Territorial Differences in Hungary's Residential Property Market

DÁNIEL OROSZ
ASSISTANT LECTURER
UNIVERSITY OF MISKOLC
e-mail: daniel.orosz@uni-miskolc.hu
https://orcid.org/0000-0003-4979-1280

ZSOLT PÉTER
ASSOCIATE PROFESSOR
UNIVERSITY OF MISKOLC
e-mail: peter.zsolt@uni-miskolc.hu
https://orcid.org/0009-0008-7202-6548

SUMMARY

Investigations related to residential real estate can still be considered topical issues today. During our research, on the one hand, we drew conclusions based on long-term data series, and on the other hand, with the help of horizontal, territorial investigations, we revealed spatial correlations regarding the events of the past decade. In our article, firstly we reviewed some concepts related to real estate, with special attention to the domestic literature. With the help of long time series data, we examined the relationship between the change in the residential population and the stock of residential real estate. We have revealed connections, or we specified the number of built residential properties and the real income per capita, as well as examined the distribution of apartments according to comfort in the regions of our country.

The aim of our research was to find out and, based on the results obtained, to visualize how the concentration of housing transactions between private individuals has changed in relation to the Central Hungarian region and the countryside. We compared the data of 2010, which was still characterized by the crisis in our country, and 2020, which can still be considered a favourable period for housing construction, but which was already affected by the Covid epidemic. With the help of the Moran I index and the territorial autocorrelation, we clarified our correlations regarding the number of built apartments and found that the territorial autocorrelation was noticeably stronger thanks to the housing policy of the period.

Keywords: residential real estate; built residential properties; regional differences; Moran I index; real estate market
Journal of Economic Literature (JEL) codes: R20, R21, R23, R30
DOI: https://doi.org/10.18096/TMP.2023.02.06

INTRODUCTION, RESEARCH QUESTION

Residential real estate is the most important asset of most Hungarian households, and buying or selling a home is one of the most important financial decisions made in our lifetime. This decision can be influenced by several relatively well-measured factors, for example the wealth accumulated by previous generations, the past, current and expected income, the location, size, condition of the property, or such little measurable factors as e.g., the subjective sense of security, the assessment of the settlement, its perceived vision of the future. The basic purpose of our studies is to summarize the most important trends of the residential real estate market in Hungary in recent decades, with regard to regional differences. In the first part of our study, we reviewed the relevant domestic and foreign literature, then in the methodological part, we explained the characteristics of regional autocorrelation and the Local-Moran's I. During the analyses, we first revealed correlations using time series data, which we supplemented with correlations based on frequency distributions based on the years 2013 and 2020 and territorial autocorrelation.

LITERATURE REVIEW

We often come across the term real estate in our everyday lives, the concept can appear, among other things, in our conversations, in scientific or less well-founded presentations, in written form in newspaper ads or online advertisements, in documents of institutions, companies dealing with real estate, in sales contracts, in connection with legacies or gifts. However, in addition to the term real estate used in public speech, legislation and the actors of scientific life define its characteristics more precisely. The law on Real Estate Registration (Act CXLI of 1997) considers real estate as the subject of real estate registration. Its basic unit is the independent property. It can be considered independent, which can be owned, sold, gifted, etc. independently of the other properties.

253/1997. (XII. 20.) Government decree on the national settlement planning and construction requirements defines the apartment (residential property in our interpretation) as follows: An apartment is a self-contained accommodation unit intended for long-term residence, the living and other rooms of which must be designed in such a way that they together enable rest and the continuation of activities at home, as well as the storage of materials and objects necessary for living. The apartment must be able to be heated, and ventilation and natural lighting must be ensured in every room.

In the English literature, real estate can be the land, or fixed, immovable, or permanently connected accessories on it, such as: buildings, fences, roads, flora, canals, utility networks and walls. Property rights in some countries include air rights, mineral rights, and surface rights. (http://www.businessdictionary.com/).

Dwelling house/residential estate means an apartment, house or other structure in which people live (http://definitions.uslegal.com).

The literature related to the Hungarian residential real estate market has many research due to the importance of the topic. We would like to emphasize the work „Ingatlangazdaságtan", which discusses the situation of our country's real estate market in the period after the regime change, including the most important property valuation methods, the practice of real estate development, marketing, financing, and housing policy (Soós et al., 2005).

Studies examining state housing policy and housing support systems can serve as an addition to the understanding of the most important national and regional processes (Mádi, 2008; Hegedűs 2006).

In the domestic literature, a prominent topic is the investigation of prices and the evaluation of real estate. Based on the calculations using different methods - based on multiple sales, hedonic and hybrid (mixed) evaluation methods - it can be said that the rise in housing prices in Hungary was significant and further increases can be expected in the near future (Horváth, 2008). Other research draws attention to the decreasing demand due to the expected unfavourable demographic processes and the resulting effects (Farkas, 2011).

With the calculations of Horváth and Székely using different hedonic methods, they came to the conclusion that the Hungarian housing market can be characterized by fairly stable relationships (Horváth & Székely, 2009).

Békés and his co-authors used a hedonic and empirical method. Their results indicate that the characteristics of settlements strongly influence the price of residential real estate, the most important of these factors being the population of the settlements and the average income, as well as the importance of such geographical characteristics as e.g., proximity to water (Békés et al., 2016).

The very first housing price index in Hungary was the "Takarék Housing Index", the source of which was its own data collected by "Takarék Jelzálogbank Nyrt.", as well as the transaction database of real estate purchased from the National Tax and Customs Office (takarekindex.hu).

Every year, OTP prepares a "Land and Real Estate Value Map" based on the database of the National Tax and Customs Office for residential and holiday real estate, car storage, agricultural land, and industrial real estate. Their latest study draws attention to the significant increase in the prices of properties in residential complexes and other condominiums (+21, +23%).

Other significant players in real estate sales, e.g., Duna House also prepares real estate market analyses/estimates, their "hedonic method" considers the property's structure, condition, size, year of construction, and several location parameters.

During the review of the foreign literature, we concluded that regional autocorrelation studies are mostly conducted in relation to the prices of residential real estate. Zhang L. and co-authors presented an empirical study on the spatial spillover effect of house prices in 25 cities of the Yangtze Delta in China based on annual panel data for the period 2000-2013. The Moran's I and LISA tests were used to investigate whether the spatial correlation of housing prices existed in the examined period, especially after 2005. They concluded that, in terms of spatial correlation, the income variable does not show an obvious effect on house prices; instead, the spatial lag of house prices plays a dominant role, and the Yangtze Delta has a significant spillover effect on house prices. Cities with a close economic connection to the city center, a high level of urbanization, optimized industrial structures and strong innovation capabilities showed a large spatial spillover effect (Zhang et al., 2019).

Wang W.-C. and co-authors (2019) in their article explored the factors affecting housing prices using regression models and used spatial autocorrelation to explore price changes in urban areas in the city of Taitung. Spatial autocorrelation analysis showed that the

selected variable contained significant spatial dependence. The results were analysed based on the spatial change of real estate prices, spatial clustering, and model analysis. The results highlighted that the locations and attributes of historical real estate transactions varied. In 2017, property prices were more concentrated than in previous years (Wang et al., 2019).

Another study used spatial autocorrelation and spatial Markov to study 353 used houses in Hefei. The results show that in the city of Hefei, high housing prices are concentrated in the south and southwest of the city, while the price level gradually weakens from the south moving northward, and housing development shows a north-south differentiation. A significant spatial autocorrelation was shown between the prices of second-hand apartments in Hefe. The "high-high" residential price clusters are mainly distributed in Shushan District and Binhu New Area, while the "low-low" residential price clusters are mostly located in Yaohai District and its surrounding areas. The number of "low-high" agglomeration and "high-low" agglomeration is small, and the degree of change is not large either (Yin et al., 2022).

