UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN
FACULTY OF GEOENGINEERING

A PROPOSAL TO IMPROVE THE SYSTEM OF VALUATING URBANIZED LAND IN VIETNAM BASED ON POLISH EXPERIENCE

Doctoral Dissertation

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ACRONYM

ADB	: Asian Development Bank
CBD	: Central Business District
CMA	: Comparative Market Analysis
DCF	: Discounted Cash Flow
EVS	: European Valuation Standards
FAO	: Food and Agriculture Organization of the United Nations
FIG	: International Federation of Suveyors
GDP	: Gross Domestic Product
GNP	: Gross National Product
IAAO	: International Association of Assesing Officers
IVS	: International Valuation Standards
IVSC	: Internation Valuation Standards Counsil
LAS	: Land Information System
LURC	: Land Use rights Certificates
MARP	: Mass Appraisal of Real Properties
MV	: Market Value
PCI	: Per Capita Income
RICS	: Royal Institute of Chartered Surveyers
TEGOVA	: The European Group of Valuers' Associations
UE	: European Onion
UNECE	: United Nations Economic Comission for Europe
UN DESA	: Department of Economic and Social Affairs
UN-HABITAT	: United Nations Human Settlements Programme
USSD	: Union Soviet Socialist Republic

1. INTRODUCTION

1.1. General introduction

The shift from centrally regulated real estate prices (statutory prices) to market prices in property valuation was one of the most important processes in the period of transition from a centrally planned economy to a market economy. As a result, real estate became a market commodity, and investors began to compete for land in the urban-rural continuum that is influenced by the urban core. In a centrally planned economy, the value of land was determined by the authorities (State), or it was assumed that land does not have a price and, therefore, belongs to the state. These assumptions led to the misuse of valuable land, and they did not promote sustainable development. Before 1989, the value of real estate in Poland was determined based on official indicators that were developed by the state administration (Mizera, Poczobutt-Odlanicki 1974). The value of real estate calculated based on these indicators was completely detached from market reality, and these values were quoted as the official property prices (this some in Vietnam). These values were also used to calculate the amount of compensation due to owners of property that was seized by the government (land expropriation) and to update perpetual usufruct fees. In Vietnam, the value (price) of land was also determined by the authorities before 1990 (Foryś and Nguyen 2016). It should be noted that the value of real estate, in particular market value, is an important measure of market performance. Property value plays a significant role on the market of urban land, and it facilitates numerous land management processes. However, the evolution of the real estate market is a process that involves many political and economic decisions. The relationships between different elements of the real estate market are evaluated, and internal market constraints are identified. The results of market analyses do not provide simple answers about supply and demand or the prices of property. The reasons behind the variations in market parameters should be explained. Therefore, the real estate market should be evaluated in a dynamic approach. The value of real estate is determined by measuring market factors that directly influence land value. Property appraisers conduct complex analyses of numerous variables that affect the market value of land, and changes in these variables are presented with the use of mapping functions. The trajectories of independent variables are determined in spatial analyses that cover long time series and account for changes in external conditions. The interactions between demand and supply components of a market

affect land prices and the performance of the real estate market. Unlike other sectors of the economy, the real estate market is characterized by a low elasticity of supply and a relatively low elasticity of demand, which is related to the unique attributes of real estate as well as the influence of external factors (legal regulations at various levels of governance, local laws, mortgage rates). Spatial phenomena associated with the real estate market are governed by certain rules and trends. Therefore, they can be analyzed with the use of statistical methods. The type of the examined variables and the accuracy with which these variables can be measured are taken into consideration in market analyses. The price of real estate denotes its market value at a given moment in time. The prices of numerous transactions conducted on the same market are analyzed to identify cause-effect relationships between an independent variable and a previously selected group of independent variables. It is generally assumed that real estate markets can be examined *ex post* with the use of statistical methods. In-depth market analyses are one of the many tools for making decisions about urban land management. Market trends applicable to different property types are also analyzed. However, the information about local markets is rarely complete or fully available, which compromises the reliability of market analyses. The fact that local markets are idiosyncratic further complicates the analytical process. Every real estate market is unique in terms of location, history, availability of market services, and the specific attributes of the urban area. In Poland, privately-owned land was not fully nationalized after the socialist doctrine and a centrally planned economy had been introduced in 1945. A completely different approach had been adopted by the USSR and other socialist countries after World War II. In Poland, official land prices and land lease fees were introduced to limit extensive land use by public entities and individuals, at least in theory. Arbitrarily imposed "administrative" prices (statutory prices) that were completely detached from market reality were regarded as an effective tool for preventing extensive land use in cities and residential districts. Land prices and lease fees were regulated by the provisions of the Act of 1961 on land management in cities and districts. The implemented valuation principles were not governed by the law of supply and demand, and they contributed to the emergence of the gray market. In principle, trade in land was not prohibited. Land could be sold and bought by individuals pursuant to the provisions of the applicable laws and regulations. However, the 1961 Act on land management in cities and districts banned the sale of State-owned land within the administrative boundaries of cities. In these areas, urban land could be leased (perpetual usufruct) to central administration units and public organizations.

Publicly owned land could also be held in perpetual usufruct by housing cooperatives, individuals and public organizations listed in the above Act. Urban land catered to public and individual needs associated with economic and social development. Trade in urban land was also regulated by the Act of 1958 on the terms and mode of land expropriation, the Act of 1961 on spatial planning, and the Act of 1972 on land for single-family homes and farmsteads, and the division of real estate in cities and districts(Źróbek red. 2020; Radziszewski 1992; Gintowt and Rudnicki 1969). Therefore, the management and administration of urban land, and the principles and procedures for calculating land prices and lease fees were regulated by acts of law. Before 1990, valuation principles in Poland were similar to those that had been adopted by other socialist countries, but certain differences were noted in the approach to land valuation and private ownership. These solutions can be modified, and Poland's experiences can be used to develop an effective approach to the valuation and pricing of urban land in Vietnam after 2020. The proposed solutions should account for the current stage of market evolution in both countries as well as information about local real estate markets, including property prices that are quoted outside the official channels. This approach supports the development of effective principles for land valuation based on factors that influence the market value of land. The following core principles are generally taken into consideration in detailed analyses of the real estate market:

- the price of urban land reflects the market value of land or the "quasi-market" value of land in transition economies,
- statutory prices set by the government are gradually abandoned in favor of market prices,
- a mixed approach to land valuation can be applied in transition economies. This approach is particularly useful when information about transaction prices on local markets is limited.

In view of the above, the Polish experience of economic liberalization in the real estate sector can be effectively used to modify the principles for determining the value of urban land in Vietnam. The present study not only contributes new theoretical knowledge, but also has practical applications because the effect of the proposed system for determining the market value of land on decision-making processes in the Vietnamese real estate sector can be evaluated. sale of publicly-owned land to foreign buyers and the

This study was undertaken to modify the Vietnamese land valuation system based on the lessons that were learned by Poland during the period of political and economic

transformation. Due to the significance of the analyzed problem and the general scarcity of comprehensive studies on the topic, the Polish experience can be harnessed to evaluate the applicability of various methods and approaches to the valuation of urban land. Despite numerous differences between the compared countries, the real estate markets in Poland and Vietnam share a certain number of similarities. The land valuation principles adopted in Poland during the transition period (1990-1995) can be modified and adapted to the specific needs of the real estate market in Vietnam. The proposed solutions can generate tangible benefits by improving land management practices in urban areas and introducing effective principles for calculating property taxes and fees based on the market value of urban land. The proposed solutions will also contribute to the protection of ecologically valuable land that is subjected to strong urbanization pressure. The developed procedures will minimize the risk of land-use conflict at the urban-rural interface and will contribute to the sustainable development of urban areas. The discussed problem is interesting both from the scientific and practical perspective. A comparative approach was proposed and the applicability the multiple regression model for determining the value of urban land was verified with the use of scientific methods. The results of this study have numerous practical applications for managing urban land in the urban-rural continuum. The study described in this dissertation also expands the existing body of knowledge about land valuation. In the experimental part of the research, the value of land determined with the use of the proposed methods was compared with real-world transaction prices on the free market.

