Chapter 6
Investment Evaluation

Abstract The evaluation of the economic efficiency of investment in real estate, involves the appraisal and comparison of costs and revenues generated from its production and management. In the following paragraphs, the possible approaches to the estimation of cash flows are briefly indicated. On the other hand, this estimate does not exhaust the task of the analyst who should support the investor by setting up a hierarchy of choices identified among a large number of alternatives and accompanied by indices, parameters and risk scenarios. Traditional measures of profitability are analysed for this purpose; however, these have an important limitation: they ignore the effects of the timing of cash flows. Lastly, the discounted cash flow analysis is introduced, and the text describes and explains the main profitability indicators that can be derived from this analysis, highlighting their limitations and strengths.

6.1 Introduction

The verification process for the feasibility of a Real Estate investment refers to the fact that the evaluation occurs in two phases: in the first, where the development hypothesis is defined, an economic verification is made. After this verification there is first a better project definition and then the market researches which are preliminary to the economic and financial final evaluation (second phase).

The evaluation of the efficiency of a generic economic Real Estate investment occurs through a cost-benefit confrontation.

Bear in mind that the efficiency concept used in economy is different to the one used in engineering. In Physics, efficiency is measured through quantity terms and is expressed by the ratio between the amount of goods—or services—and factors used: i.e., a boiler will be considered more efficient than another one, if it produces more heat in equally consumed fuel. On the other hand, economic efficiency has money as a parameter and is measured through the ratio, or the subtraction, between the final value of goods and the cost of the used factors: i.e., there is

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economic efficiency if the discounted cash value of the allowed fuel savings is higher than the higher price of the new boiler.

The main problem connected to the evaluation of the economic efficiency of a Real Estate investment through cost and benefits confrontation, is that of the monetary terms which determine the benefits. The reason is that a Real Estate investment is normally featured by costs that are close to the evaluation date, while the benefits are more distant in time and, obviously, uncertain. In the cost and benefit evaluation, with reference to the evaluation itself, it is important to focus exclusively on those costs and benefits that directly benefit or support those who have made the investment and ignore those positive or negative effects which are created by the event, but concern other subjects. In fact, if an owner plants trees around the house, there is surely energy saving to be accounted for on the air-conditioning due to less sunlight. However, the same benefit enjoyed by the rest of the neighbourhood cannot be either investigated of quantified.

6.2 Cash Flow Evaluation

The evaluation of the benefits of a Real Estate investment implies, on one hand, the evaluation of the obtainable benefits deriving from Real Estates output (held for sale) or from the administration of these (in this case the final product is the housing service), and on the other hand, the evaluation of the factors regarding production cost.

Therefore, the investor considers land and buildings as factors of production, the cost of which have to be estimated or accounted for with the cost of the other factors, which participate in the economic activity. In the land case, i.e., a permanent and non-destructible economic good, its utilization price corresponds to the interest of the capital used for purchase. Furthermore, as a result of its peculiarity (it is an original good, not increasable in price, therefore permanent) it is not subject to amortization. On the contrary, due to the rent it might increase its value over time. This is something that must be considered during the benefits evaluation phase and especially in the estimate of salvage value. Regarding the building, the utilization price is a compound part of a share of interest on the initial cost and an annual fee of amortization, required to reproduce the same good, or similar, at the end of its useful life. In terms of costs, these are the elements of greater economic commitment, which also involve a specific evaluation strictly connected to the modality of financing. Equally important is the prediction of the costs related to the management of the operation.

Feasibility and convenience of an investment are measured comparing the expenses with the activity benefits flow. Real Estate investment evaluation requires making a prediction—not at all easy—on the performance of many parameters involved in the cash flow calculation. It is fundamental for this purpose to research the operational history of the building (if it is already used) or of other comparable estates. This allows for the identification of the income and

expenditure items related to the management of the property, their volatility and therefore their influence on the profitability of the investment. In relation to the abundance of the information and data, due to marketing researches, it is possible to use statistical-econometric techniques in order to obtain predictions that are more reliable.

6.2.1 Benefits and Future Building Value Evaluation

The active items of a generic cash flow related to a Real Estate investment, considered as variables due to the building type, are usually the rent and the recovery value of the investment at the end of the holding period. The recovery value has to be proportioned to the probable sale value of the building.

For the evaluation of the gross income of a building already in use, it is important to gain information on:

- Agreed rent on a lease;
- The existence of arrears in the payment of rents;
- Volume of vacant spaces.

It is also useful to match these researches with the evaluation of the single leases, which could point out clauses or special contractual forms, concessions and agreements with effects on the rent.

If the acquisition of this information is not possible, an estimate of the potential income is always required in order to verify the accuracy of the data given by the owner and the consistency of that data with the market.

The potential income evaluation, instead, becomes the starting point for a building transformation evaluation (production from scratch or change of use).

Every property expresses a potential income as a function of:

- The interaction of supply and demand in the market area, which sets the level of the rents and the amount of the spaces that can be used;
- Its desirability in relation to the competitive framework.

It has already been shown how the performance of the supply-demand relationship plays a main role in the fluctuation of prices; the market reactions to changes in the economic climate and in particular to changes in some macroeconomic variables, were also analysed. Therefore, it now becomes necessary to collect a variety of data which, if properly interpreted, lead the analyst to formulate a prediction about the possibility and the extent of future changes in the preferences of the specific market. In order to value the potential income, it is also essential to anticipate the changes in the preferences of future tenants about the location and the quality of the real estate.

Furthermore, potential income is directly related to the predictions about the physical and qualitative decay of the building and focuses on questions that involve expenses and the probable recovery of value.

Physical characteristics of buildings are subject to an inevitable natural decay. A direct consequence of this is the decline of the desirability of the property within the competitive framework. This has an inevitable effect on the recovery value. In order to determine such effects, a fundamental parameter needs to be defined: the "Economical life" of the property.

In order to understand this notion it is, first of all, important to distinguish the "economic life of a building" from its "physical life" (duration in efficiency). The latter is strictly bound to the physical deterioration of the building, due to the passing of time. The duration in efficiency of a building, or part of it, is clearly related to the maintenance activities. Regular maintenance and modernization can extend the physical life of a building. Obviously, economic life cannot be longer than physical life. However, unlike the latter, it can be considerably reduced because of a poor compliance of the building, or of one of its components, to new quality standards of the users. This implies an inevitable loss of ranking in market preferences compared to new or retained properties. This phenomenon is called "functional obsolescence". It is caused by technological progress following the built portion of the Estate and has to be separated from the economic obsolescence, which is a factor of economic depreciation connected to variations in the building environment, or rather; it is connected to variations of particular real estate market conditions and of the economy in itself. The economic obsolescence produces a reduction of the land value, thus it is a phenomenon in contrast with the land rent.

The economic life of a building is usually shorter than its physical life. The latter might be estimated comparing similar building types of which the service duration is known because they have already reached their end. Alternatively, it is useful to refer to the physical life of the components that make up the building (Manganelli 2011). Thankfully, the evaluation of the physical life of a building does not show insurmountable problems. More complex is the obsolescence process and consequently, the economic life of the property. The factors that might influence the economic life are surely external to the Estate and might be found, for example, in modernization activities, in the rising standards of quality (functional obsolescence), in the increase of the value of urban land (rent), in socio-economic or environmental changes, in changes in transport and storage techniques (economic obsolescence).

Figure 6.1 displays when an Estate is to be considered economically obsolete, that is at the end of its useful economic life (Csillaghy 1985).

Over time, on one hand the investment value related to the constructed part of the Estate slightly decreases, in fact the physical life decreases and the rent decay becomes higher (maintenance and repairing expenses cause an increase of management costs), on the other hand there is a progressive increase of the land on which the building stands. When the lines that represent these two phenomena meet, the building must be renewed or demolished and replaced.

Figure 6.2 displays a much more detailed interpretation of the phenomenon; it shows that the value of the property is the sum of the values of the land and building. The chart highlights that the increase of the land value compensates and exceeds the effect of the depreciation of the built part. The variation of the value of the building is particularly considered not linear, but with a concave shape, as

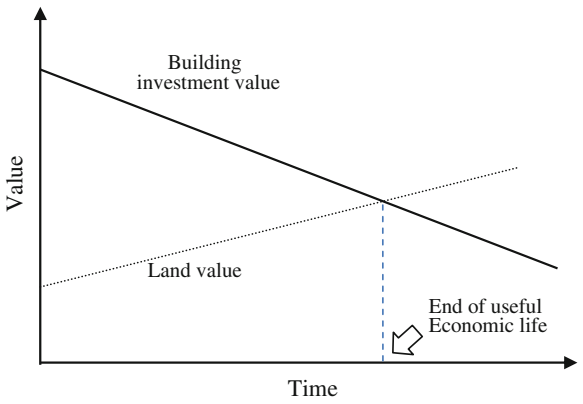

Fig. 6.1 End of the useful economic life of a building

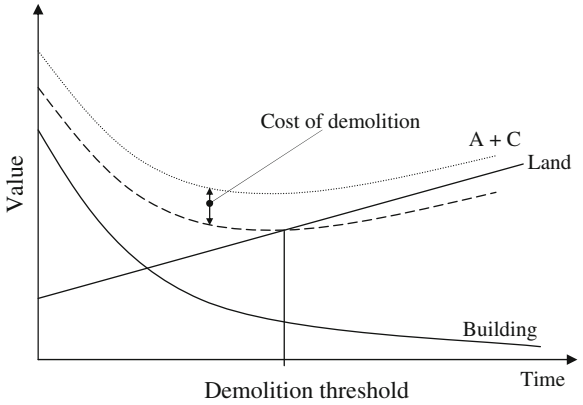

Fig. 6.2 Value curve of an estate, sum of the aliquots related to the area and to the building

shown in several empiric studies (Fisher et al. 2005; Dixon et al. 1999). The intersection between the value curve of the land (increasing) and the curve that describes the total value function (A + C), on which the demolition cost is subtracted, marks the achievement of the demolition threshold, that is the end of its economic life.

