



Project Cost Management

Investment Appraisal

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Investment Appraisal: Some introductory notes

All forms of investment appraisal work on the basis that a statement is made of the anticipated outcomes of a project which is then processed in a formal manner so that a conclusion can be drawn as to the viability of the project in either meeting a set of objective criteria which are applied to all the firm's projects, or satisfying the firm that this particular project offers the most cost effective solution to a problem.

Fundamentally, an investor will need to be satisfied that the proposed project is going to deliver a rate of return that exceeds costs by a margin that is sufficient to justify the risks taken, hence most appraisal techniques are concerned with rates of return (however defined) over time. The calculation of a rate of return for a project is the means by which its performance can be measured against the performance of alternative courses of action, and is also the means by which the impact of the project upon the investor's wealth can be measured. The time element is often used as a proxy for risk in that a short life project is inherently less vulnerable to change than a long life project.

Investment Appraisal: Some introductory notes (cont.)

Investment appraisals may be either forward looking or backward looking.

Forward looking appraisals attempt to answer the question: Is this project the best available way to achieve our current objectives?

Backward looking appraisals address the question: Has this project achieved what was expected of it, and if not, should we stay with it or get out and use the resources tied up in it elsewhere?

Types of Investment Appraisal

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There are a great number of methods of appraisal ranging from the simple, intuitive types to the highly complex. The following are just a few examples of the more commonly used methods.

Investment Appraisal: Some introductory notes (cont.)

1. Payback

This method turns Upon the length of time it takes for a projected investment to pay back the money that has been tied up in it.

A firm is evaluating two schemes for increasing its output. are as follows:

The costs and benefits of the schemes

Alternative 1

Year	Costs	Net Income	Net Cash Flow	Cumulative CF
0	-10,000		-10,000	-10,000
1		1,500	1,500	-8,500
2		2,000	2,000	-6,500
3		3,000	3,000	-3,500
4		3,500	3,500	0
5		3,500	3,500	3,500
6		3,500	3,500	7,000
7	2,000	4,000	6,000	13,000

Payback 4 years

Alternative 2

Year	Costs	Net income	Net Cash Flow	Cumulative CF
0	-12,000		-12,000	-12,000
1		2,000	2,000	-10,000
2		4,000	4,000	-6,000
3		4,000	4,000	-2,000
4		5,000	5,000	3,000
5		3,000	3,000	6,000
6		2,500	2,500	8,500
7	2,200	2,000	4,200	12,700

Payback 3.4 years

Investment Appraisal: Some introductory notes (cont.)

Note: In representing the cash flows of a project, the convention is that all sums entering or leaving the project do so at the END of the accounting period in question. Thus the net income of £2,000 shown against Year 1 of Alternative 2 represents the net surplus of income over outgoings which have taken place over the course of the first year - we have to have arrived at the end of the year before we know what this figure will be. This then gives us the problem of finding a time slot to which the £12,000 costs can be allocated. The convention here is that such costs are allocated to "Year 0" i.e. to the very end of the accounting period preceding year 1. Effectively, "Year 0" represents the start of Year 1.

An analysis of the above alternatives suggests that Alternative 2 is to be preferred on payback grounds as it recovers its capital costs in 3.4 years as opposed to the 4 years it takes to do likewise for Alternative 1.

Investment Appraisal: Some introductory notes (cont.)

Intuitively this would be a safe decision to make. The sooner a project can recover its capital costs the less interest will be paid on any borrowing that was undertaken to finance the project, and the sooner surpluses can be either reinvested into the business or extracted from it in the form of income to the owners. In addition to this, the estimates of net income in the early years are more likely to be accurate than are those for the later years when presently unforeseen changes in the market may depress them.

However, if we look further than the payback horizon, we can see that Alternative 1 may, in the longer term be a better prospect. Over seven years, and taking into account the scrap value of the equipment, it delivers a bigger margin over cost than its rival. The question then arises as to whether it is worth waiting for this additional return. Also there could be a problem in using this method if a large item of cost was forecast to arise at some time after the payback period.

Investment Appraisal: Some introductory notes (cont.)

2. Return on Capital Employed

There are many different ways of calculating ROCE (sometimes also known as the Accounting Rate of Return), what follows is simply a typical outline of the type.