In this study, the value of land was determined mostly with the use of the methods that had been deployed in Poland between 1990 and 2020. The mass appraisal approach, which is used to calculate the cadastral value of property for tax purposes, was also applied. The study covered two adjacent test fields in Poland. The first test field was the city of Olsztyn. The second test field was the Bartąg-Bartążek suburban zone in the municipality of Stawiguda which is directly adjacent to Olsztyn. These test fields were selected for the study because Olsztyn and Stawiguda had attracted considerable interest from residential property developers in recent years. In Vietnam, the test field was the Gia Lam District of Hanoi, where the number of property transactions increased significantly in recent years to cater to the demand for housing and the accompanying facilities. The applicability and functionality of detailed solutions had been previously tested in this district. This test field was also selected for the study due to the availability of information about the market prices and attributes of land. The validity of land values

calculated with the use of various methods was assessed, and the most effective solutions were modified to develop a land valuation system for Vietnam. The proposed system will cover private property transactions as well as real estate purchases made by the authorities pursuant to the provisions of the civil law.

1.2. Research thesis and hypotheses

In view of the identified formal needs and the scope of the conducted research, the following **research thesis** was formulated to address the theoretical value and practical implications of the anticipated results: **the Polish experience of economic liberalization in the real estate sector after 1990 can be used after modification to propose a system for urban land valuation in Vietnam.**

The lessons learned by Poland between 1990 and 2020 suggest that the transition from a centrally planned economy in the real estate sector requires the initiation of many formal processes and coordinated organizational efforts. The results of these measures should be reflected in legal regulations and professional standards for property appraisers. In Poland, the absence of reliable information about the transaction prices of real estate on a liberalized market was the key problem in the transition period. Informal transactions were concluded between private property owners, but these prices were not registered, which significantly impaired the availability of reliable market data and their evaluation. Centrally imposed land prices differed considerably from the prices quoted on the informal market. Land valuation methods in Poland were modified between 1990 and 1995, and these changes helped bridge the gap between statutory prices and real-world prices of urban land. The following **research hypotheses** were formulated and tested in this study:

1. Polish experiences relating to urban land valuation during the transition from a centrally planned (socialist) economy to a market economy can be harnessed to develop a modern land valuation system for Vietnam.
2. the proposed method (named improvement index method) for assessing the value of urban land in Vietnam as well as other transition countries will support rational land management in urban areas, create objective access to State-owned land, and generate new streams of revenue from the real estate sector .

Relatively poor land administration, especially improper urban land valuation (statutory prices) and inefficient and unscrupulous employees threaten tenure security

and reduce the amount of revenue that can be generated from this land. Accelerating the pace of economic development is one of the main political goals of developing countries (e.g. Vietnam). Therefore, the doctoral dissertation focused on improving the existing system of pricing for land in Vietnam, providing its own proposals for its modernization. The main purpose of such a procedure is to reduce the gap between the statutory prices level of land and their market values recorded on the non-corporate market.

1.3. Research objectives

Assessments of real estate valuation systems require in-depth analyses of the history and evolution of urban areas, the existing property appraisal systems, the effects of specific factors on land prices, as well as social and economic processes in a given country. **The main research objective was to determine the extent to which the land valuation methods that had been deployed in Poland during the economic transition period can be applied to improve the principles of calculating the value of urban land in Vietnam.**

The following **specific objectives** were formulated:

1. to describe and characterize the existing land-use types on urban areas;
2. to analyze changes in land use in urban areas general and in some countries;
3. to describe the evolution of the land valuation in Poland after 1990;
4. to determine the value of urban land with the use of various detailed method and to analyze the obtained results;
5. to propose changes in the land valuation system in Vietnam.

1.4. Research methods

Various methods were used to achieve the main research aim and specific objectives. Research methods were selected based on a review of the literature and own experiences and knowledge of various markets, including real estate markets. Urbanization processes and their impact on the market value of land were analyzed by deductive reasoning and descriptive and comparative analyses based on the reviewed literature. The collected research materials were analyzed by inferential reasoning with the use of descriptive and heuristic methods.

The first stage of research involved a review of the literature addressing the following areas of scientific inquiry:

- characteristic features of urban areas and factors that affect urban development and the market value of urban land;
- land-use types in urban areas and the value of land in the process of urban management and urban development;
- selection of attributes for determining the market value of land, including the availability of the relevant information on local real estate markets;
- analyses of the existing land valuation systems in Poland and Vietnam which provide valuable information for comparative purposes and can be used to propose changes in the procedure of calculating the value of urban land in Vietnam.

The results of an in-depth literature review as well as analyses of urbanization pressure and other factors that influence land use in urban areas were used to conduct detailed analyses in selected test fields with the use of the developed algorithms and detailed procedures. Statistical methods were selected and applied to process market data and describe the cause-effect relationships between the prices of urban land and the previously identified factors that significantly influence the value of land in urban areas. In the first stage of the study, the cause-effect relationships between the examined variables were determined in a correlation analysis. In the following stage, a multiple regression model was built to validate the cause-effect relationships between variables that affect the value of urban land. Information for the study was also obtained during a questionnaire survey involving real estate experts. The results of the survey were confronted with the opinions of professional property valuers in Poland. The publications and reports developed by the International Federation of Surveyors (FIG) and the guidelines of the Food and Agriculture Organization (FAO) for monitoring land administration systems were also reviewed.

The gathered data were processed with the use of correlation analysis and selected multiple regression models. A correlation analysis was conducted to identify factors that influence the value of urban land. Regression models were applied to determine the strength of the relationships between the price (value) of land and factors that affect land value. Real estate valuation is a process that relies on the experience and opinions of individual valuers, therefore the stepwise regression procedure was selected for further

analyses. Detailed conclusions were formulated by deductive reasoning based on own experiences and the opinions of the surveyed real estate experts (Delphi method).

1.5. Scope of research and primary data sources

Real estate valuation is a complex and multifaceted problem, which is why detailed analyses focused on the value of land in urban areas. Numerous sources of information about the land market were analyzed to achieve the described research objectives. The scope of the reviewed studies and analyses was narrowed down to urban areas, and test fields in Poland (Olsztyn) and Vietnam (Hanoi) were selected for the research. The study focused on the prices of undeveloped land and factors that influence land prices. The optimal methods for estimating the value of urban land in Vietnam were selected based on Polish experiences during the transition period of 1990-2020. The methods of determining the value of individual land plots were also analyzed. The mass appraisal model, which had been implemented in Poland after 1997, was also used for comparative purposes. The main sources of information for detailed analyses included the Polish Register of Real Estate Prices, Vietnamese databases of real estate prices, Polish Land and Building Register, base maps, topographic maps, and the results of a dedicated expert survey that was designed to elicit information about land prices and factors that influence the value of land. Local zoning plans and the accompanying base maps (graphic materials appended to the zoning plan) were also analyzed. Factors that influence land value were selected with the use of topographic maps in different scales and the geospatial resources that are available in the Polish Geoportal service. The indications of real estate market experts from both countries were also used. Selected land valuation methods were subjected to detailed analyses conducted in two test fields located in Olsztyn, Poland. The aim of these detailed analyses was to determine the difference between land value and its price in the Polish Register of Real Estate Prices. Test fields were selected for the study based on the presence of specific land-use types and the availability of reliable information about urbanization processes. The information describing the chosen test fields was additionally verified during a field survey. Land prices in the study area were adjusted for the end of 2020 to eliminate the influence of time on transaction prices. The evolution of land valuation methods on the Polish real estate market between 1990 and 2020 was analyzed, and the results of the analysis were used to select the optimal method for validating selected detailed solutions. Detailed

conclusions were formulated, and a valuation method that produced the smallest deviation of the estimated land values from real-world transaction prices was selected. The efficacy of the reviewed valuation methods was also assessed in different stages of evolution of the Polish real estate market.