MATERIALS AND/OR METHODS

During our research, we set out to explore the regional differences in residential real estate in Hungary. During the analyses, we used the CSO and TEIR databases, which contain data on 3,154 settlements in 2013 and 3,155 in 2019 and 2020 and 175 districts.

The location of the territorial units and their relationship to each other significantly influences the distribution of the indicators, so that the degree of influence can be determined, it is requiring the use of spatial econometric methods (Szendi, 2016).

Spatial econometrics examines spatial aspects (autocorrelation, spatial structures) in regression models based on cross-sectional, time-series and panel data. Spatial effects arise when the spatial location of the observation units affects the interactions between the units. The formation of territorial effects is characteristic to the greatest degree in neighbouring territorial units (Gerkman, 2010).

In the case of spatial autocorrelation, we can talk about positive spatial autocorrelation, which can be inferred from the very similar spatial grouping, and we can talk about negative spatial autocorrelation, which is characterized by a significant difference between neighbouring observation units (Varga, 2002). It follows from this that autocorrelation means the influence of neighbouring areas on each other and the mutual influence of their values. Spatial lag is suggestive of a possible diffusion process – events in one place predict an increased likelihood of similar events in neighbouring places.

Moran's I index is used to measure these spatial effects:

$$\boldsymbol{I} = \left(\frac{\boldsymbol{N}}{\sum \boldsymbol{D_{ij}}}\right) * \frac{\sum\sum(\boldsymbol{x_i} - \boldsymbol{x}) * (\boldsymbol{x_j} - \boldsymbol{x}) * \boldsymbol{D_{ij}}}{\sum(\boldsymbol{x_i} - \boldsymbol{x})^2}$$

where:
(x_i-x) *(x_j-x): the product of the difference between the values and averages belonging to the territorial units.
D_{ij}: the matrix describing the neighbourhood relations.
N: number of territorial units.

If I>-1/N-1 then there is a positive autocorrelation relationship, if I<-1/N-1 then there is a negative autocorrelation relationship between the individual territorial units. However, if I=-1/N-1, there is no autocorrelation relationship. An exact value cannot be determined, as this value depends on the neighbourhood matrix and the number of territorial units, so its maximum is close to 1, while its minimum is close to -1 (Dusek, 2004).

The test requires the determination of the appropriate weight matrix in advance. This matrix describes the spatial structure of the variables, the neighbourhood relationship (Gerkman & Ahlgren, 2011).

General form of weight matrix:

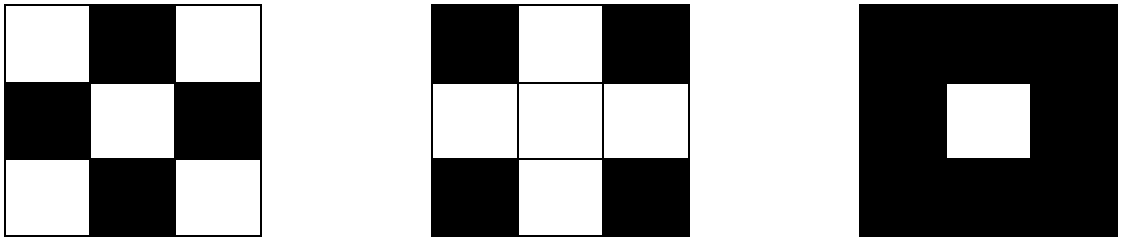
$$W = \begin{pmatrix} w_{11} & \cdots & w_{1n} \\ \vdots & \ddots & \vdots \\ w_{n1} & \cdots & w_{nn} \end{pmatrix}$$

where: n is the number of observations.

The simplest form of defining the neighbourhood matrix and the neighbourhood weights is to mark adjacent areas with 1 and non-adjacent areas with 0. So that the analysis does not show a distorted picture, we must introduce a standardized matrix, where the sum of the values of each row is equal to 1. Depending on which areas are considered bordering, we are talking about bastion, king, or queen neighbourhood (in the case of square grids) (Figure 1).

- Bastion neighbourhood: wij=1, if i has a common boundary with j, the boundary is to the right, left, up and down,

- Leader neighbourhood: wij=1 if i has a vertex in common with j, in the northeast, southeast, southwest, or northwest direction,
- Queen neighbourhood: wij=1 if i has a common boundary or vertex with j (Gerkman, 2010.).



Bastion Leader Queen

Source: Bálint (2010)

Figure 1. Square grid-based neighbourhood approaches

Neighbourhood weight can also be determined based on a threshold distance, or using the nearest method, or perhaps taking the Euclidean distance into account.

Table 1

Meaning of Local Moran's I clusters

Cluster name	Meaning	Spatial structure type
High-High	both the given NUTS 3 area unit and its neighbours have significantly above-average values	Divided spatial structure, center area
High-Low	the given NUTS 3 territorial unit significantly above average, while its neighbours have values significantly below average	Polarized spatial structure, one dominant regional center
Low-High	the given NUTS 3 territorial unit significantly below average, while its neighbours have significantly above-average values	Mosaic-like spatial structure, center-periphery areas
Low-Low	both the given NUTS 3 area unit and its neighbours have significantly below average values	Segmented spatial structure, peripheral area

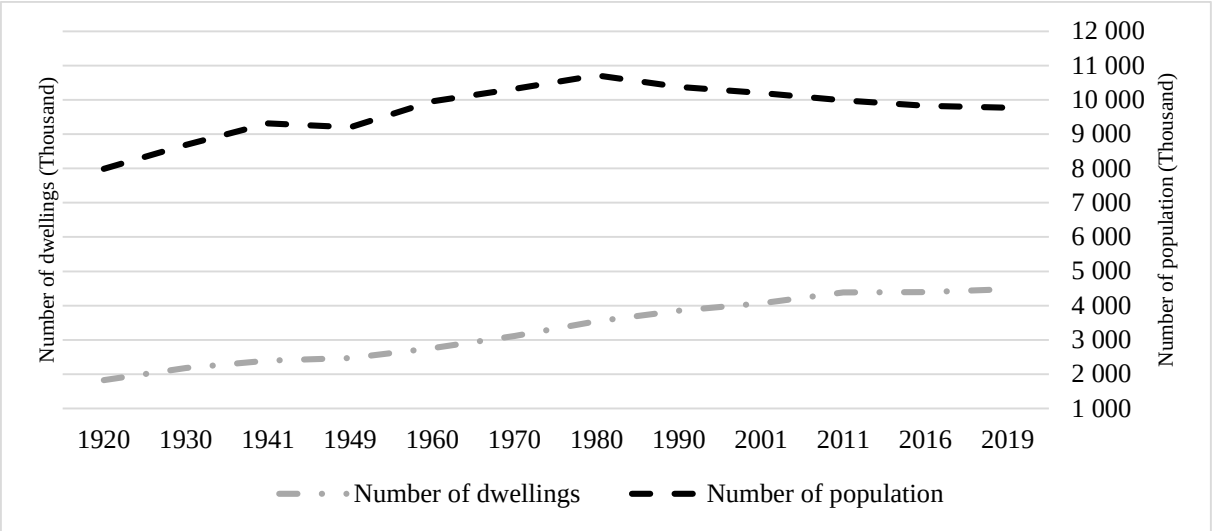
Source: Benedek and Kocziszky (2015)

The Local Moran I indicator is a local version of Moran's I characterization for the entire spatial system, which assigns a specific numerical value to each area unit. Negative values mean negative, and positive values mean positive spatial autocorrelation. The indicator also shows where these high or low values are clustered in space (HH-LL), as well as where the territorial units that differ greatly from their neighbours (HL-LH) are located, thus forming clusters (Tóth & Nagy, 2013, p. 605.). (Table 1)

DISCUSSION OF MAIN FINDINGS AND THEIR RELATION TO THE REVIEWED LITERATURE

The residential real estate stock of our country is basically determined by the processes of urbanization, since more than 70% of Hungary's population lives in cities. As a result of urbanization, as the population increases, the density of housing increases, and multi-level housing becomes common in residential areas. Health, entertainment, culture, and vacation services are

more easily available for the population and those arriving here, with a higher quality and variety.