Alternative 1

Year	Net Income	Depreciation	Profit
0			
1	1,500	1,143	357
2	2,000	1,143	857
3	3,000	1,143	1,857
4	3,500	1,143	2,357
5	3,500	1,143	2,357
6	3,500	1,143	2,357
7	4,000	1,143	2,857

Alternative 2

Year	Net Income	Depreciation	Profit
0			
1	2,000	1,400	600
2	4,000	1,400	2,600
3	4,000	1,400	2,600
4	5,000	1,400	3,600
5	3,000	1,400	1,600
6	2,500	1,400	1,100
7	2,000	1,400	600

Investment Appraisal: Some introductory notes (cont.)

Alternative 1

Total Profit:	13,000
Avg Profit:	1,857 [13,000/7]
Initial Capital Employed	10,000
Average Capital Employed	5,000
Return on Initial Capital Employed	19%
Return on Average Capital Employed	37%

Alternative 2

Total Profit:	12,700
Avg Profit:	1,814
Initial Capital Employed	12,000
Average Capital Employed	6,000
Return on Initial Capital Employed	15%
Return on Average Capital Employed	30%

The above example of ROCE which reworks the data from the Payback example requires some explanation as to the conventions used:

Depreciation (a complex subject in its own right) is worked out on the simplest basis possible. The plant cost (in Alternative 1) is £10,000, seven years later it is sold for scrap for £2,000. The average amount of depreciation pa is therefore:

$$\frac{10,000 - 2,000}{7} = 1,143$$

Investment Appraisal: Some introductory notes (cont.)

The 'Profit' each year is then calculated as being net income minus depreciation, in other words an allowance has now been made for the fact that plant wears out as part of the production process. On this basis, Total Profit comes to £13,000, and Average Profit pa to £1,857.

Return on Initial Capital Employed is therefore:

$$\frac{1,143}{10,000} = 19\%$$

Return on Average Capital Employed is:

$$\frac{1,143}{5,000} = 37\%$$

Investment Appraisal: Some introductory notes (cont.)

On these figures, Alternative 1 would be chosen as showing the best ROCE. This, however, contradicts our earlier conclusion that on the payback criterion Alternative 2 was to be preferred. If this were to be the only analysis done, then the argument would have to be settled by reference to the firm's "hurdle" rates of payback and ROCE. Provided that the firm was happy to accept a maximum payback period on all of its projects of (say) 4 years, the Alternative 1 could be accepted as satisfying this **and** having the higher rate of return. If not, then Alternative 2 could be considered and having a safer payback profile but at the cost of a lower rate of return.

This confusing situation arises because neither technique has attempted to take into account the value to the investor of the timing of the cash flows. Alternative 1 is more profitable, but the bulk of the profit comes in late on in the project. How can this be balanced against Alternative 2 which is more costly, but shows its profitability in the early years?

Investment Appraisal: Some introductory notes (cont.)

3. Discounted Cash Flow

The use of DCF enables both the weight and the timings of a project's benefits to be taken into account when evaluating it both objectively (i.e. determining whether or not it meets the investor's global criteria for all projects), and in comparison to other investment opportunities. At the heart of the DCF lies the notion that if all of the costs and benefits of a project are translated into their values at a single point in time, then by simply subtracting cost from benefit a "time free" figure will emerge which can then be evaluated against comparators which have been similarly derived.

In the example below the Net Cash Flows of Alternatives 1 & 2 have been calculated as before and set against the time periods in which they occur. Each NCF is then discounted back to its Present Value at the start of the project (Year 0) at an appropriate discount rate - in this case 15%. The DCF column itemises these figures.

Investment Appraisal: Some introductory notes (cont.)

The Net Present Value of the project is simply the sum of the DCFs and represents the present

Values of all the positive and negative cash flows of the project.