An understandable, though only qualitative, representation of the functional obsolescence is represented in Fig. 6.3, the chart shows the relationship between physical life, economic life and service life in relation to the maintenance and upgrading of functional redevelopment on one hand, and the expected increase in quality standards on the other.

The graph is constructed by assuming:

1. That the new building, obviously, has quality and performance levels higher than acceptable standards;
2. Constant growth of this minimum threshold;
3. Slight decay of the considered element.

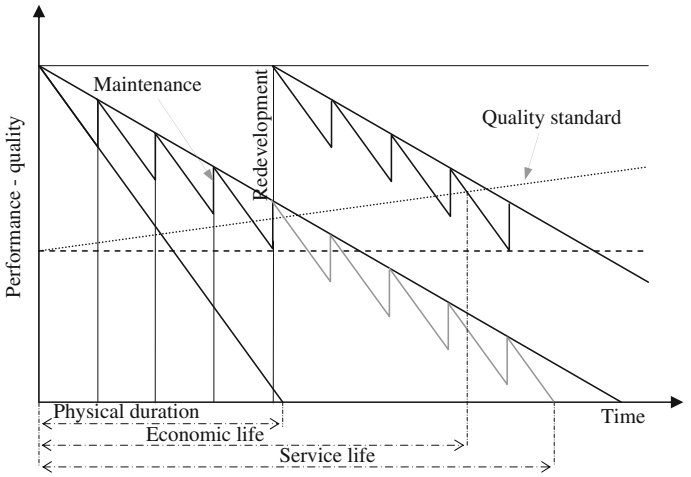

Fig. 6.3 Performance variation related to different possible interventions

All the highlighted factors have effects on the prediction of incoming flows; the effects are therefore reflections of the measurement of the gross income potential, i.e., the evaluation of odds of vacancy (non-vacancy), and uncollectible accounts. These units take into account the loss of income associated with periods of unproductivity and the deducted arrears or insolvency of the tenant, in order to determine the potential Gross Operating Income.

6.2.2 Operating and Management Expenses

Once the Gross Income has been estimated, one must perform an analysis of the parameters that affect the cost of Net Operating Income. Equally important in the cash flow evaluation is the prediction of management costs and estate maintenance. Prediction of future operating expenses is definitely less complicated than the evaluation of gross income: the expenses are less, or not at all, susceptible to those variables that, instead, influence the revenues of the properties significantly. These include the location of the property.

The operating costs of a particular type of Estate may vary, of course, in relation to the different areas of the country, depending on climatic factors and on various economic indices. However, within the same region, there are no appreciable differences between the costs associated with maintaining similar properties.

This means that it is possible to build, by observing the expenses related to various types of Estate (therefore by taking into account the age of the property,

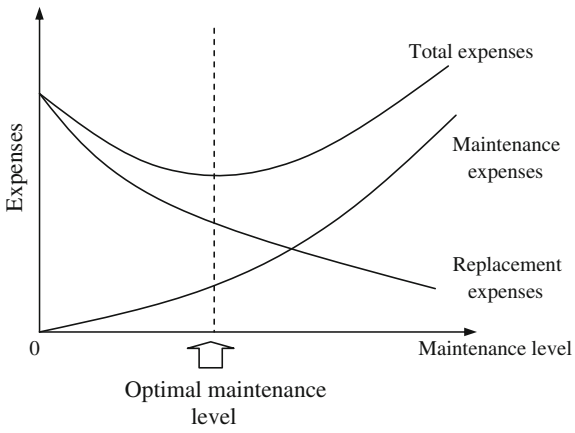

Fig. 6.4 Costs of maintenance and replacement

the quality and use of the construction), a list of expenses divided into geographical areas, thus assisting the analyst in the evaluation process. On the same conditions, the maintenance of an older building is relatively more expensive. Many other parameters may considerably change the amount of the expenses necessary for property management. Please note that in this sense, the design choices regarding the quality of buildings are determinant. The socio-economic characteristics of those who use the rented space are equally important in defining the costs. However, the prediction of time and costs of maintenance and elements replacement and the Facilities management is not easy. The data on the costs of use are not collected in a systematic way and only a few countries have specialized and reliable databases.

These expenses are necessary for Real Estate to guarantee, *ceteris paribus*, that it keeps generating a high enough rent flow.

There is still a compromise problem between maintenance and replacement expenses. In other equal conditions, an increase in maintenance level for single components causes a decrease of its replacement cost per unit of time. A good maintenance extends the useful life of the components of the building. So, generally, the higher the maintenance level (and its costs) the lower the replacement expenses. The optimal level of maintenance corresponds to the minimum of the total cost given by the sum of the costs of maintenance and replacement (Fig. 6.4).

The evaluation of operating expenses has to be developed on the basis of the accounting history of the property under study or, in the case of a new project, by analysing the expenses of similar properties. The reconstruction of the operating history, no matter how complex it is due to the absence of databases, is important as it allows us to develop an estimate of the future costs from certain references.

The costs to be deducted in gross operating income are classified into the following categories:

Table 6.1 Net operating rent for a generic estate

Potential income from rent		A
Vacancy and uncollectable shares		B
		C = (A − B)
Other incomes (i.e., parking)		D
Gross operating income		E = (C + D)
Management expenses		
Management and administration expenses	…	
Services	…	
Insurances	…	
Maintenance	…	
Taxes and duties	…	
Total operating expenses		F
Net operating rent		G = (E − F)

- *Managerial and administrative expenses*: these are expenses related to the tenement management, collection of rents, advertising, record of documents, etc.;
- *Services*: these are the expenses related to custody and caretaking, cleaning and lighting, it is important to check whether these expenses are borne by the lessee (as is usually the case) or the owner;
- *Insurance*: is the full premium that is paid for the risk of fire, lightning, explosions of gas, and to ensure the third party liability;
- *Maintenance*: are the costs incurred for interventions aimed at preventing the deterioration of the property, to ensure the functionality of the use or the extension of the term of efficiency of the building;
- *Taxes and duties*: for this subject, please refer to the next paragraph.

In Table 6.1, the items are the most common actual income and expenses arising from the management of common property.

6.2.3 Recovery Value

Another element of the income flow is the probable sale value of the Estate at the end of the holding period. Although it does not represent an annuity, but a one-off, it forms an important part of the value of investment. The value of recovery certainly depends on all those variables which have been considered in the Gross operating rent prediction, i.e., those that determine the interaction of supply and demand in the market. In predicting future scenarios, one works on the assumption that the Real Estate market works efficiently, free of constraints and bottlenecks so that the rents can be interpreted as return on capital and therefore their evolution

expresses the underlying evolution of the value of the capital from which the return is derived. So, just like any other real or financial activity, when the rent increases (decreases), the value decreases (increases). It would be too risky to imagine different conditions from those, although the reality points out—as shown in previous paragraphs—that because of the proper structural limits of the Rental Market, it does not always express prices/rents that are proxy of the dividend corresponding to the value of the property.

When estimating net operating rent, it is assumed, among other things, that the property will maintain, during the holding period, the same profitability at least for the part of it linked to the technical and functional features of the property. It is also assumed that this capability derives from the appropriate forecasting of the timing (frequency of intervention) and cost of maintenance and upgrading. Given these assumptions, the property will be valued at the end of the holding period, obviously connected to the last estimated income.

The most convenient approach to obtain the final value is to predict the trend of the relationship between net operating income and the market value, and apply this ratio to net operating income for the final year of the investment period. It is a question of estimating the capitalization rate, given by the ratio:

$$r = \frac{Net\ Operating\ Income}{Property\ Value}$$

The capitalization rate varies depending on the cost of capital and on the confidence that investors show in the cash flows from the investment. It is clear that the evaluation is not so easy. Nothing can be said about the future cost of capital; and so, with regards to the expectations of investors, the possible predictions are those reflected in the evaluation of net income flow. Therefore, the assumption of a constant relationship between the fee and the price even at the end of the holding period is reasonable. Having mentioned this, however, a final observation is necessary: the estimate shows that the capitalization rate has to be able to reflect all those variables that contribute to the making up of the property value and that are not already included (at least not totally) in the rent. Among the intrinsic features of the property, one that certainly changes at the end of the holding period and with influence on value but not on rent is the age of the building. The passing of time has effects on the value of the estate, particularly on the building. These effects are distinguishable as consequences of three depreciation factors: sheer age, incoming decay and functional obsolescence. Functional obsolescence has already been discussed. The first two factors, instead, are directly connected to the physical deterioration of the property. The latter is a unique natural event, but it may be useful to break it up in the two mentioned factors, in order to determine the relative depreciation.

Sheer age involves factors of depreciation related to the passing of time and therefore to the fact that the end of the life of the building is coming closer, even if the building and its parts preserve their original performance capabilities (if possible).

