2 Static Methods

This chapter considers simple 'static' analysis methods that assess the profitability of an investment for a time span of one (average) period. These methods focus on a single financial measure, so other target measures are ignored.

The term 'profitability' is, unless otherwise specified, used throughout this book to indicate the achievement of positive (or higher) economic returns from an investment project. However, it should not be confused with the concept of 'accounting profit', which includes non-cash items and accounting adjustments and is not always consistent with economic, wealth-maximising decision objectives. The profitability considered here can be thought of in two ways—in *absolute* terms or in *relative* terms.

Key Concept

Absolute profitability: making an investment is better than rejecting it.

Relative profitability: investing in project A is better than investing in project B (A being the more profitable investment: A and B are mutually exclusive).

In using financial analysis to assess an investment's absolute or relative profitability, specific assumptions are made:

- The model's data and linkages are known with certainty.
- All relevant effects can be isolated, allocated to a given investment project, and forecasted in the form of revenues and costs or cash inflows and outflows.
- No relationship exists between the alternative investment projects being analysed, apart from their mutual exclusivity.
- Other decisions, such as financing or production decisions, are made before the investment decision.
- The economic life of the investment projects is specified.

U. Götze et al., *Investment Appraisal*, Springer Texts in Business and Economics,
DOI 10.1007/978-3-662-45851-8_2

The last assumption means that time-related decisions, such as those related to the project's economic life or replacement time will not be covered at this point; they will be part of Chap. 5.

Furthermore, in assessing the profitability of alternative investment projects it is assumed that the alternatives are comparable in regard to their project type, the amount of capital tie-up and their economic lives. Strictly speaking, this requires identical amounts of invested capital and identical economic lives for all investment alternatives under consideration. If this is not the case, comparability can be achieved by additional premises, or by including additional activities to balance differences in the capital tie-up and/or economic lives. Such an additional assumption may be that all future investments yield at a specific interest rate which is used to calculate interest costs so that they do not have to be explicitly considered in the calculations.

The analysis models discussed in Part II can be distinguished by their treatment of how time affects the value of future returns achieved from an investment project (often referred to as the 'time value of money'). Chapter 2 describes (simple) static models that analyse one average period—that is, they ignore the passage of time. In Chap. 3, 'dynamic' discounted cash flow models will be described. These models do take time into account. More advanced models will then be presented in Part III of the book.

Static analysis models explicitly consider only one period (e.g. a year), which is assumed to be representative of all such periods (years). The data which characterise the average period are derived from data for the whole planning period (i.e. the expected life of the investment). The static models described in this book differ in regard to their target measures, but all target measures represent profit measures or are derived from them (i.e. cost, profit, average rate of return or payback time).

Accordingly the following methods are differentiated:

- The cost comparison method
- The profit comparison method
- The average rate of return method
- The static payback method

Each of the methods is explained using the following steps: (1) a description of the procedure, (2) key concepts concerning the absolute and the relative profitability measure, (3) an illustrative example and (4) an assessment of the method, with special emphasis on its underlying assumptions.

2.1 Cost Comparison Method

Description of the method

For the cost comparison method (CCM) the target measure is, as the name suggests, the cost(s) of an investment project. It is assumed when using the CCM that the revenues of mutually exclusive investment alternatives (and the option to forego the investment, if this is a permissible alternative) are identical and that only the costs differ. Costs analysed include: personnel expenditures (wages, salaries, social expenditure etc.), cost of raw materials, depreciation, interest, taxes and fees, and costs of outside services (such as repair or maintenance). The average costs for the planning period are determined for each investment alternative. Note that, for variable costs, the future production volume is a crucial determinant. Adding up all cost components gives a total cost for each alternative investment.

Assessing *absolute profitability* on the basis of total costs is not meaningful if the revenues generated by an investment differ from those that would be generated *without* the investment (i.e. the assumption of identical revenues is violated). This is usually the case for foundational or expansion investments. In these cases, absolute profitability can be judged only on the basis of profits (i.e. not using the CCM). However, for replacement or rationalisation investments, a comparison of total costs *with* the investment and total costs *without* the investment can be conclusive.

Relative profitability can be determined using the CCM in all situations where the projects under comparison have identical revenues. When considering relative profitability, it doesn't matter what the costs would have been *without* the project, since simply costs between the various project options are compared.