Alternative 1

Year	Costs	Net Income	Net Cash Flow	DCF @ 15%
0	-10,000		-10,000	-10,000
1		1,500	1,500	1,304
2		2,000	2,000	1,512
3		3,000	3,000	1,973
4		3,500	3,500	2,001
5		3,500	3,500	1,740
6		3,500	3,500	1,513
7	2,000	4,000	6,000	2,256

NPV = 2,229

Alternative 2

Year	Costs	Net income	Net Cash Flow	DCF @ 15%
0	-12,000		-12,000	-12,000
1		2,000	2,000	1,739
2		4,000	4,000	3,025
3		4,000	4,000	2,630
4		5,000	5,000	2,859
5		3,000	3,000	1,492
6		2,500	2,500	1,081
7	2,200	2,000	4,200	1,579

NPV = 2,404

Investment Appraisal: Some introductory notes (cont.)

$$\begin{aligned} & 3,500 * \frac{1}{(1+r)^n} \\ &= 3,500 * \frac{1}{(1.15)^6} \\ &= 3,500 * 0.432327 \\ &= £1,513 \end{aligned}$$

In the example, Alternative 1 is seen to have a NPV of £2,299. What this means is that if we were to finance it at a rate of interest of 15%, the income that it generated would be sufficient to pay back all the borrowed money, interest on it at 15%, and there would still be a sum of money whose PV is £2,299 left over at the end. This can be illustrated as follows:

Investment Appraisal: Some introductory notes (cont.)

Year	Net Cash Flow	Interest @ 15%	Cumulative + Interest
0	-10000		-10000
1	1500	-1500	-10000
2	2000	-1500	-9500
3	3000	-1425	-7925
4	3500	-1189	-5614
5	3500	-842	-2956
6	3500	-443	101
7	6000	15	6116

PV of 6,116 for 7 years @ 15% = 2,299

In comparing the two projects, which one offers the most promising prospects? The decision rule for this kind of analysis is that the project with **highest** NPV should be chosen provided that the rate of discount used is greater than the firm's cost of borrowing. In this case it is clearly Alternative 2 as it would show the greater surplus of revenue over all costs, including finance, over the seven years. The main reason why Alternative 2 comes out ahead (in spite of its being more expensive to set up) is that the returns come in early on in the project's life. This means that if the project is financed on borrowed money, the borrowings can be paid back more quickly and therefore generate less interest payments than, for example Alternative 1 which starts slowly and builds up to its best returns in the later years. In a way, this validates the intuition that lay behind the Payback method outlined earlier.

Investment Appraisal: Some introductory notes (cont.)

There remains, however, a nagging doubt that perhaps Alternative 2 is showing the higher NPV because it is simply a bigger project. What we now need to do is to check which of the projects is making the best use of the money tied up in it, regardless of size.

We already know that each of the alternatives generates sufficient income over its lifetime to repay the costs, interest payments on those costs (at 15%) and still have some left over at the end, i.e. they are both yielding a rate of return of at least 15%. What we now have to do is discover the rate of interest which, if applied to the project will exactly account for all the surplus of income over cost. Expressed formally, we need to find the rate of discount which will bring the NPV to zero.

There is no single formula that can be applied to the data to arrive at this figure. Trial and error is the method used. At 15% Alternative 1 has a positive NPV of 2,299. The discount rate necessary to bring this down to zero is therefore going to be greater than 15%. If a rate was applied to the NCF which resulted in a negative NPV, then clearly the project would be yielding a rate of return of less than that rate. By trial and error we can home in on the rate which will deliver a NPV of zero

Alternative 1

NPV =				2,299		316		-347
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By interpolation: $20\% + \left[\frac{316}{633} * \frac{2}{100} \right] = 20.99\%$

Investment Appraisal: Some introductory notes (cont.)

Graphically:

The graphical method requires that the NPV for a range of discount rates is calculated and that the results are plotted against each other. The IRR can then be read off at the point where the NPV curve intersects the discount rate axis - i.e. where the $NPV = 0$. Care must be taken to ensure that both positive and negative results for the NPV are found so that an intersection can actually take place. Additionally, the incremental test rates used must be fairly close together, otherwise the points on the NPV curve will approximate to a straight line which will produce an inaccurate reading at the intersection.

The test rates:

Investment Appraisal: Some introductory notes (cont.)

