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Quality of multifamily residential land as a factor supporting sustainable urban development

Izabela Rącka

Department of Management, University of Kalisz,
62-800 Kalisz, Poland
i.racka@uniwersytetkaliski.edu.pl

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Abstract: The analysis of the real estate market is one of the basic tasks of a real estate valuer. Proper analysis should be preceded by determining the spatial extent of the market. It is most often assumed that comparative properties should be located on the local market, usually seen as the market of a given town or commune. In contrast, in the absence of local market transactions, the analyzed area is extended to the regional, national and, in specific cases, even international markets. The purpose of the article is to define the boundaries of the local market in the example of the city of Poznań (Poland). The market research was mainly based on statistical analysis. The results of the conducted research show that in the case of undeveloped land for multifamily housing in Poznań, the local market should be narrowed to specific city zones, not treating the city area uniformly. Additionally, it should be noted that investors make decisions about the location of residential investments, considering land prices and real estate development opportunities, which vary in different parts of the city. The quality of life of residents and the degree of sustainable development of the city that can be achieved depend on the developers' decisions on the choice of location, as well as on the spatial and technical solutions used.

Keywords: housing market, multifamily residential land, property valuation, market analysis, prices, sustainable urban development

1. Introduction

Sustainability, which involves the parallel development of the economy, society and the environment, aims to meet the needs of modern societies in such a way that the development opportunities of future generations are not compromised. The 17 Sustainable Development Goals (SDGs) include poverty, social inequality, environmental protection, innovation or urban development measures. The implementation of these goals is monitored continuously in individual countries worldwide.

Corresponding author: *Izabela Rącka*
E-mail: mailto:i.racka@uniwersytetkaliski.edu.pl

By creating new development projects and introducing new features into urban spaces, housing developers have defined the reality and comfort of people's lives in the city for decades. New projects should be integrated into their existing surroundings to positively influence the shape and development of the urban landscape and the life of the local community. ESG (Environmental, Social, Governance) is one of the most important terms in the context of real estate development, with a direct impact on governance and corporate responsibility issues, as well as on the shape of urban spaces and the residents' quality of life.

Investments made by the ESG concept must meet the following criteria:

- Environmental – concerning the commitment to environmental protection and sustainable development and the fight against climate change, the protection of biodiversity and rational water and waste management;
- Social – relating to the company's relationship with its environment - employees, customers, business partners or the local community;
- Corporate – applying high management and control standards to ensure transparency and business responsibility. Corporate governance includes, among other things, issues relating to relations with investors and employees, proper compliance culture and risk management issues.

Considering the role of developers in sustainable urban development from a different perspective, it is pointed out that sustainable development implementation has to be applied mainly in three aspects (Pabian, 2012): environmental goals, economic objectives, and investment processes. Innovative development solutions are becoming more and more common in Poland. Extensive green areas between buildings are being designed, as growing urban vegetation helps prevent drought and benefits the mental health of residents. Rainwater tanks are installed under the buildings, which are then used to water the plants on the estate. The possibilities for applying new technologies to support sustainable development and appropriate land use depend on the location and other characteristics of the plot of land to be developed. Those characteristics, therefore, partly influence the profitability of the investment. For this reason, it is important to know the characteristics and prices of the land available in the developers' market.

One should note that plots of land located in the city centers may be developed differently than those located on the city outskirts. These areas differ in the degree of development intensity, and in the case of different locations, the investor can use different ways to achieve sustainable development goals.

The paper is structured under five sections. After this, section 2 presents the literature review, and section 3 focuses on the research methods, section 4 presents the results, section 5 discusses the results and concludes the paper.

2. Literature review

2.1. Real estate market analysis

Analysing the extensive property market for a unit valuation is a difficult task for several reasons, among which the problematic access to reliable information (Rącka, 2017; Zyga, 2016) and determining the spatial extent of the market (Wolanin, 2012; Prystupa, 2015) are significant. According to the regulations (Regulation, 2004, §26 point 1.), the most common assumption is that the comparative properties should be located in the local market, usually perceived as the market of a given city or municipality. In developed market segments, finding similar properties that have been traded is usually not difficult. This is the case in valuing dwellings or land properties for single-family residential development. Then, the city (municipality) area is often taken as the local market, and the market analysis is even narrowed down to a specific district or housing estate (Prystupa, 2015).

