# Finance Lecture 8 Notes

## Capital investment appraisal

Over the past few weeks, we have looked at the decisions that business managers may be required to make in the short-term. This week we will consider decisions involving longer term investments in a project, in a product or in capital such as a factory, a plant or a machinery.

These decisions are very important as they often involve a substantial financial investment which once committed to is very difficult to bail out of. Often a new venture will require the initial expenditure to take place immediately but returns will be expected at various times in the future.

在过去的几周里，我们研究了业务经理在短期内可能需要做出的决策。本周我们将考虑涉及对项目、产品或资本（如工厂、工厂或机器）的长期投资的决策。 这些决定非常重要，因为它们通常涉及大量的金融投资，一旦承诺就很难纾困。 通常，新企业需要立即进行初始支出，但预计在未来的不同时间会获得回报。

In practice, there are four methods used by business throughout the world to evaluate investment opportunities:

* Accounting rate of return (ARR) 会计回报率
* Payback period 投资回收期
* Net Present value 净现值
* Internal rate of return 内部收益率

## Accounting rate of return (ARR)

This method takes the average accounting operating profit that an investment will generate and expresses it as a percentage of the average investment made over the life of the project.

这种方法采用投资将产生的平均会计营业利润，并将其表示为项目生命周期内平均投资的百分比。表示投资项目每年在会计利润方面的回报率。

ARR = Average expected return (accounting profit) X 100% Average capital employed/investment

***Example***

The directors of Blackhorse Ltd are looking to take on a new service contact and have narrowed it down to one of the two contracts detailed below: Contract A Contract B £’000 £’000 Initial capital outlay 730,000 1,200,000 Profit Year 1 300,000 50,000 Profit year 2 380,000 90,000 Profit year 3 120,000 500,000 Profit year 4 10,000 500,000 Profit year 5 10,000 320,000 Proceeds from sale of equipment used in contact 60,000 68,000

Average annual profit

Average annual profit = Operating profit before depreciation Number of years

Contract A Contract B £’000 £’000 Profit before deprecation Year 1 300,000 50,000 Profit before depreciation Year 2 380,000 90,000 Profit before depreciation Year 3 120,000 500,000 Profit before depreciation Year 4 10,000 500,000 Profit before depreciation Year 5 10,000 320,000 Total profit before depreciation 820,000 1,460,000 Number of years 5 5

Average annual profit 164,000 292,000

Average capital employed/investment

Average capital employed/investment = Initial capital outlay + proceed/disposal value at the end 2

Contract A Contract B £’000 £’000 Initial capital outlay 730,000 1,200,000 Proceeds from sale of equipment used in contact 60,000 68,000 790,000 1,268,000 2 2 Average capital employed/Investment 395,000 634,000

ARR = Average expected return (accounting profit) X 100% Average capital employed/investment

Contract A Contract B £’000 £’000 Average annual profit 164,000 292,000 Average capital employed/Investment 395,000 634,000

ARR 42% 46%

## Looking at the choice between Contract A and Contract B

1. *Comparison with ROCE*

The accounting rate of return is very similar to the return on capital employed ROCE which investors use to interpret company performance. This is an advantage as it ensures individual projects investments are internally assessed in the same way that they are assessed externally by investors. The only difference is that with ARR the profit is calculated before depreciation. This is because the most appropriate way to make long term decisions is to use cash flows rather than accounting profit based on arbitrary allocations.

计回报率与投资者用来解释公司业绩的资本回报率ROCE非常相似。这是一个优势，因为它确保单个项目投资的内部评估方式与投资者外部评估的方式相同。

唯一的区别是，对于 ARR，利润是在折旧之前计算的。这是因为做出长期决策的最合适方法是使用现金流，而不是基于任意分配的会计利润。

In the above example Blackhorse Ltd will look at the company ROCE. If this is less than 42%, both contracts would be acceptable to the directors and if only one could be bid for, that would be Contract B. But if the company had a ROCE of 48%, the directors’ would have to think very carefully before bidding for either contract.