Source: own editing based on CSO and TEIR data

Figure 2. Development of dwelling stock and population from 1920 to 2019 in Hungary

We collected data on the housing stock, which we also examined depending on changes in the resident population. The population of the current territory of our country (apart from the adverse effects of World War II) tended to increase until the beginning of the 1980s, after which a clear population decrease occurred, which continues to this day. While in the 1920s more than five people lived in a residential property on average, this value decreased to around 3 by the 1980s. In 2023, CSO registered 4,586,878 residential real estates, while there were only 209 residents per 100 residential properties.

In our country, a large number of residential real estate investments are linked to housing estates. Housing estates can be found in most countries of the world, their role in the housing stock varies by continent and country, they are typically found in Europe and now more and more in Asia. Hungary is one of those countries where a significant part of the housing stock is concentrated in housing estates (Egedy, 2005).

In the domestic and international literature, in the case of housing estates, we can come across the concepts of housing estate, residential park, residential garden. In A. Ferkai's interpretation, a residential complex is a complex of buildings that is created in a relatively short time during a single construction operation, usually for a specific social class and separates from the usual image of the settlement (Ferkai, 2005).

According to Imre Perényi, a housing estate is a form of housing construction based on a unified plan, organized in an organized manner, using standard designs for multi-story residential buildings. Its components include the roads, parking lots, garages, basements, and public utilities necessary to serve the residential buildings, as well as green areas and other public spaces for the residents (Perényi, 1987).

According to the approach of the Central Statistical Office, a housing estate is primarily a combination of medium-rise and high-rise residential buildings, as well as rows of houses, mostly constructed in recent decades using factory-built technology (CSO, 1996). After World War I, in the 1920s, barracks settlements were built to improve the housing situation, which mostly consisted of one-room apartments without comfort. Despite the temporary nature of these settlements, in several cases, their demolition only took place after World War II (Gyáni,1992).

Due to the destruction of World War II and a significant decline until the 1950s, there was a severe housing shortage. This situation was further exacerbated by the modernization of agriculture, leading to people moving from villages to cities and the needs of political refugees. Industrialization led to the creation of new urban areas and sometimes entirely new cities. In Eastern and Central European countries, housing estate construction became predominant after World War II.

Table 2

Inhabited residential properties, by year of construction

Year of construction	Total (pcs)	Total (%)	In a housing estate (pcs)	In a housing estate (%)
-1945	1072728	28	12156	2
1945-1959	450204	12	27111	4
1960-1969	579570	15	109555	15
1970-1979	828900	22	335800	45
1980-1989	683506	18	255454	34
1990-1996	152199	4	11064	1
Total	**3767107**	**100**	**751140**	**100**

Source: CSO – Microcensus (1996)

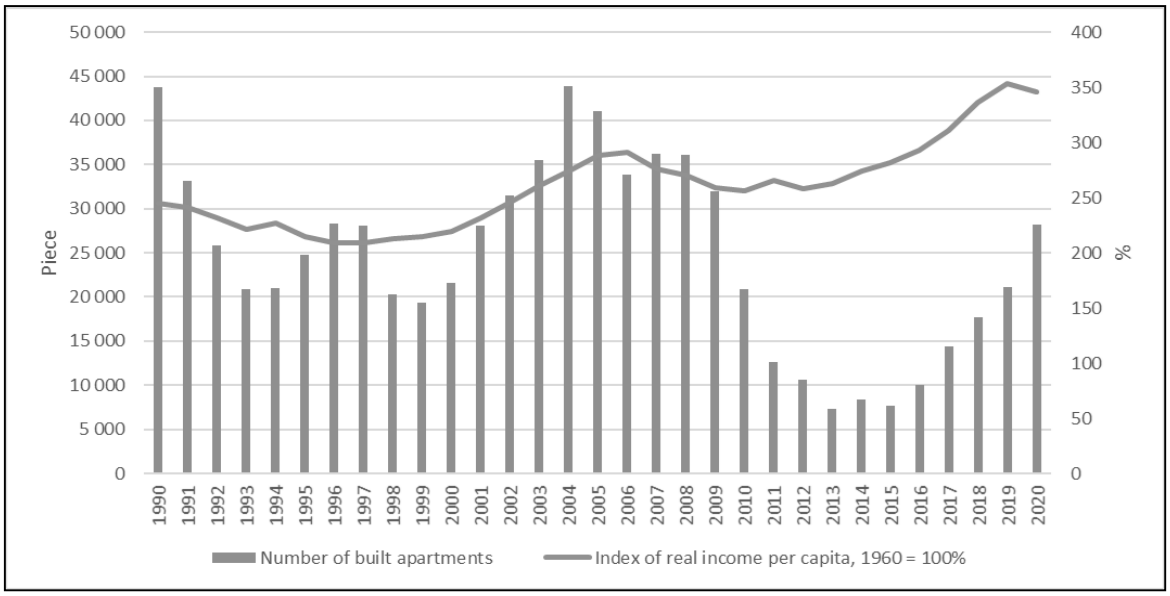
In Hungary, the housing estates of the 1950s were smaller, with 300-800 residential properties, typically consisting of 3-4 level buildings surrounding courtyards and squares. However, due to the high proportion of one-room apartments (52%), there was no substantial improvement in residential real estate size.

However, the level of comfort of the residential real estates improved, as the majority of the residential properties had a bathroom (Egedy, 2000). In the decade of the 1960s, the "15-year housing development program" was launched, which envisaged the construction of one million residential properties, of which 250,000 in Budapest. After the second half of the decade, panel technology became the determining and general. The decade of the 1970s was the most successful period in the history of housing estates in terms of housing construction: 45% of new residential properties were built in housing estates during the decade (Table 2).

From the end of the 1970s, the average size of residential properties increased significantly, thanks to the increasing proportion of two- and three-room apartments, while the number of one-room apartments decreased drastically. (Farkas, 1993).

By the end of the 1980s, housing estate construction was practically completed in Hungary, with the exception of some smaller-scale investments, the completion of which was delayed until the beginning of the 1990s (Egedy, 2000).

In this part of our study, we would like to give a brief overview of housing construction and housing stock over the past decades. In the year of the regime change, nearly 44,000 (43 771) residential properties were built. As a result of the significant economic and related real income decline of the 90s, the number of built residential properties halved within a few years, reaching the 1990 level only in 2004. The Hungarian economy has been struggling with problems from a macroeconomic point of view since 2006, which manifested itself in the decrease of real incomes by 2007, and then by 2013 the number of built residential properties dropped drastically to 7,600.



