ANALYSIS OF THE INFLUENCE OF SPECIFIC FACTORS ON REAL ESTATE PRICES IN THE REPUBLIC OF SRPSKA

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ABSTRACT

The work deals with the analysis of the real estate market and the specificities of the formation of real estate prices in the Republic of Srpska. The specificity is reflected, among other things, in the definition of the market value of real estate if the prices are known from the sales contracts entered in the Real Estate Price Register (formed on the basis of supply and demand for apartments), the formation of value zones (location factor), the value tables (relational tables and value levels), the additional factors of influence (factor of the position of the apartment in the building) and equations for estimating the value of the real estate. The analysis was done using the CAMA algorithm. The research results show that real estate prices from the Real Estate Price Register and real estate prices calculated according to the CAMA algorithm are 70% accurate, i.e. they are within the permitted deviation interval of +,- 10 %, which means that the CAMA algorithm can also be used for real estates that have not been registered in the Real Estate Price Register yet.

1. INTRODUCTION

The real estate market is an important area of activity in the market-oriented economies. The same rules apply to the real estate markets as to other markets (goods, services, capital). Greater disruptions in demand or greater offer of real estate automatically lead to a drop in prices and vice versa. Problems and crisis situations are promptly reflected on the real estate market; crises have the greatest impact on real estate prices. The fiscal moment is also important, because national and local fiscal revenues depend on turnover on the real estate market. The market value of immovable property can be considered as one of the four characteristics of immovable property which the basic paradigm of the geodetic-cadastral information system and real estate cadaster are based on (Miladinović, 2013, p.10), in addition to the location of the immovable property (plot number

and its location), rights (and the holders of rights) on the immovable property and method of use. The most important indicator of the stability of the real estate market is real estate prices. Real estate prices are largely influenced by the well-being of the nation and the individual, the demand for real estate, the offer of real estates, as well as the tax policy. Because of all this, it is extremely important to stabilize real estate prices and reach their real values. In general, there are certain (common) factors that affect real estate prices. These factors can be viewed as the offer of real estates, the demand for real estates, and external effects on the real estate market.

Real estate offer. The owner of real estate (apartment, house, business premises, etc.) will sell real estate to the buyer who offers the highest price for the given real estate. In addition to the price of real estate, as a key factor in the offer, there are a large number of factors that lead to changes in the offer. Let us state some of them (Begović, 1995, p. 40): prices of production factors (wage prices, construction costs), changes in technology (application of new technologies), as well as motives of producers (maximization of profits, state and private enterprises). The offer of real estate is specific because real estate is a special resource that differs from goods and services. One of the important differences is that real estate is a heterogeneous resource in terms of quality and quantity, and especially according to purpose. So, for example, the characteristics of the location of each real estate are different.

Demand for real estate. In addition to the price of real estate, as the most important factor affecting the demand for real estate, we can also define the following factors:

1. The growth of economic well-being affects the growth of production capacities and business premises, and accelerates the development of urban and industrial infrastructure. These tendencies increase the demand for real estate.
2. Population growth affects the demand for all types of real estate.
3. Traffic accessibility affects the demand for all types of real estate.
4. Favorable tax policy stimulates the growth of demand for real estate. Lowering tax rates on various forms of property increases demand for real estate, while increasing taxes discourages purchases and reduces demand for real estate.
5. Improving the financial situation of buyers (which stems from economic well-being, but also an organized and liquid financial sector for financing the purchase of real estate) affects the growth of demand for real estate. Therefore, the choice of more and better ways of financing will increase the demand for real estate.

6. Restructuring of the economy affects the change in demand for real estate. During the restructuring process, industrial production may increase or decrease. In this sense, the macro examples of shutting down the coal industry in Great Britain, the industrial development of large regions in China, but also local examples of the transformation of industrial cities of Central European countries into urbanized tourist centers, the development of rural and urban areas and cities, as well as hundreds of micro cases of the transformation of traditional industrial areas into urbanized land (or vice versa, turning free spaces into industrial zones and complexes) are characteristic.
7. The activities of institutional investors greatly influence the demand for real estate in which national or global economic tendencies are significant. Thus for an example, the economic instability "forces" investors to invest in real estate to protect their capital. Global economic instability and external shocks can disrupt the demand for real estate with various consequences. In periods of global crises, the prices of representative real estate may rise, while the prices of cheaper real estate may fall due to a lack of demand from some target groups. The conclusion is that global economic trends or economic instability have a strong impact on the real estate market.