On the other hand, valuers face the problem of determining the spatial extent of the analysed market, mainly when there are no market transactions concerning similar properties in the surrounding area. The issue of similarity of real estate is regulated by the Act (1997, art. 4, para. 16), according to which a similar real estate is a real estate comparable to the real estate being the subject of the valuation concerning its location, legal status, use, manner of use and other features influencing its value. The determination of similarity in terms of location is, therefore, crucial for selecting the spatial extent of the market.

Conducting a market analysis, as an element preceding the determination of the value of the property, is one of the mandatory activities of the valuer. According to the Regulation (2004, §3 point 2), it should concern particular prices, rents and terms of the transaction. In methodological studies, apart from the laconic statement, "the market analysis is aimed at determining the characteristics of the property (attributes)". (PFSRM, 2009), there are no guidelines or recommendations for conducting a property market analysis. Analysis is made all the more difficult because the real estate market is imperfect (Malienė et al., 2016). This is manifested in (Brown, 1974; Isaac, 2002):

- heterogeneity (no two properties being identical),
- non-transparency (lack of complete information about properties and their features),
- the inability to maximise utility and profitability (price is not the only selection criterion, and property features and prices are often perceived subjectively, so market participants' behaviour is irrational),
- a small number of buyers and sellers (a small number of transactions makes it difficult to value property),
- limited freedom to enter and exit the market (low property liquidity, need for large capital).

From a marketing perspective, market research is the systematic planning, collection, analysis and presentation of data and conclusions relevant to the specific problem and objective of the research. On the other hand, market analysis is a part of market research, providing diagnostic data on market phenomena (Kotler and Keller, 2012). In strategic terms, market analysis consists of an analysis of customers and competitors aimed at determining the attractiveness of a market (or part of it) for current or future participants. This attractiveness manifests itself in the profit potential, measured by return on capital over the long term (Aaker and McLoughlin, 2010, pp. 60-78).

Elements of the market analysis include the identification of:

- the leading parts of the market (submarkets),
- the current and future size of the market (based on current and potential sales),
- the growth rate of the market and its parts (examination of growth factors - demographics, sales fluctuations, pricing policy, etc.), and
- profitability of the market and its parts (level of profitability, average potential profit),
- cost structure of the industry (necessary for building competitive advantage),
- distribution channels (existing, emerging, trends),
- market trends (changes in price sensitivity of demand and supply, changing buyer preferences, regional trends),
- key success factors (elements necessary to achieve the company's marketing objectives).

According to Kucharska-Stasiak (2000), real estate market analysis comprises six stages. The first stage is to determine the market's spatial extent, which may have a different range depending on the market type - broken down by use. The residential property market is a typically local market that covers a city's area (municipality, county). However, it is impossible not to notice the phenomenon of suburbanisation, which has been taking place in Poland for at least a dozen or so years - therefore, one of the elements of the analysis of the residential real estate market should be the observation of investment and purchase activities taking place in the suburban zone (the area of neighbouring localities). The second stage of real estate market analysis is the analysis of the sociological and demographic structure of the local community. The age structure, gender, family and social status, current housing situation or habits, and traditions of the local population provide important information on the structure of demand for real estate and illustrate potential demand. The next step is to analyse the economic base in the area - an important factor is to examine the population's income level, the degree of employment, and to forecast these indicators based on planned future investments and information on the future state of employment. The next step is a supply and demand study. The demand study must take into account all the factors analysed so far: the demographic, sociological and economic situation, as well as the availability and attractiveness of various forms of foreign capital investment financing. The supply study, on the other hand, should be based on examining the existing real estate stock, assessing its condition and functionality and determining the structure or degree of use. The next step is a study of the market situation, particularly the current phase of the business cycle. The stage of the economic cycle can be identified based on data such as the number of vacancies among newly built properties, the number of sales offers in relation to purchase offers, and the ratio between construction costs and the property's market value. The final stage of the analysis is the conclusions of the market

analysis and survey, which should conclude with an assessment of the size and structure of demand, supply and competition for a given market segment. Such a study should identify the current state and consider future trends.

A similar, though somewhat less detailed, concept for conducting a market analysis is proposed by Thrall (2002). Real estate market analysis is the end result of processes aimed at investigating and documenting the myriad factors that determine the demand for a certain type of real estate, the supply of ready-to-use real estate and the territorial scope of the market. On both the demand and supply side, real estate market analysis considers the location and time horizon specific to the type of property and the risks faced by the decision-maker (investor). The stages of a real estate market analysis are (Thrall, 2002):

- establishing the spatial extent of the market,
- estimating the supply of real estate,
- estimation of demand,
- preparation of the market analysis report.