Source: Own calculation based on CSO data

Figure 3. The number of built residential properties and the development of real income per capita (1990-2020)

Our investigations included examining the correlations between the number of built residential properties and the development of real income per capita. Based on the visual analysis of Figure 3, we formulated our hypothesis that there is a probable relationship between incomes and the number of built residential properties known from the literature, the question is rather how much time has passed and to what extent changes will occur depending on the real income.

Table 3

Correlation between income and number of built residential properties (t_0=1990)

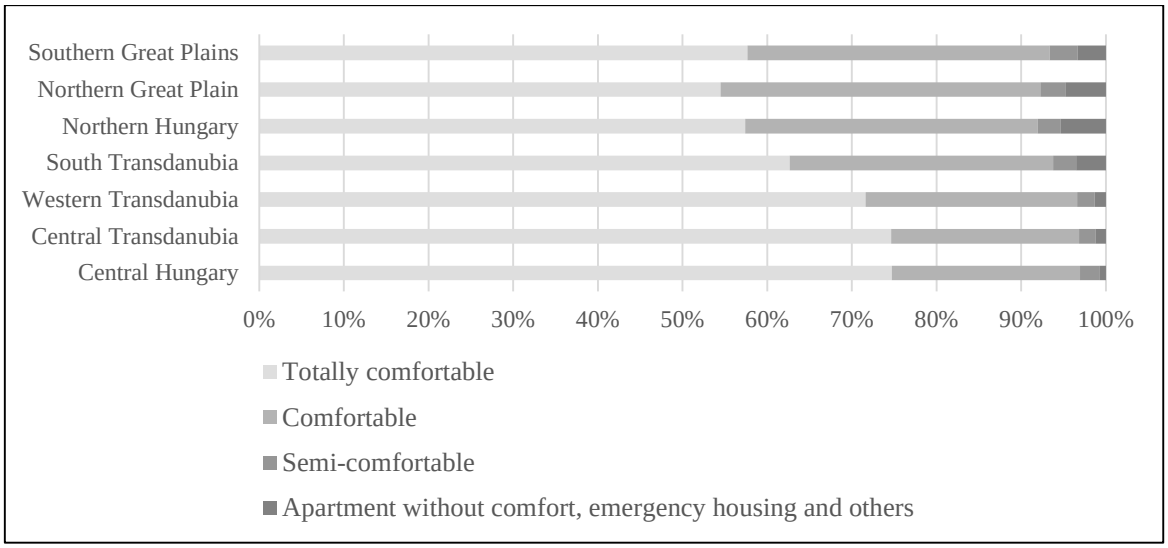
	Real income index/Number of residential properties							
Amount of delay	0 year	1 year	2 years	**3 years**	4 years	5 years	6 years	7 years
Correlation coefficient	-0,089	-0,026	-0,040	**0,417**	0,231	0,055	-0,147	-0,359
Significance level	0,632	0,893	0,839	**0,027**	0,246	0,791	0,483	0,085

Source: Own editing based on TEIR data

We performed a correlation calculation in such a way that the correlation coefficient was calculated by the real income, or we calculated the values of the built residential properties at time t0,1,2,3...n. Based on the data in Table 3, the number of residential properties built in the 3rd year fluctuates to the greatest extent, like changes in real incomes.

In parallel with the construction of a relatively small number of newly built residential properties in comparison to the existing housing stock, "the quality of the housing stock has improved, and the proportion of non-acceptable quality (substandard) housing is decreasing. By 2015, only 8.2% of the housing stock belonged here. There are still connected settlements in the country where the quality of the residential real estates is permanently poor and there is no significant new housing construction (CSO, 2016).

Figure 4 characterizes the regions of our country according to the comfort of residential properties (NUTS 2 regions before January 1, 2018). The proportion of fully equipped residential properties in the Central Hungarian and Transdanubian regions is outstanding, at nearly 75%. The largest proportion of non-comfortable, emergency- and other residential properties are found in the regions of Northern Hungary and the Northern Great Plain.



Source: own editing based on CSO data

Figure 4. Distribution of inhabited residential real estates according to comfort in the regions of our country (2016)

At the national level, in 1990, the proportion of fully equipped residential real estates did not even reach 40%, but by 2016, 95% of the residential properties belonged to the fully equipped or comfortable category (Mikrocenzus, 2016). Based on the above, it is probable that a significant part of the investments in residential real estate in the decades following the system change were related to the development and modernization of the existing real estate stock. While at the county level, 80% of the residential properties in the counties of Győr-Moson-Sopron and Komárom-Esztergom were fully comfortable, but in the counties of Pest, Fejér, Veszprém and Baranya we can talk about values over 70%, while in the counties of Nógrád and Szabolcs-Szatmár-Bereg only exceeded, in the county of Jász-Nagykun-Szolnok it did not even reach 50% (Mikrocenzus, 2016).

Our research goal was, among other things, to examine whether, if yes, what direction and extent of changes have been experienced in the past decade due to a different housing and support policy compared to the previous ones. We considered the fact that in 2010, 29.5% of the population lived in Central Hungary (in addition to a decreasing national population), and in 2020 it will already be 31.2%. In the case of used residential properties, the data in Table 4 show a tendentious decrease especially after 2014, which by the end of the period is even lower than the proportion of the population. Based on the above, it can be concluded that the relative positions of the rural areas have improved compared to the Central Hungarian Region.

Table 4

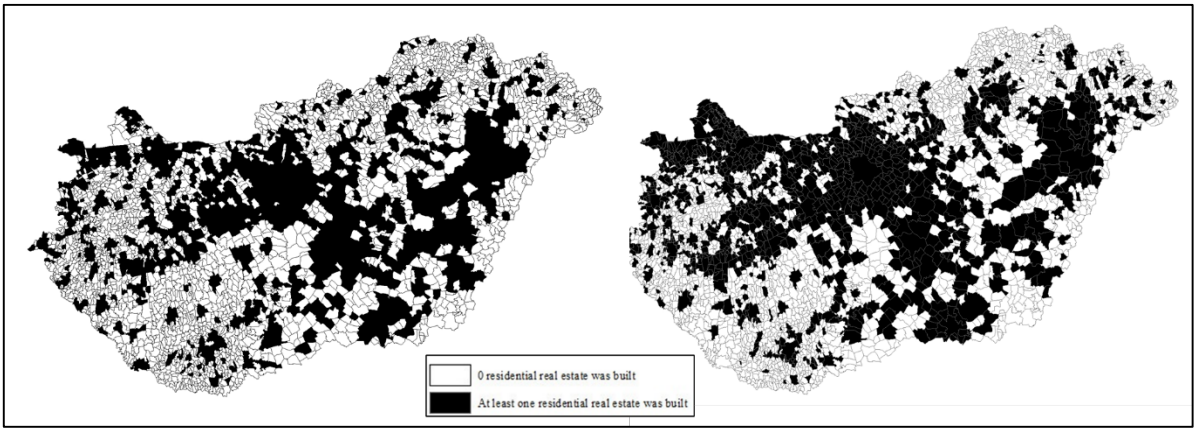
The proportion of housing transactions between private individuals in Central Hungary compared to the national value for used and new residential real estates.

Type	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
used residential real estates Central Hungary	37,7%	35,3%	36,9%	37,4%	39,7%	39,6%	36,0%	33,7%	31,6%	29,4%	26,8%
new residential real estates Central Hungary	66,4%	64,3%	65,9%	66,4%	62,0%	60,2%	49,7%	42,1%	48,4%	49,2%	54,4%

Source: own editing based on CSO data

In the 2010-2020 period, Central Hungary's share of transactions involving new residential real estate far exceeded its population ratio. Except for 2011, this high share decreased significantly (from 66.4% to 42.1%) in 2017 and started to increase again in the following years. Comparing the values with our figure for the number of newly built residential properties, it can be concluded that rural areas were more "put into position" by the period of recession than by truly favourable trends.