Key Concept

Absolute profitability is achieved if the total cost of making an investment is lower than the total cost of rejecting it.

Relative profitability is achieved if making an investment results in a total cost that is lower than that of the alternative investment project(s) under consideration.

The CCM is illustrated in the following example.

Example 2.1

To manufacture a new product, a metal-processing company needs a special component. This can be produced in the factory or bought in. To start production of the component, an investment is required for which the (mutually exclusive) projects A and B (representing different production processes) are available. The option to buy in from another company represents alternative C. The investment projects are characterised by the data given in Table 2.1. Please note that in this book interest rates always refer to a period of 1 year.

Table 2.1 Data for the investment projects A and B (CCM)

Data	Project A	Project B
Initial investment outlay (€)	240,000	600,000
Economic life (years)	6	6
Liquidation value (€)	0	60,000
Capacity (units per year)	8,000	10,000
Salaries (€ per year)	50,000	50,000
Other fixed costs (€ per year)	40,000	160,000
Wages (€ per year)	220,000	80,000
Costs of materials (€ per year)	400,000	450,000
Other variable costs (€ per year)	30,000	30,000
Rate of interest (% per year)	8	8

The buying in price of the component (alternative C) is €125 per unit.

Some of the specified cost components are variable and depend linearly on the production volume. The amounts stated for these components refer to the costs incurred at maximum production capacity.

The task now is to use the CCM to determine the cost of the three projects for a yearly production volume of 8,000 units. To find the solution, a distinction between fixed and variable costs is required. It is assumed here that the costs of materials and wages represent variable costs. In regard to wages, this can be justified by the assumption that employees can be shifted to other production departments, or that other appropriate uses of the personnel capacity are possible.

First, the average annual variable and fixed costs of the investment projects are identified. Investment project A's variable costs are taken from the sum of the given costs of materials, wages and other variable costs. The initial data are valid for a production volume of 8,000 units per year, which is identical to the production capacity of A. The variable costs of A (C_{vA}) therefore amount to:

$$C_{vA} = €650{,}000 \text{ per year}$$

The given data for investment project B refer to a capacity of 10,000 units per year and therefore a conversion to the production volume (x) of 8,000 has to be made. Variable costs of B (C_{vB}) are calculated as follows:

$$C_{vB} \ (x = 10{,}000 \text{ units}) = €560{,}000 \text{ per year},$$

$$C_{vB}(x = 8{,}000 \text{ units}) = \frac{€560{,}000/\text{year} \cdot 8{,}000\,\text{units}}{10{,}000\,\text{units}} = €448{,}000 \text{ per year.}$$

The fixed costs consist of salaries, depreciation, interest and other fixed costs. Depreciation and interest have to be calculated from the given data. The average annual depreciation can be calculated by dividing the difference between the initial investment outlay and the liquidation value by the years of the economic life. The initial investment outlay comprises the purchase price paid and additional related costs like carriage costs etc. The liquidation value is the amount receivable when reselling the investment project, less any additional costs such as demolition costs etc. (there are none in this example).

The average depreciation therefore is:

$$\frac{\text{Initial investment outlay} - \text{Liquidation value}}{\text{Economic life (in years)}} \tag{2.1}$$

$$\text{Investment project A}: \quad \frac{€240{,}000}{6\,\text{years}} = €40{,}000 \text{ per year}$$

$$\text{Investment project B}: \quad \frac{€600{,}000\text{-}€60{,}000}{6\,\text{years}} = €90{,}000 \text{ per year}$$

The approach taken here corresponds to the straight-line depreciation method. Changing to a regressive (or ‘diminishing value’) depreciation method would not affect the amount of average depreciation, as the total amount written off would be the same. However, the chosen depreciation method does influence the average amount of capital tie-up and thus affects interest costs.

Interest costs must be included in the CCM if the competing projects differ in their initial investment outlays and therefore in the average amount of capital tie-up. Interest is calculated to achieve comparability concerning this capital tie-up. It is assumed as a rule that capital can be procured or reinvested at a given rate of interest. Interest cost is calculated by multiplying the average capital tie-up by the rate of interest. To determine the average capital tie-up, different approaches can be applied. A simple procedure assumes a steady decrease between the initial investment outlay at the beginning and the liquidation value at the end. Based on this assumption the capital tie-up during the life of project A is depicted in Fig. 2.1.

