Econometric models for the estimation of the commercial value of residential real estate objects in Latvia

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***Abstract*— Real estate market formation in Latvia occurs in the conditions of practical absence of a single system of methodological approaches to real estate estimation adapted for the Latvian conditions. In the article it is proved that along with individual estimation it is possible to use methods of mass appraisal of the commercial value of the real estate, constructed on the basis of econometric models. Application of such models will allow us to receive rather precise, authentic estimation of the commercial value of residential real estate in the conditions of dynamics of the Latvian market of real estate.**

Keywords—residential real estate objects, econometric model, multiplicative regression model, cluster model

I. Introduction

The recent financial crisis in its subsequent phase affecting the real economy, it contributed to a significant deterioration in the economic situation around the world. During a financial crisis, the wealth effect is usually quite substantial due to a simultaneous decrease in real estate prices, rapid drop of stock markets and the consequent depreciation of the value of mutual funds. Furthermore, the rise in unemployment, which occurs in the next stage, reduces the purchasing power of the population due to a decrease in total income. Shrinking consumer demand is further deteriorating the condition of the economy, and growing recessionary tendencies cause an increase in public debt.

Local housing markets were also influenced by global economic and market conditions, as well as by policy decisions that were taken at the national level. The wide range of social, economic, political, cultural and institutional factors worldwide before, during and after the recent financial crisis influence the commercial value of residential real estate. Housing market is one of the most complex real estate segments, without simply quantifiable economic factors that lead to changes in the market, psychological factor also plays very important role.

The purpose of the given article is to work out a methodological approach to the estimation of the commercial value of residential real estate on the basis of econometric models and Data Mining algorithms.

The comparative approach is applied by the authors as the base approach to the estimation of real estate. The basic advantage of the comparative approach is an actual reflection of supply and demand for the estimated objects since the price of the actual deal considers the situation in the market to the most integral extent. Having enough of trustworthy information about recent deals of purchase and sale, use of the comparative approach in estimation practice, a method of comparison of sales in particular, gives the most objective volume of the commercial value of the objects sold.

Considering dwelling as an object of an economic assessment implies research of such circle of problems as: economic bases of an appraisal of residential real estate studied in the works [1]; existing approaches and methods of individual and mass appraisal of residential real estate [5]; [3] their comparison for the purpose of exposure of the most acceptable ones for the use in Latvia; econometric pricing models [5]; [10]; [1]; [5]; [7]; [9]; [11].

The correlation and regression analysis and methods of discrete space-parametric analysis have been used for the construction of econometric models [12]; [13]; [14]; [15]; [16]; [17]; [18]. A two-phase cluster analysis and solution trees have been used for the classification of the objects.

The information support has been provided by the official data of the State Land Service and the company Arco Real Estate. The statistic processing and analysis of the data have been implemented with the use of the application package IBM SPSS Statistics 19.

In the article it is proved that along with individual estimation it is possible to use methods of mass appraisal of the commercial value of the real estate, constructed on the basis of econometric models. Application of such models will allow us to receive rather precise, authentic estimation of the commercial value of residential real estate in the conditions of dynamics of the Latvian market of real estate.

II. The Methodology and Model

Modernization of the classical algorithm of the comparative approach for mass appraisal of real estate developed in following directions:

- modelling of the market by methods of multidimensional correlation and regression analysis;
- development of methods of the discrete space-parametric analysis;
- estimation of the market of real estate on the basis of means of the intellectual analysis of data (two-phase cluster analysis, solution trees).

Since all directions have their advantages and can be implemented through the collected database, the present research deals with the construction and analysis of some models of different type for the purpose of choosing the best option for further use in various applied situations.

A. Multidimensional regression models

Correlation method is considered to be one of the basic methods of mass appraisal.

The correlation and regression analysis can be determined as a set of mathematical procedures intended for measurement of closeness, direction and analytical expression of the form of relations between dependent and factor features. The closeness of relations is quantitatively expressed by plural coefficient of correlation, quality of model by determination coefficient. The work presents both additive, and multiplicative models for determination of the commercial value of real estate which have their own specificity.

