Chapter 2

Cash flow models for property investment analysis

1. Comparative investment analysis

An examination of the alternative investment types against which property may be appraised is driven by the investment policies of the UK's major investors, the larger insurance companies and pension funds, which have in the last two decades pursued a policy of portfolio diversification by retaining a mix of cash, ordinary shares and fixed interest gilts but increasing holdings of property and more recently, of index-linked gilts.

This has resulted indirectly in the property valuation profession having been made the subject of scrutiny by professionals in other capital markets (for example, see Greenwell and Co., 1976). This critical examination led to the appearance in 1980 of a report (Trott, 1980) which re-examined property investment appraisal techniques and found them deficient.

As a result of these and other coincident publications, property advisers have been placed under increasing pressure to provide analytical, defensible and accurate appraisals that are capable of comparative interpretation. This has to be contrasted with the valuer's traditional initial yield model, which leads to great difficulties in cross-investment comparative analysis.

The initial yield is an apparently simple yet effectively complex measure of the quality of an investment. Used for analysis the model is:

\[
\text{initial yield} = \frac{\text{current income}}{\text{price}}
\]

where current income and price are given and where initial yield incorporates a series of implicit measurements, of (for example) a risk free opportunity cost, expected income and capital growth, liquidity, operating expenses, psychic income, risk and other factors (see Chapter 1). This does not advance a comparative analysis, now regarded as a necessary quality of a property analysis model, for the following reasons.

1. The return on other investments may be a measure against which a property investment should be appraised. For example the redemption yield on conventional gilts is generally accepted as an indication of the equated yield target rate which should be used in property appraisals based on discounted cash flow (DCF).
2. The return on other investments may be a guide to the future value of property. If conventional gilts yield 16\% when prime shops yield 3.5\%, when little or no rental growth is currently expected (as in 1982), it is possible to conclude that prime shops will fall in price, as indeed they did in 1983 (see Table 1. 3). Advice to a vendor or purchaser should reflect that view.
3. Subject to 1 above, the return on other investments may be a guide to the implied necessary future performance of property. For example, levels of implied rental and capital growth can be computed given information regarding redemption yields on bonds and initial yields on property. Such information will aid the investor's choice between alternative property investments.
2. The development of explicit cash flow models

Formats

Explicit cash flow models for the analysis of property investment risk and return have been developed and explored quite fully in recent years in order to progress property analysis towards a capital market comparative framework.

Marshall (1976) developed an early analytical model (which he termed equated yield analysis) relying upon the explicit projection of cash flows from an investment and discounting them at a risk-adjusted opportunity cost rate (equated yield). Some debate over the implicit treatment of the expected resale price was created by the use of the equated yield to discount income flows after the end of the analysis period (usually 30 years in Marshall's examples) implying a cessation of growth after that period and, arguably, an implicit allowance for depreciation.

This explicit format has continued to be used as one of three cash-flow based models which attempt rational and comparative interpretation. Korpacz and Roth (1983) illustrate by a fully developed case study their explicit cash-flow model; Robinson (1985 and 1986) illustrates the use of spreadsheets as ideal technology for the model; and the practical UK application of explicit cash flow analysis is demonstrated for example by Baum and Butler (1986), Mason (1986) and Miles (1986).

Alongside the development of explicit models, two conventional-format alternatives have also been published. These are the rational model of Sykes (1981) and Sykes and McIntosh (1982) and the real value model of Crosby (1985). The three approaches are consistent in results obtained (that is, they equate in the simple case); all represent a useful advance on conventional practice. (See Baum (1984), Baum (1985) and Baum and Crosby (1988) for a full comparison of these approaches.) All may be described as cash-flow models.

Variables in a cash-flow model

Property investment analysis is designed to estimate the worth of a property investment to an investor. Worth may be expressed in three forms. Where the price of an investment is known, for example in a retrospective analysis after a sale, or where negotiations for a purchase by private treaty have neared completion, the worth of the investment must be expressed either as an expected rate of return or an excess value over the price (net present value) at a given target rate. Where the price is unknown, for example where an investment is to be sold by auction, the analysis is aimed at an assessment of the capital value of the investment, or the maximum price that can be paid, given a target rate of return.