Incoming decay is the factor related to the use of the property during time. The wear may compromise the functionality of the Estate, or part of it, causing the decay of its performances. The need to have to ensure efficiency equal to that of a new estate will require a scheduled maintenance or, in the absence of this, extraordinary measures with consistently increasing expenses as the time passes. The effects of the incoming decay are already accounted for in the net rent evaluation, obtained by the deduction, amongst other things, to the gross income, of the maintenance expenses, those expenses capable of ensuring the maintenance of the technical and functional capability of the estate.

The effect of age should be accounted for in the capitalization rate evaluation. In an alternative and certainly more precise way, the loss of estate value due to sheer age is summarised as the accumulation of payback shares corresponding to the value of the building in the range corresponding to the holding period.

If C_o is the cost of construction of a new building (if new) or its cost of reconstruction depreciated to the initial year (if used),[1] m is its remaining useful life and i is the interest rate, the share of re-integration is given by:

$$Q_{reint} = C_o \times \frac{i}{(1+i)^m - 1}$$

Although this amount does not correspond to an actual outlay, and therefore not included in the item to be deducted in the gross operating income, it must be financially counted in the cash flows. This allows:

- To measure the depreciation in the value of the property which is subject to capital investment through the capitalization of net income[2];
- To estimate the depreciation caused by immobility due to sheer age at the end of the holding period;
- To achieve these goals and avoid having to consider equivalent corrections to the rate of capitalization; these latter operations, however, could provide much more uncertainty.

6.2.4 Financing Management

If the investor decides to use a loan to partially finance the purchase of a property, then the contents of Table 6.1 have to be modified by adding "annual instalment of debt amortization". This will be subtracted from the Net Operating Income to

[1] At a cost estimated in this manner, for greater accuracy, it should be summed to the cost of demolition and waste transport for disposal of the building to be replaced at the end of its useful life.

[2] Land is an original and permanent source, and everything built on it has a limited life in efficiency and is therefore subject to amortization.

determine the annual cash flow before taxes. Net Operating Income means the difference between incomes and expenses of current management before financial charges and tax:

Net operating income	G
Annual instalment of debt amortization	H
Cash flow before taxes	G − H

As a matter of fact, the convenience is to be assessed from the point of view of the specific investor, by incorporating the consequences of the application for funding in the evaluation. External financing is nearly compulsory due to the large amount of capital necessary for the transfer of real estate. The tools needed to guide the choice for the most affordable financing have already been discussed.

6.2.5 Evaluation of Construction Costs

To assess the possibility of a profit from the implementation of a project it is necessary, firstly, to determine the nature and extent of the expected incomes, and finally to predict, in the amounts and time, the outflow of capital. For those investments that contemplate the transformation of estates (e.g., the construction of new buildings or renovation of existing buildings), the evaluation of the cost of the transformation with the cost of management plays an important role in taking the right decision for investment. In this sense, the estimate of the cost of the investment and the prediction of how costs will be distributed over time is crucial. Regardless of the characteristics of the project and the type of client, this information is invaluable for taking a decision on how to finance the operation. Just the considerations and patterns that can lead to the final choice may vary.

This phase of the assessment is based on the concept of 'cost value', and on the procedures for its determination.[3]

Every survey of the costs must always be in view with a wide range of factors: the quality and quantity of the projected works, the purchase price of the inputs; any other fees associated with the building production.

The preliminary analysis of costs is carried out at different times of the development of a construction project. As one moves to the next stages of completion and implementation of the project, one must modify or adapt the procedures for assessing the cost of construction in order to improve the forecasting ability and consequently allow the optimization of the design choices. The main and fundamental objectives that must be pursued prior to the estimate of the cost are:

- Facilitating the comparison of alternative solutions;
- The definition of the allocation;

[3] For more details, see Manganelli (2011).

Table 6.2 Cost item in construction activity

Cost	Promotion costs	Identification and feasibility studies, project evaluation
	Production costs	Acquisition and preparation of the areas, construction of the planned work; profit due to the organizer of the construction process; rate of use of capital employed (interest expense); surveys and geotechnical investigations, preparation of preliminary and final design, the definition of any other elaborate for the start of the procedure for the award of work, testing of works and supplies (technical costs), other expenses associated with the construction (urbanization, contributions concession etc.)
	Management and maintenance costs	Works and services to be performed in order to ensure the use of the finished work (cost of operation) and to keep the original features of the building for as long as possible (ordinary and extraordinary maintenance costs)
	Redevelopment costs	Works and services to be made to counter, from a certain point in the cycle of life, functional and economic obsolescence of the work (costs of technological upgrading, restoration, renovation, demolition and reconstruction)

- Continuous monitoring of the budget constraint;
- An indication of an objective parameter around which to develop the negotiation for the award of the work;
- The identification of the most likely invested cost or minimum price in the submission of tenders.

The estimate of the likely cost of construction is obviously preceded by the identification of the fundamental characteristics of the transformation. This is done with greater or lesser detail depending on the stage of development of the design.

The evaluation of a construction cost, in relation to the purpose and to the demanding subject can be performed to determine a generally valid result or aimed at an assessment of cost effectiveness. A public promoter is interested in order to identify the conditions that lead to the formation of prices in a contract. In this case the cost evaluation must be objective and generally valid. The companies and promoters must verify the conclusions they have reached and thus reproduce the assessment in view of the individual and specific ability, risk appetite and the needs of profit.

The task of the performer of the estimate is to identify the physical elements of a project that will have a greater economic significance, measure and evaluate the quantity, the price declines as a function of the client and his objectives, and finally bringing them together in a single figure called cost value.

The total cost can be divided into the categories shown in Table 6.2.

In the early stages of the preparation of a construction project, all of these cost elements should be evaluated with the use of procedures that can provide a reasonable, although not perfect result, which gives idea of the financial commitment required by the project. Only later, thanks to a better definition of quantitative and qualitative characteristics of the project, it will be possible to use more sophisticated evaluation procedures.

6.3 Traditional Techniques for the Analysis of Profitability

The analyst's task does not end with the formulation of a cash flow forecast and the collection of the necessary information to take the investment decision. He must support the investor setting up a hierarchy of possible choices identified among a large number of policy alternatives accompanied by economic indices, parameters, and risk scenarios.

The calculation of the profitability measures respond to this need by representing, in many ways, the relationship between the amount of invested money and the expected returns. The techniques used for the calculation of these indicators may differ for the use of the available data, and in terms of how to consider (or ignore) the different levels of risk.

This chapter analyses the virtues and weaknesses of the traditional criteria for the evaluation of profitability. Simple indicators of convenience, almost always specify the form of the relationship between prices and revenues. In most cases, for the determination of these indices it is not necessary to provide preventive analysis of expected cash flows.

6.3.1 Advantage Reports

These reports are used to quickly judge (*Rules of Thumb*) the reasonableness of the relationships between measures of value and performance. In this category, it is possible to recognize two types of indexes:

- Financial measures or reports;
- Performance/Profitability measures of reports.

Financial reports consider the relationship between incomes and operating expenses, whereas the efficiency ratios express the relationship between net operating income and value. They are very simple measures that do not constitute an exhaustive tool for analysis, but allow us to quickly filter the unacceptable investment opportunities. The more sophisticated analysis (and of course the more expensive) will be able to focus on the most promising alternatives.

While the calculation of the indices is an elementary process (it involves the simple division between two variables), their interpretation (ratio analysis) is more complex. First, the index must have an economic meaning, i.e., it must compare two quantities with an underlying logic, and secondly the interpretation of the indexes must consider the factors that affect the same variables that are used in the report. Even when analysing the indexes used for the selection among the various possibilities, the criteria for interpreting general comparison with those that characterize similar properties are valid. Thus, the study of financial or profitability reports must be preceded by the determination of relations prevailing in the market.

Table 6.3 Financial reports for estimating the reliability of the estimated flows

$Operating\ Report = \frac{Operating\ Outgoings}{Gross\ Effective\ Income}$
$\frac{Outgoing}{Revenues} Ratio = \frac{Operating\ Outgoings + Debt\ Installmet\ Payment}{Gross\ Effective\ Income}$
$Debt\ Recovery\ Ratio = \frac{Net\ Operating\ Rent}{Debt\ Installmet\ Payment}$

6.3.2 Financial Measures

Table 6.3 shows some possible financial ratio.

The calculation of these indices may reveal anomalies in expected cash flows. Their use requires, of course, the availability of data with which to make the comparison within the market. Their usefulness is noticeable even when, in the first stage of the analysis, one has the need to rapidly eliminate less attractive investment alternatives and then to concentrate the investigations on the most interesting possibilities.

A good investment strategy contemplates the property search, characterized by very low operating ratios. The operating ratio is a measure that can be misleading because it also affects the efficiency of the administration.

