

Comparison of Housing Construction Development in Selected Regions of Central Europe

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Abstract. In fast-growing countries, the economic growth, which came after the global financial crisis, ought to be manifested in the development of housing policy. The development of the region is directly related to the increase of the quality of living of its inhabitants. Housing construction and its relation with the availability of housing is a key issue for population overall. Comparison of its development in selected regions is important for experts in the field of construction, mayors of the regions, the state, but especially for the inhabitants themselves. The aim of the article is to compare the number of new dwellings with building permits and completed dwellings with final building approval between selected regions by using a mathematical statistics method – "Analysis of variance". The article also uses the tools of descriptive statistics such as a point graph, a graph of deviations from the average, basic statistical characteristics of mean and variability. Qualitative factors influencing the construction of flats as well as the causes of quantitative differences in the number of started apartments under construction and completed apartments in selected regions of Central Europe are the subjects of the article's conclusions.

1. Development of housing construction in selected countries

The end of the first decade of the 21st century was struck by the global economic crisis that has hit the lives of hundreds of millions of people not only in Central Europe but also in other parts of the world [1, 2, 3, 4]. The inhabitants of the countries began to experience uncertainty and economic instability, which manifested itself in insecurity of supporting basic human needs, in particular in the field of employment and housing [5, 6, 7]. Increasing mortgage rates and rising house prices stopped several developer projects in the building sector regarding apartments designed for different social strata of the population. This trend persists in the Central European countries to this day because people still have a problem with obtaining their own living in houses or dwelling units [8].

Housing is one of the basic human needs, which should be satisfied at the level corresponding to the overall level of socio-economic development of society [9]. The availability of housing and its quality are one of the major factors on which the society can assess the living standards of the population [10]. The number of residents living on loan (on debt) increases directly in proportion to



the growth of housing construction. The availability of housing is thus directly proportional to the individual's economic capabilities [11, 12].

The participating components that enter into the development of housing construction:

- citizen,
- the private sector and the non-government sector,
- the competence of municipalities and higher territorial units,
- state operations [13, 14].

Housing policy of the state deals with the relationships between subjects and processes related to the satisfaction of housing needs. Housing policy is also a combination of economic, social, juridical and technical aspects of housing, being directly dependent on the economic conditions of a given country. The basic criterion for the success of housing policy is to ensure long-term housing availability for all social groups of the population, as only some of them are able to pay the costs of new construction from their own resources at the current stage of the society's development [15].

2. Development of housing construction of selected regions of Central Europe in the observed period 2011 – 2014

A period of 2011-2014 was chosen as the representative period of monitoring the housing construction in individual regions lying on the border of Austria, Slovak Republic and Czech Republic. The observed period was selected in regard to the fact that the development in construction is very dynamic, rapidly changing over time and fairly dependent on the economic-demographic situation in the region. Also, obtaining relevant data from the national statistical databases of selected regions had to be consistent and appropriate for comparison. This factor was the most important in statistical surveys.

Selected regions were conceived based on the geographical location shown in the following Figure 1. The red line represents the border between the countries and some of the regions.



Figure 1. Geographical location of Central European regions

Regions that are geographically linked to each other were selected for comparisons in the field of building sector, more precisely in housing construction, specifically by the number of started and completed dwellings. Geographically, regions are in the "heart" the of Europe, as seen in figure 1. The territory of the regions is spread over 46 596 km². 50% of the mentioned territory consists of the regions of Austria (Lower Austria (La) and Burgenland (Bu)), 37% of the area is located in the territory of the Czech Republic (South Bohemian Region (SBR) and South Moravian Region (SMR))

and only 13% are regions of the Slovak Republic (Bratislava Region (Ba) and Trnava Region (TT)). 4.2 million people live in selected regions. 45% of the population of the regions has Austrian nationality, 43% has the Czech nationality and only 12% has Slovak Republic nationality.

The hypotheses that we have set when comparing selected regions of Central Europe are as follows:

- the demographic composition of the population and the size of the regions will have a significant impact on the number of dwellings with final building approval, as well as on the number of dwellings with building permits,
- the differences between the number of started and completed apartments per calendar year in individual regions will be negligible.

The main surveyed statistic value is the number of dwellings under construction (dwellings with a building permit – BP) and the number of completed dwellings (dwellings with final building approval – FBA) per calendar year in the territory of the selected region. The reference period data (2011 – 2014) are in the table 1. The data about the number of BP and FBA in the year 2015 are not yet available to the public in the territory of Austria.