The return from a property investment is a function of income, capital return and psychic income. No attempt is made to measure the latter, and shorter leaseholds may not produce a capital return. Thus gross cash flow will be made up of income and (perhaps) capital. The income may increase at reviews. Estimation of a capital return depends upon the timing of a sale so that it is necessary to estimate a likely holding period. Holding costs will be incurred during the period of ownership, and these will need to be estimated. Purchase and sale transfer costs will be payable; at each rent review a fee will be payable; letting or reletting costs may have to be faced; and management fees may be incurred.

Taxes on income and capital gain will be charged. Leaseholders may be faced with dilapidations claims. The income may be inclusive, so that the investor pays rates out of the rent received; and a service charge may not cover the cost of service provision. Properties have to be repaired and refurbished.
The estimation of values for each of these factors will produce an explicit net cash flow projection. If the price is known, the rate of return becomes the dependent variable in the analysis. If the price is not known, the target rate has to be added to the above list of independent variables, the capital value becoming the independent variable. The same model should be able to accommodate either variation. All variables are briefly considered below.

The holding period

For purely technical reasons - that is, to avoid an infinitely long cash flow projection in a freehold analysis - a finite holding period is utilised in the analysis model. For freeholds this implies the assumption of a resale or a reversion to constant growth, using Gordon's growth model (Brigham, 1985), while for leaseholds the holding period will usually equate with the remaining term.

The overriding concern in the choice of holding period must be the intentions of the investor. Discussions with the investor might reveal his likely or intended ownership period; where no intention to sell is apparent, the holding period becomes arbitrary. In either case, there are reasons for coinciding the resale date with the end of an occupation lease or a rent review period. This reflects likely practice, as there is a suspicion that fuller prices are achieved immediately after review because the purchaser's risk is reduced. While periods of 10 or 15 years are often settled on for convenience, it should be noted that slight changes in holding period return may be achieved by shortening or lengthening the holding period, and this type of exercise is one of several uses of a model.

Resale price

In the case of freeholds and long leaseholds the selection of a holding period will trigger the assumption of a resale at that date. The resale price to be projected is the most likely selling price at that date. If the most common method of market pricing is the years' purchase method, and given that the sale will usually coincide with a review, the freehold resale price is given by:

Estimated rental value (ERV) x YP in perpetuity

or: \[
\frac{ERV}{Capitalisation\ rate\ (k),\ at\ resale\ date}
\]

This requires the projection of two variables: ERV at resale and k at resale.

Estimated rental value (ERV)

A projection of rental value at the point of resale in property investment analysis need not, of course, be based upon a market-implied growth rate. While this may be a guide, it should be remembered that the implied growth rate is an average rate in perpetuity; it is also net of depreciation. This raises several issues which are discussed in Chapter 8.

Capitalisation rate (k)
The estimation of a capitalisation rate for the subject property 10 or 15 years hence requires forecasts. Firstly, yields for the type of property under consideration may be expected to change over the period. If so, the extent to which the market yield will change must be estimated. Secondly, the movement in yield of the subject property against an index of yields of such properties in a frozen state over the holding period, in other words the extent of depreciation likely to be suffered by an ageing building, needs to be estimated. Again, this is developed in Chapter 8.

Gross income flow

Forecasting gross income flow or rental growth over the holding period is important both in the estimation of the rental flow and in the prediction of the resale price. Forecasting a variable such as this might be based upon any of three methods: extrapolation of time series data, identifying relationships, or a combined approach.

Extrapolation of time series data

From a time series of rental value, it may be possible to identify a long term trend but a cyclical pattern will almost certainly obscure this to some extent. In addition there may be non-recurring influences - rent freezes, for example - which need to be smoothed away. Extrapolation of the time series therefore takes into account both cyclical variations and the long term trend. (See, for example, Field and MacGregor (1987).)

Identifying causal relationships

Forecasting the future by the analysis of past relationships is an integral forecasting tool in which the analyst forms a hypothesis by using statistical tests of data. For example, the lagged impact of consumer spending (the independent variable) upon retail property rental value (the dependent variable) might be tested by comparing the two factors over time and measuring the correlation between the two. If correlation is high, a simple prediction may be made. The ideal situation for the forecaster would be where the independent variable is seen to move in advance of the dependant variable. Analysis of the business cycle is often undertaken to find indicators which lead the economy and those leading indicators form the basis of models which predict changes in the important economic variables.