The cost-benefit ratio and the debt coverage ratio give a safety measure associated with the use of funding. Particularly, the debt coverage ratio (Debt Service Cover Ratio) is used to determine the bankability of the project. Bankability is a term usually used to define the acceptability of the whole banking sector, the overall structure of a project for the purposes of its funding. It indicates the possibility for an initiative to be financed with a certain financial structure, which therefore provides a corresponding allocation of risk.[4] This indicator should be calculated for each year of the duration of the project or the financing. This indicator is properly called Annual Debt Service Cover Ratio (*ADSCR*), corresponding to the ratio between the net operating income relative to a given year and the corresponding debt service *Dt* (calculated as the sum of principal and interest) in the same year.

$$ADSCR_t = \frac{Net\ Operating\ Income_t}{D_t}$$

Another useful indicator to determine the financial feasibility of the project is the Life Loan Debt Service Cover Ratio (*LLDSCR*). It is defined by the quotient of the sum of the discounted cash flows available for debt coverage (net operating

[4] It can occur that an investment project, that is characterized by a positive Net Present Value (NPV concept is illustrated in the following paragraphs), cannot be bankable, because during a generic life-span of the investment itself, it does not find adequate funding.

incomes)—included between the time of evaluation and the last year allowed for repayment of the loans—and the remaining debt considered at the same moment of the evaluation.

$$LLDSCR = \frac{\frac{\sum_{t=s}^{s+n} Net\ Operating\ Income}{(1+r)^t}}{D_s}$$

with

s	the time of evaluation;
$s + n$	the last year for which the proposed debt repayment;
D_s	the outstanding debt at the time of evaluation.

The numerator of the ratio is, therefore, the present value of cash flows generated by the project on which the lenders can rely on for the future return of the amounts still owed.

Indices greater than one indicate a greater financial security for investment and a greater guarantee of repayment to lenders.

Example 6.1 Through interviews with tenants, one becomes aware of the fact that some of them enjoy special concessions handed out by the owner, not mentioned in the leases. To check the reliability of the cash flow of the property in question, one passes to the analysis of the data of four comparable properties in the immediate neighbourhood. The characteristics of these buildings are similar to those of the object properties of interest.

Property A—25 units divided as:

- n. 17 apartments of 85 m^2 with 2 bedrooms leased at €480 per month;
- n. 5 apartments of 60 m^2 with a room leased at €330 per month;
- n. 3 offices of 45 m^2 rented for €250 per month.

Currently, an apartment of 85 m^2 is vacant.
Property B—19 units divided as:

- n. 7 apartments of 85 m^2 with two bedrooms rented for €500 per month;
- n. 8 apartments of 60 m^2 with a room in Holiday sold for €350 per month;
- n. 4 offices 47 m^2 leased for €260 per month.

Currently, vacancy rates are a flat of 60 m^2 and a study.
Property C—36 units divided as:

- n. 22 apartments of 80 m^2 with 2 bedrooms rented for €460 per month;
- n. 8 apartments of 58 m^2 with a rented room at €330 per month;
- n. 6 offices of 45 m^2 leased at a monthly fee of €240.

Currently, there are 2 vacant apartments of 80 m^2 and a study.
Property D—30 units divided as:

Table 6.4 Comparison of rents

	Comparable properties			
	A	B	C	D
Apartments with 2 bedrooms				
Monthly rent	€480	€500	€460	€485
Area (m^2)	85	85	80	83
Rent per square meter	€5.64	€5.88	€5.75	€5.84
Apartments with 1 bedrooms				
Monthly rent	€330	€350	€330	€335
Area (m^2)	60	60	58	60
Rent per square meter	€5.5	€5.83	€5.69	€5.58
Offices				
Monthly rent	€250	€260	€240	€265
Area (m^2)	45	47	45	51
Rent per square meter	€5.55	€5.53	€5.33	€5.19

- n. 10 apartments of 83 m^2 with two bedrooms rented for €485 per month;
- n. 13 apartments of 60 m^2 with a room rented for €335 per month;
- n. 7 offices of 51 m^2 leased for €265 per month.

A study and an apartment of 60 m^2 are not leased.

The data collected in Tables 6.4 and 6.5 sets the comparison between the four units of reference.

Table 6.4 shows that the units with 2 bedrooms make an average of €5.76 per square meter; the apartments with one room can be rented at €5.66 per unit area, while the offices are sold at about €5.40 per square meter.

Table 6.5 compares the vacancy rates of comparable properties. Note that case B has a relatively high vacancy rate with regards to the apartments with one room and offices. This can be attributed to temporary problems (malfunctioning of the systems, evictions, etc.), or to the mismanagement of the property.

Using the average data collected in the previous tables, and relying on the management skills of those who will administer the property being analysed, one can build an approximate "evaluation" of the gross income derivable from the building in question (Table 6.6).

The data in Tables 6.4 and 6.5 and therefore the synthesis carried out in Table 6.7 are a reference to test the correctness of the data provided by the owner of the estate one intends to purchase and/or to correct any inconsistencies. The comparison with similar buildings that fall into the same category is also crucial in estimating the amount of individual elements of expenditure management. The survey, in the example, shows that a reasonable program of maintenance and repair can absorb between 11 and 12 %

Table 6.5 Comparison of vacancy rates

	Comparable properties				
	A	B	C	D	Total (average)
Apartments with 2 bedrooms					
Number of units	17	7	22	10	56
Vacant units	1	0	2	0	3
Vacancy rate	5.8 %	0	9 %	0	(5.3 %)
Apartments with 1 bedroom					
Number of units	5	8	8	13	34
Vacant units	0	1	0	1	2
Vacancy rate	0	12.5 %	0	7.7 %	(5.9 %)
Offices					
Number of units	3	4	6	7	20
vacant units	0	1	1	1	3
Vacancy rate	0	25 %	16.6 %	14.2 %	(15 %)

of gross income. The situation is similar relating to property taxes. This series of comparisons and controls allows to build a picture about the likely profitability of the property of interest (Table 6.7).

What one gets is a "correct" cash flow, a reconstruction of the operating history of the Estate that outlines a good guide for predicting the immediate future. In the absence of changes—always possible—in the building or in the economic context, there is no reason to expect a substantial change in the amount of operating expenses. The possibility of different and unpredictable scenarios involves risk assessment.

The analysis of the market, of supply and demand, of its main components and the macro and micro economic indicators, however, allow to push the prediction over a short horizon, starting right from "correct" cash flow.

In the example, the assumption is that because of the high vacancy rates and stagnant rents, the last three years are characterized by an arrest in construction market. However, the same three-year period showed a linear decrease of the vacant spaces where the percentage increased from 14 to 7 %.

This has led to, over the past six months, a slight increase in the level of rents. It is expected, therefore, that the property in question will be affected by the new conditions of the market and it is probable an increase in rents. Assuming also that the maturities of leases are not contemporary, the adjustment of the total income to changes in market prices, although it occurs year after year, involves the expectation of a certain number of years for a perfect alignment.

The real estate property is in a residential neighbourhood close to the area where some of the offices and work activities of the city are, so a further

Table 6.6 Estimated gross potential income and vacancy rate

	Type of housing units		
	Two rooms	One room	Office
Potential gross income			
Fee per square meter	€5.76	€5.66	€5.40
Area (m^2)	×90	×65	×45
Rental of the individual units	€518	€368	€243
Number of units	×5	×15	×8
Potential monthly income	€2,590	€5,520	€1,944
Annual (monthly × 12)	€31,080	€66,240	€23,328
Vacancy			
Potential annual income	€31,080	€66,240	€23,328
Vacancy rate (Table 6.5)	×0.053	×0.059	×0.15
Vacancy losses	€1,647	€3,908	€3,500
Total potential gross income = 120,648 € Estimated losses for vacancy = 9,055 €			

Table 6.7 Cash flow of an apartment building

Potential gross income		€120,648
Losses for vacancy		€−9,055
		€111,593
Rental car parking		€7,500
Effective gross income		€119,093
Expenses		
Operating expenses (5 % EGI)	€5,950	
Wages	€10,000	
Various	€10,000	
Insurance	€5,000	
Supplies	€1,500	
Advertise	€600	
Maintenance and repairs	€13,000	
Property taxes	€15,000	€−61,050
Annual net income		€58,043

decline in the vacancy rate and a corresponding annual growth in rents is expected. This at least until the vacancy rate exceeds, downward, those levels considered as normal, so as to induce new real estate development initiatives. At that point, the vacancy rates will rise again at the physiological

Table 6.8 Expected cash flow for the next 6 years

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Potential gross income (€)	121,421	125,306	129,316	131,902	134,540	137,231
Losses due to vacancy (€)	−8,421	−5,012	−5,172	−7,914	−8,072	−8,232
Rental car parking (€)	8,000	8,420	8,690	8,679	8,852	9,030
Gross operating income (€)	121,000	128,714	132,834	132,667	135,320	138,029
Expenses						
Administration (€)	6,050	6,436	6,642	6,633	6,766	6,901
Managerial charger (€)	10,300	10,506	10,716	10,930	11,149	11,372
Supplies/services (€)	10,300	10,506	10,716	10,930	11,149	11,372
Insurance (€)	5,150	5,253	5,358	5,465	5,574	5,686
Various (€)	1,545	1,576	1,607	1,639	1,672	1,705
Advertising (€)	618	630	643	656	669	682
Maintenance (€)	13,390	13,658	13,931	14,209	14,493	14,783
Taxes (€)	15,000	15,000	15,000	15,000	15,000	16,050
Total expenses (€)	62,353	63,565	64,613	65,462	66,472	68,551
Annual net income (€)	58,647	65,149	68,221	67,205	68,848	69,478

Table 6.9 Ratio operating expenses/expected effective gross income

Years	1	2	3	4	5	6
Ratio	0.515	0.494	0.486	0.493	0.491	0.497

level. This scenario is reflected in the prediction of a flow that already in the third year marks a slowdown in the rate of income growth that tends to settle on measures of expected inflation (e.g., 2 %). Other revenues, those resulting from renting parking spaces, remain constant in per cent of revenues from leases of housing.

