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REALIZATION OF THE INWOOD MODEL IN THE METHODOLOGY OF CADASTRAL VALUATION OF REAL ESTATE PROPERTIES

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Formulation of the problem

The approach in terms of income capitalization is based on the need to determine the present value of the future benefits of ownership of real property. The streams of income in the period of ownership and revenue from the further resale of real estate (reversion) are capitalized (converted) into the present total value.

This approach, as well as approaches in terms of expenditures and comparable sales, requires extensive study of the market. The main areas of the research for the appraiser in the application of this approach are: expected gross income from immovable property; expected reduction in gross income through the part-time employment (job vacancies) and the shortfall of rent expenditure; expected annual operating expenses, the nature and duration of the anticipated stream of income from property and predictable income from reselling or reversion of property rights.

After making careful calculations of costs and revenues, income flows are converted to a present value using capitalization process. Rates, or factors, which are used during the capitalization, are determined by studying the eligible rates of income for similar real estate properties [5-7].

Connection with important scientific and practical tasks

Mentioned issues in this publication are closely related to the Land Code of Ukraine, the Law of Ukraine "On Land Appraisals ", International and National standards of valuation of property. The processes of improvement of methodological approaches of real-estate appraisal in our country are very slow [1-4]. The main results which are set out in the paper allow to speed up the paces and the scales of determining of the market value of the property for the future development of land and economic reform in Ukraine.

Analysis of recent researches and publications

Scientific problematic of real estate appraisal is seen in the works of a wide range of researchers. It should be noted the classic works of J. C. Eckert, G.S. Harrison, J. Friedman. The practice of the national assessment, in some measure, takes by inheritance the foreign methods, but also there is a significant number of personal methodical research works of Ukrainian scientists, the theory and practice of which are shown in the researches of Yu. Dehtyarenko, O. Drapikovskiy, I. Ivanova, Yu. Karpinskiy, M. Lyhogrud, A. Lyashenko, Yu. Mantsevych, L. Perovych, A. Petrakovska, A. Stupen`, M. P. Chernyaha and others.

Unsolved sides of a general problem

The task of cadastral valuation of real estate of the settlements because of development of the projects of practical entering of private ownership on the real estate of the settlements acquires the particular relevance. Without a detailed study of the major problems of land use at the macro and microeconomic levels, modeling of the consequences of such decisions, their information supporting by cadastral data, privatization of the property may lead to substantial losses in the management of the settlements` development and cause great damages to the interests of people. One of the solutions of these problems is a formation of adequate information models of real-estate appraisal. The complexity, diversity and shortage of processing of a problem of real estate appraisal in terms of transitional economy, the objective necessity of its scientific studying, are determined the choice of the topic, purpose and content of this study. Thus, the development of theoretical bases of real-estate appraisal, improving of its methods, implementation of applied researches are rather relevant and practically important for land management of the settlements [8].

The problem definition

The purpose of this study is to introduce the adjustments in the formulas for the calculation of capitalization factor that will allow to reduce the assumptions that are restricting the use of direct capitalization method and will meet the requirements of the modern real estate market.

The basic material of the research

The study and analysis of the data for the approach in terms of capitalization of income is performed on the interaction of the laws of supply and demand. Understanding of this interaction provides the information about trends and market expectations that should be explored using the approach.