Assuming continuous capital reduction, the average capital tie-up can be determined computationally as the average of (1) the capital invested at beginning and (2) the liquidation value at the end of the planning period (i.e. project life):

$$\text{Average capital tie-up} = \frac{\text{Initial investment outlay} + \text{Liquidation value}}{2} \tag{2.2}$$

Figure 2.1 shows that average capital tie-up is half of initial investment outlay if no liquidation value exists. This can be shown graphically (both of the marked triangles have the same sizes) or computationally (the average between the initial investment outlay and the liquidation value of zero). The average capital tie-up for project A therefore is:

$$\frac{€240{,}000}{2} = €120{,}000.$$

The annual average interest (assuming an annual interest rate of 8 %) for this project amounts to:

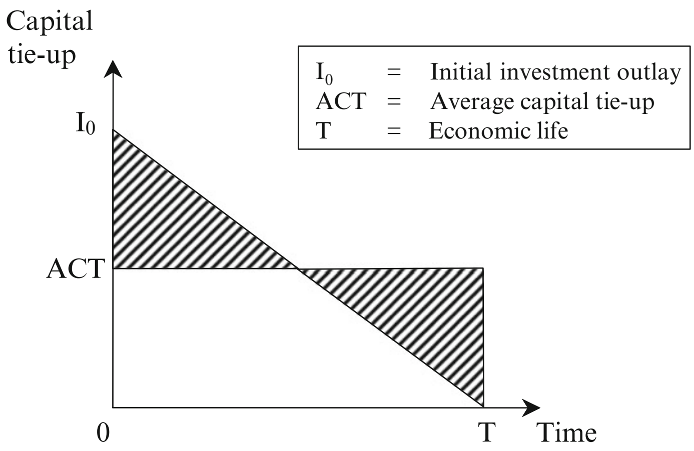

Fig. 2.1 Capital tie-up for investment project A (with zero liquidation value)

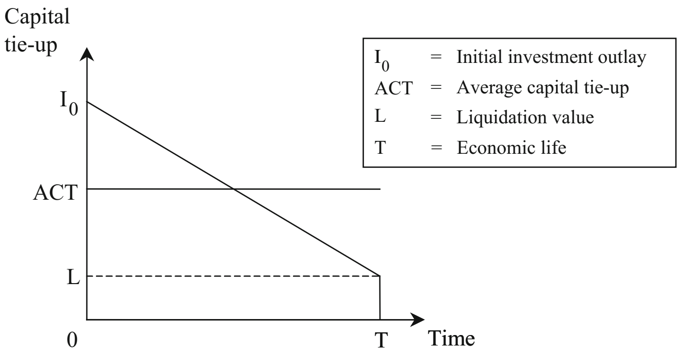

Fig. 2.2 Capital tie-up for investment project B (with positive liquidation value)

$$€120,000 \cdot 0.08 = €9,600$$

Project B shows a slightly different pattern of capital tie-up due to the positive liquidation value (see Fig. 2.2).

Thus, the average capital tie-up exceeds half of the initial investment outlay if a liquidation value exists. The average capital tie-up for project B in accordance with the general formula is:

$$\frac{€600,000 + €60,000}{2} = €330,000$$

The annual average interest (assuming an annual interest rate of 8 %) for this project amounts to:

$$€330,000 \cdot 0.08 = €26,400$$

Now that interest costs have been calculated, the total average fixed costs can be determined as:

$$\text{Salaries} + \text{Other fixed costs} + \text{Depreciation} + \text{Interest costs} \tag{2.3}$$

Investment project A:

$$€50,000/\text{year} + €40,000/\text{year} + €40,000/\text{year} + €9,600/\text{year} \\ = €139,600/\text{year}$$

Investment project B:

$$€50,000/\text{year} + €160,000/\text{year} + €90,000/\text{year} + €26,400/\text{year} \\ = €326,400/\text{year}$$

The total average costs of all three projects, given a production volume of 8,000 units per year, amount to:

Project A: €650,000/year + €139,600/year = €789,600/year
Project B: €448,000/year + €326,400/year = €774,400/year
Project C (assuming that only the component purchase price is relevant): 8,000 units/year·€125/unit = €1,000,000/year

The comparison of the average total costs shows that the investment project B is the cost minimising (and thus most profitable) alternative and therefore should be preferred. However, such a decision should be examined in light of the model's assumptions and the significance of any deviations from those assumptions.

