The use of the effective age in the calculation of the cadastral value as a factor in the sustainable development of the region

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Abstract. In the Russian Federation taxes are calculated based on the cadastral value of immovable property, formed on market information, including information related to the economic characteristics of using of a real estate object. This creates conditions for the rational and efficient use of land plots and capital construction projects (capital construction object). However, it is worth noting that today these conditions are poorly implemented due to biased cost indicators forming the base real estate taxation. The purpose of the study is to test methodological tools for calculating the cadastral value of a capital construction object, taking into account adjusted effective age in the context of sustainable development of the region. When performing repair and restoration work, physical wear is compensated only partially. In this regard, the cost of a constructed building and the cost of a building that was overhauled or reconstructed in the same year are not equivalent to each other. The proposed by the authors corrected effective age allows us to reflect the content of difference between the year of construction and the year of reconstruction or overhaul as a whole. This makes it possible to resolve the issue of using such a pricing factor as a date of overhaul (reconstruction). At the moment, regions do not have a unified position in a practical approach to this issue. To demonstrate the applicability of methodological tools, the assessment of cadastral value was carried out within the framework of the cost approach. The sample used includes 132 objects, residential and non-residential buildings located on the territory of the city of Tomsk, in respect of which reconstruction was carried out. The results showed that the calculation models of physical depreciation of a building based on corrected effective age become more flexible because partial compensation of physical depreciation is taken into account during the renovation. In total, these measures lead to the accuracy increase while calculating the cadastral value.

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1 Introduction

Real estate objects by virtue of their main characteristic - stationarity - are among the most important elements of modern economic relations. The results of cadastral valuation of real estate objects serve as the basis for calculating property taxes and other payments. Meanwhile the number of applications for revising the results of cadastral value determination has been actively increasing since 2014, and only in 2018 did not exceed the indicators of the previous year. One of the main reasons for revising the results is inaccuracy of information about real estate objects used while determining the cadastral value. As a result of such a situation, the active contesting of the results of a cadastral assessment, citizens' discontent with overstated tax burden, and authorities' difficulties with stability of budget planning in relation to tax collection, cause disputes about the adequacy of the cadastral assessment procedure. These circumstances are also confirmed by the frequent introduction of amendments to legislative acts concerning the cadastral valuation. The selection of price-forming factors used while calculating cadastral value remains debatable. Deviation from market data is observed both upward and downward, which is confirmed by the works of L.A. Leifer [1] and A.V. Kaminsky [2]. This circumstance indicates that the cadastral assessment procedure does not work well, despite a large number of scientific works on this topic [1-9]. In these conditions, improvement of the cadastral value assessment system should be carry out in order to solve existing problems, which determines the relevance of the study performed.

2 Research methodology

Foreign and domestic practice pays great attention to mass appraisal issues [10-18]. An analysis of the existing practices of cadastral valuation showed that the calculation of the cadastral value of construction project was mainly carried out under cost and comparative approaches. However, one can use the methodology of cost, comparative or income approaches to valuation when modeling a cost.

The assessment of the degree of characteristics' influence on a cost is given in the work of A.V. Pylaeva [19]. The range of the influence of such characteristic as "year of construction/year of commissioning" is 80%, which indicates the significance of this parameter. According to the current methodological guidelines, in the case of overhaul or reconstruction of an object, the completion date of overhaul as a whole (overhaul of individual systems and (or) structural elements do not relate to overhaul as a whole) or reconstruction is accepted as the date of commissioning of an object (the date of the beginning of its normative service life). However, the analysis of reports on determining the cadastral value of capital construction projects revealed that information about the date of overhaul (reconstruction) in many regions was not used in cadastral assessment due to the lack of confirmed information.