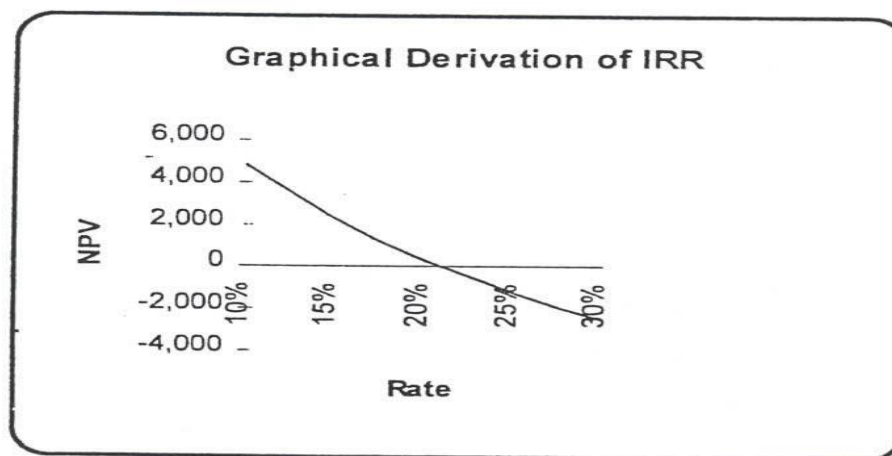
Alternative 1

Year	Costs	Net Income	Net Cash Flow	DCF @ 10%	DCF @ 15%	DCF @ 20%	DCF @ 25%	DCF @ 30%
0	-10,000		-10,000	-10,000	-10,000	-10,000	-10,000	-10,000
1		1,500	1,500	1,364	1,304	1,250	1,200	1,154
2		2,000	2,000	1,653	1,512	1,389	1,280	1,183
3		3,000	3,000	2,254	1,973	1,736	1,536	1,365
4		3,500	3,500	2,391	2,001	1,688	1,434	1,225
5		3,500	3,500	2,173	1,740	1,407	1,147	943
6		3,500	3,500	1,976	1,513	1,172	918	725
7	2,000	4,000	6,000	3,079	2,256	1,674	1,258	956

NPV = 4,889 2,299 316 -1,228 -2,448

Investment Appraisal: Some introductory notes (cont.)

The curve:



Alternative 1 has an **INTERNAL RATE OF RETURN** of 20.99% (by interpolation) or 21% (graphically). What this means is that the income generated by the project would be just sufficient to repay the cost of the project if those costs were to be financed by a loan at 20.99% interest. If borrowing investment funds cost less than this, then the project would be viable provided that there was sufficient margin between the rate and the IRR to compensate the investor for the risks of the project.

Applying the same principles to Alternative 2 we find the following:

Investment Appraisal: Some introductory notes (cont.)

Alternative 2

Year	Net Cash Flow	DCF @ 15%	DCF @ 20%	DCF @ 22%
0	-12,000	-12,000	-12,000	-12,000
1	2,000	1,739	1,667	1,639
2	4,000	3,025	2,778	2,687
3	4,000	2,630	2,315	2,203
4	5,000	2,859	2,411	2,257
5	3,000	1,492	1,206	1,110
6	2,500	1,081	837	758
7	4,200	1,579	1,172	1,044

NPV= 2,404 386 -301

In this case the IRR works out at $20\% + [(386/687) \times (2/100)] = 21.12\%$. As the decision rule in cases where the IRR is used is that the project showing the highest rate should be chosen (provided that the rate is greater than the investor's cost of finance), then Alternative 2 would be the preferred option.

Once again, this figure can be tested to see if it would work out in practice. If the £12,000 initial investment were to be borrowed at 21.12%, would the income be sufficient to pay back the loan and all the interest on it?

Investment Appraisal: Some introductory notes (cont.)

Year	Net Cash Flow	Interest @ 21.12%	Cumulative + Interest
0	-12,000		-12000
1	2000	-2532	-12532
2	4000	-2644	-11177
3	4000	-2358	-9535
4	5000	-2012	-6547
5	3000	-1381	-4928
6	2500	-1040	-3468
7	4200	-732	0

Clearly, it does.

As an indicator of potential performance and as a tool for decision making, the IRR has a number of advantages. It enables a direct comparison to be made between the performance of the project and the performance of the funds tied up in it were they to be invested elsewhere. It does this by demonstrating the rate of return to be had from the money which is tied up in each period of the project in rather the same way as interest would be calculated on a bank account. Also, by expressing the performance of the project as a percentage rate of return pa, it fits easily into the thinking of those who have to make the decision to invest against the backdrop of all the other considerations which need to impinge upon the decision such as the rate of inflation, the allowances made for risk and uncertainty, the returns on competing outlets for funds, the returns which competitors are achieving etc.