Assessment of the method

The cost comparison method requires relatively simple calculations. Making predictions from the data can be difficult and time consuming and, despite the assumption of certainty, many elements of the data will be unreliably estimated. This is a general problem of investment appraisal methods and applies to all of the approaches described in this book.

The suitability of the calculated results for supporting decision-making depends on both the quality of the data and the validity of the model's assumptions. Therefore, the model's assumptions need to be evaluated. For example, the limitations of analysing only one target measure (and ignoring other factors) must be assessed in terms of their likely importance to the decision-making process.

The static perspective of the CCM (and other models described in this chapter) is also a weakness, since static models look at one 'average' period only. Differences in the timing of costs cannot be assessed, therefore. Such differences can result from changes in prices and/or consumption over the time for each cost category. They will usually arise in regard to interest costs. As an illustration, consider the interest costs in the example shown above (comparing projects A, B and C). Capital tie-up for projects A and B is relatively high at the beginning of the planning period and lower at the end (see Figs. 2.1 and 2.2). This will result in higher interest at the beginning and lower interest towards the end of the investment. When using average data this is not considered.

Furthermore, the assumptions relating to the capital tie-up warrant more detailed discussion. Two concerns arise: the assumption of a continuous and steady decline of the capital tie-up, and the assumption that the total decrease of the capital tie-up equals the difference between initial investment outlay and liquidation value. The actual decrease in the capital tie-up, which can be interpreted as amortisation or pay back, will normally depend on the revenues (here assumed to be identical for all alternatives and, therefore, neglected) as well as on the resulting costs and the average profit (P). If these measures are equal to cash flows, apart from depreciation (D), and if no additional cash flow that is not affecting the operating result is gained, then the sum of depreciation and profit represents the total amount amortised or paid back (PB).

$$\mathrm{P} + \mathrm{D} = \mathrm{PB}$$

In the case of positive (negative) average profits, this amount paid back will be higher (lower) than the difference between initial investment outlay and liquidation value. Besides, the total amounts amortised will usually differ between project alternatives, which is inconsistent with the assumption that the revenues are identical in all alternatives. Finally, interest charges depend on capital tie-up for each alternative and can affect the amounts available to reduce the capital tie-up.

A uniform interest rate, at which money can be borrowed and reinvestments made at any time (i.e. a perfect capital market), is also assumed. This is related to the assumption that differences in capital tie-up can be equalised between projects by (fictitious) additional investments that yield interest at the same given rate or by financing objects with this interest rate. This assumption is often invalid in practice, as is the assumption that all the investment projects under consideration have identical economic lives. Both of these ‘idealistic’ assumptions, and the determination of an appropriate rate of interest, will be discussed in Chap. 3.

Making a comparison of projects by simply analysing their total costs neglects the issue of capacity utilisation as well as the composition of the costs. Idle capacity and differences in the composition of total costs (i.e. between fixed and variable costs) can be extremely important for a company. Neglecting their analysis can have serious effects, therefore.

It should also be reiterated that the assumption of (data) certainty is usually unrealistic. For example, production volumes, which are crucial to decision-making, are often uncertain. If deviations occur between forecasted production volume and the actual units of production, relative profitability can be seriously affected. The dependence of profitability results on production volumes can be shown with the use of sensitivity analysis (described in Sect. 8.3).

Finally, it should be emphasised that the CCM model ignores any consideration of project revenues. Consequently, the assessment of absolute profitability is not possible for all investment projects, which is a significant limitation of this analysis method, as it requires that the products' qualities and quantities produced with the different investment projects must be equivalent. A method that *does* incorporate project revenue data is discussed next.

2.2 Profit Comparison Method

Description of the method

As the name suggests, the profit comparison method (PCM) differs from the cost comparison method because it considers both the cost and revenues of investment projects. The target measure is the average profit, which is determined as the difference between revenues and costs. Apart from this difference, all of the other assumptions made in the CCM continue to apply for PCM.

Key Concept

Absolute profitability is achieved if an investment project leads to a profit greater than zero.