When performing repair and restoration work, physical wear is compensated only partially, in this regard, the cost of a constructed building and the cost of a building that was overhauled or reconstructed in the same year are not equivalent to each other (Figure 1). Thus, it is necessary to finalize this provision, which is presented within the framework of tools for calculating the effective age of a capital construction object. The authors believe that it is advisable to carry out assessment taking into account the comparison of difference between the year of construction and the year of reconstruction or overhaul, forming a corrected effective age of objects.
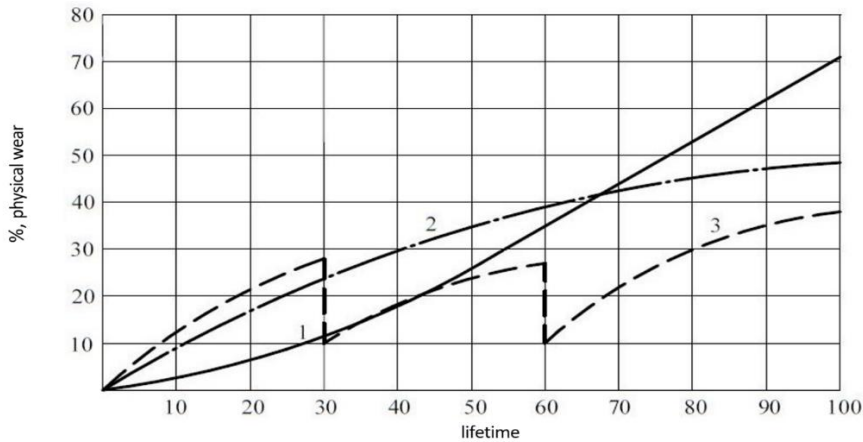
Fig. 1. Change in the physical wear of buildings 1 - according to theoretical data; 2 - according to statistical data; 3 - when performing repair and restoration work**.**

3 Research results of the study

The authors propose a toolkit for calculating the cadastral value of a capital construction object, taking into account the effective age, which makes it possible to reflect the content of difference between the year of construction and the year of reconstruction or overhaul as a whole. The formula for calculating the corrected effective age of a capital construction object is presented below:

$$CEA = D_{YA} - D_{YC} + (D_{YC} - D_{YB}) * K_2 \qquad (1)$$

Where CEA is the corrected effective age of a capital construction object;

D_{YA} – Data -the year of assessment;

D_{YC} – Data - the year of completion of overhaul in general or reconstruction;

D_{YB} – Data - the year of the beginning of the standard service life of a building (completion of construction or commissioning);

K – coefficient based on the assessment of the degree of physical depreciation according to the general characteristics of technical condition and an approximate cost of restoration work.

Five typological groups are based on the assessment of the degree of physical depreciation according to the general characteristics of the technical condition and the approximate cost of restoration work. A distinctive feature of the calculation of corrected effective age is an application of appropriate coefficients, which can be considered as downward adjustments.

Determination of physical depreciation also depends on the economic life of an object, the choice of which is based on a capitalization group. To calculate the coefficients for the five capitalization groups, adjustments were made in accordance with the indices of transition from one capitalization group to another. These coefficients are shown in table 1.

Table 1. Coefficients based on the assessment of the degree of physical depreciation according to the general characteristic of technical condition and an approximate cost of restoration work.

Capitalization group	Approximate period of economic life under normal operating conditions. years	Physical depreciation. %				
		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)

Source: compiled by the authors.

Within the framework of a cost approach, the effective age is taken into account when calculating the accumulated depreciation:

$$CV = E_{R/R} \times EP \times (1 - (1 - D_{P.}) \times (1 - D_{F.}) \times (1 - D_{E.})), \qquad (2)$$

Where CV is the cadastral value of a valuation object, rub.;

$E_{R/R}$ – expenses necessary for the reproduction or replacement of an object of assessment, rub.;

EP – entrepreneur's profit;

$D_{P.}$ – physical depreciation,

$D_{F.}$ – functional obsolescence

$D_{E.}$ – external (economic) obsolescence.