In Vietnam, the test field for detailed analyses was the Gia Lam District of Hanoi. The rapidly evolving economic and demographic reality of contemporary Vietnam has significantly contributed to the development of the Gia Lam District in recent years. The prices of real estate transactions conducted outside the official channels were also analyzed. In the studied district, land was traded mainly to cater to the growing demand for housing and the accompanying facilities. Detailed solutions were tested, and effective principles for assessing the value of urban land were formulated and used to develop a modern land valuation system for Vietnam. Basic analyzes were carried out in test fields in Poland. This was related to, inter alia, access to data on the real estate market. In the case of Vietnam, recommendations of real estate experts were used. Own research on the real estate market in Hanoi was also used.

2. LITERATURE REVIEW

2.1. Introduction

The following factors and considerations relating to land appraisal in urban areas were analyzed based on a review of the literature:

a) the progress and complexity of urbanization processes and the evolution of various land-use types in urban areas,

b) systems for managing urban areas with various levels of social and economic development and an analysis of land markets,

c) land appraisal principles in urban areas and methods for estimating and selecting parameters that affect the value of appraised property.

These factors are closely linked, and they can be used in the process of developing a land appraisal system for urban areas and formulating appraisal principles for land under development.

In connection with the need to analyze the state of the research to date, affecting the achievement of the objectives of this monograph, a review of the literature was made using the links and relations contained in the following diagrams illustrating the individual steps of this analysis (Fig 2.1). Particular attention was paid to the issues related to the selection of factors influencing the value of urbanized land. Various approaches to the selection of features influencing the market value of real estate were also analyzed.

The attention was also paid to the aspects of urban development and factors related to the globalization of urban development. The following procedure was used in these tests:

- type of publication and its author,
- research context related to and achievement of work goals,
- analysis of the obtained results and assessment of their suitability for further research,
- the possibility and legitimacy of using proven detailed solutions (e.g., multiple regression analysis to study the impact of selected market factors on the value of urbanized land).

In this chapter, only some indications resulting from the literature review are presented. Detailed analyzes are presented in the following chapters of the monograph

and will concern the analysis of specific solutions, combining them with proposals for their use in the framework of detailed own research.

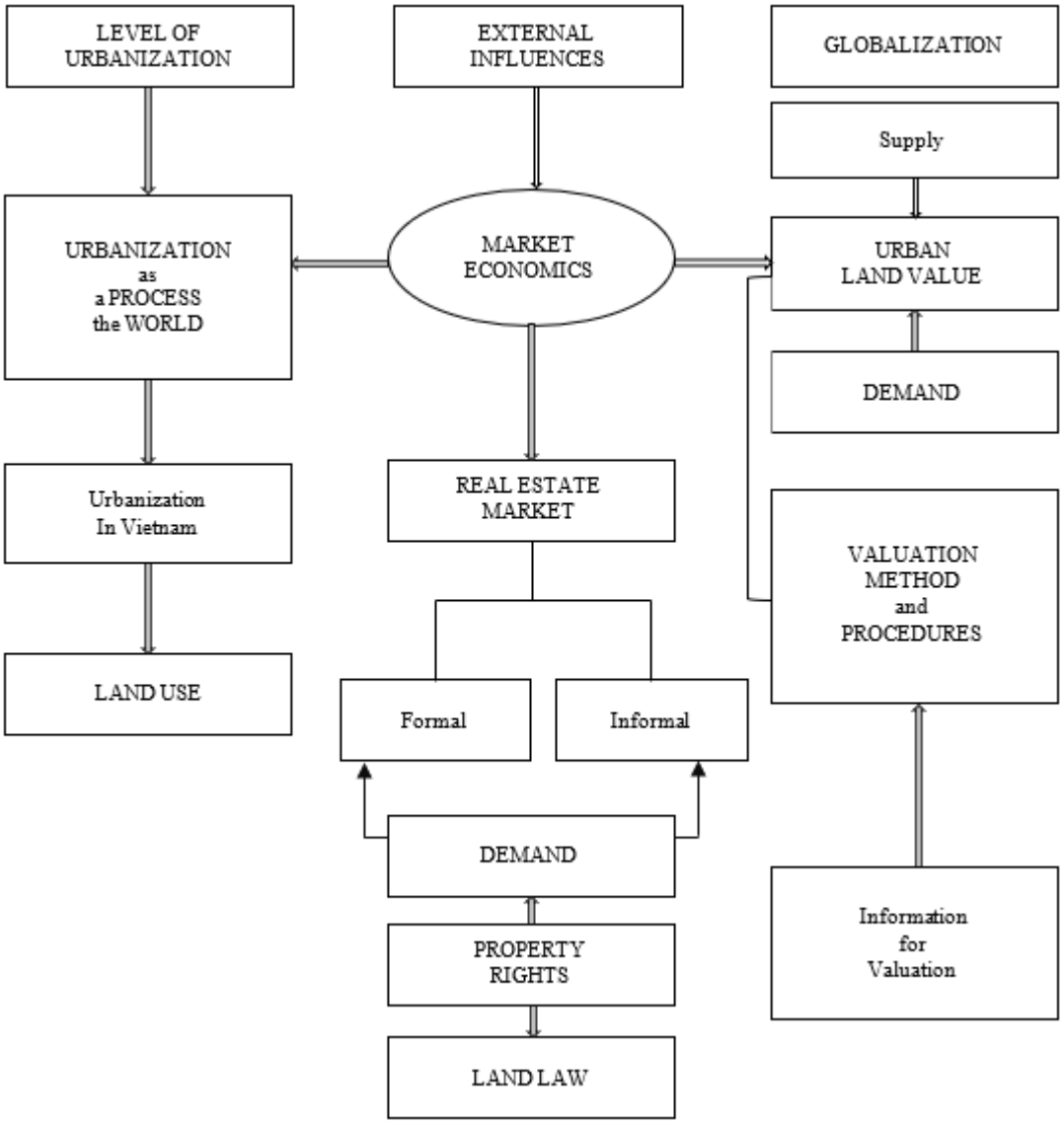


Fig. 2.1 Basic research components of detailed analyzes performed as part of the literature review