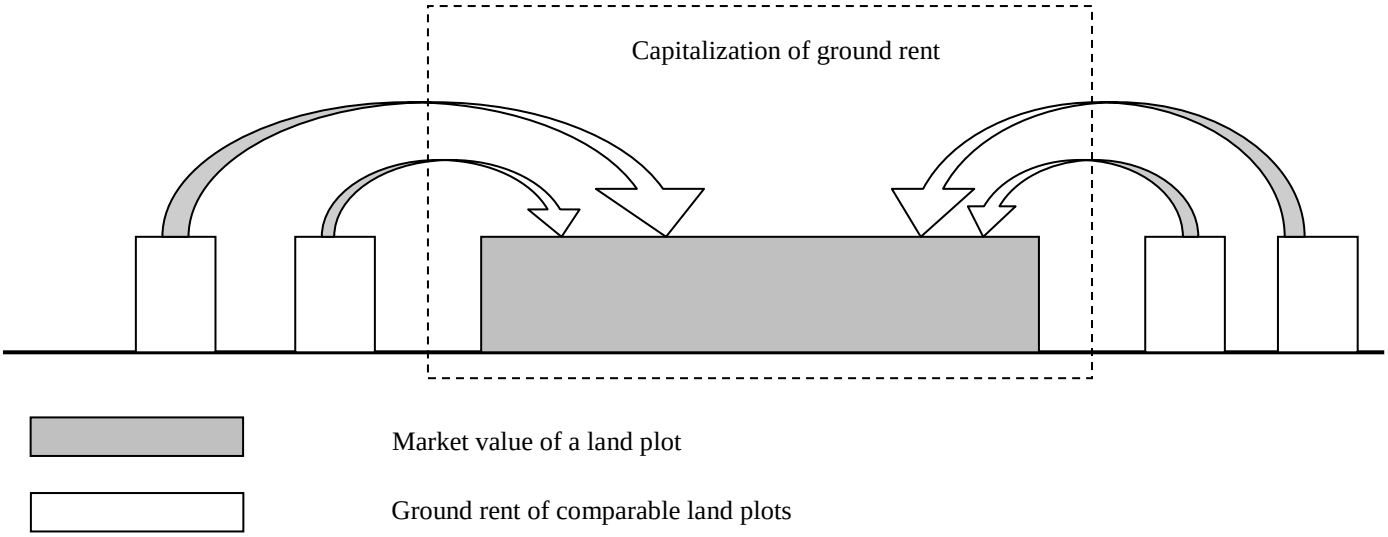

Fig.1. Graphical model of discounted cash flow approach for the assessment of the real estate market value

The methodological approach includes the methods after which we directly perform calculations of the assessed value of the property.

Investment (equity) method – is determining the real estate value as capitalized net operating income from its rental lease.

Benefits method - capitalization of income from the usage of real estate (other than rent) by the owner or user.

The methods of discounted cash flow approach haven`t those shortcomings that are typical for the cost and comparative approaches. Discounted cash flow methods make it possible to consider the risks and inflation, which is certainly positive. Negative ones include: the difficulty of constructing of adequate forecasts of development of real estate market; the complexity of consideration of a large number of pricing factors such as discount rate, capitalization rate, the risk-free rate, inflation level, risk levels and more. Not every property can be attributed to income property.

The discounted cash flow approach provides the assessment of value which is capitalizing the predictable stream of income with real estate being estimated, because of it, using of this approach begins from the collection and processing of data about costs and benefits, including:

1. Market annual rent - the annual amount, according to which the property can be taken or leased to the rent by current market conditions and typical management.

2. Potential gross income - the annual amount of lease payments, which is expected to receive from the estate, based on 100 percent employment.

3. Losses from the shortfall of rent payments - the annual amount that reduces the potential gross revenue due to the incomplete occupancy and untimely rent.

4. The actual gross income - the annual amount which is derived by deducting of the losses from the shortfall of rent payments from potential gross income and increased, in the conditions of necessity, on the amount of other types of income from property (parking, advertising, etc.).

5. Operating expenses - annual amount which is necessary for the maintenance and exploitation of real estate.

6. Net operating income - an annual amount that is obtained by deducting from the actual gross income the operating expenses.

Most of these indicators are calculated values based on market data.

Potential gross income is calculated on the basis of market rental rates for the whole area of a single object of property. Potential income also includes income, derived by improving the estate, but not included in the rent.

The value of operating expenses is determined based on market conditions of lease of single objects of property. Operating expenses are divided into:

• permanent – are not depend on the allocated status of the object;

• variable - include the expenditures for the replacement of improvement elements, useful life of which is less than useful life of improvements in general.

Operating expenses include administration expenses, the owner`s expenses, expenses for the maintenance and repair, expenses for the replacement of improvement elements with a short-term use.