In addition to the examination of higher-level territorial units, we also strive to make the trends of recent years visible at the settlement and district level. In the case of the series of settlements, we examined 3,155 settlements in the database of TEIR, while in the case of districts, the number of analysis units was 175. Figure 5 illustrates how in 2013 and 2020 in which settlements at least one residential property was built (excluding resorts). In 2013, there were 783 and in 2020 there were 1,117 settlements in Hungary where at least one residential real estate was built, which is a significant increase of more than 42%.



Source: own editing based on CSO data

Figure 5. Settlements not affected by residential real estate construction in 2013 (left) and 2020 (right)

When exploring the differences in housing construction, a methodological problem is caused by the change in the number of settlements. The distribution of built residential real estates was illustrated on a logarithmic scale, as Budapest is an outlier, and the low values of smaller settlements greatly distort the evaluation of settlement series data. Figure 5 illustrates how the distribution of built residential real estates (excluding resorts) by settlement developed in 2013 and 2020. When examining the distributions, we considered only those settlements (783 in 2013, 1117 in 2020) where at least one residential real estate was built. However, it should be noted that the increase only appears significant against an extremely low base. However, thanks to the large number of analysis units (investigated settlements), the map display clearly shows which settlements and which parts of the country are affected by the economic period. It can be observed that new housing developments mostly appeared in the neighbourhood of settlements, where they had already existed before. This raises the need to analyse neighbourhood relations later. In the least developed regions of the country, there is essentially no meaningful positive movement (e.g., Northern Hungary, settlements close to the eastern borders, Southwestern Hungary), while the settlements surrounding the capital, in the north-west, and somewhat around Lake Balaton, appear in much greater numbers. Housing construction typically continues to lag in areas less favourable for investment. Despite the reduction of the VAT on newly built residential real estates and the introduction of home building subsidies initiated by the government, their impact was not significantly felt in the least developed settlements. With these incentive systems, they achieved that developers build new residential real estates only in those settlements where they can enforce high prices. Overall, thanks to the government measures, new residential properties were not built where they could not have been built without these subsidies, but where they would have been built anyway in a few years. Thanks to these processes, territorial differences have intensified in the residential real estate market (Varga, 2022).

In 2013, there were only ten settlements where a hundred or more apartments were built. The magnitude of the concentration is shown by the fact that in 2013, these ten settlements accounted for approx. 50% of the residential properties built. However, by 2020, we can already speak of 39 such settlements, which can be said to be a significant increase.

To illustrate the settlement dynamics of housing construction, the settlements have been classified into categories (Table 5).

Table 5

Our country's settlements by built residential properties (2013, 2020)

	2013				2020			
Number of built residential properties (pcs)	Number of settlements (pcs)	Distribution of settlements (%)	Number of residential properties built in each category (pcs)	Distribution residential properties (%)	Number of settlements (pcs)	Distribution of settlements (%)	Number of residential properties built in each category (pcs)	Distribution of built residential properties (%)
0	2371	75,17	0	0	2038	64,60	0	0
1	375	11,89	375	5,14	351	11,13	351	1,24
2-9	317	10,05	1112	15,25	487	15,44	1847	6,55
10-49	72	2,28	1518	20,81	191	6,05	4438	15,73
50-99	9	0,29	625	8,57	49	1,55	3538	12,54
100-999	9	0,29	1893	25,96	35	1,11	7901	28,01
1000-	1	0,03	1770	24,27	4	0,13	10133	35,92
Total	3154	100	7293	100	3155	100	28208	100

Source: Based on TEIR data, own calculation

While in 2013 no new residential property was built in 2,371 settlements (75.17%), by 2020 there will only be 2,038 such settlements (64.6%). The proportion of settlements where only one residential real estate was built also decreased. The number of settlements where more than a thousand residential properties were built practically quadrupled, and the number of settlements with 100-999 built residential real estates also expanded to a similar extent.

Table 6

Districts of our country according to built residential properties (2013, 2020)

	2013				2020			
Number of built residential properties (pcs)	Number of settlements (pcs)	Distribution of settlements (%)	Number of residential properties built in each category (pcs)	Distribution residential properties (%)	Number of settlements (pcs)	Distribution of settlements (%)	Number of residential properties built in each category (pcs)	Distribution of built residential properties (%)
0	13	7,43	0	0	11	6,29	0	0
1	15	8,57	15	0,21	6	3,43	6	0,02
2-9	62	35,43	303	4,16	53	30,29	285	1,01
10-49	58	33,14	1257	17,26	35	20,00	938	3,33
50-99	12	6,86	897	12,32	28	16,00	1957	6,94
100-999	14	8,00	3041	41,75	35	20,00	10707	37,96
1000-	1	0,57	1770	24,30	7	4,00	14315	50,75
Total	175	100,00	7283	100,00	175	100,00	28208	100,00

Source: Based on TEIR data, own calculation

Examination of the district data shades the settlement-by-settlement results. In 2013, not a single residential property was built in 13 districts (7.43%). By 2020 (even though the national value had almost quadrupled), there were still 11 districts where no newly built residential property was registered in a single settlement. The above confirms the connection, only guessed based on the settlement series data, according to

which the country has regions with typically peripheral locations, where housing policy instruments and subsidies were ineffective or marginally effective, since the number of districts belonging to categories 0.1, 2-9 did not change drastically. A significant increase was observed in the number of districts where fifty or more residential properties were built. In the category from 50 to 99, it more than doubled, in the category from 100 to 999, and in terms of residential property constructions with a few over 1,000, this number increased from one district to seven.

During our investigations, we concluded that the spatial relationships can be further clarified through the analysis of neighbourhood relations. We calculated the Local Moran index of territorial autocorrelation for the districts of Hungary. Local Moran I calculations were made using GeoDa software. Due to the peculiarity of the method, the interpretation of the results obtained during the examination can be significantly influenced by the choice of the neighbourhood matrix, therefore I also used three different neighbourhood matrices. In this way, we can get an idea of the influencing effects they cause by comparing the calculations with the neighbourhood matrices (Table 7). It can be concluded that the values calculated with the different neighbourhood matrices for the number of newly built apartments differ less from each other.

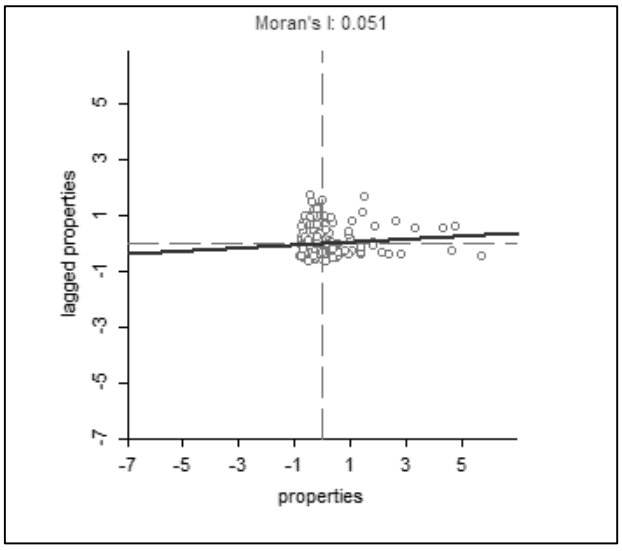
Table 7

Local Moran's investigation of the districts of Hungary in 2010

	Leader neighbourhood	**Nearest neighbourhood method**	**Threshold distance method**
Moran I	0,064	0,051	0,078
number of permutations	999	999	999
pseudo-p value	0,065	0,097	0,06
z score	1,6221	1,392	1,764
Local Moran clusters are created	high-high: 4 low-low: 10 low-high: 11 high-low: 5	high-high: 5 low-low: 9 low-high: 11 high-low: 2	high-high: 19 low-low: 6 low-high: 22 high-low: 4
significance level	95-99,9%	95-99,9%	95-99,9%

Source: own editing based on CSO data

Figure 6 shows the values of the Moran I index in the districts of Hungary in 2010 for the residential real estates built per ten thousand people. The value of its index is 0.051, which means a weak positive autocorrelation. In other words, in the case of built residential real estates, neighbouring areas only have a small effect on each other. We used the nearest neighbour method during further investigations. The autocorrelation of the areas is weak, as the number of built residential properties per ten thousand people in each area is not strongly related to each other.

