Income approach for real estate valuation

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Abstract

Purpose
The paper discusses the problematic aspects of the valuation of a property or related investment project using the discounted cash flow (DCF) analysis. The exact formula of the method is obtained taking into account the variability of the discount rate.
Design/methodology/approach
Well-known formulas of DCF analysis were refined in the case of the discount rate variability using the induction method.
Findings
The exact formulas of the DCF method with a variable discount rate are obtained.
Originality/value
The use of the obtained exact formulas reduces the calculation error from using the traditional formula with a constant discount rate.

Keywords
DCF method. Variable discount rate. Income approach. Income property.

For more than two centuries, the income approach has naturally been considered one of the most powerful and reasonable tools for income property appraisal (valuation of a real estate with commercial potential) or RE related investment project. The first in time of its emergence to implement the income approach was the direct capitalization method, which is used back in the 19th century (Fuhrer M., 1944). In the 30s of the last century the direct capitalization method was supplemented by the discounted cash flow method, or DCF analysis.

The author of the DCF analysis, apparently, should be considered Irwin Fisher, who, in particular, introduced the concept of net present value (Fisher I., 1930). Later it was supplemented with the important idea of terminal value (Solomon E., 1956). The recent global financial crisis has increased the attention of investors to the valuation of capital subjects of income property and business using values in use, such as investment value and user value, as opposed to values in exchange, primarily market value (Trifonov N., 2010). In these cases, the DCF method is the basis for the calculation.

At its inception, the DCF method was considered rather difficult to the need for a large amount of initial data and sufficient computer power, therefore, it was used as additional. At this time a single magnitude of the discount interest rate (rate of return) was used in the calculations related to different years of the forecast, which greatly simplified the calculations (see, e.g. (European Valuation Practice, 1996) or more modern (Real Estate Appraisal, 2006), (The Appraisal of Real Estate, 2013) and (International Valuation Standards, 2019). It was in this form that the method was introduced into the real estate valuation practice and is often recommended for use to this day:

$$V = \sum_{t=1}^{n} \frac{I_t}{(1+R\quad)^t}, \qquad (1)$$

where V is the present value of the valuation subject,

I_t is the value of the t-th current periodic (usually annual) cash, while I_n includes the terminal value V_n at the end of the forecast period (the value of the final return of capital),

R is discount rate,

n is the number of the last period (year).

Note that if the periodic income I_t is constant, the series can be easily summed up, passing into the formula of the direct capitalization method. This circumstance made it possible to write in (International Valuation Standards, 2019, p. 37): “Although there are many ways to implement the income approach, methods under the income approach are effectively based on discounting future amounts of cash flow to present value. They are variations of the Discounted Cash Flow (DCF) method”.

With the development of computer technology, proposals have appeared on the use of different magnitudes of the capitalization rate in one calculation (one valuation). This was due to the ideas formed by that time about the dependence of the magnitude of the capitalization rate on the risks of activities associated with the valuation subject. This was first noted in CAPM (Sharp W. F., 1964). The idea has caused numerous discussions and development. Useful literature on the matter is reflected in (Damodaran A., 2012).

Due to the difference in expected risks, it would be natural to use different magnitudes of the respective discount rate. For example, the use of one rate to discount the cash flow series, and the other to discount the terminal value (or the so-called capital reversion) which in the general case may differ by an order of magnitude. In the case of real estate leases, the first rate reflects benefits or contractual constraints, while the other is dictated by the terms of a free, open market (The Appraisal of Real Estate, 2013). In addition, it is obvious that the magnitude of the discount rate in the general case should change over time, on the one hand, due to changes in the general economic situation, on the other hand, due to possible changes in the state of the valuation subject. An example of the latter can be the assessment of an investment project for the real estate development, when, as money transfers over time to tangible assets, the investment risks (and the discount rate) should decrease.

Attempts are known to take into account rate variability in the method formula. They are reflected in the following (incorrect) formula (e.g. (Gribovsky S. V., 2016):

$$V = \sum_{t=1}^{n} \frac{I_t}{(1+R_t)^t} + \frac{V_n}{(1+R_n)^n}, \qquad (*)$$

where R_t is the discount rate during the t-th period (year) for a periodic cash,

R_n is the discount rate for the terminal value.

In this form, the formula is incorrect from the point of view of financial mathematics, but when using a constant discount rate ($R_t = R_n = const$), it goes over to the previous (1) and becomes more correct, which, apparently, is due to its origin. Getting the correct formula for the DCF method is given below.

Let the dependence of the discount rate on the period number be as follows:

Period (year, month)	1	2	…	n
Rate	R_1	R_2	...	R_n

To understand the true form of the expression describing the DCF method, we will use simple induction. First, suppose that periodic (annual) cash payments are made at the end of the period (year), there is no final return on capital (terminal value), and the forecast is made for 1 period (year). Then

$$V = \frac{I_1}{1 + R_1}.$$

In case of periodic cash payments within two years, we will receive

$$V = \frac{I_1}{1 + R_1} + \frac{I_2}{(1 + R_1)(1 + R_2)},$$

since the cash payment of the second year is discounted sequentially through the second and first years, each with its own discount rate. Similarly, for the entire forecast period of n years, the sought expression takes the form

$$V = \sum_{t=1}^{n} \frac{I_t}{\prod_{j=1}^{t} (1 + R_j)}. \qquad (2)$$

where $\prod^{n}$ $(1 + R_j)$ means the product $(1+ R_1)(1+R_2)\ldots(1+R_n)$.

j=1

The magnitude of the terminal value (final return on capital, final sale) in general case differs from the magnitude of periodic cash payments by an order. Therefore, their discount rates should also differ. Let's denote the discount rates for the final return on capital by the letter *r*. Then the formula with the inclusion of terminal value will take the following form:

$$V = \sum_{t=1}^{n} \frac{I_t}{\prod_{j=1}^{t}(1+R_j)} + \frac{V_n}{\prod_{t=1}^{n}(1+r_t)}. \tag{3}$$

The resulting expression (3) is correct from the point of view of financial mathematics and can be used if the periodic cash payment from the valuation subject arrives at the end of the period. An example would be the annual dividend accrual or the operation of a facility with a final sale. However, in real estate appraisal it is more logical to assume that the recurring income is evenly distributed over the period (for example, monthly rent throughout the year). Then it is more correct to choose the middle of the period as the moment of payment. Taking into account this remark, we obtain the other formula for the DCF model of the income approach:

$$V = \sum_{t=1}^{n} \frac{I_t}{(1+R_t)^{1/2}\prod_{j=0}^{t-1}(1+R_j)} + \frac{V_n}{\prod_{t=1}^{n}(1+r_t)}, \tag{4}$$

provided $R_0 = 0$.

Despite the external cumbersomeness, formula (4), like, indeed, formula (3), is easy to program in the Microsoft Excel package using the financial function PV.

Note that when calculating the value of an income property using the DCF method, the use of an inaccurate formula (1) or an incorrect formula (*) can introduce significant errors.

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