Based on the operating history of the same property and those comparable, it is conceivable an increase in operating expenses, which the number of tenants not affect. From these charges are, however, excluded the administration expenses and taxes. For the latter, it is suggested that it will be unchanged their impact on the effective gross income. These assumptions and expectations are therefore reflected in the prediction of cash flows for the next six years, reported in Table 6.8.

To test the feasibility of the predictions, it is useful to calculate the ratio between operating expenses and expenses actual gross income. This index is calculated for each year of the forecast and is presented in Table 6.9. Its performance should be compared with what one gets by extrapolating the

historical values of this parameter, where available publications containing this type of information.

The stability of the measured ratio legitimate estimate of property market value at the end of the sixth year (holding period), applying to the net income the average capitalization rate calculated by reference to similar properties in the same market area.

Assuming that the analyst identifies an average rate of 6 %, the market value (recovery value) provided at the end of the investment period will be approximately:

$$V_r = \frac{69{,}478€}{0.06} = 1{,}157{,}967€$$

It is still assumed that the investor has decided to use, for the purchase, a mortgage loan to amortize over 20 years with equal monthly instalments. The interest rate is 8 %. The investor and the bank agreed to a loan-to-value ratio of 70 % and a debt coverage ratio of not less than 1.2. The amount loaned is therefore bound to the more restrictive conditions laid down by these two parameters.

The analyst estimates the current value of the property in about €560,000. This means that the institution will not grant a loan of more than $0.7 \times$ €560,000 = €392,000.

The rate of amortization of the debt will not exceed €58,647/1.2 = €48,872. The maximum available amount in relation to this parameter is

$$€48{,}872 \times \frac{(1+0.08)^{20}-1}{0.08 \times (1+0.08)^{20}} = €480{,}000$$

The condition is more binding than that established by the loan-to-value ratio, so the amount at disposal for the investor is €392,000.

This means that the investor must include in the expected cash flows an instalment of the annual depreciation of €39,346.12.

$$\textit{Monthly Installment} = €392{,}000 \times \frac{\frac{0.08}{12} \times \left(1+\frac{0.08}{12}\right)^{12\times 20}}{\left(1+\frac{0.08}{12}\right)^{12\times 20}-1} = €3{,}278.84$$

$$\textit{Annual Installment} = 12 \times €13{,}278.85 = €39{,}346.16$$

Table 6.10 Cash flow expected over the next six years, in the case of financing

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Potential gross income (€)	121,421	125,306	129,316	131,902	134,540	137,231
Losses due to vacancy (€)	−8,421	−5,012	−5,172	−7,914	−8,072	−8,232
Rental car parking (€)	8,000	8,420	8,690	8,679	8,852	9,030
Effective gross income (€)	121,000	128,714	132,834	132,667	135,320	138,029
Expenses						
Administration (€)	6,050	6,436	6,642	6,633	6,766	6,901
Managerial charges (€)	10,300	10,506	10,716	10,930	11,149	11,372
Supplies (€)	10,300	10,506	10,716	10,930	11,149	11,372
Insurance (€)	5,150	5,253	5,358	5,465	5,574	5,686
Various (€)	1,545	1,576	1,607	1,639	1,672	1,705
Advertising (€)	618	630	643	656	669	682
Maintenance (€)	13,390	13,658	13,931	14,209	14,493	14,783
Taxes (€)	15,000	15,000	15,000	15,000	15,000	16,050
Total expenses (€)	62,353	63,565	64,613	65,462	66,472	68,551
Debt amortization instalment (€)	39,346	39,346	39,346	39,346	39,346	39,346
Cash flow before tax (€)	19,301	25,803	28,875	27,859	29,502	30,133

Table 6.11 Indicators of reliability of the estimated flows

$Revenue\ Cost\ Ratio = \dfrac{Operating\ Exepenses + Debt\ Payment\ Installment}{Effective\ Gross\ Income} = 84\,\%$
$Debt\ Coverage\ Index = \dfrac{Operating\ Net\ Rent}{Debt\ Payment\ Installment} = 1.49$

Table 6.10 shows the projected cash flow for the next six years in the case of financing, and finally in Table 6.11 other two financial reports are calculated.

6.3.3 Measures of Profitability

The characteristic of the traditional measures of affordability is to find a systematic relationship between capital investment and expected returns. The techniques differ depending on the way the available data are processed.

6.3.3.1 Return on Investment

It is given by the ratio between the net operating income and the price of property (the cost of investment):

$$ROI = \frac{Net\ Operating\ Income}{Net\ Invested\ Capital}$$

The Net Invested Capital, in the case of real estate investment, coincides with the property value, net of amortization and provisions. This index allows us to evaluate profitability in current management, as it excludes both the results of extraordinary administration (sales, active one-off, etc.) and financial aspects (level of indebtedness, finance charges, etc.). This last feature, however, represents one of the major limitations of ROI analysis which may in fact be crucial to assess the suitability of investments in relation to different funding opportunities.

6.3.3.2 Return on Equity

Return on equity (ROE) incorporates the effect of external financing; it measures the ratio between cash flow before tax and the amount of money paid by the investor:

$$\begin{aligned} ROE &= \frac{Cash\ Flow_{BT}}{Equity} \\ &= \frac{Net\ Operating\ Income - Debt\ Amortization\ Installment}{Investment\ Capital - Available\ Financing} \end{aligned}$$

It measures the return on equity, identified as the ratio between net income and shareholders' equity. ROE therefore varies according to the financial burden.

The level of indebtedness is crucial in the relationship between ROI and ROE: growing debt spreads the difference between the two indexes. If the return on investment is higher than the interest rate on the debt, the return on equity increases with the debt ratio. Both in the ROI that in the ROE, the cash flows are net of taxes. So, these two indicators can reasonably be used only to compare investment opportunities characterized by a tax similar.

One way to improve these measures is to try to take account taxation. Replacing the Before-Tax Cash Flow with the flow get flow adjusted for tax due from the specific investor (After-Tax Cash Flow), is obtained an index that takes into account the different effects of taxation:

$$ROE_{AT} = \frac{Cash\ Flow_{AT}}{Equity}$$

6.3.3.3 Payback Period

Another extensively used index is the so-called payback period (PP), which is the evaluation of the number of years required to recover the capital invested in the project. When the cash flow expected from an investment remains constant over the years, then this parameter is obtained by dividing the amount of money invested by the contractor to the annual cash flow:

$$Payback\ Period = \frac{Equity}{Annual\ Cash\ Flow}$$

When the cash flows are never the same from one year to another, the calculation is slightly more complicated, so the system most commonly used to calculate the PP consists of progressively adding the expected annual flows and comparing the accumulated sum at the end of each year with the initial investment.

Normally, the flows are discounted to the current period, and in this case the Discounted Payback Period (DPP) is used. This introduces another problem: that is, the choice of the discount rate which will be dealt with in the next few paragraphs. If the flows are simply summed, then one speaks of Simple Payback Method (SPM). *Ceteris paribus*, the investment that has the shortest payback period is more convenient. However, a shorter payback period does not necessarily indicate a high level of economic efficiency. An investment that has a longer payback than an alternative investment, may be more convenient if it produces (positive) flows for a longer period.

Simple Payback Method measures the time (usually in years) between the date of the initial investment and the one in which the sum of the expected cash flows resulting from the investment equals the investment itself.

This is the minimum value that satisfies the equation:

$$\sum_{t=1}^{Y}(B_t - C_t) = C_o,$$

where

Y	number of years to ensure that the income of the operation equals the initial investment;
B_t	monetary value of benefits (income, savings, cost reduction, etc.) to year t;
C_t	monetary value of costs (maintenance, operation, replacement, etc.) to year t;
$B_t - C_t$	net income in year t;
C_o	monetary value of the initial investment.

Table 6.12 Example of calculation of the SRT

Years	Cash flows (€)	
	Annuals	Cumulative
1	7,200	7,200
2	8,300	15,500
3	9,500	25,000
4	10,700	35,700
5	12,000	47,700
6	13,100	60,800
7	14,250	75,050

Example 6.2 A property can be purchased with an initial investment of €50,000. Cash flows after tax are shown in Table 6.12.

The data indicate that the initial outlay will be recovered during the sixth year. Therefore, the Payback Period (SPM) is 6 years.

6.3.4 The Limits of the Traditional Criteria of Profitability

To understand the limitations of the performance measures of the investments described so far, just remember the most important components of the expected return and observe that many of them are not brought into account in measuring the reports on traditional profitability. For the commitment of capitals, the investor expects to receive an operating cash flow during the period of investment but also a final income thanks to the disinvestment. The convenience of an investment is governed by the following factors:

1. The amount and timing of the commitment of capital;
2. The amount and timing of expected future cash flows;
3. The degree of (subjective) confidence that characterizes the expectations;
4. The investor's attitude to risk.

Subsequently, the relevant question concerns the change in the projections of the expected cash flows on the basis of the strategies and nature of the specific investor. These adjustments must be related to the quantity, quality and timing of cash flows.

An ideal measure of profitability should incorporate each of the listed factors. The most important limitation of the analysed criteria in this section is that to ignore the effects of the timing of cash flows. For this reason, the indicators presented so far represent only the instruments for more sophisticated analysis

based on measurements that take into account the time factor. Remember that the analysis conducted through the indexes is complementary to flows analysis.

The techniques described in the next paragraph are all "time-adjusted" types, as serving at the time of the assessment of future cash flows. Some techniques perform corrections just in order of temporal homogenization of cash flows, others also include adjustments related to the risk of the investment.