When constructing multidimensional regression models there might be a problem in considering polytypic price-making factors. Characteristics (features) of the real estate objects, being price-making factors of the regression model, can be of various nature. A part of them are quantitative characteristics (area of the object), others - discrete (number of rooms, the floor), another part have qualitative character (type of a building, features of the layout of an apartment, etc.). A case of the combination of polytypic features has the greatest applied value.

Methods of the regression analysis are methods of processing the quantitative (numerical) values. Features of non-numerical nature for considering them in regression models are led to quasi quantitative type by digitization procedure, i.e. by assigning some numerical labels to their values. Binary features can be digitized arbitrarily, however in linear regression models for vizualization reasons their gradation is more often assigned values 0 and 1. The nominal feature having more of two gradations, can be described by the system of binary variables.

In the considered cases fictitious variables are introduced in the regression model, which allows us to consider such qualitative features as Residential district, Technical condition, Type of the building.

B. Methodology of the discrete space-parametric analysis (cluster analysis)

Along with the method of correlation and regression analysis for mass appraisal it is possible to use methodology of cluster analysis. The basic idea of this methodology is that the model of mass appraisal is created by sectioning (grouping, stratification) the initial set of data on the prices of objects of real estate according to price-making factors, mainly correlating with the prices of objects and calculation of the coefficients of the model by comparing average values of the initial and truncated sets. The work presents constructed cluster models based on the method of parallel sections and successive sections.

Method of sections is a method of constructing models of mass appraisal of real estate objects, based on the methodology of the cluster analysis. It implies splitting the estimated set of objects into groups having common features, finding a single group cost within each group and calculating the coefficients of the model through the comparison of group costs. Parallel sectioning is splitting the initial sample into a number of homogeneous groups of objects according to the individual group features.

If it is necessary to cluster the data that have both quantitative (e.g., Value of the deal, Total space) and categorial (e.g., Type of the building, Residential district, Technical condition) variables, and the volume of the data is large enough, the method of two-phase cluster analysis - scalable procedure of the cluster analysis, is used, which enables working with data of various types. At the first stage of work of an algorithm the observations are preliminary clustered in a considerable quantity of sub-clusters. At the second stage the sub-clusters received are grouped in the required amount of clusters. If the required amount of clusters is not known, the procedure automatically determines it. The cluster analysis helps to segment various groups of objects of residential real estate, being based on price-making factors.

III. THE FINDINGS

A. The additive model of the regression model of the estimation of real estate in Daugavpils and Riga

The formula for calculation of the commercial value of an apartment is deduced as the equation of plural linear regression where Sum of the deal acts as a dependent variable and the factors able to influence the apartment cost act as independent variables.

As an algorithm of an exception of independent variables the Stepwize method has been applied. It is a step-by-step method that initially includes all independent variables into the equation of regression, and then serially deletes all variables whose correlation with criterion has a significance value above the set threshold value. The basic idea of this method is the change of a share of influence of an independent variable on a criterion at occurrence of other independent variables in the equation. If the influence of any of the included variables becomes too weak, it is excluded from the equation.

The following formula has been received as a result:

$$\textit{Value of the deal (f1)} = \textit{Area} * B + B1 + B2 + B3 + C \qquad (1)$$

In the model received $z1$=1 if Residential district=Centre, and $z1$=0, if an apartment is located in another city district.

z2=1 if Technical condition = perfect or Technical condition = good. *z3*=1if Type of the building = Prewar and Stalinist, *z3*=0 if Type of the building <> Prewar and Stalinist.

Positive coefficients at independent variables indicate that they increase value of a dependent variable. However, the ratio of coefficients does not allow making a conclusion about influence of this or that factor on a dependent variable. To solve this problem the standardized coefficients of linear regression (β), reflecting private correlations of dependent and independent variables are used.