Investment Appraisal: Some introductory notes (cont.)

The method is not without its drawbacks, however, and chief of these is that it can, under certain circumstances, produce two (or more) different answers to the same problem.

This is shown in the example given below. The example is admittedly somewhat contrived, but it does illustrate the possibility of **multiple yields**.

Multiple Yields

Year	NCF	DCF @ 4.00%	DCF @ 5.00%	DCF @ 37.00%	DCF @ 39.00%
0	-1,100	-1,100.00	-1,100.00	-1,100.00	-1,100.00
1	1,500	1,442.31	1,428.57	1,094.89	1,079.14
2	-1,500	-1386.83	-1,360.54	-799.19	-776.36
3	5,000	4,444.98	4,319.19	1,944.50	1,861.77
4	-3,995	-3,414.94	-3,286.70	-1,134.06	-1,070.18
TOTAL	-95.00	-14.49	0.52	6.15	-5.63

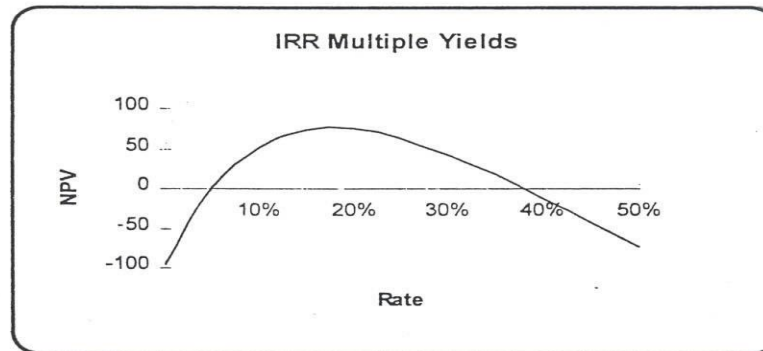
Investment Appraisal: Some introductory notes (cont.)

$$\text{IRR (1)} = 4.52\%$$

$$\text{IRR (2)} = 39.09\%$$

In this case the NPV can be brought to zero at both 4.52% and 39.09%!!

What is happening can be shown graphically:



Or in table form:

Rate	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
NPV	-95	0.52	51	73	75	63	43	17	-11	-42	-74

Investment Appraisal: Some introductory notes (cont.)

Whilst the possibility of a multiple yield exists in any IRR calculation, it is most likely to occur in situations where there are substantial changes from positive to negative in the NCF, or in situations where there is an unusual pattern of cash flows e.g. large negative CFs at the very end of a project. If it is suspected that there might be a multiple yield, then the project should be tested at a variety of rates to get a feel for the direction of the NPV.

Having said this, we are still left with a problem which has two very different answers. One way to overcome this is to rearrange the NCF in such a way as to eliminate the changes of sign in the NCF. In the example below the costs are brought back to their Present Values at 10%, and then a rearranged NCF column is constructed out of this and the positive cash flows from the other years. This is then discounted in the normal way and the IRR found by interpolation between the NPV s at 10% and 12%.

Investment Appraisal: Some introductory notes (cont.)

Multiple Yields

Year	NCF	PV costs @10%	Rearranged CF	DCF @ 10.00%	DCF @ 12.00%
0	-1100	-1100	-5068	-5068	-5068
1	1500	0	1500	1364	1339
2	-1500	-1240	0	0	0
3	5000	0	500	3757	3559
4	-3995	-2729	0	0	0
TOTAL		-5068		52	-170

