings
- impact on dividend policy
- impact on stock beta.

2 Methods of Project evaluation

5. Payback period

The payback period is defined as the time it takes for the accumulated cashflow to become neutral.

- In many small companies it is cashflow that is crucial and so the speed at which a project can recoup its initial investment is vital.
- **The project with the faster payback period will be preferred.**
- Alternatively, the method can be used to identify the project that generates the most funds over a specific period, say three years.

Question

The directors of ABC, a manufacturing company, evaluate projects using the payback method. The directors are reluctant to switch to the net present value criterion and are justifying their reluctance on the basis that the company has grown steadily since it was founded 20 years ago.

Describe the relevance of the payback criterion to ABC.

Solution

- The payback criterion does not make a full allowance for the time value of money
- or for risks and rewards associated with cash flows after the payback period has elapsed
- The criterion is not, therefore, necessarily consistent with the basic criterion of maximising shareholder wealth
- Despite that, it is realistic to suggest that a project that has a short payback period is likely to have a positive NPV and so it may be a satisfactory basis for identifying satisfactory projects
- ABC may also operate in a relatively low-risk industry and so have a low required rate of return on projects, in which case there is less risk of payback being misleading
- The fact that the criterion has been used for many years does not, in itself, mean that it has been successful. For example, the company could have invested in a number of negative NPV projects without that ever being noticed
- The company will also be unaware of the opportunity cost of investing in projects that had lower NPVs than alternatives that could have been selected instead

Question

A computer manufacturer is to develop a new chip to be produced from 1 January 2008 until 31 December 2020. Development begins on 1 January 2006. The cost of development comprises £9 million payable on 1 January 2006 and £12 million payable continuously during 2007.
From 1 January 2008 the chip will be ready for production and it is assumed that income will be received half yearly in arrear at a rate of £5 million per annum.

(i) Calculate the discounted payback period at an effective rate of interest of 9% per annum. [6]
(ii) Without doing any further calculations, explain whether the discounted payback period would be greater than, less than or equal to that given in part (i) if the effective interest rate were substantially greater than 9% per annum

Solution

Work in millions:

PV of liabilities $= 9 + 12v\,\bar{a}_{\overline{1}|}$ at 9%

$$= 9 + 12v.\frac{i}{\delta}v$$

$$= 9 + 12 \times 0.91743^2 \times 1.044354$$

$$= 19.54811$$

The assets up to $(k+2)$ years from 1 January 2006 have:

$$PV = 5v^2 a^{(2)}_{\overline{k}|} = 5v^2 \frac{i}{i^{(2)}} a_{\overline{k}|}$$

$$= 5 \times 0.84168 \times 1.022015 \times a_{\overline{k}|}$$

Solution

With $k = 6, PV = 4.301048 \times 4.4859$

$= 19.2941$

The next payment of 2.5 million at $k = 6.5$ is made at time 8.5 and has present value $= 2.5 \times v^{8.5} = 1.2018$

This would make PV of assets (20.5m) > PV of liabilities (19.5m)

$\Rightarrow$ Discounted payback period = 8.5 years.

(ii) The income of the development is received later than the costs are incurred. Hence an increase in the rate of interest will reduce the present value of the income more than the present value of the outgo. Hence the DPP will increase.

2 Methods of Project evaluation

6. Nominal returns

This is a variant of the payback period where one simply compares the ratio of cash generated to cash consumed over a period.

- It can give a quick idea of the relative profitability of projects and is an adequate approach where the ratio can quickly be seen to be high.

2 Methods of Project evaluation

7. Strategic fit

Strategic fit will normally form a part of every project evaluation as every project should fit logically with the business, building on its areas of expertise, resources or customer base.

- A particular future business scenario is identified, and a business response developed, on the assumption that this future projection holds good. Such an investment can reap huge rewards if the future goes as predicted and there are opportunities to be gained by being ahead of the pack. If things do not turn out as expected however, the project has to be carefully monitored to limit the potential downside.

- If a business makes the right investment decision then the required return comes as a byproduct and is not the deciding factor.

2 Methods of Project evaluation

8. Opportunity cost

The opportunity cost method asks 'What alternative ways could we spend this money and what return would be achieved?'

- It is all too easy to put up a project that may satisfy the business criteria for acceptance but may not actually be the best way of proceeding. There may be some alternative opportunity that is even better that has not been considered.
- This method can also on occasion justify spending when there is surplus capital that cannot for some reason be invested to earn the cost of capital return.
- This is not really a new method as all the items could be incorporated in the main methods; it is the focus of attention on alternatives that is the difference.