TABLE I. REGRESSION COEFFICIENTS

Unstandardized coefficients	Daugavpils	Riga
B	238	817
B1 (Residential district=Centre)	3329	9764
B2 (Technical condition = perfect) B2 (Technical condition = good)	2859 924	10580 5571
B3 (Type of the building = Prewar and Stalinist)	1236	9735
C	-4178	-21966

Private correlation is understood as the influence made on a dependent variable by one independent variable at fixed values of other independent variables (taking into account influence of the latter). The more the given independent variable correlates with other independent variables, the less absolute value of its coefficient β is.

TABLE II. STANDARDIZED COEFFICIENTS OF REGRESSION

Standardized coefficients	Daugavpils	Riga
β	0.659	0.604
β1 (Residential district=Centre)	0.325	0.219
β2 (Technical condition = perfect) β2 (Technical condition = good)	0.137 0.094	0.230 0.138
β3 (Type of the building = Prewar and Stalinist)	0.114	0.215
R R2	0.879 0.773	0.834 0.695

Having analyzed the received equation of regression it is possible to draw a conclusion that the commercial value of an apartment is determined by its area. Such factors as Micro-district (if it is the centre), Technical condition (if it perfect or good), and Type of the building (if it is Prewar or Stalinist type apartment) significantly increase value of an apartment. The impact of the Micro-district is more considerable on the cost of apartments in Daugavpils, and that of Technical condition and Type of the building is stronger in Riga.

The coefficient of multiple correlation *R* is a measure of connection of the whole set of independent variables and a dependent variable. Value R^2 (determination coefficient) is equal to a share of a dispersion of a dependent variable caused by the impact of independent variables. Thus, 77,3 % (in Daugavpils) and 69,5 % (in Riga) dispersions of a variable Sum of the deal are determined by cumulative influence of variables *Total area of rooms*, *Micro-district, Technical condition*, *Type of the building*.

There is a direct significant strong connection between *Sum of the deal* and *Sum of the deal (f1) (Spearman's Correlation Coefficient, r=0.887).* The least precise received formula allows us to forecast the cost of one-room apartments in Riga (*Paired Samples Test, p <0.05*). It can be explained by the fact that the cost of this particular type of apartments does not depend on its area.

B. The multiplicative model based on the method of regression analysis

The model represents the product of characteristics and their scales. Hence, characteristics can compensate each other, which enables using parameters connected with each other. The model is more accurate than the additive one.

$$\text{Value of the deal (f2)} = Area^{B} * B1 * B2 * B3 * C \quad (2)$$

TABLE III. COEFFICIENTS

Unstandardized coefficients	Daugavpils	Riga
B	1.15	1.3
B1 (Residential district=Centre)	1.44	1.3
B2 (Technical condition = perfect) B2 (Technical condition = good)	1.36 1.16	1.42 1.21
B3 (Type of the building = Prewar and Stalinist)	1.08	1.23
C	78.78	125.26

Coefficient of determination of the constructed model for R^2Daugavpils is 0,84, for Riga - 0,75. In practice a value greater than 0,7 is an acceptable value of this coefficient.

C. Multidimensional multiplicative regression model based on the cadastral value

Both in Daugavpils and Riga the cadastral value of apartments and their commercial value differ significantly. The commercial value can exceed the cadastral value in 2-4 times.

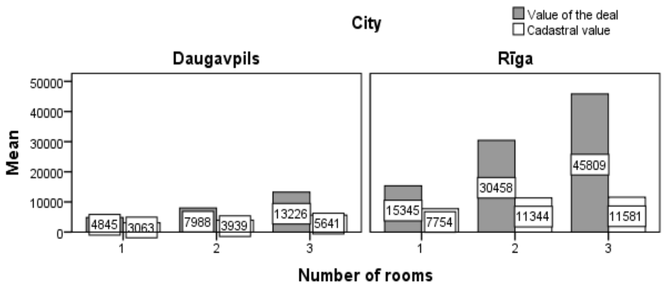

Fig. 1. Comparison of the average commercial and cadastral value of apartments in Daugavpils and Riga

The least difference can be observed in case of one-room apartments, the greatest one – in three-room apartments. The amount of rooms significantly influences the size of the difference between the cadastral and commercial value (ANOVA, p<0,001).