A combined approach

The most common method of forecasting utilised in the property market is an approach which combines extrapolation with a causal analysis, almost certainly in an informal framework, although formal econometric models are gaining popularity. The analyst is likely to base projections primarily on extrapolation coloured by causal influences (the forthcoming supply of new property in the sector, for example). (Forecasting cash flows is discussed further in Section 4 of this chapter.)

Regular expenses
Implicit within the gross cash flow from a property investment is a series of regularly recurring expenses. These include management costs, either fees charged by an agent or the time of staff. In the former case they may be based upon a percentage of gross rents; in the latter, they need more careful estimation, and may have to be increased over time. Repairs and maintenance will normally be covered, like insurance, by the tenant's obligations under a full repairing and insuring lease; if not, they must be accounted for, as must the exceptional burden of rates.

While the investor who provides services, for example to the common parts of a multi-tenanted office building or shopping centre, will usually expect to recover these expenses in a service charge, the amount received may not quite match the cost of provision through a lagging effect or other causes, in which case an allowance needs to be made.

All expenses not tied to rent must be subject to an allowance for anticipated cost inflation.

*Periodic expenses*

While most leases place the burden of normal repairs upon tenants, landlords will expect to have to bear some expenditure from time to time, and the burden of repair is effectively shared. In addition to this, improvements may be necessary to make the property marketable.

Thus at the end of an occupation lease the investor will be faced with the prospect of redeveloping, refurbishing, repairing or redecorating the property and the leaseholder may be faced with a claim for dilapidations. If the lease end falls within the holding period, the prospect must be allowed for, again with an inflation factor. This is dealt with in Chapter 8.

*Fees*

In order to strip out all costs to leave a net return estimate, acquisition fees and sale fees at the end of the holding period need to be removed from the cash flow. These will normally be based upon the purchase and sale prices.

Rent review fees, based upon the new rent agreed, need to be allowed for at each review, and re-leasing fees, again based on the new rent agreed, have to be provided for at the lease end. Advertising costs may be additional to both sale and re-leasing fees. VAT should be added to all expenses where appropriate.

*Taxes*

Property investment analysis for the individual investor or fund can, and should, be absolutely specific regarding the tax implications of the purchase. Thus capital and writing down allowances should be taken into account where appropriate. Income or corporation tax should be removed from the income flow. Capital gains tax payable upon resale can be estimated given an estimation of purchase price, sale price, intervening expenditure, holding period and intervening inflation, all of which are central to a model of this nature.

*The target rate of return*

The principal purpose of property investment analysis is the facilitation of decision making. The basic criterion for decision making in investment, risk considerations apart, is the expected or required rate of return (IRR). This is normally termed the target rate of return.
The target rate should be based upon the return required by the investor to compensate for the loss of capital employed in the project which could have been employed elsewhere, that is the opportunity cost of capital (for example, the redemption yield on similar maturity gilts). It may be adjusted for risk (in which case it becomes a risk-adjusted discount rate).

It is common to see no distinction between the required return on borrowed and equity funds. This is, however, unrealistic. Financial markets cannot be assumed to be efficient, so that the opportunity cost of equity to an equity investor such as a pension fund and the actual cost of equity (dividends required by investors) to an equity/debt investor such as a property company may not equate with the actual cost of borrowing capital. Consequently, the analyst should rely upon the concept of opportunity cost (and not the actual cost of capital) in the estimation of target rate.

In certain circumstances the cost of borrowing may be taken into account by using the weighted average cost of capital. For a fuller discussion of the weighted average cost of capital see Brigham (1985) and Brealey and Myers (1985). The target rate is discussed in more depth in Section 4 of this chapter, but is treated simplistically in the analyses exemplified in this book.

3. Risk/return analysis

A present value or internal rate of return analysis based upon income and expense projection is a first base level of property investment analysis. Analysts are increasingly forced to use market analysis to predict the uncertain, that is to make an estimate of the cash flow likely to be produced by the investment. This element of uncertainty demands another level of decision-aiding analysis. However, risk analysis, well explored in financial theory, has not yet been the subject of comprehensive examination in the real estate sector, and neither acceptable definitions nor empirical tests of real estate risk have yet been developed. There is an absence of reported data regarding the riskiness of individual real estate investments, both in terms of quantum and source (although developments are being made: see for example the research of Brown (1985)).