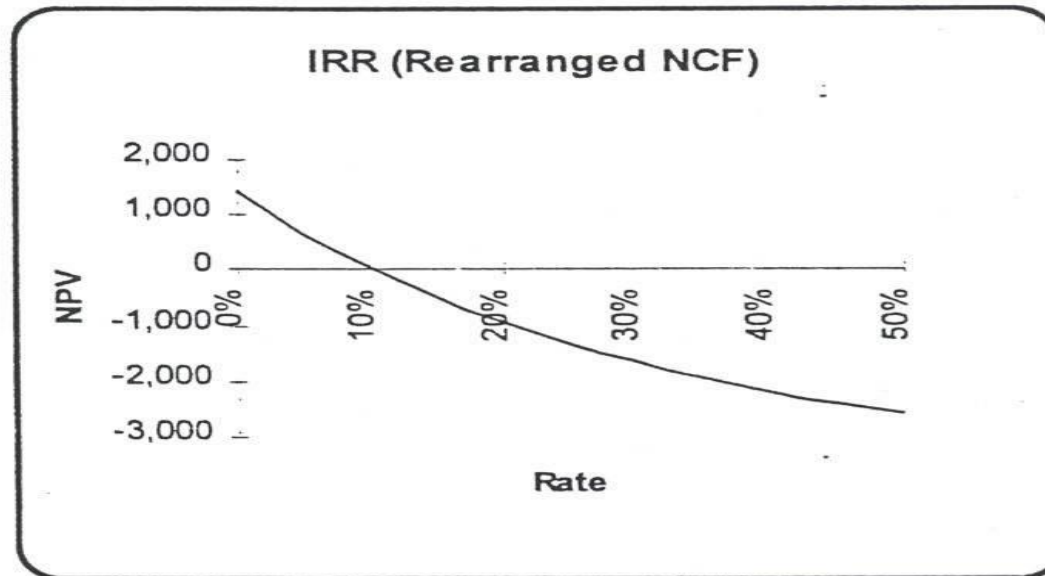
IRR = 10.47%

This gives yet another result, 10.47%.

Which is correct?

If the rearranged cash flows are discounted over a range of rates, and the results presented graphically it can be seen that 10.47% is the unique solution to the problem:

Investment Appraisal: Some introductory notes (cont.)



Rate	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
NPV	1431	679	51	-476	-924	-1308	-1638	-1924	-2174	-2393	-2586

Investment Appraisal: Some introductory notes (cont.)

The above method sorts out the problem of multiple yields, but at a cost. The costs of the project have been discounted at a given rate (10%) whereas the benefits have been allowed to find their own level. In reality this may not be such a bad thing in that the costs of financing the project should be known in advance along with all the other costs.

Another drawback of the IRR (and NPV) methods centres around the problem of **reinvestment rates**.

The NPV is worked out on the assumption that once the initial costs (and interest on them) have been recovered out of the income of the project, any further surpluses will attract interest at a rate equal to the discount rate. Another example will help to explain this.

Investment Appraisal: Some introductory notes (cont.)

Project A

Project B

Year	NCF	Interest @ 10.05%	Cumulative + Interest		NCF	Interest @ 16.63%	Cumulative + Interest
0	-475		-475.00		-475		-475.00
1	150	-47.72	-372.72		400	-79.01	-154.01
2	150	-37.45	-260.17		100	-25.62	-79.63
3	150	-26.14	-136.31		50	-13.24	-42.87
4	150	-13.69	0.00		50	-7.13	0.00

Projects A and B have IRRs of 10% and 16% respectively. Project B is able to achieve its higher rate of return not because it delivers a great deal more over costs than Project A (they both have a surplus of £125), but because its benefits are available sooner and are assumed to be reinvested in the project at a rate of interest of 16.63%. The question then arises as to why it is logical that the surpluses of Project B can be invested at such a much higher rate than the surpluses of Project A?

Investment Appraisal: Some introductory notes (cont.)

Clearly this is not logical and constitutes one of the biggest drawbacks to the use of IRR as a decision tool. There is no reason why sums of money arising from different sources should be regarded as being able to be reinvested at such different rates. In reality, a firm would choose to invest its surpluses in the same way and at the same rate, regardless of the source.

To overcome this problem either the use of IRR should be abandoned in favour of NPV, or a modified version of IRR could be used.

The Modified or Adjusted Internal Rate of Return

This rather complex measure calculates the cut off rate of return which can be accepted for a project in situations where there will be a discrepancy between the borrowing rate and the reinvestment rate. This is not an infrequent occurrence - the rate at which a firm is able to borrow funds would normally be greater than the rate at which it could reinvest any surpluses that it makes.

Example: *A firm is evaluating a project, the NCF of which is given below. The project will be financed by a loan taken out at 12%, but the firm is only able to reinvest any surpluses at 5%.*

Borrowing Rate	12%
Reinvestment Rate	5.0%

The Modified or Adjusted Internal Rate of Return (cont.)