Source: own study

2.2. Land use in urban areas

Rapid population growth in cities requires changes in land-use regulations and urban planning. Land-use regulations should also be modified to control urban growth and implement modern environmental protection standards. In well-developed urban management systems, urban planners and the local authorities make zoning decisions to

accommodate the growing number of urban residents (Vietnam) or to reduce the number of multi-generational households (Poland). Land also has to be effectively zoned for the construction of urban infrastructure and the accompanying services. Land resources also have to be allocated to the development of recreational areas, parks and residential greenery (Angel et al. 2007). The main goal of land-use planning in urban areas is to promote the sustainable development of cities and guarantee high living and recreational standards for urban residents (Ewing et al. 2003). Urban residents should be provided with access to public information relating to land use and land management. Comprehensive renewal and revitalization projects take a long time to complete (Bendor et al. 2014). Land-use regulations in cities should also be modified to prevent urban sprawl. Urban sprawl leads to the territorial disintegration of cities and the segmentation of the real estate market into submarkets whose area is difficult to define. This phenomenon also gives rise to transitional zones characterized by different types of land use (Źróbek 2020, 2011; Pacione 2005). In large cities, transitional zones incorporate complex and highly specific land-use types. Transitional zones are susceptible to land-use conflict, in particular along the urban-rural boundary, which could be attributed to the introduction of new functions to rural areas. These sites are often adjacent to land that is zoned for urban development (Korsunsky 2019). In Poland and Vietnam, many urban areas have a complex land-use structure because the development of urban functions has to be reconciled with environmental protection needs. In Poland, the first nature conservation sites were introduced in 1997, and their number has increased significantly after Poland had joined the European Union. These sites should also be taken into consideration in urban planning (Brawner 2015; Źróbek 1985). The validity and reliability of land-use data plays a very important role in urban planning processes.

According to Ondoño (2021), cadastral systems can be used to analyze the rate of changes in land use in urban areas. The cited authors concluded that urban land-use structures should be effectively monitored to guarantee rational management of land resources in cities and prevent urban sprawl. The real estate cadaster facilitates analyses of land-use changes in urban areas and transitional zones. Similar observations were made by Ting and Williamson (2013) who also noted that economic considerations (increase in land prices) affect the development of cities and the surrounding urbanized areas. Land-use management is an important part of urban planning systems. Land-use regulations enhance efficient use of resources and promote sustainable urban planning (World bank

2008; ADB 2006) Land-use management systems also minimize the risk of spatial conflict in areas undergoing urbanization.

2.3. Principles and procedures of appraising land in urbanized areas

Four groups of factors that affect the value of land have been selected based on a review of the discussed valuation models: land attribute factors, location factors, regional factors, and macro factors:

- the group of land attribute factors consists of factors that are directly related to a parcel of land and which differentiate parcels in the same area, including physical properties, land management, soil characteristics, and legal factors;

- the group of location factors consists of factors that affect the price of land, reflect the position of an individual land parcel and present the correlations between a given parcel and the surrounding objects in the examined area;

- the group of regional factors consists of surrounding elements that affect a land parcel, including infrastructure, environment, society, geography, and terrain (plants, hydrology);

- the group of macro factors consists of general external factors at the macro level, including macroeconomic factors, macro policy factors.

2.3.1. Land attribute factors

Land parcel area: the area of a land parcel is an important determinant of the value of urban land (Bao et al. 2014). Numerous studies have demonstrated that land plots affect land values (Tran and Bui 2015; Colwell and Munneke 1999. A linear logarithmic relationship was also reported between parcel value and its area (McMillen and Thorsnes 1998). The price of a land parcel is also affected by its size which can facilitate or compromise production or can exceed the financial capabilities of the user or buyer of land (Nguyen and Hoang 2011).

Shape of a land parcel: when describing a parcel of land, the shape of a land parcel is always mentioned because it has a great influence to the current use or potential use of a site. The most desirable parcels have the shape of a square or a rectangle. According to Nguyen and Hoang (2011), the value of land plots can be arranged in the following

descending order based on their shape: square-like rectangle, rectangle, hatched trapezoid, non-square shapes such as polygons, L-shaped, and posterior trapezoid shapes.

Land parcel width: parcels with a narrow frontage cannot be effectively displayed or used for business, commerce or residential development, which also affects their prices (Ho and Nguyen 2006).

Land parcel depth: A parcel that is too shallow or too deep relative to the road surface is not suitable for any purpose, which affects its price (Ho and Nguyen 2006).

Elevation: In a study by Demetriou (2016), elevation in a land consolidation project was defined as the height of a location adjacent to the main road. According to Gao and Asami (2007), land prices decrease by elevation.

Slope: according to Ho and Nguyen (2006).parcels with a considerable slope are not suitable for investment due to high development costs, which affects the prices of residential land.

2.3.2. Location factors

Location is the key determinant of land prices, and it can be evaluated in terms of economic opportunity, living landscape, expected residence, or commuting convenience (Atack and Margo 1998). Location factors are important for both urban and agricultural land (Choione 1981).

Distance to a central area: central Business District (CBD) is the administrative and commercial center of a city or iconic city locations. The distance to CBD is calculated as the sum of straight-line distances from a parcel along main roads plus the distance from the main road to the center (Yowaldi 2012, Nzaun 2003). The relationship between individual and organization land use in urban structure was researched by Alonso (1964). In addition, Alonso also noted that the city is most developed in CBD and gradually decreases in the surrounding area. The hypothesis postulating that land prices change in the direction of the changes in distance from CBD was justified in the past. However, at present, the relationship between land prices and distance to CBD is increasingly complicated due to new forms of dense development in business and retail centers (Hu et al. 2016; Anderson et al. 1976).

Distance to a market, a trade center or a consumer market: the proximity of a market, a shopping center or a consumer market increases the ease of access to a land plot and reduces travel costs, but it can also cause noise pollution and congestion. According

So et al. (1997) distance to shopping center is important factors in determining prices of properties. Research has shown that every 1% nearer to the shopping mall can increase the value of the property by 0.077% (using the assessed prices data) and 0.145% (using the offering prices data) (Malaitham et al. 2020).

Distance to school: many people are attracted to living around schools. Topcu and Kubat (2009) show that the distances from universities are an influential factor in determining residential land values.

Distance to the main road: the greater the distance from a land plot to the main road, the lower the price because distance increases the time and cost of travel and transport. The profitability of land plots situated remotely from a main road is also compromised (Le 2011). It can be concluded that the value of land will increase in the proximity of the main road. This factor is measured by the straight distance from the parcel to the nearest main road (Nzau 2003).

Distance to a public transport stop: the positive effect of effective public transport on land prices has also been experimentally tested. The distance to public transport was found to be positively associated with land prices (Lee 2002). In Hong Kong, buyers are willing to pay more for land plots with convenient access to public transport (So et al. 1997).

Distance to a bus station (train station): a study analyzing the factors that influence land prices in Thailand has revealed that distance to a bus terminal is a determinant significant of land value (Bao et al. 2014). In Japan, the value of urban land is strongly influenced by the bus terminal system as many people move between cities and suburbs by this mode of transport (Tsutsumi et al. 2011).

Distance to an airport: the proximity of an airport can exert both a positive and a negative influence on the value of land. The benefits associated with easy access to an airport and the relevant transport infrastructure outweigh the disadvantages of noise pollution (Tomkins et al. 1998). Research has demonstrated that the price of standard accommodation situated 2.5 km from an airport terminal is around 19% higher than the price of similar property located at an average distance from the terminal (Chin and Chau 2003).

Distance to amusement parks, sports facilities, post offices, police stations, community centers, parks: relating to some of the remaining public services, Topcu and Kubat (2009) used several factors to determine the extent to which public services, such as sports facilities, entertainment sites, amusement parts, police stations, nursing homes

and community centers, affect the price of urban land in Turkey. The proximity of public parks was also found to exert a profound impact on the ecological value of urban landscapes in China (Hu et al. 2016).