Table 1. Housing construction in the selected regions of Central European countries [16], [17], [18].

Country		SR ^c		CZ ^d		A ^e		
Selected regions		Trnava Region (TT)	Bratislava Region (Ba)	South Moravian Region (SMR)	South Bohemian Region (SBR)	Lower Austria (La)	Burgenland (Bu)	
Observed period	2011	BP ^a	1 890	2 224	3 380	2 193	2 840	930
		FBA ^b	2 614	3 628	3 608	2 028	2 671	1 043
	2012	BP ^a	1 887	2 715	3 008	1 485	3 054	1 105
		FBA ^b	2 403	4 570	3 770	1 983	2 974	1 049
	2013	BP ^a	2 204	4 109	2 807	1 481	2 974	981
		FBA ^b	2 334	3 568	3 516	1 311	3 262	1 012
	2014	BP ^a	2 452	3 893	3 650	1 484	3 229	1 078
		FBA ^b	2 334	3 591	3 242	1 287	3 525	963

^a BP – building permit, ^b FBA – final building approval, ^c SR – Slovak Republic, ^d CZ – Czech Republic, ^e A – Austria.

The data needed to compare the selected regions are obtained from the statistical offices of the respective countries. Data from the regions of Lower Austria and Burgenland had to be cleared of the number of garages and non-residential premises so that the results of the statistical survey, that is, the comparison of the started and completed housing units, were relevant and reliable. The findings within the monitored period clearly show that in the Bratislava Region, the South Moravian Region and Lower Austria, the total number of completed dwellings is higher than in the group of regions - Trnava, South Bohemian Region and Burgenland. The total number of completed dwellings in all regions in the monitored period 2011 to 2014 is 62 286 dwelling units. Of the total, the highest amount of completed apartments was in the Bratislava Region – 25%. The lowest number of completed was in Burgenland – 7%.

Comparison of development of housing construction shows that regions whose geographic location is more westward have smaller annual differences between the amount of BP and FBA. These are Burgenland, Lower Austria and the South Bohemian Region. In Trnava, Bratislava and South Moravian Region there are bigger differences between annual amount of BP and FBA. This fact is confirmed by the following figure 2, which shows the average BP and FBA per year/region.

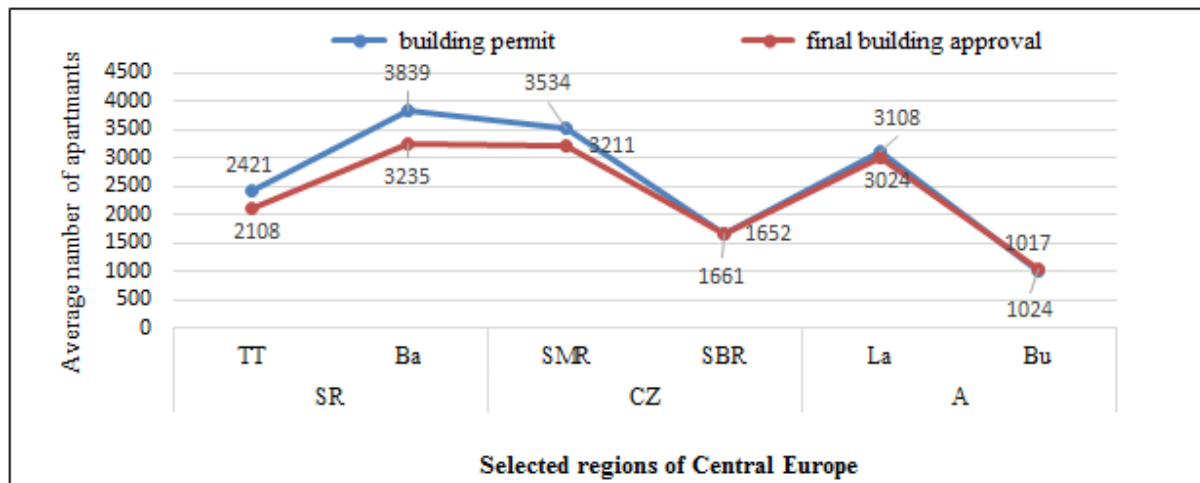


Figure 2. Average annual amount of BP and FBA of selected regions of Central Europe over the monitored period 2011-2014