Finally, it is worth remembering that there is no absolute indicator of profitability: only the economic operator, knowing the characteristics of the investment, is able to decide the type of economic and financial analysis and indicators that can best support the final decision. For example, a real estate promoter whose main activity is the building industry, who promotes real estate investment and therefore carries them out directly, will surely be interested in both a prior analysis of a single real estate transaction to be developed and an analysis of the financial statements in order to assess the industrial enterprise management.

6.4 Modern Techniques for the Analysis of Profitability

Despite their differences, the procedures to be used for the measurement of "time adjusted" profitability indicators need to be based on some common recruitment or assumptions. They are, for example, those concerning the time horizon of the analysis, the discount rate, the residual value, etc. If not supplied by the client, the corresponding data should be identified, selected, estimated or defined by the evaluator. The same parameters will of course apply to all alternative solutions.

6.4.1 Introduction to Discounted Cash-Flow Analysis

According to modern investment analysis, a proposal is acceptable as long as its return rate is higher than the marginal cost of capital committed. In this sense, the technique to be used in the evaluation of investments cannot fail to consider the time, factor which essentially the cost of capital depends on. The main assumption of financial theory is, precisely, the allocation of a financial value to the time.

The most commonly used technique for evaluation is therefore the Discounted Cash-Flow Analysis (DCF). The choice of this technique, accompanied by its main profitability indicators, is based on the notion that, in the preventive stage and in the case of real estate investments, these indicators are more effective in supporting decisions compared to others that may be more useful in the analysis of management and budget. The techniques described in the previous paragraph, and the indicators defined as elementary, arising from them, do not take into account the evolution of the cash inflows (revenue or income) and negative flows (outputs or costs) over time. The current available technology and the huge increase in the possibilities of calculation resulted in the replacement of these basic indicators

(Rules of Thumb) with technical analysis—it is precisely the DCF—able to analyse the time evolution of alternative scenarios.

In a more general framework, the analysis of investment through the criteria of cash flows falls within the aim of economic evaluations aimed at investigating the net present value of an investment, even public. The discount cash flow is at the basis of Cost Benefit Analysis (CBA) of an investment project. In its simplest form the analysis of cash flows consists of a monetary evaluation, that does not take into account the social effects. In this sense, the perspective is strictly private. On the other hand, the investor, in general and therefore in real estate, has as his main goal, the maximization of profit.

The evaluation of the profitability analysis of the cash flows is based on the determination of the present value or of the financial sum of flows (revenues minus costs) discounted at the initial time and generated directly from the investment and in favour or disfavour of those who make it. This is the case of the Revenue and Cost Analysis (RCA).

6.4.2 The Net Present Value

The increase of wealth which is initially estimated, and which the operator makes through investment, is defined as net present value (NPV). The NPV is a key indicator of the profitability of the investment and represents the sum of the present values of the incoming and outgoing individual cash flows.

The general formula that describes the NPV is as follows:

$$\text{NPV} = \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

where

N number of periods, investment time horizon or period of analysis;
CF_t expected cash flows;
r discount rate (minimum acceptable rate of return).

If, as in the case of investment property, the initial capital investment—the purchase price—at year zero is CI, the Net Present Value can also be determined as:

$$\text{NPV} = \sum_{t=1}^{N} \frac{CF_t}{(1+r)^t} - CI$$

If the current value is greater than the initial invested amount, it means that the expected return is higher than the rate used for discounting. If the latter coincides with the minimum acceptable return, it means that the investment project deserves

Table 6.13 Expected cash flows

Years (t)	Expected cash flows (€) (CF_t)	Present value (€) ($CF_t/(1 + i)^t$)
1	13,500	12,272
2	14,000	11,570
3	14,600	10,969
4	15,000	10,245
5	16,000	9,934
6	16,200	9,144
7	16,500	8,467
8	16,500 + 50,000	31,022
	Total	103,623

to be considered. A positive NPV indicates that the return on investment will exceed the minimum amount acceptable. An NPV less than zero means, however, that the project does not meet the expectations of gain.

The cash flow CF, used for the evaluation of economic feasibility of an investment should be calculated as such:

- *Monetary*, or it must involve an actual entry or exit of cash;
- *Differential*, closely related to the project.

In the analysis of cash flows, monetary flows are represented by the difference, each time, between revenues (rental or sales) and the cost of construction and management (in the case of rent). The flows may be considered net and /or gross of both the financial burden and of taxes.

In a context of certainty, where the cash flows are not subject to any risk about their actual occurrence in terms of quantity and time, the problem remains in the choice of discount rate. Thus, the NPV will take as many values as are the discount rates used or usable for the specific investment.

As said, the profitability of an investment is to be considered acceptable if the NPV is positive, that is when revenues exceed costs, both of them discounted.

Example 6.3 Consider the possibility of investing in a property of which expected cash flows for the next 8 years are listed in Table 6.13. From the disinvestment, expected by the end of the eighth year one expects to earn €50,000. The purchase of the Estate involves an outlay of €95,000 and the investor has fixed the minimum rate of return of 10 %.

One gets an NPV = €103,623 = €−95,000 + €8,623, which is greater than zero. This indicates that, according to forecasts, the investment makes it more than the minimum acceptable rate.

6.4.3 The Internal Rate of Return

The problem of choosing the rate may be bypassed, but just apparently, by using another indicator of profitability: the IRR, Internal Rate of Return. The IRR is the discount rate that makes the net present value of all cash flows (both positive and negative) equal to zero. It can also be defined as the discount rate that equalises the positive and negative flows for a particular investment.

Specifically, the IRR is obtained by zeroing the NPV and solving the above equation with respect to the rate (r).

$$\text{NPV } (r) = \sum_{t=0}^{N} \frac{CF_t}{(1 + IRR)^t} = 0$$

or

$$\text{NPV } (r) = \sum_{t=1}^{N} \frac{CF_t}{(1 + IRR)^t} - CI = 0$$

The IRR measures the return on invested capital. This solution on its own, however, does not indicate whether it is convenient to implement the project or not. The choice of the investor depends on the outcome of the comparison between the IRR determined as described above, and a rate that defines the minimum expected return from that particular subject in relation to the specific transaction. The problem identified in the calculation of NPV, i.e., the choice of the discount rate, is therefore replaced—in the use of IRR—by the choice of the so-called minimum acceptable rate of return (MARR). As a matter of fact the two problems are perfectly super imposable if on the one hand, the solutions in which the IRR is higher than the MARR are considered to be acceptable, and on the other the choice of the MARR as a discount rate supplies positive NPVs for the same solutions.

From a practical point of view the IRR, which requires the solution of an equation of n degrees, can be obtained by trial and error or successive approximations, and by proceeding to recalculate the NPV with r gradually increasing (or decreasing) to obtain a value close to zero.

Generally, for the determination of the IRR, the equation to be solved should be the following:

$$F(r) = 0,$$

where F indicates the difference between the present value of the revenues and costs of the investment. The solutions of $F(r)$ are those that are financially acceptable; obviously complex or imaginary solutions cannot be accepted.

If the investment matches a series of initial costs, followed by a series of revenue (and where the discounted costs are lower than the revenues discounted), then the curve that represents the NPV function of assay intersects once l 'x-axis and $F(r)$ admits only one positive real solution (Fig. 6.5).

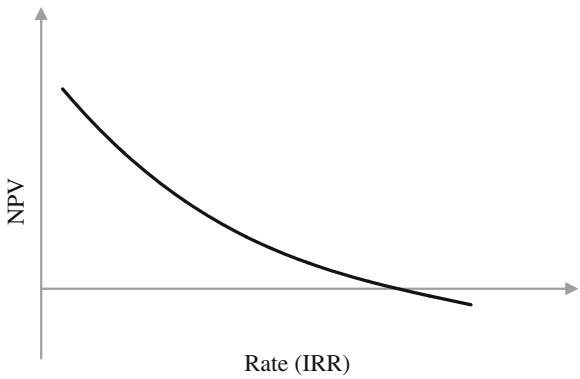

Fig. 6.5 NPV and IRR

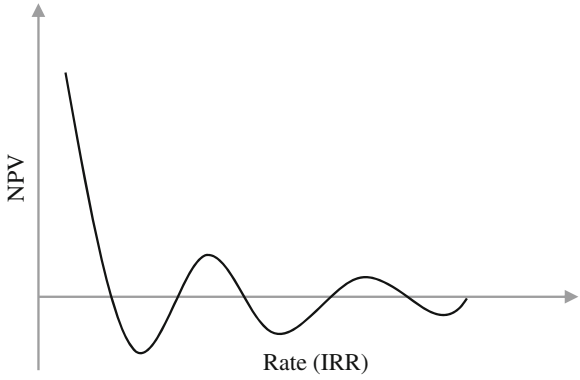

Fig. 6.6 Multiple IRR

If in the DCF there is an alternation of positive and negative net flows, problems may arise in the definition of the IRR, as the presence of multiple IRR, where the curve of NPV (Fig. 6.6) has more of an intersection with the x-axis, or the indeterminacy of the IRR (the curve has no intersection).

If one encounters these situations, it is still possible to adopt procedures able to guarantee a result. In case there are no real solutions available, one option is to eliminate a change of sign (maybe distributing the figures over several periods) and then redo the calculation to obtain a solution.