低ROCE时的情况可能有以下解释：

1. **资本效率较低：** 公司可能正在使用较多的资本，但由于一些原因（例如市场不景气、高成本等），未能获得良好的盈利。这时，即使项目的ROCE较低，公司仍然愿意接受这些合同，因为其他投资机会可能也面临类似的低回报。
2. **项目回本期较长：** 有时一些项目可能需要较长的时间才能实现回本，尤其是在一开始可能需要较高的投资。即使ROCE较低，长期来看，项目可能仍然具有潜在的盈利性。

而当ROCE高时，需要仔细考虑可能有以下原因：

1. **高回报带来高期望：** 高ROCE可能说明项目具有更好的盈利能力，但也带来了更高的期望。公司可能会更加审慎地考虑是否承担高期望下的风险，以及项目是否足以实现这一高回报。
2. **资本利用效率：** 高ROCE可能表明公司有效地利用了资本，但也可能说明市场对该项目存在较高期望，公司需要确保能够保持高水平的绩效。
3. *Timing and uncertainty of cash flows*

For Blackhorse Ltd, if only one contract could be accepted, it would be contract B. But in looking at the timing of profits, contract A receives more of its profits earlier in the contract’s life and has a smaller capital outlay资本支出. The further into the future estimates are made, there is more risk they are incorrect. The directors may consider contract A with its earlier profits to be less risky than contract B and that the difference of only 4% in ARR does not compensate this extra risk.

1. *Absolute profits*

In the above example contract B has the greater absolute profit £1,460,000 compared to £820,000, so contract B would be selected. In some situations, the contract making the higher profits in total will not have the higher ARR due to the initial outlay. The Directors will need to consider whether the difference in ARR makes up for a lower total profit figure.

1. *Cash flow V Accounting profit*

Although ARR allows comparison with ROCE, it is criticised as it uses accounting profit rather than cash flows. Cash flows are more relevant as they are considered a better predictor of future wealth than profits.

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## Payback Period

The payback period is the length of time it takes for an initial investment to be repaid out of the net cash inflows from a project.

投资回收期是从项目净现金流入中偿还初始投资所需的时间长度。

Estimating future cash flows is difficult and is harder the further into the future the estimates are required. Therefore, a business may prefer a project with the quickest payback period to reduce the risk involved in estimating and so that funds are available again for new projects.

估计未来的现金流量是困难的，而且越是需要估计的未来，就越难。因此，企业可能更喜欢投资回收期最快的项目，以降低估算所涉及的风险，以便为新项目再次提供资金。

If we look at Blackhorse Ltd and assume the profit before depreciation = cash inflow, the payback period can be calculated.

如果我们看一下Blackhorse Ltd，假设折旧前的利润=现金流入，则可以计算出投资回收期。

Contract A Contract B Net Cumulative Net Cumulative Cash flow Cash flow Cash flow Cash flow £’000 £’000 £’000 £’000 Initial capital outlay (730,000) (730,000) ( 1,200,000) (1,200,000) Cash flow Year 1 300,000 (430,000) 50,000 (1,150,000) Cash flow Year 2 380,000 (50,000) 90,000 (1,060,000) Cash flow year 3 120,000 70,000 500,000 ( 560,000) Cash flow year 4 10,000 80,000 500,000 (60,000) Cash flow year 5 10,000 90,000 320,000 260,000 Proceeds from equipment sale 60,000 150,000 68,000 328,000

From the above table it can be seen the initial cash outlay in contract A is recouped in year 3. If it is assumed cash flows arise evenly throughout year 3 120,000/12 =10,000 per month, a further 5 months is required for the cumulative cash flow to be nil and the initial outlay to have been recouped. The payback period for contract A is 2 years and 5 months.

从上表可以看出，合同 A 的初始现金支出在第 3 年收回。如果假设整个第 3 120,000/12 年每月平均产生现金流量 = 10,000，则还需要 5 个月才能使累计现金流量为零并收回初始支出。合同 A 的投资回收期为 2 年零 5 个月。

For Contract B, the cumulative cash flow is zero at some point in year 5. Again, assuming cash flows arise evenly in the year, 320,000/12 £26,700 is received in each month in year 5 and therefore it takes £60,000/£26,700 2.2 months into year 5 to recoup the initial outlay. Therefore, the payback period is 4 years and 2 months.

Using the payback method, contract A would be chosen if resources were scarce and only one contract could be bid for. The payback period for contract A being 2 years and 5 months, while that for contract B being 4 years 2 months. If Blackhorse Ltd had a required payback period of 5 years and there were adequate resources, both contracts could be accepted.