As one of calculation methods for calculating physical depreciation, one can apply an effective age method according to the formula:

$$D_{P.} = \frac{EfA}{PEL} K_m, \qquad (3)$$

Where $D_{P.}$ is physical depreciation,

EfA – effective age of an object – chronological age of a real estate object, corrected in accordance with its operative conditions;

PEL – the period of the economic life of an object

K_m – the coefficient of real estate type.

When calculating the cadastral value, a coefficient of real estate type characterizes the limiting state of a real estate object, in which its further operation without overhaul is prohibited, and is taken for residential real estate objects equal to 0.7 and for other real estate objects - 0.6 [20].

4 Discussion of the results

In order to test the possibility of using methodological tools for calculating the cadastral value, taking into account the corrected effective age of a capital construction object within the framework of a cost approach, approbation was carried out on the example of the city of Tomsk. The objects of observation are buildings in respect of which reconstruction has been carried out. The data of the Federal Service for State Registration, Cadastre and Cartography, the Department of Architecture and Urban Planning of the Tomsk City Administration, the Tomsk Regional Center for Inventory and Cadastre, presented on official websites, served as a source base for the study.

The authorities of the city of Tomsk issued 4904 building permissions (in 2008-2020) and 2047 commissioning certificates (in 2007-2020). In respect to reconstruction, they issued 152 building permissions and 132 commissioning certificates.

Buildings located on the territory of the city of Tomsk are considered as a complete set, corresponding to a certain general totality and possessing a certain property - the presence of information about commissioning certificates and building permissions, namely, the presence of information about reconstruction within the framework of the issued permits. However, not all buildings in general totality are included in the sample, so the evaluation model of buildings is based on a subset of complete set of buildings possessing information about the most part of price-forming factors (type, purpose, address, number of floors, number of underground floors, year of completion or commissioning, the material of walls, area). In particular, inconsistencies were revealed in information concerning the characteristics of pricing factors of evaluation objects, which indicates the presence of an information disproportion and leads to discrepancy in indicator of the cadastral value. Regarding some objects, inconsistencies were identified in two or three parameters at the same time (for example, the number of floors, the year of completion, the year of commissioning, area, purpose, etc.). Having analyzed the data provided, the authors found that 132 objects had complete information about price-forming factors.

The cadastral value was calculated according to three methods:

I. Cadastral valuation was carried out according to a current methodology (within the framework of approved methodological guidelines) without application of such price-forming factor as a date of overhaul (reconstruction);

II. Cadastral valuation was carried out by means of methodological tools for calculating the cadastral value, taking into account physical depreciation, based on the corrected effective age of a capital construction object (within the framework of the proposed methodological tools);

III. Cadastral valuation was carried out according to a current methodology (within the framework of approved methodological guidelines) with application of such price-forming factor as a date of overhaul (reconstruction);

The comparative unit method was used to determine the cost of the replacement of assessed items. This method assumes that data on building cost of any unit of measurement can be used, for example, 1 cubic meter of building volume or 1 square meter of total area. The calculations were based on information taken from reference books on consolidated index of construction cost (produced by OOO KO-INVEST) for construction conditions in the Tomsk region.

The calculation of cadastral value based on a cost approach was carried out in the following sequence:

- cost calculation for replacement of valuation objects;
- definition of entrepreneur's profit;
- definition of depreciation and obsolescence;

- determination of the cadastral value of valuation objects by summing up the costs for their creation, entrepreneur's profit and subtracting their physical depreciation and obsolescence.

