Methodological tools for calculating the cadastral value based on the corrected effective age of the capital construction object

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Abstract. The authors consider the cadastral valuation system in the Russian Federation. There is a variety of studies, but there is an active contestation of the results of the cadastral assessment, which leads to citizens' dissatisfaction with the overestimated tax burden, as well as unstable budget planning in terms of tax collection due to biased cost indicators. In this connection, the category "disproportion" has been clarified in the context of the assessment of the cadastral value, which affects the formation of the tax base for real estate objects. The purpose of the study is to develop methodological tools to calculate the cadastral value, taking into account the adjusted effective age of a capital construction facility. The cost of a constructed building and the cost of a building that underwent overhaul or reconstruction in the same year are not equivalent to each other, because repair and restoration work reduces wear and tear only partially. The use of tools that shows the difference between the year of construction and the year of reconstruction or overhaul as a whole makes it possible not only to reduce the information imbalance in determining the cadastral value, but also the methodological disproportion in relation to the use of such a pricing factor as “the date of the overhaul (reconstruction) ", because the regions do not have a unified position in practice. Also, the use of the parameter "effective age" allows you to reasonably apply the methods of income, cost and comparative approaches.

1 Introduction

Real estate is viewed as a tangible asset, a tool to generate income and an investment object. Most countries are characterized by a mixed administrative and economic mechanism for real estate taxation. Such a mechanism includes the following tools: economic assessment, actualization and indexation of value, construction of price maps of the territory, etc. This indicates the intention to use real estate effectively in order to increase the investment potential in general. However, depending on the goals, the opposite of the motivation of market participants in determining the cost is still preserved. For example, during purchase and sale transactions, citizens seek to increase the economic attractiveness of their property

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and increase the value of real estate. However, taxation changes that. Owners are interested in understating the value in order to get benefits and reduce the taxes that they pay.

The economic policy of the state cannot ignore such discrepancies and must use market instruments to calculate the tax base of real estate. The main goal is to approximate the tax base of real estate objects to real market indicators. This will ensure a balance of interests of the state and citizens: a competent assessment of the value of real estate contributes to the correct decision-making, both in the public and private sectors.

Foreign and domestic practice pays great attention to mass appraisal issues. For example, there are various mass appraisal models based on the approach of comparing sales with approaches of computational intelligence [1] or using spatial modeling [2]. For commercial real estate, mass appraisal models are used based on spatial analysis [3], multiple regression [4], or the possibility of a non-deterministic relationship between real estate variables [5]. For residential real estate, one can distinguish mass appraisal models based on the relationship between housing prices and the energy efficiency of a building [6], the cost method and dependence on current trends in the real estate market [7]. At the same time, Russia widely uses the methodology of discrete spatial-parametric modeling of the real estate market [8], as well as the assessment methodology based on the correlation-regression modeling of the market [9] in the framework of the mass appraisal of real estate in order to comparative taxation. In order to develop the existing practice of mass appraisal, the authors consider methodological tools to calculate the cadastral value, taking into account the adjusted effective age of the capital construction facility.

In the Russian Federation, the tax base is the cadastral value of real estate, which is formed on the basis of market information and information related to the economic characteristics of the use of real estate. This creates conditions for the rational and efficient use of land and capital construction projects. However, it should be noted that today these conditions are poorly implemented due to biased cost indicators that form the basis for real estate taxation. The issues of selection of pricing factors used in the calculation of the cadastral value remain debatable. In this regard, we have identified disproportions from the standpoint of determining the cadastral value, which lead to a similar kind of distortion of the results of the cadastral valuation (informational, organizational, methodological and territorial). The disproportion in determining the cadastral value of real estate objects is the lack of proportionality of the current level of development of the cadastral value assessment, as well as the ratio of indicators that characterize the objects of assessment. As a result, the presence of disproportions predetermines the contestation of the cadastral value and the unstable nature of tax revenues to the budget.

Since 2020, state budgetary institutions for cadastral valuation have been fully functioning in all regions of the country [10]. There are a number of advantages to having a kind of monopolization if budgetary institutions have the authority to cadastral valuation. Firstly, the basic requirements for employees of a budgetary institution are legally fixed. Secondly, specific responsibilities and powers of budgetary institutions are established. And, thirdly, the performer of the cadastral valuation is permanent. However, this transition does not reduce the problem of the high level of contestation of the results of the cadastral valuation. One of the fundamental reasons for the mass contestation of the cadastral value is the informational and methodological imbalances that arise between the cadastral valuation operators, the rights registration authority, independent appraisers and copyright holders.