使用投资回收法，如果资源稀缺且只能投标一个合同，则选择合同 A。合同A的投资回收期为2年5个月，合同B的投资回收期为4年2个月。如果Blackhorse Ltd有5年的投资回收期，并且有足够的资源，那么这两份合同都可以被接受。

The payback period is quick and easy to calculate. Effectively it values earlier cash flows higher than those received later and so to some extent reduces the risk of uncertainty in estimating future cash flows. But it is a very crude method and can mean that potentially less profitable options are preferred.

In the case of Blackhorse Ltd the payback period would lead directors to choose contract A over contract B but contract B is more profitable in terms of absolute profits and the ARR.

在Blackhorse Ltd的案例中，投资回收期将导致董事选择合同A而不是合同B，但合同B在绝对利润和ARR方面更有利可图。

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## Investment Appraisal with Discount Rates以折扣率进行投资评估

## Compounding复利是指投资的利息也会产生利息。

If you invested a student loan of £3,000 in a bank today, in one year’s time would you be happy to receive £3,000?

It is unlikely as what you can buy for £3,000 in one year’s time is less than that you could buy today. If you delay consumption of £3,000 you will expect a return to cover inflation at the very least. This is the time value of money. You may expect a 10% return.

这不太可能，因为您在一年内可以以 3,000 英镑的价格购买的东西比您今天可以购买的价格要少。如果您延迟消费 3,000 英镑，您将期望至少获得回报以弥补通货膨胀。这就是货币的时间价值。您可能会期望获得 10% 的回报。

At the end of the first year, you would have £3,000 x 10% = £300 interest利息. The value of your investment would be £3,300.

If you leave the money in the bank for another year, you will have £3,300 x 10% = £330 interest. The value of your investment would be £3,300 + £330 =£3,630.

Investment X (1+r) n Where r is the interest rate and n is the number of years.

£3,000 x (1+10%) 2 = 3,630

In year 10 the investment is worth £3,000 X (1+10%)10 = £3,000 X 2.594 =£7,782

This looks brilliant if you are thinking of investing in a project, but compound loans work the same way. A loan of £3,000 with a compound interest rate and no capital repayments will quickly grow.

## 如果您正在考虑投资一个项目，这看起来很棒，但复合贷款的工作方式相同。3,000英镑的复利贷款，没有资本偿还，将迅速增长。

## Discounting贴现/折现 折现是与复利相反的概念，主要用于投资评估。在未来某个时间点预期会收到的现金流量，要通过适当的折现率折算成当前的价值。这种做法是基于货币的时间价值原则：由于通货膨胀和资金的潜在机会成本，未来的钱不如现在的钱值钱。

With investment appraisal we use the reverse of compounding. We estimate cash flows we expect in future years and discount them at an appropriate rate. The rate used for discounting takes into account inflation, but also the firm’s required rate of return.

This means the discount rate applied will differ between companies and for different projects for the same company, as it will take account of risk.

在投资评估中，我们使用复利的反向方法。我们估计未来几年的预期现金流，并以适当的利率贴现。用于贴现的利率考虑了通货膨胀，但也考虑了公司所需的回报率。 这意味着不同公司以及同一公司的不同项目所适用的贴现率将有所不同，因为它将考虑风险。

The higher the level of risk attached to a project the higher the return required and so the higher the discount rate that is applied. If you have £1,000 to invest and had the choice of investing in a start- up technology business or an established retail business both offering to return your investment plus 10%. It is probable you would choose the established retail business. But if the retail business was offering you a 10% return and the start- up technology business a 20% return, you may be indifferent into which you will invest.

项目的风险水平越高，所需的回报就越高，因此应用的贴现率就越高。如果您有 1,000 英镑的投资，并且可以选择投资初创技术企业或成熟的零售企业，两者都提供 10% 的投资回报。您可能会选择成熟的零售业务。但是，如果零售业务为您提供 10% 的回报，而初创技术业务为您提供 20% 的回报，您可能对投资对象漠不关心。