Distance to rivers and lakes: land plots with a lake view provide an open perspective and maximize human comfort, and this factor affects the prices of residential land (Hu et al. 2016). Darling (1973) found that land plots situated directly on a lake always fetch significantly higher prices. Rivers play an role in urban open space, and they have a profound impact on the ecological value of urban landscapes (Hu et al. 2016).

Distance to a forest: a study investigating the benefits of forests in urban areas in Finland revealed that consumers appreciate green housing and access to recreational areas in forests. However, the effect of urban forests on land prices is not linear because forests are too close to reduce the price of residential land, where the size and quality of a forest and the distance separating a land plot from a forest influence the increase in property prices (Tyrvainen 1997).

Distance to a landfill or an industrial zone: the proximity of areas that cause discomfort to humans has a direct negative impact on land values (Bovkir and Arif 2018).

2.3.3. Regional factors

Infrastructure: The density of the road network: in addition to traffic types, accessibility to external roads, the overall structure of the transportation network and the condition of public transport, the density of the road network is yet another component of technical infrastructure that affects land prices. According to Hu et al. (2016), a high-density distribution network provides more advantages in traffic and transportability than a low density road network. Convenient transportation to urban areas enhances exchange and trade with the outside world, and it can promote a city's development to a certain extent.

Environment: land prices are affected by the quality of the local environment and its components, including the water environment, air environment and noise (Nguyen and Nguyen 2013).

Air environment: chattopadhyay (1999) evaluated buyers' willingness to pay a higher price to avoid residential air pollution and found that consumers in the United States were willing to pay more for land plots characterized by low levels of dust and sulfur dioxide pollution.

Water environment: Renigier-Bołozor et al. (2019[b], 2022) demonstrated that water quality determined based on the concentration of bacteria in waste also has a significant effect on land value.

Noise environment: studies investigating the impact of road and railway noise on land values indicate that excessive noise decreases the value of land (Nzau 2003). There is a negative relationship between airport noise and the price of land plots near the airport. However, consumers respond differently to noise pollution. Low-income buyers are less willing to pay more for noise-free land than high-income consumers (Chin and Chau 2003).

Society: population density: the land price is closely related to population density because land is used more intensively in densely populated areas (Goodwin et al. 2003). The expansion of the urban population certainly leads to increased housing demand. Higher housing demand may increase the demand for land. The supply of land is limited; therefore, an increase in demand will lead to an increase in land prices (Jiang et al. 2013). According Bao et al. (2014), the Chinese land market is characterized by high population density and unbalanced economic development.

Per capita income: income growth not only improves living conditions but also creates opportunities for real estate investment. The consumers' purchasing power increases with an improvement in living standards, which increases the demand for housing and residential land, and drives the prices of residential land (Borchers et al. 2014). Jiang et al. (2013) analyzed per capita income as a measure of living standards.

Educational level: this factor generally exerts a considerable influence on land prices. Residential areas inhabited by highly educated dwellers are often characterized by high levels of social order and stability as well as a high-quality environment. Such areas create a good impression on potential buyers, which indirectly increases demand and, consequently, land prices (Ho and Nguyen 2006)

Security: this factor significantly affects land prices. Order and security instill a feeling of safety in both residents and businesses who are more inclined to invest, buy, sell and settle down in safe areas, which leads to an increase in land prices (Ho and Nguyen 2006). Residential buyers are less likely to buy property in areas with high crime rates. Crime rates can be expressed by other variables such as the number of burglaries and theft occurring per unit of population (Chin and Chau 2003).

2.3.4. Macro factors

Policy factors involve mainly the State's intervention in land prices. The aim of State policy is to further the interests of the society and to promote macroeconomic development, and the relevant policies are formulated to promote land transfer or restrict the use of a certain land types, which significantly influences the prices of price. The specific factors that affect land prices include the planning policy, land price policy, tax policy.

Planning policy: in planning, the regulations on utilities, volume ratio and architectural density exert a significant influence on land prices. The price of the same plot of land varies considerably depending on whether it is used for business, housing or industry. Land-use efficiency is highest for business projects and lower for residential and industrial development. Land-use regulations significantly affect social and economic efficiency in land use (Ho and Nguyen 2006).

Land price policy: the land price policy is directly responsible for land price fluctuations. A relaxed land price policy implies low levels of government control over land prices, which contributes to an increase in land prices. In turn, a strict land price policy implies that the government introduces various measures to control land prices, which leads to a decrease in prices. The land price policy also indirectly affects investment in land and, consequently, land prices (Ho and Nguyen 2006).

Tax policy: both corporate and personal income tax rates have a significant impact on land prices. Higher taxes lead to the accumulation of wealth in land, which decreases land prices, social investment, and economic growth. In contrast, a decrease in the cumulative tax increases land prices (Ho and Nguyen 2006).

Economic growth rate: the economic development of a city reflects on the overall strength of a region, and it exerts a certain influence on the prices of urban land. A city characterized by high levels of economic development will enjoy the economic benefits of land use, as well as a high demand for land. The gross domestic product (GDP) and per capita growth (PCI) are important indicators of economic development in an urban area. Economic growth rate have a positive impact on urban land prices. The overall demand for land continues to increase and drives land prices (Jiang et al. 2013).

Bank interest: the property market is characterized by a high number of transactions, which implies that investments and the sale of land involve usable capital. Therefore, investors and land appraisers should be familiar with the situation on the capital market and current lending policies, in particular when interest rates fluctuate (Ho and Nguyen 2006; Taylor and Brester 2005).

Inflation rate: price fluctuations are directly influenced by the situation on the property market, and the higher the inflation rate, the higher the price of land. A rapid increase in land prices is observed only in urban areas, whereas rural areas are relatively unaffected, even when migration significantly decreases he problems related to the prices (Ho and Nguyen 2006; Taylor and Brester 2005).

The problems related to the selection and application of the various factors related to the land value estimation are shown in Table 2.1 below.

The value of land in urbanized areas should correspond to its market price. The following factors influence the value of urban land in different countries:

- land category in the local zoning plan and the existing land-use types,
- demand and supply on the local real estate market,
- level of socioeconomic development.

Land is often appraised based on the Highest and Best Use concept. The value of land is also influenced by location, land form and structural features, local economic growth and formal requirements (Renigier-Biłozor et al. 2019; Rabianski 2007; Sheppard 2022; Źróbek red. 2020).

According to the literature, the following categories of factors influence land value can be extracted:

- land availability and land use,
- physical attributes of land (land lot/parcel/plot, land property),
- location (general, relative and detailed),
- prices on the local market,
- the extent to which the market value influences transaction prices.