An interesting concept of market analysis is presented by Gaca (2018), proposing to study the impact of real estate market characteristics on price differentiation. According to the author, both parametric (e.g. classical multiple linear regression model) and non-parametric (e.g. Spearman's rank correlation method) statistical methods can be used to analyse the impact of the variability of property characteristics on the variability of their prices. The relationship between prices and property characteristics is correlational; hence, the strength and direction of the relationship can be determined through the values of the correlation coefficients, which can lead to the determination of the impact of individual characteristics on price variation (feature weights).

2.2. Spatial extent of the real estate market

Determining the market's spatial extent is a fundamental, key element of real estate market analysis. It involves determining from which territorial area the majority of customers are interested in acquiring a given property. The spatial extent of the market is presented on maps, so it is advisable to use geoinformatics programmes and methods. Appropriate tools for the selection and presentation of data, e.g., in a Geographic Information System (GIS), can help determine the spatial extent of the analysed market (Basista, 2013). Thrall (2002) proposes that the spatial extent of the market should be determined using W. Applebaum's methods, the spotting method and the analogue method, based on which three market zones can be distinguished: zone one - the core - covers 60-70% of customers (nowadays it is often assumed that as many as 80% of customers reside there), zone two - 15-25%, zone three - less than 15%. In the case of the residential property market, the territorial coverage may be determined by the country's administrative division (e.g., the local market relevant for the analysis of residential transactions is most often the area of a city/municipality). In view of the observed suburbanisation processes, this area may be extended to suburban areas, taking into account the distance or commuting time to work or other important or characteristic places in the city (Thrall, 2002).

The criterion of spatial extent distinguishes four types of real estate market (Gawron, 2012):

- local market - which is most often the location of transactions related to residential real estate and small commercial spaces, concerning those looking for real estate in the immediate vicinity,
- regional market - having a broader scope, being the market for administrative, office, sports, larger commercial and industrial facilities,
- national market - with natural boundaries close to the administrative borders of a country, formed by facilities of national scope, such as central administration, large commercial, industrial, religious facilities,
- international market - with its scope encompassing facilities transcending national borders, mainly related to tourism, such as hotel chains, airports, and historic and luxury facilities, e.g. castles.

Stachura (2007) proposes within the spatial criterion to distinguish the classification:

- local - covering the area of counties (and within them municipalities),
- regional - dividing the country's area into voivodeships,
- urban - dividing the real estate market into:

- urbanised area (space with a predominantly non-agricultural population, with a predominantly urban form of residence),
- non-urbanised area (space with predominantly agricultural population).

This concept seems to be inconsistent in terms of spatial boundaries, but the author's distinction of urban classification is particularly interesting, even deserving a separate place in the division of the real estate market, e.g. as an urban criterion:

- urbanised area - space with a predominantly non-agricultural population, with a predominantly urban form of residence,
- non-urbanised area - a space with a predominantly agricultural population, with a predominantly suburban or rural form of residence.

According to Polish Regulations (Regulation, 2004; Regulation, 2023), the type of market, its area, and the period of the survey shall be determined by the valuer, taking into account, in particular, the subject matter, scope, purpose and manner of the valuation, the availability of data and the similarity of the markets." The area does not have to correspond to the administrative division. The area of the property market to be analysed should reflect the socio-economic similarity affecting the level of property prices (Regulation, 2023). The Explanatory Memorandum to Regulation (2023) indicates that the area of the analysed market should be as homogeneous as possible, i.e. it should be characterised by the socio-economic similarity affecting the level of property prices, while the area need not correspond to an administrative division.

Polish regulations, especially in the area of real estate management, do not define the territorial scope of the market in detail or define concepts such as 'local market' or 'regional market'. However, judicial case law in this area has developed a definition of the concepts of local and regional markets, reducing them territorially to the administrative boundaries of cities, municipalities, districts, and provinces (Krajewska, 2013). Jurisprudence has established that regulations in local government acts may help define these concepts (Ministry of Transport, Construction and Maritime Economy, 2012). The word 'local' includes the territory of the municipality and the county, while 'regional' includes the territory of the province (Act 1990, art. 6.1, art. 7.1.4; Act, 1998, art. 1; WSA in Warsaw, 2008). This position has been confirmed in a number of other judgments of Provincial Administrative Courts (WSA in Wrocław 2009; WSA in Bydgoszcz 2009).