All these, as well as other factors determine the demand for real estate.

External effects on the real estate market. The real estate market operates in an environment that is influenced by numerous and powerful external effects. Both positive and negative external effects are particularly intense in urban areas. Negative external effects such as air pollution, car noise or traffic congestion have become symbols of big cities, but they have a positive effect on real estate prices in those areas. Namely, the real estate in the city center, which is exposed to those negative external effects, is more expensive than the real estate on the outskirts of the city. The existence of external factors conditions the creation and expansion of cities. In the course of that a special group of external factors is especially important - agglomeration effects (Begović, 1995).

The larger the city is, that is, the greater the spatial concentration of population and activities is, the agglomeration effects are more intense. Positive agglomeration effects in consumption are reflected in the fact that a change in the size of a city leads to a change in convenience in consumption (specialized health services, education services, culture services, sports services, etc. are found in large cities and they have the highest quality of these services). The presence of these institutions (services) significantly affects the real estate market.

These market relations inherent in the relations in the markets of all other goods and services represent the foundation for the formation of the real estate market in every national economy. In that context, the study of supply and demand for real estate is extremely important for the formation of an organized market for these goods, both in Bosnia and Herzegovina and in the Republic of Srpska. In this paper, we also deal with the specificities of the formation of real estate prices in the Republic of Srpska in addition to these factors, i.e. relationships.

2. LITERATURE REVIEW

Recently, the question of the influence of factors on the real estate prices has attracted a lot of researchers and economic policy makers' attention and interest in the world. Let us state some authors and studies that dealt with the issue of the influence of factors on real estate prices.

Advanced information and communication technologies, such as statistical modeling and searching large amounts of data (data mining) are extremely important for determining the impact of factors on real estate prices. Thus, the authors (Ersoz, Ersoz & Soydan, 2018) using data mining techniques (CHAID and C&RT algorithms) believe that the size of the real estate, the distance from the city center, the popularity of the environment in which the property is located and the year of construction have the biggest influence on the price of real estate.

Ćetković et al. (2018) dealt with the prediction of the real estate prices. The authors tried to obtain accurate output data showing price predictions on the real estate markets of the observed EU member states. Through an artificial neural network, they see the possibility for precision of input data and determining the dependence of prices on variable inputs. Such forecasts can be used for the purpose of accounting, sales, but also for the feasibility of construction facilities in order to predict the sales price. Therefore, the goal of this research is to build a forecast model of real estate market values in the EU countries, depending on the influence of macroeconomic indicators.

All factors that determine the price of real estate can be divided into two groups (Hill, 2011). The first group consists of internal or physical characteristics such as: area, number of rooms, number of bathrooms and similar characteristics. The second group consists of locational characteristics, such as: the distance of the property from the city center, the distance from some nearby facilities (main road, shopping center, park, stadium, hall, etc.), as well as belonging of the real estate to a certain part of the city.

Analyzing the factors that influence the real estate prices McDonald & McMillen (2007) came to the conclusion that we can single out nine factors

that most determine real estate prices, and they are: the real estate area, the land area, the year of construction of real estate, the number of rooms, the number of bathrooms, as well as whether the property has a garage, swimming pool, fireplace and air conditioning.

From all of the above, we can conclude that there is no single set of factors that describe the impact and importance they have on real estate prices.

3. RESEARCH METHODOLOGY

In this research, 525 high-quality (processed) transactions (with no observed "outlayers") were selected from the Real Estate Price Register, for the period from the first quarter of 2018 to the third quarter of 2021, which represents about 4.5% of the Housing Fund. Each transaction from the Real Estate Price Register has assigned coordinates based on which it can be visually represented in GIS tools. The analysis was done by using the CAMA (Computer Assisted Mass Appraisal) algorithm. CAMA is a computer algorithm for mass and individual calculation of the real estate values. Mass appraisal or mass appraisal by a computer (eng. Computer Asissted Mass Appraisal-CAMA) are terms that are commonly used to assess the value of the real estate for the purpose of defining property tax.