The project type of the building has a significant impact on both the cadastral and commercial values of apartments. The apartments in the 103rd-series and Lithuanian design have the highest cadastral value, while apartments in Prewar and Stalinist type buildings have the highest commercial value.

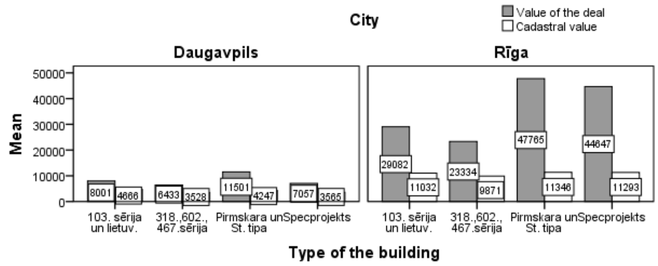

Fig. 2. Comparison of the average commercial and cadastral value of apartments of various types in Daugavpils and Riga

The project type makes a great impact on the correlation between the cadastral and commercial values of apartments, too. Commercial value of apartments in Prewar and Stalinist type buildings in Daugavpils differ from the commercial value in 2.8 times, in Riga – in 4.67 times.

There is also the effect of mutual influence of the Number of rooms and Project Type of the building on the correlation between the commercial and cadastral values of apartments. The biggest difference both in Riga and Daugavpils is observed for three-room apartments of Prewar and Stalinist type.

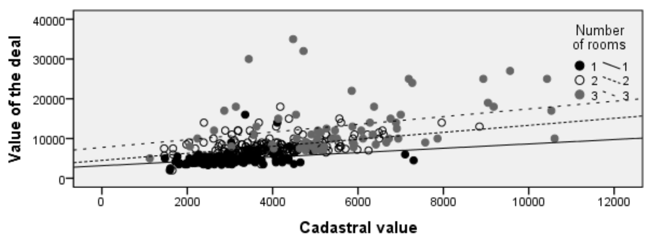

Fig. 3. Correlation of the commercial and cadastral values of the apartments with different number of rooms in Daugavpils

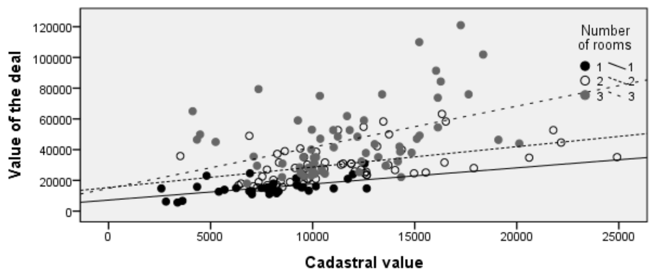

Fig. 4. Correlation of the commercial and cadastral values of the apartments with different number of rooms in Riga

There is a close to the linear direct moderate significant correlation observed between The Sum of the Deal and Cadastral Value. In Daugavpils this correlation is closer (*Pearson Correlation, r=0,569*) than in Riga (*Pearson Correlation, r=0,495*).

Commercial value (f5)= Cadastral value ^B1 Number of rooms^B2*B3*C*(3)

TABLE IV. COEFFICIENTS

Unstandardized coefficients	**Daugavpils**	**Riga**
B1	0,365	0,338
B2	0,350	0,412
B3 (Technical condition = good)	1.19	1.19
B3 (Technical condition = perfect)	1.56	1.36
C	175,39	374,65
B1	0,365	0,338

The coefficient of determination of the constructed model R^2 *for Daugavpils* is 0,64, for Riga – 0,65.