As argued by Wolanin (2012), this problem is not uniformly resolved in the judicial decision-making practice. Indeed, the local real estate market is most often assumed to be the area of a municipality, as the municipality performs public tasks of local importance. However, this is not a universal determinant since, especially in large urban municipalities, several local real estate markets can be distinguished, corresponding, for example, to the area of a city district or even its part. This is why the property valuer, in defining the local real estate market, must be guided by the subject, scope, purpose and manner of valuation and availability of data. Thus, the local real estate market is defined in an individualised manner, which requires proper indication and justification in the appraisal report so that the local real estate market does not cover various markets differentiated in terms of the features shaping supply and demand of real estate in trade. Therefore, a local real estate market should be regarded as a market with homogeneous characteristics influencing the supply of and demand for real estate in circulation".

Similarly, with regard to the division of a large city into several local markets and the peculiarities of real estate, Prystupa (2015) opines that a local market may be smaller in scope than the area of the entire city (municipality, county). An example of this is Warsaw, which consists of many local markets and can only be considered a market area for specific properties. Similarly, studies conducted by Rącka et al. (2017) and Gaca (2018) prove that the residential real estate market in various cities in Poland is spatially differentiated, with turnover and prices differing in the inner city zones and beyond.

The local nature of the residential property market is confirmed by the research of Foryś (2014), who proves that on the scale of the entire local market, there are trends that do not differ from the behaviour of other comparable local markets. However, if individual parts of the local market are analysed, e.g. neighbourhoods or settlements, one can register trends that are different, sometimes even opposite to the general ones observed in cities across the country. Significant differences may appear especially in areas particularly attractive to buyers. Therefore, it should be emphasised that the notion of "local market" should not be identified with the area delimited by the administrative borders of the city (commune, poviat, etc.), which is connected with both the possibility of its narrowing and

expansion. In any case, when delimiting the area of the local market, economic factors should be taken into account first and foremost as decisive ones, including those related to both the nature and type of real estate, as well as factors influencing the formation of demand and supply.

In case law, the local market area is usually assigned to the territory of a municipality or sometimes a county, while the regional market area is territorially identified with the territory of a province. Such reasoning often leads to irrational actions. For this reason, it would be inaccurate to automatically and categorically assume that the administrative division is identical to the economic division affecting prices and the determined value of real estate. This is also confirmed by the Supreme Administrative Court, indicating that economic and social similarity, proximity, consistency of development or communication links take precedence over administrative boundaries. Noteworthy is the view presented by the Provincial Administrative Court in Łódź (Judgment, 2019) indicating that in the case of real estate located on the border of the administrative division of the country, real estate located closer, although formally located in a different administrative unit, may constitute a more representative group for comparing the value of real estate. With the above in mind, the area of the analysed real estate market should each time be determined on an individual basis for a given valuation case by an expert with expertise in real estate appraisal, in compliance with the guidelines in this respect laid down by law (Explanatory Memorandum to Regulation, 2023).

3. Research method

The research problem is to define the boundaries of the local market, where there are properties similar to the ones that are under the investor's interest. The study aims to analyse the local market. Statistical analysis of 178 transactions concluded in 2018-H12023 in Poznań, Poland, was primarily used for market analysis.

In order to indicate the area of local markets in Poznań, the market for undeveloped land intended for multifamily residential buildings in specific locations in the city was identified and monitored, conventionally divided into four zones: central, downtown, intermediate and city outskirts.

That was followed by a statistical analysis of the transactions, an analysis of variance (ANOVA) and z-Tests. The basic principle of ANOVA is to test for differences among the means of the populations by examining the amount of variation within each of these samples relative to the amount of variation between the samples. A one-way ANOVA was used as we collected data about one categorical independent variable (unit price) and one quantitative dependent variable (city zone). The independent variable should have at least three categories. There are five steps to ANOVA: 1. Formulate a hypothesis. 2. Set a significance level. 3. Compute an F-Statistic. 4. Use the F-Statistic to derive a p-value. 5. Compare the p-value and significance level to decide whether or not to reject the null hypothesis. To interpret the key results for One-Way ANOVA, it is necessary to:

1. Determine whether the differences between group means are statistically significant. One should compare the p-value to the significance level to assess the null hypothesis to determine whether any of the differences between the means are statistically significant. The null hypothesis states that the population means are all equal. A significance level indicates a risk of concluding a difference exists when there is no actual difference. Suppose p-value ≤ α, the differences between some means are statistically significant. We must reject the null hypothesis and conclude that not all population means are equal. If p-value > α, the differences between the means are not statistically significant. If the p-value exceeds the significance level, there is insufficient evidence to reject the null hypothesis that the population means are all equal.
2. Examine the group means. The interval plot can be used to display the mean and confidence interval for each group. The interval plots show a sample mean and α (1-α) confidence interval for the mean of a group.
3. Compare the group means. If the one-way ANOVA p-value is less than the significance level, some of the group means are different, but it is not known which pairs of groups. In that case, tests for differences of means should be used to determine whether the mean difference between specific pairs of groups is statistically significant and to estimate how much they differ.
4. Determine how well the model fits the data by examining the goodness-of-fit statistics. S can be used to assess how well the model describes the response, R-sq, which is the percentage of

variation in the response that is explained by the model, and predicted R-sq to determine how well the model predicts the response for new observations.

5. Determine whether the model meets the assumptions of the analysis. The residual plots can help determine whether the model is adequate and meets the assumptions of the analysis. If the assumptions are unmet, the model may not fit the data well, and the results must be interpreted cautiously.

The z-Test is a Two-sample-means analysis tool that performs a two-sample z-Test for means with known variances. This tool tests the null hypothesis that there is no difference between two population means against one-sided or two-sided alternative hypotheses. Understanding the output: "P(Z <= z) one-tail" is really P(Z >= ABS(z)), the probability of a z-value further from 0 in the same direction as the observed z value when there is no difference between the population means. "P(Z <= z) two-tail" is P(Z >= ABS(z) or Z <= -ABS(z)), the probability of a z-value further from 0 in either direction than the observed z-value when there is no difference between the population means. The two-tailed result is just the one-tailed result multiplied by 2. The z-Test tool can also be used where the null hypothesis is that there is a specific nonzero value for the difference between the two population means (Microsoft, 2024).

4. Results and discussion

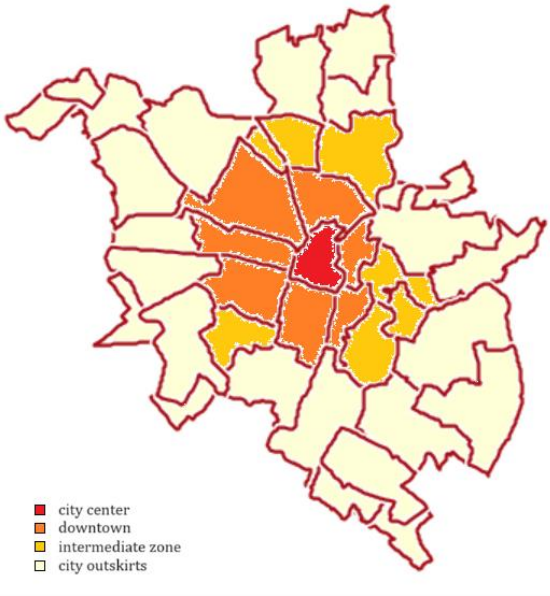
Poznań is divided into zones, diverse in their functional and spatial structure. The city is dominated by fragmented, mixed, diverse forms of development, in which areas of large modernist settlements, downtown districts, and concentrated single-family housing stand out, thanks to their concentration. Characteristics are also the areas of post-industrial and post-military buildings transformed to implement other functions, including housing and services. Poznań is generally characterised by medium-high buildings up to 20 m and low-rise buildings (Study, 2014).

In the central zone of Poznań, metropolitan and center-forming functions are most concentrated, located in downtown buildings. The typical height in the functional downtown area is up to 5 storeys, i.e. approx. 18 m to the cornice. Nowadays, there are changes in the height of buildings in the area of the center in its western and north-western parts, and above all in its south-western part (the so-called City), where tall and high-rise buildings are being built emphasizing the edge of the city center (including Andersia Tower, Poznań Financial Center, Novotel Poznań). Around the center is an interpenetration of city-wide and residential functions, mainly in downtown and quarter buildings, in historically shaped functional and spatial structures of districts. In compact central and downtown buildings, the building area in relation to the building plot area is 80-100%.