The real estate price formation process starts in the Real Estate Price Register and ends with quality control and model calibration and it is an iterative process. The process of forming the real estate price can be shown in several steps (they do not have to be conditioned in the specified order):

1. Downloading the market data, the real estate market analysis and selection of quality transactions (Real Estate Price Register),
2. Time adjustment of transaction prices,
3. Downloading the real estate data (cadastral records) and data analysis,
4. Determining the ambition of the model (defining the value levels)
5. Creating value zones and assigning value levels to each zone,
6. Creating relational tables,
7. Creating value tables,
8. Determining (modeling) the influence of other factors,
9. Quality control (zone, level, uniformity of assessment) - model calibration (first iteration)
10. Second, third ..nth iteration (repetition of the previous procedure).

The CAMA algorithm for apartments is used to calculate the price of apartments in a building that is fully used for housing and has more than two apartments, a multi-purpose apartments in a building, service apartments or special purpose

apartments, accommodation and other similar units used for housing. The model is based on the market comparison method. The model consists of layers of value zones and value levels, value tables, points, point classes and factors (renovation factor, etc.), properties of the parts of the buildings, the location of the apartment in the building, the total area of additional rooms of the apartment (such as terrace, loggia and/or balcony) as well as a distance from the economic infrastructure facilities. The values in the table of value levels are expressed for the reference unit for valuation (value assessment). The structure of the real estate price formation model is based on: value zones (location parameter), value tables (value levels and relational tables), additional factors of influence or quality (floor, elevator, distance from significant infrastructure facilities, etc.) and equations for estimating the value of real estate. The model should contain those data (attributes, characteristics) that are in the cadastre or real estate register and in transactions (Real Estate Price Register). It is desirable that the Real Estate Price Register has more real estate characteristics than the model and as many as there are in the cadastre. At the same time, care should be taken to match the types and values of the surfaces according to the records.

Analysis of the specific factors that influence the real estate prices (location, area of the apartment, year of construction, number of floors of the apartment and having an elevator).

Each real estate is geo-located. Residential and residential-business buildings with the associated special parts are represented with the coordinates of the entrance of the buildings. The entrance coordinates are determined based on the street and house number coordinates from the Address Register. The real estate address is an integral part of the real estate data. The most influential factors, which are, in addition to the location, the area of the apartment, the year the building was built, the floor where the apartment is and the presence of an elevator, are determined by the correlation analysis (Table 1).

Table 1: Results of the correlation analysis for the most influential factors

Correlation	AREA	PRICE	YEAR OF CONSTRUCTION	FLOOR	ELEVATOR
AREA	1	- 0.30	- 0.03	0.08	- 0.06
PRICE	- 0.30	1	0.53	- 0.18	0.21
YEAR OF CONSTRUCTION	- 0.03	0.53	1	- 0.08	0.32
FLOOR	0.08	- 0.18	- 0.08	1	0.34
ELEVATOR	- 0.06	0.21	0.32	0.34	1

Source: author's compilation

The mentioned factors were used in the model for the formation of the real estate price. Other factors (variables, corrective factors) can also be modeled and used: the distance from the important infrastructure facilities, the total number of the apartments in the building, renovation, building quality, etc. The impact of the location on the real estate value can vary, from 40% in rural areas to 80% in urban areas. It is necessary to perform a time adjustment of the data.

Time adjustment of data

Time adjustment of data starts from defining the analytical areas. Analytical areas are spatial (geographical) zones created on the basis of a spatial (market) analysis of certain real estate and are most often common to real estate of similar purpose or use, such as apartments, houses and residential (construction) lands. Value zones are related to the model while analytical areas are related to the market. For separate transactions (525), time-comparative adjustment is made on the selected date (September 30, 2021). Through time adjustment, the prices of market transactions are adjusted to the date of September 30, 2021 in relation to the area and the date of the transaction. The time-adjusted (C_{VP}) price is obtained by multiplying the price index (I) and the transaction price (C).

The price index is determined from a linear regression depending on the surface class. Four surface classes were created (Table 2) and each transaction was assigned a surface class label.