Geographic location can play one of the major factors affecting housing construction in the region. The Bratislava and Trnava Regions are the most perspective regions, situated in the western part of the Slovak Republic. Also the capital of the Slovak Republic - Bratislava, lies in a good strategic location. It connects the major transport junctions of the Central European capitals - Prague, Vienna and Budapest. Bratislava Region benefits from this advantageous location, in the meaning of economic, transport and logistics aspects. It is becoming the centre of the IT industry and together with the Volkswagen Slovakia (11,000 employees), they create a good purchasing power of the population. Therefore, the development of the average number of completed apartments and apartments in construction is not surprising.

The Lower Austria Region lies in the shadow of the capital city of Vienna, and it does not have the any famous travel destinations, such as Salzburg, Tyrol, Upper Austria or Carinthia. Nevertheless, they sustain stability in the field of construction.

3. Comparison of housing construction development in selected regions of Central Europe using the mathematical statistics method – "Analysis of variance"

Using the methods of mathematical statistics and its tools, we examined whether the average (mean) amounts of flats with a building permit and a final building approval in selected regions of Central Europe are comparable. We used a quantitative method of "Analysis of variance". We determined the Analysis of variance by either a parametric or nonparametric test [19], [20]. It was used an intuitive software program for data analysis, data visualization, statistical modelling and predictive analysis STATGRAPHICS CENTURION XVII when applying the Analysis of variance method, due to the numerical difficulty of the individual test calculations [21].

The "Analysis of variance" method can be performed by a parametric F-test or a nonparametric Kriskal-Wallis test. To conduct a parametric test, BP and FBA data must meet two basic conditions:

1. homoskedasticity - the identity of the dispersion of apartments between the observation years,
2. test to verify the normality of groups of apartments according to its structure.

The results of p-values of tests must be higher than the chosen level of significance – 0.05. Before we come to the actual use of the "Analysis of variance" method, it is advisable to carry out a descriptive statistic of the obtained data on the number of started and completed dwellings in the regions. Before we come to the actual use of the "Analysis of variance" method, it is advisable to carry out a descriptive statistic of the obtained data – the number of started and completed dwellings in the

regions. The following table summarizes the basic statistical characteristics of the number of dwellings with approval decision and building permit (BSCH):

μ – the average number of apartments in the specific region in the period 2011 – 2014

σ – the standard deviation of apartments in the specific region in the period 2011 – 2014

Table 2. Basic statistical characteristics of housing construction

Type	BSCH ^f	Selected regions of Central Europe					
		SR ^c		CZ ^d		A ^e	
		Trnava Region (TT)	Bratislava Region (BA)	South Moravian Region (SMR)	South Bohemian Region (SBR)	Lower Austria (La)	Burgenland (Bu)
BP^a	μ	2108	3235	1660	3211	3024	1023
	σ	273	911	355	377	163	82
FBA^b	μ	2421	3839	3534	1652	3108	1016
	σ	133	488	221	405	368	39

^a BP – building permit, ^b FBA – final building approval, ^c SR – Slovak Republic, ^d CZ – Czech Republic, ^e A – Austria, ^f BSCH – basic statistical characteristics.

Table 2 shows that the region of Burgenland (Austria) has the lowest rate of the standard deviation of both started and completed dwellings. On the other hand, the highest rate of the standard deviation of started and completed apartments is the Bratislava Region (Slovak Republic). The rising rate of this statistical feature indicates that there is increased or decreased demand for new real estate in the specific region. It cannot be stated that the building industry in the region was stable. The point graph (figure 3) displays the number of apartments with building permit for a visual analysis of the data and characteristics stated in table 1, and table 2.