As one moves away from the center, city-wide functions disappear in favor of residential functions, mostly located in block-like buildings of large housing estates and in detached buildings. Residential areas in block and quarter buildings are located mainly within housing estates in the northern part of the city (Piątkowo, Winogrady, Naramowice), eastern (Rataje), southern and south-western (Dębiec, Grunwald). In some places, old warehouses and industrial buildings are being replaced by high-rise residential buildings, which largely contribute to the rehabilitation of urban space (e.g. Naramowice). The estate areas are shaped by buildings from the 1970s and 1980s, including 11-16-story residential skyscrapers. A characteristic feature of the building height in the city is its lowering as one approaches open green areas (green wedges) and towards the city's peripheral areas. Multifamily block housing development of modernist estates from the 1960s-1980s. The 20th century is characterized by relatively low intensity; the development area does not exceed 25%, unlike the so-called development estates, where the development area reaches 45%. The greatest development dynamics of the low-rise multifamily housing function occur in Strzeszyn.

Pursuant to the provisions of (Regulation, 2023), it is up to the property appraiser to determine the local market characteristics. Therefore, by examining the mechanisms operating in the Poznań market, it was found that the detailed location within the city itself has a key impact on real estate prices. To justify the above-mentioned observations, the market of undeveloped real estate intended for multifamily residential development in individual locations of the city was identified and observed, conventionally divided into four zones: city center, downtown, intermediate zone, and city outskirts (Fig. 1).

Figure 1: City Zones in Poznań



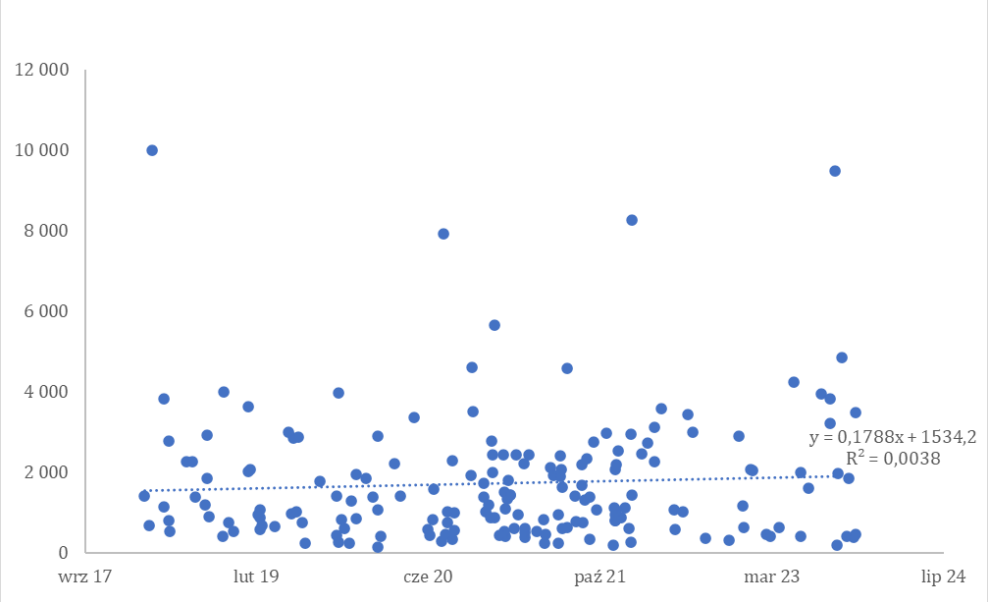
Source: Own work

The property's location is a key feature determining the price of land. The analysis of the value of land intended for multifamily housing showed how much the prices of real estate located in the central and downtown zones differ from those obtained in the intermediate zone.

When searching for market transactions, the following criteria were adopted:

- subject and scope of the market - the market of undeveloped real estate intended for multifamily residential development in the entire city of Poznań, divided into zones: city center, downtown, intermediate zone, outskirts,
- parameter for comparison – 1 m2 of land surface,
- analysis period – 2018-H1 2023,
- price changes - the time trend can be considered insignificant (which is confirmed by research using regression analysis - Fig. 2).

Figure 2: The time trend in Poznań from 2018 to H12023



Note: the unit of time is a day.
Source: Own study.

The properties collected in the database are subject to ownership and perpetual usufruct. There is a noticeable differentiation in the prices of these rights on the local market, mainly due to additional costs for the perpetual usufruct of land, with relatively high values of ownership rights. The market results confirm this market image analysis published in industry magazines (Szarafińska and Rutkowska, 2010).

To confirm the equality of average unit prices of land under ownership and perpetual usufruct, a z-Test was conducted. We tested the null hypothesis that there is no difference between two population means against either one-sided or two-sided hypotheses alternative. As a result, we can see no difference between the population means (Table 1).