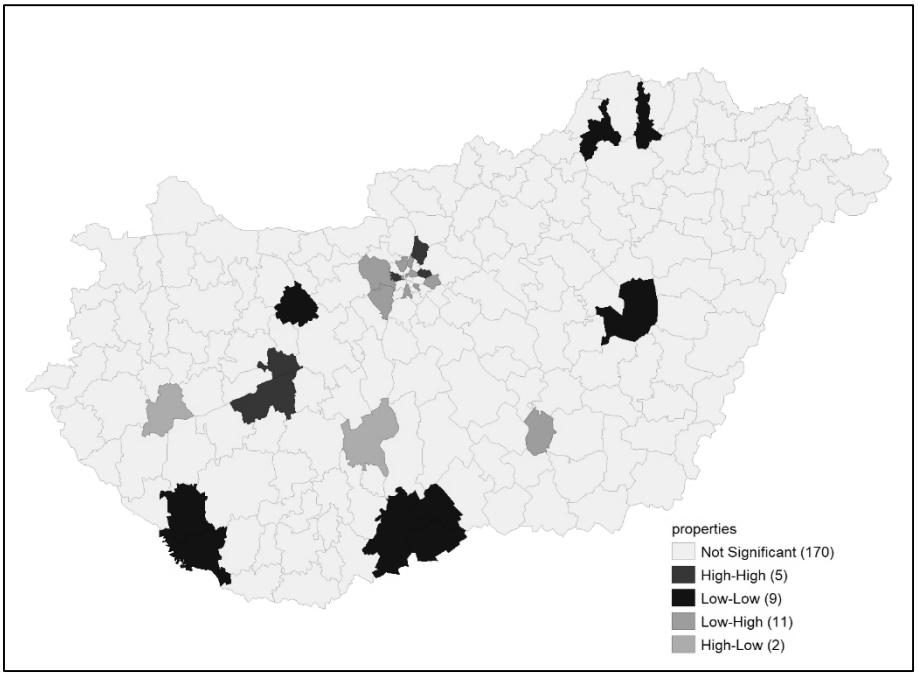


Source: own editing based on CSO data

Figure 6. Moran I index in the case of specific built residential properties in the districts of Hungary (2010)

To eliminate random errors, the analysis was performed with a high number of permutations (999). The value of the probability variable p is low, but the standard deviation (z score) of the values is high, which proves that autocorrelation exists. The Moran Scatter plot created during the analysis classifies the territorial units into four main types of territorial autocorrelation. The upper right (High-high cluster) and lower left (Low-low cluster) corners of the figure correspond to positive regional autocorrelation, negative autocorrelation values are also shown in the lower right (High-low cluster) and upper left (Low-high cluster) illustrates.

Figure 7 illustrates the cluster map of Local Moran's I calculation. No significant autocorrelation can be detected in 170 of the 197 territorial units included in the study, the remaining 27 territorial units can be divided into four categories. Examining the data from 2010, 5 territorial units can be classified into the category in which the analysed neighbourhoods and their neighbours had values of built residential real estates per ten thousand people that were significantly above the average. The high - high category (territorial units with a high value, the neighbourhood of which also has a high value) includes the districts of Balatonalmád, Siófok, Dunakeszi and the 12th and 16th districts of Budapest. The districts of Barcsi, Nagyatád, Baja, Jánoshalm, Bácsalmás, Mór, Karcag, Szikszó, Kazincbarcika are in the low-low group (territorial units of low value, in which case the neighbourhood also has a low value) in terms of the number of built residential real estates per ten thousand people. In the low-high category (territorial units of low value, in the case of which the neighbourhood has a high value.) there are the Érd, Budakeszi, Csongrád districts and the 1st, 4th, 14th, 18th, 21st districts of Budapest. The two areas located in the high-low cluster are the districts of Keszthely and Paks.



Source: own editing based on CSO data

Figure 7. Neighbourhood effects – weak spatial autocorrelation (2010)

For the year 2020, the autocorrelation of the built residential real estates is again tested using several neighbourhood matrices. Table 8 summarizes the results for the year 2020.

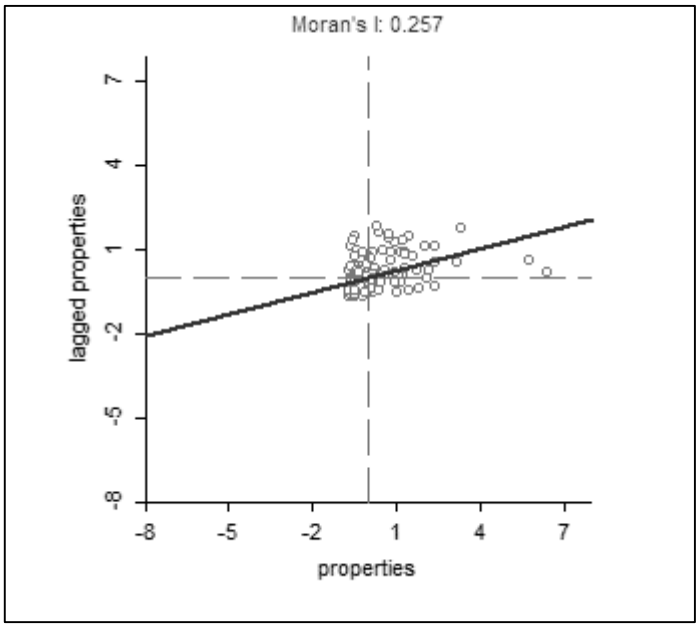
Table 8

Local Moran's investigation of the districts of Hungary in 2020

	Leader neighbourhood	**Nearest neighbourhood method**	**Threshold distance method**
Moran I	0,241	0,257	0,252
number of permutations	999	999	999
pseudo-p value	0,001	0,001	0,001
z score	5,6860	6,1082	5,5265
Local Moran clusters are created	high-high: 15 low-low: 33 low-high: 8 high-low: 2	high-high: 15 low-low: 32 low-high: 4 high-low: 1	high-high: 31 low-low: 31 low-high: 12 high-low: 1
significance level	95-99,9%	95-99,9%	95-99,9%