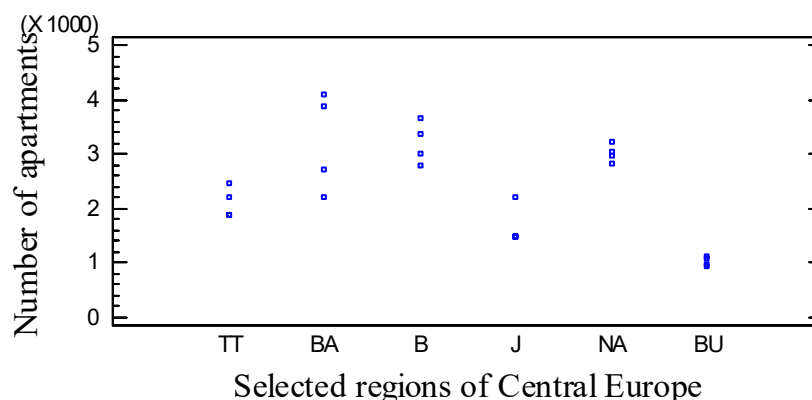


Figure 3. Point graph – comparison of the number of flats with building permit

Point graph shows that the housing construction is more stable and homogeneous in the Lower Austria (Na) and Burgenland (Bu) regions, than in the Bratislava Region (Ba) and the South Bohemian Region (B) in a calendar year. Another graph of descriptive statistics visually interprets the results of the deviations of the number of apartments with BFA from the average annual number of apartments in the selected region.

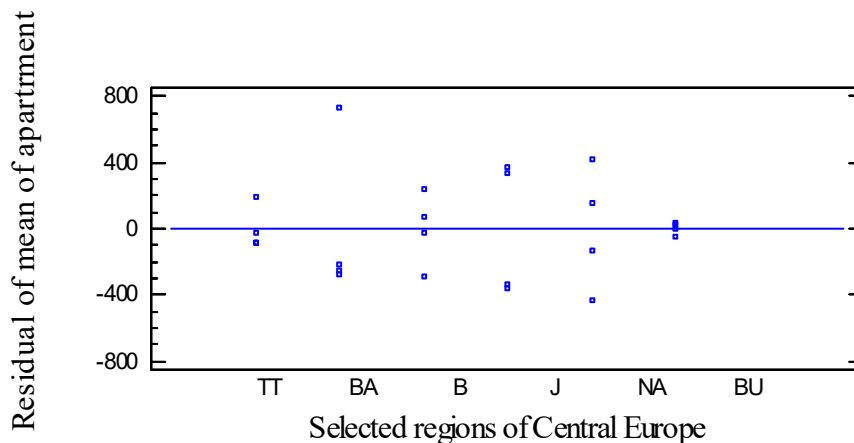


Figure 4. Comparison of deviations from the average number of dwellings with the final building approval decision

Selected regions of Central Europe are shown on the x axis. The y-axis shows the deviations of the number of apartments with BFA from the average annual number of apartments with BFA. It is interesting to note that in Lower Austria (Na) there is a proportional distribution of variations of the number of BFAs in both directions. In the South Moravian Region (J), the variations of the number of BFA for apartments are at ± 400 from the average.

3.1. Application of the method "Analysis of variance" of apartments with a final building approval

Comparison of the number of completed apartments per year between selected Central European regions using the quantitative method is covered in subchapter 3.1. In order to find out if it is possible to carry out the parametric test of the "Analysis of variance" method of the number of apartments with the final building approval decision, the following requirements were analyzed:

1. **Homoscedasticity** - the resulting p-value (Levene's test) to verify the homogeneity of individual annual apartments with BFA between regions was 0.285. The P-value is higher than the chosen significance level of 0.05. We consider the homoscedasticity condition to be fulfilled.
2. **The normality of the annual number** of flats with BFA in each region - in the Lower Austria Region (A) the p-value was lower than the chosen significance level of 0.05. We used the Kolmogorov-Smirnov test to verify the normality of data, given the low number of data obtained. The resulting test values for verifying the probability distribution in the regions are: p-value of the Trnava Region (SR) is 0.794; p-value of the Bratislava Region (SR) is 0.842; p-value of the South Bohemian Region (CZ) is 0.793; p-value of the South Moravian Region (CZ) is 0.415; p-value of the Lower Austria (A) is 0.043; p-value of the Burgenland (A) is 0.975. The condition of normality of the annual number of apartments with BFA in the region was not fulfilled.

The results indicate that the parametric F-test cannot be used, because of unfulfilled requirements. Therefore, we proceed to the nonparametric Kruskal-Wallis test, because its only condition for realization is the homoscedasticity which has been fulfilled.

Table 3 shows that the resulting p-value of the nonparametric Kruskal-Wallis test of the "Scattering Analysis" method of the number of completed apartments is 0.0007. The value is lower than the chosen significance level of 0.05. The result of this test was the confirmation of the hypothesis that there are statistically significant differences between variations in the number of flats with BFA between the Central European regions, with a 95.0% confidence.