Table 1: z-Test with two samples for averages: ownership and perpetual usufruct, a = 0.05

Category (unit prices)	Variable 1 perpetual usufruct	Variable 2 ownership
Mean	1507.7750	1737.0363
Variance	1891106	2516756
Observations	13	165
Hipothesized Mean Difference	0	
z	-0.57186	
P(Z<=z) one-tail	0.283707	
z-Test one-tail	1.644854	
P(Z<=z) two-tail	0.567414	
z-Test two-til	1.959964	

Source: Own study.

Analyzing the multifamily undeveloped real estate market in Poznań, it was found that the type of right to land (ownership or perpetual usufruct) does not have a decisive influence on the transaction price obtained - real estate with different rights to land form the same market segment.

The analyzed market was relatively well-developed; nearly 200 transactions were concluded over six years, for which basic statistical measures were determined (Table 2).

Table 2: Unit price statictics in 4 zones in Poznań (2018-H1 2023)

	City Center	Downtown	Intermediate zone	Outskirts
Mean	3591	1923	1182	814
Standard error	640	157	105	125
Median	3820	1917	1007	610
Standard deviation	2640	1477	681	687
Kurtosis	0.88	9.92	1.91	15.13
Skewness	0.90	2.39	1.28	3.43
Range	9751	9285	3300	3811
Minimum	249	200	180	134
Maximum	10000	9485	3480	3945
Sum	61049	171106	49651	24407
Count	17	89	42	30
Confidence Level(95.0%)	1357	311	212	257

Source: Own study.

To test the null hypothesis that the means of four populations are all equal., an analysis of variance (ANOVA) was conducted. A one-way ANOVA was used as we collected data about one categorical independent variable (unit price) and one quantitative dependent variable (city zone). The independent variable had four categories. In the first step, a hypothesis was formulated (the mean unit prices in all zones are equal). We set a significance level of a=0.05. We computed an F-Statistic (F=17,2505). After that we used the F-Statistic to derive a p-value of $7{,}485^{e\text{-}10}$. Finaly, we compared the p-value and significance level to reject the null hypothesis (Table 3).

Table 3: ANOVA – unit prices in 4 zones in Poznań (2028-H1 2023)

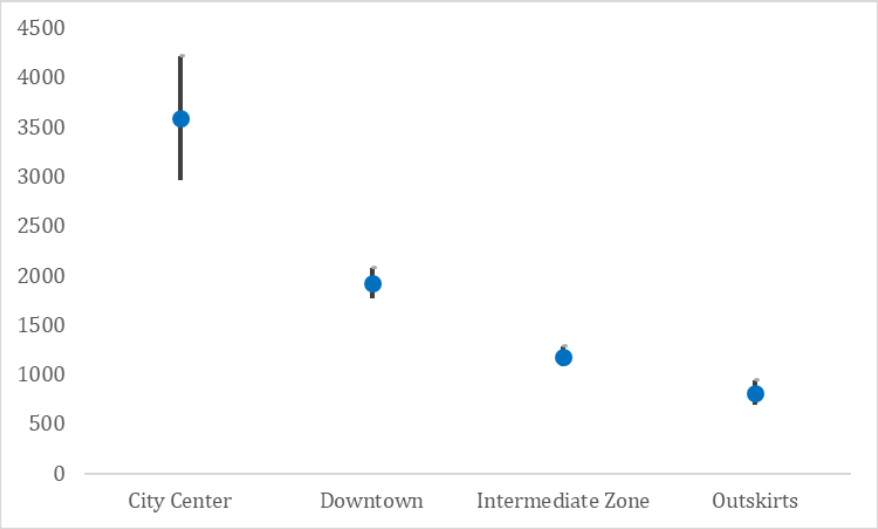
Groups	Count	Sum	Average	Variance
City Center	17	61049	3591	6969300
Downtown	89	171106	1923	2180658
Intermediate Zone	42	49651	1182	463525
Outskirts	30	24407	814	472315

ANOVA						
Source of variation	SS	df	MS	F	p=Value	F-Test
Between groups	99966380	3	33322127	17.2505	$7.49E^{-10}$	2.6565
Within groups	336108344	174	1931657			
Total	436074724	177				

Source: Own study.

The differences between group means are statistically significant. The null hypothesis states that the population means are all equal. P-value ≤ α, so the differences between some means are statistically significant. We must reject the null hypothesis and conclude that not all population means are equal. The group means, and the interval plots are presented below (Figure 3).