Management expenses include the value of labor power and equipment which are necessary for property management. They are considered in operating expenses regardless of who manages the item of immovable property- the owner or manager, and correspond to a certain percentage from the actual gross income, depending on the type of property.

The owner`s expenses are the expenses associated with the implementation of his rights on the land plot, buildings and structures, such as:

• the cost of utilities (heating, sewerage, water supply, etc.);

• the expenditures for protection, including fire safety;

• the expenditures for sanitization etc.

• the expenditures for the property insurance;

• land tax and real property tax.

Expenses for the maintenance and repair consist of expenses related to the wear and tear, aging and protection of buildings and structures from external factors during their lifetime.

Expenses for the replacement of improvement elements with a short-term use consist of annual allocations of funds that are necessary for their replacement. These expenses are calculated by dividing the amount of expenses for creation of improvement elements` data to the terms of their use.

Operating expenses leave out the annual depreciation amount on the land improvements and the expenses of debt servicing mortgage obligations, taxes, business expenses which are not related to real estate.

It must be emphasized that all the income data and expenditures should reflect the current market conditions and typical property management. As in a comparative approach, to develop common indicators two methods can be used:

• stratification, i.e. the distribution of property on homogeneous groups, within which we can calculate typical (e.g., median or weighted average) value of the potential gross income, expenditures from the shortfall of rent payments, operating expenses;

• multiple regression analysis, where the typical parameters are determined as a function of variables such as location, size of improvements, the type of construction, age and other relevant factors.

At the same time as data sources can be used special databases, newspapers, analytical publications, etc. Except obtaining the preliminary specific data, market researches provide the qualitative information to determine the comparability and possibility of applicability of the results of analysis. This gives the possibility to avoid uncharacteristic for the market sizes of revenues and operating expenses related to the individual characteristics of property management, which should not be taken into account when determining the market value.

Under the direct capitalization method [9,10] capitalization factor R is a factor that allows to convert net operating income $Д_0$ in the current value $Ц_0$ of the item of immovable property using the formula:

$$Ц_0 = \frac{Д_0}{R}. \quad (1)$$

The capitalization factor consists of two elements:

• rate of return on investments;

• investment rate of return (capital return rate).

Rate of return on investments is determined by the market earning power of risk-free and marketable instruments and risk premium associated with the uncertainty of obtaining of the income in future and underliquidity of the object of assessment. Recall ratio of capital is determined by the annual loss of capital during the expected period of use of property, by the nature of change of the value of net income and by the method of reinvesting of earned revenues.

There are three models of repatriation of capital:

• straightforward - Ringo model;

• on fund of returning - Hoskold model;

• annuity - Inwood model.

Inwood model is used more widely that provides uniform (in absolute value) repatriation of capital. In accordance with the Inwood model, a capitalization rate is:

$$R = r + K_3(r,n), \quad (2)$$

where

$$K_3(r,n) = \frac{r}{(1+r)^n - 1}, \quad (3)$$

where: r - the discount rate; n - residual life.

The factor of the fund of compensation $K_3(r,n)$ characterizes the value of payments which in the time of reinvestment with the income r will provide the savings for the period of n years by the amount sum which is equal to 1. The numerical values of this factor are presented in the third column of the table of six features of compound interest. This element in the formula (2) reflects the need to return the capital, spent on the acquisition of the lost capital on the expected term of exploitation. There are the key assumptions through which this model is true:

• the expected term of exploitation of item of immovable property - n years;

• during of all term of exploitation (forecast period) item of immovable property brings constant net operating income $Д_0$;

• annual payments (formed by net operating income) arrive at the beginning of each year (advance payments);

• a part of periodic income, which is representing a repatriation of capital, is reinvested by rate of return on investments;

• at the end of their term of exploitation (of forecast period) item of immovable property entirely loses its value, in other words, future value $Ц_n$ is zero.