Table 3. Analysis of variance of the number of apartments with the final building approval decision utilizing a non-parametric test

Kruskal-Wallis test	Selected regions of Central Europe					
	SR ^a		CZ ^b		A ^c	
	Trnava Region (TT)	Bratislava Region (BA)	South Moravian Region (SMR)	South Bohemian Region (SBR)	Lower Austria (La)	Burgenland (Bu)
Number of groups	4	4	4	4	4	4
Median of number of flats with BP	10.5	21.25	19.0	6.5	15.25	2.5
P-value	0.0007					

^aSR – Slovak Republic, ^bCZ – Czech Republic, ^cA – Austria.

3.2. Application of the method "Analysis of variance" of apartments with a building permit

The stability of the building construction activity also depends on the number of planned apartments with building permit per calendar year. For sustainable development in the building construction sector, it may also be necessary to monitor their development in relation to neighbouring regions. Comparison of the number of apartments under construction between the Central European regions is the subject of the following part.

To use the parametric test of the average number of flats with a building permit, the following conditions were met:

- 1. Homoscedasticity** – the resulting p-value (Cochrans test) to verify homogeneity of individual apartments with BFA between regions was 0.388. The P-value is higher than the chosen significance level of 0.05. We consider the homoscedasticity condition to be fulfilled.
- 2. Normality** of the annual number of apartments with BP in each region. To verify the normality of data, we used the Kolmogorov-Smirnov test, given the low number of data obtained. The resulting test values for verifying the probability distribution in the regions are: p-value of the Trnava Region (SR) is 0.251; p-value of the Bratislava Region (SR) is 0.654; p-value of the South Bohemian Region (CZ) is 0.146; p-value of the South Moravian Region (CZ) is 0.215; p-value of Lower Austria (A) is 0.102; p-value of Burgenland (A) is 0.903. The normality of the annual number of apartments with BFA in the region was fulfilled.

The results of fulfilling the conditions required to conduct the parametric F-test show that this specific test can be used because the condition of homoscedasticity and normal distribution of the number of apartments with BP in each region was fulfilled.

Table 4. Analysis of variance of the number of apartments with building permit using parametric test

Distribution of apartments with building permit	Sum of squares	Average F-ratio	P-value
Variance between groups	1,707 E7	3,41 E6	
Variance inside groups	3,616 E6	200 897	17.00 0.0027
Total variance	2,09 E7		

Table 4 shows that the resulting p-value of the variance analysis of the number of apartments with building permit by F-test is 0.0027. The value is lower than the chosen significance level of 0.05. We can confirm that there are statistically significant differences between variations in the number of apartments with BP between selected regions, with a 95.0% confidence.

4. Discussions and conclusion

The selected regions are located in the territory of three countries in which the statistical collection of construction data falls under the national statistical office, with different ways of recording and evaluating them. After negotiations with the persons working in the area specific offices, the data regarding the number of apartments with BP and BFA were processed so that the method of comparison could be used subsequently.

The calculated basic characteristics of the descriptive statistics regarding the number of apartments with BP and apartments with BFA as well as the performed graphical analysis provide us with an initial picture of the development of housing construction in the regions. Larger differences between the number of completed and completed flats per year are recorded in the regions of the Slovak Republic; on the other hand, almost the variation in the difference between the number of completed and completed flats is in the regions of Austria. Larger differences between the number of started and completed apartments per year are recorded in the regions of the Slovak Republic; on the other hand, there is almost zero variability of the difference between the number of started and completed apartments in the regions of Austria. We reject the hypothesis about comparable annual amounts of BP and BFA in individual regions, especially for regions that are situated on the territory of the Slovak Republic. These differences are due to the inconsistent legislative regulations and standards of the country.

The Bratislava Region is the smallest among the selected regions and the number of inhabitants is one of the lowest, but it has a tendency to increase the building construction development, which is also confirmed by the basic statistical characteristics. In order to verify the conclusions from the results of the descriptive statistics, we used the Analysis of variance method to conclude that there are statistical differences between the number of started and completed flats in the comparison of selected regions.

With the current European urbanization trend, the importance of regions will continue to grow further. Stability and growth in the building construction sector in the region will ultimately always depend on the ability to provide appropriate employment opportunities for its inhabitants. In the area of employment, the regions can be helpful to each other not only by the exchange of experience, but also in the development of international cross-border cooperation partnerships.

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