NPV or IRR?

All levels of decision technology for real estate investment discussed herein are based on DCF analysis and utilise a return measure. Estimation of return may be by net present value (NPV) or internal rate of return (IRR). These alternatives are assessed in detail in Baum and Crosby (1988). The conclusion reached is that NPV is clearly preferable as a decision aid, even though IRR has attractions for practitioners. Both NPV and IRR are utilized in the cash flow model illustrated below, but the preferred output is NPV.

Example

This simple example forms the basis of further work in Chapter 8. It shows the use of the following variables: holding period, resale price, gross income flow, fees (rent review in this case) and target rate. The example ignores regular expenses, periodic expenses and taxes, which are nonetheless easily incorporated in this format.

Assume a property is for sale at a price of £800 per square foot. The current estimated rental value is £40 per annum per square foot.
The average redemption yield on long dated gilts is currently around 9%. A 2% risk premium is required over this rate.

A fee of 7% of the new rent will be paid at each (5-yearly) rent review. Rental growth until the first rent review is estimated at 8% per annum and this rate of growth is projected to remain constant over reviews 2 and 3.

The current capitalisation rate (implied by a rental value of £40 against a price of £800) is 5%. This is forecast to remain constant over the holding period.

Projected rental values are therefore as follows: at the first review, the current ERV will have risen from £40 to £59; at the second review, this will become £86; at the third review (that is, the end of the holding period) the rental value will be £127. This will not influence the rental income but will determine the resale value of the property at the end of the holding period. This is given by:

\[
\text{ERV at review 3 (year 15)} = \frac{\text{ERV at year 15}}{\text{year 15 capitalisation rate}}
\]

Given a risk premium of 2% over the gilt yield of 9% a target rate of 11% is used to calculate NPV.

The cash flow shown details the combined effect of these projections and the deduction of rent review fees at year 5, 10 and 15. The analysis shows that the decision is to buy, because the IRR exceeds the target rate and the NPV is positive. This simple example is used as the basis of the illustration of risk analysis in the remainder of this chapter and also forms the basis of the depreciation-sensitive model developed in Chapter 8.

<table>
<thead>
<tr>
<th>DATA</th>
<th>PROJECTIONS</th>
<th>(£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td></td>
<td>£800.00</td>
</tr>
<tr>
<td>ERV</td>
<td></td>
<td>£40</td>
</tr>
<tr>
<td>Gilt redemption yield</td>
<td></td>
<td>9.00%</td>
</tr>
<tr>
<td>Risk premium</td>
<td></td>
<td>2.00%</td>
</tr>
<tr>
<td>Rent review fee</td>
<td></td>
<td>7.00%</td>
</tr>
<tr>
<td>Rental growth review 1</td>
<td></td>
<td>8.00%</td>
</tr>
<tr>
<td>Rental growth review 2</td>
<td></td>
<td>8.00%</td>
</tr>
<tr>
<td>Rental growth review 3</td>
<td></td>
<td>8.00%</td>
</tr>
<tr>
<td>Year 0 capitalisation rate</td>
<td></td>
<td>5.00%</td>
</tr>
<tr>
<td>Year 15 capitalisation rate</td>
<td></td>
<td>5.00%</td>
</tr>
<tr>
<td>ERV, review 1</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>ERV, review 2</td>
<td></td>
<td>86</td>
</tr>
<tr>
<td>ERV, review 3</td>
<td></td>
<td>127</td>
</tr>
<tr>
<td>Net resale value</td>
<td></td>
<td>2,538</td>
</tr>
<tr>
<td>Target rate (%)</td>
<td></td>
<td>11.00</td>
</tr>
<tr>
<td>NPV (£)</td>
<td></td>
<td>113.00</td>
</tr>
<tr>
<td>IRR (%)</td>
<td></td>
<td>12.27</td>
</tr>
</tbody>
</table>
### CASH FLOW STATEMENT

<table>
<thead>
<tr>
<th>Year</th>
<th>Capital</th>
<th>Income</th>
<th>Outflow</th>
<th>Net cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(800)</td>
<td></td>
<td>(800)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>40</td>
<td>40</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
<td>40</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>40</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>40</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>(4)</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>59</td>
<td>59</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>59</td>
<td>59</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>59</td>
<td>59</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>59</td>
<td>59</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>59</td>
<td>(6)</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>86</td>
<td>86</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>86</td>
<td>86</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>86</td>
<td>86</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>86</td>
<td>86</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>2,538</td>
<td>86</td>
<td>(9)</td>
<td>2,615</td>
</tr>
</tbody>
</table>

**Sensitivity analysis: a first exploration of risk and return**

Risk is defined by Reilly (1985) as "uncertainty regarding the expected rate of return from an investment." In the example the investment suffers from two major uncertainties. These are the estimated growth in rental value and the anticipated resale capitalisation rate.