Year	NCF	PV Costs @ 12.00%	TV Revenue @ 5.00%
0	-100,000	-100,000	0
1	40,000	0	48,620
2	50,000	0	57,881
3	30,000	0	33,075
4	40,000	0	42,000
5	-10,000	-5,674	0
TOTALS		-105,674	181,577

IRR 20.4%

MIRR 11.4%

The Modified or Adjusted Internal Rate of Return (cont.)

To calculate the MIRR it is necessary to reorganise the data in such a way that the negative elements of the NCF are separated from its positive elements. Negative elements (costs) are discounted back to NPV at the, BORROWING rate, and the positive elements (surpluses) are compounded forward to TV (Terminal Value) at the REINVESTMENT rate.

The MIRR is then arrived at by applying the following formula:

$$\text{MIRR} = \left[TV_r / PV_c^{(1/n)} \right] - 1$$

Where:

TV = Terminal Value of surpluses at the reinvestment rate

PV = Present Value of costs at the borrowing rate

n = Length of appraisal period in years

The Modified or Adjusted Internal Rate of Return (cont.)

Substituting:

$$\text{MIRR} = \left[(181,577 / -105,674)^{(1/5)} \right] - 1$$

$$\text{MIRR} = 11.4\%$$

Using the IRR method, all costs and surplus revenues are assumed to have the same rate of discount applied to them. In the example above, the IRR shows a return of 20.4% which is comfortably above the borrowing rate and which would "therefore signal acceptance of the project. If, however, the surpluses generated by the project are reinvested at a known rate (in this case 5%), then a different picture emerges:

The Modified or Adjusted Internal Rate of Return (cont.)

Year	Costs	Cost + Interest @ 12.0%	Revenue	Revenue + Interest @ 5.0%
0	-100,000	-100,000	0	0
1	0	-12,000	40,000	40,000
2	0	-13,440	50,000	52,000
3	0	-15,053	30,000	34,600
4	0	-16,859	40,000	46,330
5	-10,000	-28,882	0	8,647
TOTALS		-186,234		181,577

When the costs are rolled forward at 12% and the revenues at 5%, the former exceed the latter by the end of the period by £4,657. In other words, although the borrowing costs were lower than the IRR, they are not sufficiently below to compensate for the modest returns being generated by the surpluses in the project.

The Modified or Adjusted Internal Rate of Return (cont.)

The MIRR of 11.4% may be seen as the real cut-off point for the cost of capital **given the reinvestment rate of 5%**. The decision rule therefore is that the project should be accepted only if the cost of capital is LESS than the MIRR.

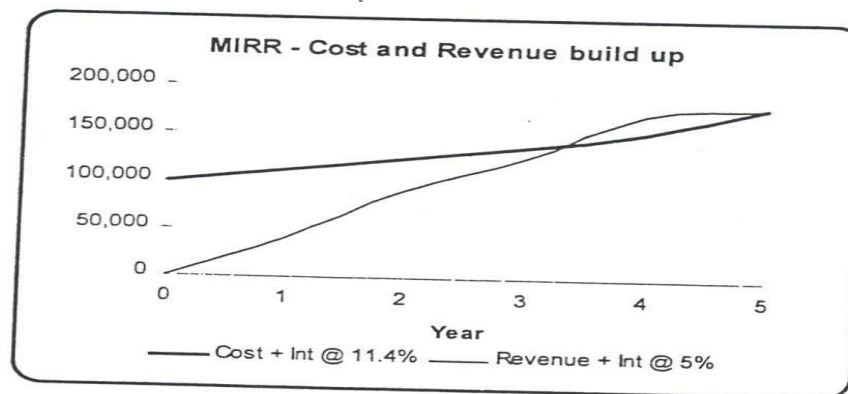
What is happening can be shown graphically in the example below where the reinvestment rate has been held at 5% whilst the borrowing rate is allowed to fluctuate.

At borrowing rates of less than 11.4%, the NTV is positive. When the rate exceeds 11.4% the NTV becomes negative. Again, this may be illustrated graphically to show exactly what is going on to produce this result. In the chart below, it can be seen that when the costs are compounded forward by 11.4% pa for 5 years, they exactly match the revenues that have been compounded at 5%.

The Modified or Adjusted Internal Rate of Return (cont.)