The situation with multiple IRR, i.e., with more than one real solution, is more delicate. In this case if in fact one is using the iterative and automatic calculation formula on spreadsheets, it is likely, if the solution found is not clearly erroneous, to interpret it as the correct solution. Therefore, it is appropriate, when there is more than one sign variation in net flows, to verify the solution, for example through the analytical study of the function $F(r) = 0$. From the operational point of view, a possible approach in solving the problem of multiple IRR is the calculation of a *Modified IRR,* to move back (discounting) to the beginning of period costs and forward (postponing) the income to obtain a single sign variation. The operations of anticipation and postponement are obviously performed by adopting an interest rate

Table 6.14 Calculation of the Modified IRR

Cash flow forecast—year 2	€8,500
Initial value of cash flow	
Year 2: [€8,500/$(1 + 0.15)^2$]	€6,427
Initial expenditure	€2,300
Initial value	€−8,727
Cash flow forecast—year 1	€9,800
Final value of cash flow	
Year 1: [€9,800 × (1 + 0.15)]	€11,270
The Modified IRR is the rate that allows to get a present value of €8,727 discounting the final value of €9,775	€8,727 × $(1 + \text{IRR})^2$ = €11,270

Modified IRR is 13.64 %

that reflects only the cost of the transfer of money (cash) that is included in the time without the risk associated with the particular investment activities.

Another method that avoids the problem of multiple solutions is the calculation of *Adjusted IRR*. This technique eliminates the sign variations in the cash flow of the *i*-th year, adding part of the adjacent flows, discounted at a fixed rate in order to meet the temporal fairness.

Example 6.4 An investment proposal that requires an initial outlay of €2,300, promises to earn €9,800 by the end of the first year. After taxation and expenses to cover financing, the transaction will be completed at the end of the second year with a loss of €8,500.

The calculation of the IRR provides two solutions: 21 and 204 %. Neither are correct. Modified IRR is then calculated, using a discount rate (for transactions of accumulation of flows) of 15 %. The results are listed in Table 6.14.

This technique is very sensitive to the rate used in the operations of accumulation. At rates of 10 and 20 % respectively, obtained an $\text{IRR}_{10} = 7.52$ % and an $\text{IRR}_{20} = 19.74$ %.

The calculation of the IRR, in this case, compensates the negative input of the second year (€8,500), and cancels the change of sign, using the cash flow for the first year. If one considers a reinvestment of €9,800, assuming a 15 % rate at the end of the second year, there is a value of €11,270. The last year of management recorded a positive entry of €2,770 = €11,270 − €8,500. The rate that allows one to gain the final amount of € 2,770 starting from the initial investment of €2,300 is 9.7 %. One still gets a different rate from that result from the application of the modified IRR.

The basic problem of these calculation gimmicks lies in the need to find a new "intermediate" rate with which to perform the accumulation of cash flows. This parameter, in the case of modified IRR and adjusted IRR, is unique and is used to move through time both the positive cash flows and both the negative ones. Some analysts believe that it is not appropriate to use a single rate, the determination of which would still be appropriate to discuss. They think that they need at least two intermediate rates: one that takes into account the cost of capital to be used to discount negative cash flows and the other fixed rate according to the real possibility of gain on reinvested funds, used to accumulate revenue positive at the end of the projection period. By doing this one gets a new formulation of IRR, that in Anglo-Saxon countries is called financial management rate of return (FMRR). It is still an attempt to bypass the limitations of the IRR.

The problem of alternating negative and positive cash flow, which in theory does not seem satisfactory in resolving the limits of the proposed methods, is actually less significant in the analysis of real estate investments which are usually characterized by an initial period of negative flows (processing costs) followed by a second period of positive cash flows (rental, sales). So the problem of interpretation of IRR remains, i.e., the definition of the threshold of acceptability of Real Estate investment, in other the choice of the discount rate to use for the calculation of NPV.

Today, the calculation of the NPV and IRR is highly facilitated by the use of computers, even software in common use, as Excel, have functions that allow the automatic calculation of both the NPV, IRR of both.

NPV and IRR are both an expression of the same criteria based on the comparison with the rate of return required by the investor. A positive NPV is equivalent to a greater IRR rather than the minimum required rate of return. This circumstance does not imply an immediate decision about investing, but it is only part of a procedure leading to the final decision. The investment involves, of course, a renunciation of the use of resources that could have alternative uses in other investment initiatives. The choice could therefore lead to a comparison between investment alternatives.

The two parameters—NPV and IRR—may show some limitations when used for inter-project comparisons aimed at defining an order between possible investment alternatives. In fact, it may happen that the order derived from the use of NPV as a criterion of choice, does not coincide with the order defined by IRR. As the example of Fig. 6.7, fixed the minimum rate of return in 5 %, the calculation of the NPV indicates that project A (dashed line) is more convenient than project B (solid line). However, the order is reversed if one uses the IRR as criterion of choice. The NPV promotes projects with greater capital intensity.

An obvious limitation of the NPV is connected to the choice of the minimum expected rate of return. The choice of the rate may change the order of preference. Specifically higher rates are disadvantageous for those investments whose revenues are more distant in time. On the other hand, the IRR is not immune from the lack of insensitivity to the relative size of the projects. This shows that neither the

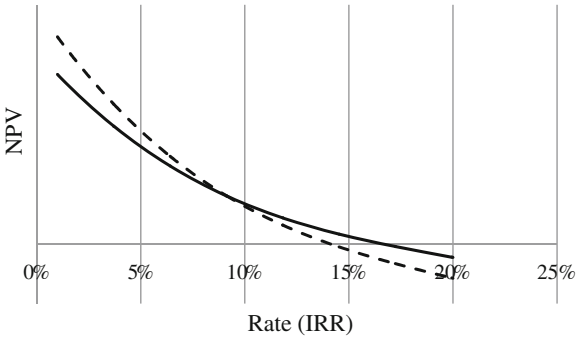

Fig. 6.7 Example of a possible relation between NPV and IRR

NPV nor the IRR are perfect markers and there is not a parameter that is good or better than the other is.

Some analysts question the usefulness of the IRR, highlighting the critical issues relating it to the issue of reinvestment of cash flows. This problem also arises when comparing investment alternatives characterized by very different patterns of cash flows. IRR calculation implicitly assumes that the revenues are reinvested at the internal rate of return. This means that the IRR method is discriminating, in the case of inter-project comparisons, only if one can invest the revenues at an equally high active interest.

Example 6.5 An investor must choose between two alternatives that require the same amount of initial outlay and have an identical time horizon. The expected cash flows are listed in Table 6.16. The Investment A (IRR = 20 %) seems cheaper than the B (IRR = 18 %) (Table 6.15).

Assuming now that the maximum available gain on reinvested funds is 10 %, the internal rate of return is calculated. In this way, the IRR of the alternative A drops to 17.24 %, and is lower than that calculated for the alternative B. It reverses, therefore, the hierarchy between the two possibilities of investment (Table 6.16).

The problem of reinvestment rate prejudices the use of the technique of the Internal Rate of Return, even when alternative investments have different durations. Example 6.5 is proof of it.

Example 6.6 An investor must choose between the two alternatives shown in Table 6.17.

Both alternatives have an IRR of 15 %, but they are equally desirable only if the reinvestment rate continues to hold 15 %. If one reduces the reinvestment rate of 10 %, the alternative A proves to be less convenient B.

Table 6.15 Cash flows relating to two investment alternatives and measure of the IRR

	Investment alternatives	
	A	B
Invested capital	€10,694	€10,694
Net cash flow, 1st year	€7,000	€0
Net cash flow, 2nd year	€7,000	€14,890
	Reinvestment at IRR = 20 %	Reinvestment at IRR = 18 %
Cash flow—year 1	€8,400 = [€ 7,000 (1 + 0.2)]	€0
Cash Flow—year 2	€7,000	€14,890
Total	€15,400	€14,890
Present value	$[€15,400/(1 + 0.2)^2]$	$[€14,890/(1 + 0.18)^2]$
Invested capital	€10,694	€10,694
NPV	€0	€0

Table 6.16 Cash flows relating to two investment alternatives with income reinvested at different rate from the IRR

	Investment alternatives	
	A reinvestment at IRR = 20 %	B reinvestment at IRR = 18 %
Cash flow—year 1	€7,700 = [€7,000 × (1 + 0.1)]	€0
Cash flow—year 2	€7,000	€14,890
Total	€14,700	€14,890
Present value	$[€14,700/(1 + k_A)^2]$	$[€14,890/(1 + k_A)^2]$
Invested capital	€10,694	€10,694€
NPV	$k_A = 17.24$ %	$k_B = 18$ %

Calculations show, in fact, that the total gain in the period of 5 years is 11.9 % for the Investment A and 12.7 % for B (Table 6.18).

Regarding the problem of reinvestment, the opinions of the analysts do not agree. In fact it is difficult to argue that the reinvestment always give the same return as the initial investment. The assumption of reinvestment at equal rates to those of the investment also highlights a further forcing. In fact, when one compares the two operational alternative proposals that have different rates of profitability, their income will be reinvested with different rates of profitability. This seems unrealistic.