Table 2: Surface classes

Surface class label	Surface[m^2]	Number of transactions
P1	< 44	131
P2	45 - 60	180
P3	61 - 75	118
P4	> 75	95

Source: author's compilation

Creation of the value zones

A zone is a geographical area where the subject (similar) real estates have approximately the same market value. It represents a location parameter in the model. When modelling in the phase of time adjustment of transactions, it always starts with preliminary zones that are created based on the knowledge of the market, the fund and the geographical boundaries. When determining zones, the certain principles should be followed: the knowledge of the market and the height of the average value of the apartments, the location (distance from the centre), the similarity of the structure of the fund of the buildings and

geographical (physical) boundaries. It will not be possible to fully comply with all the principles due to the state of the market and the fund of the buildings (e.g. residential buildings of recent construction in a neighbourhood which is dominated by the buildings of older construction, etc.). In order to comply with all the principles, a more reliable market is needed[1], the exclusion of certain transactions that "spoil" neighbouring transactions, several smaller micro-zones and other.

Creation of the value tables (value levels and relational tables)

First, the value levels and relational tables are defined. The basic unit for forming the real estate price is the reference real estate (norm property, norm object). Reference immovable property is the most common immovable property of certain characteristics in the cadastral records or on the market (most often they match). For example, for the apartments, the basic characteristics are the area and the year of construction, while for the houses, the basic characteristics are the area of the building and the area and degree of development of the accompanying land. In our example, the reference apartment is a 57 m^2 apartment, built in the period of 1970-1980. Based on the prices of the reference apartment, the difference between the highest and lowest price, the number of value levels and thus the smallest number of zones is determined. Each zone has its own value level. The level for each zone reflects the value of the reference apartment in that zone. The lowest price of the reference apartment is 75. 000 BAM while the highest is 130,000 BAM (the difference is 55,000 BAM). A total of seven (7) value levels were determined. In the lower value levels, the prices of apartments are lower, while in the higher value levels, the prices of apartments are higher. Table 3 shows the value levels.

Table 3: Illustration of the value levels

Mark of value level	Price of the reference apartment [BAM]	Difference between levels [%]
1	75,000	
2	82,500	10.0
3	90,750	10.0
4	99,800	10.0
5	109,500	9.7
6	120,000	9.6
7	130,000	8.3

Source: author's compilation

1 Good perception of the market by the buyer and seller, the prices in the contracts are as close as possible to the real (theoretical) prices in relation to the location and characteristics of the apartment.

The relational table (RT) defines the influence (relationship) of the area and the year of construction on the price (C) or value (V) of the real estate. Influence theory, market data and influence functions based on sales analysis and influence theory are used to create the relational table. Relational tables are determined for individual value levels. It represents a 2D matrix (table) defined by surface classes (rows) and time periods (columns). The ultimate goal is to determine the value tables (Basic RT) which are part of the model for the formation of the real estate price. Value tables can be reached in four steps: determination of relational tables by value levels; normalization of relational tables by value levels; aggregation of normalized relational tables of all value levels into one relational table (Basic RT) and normalization of relational table coefficients, for the purposes of creating value tables. Each transaction is assigned a surface class label and a construction period label which it belongs to. Six more detailed surface classes (labeled[2] 1-6) and nine (9) construction periods (labeled 10-19) were used. The first step is to determine the number of transactions (N), average price (AVG_PRICE [KM]) and average apartment area (AVG_SIZE [m^2]) by defined surface classes and construction periods. Table 4 illustrates the relational table for the first value level.

Table 4: Illustration of the relational table for the first value level / VN = 1, V = 75 000 BAM

		COLUMNS =>		10	11	12	13	14	15	16	17	18	19	
	ROWS	Surface classes / Period of construction 1944		- 1954	1945 1964	1955 1974	1965 1984	1975 1994	1985 2004	1995 2009	2005 2014	2010 -	2015 control:	
N	1	0	29	0	0	0	0	0	0	0	0	0	0	0
AVG(PRICE)				0	0	0	0	0	0	0	0	0	0	
AVG(SIZE)				0	0	0	0	0	0	0	0	0	0	
N	2	30	49	0	0	1	0	5	1	1	0	0	0	8
AVG(PRICE)				0	0	52734	0	74438	82342	58214	0	0	0	
AVG(SIZE)				0	0	39	0	45	45	46	0	0	0	
N	3	50	74	0	0	0	0	7	1	0	0	0	0	8
AVG(PRICE)				0	0	0	0	114418	122299	0	0	0	0	
AVG(SIZE)				0	0	0	0	65	67	0	0	0	0	
N	4	75	99	0	0	0	0	1	0	1	0	0	0	2
AVG(PRICE)				0	0	0	0	135363	0	170831	0	0	0	
AVG(SIZE)				0	0	0	0	78	0	92	0	0	0	
N	5	100	129	0	0	0	0	0	0	0	0	0	0	0
AVG(PRICE)				0	0	0	0	0	0	0	0	0	0	
AVG(SIZE)				0	0	0	0	0	0	0	0	0	0	
N	6	130	-	0	0	0	0	0	0	0	0	0	0	0
AVG(PRICE)				0	0	0	0	0	0	0	0	0	0	
AVG(SIZE)				0	0	0	0	0	0	0	0	0	0	
													control:	18