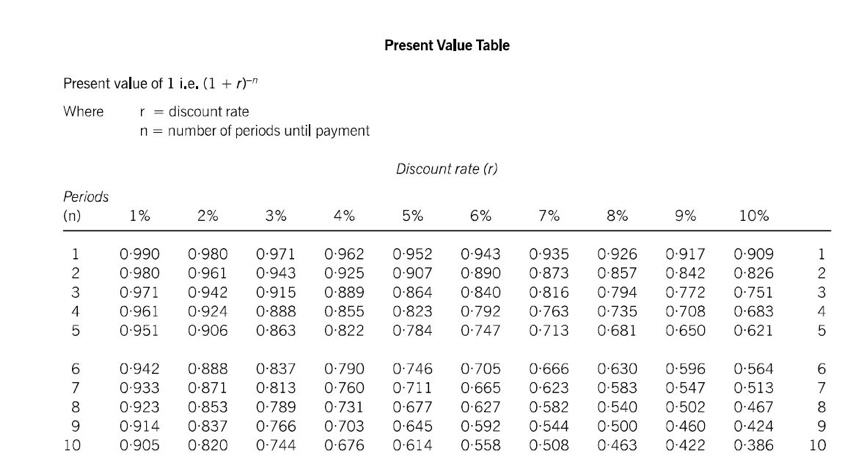
The discount rate used by a company is also referred to as the cost of capital.

公司使用的贴现率也称为资本成本。

To calculate what £3,600 to be received in a 2-year time is worth today with a discount rate of 10%:

£3,600 x 1 = £3,000 (1+10%)\*\*2

Discount rates do not need to be calculated manually but can be found in a table:



Net Present value净现值

## 净现值的解释是，如果NPV为正，则项目的回报超过了初始投资，被认为是有利可图的。如果NPV为负，则项目可能不具有经济吸引力。

Olivos Ltd

The managers of Olivos Ltd are looking at investing in a wind turbine. The initial capital outlay will be £550,000, but then the following cash inflows and outflows are expected:

Cash inflow Cash outflow £ £ Year 1 80,000 60,000 Year 2 100,000 60,000 Year 3 350,000 60,000 Year 4 350,000 75,000 Year 5 220,000 75,000 Year 6 90,000 70,000

The wind turbine will be dismantled拆除 at the end of year 6 at a cost of £20,000. The cost of capital for Olivos Ltd is 18%. Should the project be accepted?

(The net cash outflow in year 6 is the cash outflow £70,000 + dismantling cost £20,000 = £90,000)

Cash inflow Cash outflow Net cashflow Discount factor Discounted £ £ £ (from table) 18% Cash flow Year 0 550,000 (550,000) 1 (550,000) Year 1 80,000 60,000 20,000 0.847 16,940 Year 2 100,000 60,000 40,000 0.718 28,720 Year 3 350,000 60,000 290,000 0.609 176,610 Year 4 350,000 75,000 275,000 0.516 141,900 Year 5 220,000 75,000 145,000 0.437 63,365 Year 6 90,000 90,000 0 0.370 0 220,000 (122,465)

Net cash flows have been discounted by the rate of return the company wants, taking account of opportunity cost of alternative projects, risk, and inflation.

考虑到替代项目的机会成本、风险和通货膨胀，净现金流已按公司期望的回报率进行贴现。

An investment which has a positive net present value should be accepted. 应接受具有正净现值的投资。

An investment with a negative net present value should be rejected. 净现值为负的投资应被拒绝。

Olivos Ltd should not invest in a wind turbine. The net present value is -122,465

Notice, if the managers had just looked at net cash flow without applying a discount factor the project would have been accepted. Net cash flow +220,000. This would not have been the correct decision as no account would have been made for the time value of money.

请注意，如果经理们只看净现金流量而不应用贴现系数，那么该项目就会被接受。 净现金流 +220,000。这不是正确的决定，因为不会对货币的时间价值进行说明。

Net present value is regarded as a good method of investment appraisal as it uses cash flows in calculations which are a good predictor of wealth generation.

净现值被认为是一种很好的投资评估方法，因为它在计算中使用现金流，这是财富产生的良好预测指标。

Discounting at the cost of capital to a particular company or project to bring cash flows to their net present value allows factors such as risk, opportunity cost and the time value of money to be taken into consideration.

以资本成本对特定公司或项目进行贴现，使现金流达到其净现值，可以考虑风险、机会成本和货币时间价值等因素。

However, the answer is only as accurate as the assumptions on which the estimated cash flows are based. 然而，答案的准确程度取决于估计现金流量所依据的假设。

In deciding or presenting the information, it is vital that the assumptions are understood and challenged. It will often be appropriate to present sensitivity analysis. That is to ask the question what if revenues are 5% less than the estimate will there still be a positive NPV. This is especially important if one estimate is crucial to the success of the project, or a substantial number of resources are invested for a long period of time. Generally, the further into the future an estimate is made the less reliable it is.