2 Methods of Project evaluation

9. Hurdle rates

The emphasis is that the company sets a target rate of return, or a hurdle rate. This could typically be quite high and well in excess of the true cost of capital.

- This is not a new method but can be incorporated in the methods above.
- The approach has the advantage of exposing the high potential projects which, if managed well, will bring in high returns.
- The flip side is that many excellent low-risk projects that would deliver good returns above the cost of capital (but below the hurdle rate) will never be considered.

2 Example

Outline the advantages of setting a standard hurdle rate of, for example, 15% p.a. for all investment projects undertaken by a large company.

Solution:

- The net present value criterion is the only method of investment appraisal that is entirely consistent with the concept of maximising shareholder wealth
- One of the problems associated with applying that concept is that each project should be evaluated at an appropriate discount rate that takes account of the risks associated with future cash flows
- Determining a suitable discount rate can be complicated, so setting a blanket rate across the whole company will have the effect of simplifying the application of NPV analysis
- Setting a blanket rate will avoid the pressures associated with managers arguing for reduced discount rates to justify projects that they are keen to promote
- The rate may not be perfectly suited to all projects, but it has been decided by the board and so they can be satisfied that projects are achieving an acceptable benchmark rate
- The company can also track the success rate of projects to determine whether the 15% threshold is leading to the acceptance of too many projects or too few

2 Methods of Project evaluation

10. Receipts/costs ratio

$$\frac{NPV\ of\ the\ \ gross\ revenues}{NPV\ of\ the\ capital\ and\ running\ costs}$$

3 Results of evaluation – Initial result

1. **Initial result**

- The result of an NPV calculation would usually be regarded as satisfactory if it was positive.
- The result of an IRR calculation would be regarded as satisfactory if it exceeded a predetermined 'hurdle rate' set by the sponsor.
- The payback period would be regarded as satisfactory if it was less than a predetermined period set by the sponsor.

3.1 Simulation

1. Sensitivity analysis

Having modelled the project for the purposes of evaluation, we may wish to apply sensitivity analysis to see how the value of the project changes with differing future conditions.

- We take each key assumption in turn and assess the effect on NPV of the most optimistic and pessimistic results occurring.
- A broad idea of the sensitivity of the results to varying assumptions can be obtained by assuming that all the costs are, for example, say 10% higher than the most likely values and all the revenues are, for example, say 10% worse than the most likely values.
- In this way, we can identify which are the variables that have the greatest effect on the outcome of the project, thereby determining where more information is needed

3.1 Simulation

2. Scenario testing

We consider some plausible combinations of input values and see what effect these have on the project.

- scenario testing will involve a limited number of plausible combinations, which may or may not include the most optimistic and pessimistic values.

3.1 Simulation

3. Monte Carlo simulation

Here we look at the entire distribution of possible project outcomes.

In order to do this we need to:
- model the project (usually on a computer), allowing for interdependencies and serial correlations
- specify probabilities for the distribution of the key variables (possibly investigated by the use of sensitivity testing)
- simulate the cashflows many times using values extracted randomly from the distributions of possible variable inputs
- record and order the outputs to assess their probability distributions.

This process is critically dependent on:
- appropriate model design
- appropriate assessment of the probability distribution of the inputs.

3.2 Results of the analysis

- The results obtained might, if very unsatisfactory, suggest that further analysis is not worthwhile without some fundamental redesign of the project.

- If, however, the results appear satisfactory, it is not sufficient to stop there, and a proper risk analysis should be undertaken

3.3 A note about tax

In the initial stages of the analysis it will usually be sensible to exclude the negative cashflows resulting from corporation tax, since these will depend (among other things) on the method of finance adopted and it is an unnecessary complication to rework the tax every time the NPV is reworked during the analysis.

At the final stage, when the investment submission is being prepared, the negative cashflows arising in respect of corporation tax can be evaluated (allowing for appropriate timelags in the collection of the tax) and discounted in order to arrive at a suitable deduction from the NPV.

Question

A piece of land is available for sale for £5,000,000. A property developer, who can lend and borrow money at a rate of 15% per annum, believes that she can build housing on the land and sell it for a profit. The total cost of development would be £7,000,000 which would be incurred continuously over the first two years after purchase of the land. The development would then be complete.
The developer has three possible project strategies. She believes that she can sell the completed housing:

in three years time for £16,500,000
in four years time for £18,000,000
in five years time for £20,500,000

The developer also believes that she can obtain a rental income from the housing between the time that the development is completed and the time of sale. The rental income is payable quarterly in advance and is expected to be £500,000 in the first year of payment. Thereafter, the rental income is expected to increase by £50,000 per annum at the beginning of each year that the income is paid.