Source: author's compilation

2 Arbitrary marks, surface classes and periods of construction.

The second step is the normalization of the value table. Normalization of the value table implies that the average price in the relational table is divided by the value of the value level. For example (picture above) the average price of 74,438 BAM for five (5) transactions in the surface class from 30 m^2 to 49 m^2 and the construction period from 1975-1984 is divided by 75,000 BAM and the normalized value of the table field of 0.99 is obtained (Table 5).

Table 5: Illustration of the normalized relation table for the first value level

Normalization of the value table for VN1

		COLUMNS =>		10	11	12	13	14	15	16	17	18	19
		Surface classes /		-	1945	1955	1965	1975	1985	1995	2005	2010	2015
	ROWS	Period of construction		1944	1954	1964	1974	1984	1994	2004	2009	2014	-
F_RT_1	1	0	29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F_RT_1	2	30	49	0.00	0.00	0.70	0.00	0.99	1.10	0.78	0.00	0.00	0.00
F_RT_1	3	50	74	0.00	0.00	0.00	0.00	1.53	1.63	0.00	0.00	0.00	0.00
F_RT_1	4	75	99	0.00	0.00	0.00	0.00	1.80	0.00	2.28	0.00	0.00	0.00
F_RT_1	5	100	129	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F_RT_1	6	130	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author's compilation

After determining the relational table, the value table by levels is determined. The coefficients of the relational table are normalized for the reference apartment (e.g. if the coefficient in the cell is different from 1). In view of that, the model is based on the reference apartment whose coefficient is emphasized, the normalization of the coefficients is performed in a way that all coefficients are divided by the value of the coefficient for the reference apartment (0.9) and the table (Table 6) of the normalized coefficients for the influence of area and the year of construction is obtained based on the price of real estate.

Table 6: Table of the normalized coefficients

Base of surface class [m^2]/ construction period	30	50	75	100	130
before 1944	0.50	0.91	1.45	2.02	2.74
1945-1954	0.57	0.96	1.45	1.96	2.57
1955-1964	0.70	1.06	1.47	1.85	2.29
1965-1974	0.64	1.00	1.42	1.81	2.27
1975-1984	0.71	1.10	1.54	1.97	2.45
1985-1994	0.63	1.09	1.67	2.27	2.99
1995-2004	0.70	1.11	1.61	2.09	2.66
2005-2009	0.77	1.20	1.71	2.19	2.75
2010-2014	0.68	1.20	1.87	2.57	3.43
after 2015	0.78	1.20	1.70	2.17	2.72

Source: Author's compilation

The values in the value table are calculated by multiplying the normalized coefficients from the previous table with the value of the reference apartment in the value level by the surface classes and construction periods. The reference apartment is placed in the surface class of 50m^2 - 74m^2 and was built in the construction period of 1965-1974 and for the first value level (75,000 BAM) is multiplied by a coefficient of 1.0.

Table 7: Value table with bases

Surface [m^2] from	to	Construction period	- 1944	1945 1954	1955 1964	1965 1974	1975 1984	1985 1994	1995 2004	2005 2009	2010 2014	2015 -
-	29	basis	0	0	0	0	0	0	0	0	0	0
		additional m^2										
30	49	basis	37624	42394	52526	48363	53620	47485	52510	57777	51003	58308
		additional m^2										
50	74	basis	67950	71806	79333	75000	82382	81572	83572	90029	89638	90178
		additional m^2										
75	99	basis	108634	109098	110051	106244	115844	125331	120851	128022	140242	127471
		additional m^2										
100	129	basis	151546	146793	138817	136024	147540	169978	157002	164350	192663	162952
		additional m^2										
130	-	basis	205305	192419	171561	170405	183951	224430	199324	206398	257383	203855
		additional m^2										