Relative profitability is achieved if an investment project leads to a higher profit than the alternative investment project(s).

Example 2.2

The PCM is illustrated in the following example. A company has the choice between the following two investment projects A and B:

Table 2.2 Data for the investment projects A and B (PCM)

Data	Project A	Project B
Initial investment outlay (€)	180,000	200,000
Freight charges (€)	15,000	25,000
Set-up charges (€)	2,000	2,000
Economic life (years)	5	5
Liquidation value at the end of the economic life (€)	12,000	17,000
Other fixed costs (€ per year)	4,000	20,000
Production and sales volume (units per year)	9,000	12,000
Sales price (€ per unit)	10	10
Variable costs (€ per unit)	2	1.90
Rate of interest (% per year)	6	6

To assess the absolute and relative profitability of the two investment projects, the projects' average revenues and costs must be determined. The annual revenues of projects A (R_A) and B (R_B) amount to:

$$R_A = 9,000\ \text{units/year} \cdot €10/\text{unit} = €90,000\ \text{per year and}$$

$$R_B = 12,000\ \text{units/year} \cdot €10/\text{unit} = €120,000\ \text{per year.}$$

The average cost can be determined in the same way as for the CCM approach described in Sect. 2.1. The amounts for each cost category, as well as the average total costs of projects A (C_A) and B (C_B), are shown in the following table:

Table 2.3 Cost categories for the investment projects A and B (PCM)

Cost category (each in € per year)	Project A	Project B
Depreciation	37,000	42,000
Interest	6,270	7,320
Other fixed costs	4,000	20,000
Variable costs	18,000	22,800
Total costs	65,270	92,120

The average profits for alternatives A (P_A) and B (P_B) amount to:

$$P_A = R_A - C_A = €90,000/\text{year} - €65,270/\text{year} = €24,730\ \text{per year}$$

$$P_B = R_B - C_B = €120,000/\text{year} - €92,120/\text{year} = €27,880\ \text{per year}$$

Both investment projects achieve absolute profitability, since they earn a positive profit. Project B achieves relative profitability because of its higher average profit.

Assessment of the method

The PCM acknowledges the fact that different investment opportunities (projects) lead to different revenues. Thus, the method has a wider range of use than the CCM. However, its application may be restricted by the fact that it is impossible to allocate revenues to some investment projects; in these cases the CCM has to be used. Apart from this difference, both methods have broadly the same strengths and weaknesses. Therefore the corresponding earlier assessment of the CCM applies equally to the PCM.

The next section introduces an analysis method that differs from the CCM and PCM in regard to the assumption it makes about differences in capital tie-ups between competing investment projects.

2.3 Average Rate of Return Method

Description of the method

The average rate of return (ARR) method differs from the PCM in regard to its target measure. The ARR method combines a profit measure with a capital measure to focus on the return (expressed as a rate of interest) earned on the capital invested. Both the profit measure and the capital measure can be defined differently. Average capital tie-up can be used as the capital measure, while the profit measure can be determined by adding average profit and average interest. This leads to the following formula:

$$\text{Average rate of return} = \frac{\text{Average profit} + \text{Average interests}}{\text{Average capital tie-up}} \tag{2.4}$$

The average interest is derived by applying a given interest rate to the average tie-up capital. When using the PCM (Sect. 2.2), this interest is subtracted from revenues as a component of cost. For the ARR method this step is reversed by adding the interest amount back to the profit calculated using the PCM. The sum of average profit and average interest represents a surplus, which is compared to the average capital tie-up to determine the ARR method profitability measure.

The ARR method enables an assessment to be made of both absolute and relative profitability.

Key Concept

Absolute profitability is achieved if an investment project leads to an average rate of return higher than a given percentage.

Relative profitability is achieved if an investment project leads to a higher average rate of return than the alternative investment project(s).

The determination of a target average rate of return is at the decision-maker's discretion and depends on existing investment and financing opportunities. If it can be assumed that internal funds should be used and an alternative investment opportunity exists, which could earn a given rate of interest, then this rate is suitable as a target for investment options. If this rate equals that used by the PCM, both methods will produce the same result in regard to absolute profitability. Different results are possible in regard to relative profitability. The determination and interpretation of the average rate of return will be illustrated by the following example.