Question

(i) Determine the optimum strategy if this is based upon using net present value as the decision criterion.

(ii) Determine which strategy would be optimal if the discounted payback period were to be used as the decision criterion.

(iii) If the housing is sold in six years time, the developer believes that she can obtain an internal rate of return on the project of 17.5% per annum. Calculate the sale price that the developer believes that she can receive.

(iv) Suggest reasons why the developer may not achieve an internal rate of return of 17.5% per annum even if she sells the housing for the sale price calculated in (iii).

Solution

(i) Net present value of costs $= 5,000,000 + 3,500,000\overline{a}_{\overline{2}|} = 5,000,000 + 3,500,000\frac{i}{\delta}a_{\overline{2}|}$

$= 5,000,000 + 3,500,000 \times 1.073254 \times 1.6257 = 11,106,762$

Net present value of benefits $= 450,000v^2\ddot{a}^{(4)}_{\overline{n-2}|} + 50,000v^2\left(I\ddot{a}\right)^{(4)}_{\overline{n-2}|} + S_n v^n$

$= 450,000v^2\frac{i}{d^{(4)}}a_{\overline{n-2}|} + 50,000v^2\frac{i}{d^{(4)}}\left(Ia\right)_{\overline{n-2}|} + S_n v^n$

where n is the year of sale and n S are the sale proceeds if the sale is made in year n.
If n = 3 the NPV of benefits

$= \left(450,000 \times 0.75614 \times 1.092113 \times 0.86957\right)$
$+ \left(50,000 \times 0.75614 \times 1.092113 \times 0.86957\right)$
$+ \left(16,500,000 \times 0.65752\right)$
$= 323,137 + 35,904 + 10,849,080 = 11,208,121$

Solution

Hence net present value of the project is 11,208,121 11,106,762 = 101,359

Note that if n = 4 the extra benefits in year 4 consist of an extra £1.5 million on the sale proceeds and an extra £650,000 rental income. This is clearly less than the amount that could have been obtained if the sale had been made at the end of year 3 and the proceeds invested at 15% per annum. Hence selling in year 4 is not an optimum strategy.

If n = 5 the NPV of benefits
450,000 0.75614 1.092113 2.2832
50,000 0.75614 1.092113 4.3544
20,500,000 0.49718
848,450 179,791 10,192,190 11,220,431

Hence net present value of the project is 11,220,431 11,106,762 = 113,669
Hence the optimum strategy if net present value is used as the criterion is to sell the housing after 5 years.

Solution

(ii) If the discounted payback period is used as the criterion, the optimum strategy is that which minimises the first time when the net present value is positive. By inspection, this is when the housing is sold after 3 years

(iii) We require

$$5,000,000+3,500,000\frac{i}{\delta}a_{\overline{2}|}=450,000v^2\ddot{a}^{(4)}_{\overline{n-2}|}+50,000v^2\left(I\ddot{a}\right)^{(4)}_{\overline{n-2}|}+S_nv^n \text{ at } 17.5\%$$

$$\text{LHS}=5,000,000+3,500,000\left(\frac{1-v^2_{0.175}}{\delta_{0.175}}\right)=5,000,000+3,500,000\left(\frac{1-0.72431}{0.16127}\right)$$

$$=10,983,227$$

$$\text{RHS}=450,000v^2_{0.175}\left(\frac{1-v^4_{0.175}}{d^{(4)}}\right)+50,000v^2_{0.175}\left(\frac{\ddot{a}_{\overline{4}|}-4v^4_{0.175}}{d^{(4)}}\right)+S_6v^6_{0.175}$$

$$d^{(4)}_{0.175}=4\left(1-v^{1/4}\right)=0.15806$$

$$\ddot{a}_{\overline{4}|}=\frac{1-v^4}{d}=3.1918$$

Solution

Therefore we have on the RHS

$$450,000 \times 0.72431 \times 3.0076 + 50,000 \times 0.72431 \times \left(\frac{3.1918 - 2.0985}{0.15806} \right) + 0.37999 S_6$$

$$= 980,296 + 250,502 + 0.37999 S_6$$

$$\text{For equality } S_6 = \frac{10,983,227 - 1,230,798}{0.37999} = £25,665,000$$

(iv) Reasons investor may not achieve the internal rate of return:

Allowance for expenses when buying/selling which may be significant.
There may be periods when the property is unoccupied and no rental income is received.
Rental income may be reduced by maintenance expenses.
Tax on rental income and/or sale proceeds