Source: Author's compilation

For example, for a base of 30m^2 in the first value level for a building built after 2015, a coefficient of 0.78 is used (Table 6) and it is multiplied by the value of the reference apartment of 75,000 BAM. In this way, the base value of 58,308 BAM is obtained (previous table). How is the value of 35m^2 apartment determined? It is determined by determining the value of an additional square meter in the observed surface class. The value multiplied by the coefficient from the relational table for additional square meters is linearized so that there is no "breakthrough" of prices between surface classes. The value of the additional square meter is determined by dividing the difference in the base values of two adjacent surface classes by the difference in the base surfaces of the adjacent classes. For an example, if the additional square meter is calculated for the previous example, the value of the base of 30m^2 is subtracted from the value of the base of 50m^2 (90,178 BAM - 58,308 BAM = 31,870 BAM), and then it is divided by the difference in the area of the base (50m^2 - 30m^2 = 20m^2). A value of 1,593 BAM is

obtained for an additional square meter in the second surface class for the period after 2015. Other values for an additional square meter are shown in Table 7.

Table 8: Value table with bases and additional square meters

Surface [m²]		Construction period	-	1945	1955	1965	1975	1985	1995	2005	2010	2015
from	to		1944	1954	1964	1974	1984	1994	2004	2009	2014	-
-	29	basis	0	0	0	0	0	0	0	0	0	0
		additional m²	1254	1413	1751	1612	1787	1583	1750	1926	1700	1944
30	49	basis	37624	42394	52526	48363	53620	47485	52510	57777	51003	58308
		additional m²	1516	1471	1340	1332	1438	1704	1553	1613	1932	1593
50	74	basis	67950	71806	79333	75000	82382	81572	83572	90029	89638	90178
		additional m²	1627	1492	1229	1250	1338	1750	1491	1520	2024	1492
75	99	basis	108634	109098	110051	106244	115844	125331	120851	128022	140242	127471
		additional m²	1716	1508	1151	1191	1268	1786	1446	1453	2097	1419
100	129	basis	151546	146793	138817	136024	147540	169978	157002	164350	192663	162952
		additional m²	1792	1521	1091	1146	1214	1815	1411	1402	2157	1363
130	-	basis	205305	192419	171561	170405	183951	224430	199324	206398	257383	203855
		additional m²	1964	1557	860	984	1014	1892	1294	1220	2306	1162

Source: Author's compilation

Modeling the influence of other factors

Additional factors have a corrective effect on the real estate price and are multiplied (or added) to the estimated transaction price, in such a way that the factor with the greatest impact is multiplied (or added) first, followed by other factors of less impact. Additional influential parameters used in the formation of the real estate price are the floor of the apartment and the existence of an elevator in the building. The mentioned parameters are integrated into one factor - the factor of the location of the apartment in the building, and they can be used separately as well. Also, some other factors can be added (e.g. the total number of the apartments in the building, the orientation of the apartment, a renovated staircase in older buildings, the existence of a parking lot/basement in the building, and similar). The value of the factor of the location of the apartment in the building is determined based on the score table by classes (Table 8 and Table 9), based on the defined criteria (score). These values are determined empirically.

Table 9: Scoreboard of criteria

Description	Scores
Not in the basement and has an elevator	
The apartment is located on the ground floor, on the first, second or third floor and has an elevator	10
The apartment is located on the 4th and higher floors and is not in the attic and has an elevator	8
The apartment is located in the attic and has an elevator	7
Lower floors and without an elevator	
The apartment is located on the ground floor up to the fourth floor, there is no elevator and there is no information about an elevator	9
Higher floors and without an elevator	
The apartment is located on the 4th and higher floors, not in the attic and there is no elevator	6
The apartment is in the attic and there is no elevator	4
Basement apartment or in the basement	
The aparment is in the cellar or basement	2