Table 2 shows a fragment of the results of the cadastral assessment within the framework of a current methodology (according to approved methodological guidelines) without applying such price-forming factor as a date of overhaul/reconstruction (I) and with applying of this price-forming factor (a date of overhaul/reconstruction) (III), as well as methodological tools for calculating the cadastral value taking into account physical depreciation based on the corrected effective age of a capital construction object (II)

Having analyzed the results obtained, the authors found that the indicator of the cadastral value calculated with application of a pricing factor "a date of overhaul/reconstruction" can be significantly overestimated in comparison with the indicator of the cadastral value calculated without taking into account this factor (Figure 2). There are negative indicators in discrepancies between results obtained within the framework of the proposed tools and the approved results of the cadastral valuation. It was found that a negative deviation is typical for objects having inconsistencies in information about the years of completion of construction or commissioning, including those containing data on reconstruction.
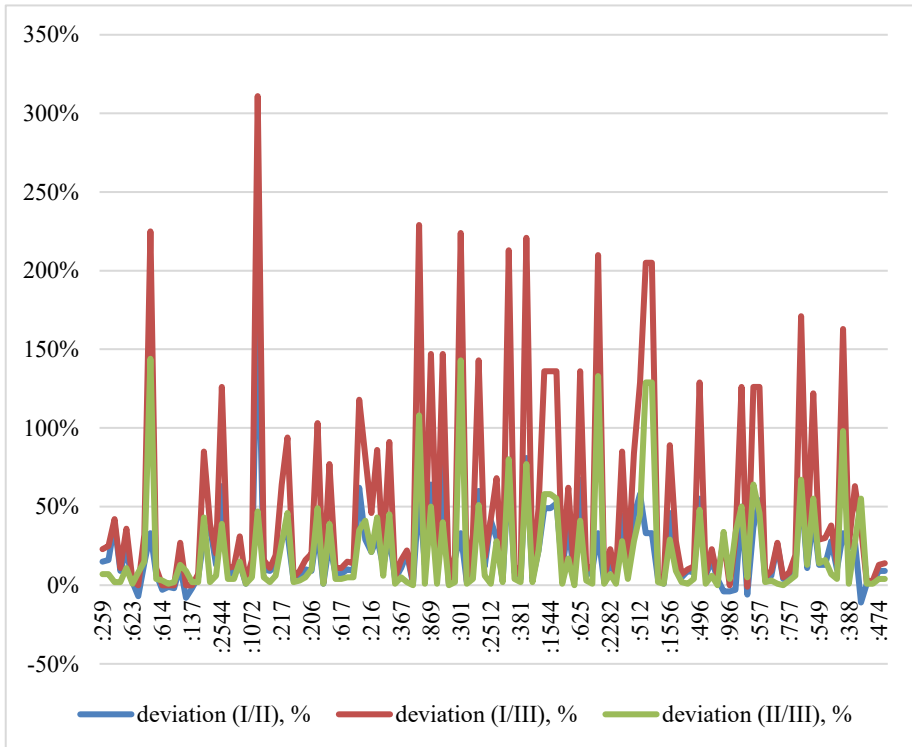

Fig. 2. The ratio of deviations between the results obtained for all objects in the sample. Source: compiled by the authors.

Table 2. Results of determining the cadastral value of appraisal objects and deviations between the results obtained (fragment).