For this reason some privilege the method that here is defined calibrated (CIRR), able to always provide unique solutions. To calculate the CIRR the formula IRR should be amended as follows:

Table 6.17 Cash flows for two investment alternatives

	Investment alternatives	
	A (€)	B (€)
Invested capital	22,832	33,522
Estimated cash flows		
Year 1	10,000	10,000
Year 2	10,000	10,000
Year 3	10,000	10,000
Year 4	0	10,000
Year 5	0	10,000

Table 6.18 Cash flows related to two investment alternatives with income reinvested at different rate from the IRR

	Investment alternatives	
Future value of cash flows with the chin reinvestment rate of 10 %		
	A	B
Year 1	€14,641	€14,641
Year 2	€13,310	€13,310
Year 3	€12,100	€12,100
Year 4	€0	€11,000
Year 5	€0	€10,000
Future value of all cash flows	€40,051	€61,051
Discount rate that deletes NPV	11.9 %	12.7 %

$$\sum_{t=1}^{N} \frac{CF_t \times (1 + r_t)^{n-t}}{(1 + i)^t} - CI = 0$$

where r_t represents the rate of return on reinvestment of positive balances. The CIRR is the value of i that reflects the positive balances in order to equalize the initial investment.

Naturally the CIRR is equal to the IRR when $r = i$. If $r_t > i$, then the CIRR is greater than the IRR and vice versa.

According to Marshall's preference of CIRR over IRR is justified because the former "incorporates the expected real income from reinvestment of profits while the IRR assumes that the reinvestment makes as the initial investment, without that there is a logical basis for this assumption. In addition, when comparing two alternative programs with different IRR, we speculate that even the reinvestment rates are different, when in fact it would be logical to expect the same rate of return from the reinvestment of the profits of both programs".

If one wants to use the CIRR instead of IRR, one could use either the official current discount rate or the current yield of government bonds as a reinvestment

rate, and still apply the same discount rate to all possible alternatives taken into consideration.

Other authors consider the IRR more technically correct. Kerr (1980) rejects the CIRR because "the models based on the reinvestment rate, created to avoid the ambiguity of the IRR, are incorrect because the measure of the desirability of a potential investment is contaminated by the projected income from other investments".

Finally, there are those who recognize that both IRR and CIRR have pros and cons and that each one may be preferred to another depending on the circumstances (Raper 1981).

NPV and IRR are thus two decision criteria that share the same mathematical formulation and, to some extent, the same gaps. The border between the merits and demerits of the two indicators is very thin. The literature is full of texts that favour one or the other method, and support these choices with a wide variety of reasons.

6.4.4 Other Indicators

It has been said that the use of profitability indexes (IRR, NPV) could bring out some problems with the interpretation of the result when there is the need to make inter-project comparisons, especially in situations with different timing flows and amount of capital. Therefore it may be useful, in order to complete the picture of the information needed for the final choice, to measure another indicator: Discounted Benefit/Cost (B/C) Ratio. This parameter is not an alternative to NPV or IRR but because of the limitations and difficulties associated with its use, it incorporates the previous information.

It defines a profitability index (PI), calculated by dividing the present value of expected cash flows to the initial capital invested. The quotient is the current value for every euro of initial outlay. The choice must fall on the project that has the highest profitability index, unless there are substantial differences in the risk profiles of the various alternatives.

$$PI = \frac{CF\ Actual\ Value}{Initial\ Investment}$$

When one uses the profitability index as a tool for the preliminary identification of investment opportunities that require further analysis, the rule, to discard the alternatives with a *PI* less than 1, obviously applies. This, of course, is the variant of the rule that requires not to consider projects that have an NPV less than zero.

The net present value is a more appropriate criterion with respect to *PI*, when the investor has to decide about the convenience of mutually exclusive opportunities. In situations where one has to choose, for example, between financing alternatives, or whether to rent or to buy, whether to sell or to buy, and generally

Table 6.19 Calculation of NPV and B/C to investment alternatives

	Investment alternatives	
	Mall	Office building
Discounted net cash flows	€90,000	€110,000
Initial expense	€−60,000	€−75,000
Net present value	€30,000	€35,000
Profitability index	1.50	1.46

whenever one finds ourselves at a crossroads, it is preferable to use the approach of NPV, because it better expresses the gain obtainable from the project.

Example 6.7 An investor owns a piece of land worth €60,000, which would be used as mortgage collateral to access a loan to be used to build a small mall. Alternatively, investing equity capital for an amount of €15,000, in addition to the capital obtained through financing, he could construct an office building. The present value of the expected cash flows from the "mall" solution is about €90,000, and in the case of the "office" solution, €110,000.

Calculations in Table 6.19 show that the *PI* and the NPV give different signals. In this case, the investor must rely upon the information provided by the Net Present Value, because this criterion shows what really is obtained from the project.

In the field of real estate, one may also have to decide between various mutually dependent investment proposals. If the investment decisions are connected in this way, one has to build the various possible combinations and treat each of them as an opportunity, independent from the others.

Another indicator is the discounted payback period (DPP), which is the time (measured in years), after which the current value of the expected cash flows, that result from the investment, equals the investment itself. This procedure is similar to a payback period; however, the payback period only measures how long it takes for the initial cash outflow to be paid back, ignoring the time value of money.

The DPP is the minimum value that satisfies the equation:

$$\sum_{t=1}^{Y} \frac{(B_t + C_t)}{(1+i)^t} = C_o$$

i the discount rate.

If the annual net earnings are constant over time, the solution will be:

$$DPP = \frac{\frac{1}{1-(PP \times i)}}{\log(1+i)}$$

When $i \neq 0$, since for $i = 0$, DPP = PP.

If the net income varies over the years, one has to add up, year after year, their present value until the amount received does not equal or exceed the initial investment, as in the previous example.

An alternative procedure to detect DPP is to find the moment when the IP ratio is equal to 1. One has to compute this ratio for each year of the analysis period (holding period), proceeding to subsequent attempts until the one closest to the unit indicates the DPP sought.

Although this indicator has strong limitations, it does not provide any indication about the optimal size of the investment or about the economically more efficient choice between alternative investments.

The payback period is a parameter investors like to see, given its immediate and easy interpretation. This method, however, can lead to misconceptions about the potential of a real estate investment: properties can provide high profitability but on a longer time may be less convenient than others that concentrate most of the benefits in the early years of the holding period.

6.4.5 The Discount Rate

An important problem remains to be analysed: the choice of the discount rate, i.e., the minimum rate of return.

In the examples in this section, one saw how a small adjustment in the selected rate may produce huge changes in NPV, or profoundly alter the hierarchy of investment opportunities, especially when the expected cash flows have very long and different temporal distribution patterns. The determination of rate should be carried out, therefore, with the utmost care.

One of the methods proposed for this task is based on the consideration that the investor commits his money, and this requires a fee, the motivations of which are reflected in an equivalent number of components of the reference rate. The latter can therefore be obtained by the following sum:

Reference Rate = Risk Free Rate + Fee for	Risk tolerance Waiver of Immediate Consumption Lack of Liquidity Portfolio Management

The base rate (risk-free) corresponds to that definite return that it is owed to the investor, merely for the wait.

In the absence of risk and should the aim of maximizing the profit prevail, the penalization of flows that are more distant in time by applying a discount factor is justified by the implicit opportunity cost of invest an amount of money in the financial markets, that is, giving it in loan at an interest rate *r*. This rate, in a world of certainty, can be thought of as the interest rate applied to a solvable borrower. This is usually the State.[5] For this reason, the interest rate paid on short-term Treasury bonds, on bonds that do not involve risks, whose limited duration is a guarantee against risks of loss due to inflation, is usually called *risk-free* rate. There are, however, obvious difficulties in the appropriate estimate of the remaining terms of the sum. This approach is therefore impractical.

The problem is simplified by reducing the sum of just two terms: the risk free rate and the risk premium. The latter, which is required to compensate for the tolerance of risks, changes depending on the investor's ability to perceive and accept the dangers of failure. In the preceding paragraphs, it has already been pointed out that the compromise between risk and yield varies from one investor to another. It is a question of individual function, but the rule is that the intensification of perceived risk grows proportionally to the premium required to bear them.

Another way to determine the reference rate is to refer to the marginal cost of capital, i.e., the cost of an additional euro of investment. In real estate investments, he marginal cost may be denoted in the annual expenditure for repayment of the loan.

Many analysts agree, however, to recognize a greater significance to the approach of the cost as capital opportunity. This concept is equivalent to the maximum gain that the investor can obtain by engaging funds in alternative investments that are available and characterized by the same kind of risk exposure. Since it is unlikely that the investor agrees to venture into a project that provides a gain that is lower than that obtainable through equally risky transactions, the opportunity cost coincides with the minimum acceptable rate of return. Its use as a discount rate allows to compare projects classified in the same risk category, even when there are large differences in the amount and the timing of cash flows.

It summarizes the approach of the marginal price of capital and the opportunity cost, the weighted average cost of capital or WACC. It represents the cost borne by the investor to compensate the equity used in the real estate transaction and debt, which is the capital provided by third-party lenders. The formula operates the weighted average; the WACC is calculated taking into account the relative weights of each component of the capital structure, including the cost of equity and cost of debt:

[5] It is worth mentioning that in spite of the name, even the government bonds issued by the State are not immune to inflation risk.

$$WACC = k_e \frac{E}{(D+E)} + k_d(1-t)\frac{D}{(D+E)}$$

where:
k_e cost of equity;
E total shareholder's equity;
D total debt;
K_d cost of debt;
t tax rate on income taxes.

As far as the quantification of the two components of the WACC is concerned, the equity cost, which immediately calls to mind the "cost opportunity" concept, re-proposes evaluation problems that have already been highlighted.

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