Today, mass appraisal methods are used for cadastral valuation in the course of building unified models to determine the cadastral value of real estate objects that have similar characteristics. However, if it is not possible to apply mass appraisal methods, the cadastral value is determined individually.

2 Research methodology

To model the cost, the methodology of any of the approaches to valuation can be used: cost, comparative or income. An analysis of the existing practices of cadastral valuation showed that the cadastral value was mainly calculated using the cost and comparative approaches.

Some types of capital construction projects (for example, apartment buildings, structures) are characterized by a lack of reliable information about the prices of completed transactions and offers. As a result, the lack of the necessary amount of market information does not make it possible to use a comparative approach and there is a transition to the use of a cost approach in practice.

The decision to refuse to apply the income approach in the mass appraisal of the cadastral value is based on the following justifications:

– the capital construction facility cannot independently generate income in isolation from the land plot;

– lack of reliable data on income and expenses for real estate, total capitalization rate and discount rate;

– a wide range of rental rates for objects-analogues, therefore it is not possible to obtain reliable data on the amount of income from objects of appraisal;

– operating costs are largely individual and depend on the design solutions of the objects, the ratio of areas and technical equipment;

– and others.

However, the above circumstances do not prevent the application of the income approach to the individual assessment of the cadastral value of a property. The use of the income approach is advisable because of the need to clarify one of the key parameters of the cost approach, which is external obsolescence.

In the case of overhaul or reconstruction of a facility, the date of putting the facility into operation (the date of the beginning of its service) can be considered the date of completion of the overhaul as a whole (overhaul of individual systems and (or) structural elements does not apply to the overhaul as a whole) or reconstruction in accordance with current guidelines. However, the analysis of existing reports for determining the cadastral value of capital construction facilities made it possible to find out that many regions did not use information on the date of the overhaul (reconstruction) and did a cadastral valuation, since there was no confirmed information.

The cost of a constructed building and the cost of a building that underwent overhaul or reconstruction in the same year are not equivalent to each other, because repair and restoration work reduces wear and tear only partially. In particular, there is a contradiction in the motivation of real estate owners to improve real estate and in the motivation to reduce tax payments due to high physical depreciation in the absence of major repairs and reconstruction. There is a provision for methodological guidelines [11]. It states that the date of putting the object into operation is the date of completion of the overhaul as a whole or reconstruction. As a result, this provision cannot be applied. Thus, it is necessary to refine this provision, which is presented as part of the toolkit for calculating the effective age of a capital construction object. Thus, it is advisable to appreciate, taking into account the comparison of the difference between the year of construction and the year of reconstruction or overhaul, forming the corrected effective age of facilities. The application of this approach makes it possible not only to reduce the informational imbalance in determining the cadastral value, but also to solve the problem of using such a pricing factor as “the date of the overhaul (reconstruction)”, because the regions do not have a unified position in practice.

3 Research results of the study

In the authors opinion, the proposed toolkit to calculate the cadastral value, taking into account the effective age of the capital construction object, which makes it possible to reflect the content of the difference between the year of construction and the year of reconstruction or overhaul as a whole (Table 1), is aimed at eliminating the above circumstances.

Five typological groups are based on an assessment of the degree of physical deterioration according to the general characteristics of the technical condition and the approximate cost of restoration work. Untimely restoration of the bearing capacity of structural elements, as a rule, leads to an increase in the cost of restoration work. The reason for applying the coefficients to the calculation of the effective age of buildings is the regularity of the ratio of physical wear and tear and the cost of the necessary overhaul (reconstruction), which aims to restore the facility, taking into account the replacement cost of structural elements. A distinctive feature of the proposed tools to calculate the effective age is the use of appropriate coefficients, which can be considered as downward adjustments.

Table 1. Calculation of the effective age based on the assessment of the degree of physical deterioration and the approximate cost of restoration work (Source: compiled by the authors).