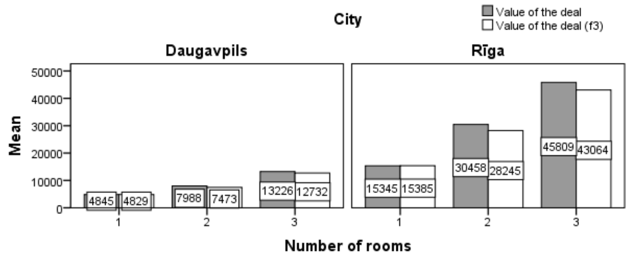

Fig. 5. Commercial value of apartments in Daugavpils and Riga and its forecast on the basis of econometric model based on the cadastral value

The analysis has shown that the application of econometric models of mass appraisal enables having rather precise, trustworthy estimation of the commercial value of the residential real estate in the conditions of dynamics of the Latvian real estate market.

D. The cluster model based on the method of parallel sections

Models of the estimation of the commercial value of residential real estate objects, based on the cluster analysis, are implemented within the limits of the expression (equation (4)):

$$Value\ (mm) = V*K1*K2*K3 \quad (4)$$

Here *V* – the basic rate of the cost (cost of a square meter of the total area of the basic estimated object); *K1* - location coefficient; *K2* - coefficient of technical condition; *K3* - coefficient of type of the building.

The average price of a square meter of the total area of an apartment (for all objects of an experimental sample) is accepted as the basic rate of the cost *V*. Value of the coefficient of location of the target zone *K1* is calculated as the ratio of average price of a square meter of the total area of all sampled objects in this zone to the average price of a square meter in the whole experimental sample. Central districts of the cities are selected as one of target zones, while all other districts are united into the second zone. For calculating values of the coefficient Technical condition *K2* the average values of prices for the objects in different technical condition are calculated at first, and then their ratio to the average price of all considered real estate objects is found. Calculation of values of the coefficient Type of the building *K3* should be preceded by calculation of the average price of a square meter of apartments of type *Prewar and Stalinist,* having separated them from all other types that form the second target group. The ratio of average prices in the target groups will give a value of the coefficients that are being calculated.

TABLE V. COEFFICIENTS OF THE CLUSTER MODEL

Coefficients	Daugavpils	Riga
V	173	595
K1 (Residential district=Centre) K1 (Residential district≠Centre)	1,37 0,87	1,37 0,85
K2 (Technical condition = perfect) K2 (Technical condition = good) K2 (Technical condition = satisfactory)	1,24 1,14 0,92	1,31 0,95 0,74
K3 (Type of the building = Prewar and Stalinist) K3 (Type of the building ≠Prewar and Stalinist)	1,33 0,91	1,32 0,88

The commercial value of an apartment corresponding to the cluster model can be calculated by the equation (5):

Commercial value (f5) = Value (mm) Total area of the rooms* (5)

E. The cluster model based on the method of successive sections

The model of the estimation of real estate based on the method of successive sections can be implemented through equation (4):

$$Value\ (mm) = V*K1*K2*K3 \quad (6)$$

The average cost of a square meter of the total area of the objects of real estate in the whole experimental sample is taken as a base rate of the value V: *V=173,43 LVL (Daugavpils), V=638,50 LVL (Riga).*

Value of the location coefficient *K1* depends on the price zone. In the method of successive sections, as well as in the method of parallel sections, value of the location coefficient (a price zone) is calculated as the correlation of an average price of sq. meter of the total area of objects of real estate in the given price zone and average cost of the square meter of the total area of the objects of real estate in the whole experimental sample. The central districts of the cities are considered to be one of target zones, while all other districts are united in the second zone.

TABLE VI. LOCATION COEFFICIENTS

Coefficients	Daugavpils	Riga
K1 (Micro-district = centre) K1 (Micro-district ≠centre)	1,37 0,87	1,37 0,85
K1 (Micro-district = centre) K1 (Micro-district ≠centre)	1,37 0,87	1,37 0,85

The coefficients of technical condition are calculated separately for each zone of location.