Sensitivity analysis was developed as a means of identifying the independent variable changes in which cause the greatest change in the dependent variable. Many other simple explorations of risk are made possible by this technique.

In the example, it is a straightforward matter to alter either of these variables by the same relative amount and to test the effect on the result. For example, a one-tenth improvement in rental growth is slightly more beneficial than a one-tenth fall in resale capitalisation rate. Alternatively, it may be useful to alter the variables by an equally likely amount. A one-tenth improvement in rental growth may be as likely as a one-twentieth fall in resale capitalisation rate, in which case the relative effect of these variations would be, of course, to confirm the extra sensitivity of the result to rental growth.

Sensitivity analysis therefore allows a more informed decision to be made. It does, however, fail to address a vital point. What is the probability of the possible variations becoming fact? This will surely qualify the above analysis, as it requires an element of qualitative or subjective judgement. The best outcome in the case of alternative investment A may be less profitable than the best outcome in alternative B: but the latter may be much less likely than the former. This element of risk must be taken into account in a full analysis. It is not enough to say what could happen; it is necessary to qualify such hypotheses.

**Risk adjustment techniques**
Both the potential variation and the chances of variation in the outcome from that which is expected should be taken into account in a full risk-return analysis utilising methods of varying formality. Such methods are widely practised, both consciously and unconsciously, in both the capital markets and in real estate.

Three manifestations of risk-adjustment techniques relevant in this context are the risk adjusted discount rate; the certainty equivalent technique; and a hybrid of these, suitable for UK property investment analysis, termed the sliced income method. These are described in detail in Baum and Crosby (1988). For the remainder of this book, particularly in Chapter 8, the risk-adjusted discount rate is utilised.

**Risk-adjusted discount rate**

Whether by NPV or IRR, a point return estimate has to incorporate allowances for risks (defined here as variance of possible returns) when used to choose between alternatives. Choosing on the basis of IRRs alone where risks differ presumes indifference to risk. Given that investors are risk averse a choice on the basis of IRR must therefore involve a risk adjustment.

Either the discount rate or the income may be adjusted to take account of risk. The use of the risk-adjusted discount rate is to adjust the former and is derived from Fisher (1930). The interest (or discount) rate (I) can be constructed from the following function:

\[
(1 + i) (1 + d) (1 + r) - 1
\]

where i represents a return for time preference, d represents a return for expected inflation and r represents a return for risk. The risk free rate (RFR), 9% in the example, is a function of i and d:

\[
RFR = (1 + i) (1 + d) - 1
\]

so \[
RADR = (1 + i) (1 + RFR) - 1
\]

This is the risk-adjusted discount rate. The greater the amount of perceived risk, the higher is RFR. This risk adjustment method is used in the example shown above.

Note that this is not the way the risk-adjusted discount rate (RADR) is normally constructed in practice. Instead, the RADR is usually found by RFR + r. The difference is usually small, and can be shown to be unimportant as the choice of r is arbitrary. In the example RFR = 9% and r = 2%. \((1 + RFR) (1 + r) - 1 = 11.18\%\); \(RFR + r = 11\%\). Such fine distinction in the RADR would normally be pointless.

The use of risk-adjusted discount rates implies that more return is required to compensate for greater risk. How much more is impossible to determine objectively; this depends upon the risk-return indifference curve of the investor, a subjective matter.

**4. Conclusions**

**Implicit and explicit models**

The continuing shift away from implicit property valuation and analysis models toward explicit cash flow projections might not produce better valuations and analyses. One benefit that has unarguably flowed, however, is the exposure of relevant variables for analysis.