Example 2.3

In this example, Example 2.2 is considered again. The absolute and relative profitabilities are determined for the alternative investment projects. Assume that the relevant interest rate is 6 % per year. The ARR method requires the determination of average profit, interest and capital tie-up for each project.

Table 2.4 Relevant measures for the investment projects A and B (ARR method)

Relevant measures	Project A	Project B
Profit (€ per year)	24,730	27,880
Interest (€ per year)	6,270	7,320
Average capital tie-up (€)	104,500	122,000

The average rates of return for projects A (ARR_A) and B (ARR_B) can be determined according to the formula given above, as follows:

$$\mathrm{ARR_A} = \frac{€24{,}730/\mathrm{year} + €6{,}270/\mathrm{year}}{€104{,}500} = 0.2967/\mathrm{year} \ \ (\text{or } 29.67\ \%) \ \ \text{and}$$

$$\mathrm{ARR_B} = \frac{€27{,}880/\mathrm{year} + €7{,}320/\mathrm{year}}{€122{,}000} = 0.2885/\mathrm{year} \ \ (\text{or } 28.85\ \%).$$

It is obvious that both projects achieve *absolute* profitability, since the rate of return they generate exceeds the relevant interest rate of 6 %. Investment project A achieves *relative* profitability due to its higher rate of return. This example illustrates that investment recommendations can be inconsistent between the PCM and the ARR method analyses if the considered alternatives require different capital tie-ups. An absolutely profitable investment project with lower capital tie-ups usually appears more attractive when using the ARR method than it does using the PCM.

Assessment of the method

In most respects, the ARR method resembles the CCM and the PCM. Therefore, the previous assessments of these models apply also to the ARR method. The PCM in particular has the same range of application and thus is competing. However, the following aspects should be noted. As for the PCM, the revenues of the investment alternatives are explicitly considered in the ARR method, but a different target measure is utilised.

Therefore, different investment assumptions are made about the balance of differences in capital tie-up. Using the PCM, it is assumed—as described above—that lower levels of capital tie-up are compensated by other investment(s) that yield the given uniform rate of interest used in the calculation (or a financing project with this interest rate). With the ARR method, however, it is implicitly assumed that smaller capital tie-up is balanced by a further (hypothetical) investment that earns the same rate of return as the project under consideration with the smaller capital tie-up. The reason for this is as follows: a comparison of average rates of return can only be meaningful, if the capital bases to which the rates refer are equal. This is not the case when differences exist in capital tie-up, so an adjustment is necessary which is achieved by assuming that the investment with the smaller capital tie-up is supplemented by a fictitious investment. In the case of the projects considered in the example above, A has to be supplemented by an investment yielding 29.67 % with a capital tie-up of €17.500 (= €122.000 − €104.500).

If the project with the highest capital tie-up also yields the highest rate of return, then the compensation assumption made for the ARR method is not problematic because the hypothetical investment project has no influence on the profitability. But, if this is *not* the case (i.e. the highest rate of profitability is earned by an alternative project with a lower capital tie-up), then this can affect the profitabilities and it becomes important whether the above assumption is justified. That is, it has to be questioned whether the capital tie-up differences can be balanced by another investment or financial project that yields a return close to that of the project with the lower capital tie-up. The answer to this question will determine whether it is better to use the ARR method or the PCM. It should be noted here that the rate of interest used should reflect alternative investment and financing opportunities. If, in the Example 2.3 above, the differences in capital tie-up are balanced by projects yielding 29.67 %, a question arises as to why the given rate of interest is assumed to be only 6 %. The changing orders of the relative profitability (between the PCM and the ARR method) can also be explained by the big differences in assumed interest rates.

If several investment opportunities exist with comparable rates of return, which are similar to that of the investment project with the lower capital tie-up and if the projects are competing for limited resources, the use of the ARR method may be appropriate. However, this can be considered as a special case. In reality, the profitability of the investment project under consideration will rarely correspond with the interest rate of investment or financing projects that are used to balance differences in capital tie-up. Besides this, an inconsistency of assumptions arises if several projects are included at the same time whose profitabilities drop with increasing capital tie-ups as in this case different assumptions are made during the selection process.