Average values of the specific prices of real estate objects having different technical condition are divided by average values of the prices of all real estate objects found in the corresponding zones.

TABLE VII. COEFFICIENTS OF TECHNICAL CONDITION

Micro-district	Coefficients	Daugav-pils	Riga
Micro-district = centre	K2 (Technical condition= perfect)	1,11	1,04
	K2 (Technical condition = good)	1,06	1,04
	K2 (Technical condition = satisfactory)	0,95	0,60
Micro-district ≠centre	K2 (Technical condition = perfect)	1,35	1,27
	K2 (Technical condition = good)	1,15	1,00
	K2 (Technical condition = satisfactory)	0,92	0,85

The coefficients of the type of the building are calculated separately for different location zones and technical condition of the apartments in these zones.

The commercial value of an apartment corresponding to the analysed model can be found through the equation (7):

Commercial value (f7) = Value (mm) Total area of rooms* (7)

TABLE VIII. COEFFICIENTS OF THE TYPE OF THE BUILDING

Micro-district	Technical condition	Coefficients	Daugavpils	Riga
Centre	perfect	K3 (Type of the building = Prewar and Stalinist) K3 (Type of the building ≠ Prewar and Stalinist)	1,59 0,70	1,17 0,78
	good	K3 (Type of the building = Prewar and Stalinis) K3 (Type of the building ≠ Prewar and Stalinist)	1,03 0,92	0,99 1,02
	satisfactory	K3 (Type of the building = Prewar and Stalinist) K3 (Type of the building ≠ Prewar and Stalinist)	1,06 0,87	0,83 1,17
≠Centre	perfect	K3 (Type of the building = Prewar and Stalinist) K3 (Type of the building ≠ Prewar and Stalinist)	1.00 1.00	1,55 1,27
	good	K3 (Type of the building = Prewar and Stalinist) K3 (Type of the building ≠ Prewar and Stalinist)	1,03 0,98	1,36 0,95

Micro-district	Technical condition	Coefficients	Daugavpils	Riga
	satisfactory	K3 (Type of the building = Prewar and Stalinist) K3 (Type of the building ≠ Prewar and Stalinist)	0,94 1,00	1, 01 1,00

F. The analysis of quality of the constructed econometric models

The estimation of quality of the constructed models is carried out on the basis of the data about the difference between Sum of the deal and forecasted Commercial value by means of determination coefficient.

The determination coefficient is one of the generalized measures of quality of a model of estimation. It shows what share of the change of commercial prices is explained by the factors included in the model of estimation.

TABLE IX. DETERMINATION COEFFICIENTS

Model's characteristics	City	R^2
(f1) Additive regression model on the basis of Total area of rooms	Daugavpils Riga	0,77 0,70
(f2) Multiplicative regression model on the basis of Total area of rooms	Daugavpils Riga	0,84 0,75
(f3) Multiplicative regression model on the basis of Cadastral value	Daugavpils Riga	0,64 0,65
(f5) Model of cluster analysis based on the method of parallel sections	Daugavpils Riga	0,73 0,64
(f7) Model of cluster analysis based on the method of successive sections	Daugavpils Riga	0,59 0,78

The comparative analysis of constructed econometric models shows that the most accurate of the presented is the multiplicative model. This model gives significant differences from the observable commercial value only for two-room apartments in Daugavpils (Paired Samples Test, p <0,05).). The observable cost is 7988 Ls, while the forecasted one is 7737 Ls. There is a significant direct correlative connection between the observable and forecasted cost of apartments in Daugavpils and Riga for all constructed models. The strongest connection occurs between observable marketable value and its estimation received on the basis of the multiplicative model.