The relationship between implicit and explicit models can be represented by a simple equation (loosely Gordon's growth model). Where k represents the all-risks yield (initial yield for a fully let
property), \( e \) represents an overall return (redemption yield if a sale is envisaged) and \( g \) represents income growth, then (ceteris paribus) the left hand side of Equation (1) represents an all risks yield approach while the right hand side of the equation represents a growth explicit model.

\[
k = e - g \tag{1}
\]

Fisher (1930) allows an expansion of this model. The overall return on an investment \( e \) is a reward for three factors. These are \( p \), liquidity preference, \( d \), anticipated inflation, and \( r \), a risk premium.

\[
k = p + d + r - g \tag{2}
\]

This model holds for all assets. It is an extremely useful representation of the variables that property analysts are now beginning to struggle with. However, given that property analysis is more commonly based on nominal returns, \( d \) is not typically exposed and the model becomes as shown in Equation 3.

\[
k = (p + d) + r - g \tag{3}
\]

(\( p + d \)) is a risk-free inflation-prone opportunity cost rate (RFR) traditionally derived from the redemption yield on conventional gilts. (This is faulty, as the risk of inflation being other than as expected is ignored, but this represents the popular approach.)

Hence,

\[
k = RFR + r - g \tag{4}
\]

The importance of Equation 4, faulty though it is, is that it exposes \( r \) and \( g \) as the two variables currently requiring exploration in the property context. While \( k \) and RFR are derived from market evidence, \( r \), a property risk premium over gilts, requires theoretical and empirical work at the market, sector and individual property level, and \( g \), estimated rental growth, is the most difficult variable to deal with, requiring considerably more research and expertise.

Unresolved issues

Much recent debate has correctly centred on major variables in an explicit model the very purpose of which is the exposure of those variables for analysis.

1. The discount or target rate was the subject of Brown's doctoral work (Brown 1985), which included an adaptation of modern portfolio theory for the assessment of target rates for sectors of the commercial property market. Fraser (1986) argued for a radical approach to the estimation of the target rate, implying a negative risk premium. Many other academics and practitioners have adopted a 2% premium over the redemption yield on long dated gilts as the target rate for all property investments. This is patently simplistic. Lack of agreement between more advanced commentators leaves this as an important issue to be addressed in an explicit framework.

2. The forecast income pattern is usually modelled by a constant rate of rental growth, which also becomes imputed into the projected resale price. Market valuation models avoid this problem by tying income forecasts to an implied market expectation, utilising a formula which relates the three variables of target rate, initial yield and rental growth. Crosby (1985) clearly shows that the subjectivity involved in the choice of target rate does not greatly
impact upon a valuation as its effect is cancelled by the rate of rental growth implied. As target rate \((e)\) increases, the rate of growth \((g)\) will fall, given a value for the market determined initial yield \((k)\) and the broad relationship shown in Equation 1 above.

This is, however, of no use in a property investment analysis which is primarily for the purpose of aiding a decision to purchase or sell an investment, in other words to assess a subjective value which differs from the market estimate. Both target rate and expected growth (or otherwise) in income are variables which must be subjectively assessed.

**A third independent variable?**

This is the pre-depreciation state of the art. However, there is a growing perception that depreciation and obsolescence have to be accounted for in property appraisal models:

> There has been much discussion in the property investment market ... of the problems associated with obsolescence and its effect on property values... There has been comparatively little thought given to the means of analysing its effect. There is a clear need for the profession to address this aspect of the problem... (Debenham, Tewson and Chinnocks, 1985)

Depreciation and obsolescence therefore require exploration. The problem was referred to in Chapter 1 in two contexts.

Firstly, it appears to impact upon income and (capital growth) \((g)\). In building a cash flow model for property investment analysis, this effect must be taken into account. The basic model presented in Section 2 of this chapter is a simple framework upon which may be constructed the modifications demanded by depreciation.

The second context within which depreciation becomes relevant is property investment risk \((r)\). Given that knowledge is imperfect, should depreciation be treated as a variable capable of deterministic evaluation, as a risk, or as both? Section 3 of this chapter presents alternative risk/return analysis techniques for the individual investment which will provide the basis for analysis using a depreciation-sensitive model. Chapter 8 develops such a model.

This is not, however, the major objective. Chapters 3 to 7 attempt to provide a fuller understanding of the nature of depreciation which will inform decision-making. Chapter 8 then facilitates a fuller exploration of the impact of depreciation, whether it be treated as a deterministic variable, as a risk, or as both.