Technical condition assessment	**Approximate cost of work, % of the cost of structural elements**	**Physical wear calculated based on the beginning of the service life, %**	**Effective age of the capital construction facility**
I (good)	up to 10	0-20	$D_a - D_r + (D_r - D_l) * k_1$
II (satisfactory)	15-30	21-40	$D_a - D_r + (D_r - D_l) * k_2$
III (unsatisfactory)	40-80	41-60	$D_a - D_r + (D_r - D_l) * k_3$
IV (dilapidated)	90-120	61-70	$D_a - D_r + (D_r - D_l) * k_4$
V (bad)	-	from 71	$D_a - D_r + (D_r - D_l) * k_5$

Where D_a– assessment year;

D_r– year of completion of the overhaul as a whole or reconstruction;

D_l– year of start of the life of the building (completion of construction or putting the building into operation);

k_{1-5}. – coefficient based on the assessment of the degree of physical wear and tear according to the general characteristics of the technical condition and the approximate cost of restoration work.

The definition of wear and tear also depends on the economic life of the facility, the choice of which is based on the type of capital construction. Therefore, the data of IV type of capital construction (service life is 50 years) were taken as the basis for substantiating the indicators of coefficients based on an assessment of the degree of physical wear and tear according to the general characteristics of the technical condition and the approximate cost of restoration work.

To calculate the coefficients for the remaining (I, II, III and V) types, an adjustment was made in accordance with the indices of transition from one type to another. These coefficients are reflected in table 2.

Table 2. Coefficients based on an assessment of the degree of physical wear and tear according to the general characteristics of the technical condition and the approximate cost of restoration work (Source: compiled by the authors).

The type of capital construction	Estimated economic life under normal operating conditions. year	Physical wear and tear. %				
		0-20	21-40	41-60	61-70	71-…
I	150	0.35 (+0.25)	0.55 (+0.25)	0.65 (+0.25)	0.75 (+0.25)	0.85 (+0.25)
II	100	0.26 (+0.16)	0.46 (+0.16)	0.56 (+0.16)	0.66 (+0.16)	0.76 (+0.16)
III	80	0.18 (+0.08)	0.38 (+0.08)	0.48 (+0.08)	0.58 (+0.08)	0.68 (+0.08)
IV	50	0.10	0.30	0.40	0.50	0.60
V	30	-	0.16 (-0.14)	0.26 (-0.14)	0.36 (-0.14)	0.46 (-0.14)

4 Discussion of the results

Thus, the use of the above tools to calculate the effective age is possible using three approaches in assessing the cadastral value: costly, comparative and profitable.

The effective age is taken into account in the calculation of accumulated depreciation under the cost approach:

$$AW = 1 - \left(1 - W_{ph.}\right) \times \left(1 - W_{fun.}\right) \times (1 - W_{ec.}) \quad (1)$$

where AW – accumulated wear and tear of appraised objects, $W_{ph.}$ – physical wear and tear of the object of appraise, $W_{fun.}$ – functional obsolescence of the object of appraise, $W_{ec.}$ – economic obsolescence of the object of appraise.

Physical deterioration of a structure (building, structure) is a loss of value due to aging processes during operation, decomposition (dilapidation), decay, corrosion or structural defects, as well as mechanical damage to building elements, that is, a decrease in the physical and mechanical characteristics of an object. This is a deterioration that can affect the durability, reliability, convenience and cost of operation, as well as the aesthetic characteristics of the object.

Physical wear and tear can be determined in a variety of ways, most of which are based on comparison with peers whose physical state is known. The effective age method is usually used as one of the methods to calculate physical wear and tear:

$$W_{ph.} = \frac{EffA}{EcL} \text{К}_m \quad (2)$$

where $W_{ph.}$ – the amount of physical wear and of an object, $EffA$ – the effective age of an object is the chronological age of the property, which is adjusted in accordance with the operating conditions of this property, EcL – economic life of an object, К_m – coefficient of object of real estate type.

When calculating the cadastral value, the real estate type coefficient characterizes the limiting state of the property, at which its further operation is forbidden if there is no capital work, and is assumed to be 0.7 for residential properties and 0.6 for other properties.