According to the assumptions which are given above, Inwood formula is a Specific case of the formula of discounted cash flow method. After appropriate transformations we obtain:

$$Ц_0(n,r) = Д_0 \cdot \sum_{r-1}^{n} \frac{1}{(1-r)^t} = Д_0 \cdot \frac{1 - \frac{1}{(1+r)^n}}{r} = \quad (4)$$

$$= Д_0 \cdot K_5(r,n) = \frac{Д_0}{K_6(r,n)}$$

where $K_6(r,n)=\dfrac{r}{1-\dfrac{1}{(1+r)^n}}$ - the payment for amortization of the unit (sixth column in table of six features) of compound interest.

Hence, in accordance with determination of capitalization ratio we write: $R=K_6(r,n)$.

Considering, that $K_6(r,n)=r+K_3(r,n)$, we obtain the above formula (2) for the capitalization ratio.

For the case when the flow of earning power is considered as unlimited in time or if the value of the item of immovable property remains unchanged and therefore in full will be returned at resale, there are no necessity in refunding, and capitalization ratio is equal to the rate of return:

$$R=r\ . \qquad (5)$$

In practice, the above assumptions are not true. Rental rates for a long period of time are increasing and it is not known when this growing will stop. It is doubtful assumption that with the end of normative lifetime of real estate its cost will be zero. If the land plot is privately owned, then even by completely destroyed building the owner will remain as the owner of some capital in the amount of value of a land plot and a part of elements of building. Thus, the problem is the introduction of adjustments in the formulas for the calculation of capitalization ratio that will help to reduce the assumptions that restrict the use of direct capitalization method and will meet the requirements of the recent market.

Thus, we consider some specific cases.

Specific case 1. We will consider the situation where the real estate market and the item of immovable property show consistency that allows to make the following assumptions:

• forecast period - n years;

• throughout all forecast period the item of immovable property brings constant net operating income, which is equal to $Д_0$;

• annual payments (formed by net operating income) arrive at the beginning of each year (advance payments);

• a part of periodic income, which is representing a repatriation of capital, is reinvested by rate of return on investments;

• at the end of forecast period the item of immovable property partially loses its value.

We know that the percentage of lost value is $I=(1-\gamma)$, i.e. the future value is $Ц_n=\gamma\times Ц_0$.

In this case, the calculation of the present value of flow of money amounts to the solution of simple linear equation with respect to $Ц_0$:

$$Ц_0=Д_0\cdot\sum\frac{1}{(1+r)^n}+\gamma\cdot\frac{Ц_0}{(1+r)^n}\ . \qquad (6)$$

We will replace γ by the value of depreciation I (in percent) that we can expect at the end of the term of the forecast period: $\gamma=1-I$, $Ц_n=Ц_0\times(1-I)$. We obtain a formula for calculating of the present value:

$$Ц_0=Д_0\cdot\frac{(1+r)^n-1}{r\cdot\left[(1+r)^n-\gamma\right]}. \qquad (7)$$

From here

$$R=\frac{r\cdot(1+r)^n-\gamma}{(1+r)^n-1}=r+\frac{r\cdot(1-\gamma)}{(1+r)^n-1}=\\ =r+I\cdot\frac{r}{(1+r)^n-1}\ . \qquad (8)$$

Or, if we present it in the standard form:

$$R=r+I\times K_3(r,n). \qquad (9)$$

Specific case 2. We will consider the situation where the market value of the item of immovable property is increasing due to the general increase of the prices in real estate market and the simultaneous loss in value due to wear and tear of the item. We will formulate the basic assumptions for the development of formula:

• the first four assumptions are identical with a Specific case 1;

• during the whole forecast period in real estate market it is expected the increasing of prices with an annual rate equal to g. Therefore, at the end of the forecast period the prices on the real estate market will grow in $(1+g)$ times. A similar increase is expected for the object of evaluation;

• at the end of forecast period the item of immovable property partially loses its value.

We know that the percentage of lost value, i.e. future value in the prices of the current year is $Ц_n=\gamma\times Ц_0$.