Source: author's compilation

Table 10: Determination of factors

Class	Scores		Factors value
	from	to	
1	0	3	0.9
2	4	7	0.95
3	8	10	1

Source: author's compilation

From the above table, it can be seen that for the apartments from the ground floor to the attic (excluding the attic) in a building with an elevator and apartments located up to the fourth floor (excluding the attic) in a building without an elevator or without information about an elevator, the factor 1 is assigned and does not affect to the previously determined estimated price (value) of the apartment from the value table. For the apartments located in the cellar or basement, the lowest factor (0.9) is assigned, which reduces the estimated price (value) of the apartment from the value table by 10%. For the other apartments of other characteristics, a factor of 0.95 is assigned. Regarding the mentioned, factors are determined empirically, in accordance with knowledge about the impact on the price of the apartment, other divisions (classes and scores) are also possible. For an example, a higher factor than 1 can be used for the first group of apartments, for example 1.05 (an additional 5% on the estimated price of the apartment).

Based on the value table (the influence of location, surface and the year of construction) and the factors of the location of the apartment (floor and the existence of an elevator), the market price of the apartment is calculated using the equation:

$$V_P = V_T \cdot F_{\text{of the location of the apartment in the building}}$$

where:

V – is the market price of the apartment,

V_T – is the price (value) of the apartment from the value table and

F – is the influence factor of the position of the apartment in the building.

Using the previous formula, we can calculate the market price of all analyzed apartments (Table 10).

The results of the research show that real estate prices from the Real Estate Price Register maintained by RUGIPP (column: Price from contract) and real estate prices calculated according to the CAMA algorithm are 70% accurate, i.e. they are within the permitted deviation interval of +,- 10%, which means that the CAMA algorithm can also be used for real estates that have not been registered in the Real Estate Price Register yet.

4. CONCLUSIONS

Offer and demand for real estate largely depends on real estate prices. These market relations inherent in the relations in the markets of all other goods and services represent the foundation for the formation of the real estate market in every national economy. In that context, the study of offer and demand for real estate is extremely important for the formation of the organized market of these goods, both in Bosnia and Herzegovina and in the Republic of Srpska.

The specificity of the real estate price formation is reflected in the definition of the market value of real estate if prices are known from sales contracts entered in the Real Estate Price Register (formed on the basis of supply and demand for apartments), the formation of value zones (location factor), the value tables (relational tables and value levels), the additional factors of influence (factor of the location of the apartment in the building) and the equation for estimating the value of real estate.