These problems are avoided by using the PCM. Additionally, the determination of the rate of interest used by the PCM should reflect and approximate the interest rate of the relevant investments and financing objects that balance the differences in capital tie-up. Thus, the assumptions underlying the PCM are closer to reality, making it a more suitable method. Further, if the interest rate of the balancing investment or financing objects is as high as is assumed in the average rate of return method (e.g. alternative investments exist that yield a rate of about 30 %, as in the example above), then the rate of interest should be adjusted towards this rate, and the result of the profit comparison method then becomes identical to that of the average rate of return method.

2.4 Static Payback Period Method

Description of the method

The target measure used for the static payback period (SPP) method is the time it takes to recover the capital invested in the project. It can be calculated based on average figures or on total figures. Average figures are used here.

> **Key Concept**
> The payback period of an investment project is the period after which the capital invested is regained from the average cash flow surpluses generated by the project.

The SPP method offers a measure of the risk connected with an investment. Judging the absolute and the relative profitability of investment projects based only on the SPP method is not a suitable analysis, because any costs and revenues occurring after the payback period will be completely ignored. Thus the SPP method is only useful as a supplementary appraisal method. Notwithstanding this, the general decision rules offered by the SPP method can be expressed as follows:

> **Key Concept**
> *Absolute profitability* is achieved if an investment project's payback period is shorter than a target length of time (usually expressed in years).
> *Relative profitability* is achieved if an investment project has a shorter payback period than the alternative investment project(s).

The SPP can be determined by dividing the capital tie-up by the average cash flow surpluses:

$$\text{Payback period} = \frac{\text{Capital tie-up}}{\text{Average cash flow surpluses}} \tag{2.5}$$

The capital tie-up corresponds with the initial investment outlay. If the project has an expected liquidation value that can be estimated with some certainty, it may be useful to subtract it from the initial investment outlay, since the SPP is often viewed as a measure of project risk. Another option is to distribute it according to the average cash flow surpluses over the years of the project's economic life. Both options will be neglected here.

A project's average net cash flows are the key measures when using the SPP method. Average cash flow is not the same as average profit. While profit is defined as the difference between revenues and costs, cash flow represents the net balance of cash inflows and outflows. A number of differences exist between revenues and cash inflows and between costs and cash outflows. For investment appraisal, depreciation is the most relevant of these differences, since it is considered as a cost (thus influencing profit) but is not a cash outflow. Average net cash flow can be derived by adding the depreciation cost back into the average profit figure. Note that, since the SPP method relates a project's average net cash flow to the capital tie-up, using the average profit (including depreciation) instead of the average net cash flow would result in double counting.

The way in which interest costs are dealt with also warrants discussion. Interest costs are included in the calculation of profit, just as depreciation costs are. But, the inclusion of interest in a project's cash flows depends on whether it represents a relevant cash outflow (i.e. the project is financed by debt) or not (i.e. the project is financed using internal funds). The first case is assumed here. So, interest represents a cost (in the calculation of profit) as well as a cash outflow and, unlike for depreciation, there is no adjustment required to convert profit to net cash flow.

To sum up, a project's average net cash flow can be expressed as follows:

$$\text{Average net cash flow} = \text{Average profit} + \text{Depreciation} \tag{2.6}$$

Example 2.4
The determination of the SPP method is illustrated with the help of an example. The data is taken from Example 2.2. Assume the company has decided that its investment projects must pay back their initial investment outlay within 4 years. The relevant information is:

Table 2.5 Relevant measures for the investment projects A and B (SPP method)

Relevant measures	Project A	Project B
Profit (€ per year)	24,730	27,880
Depreciation (€ per year)	37,000	42,000
Capital tie-up (€)	197,000	227,000

The static payback periods of the two projects A (PP_A) and B (PP_B) are calculated as follows:

$$PP_A = \frac{€197{,}000}{€24{,}730/\text{year} + €37{,}000/\text{year}} = 3.19 \text{ years}$$

$$PP_B = \frac{€227{,}000}{€27{,}880/\text{year} + €42{,}000/\text{year}} = 3.25 \text{ years}$$

These two projects, as shown, have similar payback periods. While project A is the relatively more profitable project, both are absolutely profitable because their payback periods are less than the required 4 years.