Under these assumptions the equation to calculate the present value of the item of immovable property will look like:

$$Ц_0=Д_0\times\sum\frac{1}{(1+r)^n}+\gamma\cdot(1+g)^n\cdot Ц_0\ . \qquad (10)$$

After the above transformations, capitalization ratio can be written as:

$$R=r+K_3(r,n)\times\left[1-(1-I_n)\cdot(1+g)^n\right], \qquad (11)$$

or

$$R=r+K_3(r,n)\times[1-\alpha]. \qquad (12)$$

We will consider the specific situations:

1. Increasing of real estate is lacking, a partial wear and tear is projected:

$$R=r+I\times K_3(r,n).$$

This formula coincides with formula (9).

2. Increasing of real estate is lacking, a full wear and tear is projected:

$$R=r+K_3(r,n).$$

This formula coincides with formula (2).

3. Increasing of the real estate during the forecast period is forecasted, loss in value, due to wear and tear, is negligible:

$$R = r + \left\lfloor 1 - (1+g)^n \right\rfloor \times K_3(r,n). \qquad (13)$$

4. Increasing of real estate is lacking, wear and tear during the forecast period is insignificant (we can ignore reducing of the value):

$$R = r \ .$$

This formula coincides with formula (5).

Specific case 3. We will consider the situation where simultaneously (with the same rate) with the growth in prices of property the rent rates are increasing. We will formulate the basic assumptions for the development of formula:

• forecast period - n years;

• throughout the forecast period the rent is increasing, and therefore, the item of immovable property is bringing the net operating income, which increases annually with a rate equal to g;

• annual payments (formed by net operating income) arrive at the beginning of each year (advance payments);

• a part of periodic income, which is representing a repatriation of capital, is reinvested by rate of return on investments;

• at the end of forecast period the item of immovable property fully loses its value.

Under these assumptions the equation to calculate the present value of the item of immovable property can be written as:

$$Ц_0 = Д_0 \times \sum_{t=1}^{n} \frac{(1+g)^t}{(1+r)^t} + \gamma \cdot \frac{(1+g)^n}{(1+r)^n} \cdot Ц_0 \qquad (14)$$

After the simple transformations, we obtain the solution of this equation by which the capitalization rate is:

$$R = \frac{r-g}{1+g} \cdot \frac{(1+r)^n}{(1+r)^n - (1+g)^n}. \qquad (15)$$

With the introduction of additional assumptions this formula is easily transformed into well-known formulas. For example, when $g = 0$ (no increasing in the payments), formula (15) becomes the traditional formula for capitalization ratio (2).

Specific case 4. We will consider the situation where rent rates are rising with a constant rate g. Total wear and tear during the forecast period is unexpected.

We will formulate the basic assumptions for the development of formula:

• the first four assumptions are identical with particular case 3;

• at the end of forecast period the item of immovable property doesn`t lose its initial cost (we can ignore the loss in the value caused by wear and tear during the forecast period);

• during the whole forecast period in real estate market it is expected the increasing of prices with an annual rate equal to g. Therefore, at the end of the forecast period the prices on the real estate market will grow in $(1+g)$ times. A similar increase is expected for the object of evaluation.

Under these assumptions the equation to calculate the present value of the item of immovable property can be written as:

$$Ц_0 = Д_0 \times \sum_{t=1}^{n} \frac{(1+g)^t}{(1+r)^t} + (1+g)^n \cdot Ц_0 \ .$$

From here

$$Ц_0 = \frac{Д_0 \cdot (1+g)}{r-g} = \frac{Д_0 \cdot (1+g)}{R},$$

where $R = r - g$.

So, we get the famous Gordon formula. Applying of the Gordon formula as a basic formula of direct capitalization method is permissible if we expect that for a quite long period of time the increasing of the rent will be substantially more significant than its fall through the wear and tear of the building. So, if we assume that for a long time the rental rate will increase with a constant rate g, then the capitalization ratio can be $R = r - g$.