在决定或呈现信息时，理解和挑战假设至关重要。通常适合进行敏感性分析。也就是说，如果收入比估计值低 5%，那么 NPV 是否仍然为正。如果一个估计对项目的成功至关重要，或者长期投入大量资源，这一点尤其重要。一般来说，估计越远，它的可靠性就越低。

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## Internal Rate of Return (IRR)

内部收益率（Internal Rate of Return，IRR）是一种用于评估投资项目吸引力的财务指标。IRR是投资的年均收益率，即使得项目的净现值（NPV）为零的贴现率。具体来说，IRR是使项目的现金流入和现金流出的现值之和等于零的贴现率。

IRR的计算涉及将项目未来的现金流入和现金流出贴现到当前值，然后找到使这两者净现值为零的贴现率。这一贴现率就是IRR。

The internal rate of return of a particular investment is the discount rate that, when applied to its future cash flows, will produce an NPV of zero.

特定投资的内部收益率是贴现率，当应用于其未来现金流时，将产生零净现值。

The internal rate of return represents the return from an investment opportunity.

内部收益率代表投资机会的回报。

The way to obtain an IRR is through a computer package, trial, and error with linear interpolation or graphically. 获得 IRR 的方法是通过计算机软件包、线性插值或图形方式进行试错。

Olivos Ltd Revisited.

In the above example of Olivos Ltd we had a negative cash flow.

The return on the project that produces a zero NPV and therefore is the internal rate of return must be less than the discount factor of 18% that was applied to the project. So, discount at 10% and 7%.

产生零净现值（因此是内部收益率）的项目的回报率必须低于应用于该项目的 18% 的贴现系数。 因此，折扣为 10% 和 7%。

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Net cash flow | Discount factor 10% | Discounted cash flow | Net cash flow | Discount factor 7% | Discounted cash flow |
| Year 0 | (550,000) | 1 | (550,000) | (550,000) | 1 | (550,000) |
| Year 1 | 20,000 | 0.909 | 18,180 | 20,000 | 0.935 | 18,700 |
| Year 2 | 40,000 | 0.826 | 33,040 | 40,000 | 0.873 | 34,920 |
| Year 3 | 290,000 | 0.751 | 217,790 | 290,000 | 0.816 | 236,640 |
| Year 4 | 270,000 | 0.683 | 184,410 | 270,000 | 0.763 | 206,010 |
| Year 5 | 145,000 | 0.621 | 90,045 | 145,000 | 0.713 | 103,385 |
| Year 6 | 0 | 0.565 | 0 | 0 | 0.666 | 0 |
|  |  |  | (6,535) |  |  | 49,655 |

From the table we have two figures either side of zero. Linear interpolation can now be used to estimate the IRR.

The difference in the cash flows is (6,535) + 49,655 = £56,190

The difference in the discount rate used is (10%-7%)3%

The distance between 10% and IRR is 6,535 X 3% = 0.3% IRR is 10%-0.3% = 9.7% 56,190

The distance between 7% and IRR is 49,655 X 3% = 2.7% IRR is 7% + 2.7% = 9.7% 56,190

The IRR is 9.7% and this project should only be accepted if this is greater than Olivos Ltd opportunity cost of capital.

If there are two projects to choose between, all other things being equal, the project with the higher IRR should be selected.

There are two problems with IRR compared to NPV:

* If cash flows are erratic, some years positive some years negative, more than one IRR would be produced.
* If it is just a percentage, no account is taken of the size of the investment a project with an initial outlay of £50,000 with an IRR of 20% with have profits of £10,000. Whereas a project with an initial outlay of £500,000 with an IRR of 5% will have profits of £25,000. A business may want to acknowledge the absolute profits, as this may be preferred if there are no alternative projects.

与净现值相比，内部收益率存在两个问题：如果现金流不稳定，有些年份为正，有些年份为负，则会产生不止一个内部收益率。 如果只是一个百分比，则不考虑投资规模，初始支出为 50,000 英镑，内部收益率为 20%，利润为 10,000 英镑的项目。而初始支出为 500,000 英镑且内部收益率为 5% 的项目将获得 25,000 英镑的利润。企业可能希望承认绝对利润，因为如果没有替代项目，这可能是首选。