Table 2.1 Factors in literature

Author/ Country	Issues	Factors						
		Individual	**Regional (Location)**	**Infrastructure**	**Environment**	**Social**	**Economic**	**Legal**
Topcu and Kubat (2009)	The analysis of urban features that affect land values in residential areas	- Spatial integration values	- Distances from the sea - Distance from CBD - Distance from University - Distance from the sanitary facilities	Façade of buildings on the streets in harmony with surroundings				
Colwell and Munneke (1999)	Land prices and land assembly in the CDB	- Land area	- Distance to CBD					
Tran and Bui (2015)	Hedonic model and software for land pricing and selecting key feature of land price	- Land area - Façade width - Total Floor area	- Width of road to house - Convenience of the entrance to the house - Distance to city center - Distance to district center - Distance to school - Distance to market	- Quality of the area's hygiene - School quality - Medical quality				- Status of land use right certific ates
Nguyen and Hoang (2011)	Research factors affect land prices in Bac Ninh city, Bac Ninh province in 2011	- Land area - Façade width - Shape	- Location - Distance to main road				- The ability to bring income of the land plot, Income	
Chin and Chau (2003)	A Critical review of literature on the hedonic price model	- View of the sea, lakes - View of hills - Obstructed view	- Proximity to good schools - Proximity to hospitals - Proximity to place of worship (mosques, churches, temples)		- Environm ental quality	- Crime rate	Income of residents	

		- Length of land lease	- Proximity to shopping center - Distance from CBD		- Traffic/air port noise			
Hu et al (2016)	- Spatially non – stationary relationships between urban residential land price and impact factors in Wuhan city, China	- Land area	- Distance to CBD - Distance to nearest metro - Distance to nearest hospital - Distance to nearest school - Distance to nearest park - Distance to nearest river - Distance to nearest lake - Distance to nearest industry district - Distance to nearest college	- Road density				
Nguyen (2011)	Application of the "decision tree" model in mass land valuation in Vietnam	- Facade width	- Distance to city centrum - Distance to district center - Near business environment - Contiguous road type	- Ecological environment		- Security - Residential occupation type	- Business ability	
Gao and Asami (2007)	Effect of urban landscapes on land price in two Japanese cities	- lot shape - frontage	- Rearest station	- Railway lines - Road types		Population density		
Chicoine (1981)	Farmland values at the urban fringe: An analysis of sale prices	- Industrial/ commercial land use Minning/ quarrying land use Septic tank soil limitations	- Distance to Chicago - Distance to nearest freeway exchange	- Frontage road type				

Source: own study based on Gwamna et al. 2015

On well-developed markets, the difference between the value and transaction price of land generally does not exceed 2-5% of the market value. The Polish real estate sector is still a developing market, and the above difference is higher in the range of 10-25% of the market value (Prusik and Źróbek 2016). In research studies, the price of land is regarded as the sum of value exchange for the benefit of having or using the product (real estate). Transaction prices are often set individually, and land plots with similar parameters and designation, such as land zoned for residential construction, can fetch different prices. The difference between the market value and the price of land have been extensively researched (d'Amato et al. 2022; Parker 2016; Crosby et al. 2018; Babawale 2013; Boyd and Irons 2002). An analysis of court rulings in United Kingdom indicates that land appraisal involves specific calculative practices. According to British courts, the margin of error between the appraised value of land and its transaction price should not exceed 10 - 15% Crosby et al. 2018. The accuracy of land valuations has also been studied in other countries, including Greece, Nigeria and Poland (Prusik and Źróbek 2016). The difference between the appraised value of urban land and the purchase price in the sale contract can be minimized when the applied valuation method accounts for the socioeconomic status of potential buyers on the local property market. Such methods increase market transparency and enable buyers to wisely invest in property. Land value is also influenced by the physical attributes of property (Colwell and Munneke, 2009; Han and Basuki, 2001), as well as market factors such as demand, supply, type of transaction and mortgage. Urbanized areas form a complex system of interconnected land-use types whose designation is defined in the local zoning plan. Changes in market conditions determine the extent to which various categories of factors influence the market value of land (Źróbek 2009, 2011). The date of the transaction as well as monthly, quarterly and annual changes in property prices should also be considered. Location-related factors are difficult to identify. These factors change over time, and they differ across cities and the adjacent areas that are influenced by the urban core. The availability of transport infrastructure and public utilities also affects the value of land. The market value of land in urbanized areas is influenced directly and indirectly by a wide variety of factors. Urban development projects, such as the construction of new roads or the expansion of public utility networks, further complicate land appraisal. The factors that determine the evolution of the urban land market play different roles in this process, and their scale and intensity vary. Some of these factors are correlated, and in some cases, several requirements have to be met simultaneously to guarantee effective urban

management (financial status, impact, marketing, urban planners' and developers' knowledge and skills). The importance of public-private partnerships in urban management has been emphasized by Źróbek (2020). The real estate market is an imperfect market (Kucharska 2016). The view that the real estate market is perfect (theoretical approach) and that its characteristic features are unrelated has also been postulated in research. This descriptive model deviates from real-world processes on local real estate markets (Williamson and Ting, 2001). The real estate market is characterized by many closely linked attributes (Źróbek 2000; Źróbek 2005). The factors that are responsible for the specificity of local markets are identified by professional property appraisers. In Poland, the licensing requirements and professional standards of real estate appraisers are set forth by the Real Estate Management Act of 1997 (Poland).

The effectiveness, transparency and completeness of specific (local) real estate markets have also been analyzed in the literature. The real estate market is also influenced by legal regulations and changes in the behavior of market actors (Lorenz 2006).

Models describing local real estate markets can confirm or refute previous assumptions. Their suitability for land valuation should be always verified by professional property appraisers. Input data for the modelling process have to be carefully selected and verified in early stages of market analysis.

2.4. The trend of land price investigations using regression models

The multiple regression model is useful in selected factors influencing on the urban land price. It can be useful in land price trends too. It is importants that the real estate system in an unstable stochastic process (Sampathkumrr et al. 2015). Normally decisions of investors concerning urban land are based on the market trends to real maximum returns in a situation where there is no official price quotation on the urbanized land market, investors use data from the shadow economy (not official real estate market). In formation obtained from local experts is then very helpful. Large amount of data influences land price is required for analysis urban land price (Brown and Reed 2012).

The problem of large number of factors and their verification is also highlighted by the authors dealing with the estimation of the market value of land in Poland Poland (Foryś and Nguyen 2016; Prystupa 2016; Zyzdroń and Walkowiak 2013; Doszyń 2010; Bituer 2007; Renigier-Biłozor 2008; Parzych 2007; Kokot 2004; Hozer 2002;). Prystupa (2016) pointed out, inter alia, that the explanatory variables were non-random quantities

and that there was no collinearity between them. Moreover, the number of explanatory variables should be lower than the number of urban land transaction prices. In market research, multi-regression model are especially popular, but the imperfections of the regression model itself, as well as the characteristics of real estate, can cause contradictory and unfounded conclusion them, especially since the most important – taking into account the value features of the land property as real object (Preach et al. 2013). There was also the issue of quantifying the states of real estate features the subject of other studies (Foryś 2011; Hozer 2001; Bełej and Źróbek 2000). The various factors that affect land prices have to be studied and their impact on price has also to be modeled (BenDor et al. 2014) Over the last three decades there have been a large number of empirical studies analyzing land prices. Individual urban land values were found by estimating and removing the predicted values and final results were largely adopted. Professional valuers estimate real estate value (urban land) based on current bid prices from open market values as a base. Artificial Neural Network is sometimes used when there is a used to forecast future real estate prices in urban areas. Birch and Sunderman (2003) developed a regression model with improved and vacant land sales incorporated into the single data sets. Normally in market analysis, regression model can be used for prediction and forecasting. Some authors used this statistical model to understand which among the independent variables are related to the dependent variable and explore the forms of these relationships (Prystupa 2016; Bitner 2007). Accuracy of model is examined using standard measures (Parzych 2018):

- chi – square test,
- mean absolute percentage error,
- percentage root mean squared error.