The comparative approach is used to assess real estate in the case when it is possible to select a sufficient number of analogous objects with known prices of transactions and (or) offers. The calculation of the cost is accompanied by an analysis of the factors by which the appraised object differs from similar objects. One of the elements of comparison, according to which the prices of analogue objects are adjusted, is the physical condition (size, quality of construction work, condition of the building) [12]. Thus, it is possible to take into account the effective age as an independent element of comparison, if all the information that is necessary to determine it is available. The calculation of the adjustment "the physical condition of the capital construction object" is presented in the following formula:

$$k_{phc} = \frac{1-W_{ao}}{1-W_{oa}} = \frac{1-{EffA_{ao}}/{EcL_{ao}}}{1-{EffA_{oa}}/{EcL_{oa}}} \quad (3)$$

where k_{phc} – adjustment of the "physical condition of the capital construction object", W_{ao} – the value of the physical wear and tear of an analogue object, W_{oa} – the amount of physical wear and tear of the object of assessment, $EffA_{ao}$ – effective age of an analogue object, EcL_{ao} – economic life of an object, $EffA_{oa}$ – effective age of the object of assessment, EcL_{oa}– economic life of assessment.

The above formula is applied to the situation of selecting analogous objects in their natural positioning in the real estate market:

– as single real estate objects, including land and improvements

– with the further distribution of the cost of the analogue object by the cost of the specified components and the adjustment of the cost of improvements for differences in physical condition and other differences.

In case of adjustment of the value of a single property, it is necessary to modify the above formula as follows:

$$k_{phc} = \frac{1-W_{ao}}{1-W_{oa}} \times ShI = \frac{1-{EffA_{ao}}/{EcL_{ao}}}{1-{EffA_{oa}}/{EcL_{oa}}} \times ShI \quad (4)$$

where ShI – the share of improvements in the value of a single property (determined by empirical methods, or on the basis of information available to the appraiser, for example, a real estate appraiser's handbook edited by L.A. Leifer).

As part of the income approach, the effective age is used in determining the forecast period, as well as in determining the capitalization rate (ratio) in the framework of the direct capitalization method of net operating income. The direct capitalization method calculates the value of a property by converting income using cash flow rates as capitalization tools: capitalization ratios or income multipliers:

$$V_o = \frac{I_o}{R_o} \quad (5)$$

where V_o– value of the real estate object, I_o – net operating income, R_o – capitalization ratio.

Accordingly, the capitalization ratio can be found using one of the models. Ellwood model [13]:

$$R_o = Y_o - \Delta\, SFF = Y_o - \Delta\, \frac{Y_0}{(1+Y_0)^k - 1} \quad (6)$$

Inwood model (model of full depreciation technique) [13]:

$$R_o = Y_o + SFF = Y_o + \frac{Y_0}{(1+Y_0)^k - 1} \quad (7)$$

Ring's model (Model technique of linear price change) [13]:

$$R_o = Y_o - \frac{\Delta}{k} \quad (8)$$

where R_o – capitalization ratio, Y_o – rate of return on equity (rate of return on investment, discount rate), k – the period when the improvement wears out by 100%, Δ – value change over the forecast period, SFF – compensation fund factor.

The most correct option seems to be the combination of the Ellwood model and the Inwood model. At the same time, the parameter Δ is defined as the growth rate, which, in the context of the analysis of the operation of the object until the end of its economic life, means the depreciation of the asset under the influence of accumulated depreciation. That is, the expected interval of this parameter is as follows: $-1 < \Delta < 0$. This parameter is specified by the value of the liquidation value of the capital construction object by the term given in FSBU 6 / 2020 [14].

The Inwood model calculates $\frac{Y_0}{(1+Y_0)^k - 1}$ based on the discount rate. $\Delta = -1$ (growth rate in case of complete depreciation of the asset at the end of the forecast period) and other equal conditions ensure the equality of the result of applying capitalization according to the Ellwood-Inwood calculation model and the result of applying the discounted cash flow method.

5 Conclusion

As noted earlier, the cost of a constructed building and the cost of a building that underwent overhaul or reconstruction in the same year are not equivalent to each other, because repair and restoration work reduces wear and tear only partially. In particular, there is a contradiction in the motivation of real estate owners to improve real estate and in the motivation to reduce tax payments due to high physical depreciation in the absence of major repairs and reconstruction. Thus, it is advisable to evaluate it taking into account the comparison of the difference between the year of construction and the year of reconstruction or overhaul, forming the corrected effective age of objects.

Thus, it is possible to solve one of the problems of manifestation of informational and methodological imbalances that affect the contestation of the cadastral value. By modifying the calculation of the effective age, the models to calculate the physical wear and tear of the building become more flexible. The use of the “effective age” parameter also makes it possible to reasonably apply the methods of the comparative approach and the income approach. Together, these activities lead to an increase in the accuracy of the calculation of the cadastral value.

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