Figure 3: The group means and the interval plots



Source: Own study.

As the one-way ANOVA p-value is less than the significance level, some of the group means are different, but it is not known which pairs of groups. Therefore, we used z-Tests for differences of means to determine whether the mean difference between specific pairs of groups is statistically significant. The z-Test is a Two-sample Means analysis tool that performs a two-sample z-Test for means with known variances. We used this tool to test the null hypothesis that there is no difference between two population means against one-sided or two-sided alternative hypotheses. The results are shown in Table 4.

Table 4: z-Test with two samples for averages: Zones in pairs, a = 0.05

Pair	Mean		Count			one-tail		two-tail	
	1	2	1	2	z	P(Z<=z)	z-Test one-tail	P(Z<=z)	z-Test
City Center Downtown	1508	1737	13	165	-0.57	0.28	1.64	0.57	1.99
City Center Intermediate Zone	3591	1182	17	42	3.71	0.00	1.64	0.00	1.96
City Center Outskirts	3591	814	17	30	4.26	0.00	1.64	0.00	1.96
Downtown Intermediate Zone	1923	1182	89	42	3.93	0.00	1.64	0.00	1.96
Downtown Outskirts	1923	814	89	30	5.53	0.00	1.64	0.00	1.96
Intermediate Zone Outskirts	1182	814	42	30	2.25	0.01	1.64	0.02	1.96

Source: Own study.

Analyzing the multifamily undeveloped real estate market in Poznań, it was found that the location in a zone (City Center, Downtown, Intermediate Zone, Outskirts) does have a decisive influence on the transaction price obtained.

All hypotheses about equality of means in pairs should be rejected. This means that average unit prices in individual locations differ; hence, each market identified within MAIST can be considered local.

5. Discussion of results and conclusions

During the analysis, we found that the most expensive were properties attractively located in surroundings determined by the quality and degree of development as well as the degree of infrastructure and development of neighbourhoods. The investment opportunities measured by development factor, the number of storeys that can be built on the land, the ratio of the building to the size of the plot, etc. (resulting from planning conditions), as well as the geometry of the plot and the terrain, also had a significant impact on the transaction price.

It can be clearly noticed that prices in individual areas showed a pattern related to the proportional impact of the location closer to the city center on the price level.

The market value of real estate is influenced by various market features, in particular location and those that determine the investment potential of undeveloped land and the comfort of use of real estate that will be developed in the future. The collected material is characterized by a high level of discrepancy in terms of plot areas. The results of the analysis showed that the relationship between the area and the unit price in the selected set of transactions is statistically insignificant (the study was carried out using Pearson's linear correlation, where the value of the coefficient r = 0.176 was obtained, with the limit value of the coefficient r* for rejecting the null hypothesis of no relationship between the variables equal to r*=0.193 for α=0.01). The analyzed market is specific; the price level change is determined by each property's individual characteristics, excluding the land area. The results of the regression analysis for the change in the price level over time, presented in Fig. 2, also indicate that there is no basis for stating a statistically significant change in the price level over time for the examined set.

The research shows that within the analyzed segment, the location in relation to the city center greatly impacted real estate prices. It was established that the city center and downtown are specific areas where the supply of available land is limited, which indirectly translates into price level. The property's location in an appropriate city zone and among historical buildings determines whether the area is subject to conservation protection and the related conditions to implement investments.

However, conservation restrictions do not make investors reluctant to pay a higher price for the property than in the case of areas away from the center.

In the valuation of real estate, the inclusion of real estate located outside the area in which the real estate being valued is located for comparison could result in the lack of comparability of the real estate.

Referring to the spatial extent of the market, which should be analyzed when valuing real estate for a developer, attention should be paid to the consistency of the obtained research results in determining the spatial extent of the market by Prystupa (2015). It was proven that the local market does not always have to be the market of a city or municipality. It is difficult to find similar properties to correctly determine the property's value. The area of the city (municipality) is often taken as the local market, but in Poznań, the market analysis should be narrowed down to specific districts or housing estates.

Investors decide on the location of residential investments, considering land prices and real estate development opportunities, which vary in different parts of the city. The quality of life of residents and the degree of sustainable development of the city that can be achieved depend on the developers' decisions on the choice of location and the spatial and technical solutions used.

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Conflicts of interest

The author declares no conflict of interest.

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