Table 11: The process of forming real estate prices using the CAMA algorithm

Date of contract	Quarter of the year	Useful area [m^2]	Price from contract [KM]	Year of construction	Floors from SPR	Floor number from SPR	Elevator ([Yes/ No])	Average price from contract [KM/m^2]	Time adjusted price by CAMA method) C_{VP} [KM]	Assessed price [KM]	k' (C_{vp}/C_{pr})	Assessed price C_{PR}, V_{PR} [KM]	k'' (C_{vp}/C_{pr})	e (C_{vp}/C_{pr}-1)	k_i-Me_k	ABS (k_i-Me_k)
1/24/2018	Q01	35	85750	2018	П6	П5	Yes	2450	100300	114878	0.87	114878	0.87	0.15	0.0279	0.0279
1/31/2018	Q01	44	76500	1972	12	П7	Yes	1739	89481	81081	1.10	81081	1.10	-0.10	0.0796	0.0796
2/8/2018	Q01	38	60000	1976	П10	ПР	Yes	1579	70181	78801	0.89	78801	0.89	0.12	-0.0101	0.0101
2/13/2018	Q01	41	75600	1973	П4	П1	No	1844	88428	83850	1.05	83850	1.05	-0.05	0.1538	0.1538
2/28/2018	Q01	33	65000	1980	П4	П1	No	1970	76029	77091	0.99	77091	0.99	0.01	0.0855	0.0855
3/8/2018	Q01	26	66000	2013	П3	П1	No	2538	77199	70723	1.09	70723	1.09	-0.09	0.2820	0.2820
3/13/2018	Q01	34	75000	1982	П4	П3	No	2206	87726	86683	1.01	86683	1.01	-0.01	0.1113	0.1113
3/23/2018	Q01	41	64000	1981	П4	П3	No	1561	74860	76383	0.98	76383	0.98	0.02	-0.0439	0.0439
3/28/2018	Q01	26	62500	2015	П7	П5	Yes	2404	73105	87592	0.83	87592	0.83	0.20	-0.0106	0.0106
4/12/2018	Q02	44	98000	2007	П5	П3	Yes	2227	113255	139280	0.81	139280	0.81	0.23	-0.0321	0.0321
4/18/2018	Q02	35	73000	1960	П3	П2	No	2086	84363	86472	0.98	86472	0.98	0.02	0.1660	0.1660
4/18/2018	Q02	25	42500	2007	П6	ПК	Yes	1700	49116	64068	0.77	60865	0.81	0.24	-0.1166	0.1166
4/19/2018	Q02	41	60000	1972	П8	ПР	Yes	1463	69340	76246	0.91	76246	0.91	0.10	-0.1145	0.1145
4/19/2018	Q02	44	55243.35	1980	П5	ПР	Yes	1256	63843	98141	0.65	98141	0.65	0.54	-0.2502	0.2502
5/25/2018	Q02	41	94627	2007	П6	П2	Yes	2325	110163	120825	0.91	120825	0.91	0.10	0.1022	0.1022
5/31/2018	Q02	31	80000	2005	П5	П4	Yes	2581	92453	95023	0.97	95023	0.97	0.03	0.1634	0.1634
6/14/2018	Q02	42	80000	1970	П8	ПР	Yes	1905	92453	85622	1.08	85622	1.08	-0.08	0.1790	0.1790
6/19/2018	Q02	40	84000	1974	П10	П2	Yes	2100	97076	82078	1.18	82078	1.18	-0.18	0.2591	0.2591
6/26/2018	Q02	40	60000	1970	П4	П2	No	1500	69340	82078	0.84	82078	0.84	0.18	-0.0559	0.0559
7/17/2018	Q03	36	62600	1970	П4	П3	No	1739	71479	74989	0.95	74989	0.95	0.05	0.0524	0.0524
7/20/2018	Q03	40	97500	2012	П4	ПН	Yes	2438	111328	121888	0.91	115794	0.96	0.04	0.1162	0.1162
7/30/2018	Q03	28	36400	1969	П2	П1	No	1300	41563	72222	0.58	72222	0.58	0.74	-0.2341	0.2341
7/30/2018	Q03	39	63564.47	1975	П6	П2	Yes	1630	72580	80541	0.90	80541	0.90	0.11	-0.1228	0.1228
8/1/2018	Q03	15	29900	1961	П3	П1	No	1993	34141	42021	0.81	42021	0.81	0.23	0.0029	0.0029

Source: author's compilation

Bosnia and Herzegovina and Republika Srpska are making efforts to modernize the situation on the real estate market, but due to the influence of historical, developmental, political and other factors, the process has slowed down.

The academic community should not only use this model of the real estate price formation, but also continue to develop it, i.e. adapt its to specific cases (problems). This was exactly the case with our research. The software was adapted to this particular research.

Conflict of interests

The author declares there is no conflict of interest.

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АНАЛИЗА УТИЦАЈА СПЕЦИФИЧНИХ ФАКТОРА НА ЦИЈЕНЕ НЕПОКРЕТНОСТИ У РЕПУБЛИЦИ СРПСКОЈ

1 Драган Станковић, Републичка управа за геодетске и имовинско правне послове Републике Српске, Бања Лука, Босна и Херцеговина

САЖЕТАК

Рад се бави анализом тржишта непокретности и специфичностима формирања цијена непокретности у Републици Српској. Специфичност се, између осталог, огледа у дефинисању тржишне вриједности непокретности ако су познате цијене из купопродајних уговора који се уписују у Регистар цијена непокретности (формиране на основу понуде и тражње за становима), формирању вриједносних зона (локацијски фактор), вриједносних табела (релационе табеле и вриједносни нивои), додатним факторима утицаја (фактор положаја стана у згради) и једначине за процјену вриједности непокретности. Анализа је урађена коришћењем ЦАМА алгоритма. Резултати истраживања показују да су цијене непокретности из Регистра цијена непокретности и цијене непокретности израчунате према ЦАМА алгоритму у 70% тачне, тј. налазе се у дозвољеном интервалу одступања од +,- 10%, што значи да се ЦАМА алгоритам може користити и за непокретности које још нису евидентиране у Регистру цијена непокретности.

Кључне ријечи: *цијене непокретности, вриједносни нивои и табеле, релациона табела, ЦАМА алгоритам.*