Source: Own editing

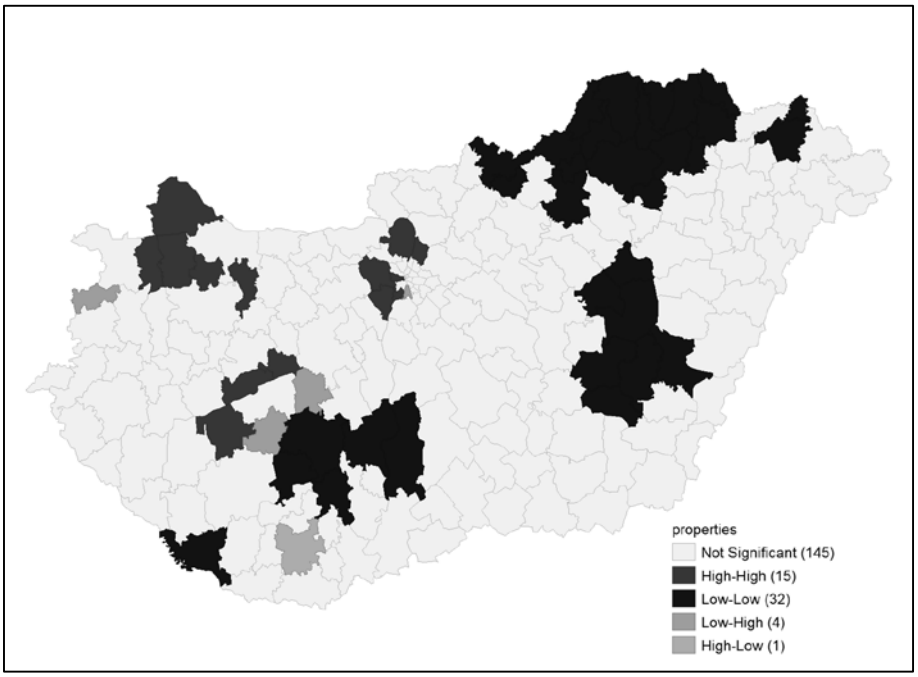
Figure 8 illustrates the values of the Moran I index in the districts of Hungary in 2020 for the built residential real estates per ten thousand people. The value of its index is 0.257, which means a weak positive autocorrelation (from 2013 to 2020, the strength of the autocorrelation increased significantly). In other words, in the case of built residential real estates, neighbouring areas have a small influence on each other. The autocorrelation of the areas is weak, as the number of built residential real estates per ten thousand people in each area is not strongly related to each other.



Source: own editing based on CSO data

Figure 8: Moran I index in the case of specific built residential properties in the districts of Hungary (2020)

To eliminate random errors, I again performed the analysis with a high number of permutations (999). The value of the probability variable p is low, but the standard deviation (z score) of the values is high, which proves that autocorrelation exists. Figure 9 illustrates the cluster map of Local Moran's I calculation.



Source: own editing based on CSO data

Figure 9: Neighbourhood effects – weak spatial autocorrelation (2020)

No significant autocorrelation can be detected in 145 of the 197 territorial units included in the study, the remaining 52 territorial units can be divided into four categories. Examining the 2020 data, 15 territorial units can be classified in the category in which the analysed neighbourhoods and their neighbours had values of built residential properties per ten thousand people that were significantly above average. The members of the high-high cluster are the districts of Mosonmagyaróvár, Csorna, Kapuvár, Tét, Pannonhalma, Szentendre, Dunakeszi, Budakeszi, Érd, Fonyód, Balatonfüred, Balatonalmádi, as well as the 1st, 12th, 22nd districts of Budapest.

The low - low cluster includes those territorial units with a lower-than-average value in terms of the number of built residential properties per thousand people, as well as their neighbours. These areas are mostly located in the north-eastern part of the country. The cluster is made up of 32 territorial units: all but two districts of the Borsod-Abaúj-Zemplén county (Mezőkövesd, Mezőcsát districts) belong to it, as well as Záhony, Kisvárda, Tiszafüred, Karcagi Kunhegyes, Mezőtúr, Gyomaendrőd, Szeghalom, Szarvas, Eger, Bélapátfalva, Salgótarján, Bátonyterenye, Barcs, Dombóvár, Tamási, Bonyhád, Paks, Kalocsa districts.

The areas of the low-high cluster are Kőszeg, Tab, Enying, Budapest 21st district. The area located in the low-high cluster is the Pécs district.

Comparing the 2013 and 2020 maps, can be established that the number of districts belonging to the high-high and low-low categories has increased significantly.

At the neighbourhood level, contiguous areas with similar situations that differ positively (relevant parts of Central Hungary, Northwestern Hungary, Balaton's elbow) or negatively (a part of Northern Hungary, the middle of the Great Plain, the area affecting Southwestern Hungary) from the average in terms of the specific values of the built apartments have become more extensive. This presupposes a kind of similarity and cohesion at a narrower regional level, while at the national level it leads to growing differences between larger regions.

CONCLUSION

Even though there is no uniform internationally accepted concept for the concept of real estate, the legislation and with the help of actors from scientific life, we can clarify its most important characteristics. We can also state that, in accordance with the importance of the topic, many specialized literatures have been produced in recent decades, but relatively few articles focusing specifically on territorial connections have been produced. In our country, the residential population reached its maximum at the beginning of the 1980s, in the period from the 1920s to the present, it has been continuously decreasing, while the growth of the residential real estate stock is continuous. The reason for this is that there is a demand for newly built residential

properties even in a period of declining residential population, while residential property closures are not typical in our country.

It can be concluded that the high values of built residential real estates of the decades before the regime change are not expected soon, and the 2015 data, which is considered outstanding, is significantly lower than the average of previous decades. In the decades following the system change, very significant fluctuations can be observed regarding the number of built residential properties.

With the help of a correlation coefficient, we clarified the known relationship between real income and the number of built residential properties and found that the data on built residential properties 3 years later move the most with changes in real income. We also found that there are still significant differences in the comfort of residential properties in the regions of our country. Throughout the 2010-2020 period, the share of housing transactions between private individuals far exceeded the population ratio of the Central Hungary region. From 2013, this high share decreased significantly (from 66.4% to 42.1%) by 2017, except for 2011, and started to increase again in the following years. However, it can be concluded that the positions of the region were improved by the period of decline rather than by truly favourable trends. From 2013 to 2020, the number of built residential properties almost quadrupled, and at the same time, the number of settlements where at least one residential property was built also increased significantly. The township maps clearly illustrate that in the country's least developed regions there is essentially no meaningful positive movement. The previously only guessed connection was confirmed by the Moran I index area autocorrelation calculations for districts and the map representation. The results show that the areas where the neighbours of territorial units with high values also have high values, or the areas where the neighbours of territorial units with low values have low values, have become more extensive.

Author's contribution

Zsolt Péter's contribution to the study is 50%, Dániel Orosz's contribution to the study is 50%.

REFERENCES

Bálint, L. (2010). *Területi halandósági különbségek alakulása Magyarországon 1980-2006*. (Kutatási jelentések 90.) Budapest: Központi Statisztikai Hivatal Népességtudományi Kutatóintézet.

Békés, G., Horváth Á., & Sápi Z. (2016). Lakóingatlan-árak és települési különbségek (Residential property prices and settlement differences). *Közgazdasági Szemle, LXIII*(12), 1289—1323. https://doi.org/10.18414/KSZ.2016.12.1289

Benedek, J., & Kocziszky, Gy. (2015). Paths of Convergence and Polarization in the Visegrad-countries. I: Th. Lang, S. Henn, W. Sgibner, & K. Ehrlich (Eds.), *Understanding Geographies of Polarization and Peripheralization – Perspectives from Central and Eastern Europe and Beyond* (pp. 217-235). Palgrave MacMillan. https://doi.org/10.1057/9781137415080_12

Dusek, T. (2004). *A területi elemzések alapjai Regionális tudományi tanulmányok, 10.*, Budapest: ELTE Regionális Földrajzi Tanszék, MTA-ELTE Regionális Tudományi Kutatócsoport. 245 p.