TABLE X. COEFFICIENTS OF CORRELATION BETWEEN OBSERVABLE AND FORECASTED COMMERCIAL VALUE OF APARTMENTS IN DAUGAVPILS AND RIGA

	Value of the deal	
	Daugavpils	***Riga***
Value of the deal (f1)	0,909	0,821
Value of the deal (f2)	0,917	0,847
Value of the deal (f4)	0,687	0,691

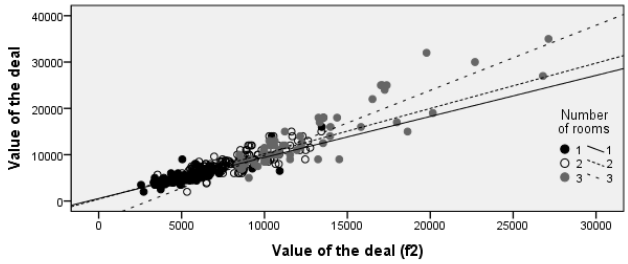

Fig. 6. Correlation between the observable cost and estimation of apartments according to the multiplicative model in Daugavpils

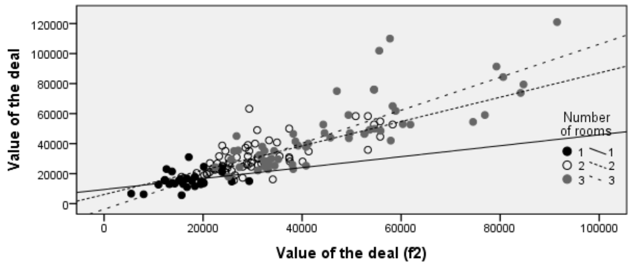

Fig. 7. Correlation between the observable cost and estimation of apartments according to the multiplicative model in Riga

G. Optimal combination of the forecasts of various models

The constructed models of estimation of commercial value of apartments in Daugavpils and Riga do not settle an arsenal of other possible or already available models of mass appraisal of residential real estate. Naturally there might be a question of the possibility to use simultaneously several models in order to increase the accuracy of estimation. In other words, is an optimum combination of forecasts of various models possible? The present work gives an affirmative answer to this question and presents the algorithm of an optimum combination of results of various models.

Let us express an optimum value Commercial value (T) through Commercial value (f1), Commercial value (f2), Commercial value (f5). These three models provide the best forecasted results. T=f(f1,f2,f5)

The task is to calculate the combination f1, f2, f5 so that Commercial value (T) comes closer to Sum of the deal than each of separate estimations. The optimum combination has been found on the basis of the procedure of the generalized method of the least squares of Ejtkena. The result is as follows:

$$T\ (Daugavpils) = -0{,}55*f1+1{,}70*f2+0{,}03*f5-980{,}49 \quad (8)$$

$$T\ (Riga) = -0{,}07*f1+1{,}23*f2-0{,}13*f5-1407{,}54 \quad (9)$$

Determination coefficient of the received combined model is 0,85 for Daugavpils and 0,75 for Riga. Thus, the forecasted cost of apartments from one-room to three-room both in Daugavpils and in Riga presents no significant difference from the observable (Paired Samples Test, p> 0,05). The main drawback of each of separate models is that despite general quite good indicators there is a category of apartments the predicted cost of which significantly differs from the observed cost. So, for example, the multiplicative regression model yields unsatisfactory result for two-room apartments in Daugavpils. The combined model allows us to improve these disadvantages.

Thus, the optimum combination of the results of calculations on three models allows improving accuracy of forecasting the commercial value of objects of real estate.

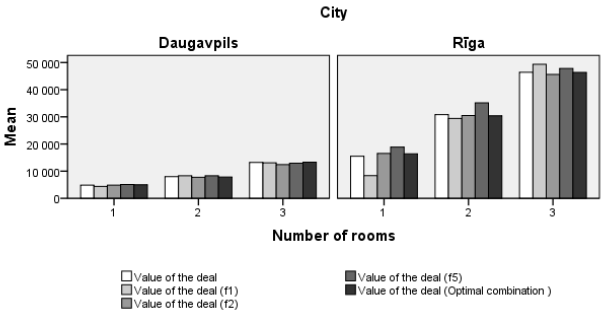

Fig. 8. Observed sum of the deal and forecasted commercial value of apartments in Daugavpils and Riga