The coefficient of determination reflects normally the fit of the linear function to real data (prices and features of real estate). It should be clearly stated that the construction of regression models is one of the most popular methods of analyzing statistical data related to the urban real estate market. Regression models must assume an estimation error. The idea of regression is to minimize the estimation error to such an extent that the model is useful in its forecasts. Regression analysis enables you to create a mathematical function describing the relationship between the predictor (predictors) ant the dependent variable (market price), taking into account the random error (Cellmer 1999b). The use of regression in practice courses clown to two phases:

1. constructing a regression model – now the expected value of the dependent variable depends on the explanatory variables; the model shall be constructed to best fit the sample data.
2. application of the model (scoring) – the use of the calculated model for data in which we only know the explanatory variables, in order determine the expected value of the dependent variable. The overall goal of regression is to quantity the relationship between multiple independent (exploratory) variables and the dependent (recitation, response) variable. It is important that method allows you to investigate the relationship between data sizes on this basis of know values of others. Regression in which more than one variable occurs the explanatory text is called multiple regression. Multiple regression is useful in real estate market analyzes. It allows among other things, to determine the impact of individual features or real estate (urban land) on their market value. It also allows to forecast the market value in the event of change in the value of the adopted market feat.

2.5. Information for the purposes of management and valuation of urban land

As far as urban land management is concerned information is one of the most crucial elements of an efficient decision-making process. One of elements of this process in market value of land. Lack of information or its poor quality may lead to improper decision making. Obtaining an appropriate set of information and its processing determines the effectiveness of the decision made. The process of identifying potential opportunities and threats can be even define as searching for information sources, obtaining information, its initial selection, gathering useful information and finally transferring it to decision making process as urban land valuation (Renigier-Biłozor et. al. 2022; Źróbek red. 2020; Gorzeń–Mitkal 2007; Brzezicka and Wiśniewski 2004). A good – quality land registration system is good base for valuation. Land registration and cadastre are the most common public registering that provide legal and geospatial data to information recorded at other land related public registers (Źróbek red. 2020; Konowalczuk 2016). Together with land registers, they provide geographical and administrative datasets concerning the legal objects required for valuation. There are several international standards related to the many aspects of real estate valuation:

- European valuation standards (TEGoVA),
- International valuation standards (IVSC),

- Mass appraisal of real property (IAAO),
- Ratio studies (IAAO) and others.

These standards recommend sources of information for the purposes of real estate valuation. They also provide the scope of data necessary to estimate value of land. Normally land information systems are based on the relationships between person's and land. Formal system is necessary to register land and property. A system for recording land ownership (other rights), land values, land use and other land – related data is an indispensable tool for a market economy, (Oosterom and Lemmmen 2003). A good land information system includes spatial (parcel) and non – spatial data (owner, user). Most of the countries with a formal land information system in place have already computerized their system (e.g., The Netherlands). In cadastral systems information about property transactions are very important too. Standardization of valuation and taxation databases provides governments with a common basis for the development of local or national databases (Bird and Slack 2002). The greatest challenges to any country's cadastral system are the informal settlements (Grant et al. 2018) think, that cadaster is the core engine for spatially enabled land administration. Information systems should be built using a "fit for purpose" approach. Important are technology, and spatial data infrastructure. According to UNECE (2005), the following benefits the modern cadaster arise:

a) a guarantee of ownership (other right to land) and security of tenure,
b) support for land and property taxation,
c) provide security of credit,
d) develop and monitor land markets,
e) protect land resources and support environmental monitoring,
f) facilities the management of State – owned land,
g) reduce land disputes,
h) facilities rural land reform,
i) improve urban land reform,
j) improve urban planning and infrastructure development
k) produce statistical data.

As it results from this list of cadastre characteristics, it guarantees the efficient functioning of the urban land valuation system in Vietnam. It also comprises of parcel geometric description (FIG). Good cadastral system includes parcels and registered land rights that support the functions of property valuation and mass appraisal procedures. Can

be useful in the administrative functionality of the current (land use) and future land use plan and use of land (Dawidowicz and Źróbek 2017; Lemmen et al. 2015; Williamson et al. 2010). According to FIG (1995) important elements the define good cadastral system include:

1) a map capturing entire land parcels within a given jurisdiction,
2) land registers bearing information linkable to the cadastral parcels (plots),
3) primary key or unique identifier linking all parcels ,
4) the capacity for continuous updating ,
5) general public access to cadastral registers.

In the process of valuating urban land, information form data sources other than the cadaster is necessary. It is especially about the land information system (LAS) that integrates data from other databases. A typical LAS links the cadastre and topographical data. It also can links the environment data, legal and social rights to land. Important are data from real estate market too (Landmark 2020; Badurek 2009). It involves processes of recording, determining and sharing information about tenure, value and use of urban land resources. Key roles of an integrated LAS include (Kuria 2017):

a) developing procedures and set of technical processes to enable the registration of interests and rights in real property,
b) computerizing the land procedures and real estate transactions,
c) creation of land parcel data applying standard editing tools for cadastral and the capability to generate reports with respect to a predefined template,
d) a public service module that permits general set of technical procedures for registration of rights and interests in urban land.

The spatial land parcel details will provide specific parcel position with respect to the surrounding. It is important in process of urban land valuation.

2.6. Summary (literature review, principles of property appraisal)

A review of the literature indicates that land valuation in urbanized areas should account for the property's designation in the local zoning plan and other factors that affect the real estate market. The value of land is also influenced by its location, including absolute location as well as location relative to urban services and utilities. Macroeconomic and microeconomic factors exert a considerable impact on the value of urban land. These factors characterize specific market segments, such as the market of

land for residential construction. Local attributes also influence property prices, but they are difficult to identify and quantify. The experience and skills of local appraisers play a very important role in this process. Analyses of urban development models in different countries promote a better understanding of the processes on local real estate markets at land support the identification of market attributes that influence transaction prices. Time is also an important criterion in real estate analyses. The relationships between property prices and market attributes evolve over time, and the number of attributes, their impact and the direction of the modeled relationships can change. Statistical models for evaluating the strength of the correlations between real estate value and market attributes can be applied to generate objective results. Valid and reliable information about transaction prices, the terms of property transactions, as well as factors that are specific to a given market also play an important role in property appraisal. Urbanization processes and their dynamics are equally valid concerns. The price of land is determined individually in each transaction in consideration of the applicable legal regulations. Land prices are also influenced by the demand and supply on the urban property market.

The impact of various factors and attributes on the market value of real estate has been extensively researched. A different approach was used to analyze transactions where the value of land was determined by public administration bodies at different levels of government. Such practices were frequently encountered in Poland before 1990 (Źróbek red. 2020). Other studies relied on the classical land rent theory (Cheshire and Sheppard, 1995). The indications contained in the literature review were largely used in the implementation of previously planned tasks related to the implementation of research objectives. This allowed, among others, the selection of features for estimating the value of land real estate and the use of principles related to the development of urban areas. It also gave the basis for the adoption of effective assumptions related to the planning of the research experiment in the basic fields. Finally, it gave the opportunity to critically evaluate the results obtained and adopt assumptions for the modernization of the urban land estimation system in Vietnam.

3. URBANIZATION- GENERAL ANALYSIS

3.1. Introduction

As already mentioned, the main subject of research is the value of urbanized land. Urban areas are characterized by, among other things, the dynamics of shaping the value of land properties. Thus, urbanization has a significant impact on the shaping of land value. It also contributes to the improvement of methods related to the management of these areas. Continuous population growth and rural out-migration increases pressure on urban areas. This process is not always effectively controlled, which leads to urban sprawl, namely unrestricted growth of urban areas. Urban sprawl decreases the availability of farmland per capita (approx. 0.2 ha) around the world.