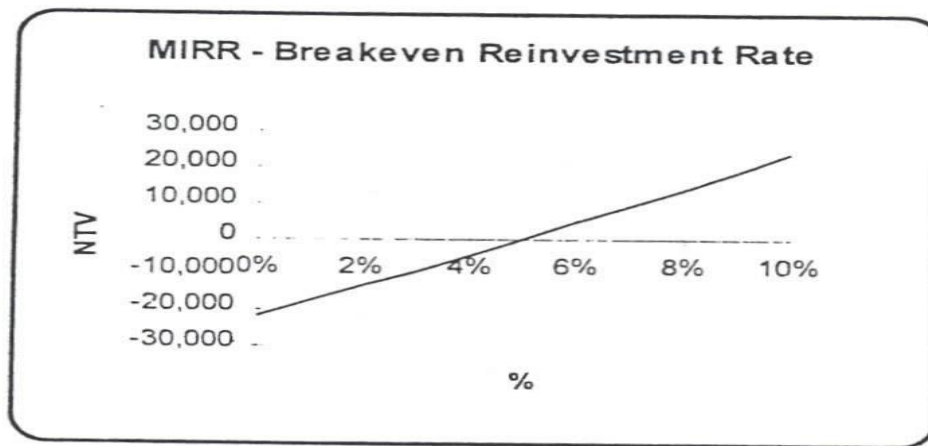
Year	Cost + Int @ 11.4%	Revenue + Int @ 5.0%
0	100,000	0
1	111,402	40,000
2	124,103	92,000
3	138,253	126,600
4	154,015	172,930
5	181,575	181,577

In the event of the cost of capital exceeding 11.4%, then obviously the costs would build up to a sum greater than the revenue by the end of the appraisal period. At 18%, for example, (and still below the IRR) the gap between them would be £57,000.



The Modified or Adjusted Internal Rate of Return (cont.)

It follows also that changing the reinvestment rate would also influence the size of the gap. Indeed, by a process of trial, error and interpolation similar to that used to calculate the IRR, it would be possible to derive a "breakeven" reinvestment rate which, when combined with a known borrowing rate would return a NTV of zero:



In this example the NTV is derived using a borrowing rate of 12% and a variety of reinvestment rates. NTV is seen to be zero approximately half way between 4% and 6% - i.e. at 5%. Arriving at the same conclusion by interpolation:

The Modified or Adjusted Internal Rate of Return (cont.)

Borrowing Rate 12%

Reinvestment Rate	NTV
0%	-21,579
2%	-13,210
4%	-4,494
6%	4,579
8%	14,018
10%	23,835

The breakeven rate is:

$$4\% + [(4,494/(4,494+4,579))*(2/100)] = 4.99\%$$

What this suggests is that the cut off rate for borrowing of 12% can only be accepted if the reinvestment rate is at least 5%. Anything less than this and the project would fail to achieve a positive Net Terminal Value.

Some concluding thoughts on the MIRR.

Although the MIRR satisfies the need to take account of the reinvestment rate in determining the rate of return of a project, it, too, suffers from one or two drawbacks.

Firstly there is a technical problem which relates to the actual calculation. If the NCF consists of a single outflow followed by a series of inflows - not untypical for property investments - then the MIRR will remain unchanged regardless of the borrowing rate. The PV of the costs at the borrowing rate will obviously not change if those costs occur in period 0 and are not, therefore, subject to the discounting process.

Some concluding thoughts on the MIRR (cont.)

- Secondly there is the judgemental problem of choosing an appropriate reinvestment rate - or more appropriately - a series of reinvestment rates which could be applied each time the project releases some income to be reinvested. To do this the investor must be confident in predicting the rates of interest that will be available for investments of a particular risk for many years into the future. In the examples above it was assumed that it would always be possible to reinvest at 5%. Perhaps it would be reasonable to argue that 5% represents the minimum return that would be available, and that any investment opportunities offering more than this rate should be taken, and that their contribution to the project should be treated as a bonus. The logic here is the same as that applied to selecting a sinking fund rate.

Whilst this approach is safe, it is hardly adventurous. The lower the chosen reinvestment rate, the less likely it becomes that a project selected on MIRR criteria will show a loss, but the more likely it becomes that perfectly robust projects will not be selected at all.

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