Assessment of the method
The comments made in regard to the previous three methods also apply to the SPP method, including the possible inconsistency between the assumptions concerning the capital tie-up when determining interest costs (see Fig. 2.1) and the average cash

flow surpluses which are available for amortisation according to the SPP method. It must be emphasised that the SPP should not be used as an exclusive decision criterion because it fails to incorporate any profits or cash flows occurring after the payback period. However, it is a useful supplementary investment appraisal tool since it provides some indication of the risk connected with an investment project. In this context the payback period can be interpreted as a critical factor in considering a project's economic life and, therefore, as a result of a sensitivity analysis.

All the methods described in this chapter omit any consideration of the time value of money, as they use average measures rather than tracking cash flows over time. The methods described in the following chapter will allow more meaningful analyses by discounting cash flows to one point in time (making them comparable) and by analysing different cash flows from different periods. This will enrich the investment appraisal process since the analysis of average indicators limits the usefulness of the results.

Assessment Material

Exercise 2.1 (Cost Comparison Method)

A car manufacturer wants to use the cost comparison method to assess whether he should continue to buy in a special component or manufacture it in-house instead. Two companies are offering different types of equipment to produce the part, giving the following data:

Table 2.6 Data for the two machines A and B

Data	Machine A	Machine B
Initial investment outlay (€)	120,000	80,000
Economic life (years)	10	10
Liquidation value (€)	10,000	0
Method of depreciation	Straight-line	Straight-line
Capacity (units per year)	12,000	10,000
Wages (€ per year)	24,000	28,000
Salaries (€ per year)	8,000	6,000
Materials (€ per year)	23,000	23,000
Other fixed costs (€ per year)	19,000	14,000
Other variable costs (€ per year)	8,000	9,000
Rate of interest (% per year)	5	5

The variable costs are in proportion to the volume produced; the above data relate to the capacity being fully utilised. The unit buying in price for the parts is €10.

(a) Which of the alternatives (machine A, machine B or buying in (alternative C)) would you recommend if the number of these special components required each year was 6,000 units?
(b) Which machine would you select if the required volume was 10,000 units per year?
(c) Which assumptions have you used in question a) in respect of the amount of capital tied up? What other assumptions has the cost comparison been based on?
(d) Describe the changes in average depreciation and interest that occur if, instead of straight-line depreciation, the declining balance method of depreciation for machine B is used, whereby
   (d1) The rate of depreciation is 30 % followed by a switch to the straight-line method to reach the liquidation value of €0.
   (d2) Depreciation is carried out until there is a liquidation value of €10,000.
   It is not necessary to calculate the results; just discuss the general impact on the project appraisal.

Exercise 2.2 (Cost Comparison Method)

The cost comparison method is to be applied in assessing two alternative investment projects, A and B, as well as alternative C (buying in from outside). The following data are available:

Table 2.7 Data for the investment projects A and B

Data	Alternative A	Alternative B
Initial investment outlay (€)	13,000	12,000
Liquidation value (€)	4,000	2,000
Economic life (years)	6	6
Capacity (units per year)	10,000	8,000
Rate of interest (% per year)	10	10
Variable costs (€ per year) (x = Production volume)	$-\frac{8}{100,000}x^2 + 1.7x$	0.8x
Other fixed costs (€ per year)	50	600

The items can be bought in at a unit price of €1.50 for volumes of up to 10,000 units.

(a) Ascertain the cost functions C_A, C_B and C_C for the various alternatives.
(b) Which alternative is preferred when the production volume is
   (b1) 4,000 units?
   (b2) 8,000 units?
   (b3) 10,000 units?
   What costs arise with this alternative?

Exercise 2.3 (Profit Comparison, Average Rate of Return and Payback Method)

A company is planning to undertake an investment project. The following data have been calculated for two alternatives, A and B:

Table 2.8 Data for the alternatives A and B

Data	Alternative A	Alternative B
Economic life (years)	8	8
Sales volume (units per year)	20,000	24,000
Sales price (€ per unit)	8	8
Initial investment outlay (€)	200,000	240,000
Construction costs (€)	18,000	28,000
Freight costs (€)	2,000	2,000
Liquidation value at the end of the period (€)	16,000	16,000
Fixed operating costs (€ per year)	6,000	22,000
Variable unit costs (€ per unit)	4.60	4.40
Rate of interest (% per year)	6	6

Ascertain the preferred project using

(a) The profit comparison method.
(b) The average rate of return method.
(c) The static payback method.

Further reading: see recommendations at the end of this part.

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