Egedy, T. (2000). A magyar lakótelepek helyzetének értékelése (Evaluation of the situation of Hungarian housing estates). *Földrajzi Értesítő*, *XLIX*(3–4), 265–283. https://www.mtafki.hu/konyvtar/kiadv/FE2000/FE20003-4_265-283.pdf

Egedy, T (2005). Kedvencből mostohagyerek? – A lakótelepek helyzete (From favorite to stepchild? - The situation of housing estates). *Beszélő, X*(3). http://beszelo.c3.hu/cikkek/kiskedvencbol-mostohagyerek

Farkas, E. J. (1993). Az önkormányzati tulajdonú bérlakások eladása (The sale of municipally owned rental apartments). *Statisztikai Szemle*, *71*(8-9), 739-740. https://www.ksh.hu/statszemle_archive/all/1993/1993_08-09/1993_08-09_0739_0740.pdf

Farkas. M. (2011). *Housing Demand and Demographics Trends: Evidence from Hungary.* MA Thesis, Central European University, Department of Economics, Budapest, 42 p. https://www.etd.ceu.edu/2011/farkas_miklos.pdf

Ferkai, A. (2005). *Lakótelepek (Housing estates).* Budapest: Budapest Főváros Önkormányzata Főpolgármesteri Hivatala. 78 p. https://library.hungaricana.hu/hu/view/VaroshazaKiado_0112/?pg=5&layout=s

Gerkman, L. (2010). *Topics in Spatial Econometrics: With Applications to House Prices.* Publications of the Hanken School of Economics, Economics and Society, Nr. 219., 128 p. https://helda.helsinki.fi/server/api/core/bitstreams/88b3b609-bc21-4d56-9c84-27ed81662b19/content

Gerkman, L., & Ahlgren, N. (2011). Practical Proposals for Specifying k-Nearest Neighbours Weights Matrices. *Hanken School of Economics Working Papers,* 555.

www.researchgate.net/profile/LindaGerkman/publication/238597174_Practical_Proposals_for_Specifying_kNearest_Neighbours_Weights_Matrices/links/0deec536c91764be72000000/Practical-Proposals-for-Specifying-k-Nearest-Neighbours-Weights Matrices.pdf

Gyáni, G. (1992). *Bérkaszárnya és nyomortelep (Rent-barracks and slum).* Budapest: Magvető Kiadó. http://real.mtak.hu/118170/1/2924-Tanulmányszöveg-9579-1-10-20170920.pdf

Hegedűs, J. (2006). Lakáspolitika és a lakáspiac – a közpolitika korlátai (Housing policy and the housing market - the limits of public policy). *Esély*, *2006*(5), 65-100. https://www.esely.org/kiadvanyok/2006_5/HEGEDUS.pdf

Horváth, Á. B. (2008). *Az 1995 óta tartó lakóingatlan-áremelkedés mérése és okai.* Budapesti Corvinus Egyetem. Budapest. https://phd.lib.uni-corvinus.hu/362/1/horvath_aron.pdf

Horváth, Á., & Székely, G. (2009): Hedonikus módszer alkalmazása a használt lakások áralakulásának megfigyelésében (Application of the hedonic method in monitoring the price development of used residential properties). *Statisztikai Szemle*, *87*(6), 595-607. https://eltinga.hu/wp-content/uploads/2022/10/lakasarak_Mo.pdf

KSH (1996). *Mikrocenzus, 1996: A népesség és a lakások jellemzői (Microcensus, 1996).* Budapest: KSH. https://library.hungaricana.hu/en/view/NEDA_1996_nepesseg_lakasok/?pg=0&layout=s

KSH (2016). *Mikrocenzus, 2016: Lakáskörülmények (Microcensus, 2016).* Budapest: KSH. https://www.ksh.hu/docs/hun/xftp/idoszaki/mikrocenzus2016/mikrocenzus_2016_7.pdf

KSH (2016). *TÉR-KÉP 2015: A lakáspiaci folyamatok területi egyenlőtlenségei (Territorial inequalities in residential property market processes* (pp. 53-65)). Budapest: Központi Statisztikai Hivatal. https://www.ksh.hu/docs/hun/xftp/idoszaki/pdf/ter_kep_2015.pdf

Mádi, L. (2008). *Lakáspolitika – Otthonteremtés: Történések és tapasztalatok a közelmúlt magyarországi időszakából (Housing policy - Home creation: Events and experiences from the recent period in Hungary).* PhD értekezés, Nyugat-Magyarországi Egyetem Közgazdaságtudományi Kar, Sopron. http://ilex.efe.hu/PhD/ktk/madil/magyar.pdf

Perényi, I. (1987). *Urbanisztikai kézikönyv (Urban Planning Handbook).* Budapest: Építésügyi Tájékoztatási Központ.

Soós, J. (Ed.) (2005). *Ingatlangazdaságtan (Real estate economics)* (pp.19-35., pp. 235-239). Budapest: KJK-KERSZÖV Jogi és Üzleti Kiadó Kft.

Szendi, D. (2016). *Perifériák felzárkóztatásának esélyei, különös tekintettel Kelet-Közép-Európa két térségére (Convergence chances of peripheral regions, with special regards on two territories from East-Central Europe).* Doktori értekezés, Miskolci Egyetem, Miskolc. https://doi.org/10.14750/ME.2016.025

Takarékindex.hu (2018). *Takarék House Price Index Methodological guide.* Budapest: MBH index. https://www.mbhindex.hu/sw/static/file/takarekindex.hu-files-24-74950.pdf

Tóth, G., & Nagy, Z. (2013). Eltérő vagy azonos fejlődési pályák? A hazai nagyvárosok és térségek összehasonlító vizsgálata (Different or the same developmental paths? A comparative study of major domestic cities and regions). *Területi Statisztika*, *53*(6), 593–612. http://real.mtak.hu/14627/1/toth_nagy.pdf

USLegal (2016). *Dwelling House Law & Legal Definition.* US Legal. http://definitions.uslegal.com/d/dwelling-house/

Varga, A. (2002). Térökonometria. *Statisztikai Szemle*, *80*(4), 354–370. https://www.ksh.hu/statszemle_archive/2002/2002_04/2002_04_354.pdf

Varga, D. (2022). Építési Piaci Prognózis 2021-2024 (Construction Market Forecast 2021-2024). A mi otthonunk. https://amiotthonunk.hu/epitesi-piaci-prognozis-2021-2024/

Wang, W.-C. (2019). An Application of the Spatial Autocorrelation Method on the Change of Real Estate Prices in Taitung City. *ISPRS International Journal of Geo-Information*, *8*(6), 249. https://doi.org/10.3390/ijgi8060249

WebFinance Inc. (2016). Real estate definition. Business Dictionary. http://www.businessdictionary.com/definition/real-estate.html

Yin, Z., Sun, R., & Bi, Y. (2022). Spatial-Temporal Change Trend Analysis of Second-Hand House Price in Hefei Based on Spatial Network. *Computational Intelligence and Neuroscience*, *2022*(SI), 6848038. https://doi.org/10.1155/2022/6848038

Zhang, L., Wang, H., Song, Y., & Wen, H. (2019). Spatial Spillover of House Prices: An Empirical Study of the Yangtze Delta Urban Agglomeration in China. *Sustainability*, *11*(2), 544. https://doi.org/10.3390/su11020544

Copyright and License