Specific case 5. We will consider the situation where a change in value of the item of immovable property occurs under the influence of two opposing factors. On the one hand, this is wear and tear, which reduces the value of the property, on the other hand, this is active market development of similar property that increases property values. This situation, in our opinion, is the most typical of the modern market. We will formulate the basic assumptions for the development of formula:

• forecast period - n years;

• throughout the forecast period the rent is increasing, and therefore, the item of immovable property is bringing the net operating income, which increases annually with a rate equal to g: $Д_t = Д_0 \cdot (1+g)^n$;

• annual payments (formed by net operating income) arrive at the beginning of each year (advance payments);

• a part of periodic income, which is representing a repatriation of capital, is reinvested by rate of return on investments;

• at the end of forecast period the item of immovable property partially loses its value due to wear and tear $Ц_n = Ц_0 \times (1-I)$.

• during the whole forecast period in real estate market it is expected the increasing of prices with an annual rate equal to g. Therefore, at the end of the forecast period the prices on the real estate market will

grow in $(1+g)$ times. A similar increase is expected for the object of evaluation.

Thus, the final expression for the value of the reversion taking into account two factors (growth of the prices on the market and wear and tear) is:

$$Ц_n = Ц_0 \times (1-I)\cdot(1+g)^n .$$

After the simple transformations we obtain the formula for capitalization ratio:

$$R = (r-g)\cdot\left(\frac{(1+r)^n - (1-I)\cdot(1+g)^n}{(1+r)^n - (1+g)^n}\right). \qquad (16)$$

Expression (16) taking into account relevant conclusions is reduced to previously obtained formulas. For example, if during the forecast period wear and tear is not exist ($I=0$), then the expression for the total capitalization ratio becomes as well-known formula Gordon $R = r - g$.

The table presents the formulas for the calculation of capitalization ratio for the above specific cases.

The formulas for the calculation of capitalization ratio for specific cases

№	Description of the situation (basic assumptions)	Calculating formulas of capitalization ratio
1	Wear and tear is lacking, payments are constant, increasing of the prices of the property is lacking.	$R = r$
2	Full wear and tear of the property at the end term of exploitation, payments are constant.	$R = r + K_3(r,n)$
3	Partial loss in value. Wear and tear is expressed on a percentage base, for the period n is equal to I . The increasing of the prices on real estate market is lacking.	$R = r + I \times K_3(r,n)$
4	Wear and tear is lacking. The cost of real estate is growing with an annual rate g , payments are constant.	$R = r + \left[1-(1+g)^n\right]\times K_3(r,n)$
5	Partial loss in value. Total wear and tear for the period n is equal to I . The cost of real estate is growing with an annual rate g . Payments are constant.	$R = r + K_3(r,n)\times\left[1-(1-I_n)\cdot(1+g)^n\right]$ $R = r + K_3(r,n)\times[1-\alpha]$
6	The prices on real estate market do not change. Payments increase with an annual rate g .	$R = r - g$ (independent of n)
7	Total loss in value at the end of the period. Payments increase with an annual rate g .	$R = \frac{r-g}{1+g}\cdot\frac{(1+r)^n}{(1+r)^n-(1+g)^n}$
8	Partial loss in value at the end of the period. The cost of real estate is growing with the rate g . Payments increase with an annual rate g .	$R = (r-g)\cdot\left(\frac{(1+r)^n-(1-I)\cdot(1+g)^n}{(1+r)^n-(1+g)^n}\right)$

Conclusions

The proposed formulas enable to use a direct capitalization method in situation when real estate properties do not completely lose their cost value and there is a necessity of compensation of only a part of the initial investments. Also, derived formulas take into account the expected rental growth over the forecast period and the expected increase of the real estate prices.

Before the performing of the researches, we had anticipated that inflation is permanent, stable. However, now we can say that the above formulas are completely consistent for variable inflation processes. In a transitional economy of Ukraine annual rates of general inflation are changing, however, during this the nominal discount rates, the rates of the growth of property values and rents are changing accordingly, so that their differences are not significantly changed. So, when for the future the inflation rate is projected over the years, we can confirm that we obtained formulas will not give significant errors.

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The obtained results permit the use of the direct capitalization method in situations when real estate properties do not completely lose their cost value and there is a necessity of compensation of only a part of the initial investments, and also, take into account the expected rental growth over the forecast period and the expected increase of the real estate prices.