H. Classification of apartments in Daugavpils and Riga depending on their price and price-making characteristics

Two-phase cluster analysis in space of such price-making features as Number of rooms, Total area of rooms, Sum of the deal, Technical condition, Micro-ditrict, Type of the building has allowed us to divide the real estate market of Daugavpils and Riga into homogeneous clusters. The clusters consist of the objects similar both in price and price-making features. The greatest volume (44 %) in Daugavpils is made up of the cluster of apartments of the average price category the price of which varies in a range from 3500 Ls to 18000 Ls concerning the average cost of 7913 Ls. 50 % of apartments of this group have been sold at the price ranging from 7500 Ls to 8700 Ls. 72 % of the cluster are made up of two-room apartments with the average area of 50 m2. These apartments are not located in the city centre and are not apartments of Prewar or Stalinist type. In Daugavpils 30 % of apartments can be called cheap. They have been sold at the price ranging from 2000 Ls to 9000 Ls, the average Sum of the deal made 4594 Ls. These are one-room apartments with the average area of 31.5 m2 in satisfactory condition; only 7% of these apartments are located in the centre. The apartments with the average cost of 12035 Ls constitute about 26 % in Daugavpils. These are mainly apartments of Prewar and Stalinist type buildings located in the city centre.

In the market of real estate of Riga four clusters can be divided. The cluster of apartments with the average cost of 27511 Ls and the average area of 57m2 is the greatest in size (39 %). These are two-room and three-room apartments in good condition, located outside the city centre. The cluster of apartments with the average cost of 15490 Ls is the smallest in size in Riga (18 %). These are one-room apartments with the average area of 36 m2, in good technical condition and located outside the centre. The most expensive apartments, with the average cost of 60033 Ls, are three-room apartments, 53 % of which are in the excellent technical condition. 59 % of such apartments are located in the city centre, 59 % are apartments of Prewar and Stalinist type buildings. The category of apartments with the average cost of 33793 constitutes 23 %. These are one-room and two-room apartments with the average area of 49. 69 % of such apartments are located in the city centre, 57 % are made up of the apartments in Prewar and Stalinist type buildings.

The cluster analysis makes it possible to classify the objects of real estate characterized by both categorical and quantitative indicators.

IV. CONCLUSIONS

The estimation of the commercial value of real estate objects as a process consists of studying the estimated object and the market of the estimated object, creation of economic-mathematical model of this market and estimation of the objects of real estate included into this market.

Using the price-making factors the econometric models of two types have been created:

- classifying - allow classifying the objects of real estate into homogeneous clusters (cluster analysis and solution trees);
- forecasting – allow forecasting value of the object of real estate (multidimensional regression models, methodology of discrete space-parametric analysis (cluster analysis)).

At the decision of tasks of mass appraisal of objects of residential real estate within the limits of the comparative approach the application of regression models is perspective development of the estimation practice. However, at creating the models of estimation of value it is necessary to search for the compromise between the complexity of estimation and accuracy of the result. As the calculations presented above show, the accurate indicators of three considered models are comparable with each other. The most universal and exact one is the multiplicative regression model. However, for its construction it is necessary to have certain computer software and some knowledge of mathematical statistics.

As an alternative of the regression analysis at the creation of models of estimation of value the approach of cluster analysis can be used − a method of sections (groupings). From the theoretical point of view the method of sections is “rougher" than a method of the regression analysis, but it is characterized by simplicity and low labour input. The additional coefficients, representing factors that influence the value of objects of real estate, such as number of rooms in apartment, its layout, the floor etc. can be added to the work in order to provide statistical reliability of the formula received.

The optimum combination of the results of calculations on various models allows us to improve the accuracy of forecasting the commercial value of real estate objects. Models provided an opportunity to more accurately approximate the amount of the transaction to the market price.

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