Cadastral number of appraisal object	Area, sq.m	Year of construction / commissioning	Year of reconstruction	PD (I)	PD (II)	PD (III)	k	CV (I), rub.	CV (II), rub.	CV (III), rub.	Deviation (8/9), %	(8/10), %	(9/10), %
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
:259	7347.3	1972	2018	0.19	0.07	0.00	0.35	157 387 688,11	180 569 421,48	193 051 893,30	14.7	22.7	6.9
:1049	5878.1	1991	2016	0.11	0.05	0.01	0.35	129 847 254,78	139 351 839,88	144 469 693,39	7.3	11.3	3.7
:4810	1084.4	1904	2008	0.46	0.31	0.04	0.65	20 875 491,99	26 504 143,17	36 957 352,49	27.0	77.0	39.4
:4266	3699	1934	2015	0.34	0.19	0.02	0.55	104 691 757,63	127 819 118,63	156 085 893,19	22.1	49.1	22.1
:518	219.4	1962	2011	0.23	0.14	0.03	0.55	5 395 363,82	6 011 777,15	6 765 171,22	11.4	25.4	12.5
:440	136.5	2013	2017	0.04	0.02	0.01	0.26	3 554 793,92	3 631 678,40	3 658 691,87	2.2	2.9	0.7
:1052	56.7	1999	2011	0.15	0.08	0.06	0.18	1 621 202,19	1 761 960,68	1 792 858,89	8.7	10.6	1.8
:410	2000.2	1952	2008	0.59	0.33	0.10	0.48	33 439 409,17	54 032 427,79	73 041 368,06	61.6	118.4	35.2
:6402	28.9	2013	2019	0.05	0.01	0.00	0.18	751 211,39	780 237,25	786 608,78	3.9	4.7	0.8
:522	140.1	1973	2015	0.40	0.17	0.04	0.38	2 154 403,18	2 975 960,95	3 479 496,35	38.1	61.5	16.9
:162	2258.9	1955	2014	0.48	0.25	0.04	0.48	11 459 426,85	16 530 223,23	21 210 958,35	44.3	85.1	28.3

:57	:724	:391	:378	:582	:259	:667	:301	:869	:4803	:1176
22.4	30.2	20.1	44.4	20	73.6	49.2	40.4	36.7	82.9	11275
1972	1958	2007	1949	2009	2000	1946	1927	1959	2004	1985
2011	2016	2017	2012	2012	2012	2016	2017	2018	2019	2013
0.70	0.70	0.28	0.60	0.14	0.27	0.70	0.70	0.60	0.18	0.26
0.51	0.48	0.08	0.45	0.10	0.15	0.46	0.60	0.34	0.02	0.12
0.19	0.06	0.05	0.10	0.10	0.10	0.04	0.03	0.01	0.00	0.05
0.36	0.36	0.16	0.40	0.10	0.30	0.50	0.50	0.40	0.10	0.38
293,512.33	324,955.53	553,087.29	608,196.46	706,822.92	1 938 108,96	565,634.45	543,521.78	443,519.23	1 669 451,86	189 597 990,36
475,229.07	565,855.89	703,649.94	835,053.75	737,890.25	2 248 628,87	1 025 683,81	619,614.82	726,928.02	1 999 270,40	222 733 102,24
795,744.53	1 018 193,98	732,328.54	1 371 483,03	741,342.18	2 381 708,83	1 817 572,04	1 761 010,55	1 093 274,90	2 035 916,91	243 041 719,19
61.9	74.1	27.2	37.3	4.4	16.0	81.3	14.0	63.9	19.8	17.5
171.1	213.3	32.4	125.5	4.9	22.9	221.3	224.0	146.5	22.0	28.2
67.4	79.9	4.1	64.2	0.5	5.9	77.2	184.2	50.4	1.8	9.1

Source: compiled by the authors.

Thus, the application of corrected effective age makes it possible to reflect the content of difference between the year of construction, the year of reconstruction or overhaul as a whole when calculating physical depreciation. Moreover, the application of corrected effective age is justified from an economic point of view, since the use of a pricing factor "a date of overhaul/reconstruction" significantly overestimates the results of evaluation.

5 Conclusion

Approbation of the methodological tools proposed by the authors for calculating the cadastral value, taking into account physical depreciation on the base of corrected effective age within the framework of a cost approach, performed on real data of real estate objects,

in respect of which reconstruction was carried out, allows us to conclude that its application is viable and expedient. Calculation models of physical depreciation of a building based on corrected effective age are more flexible due to the fact that partial compensation of physical depreciation is taken into account during the renovation. This circumstance indicates the possibility of using the tools and to identificate regularities between the assessment of a degree of physical depreciation and an approximate cost of restoration work when calculating the effective age. Thus, the use of the effective age in calculating the cadastral value is considered by the authors as one of the factors for the sustainable economic development of the region.

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