Land is a limited resource, and rational land management policies should be based on economic principles that promote the sustainable development of regions and entire continents. The value of land is a factor that helps regulate the land market. The registration of property rights in spatial planning systems also plays an important role. Population growth is correlated with land-use type (Klein et al. 2017). Residential and commercial land-use types predominate in cities and the surrounding areas.

3.2. Features of urbanization

According to the United Nations Department of Economic and Social Affairs, urbanization is a complex socioeconomic process that transforms the built environment and leads to the conversion of formerly rural settlements to urban settlements. Urbanization shifts the spatial distribution of a population from rural to urban areas, and induces changes in dominant occupations and lifestyles. This process also alters the demographic and social structure of urban and rural areas (UN DESA 2019). The rate of urbanization differs across cities, regions and countries. Cities are the contemporary centers of urbanization which is linked with:

- economic growth,
- development of services and logistic centers,
- dissemination of knowledge and innovation,
- technological progress,
- modern management methods and organizations.

The level of urbanization in the world from 1500 to 2016 is shown in Fig. 3.1. Urbanization significantly increases the prices of land, which leads to changes in economic structures and affects many social processes. The global rise of urbanization is presented in Fig. 3.2 (UN DESA 2018).

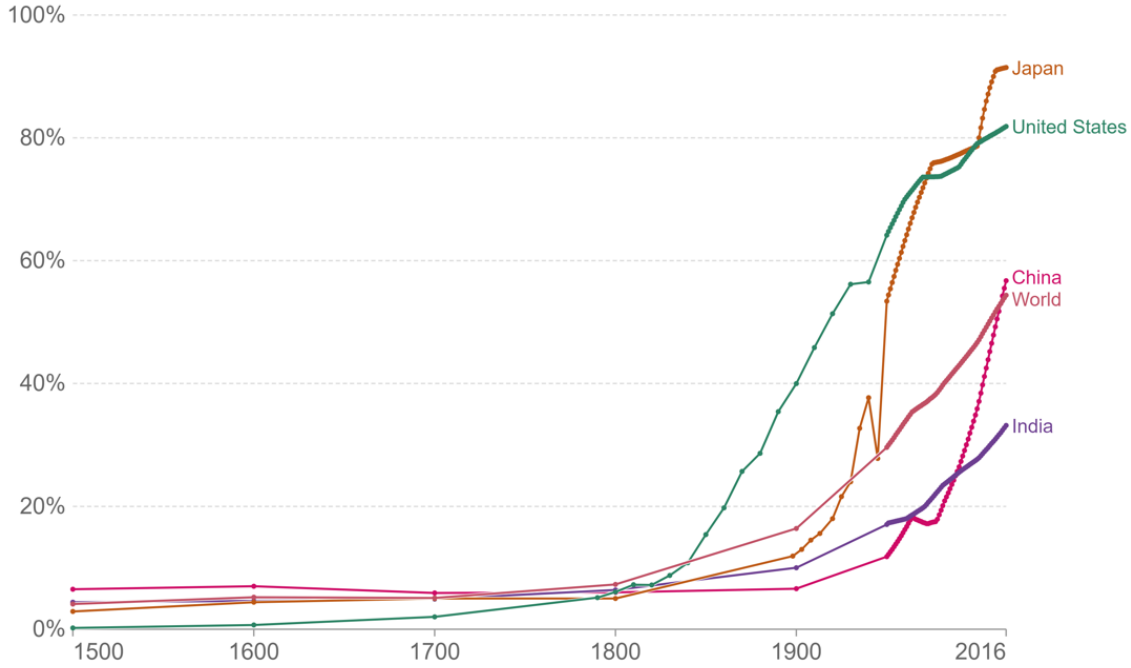


Fig. 3.1 Global urbanization levels from1500 to 2016

Source: urbanization - Our World in Data

The urbanization process in Asia and the Pacific is proceeding at an unprecedented rate due to rapid population growth and the economic development of these regions after 2000. The progress of urbanization is linked with changes in living standards and the establishment of a specific urbanized environment. Urbanization leads to an increase in population density and the conversion of land use from non-urban to urban use, and it creates new employment opportunities outside agriculture. The prices of land are higher in areas that are situated close to the urban core and have access to public utilities and transport networks. Urbanization can contribute to land-use conflict, in particular in transitional zones along the rural-urban boundary. Environmental protection in in transitional zones plays an important role in planning the development of urban areas (Źróbek red. 2020; McGranahan and Satterthwaite 2014; Haase 2013). Changes in the structure of the rural and urban population between 1950 and 2020 and a forecast for 2050 are presented in Fig. 3.2 (UN DESA 2018). In 2000, the number of urban dwellers surpassed the size of the rural population.

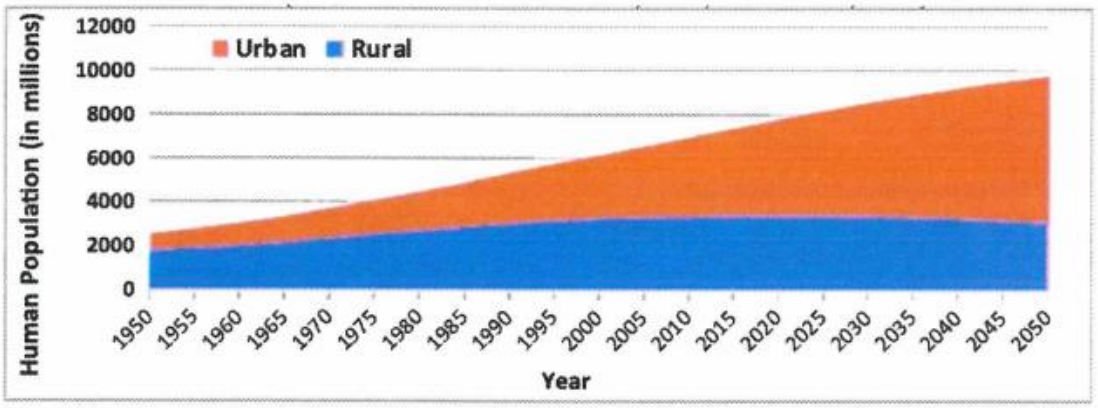


Fig. 3.2 World's Rural and Urban Population

Source: UN DESA (2018)

More than half of the world's population has been living in cities since 2007, which has led to the rapid growth of urban areas. Modern cities are the hubs of commerce, infrastructure, finance and education. The most rapid population growth was observed in Asia and Africa relative to Europe and North America. The percentage increase in the urban population of selected Asian countries is presented in the Table 3.1 below.

Table 3.1 The urban population of selected Asian countries

Country	**Year (%)**			
	2020	**2030**	**2040**	**2050**
Cambodia	24.2	29.0	34.8	41.2
Malaysia	77.2	81.8	85.0	87.3
Thailand	51.4	58.4	64.4	69.5
Vietnam	37.3	44.5	51.2	57.3

Source: UN DESA (2018)

Rapid urbanization poses new challenges and requires sound land management practices in cities and transitional zones (urban peripheries) that are consistent with sustainable development principles. Urban development is characterized by:

– development of vacant land, mostly farmland, for urban purposes,

– rapid changes in land-use, with a predominance of urban land-use types (housing, services, industry, infrastructure).

Most of these processes take place in the transitional zone between urban and rural areas. Downtown districts in cities are undergoing redevelopment, and old structures and

buildings are revitalized. Urban development proceeds in the direction of the urban-rural interface, leads to the annexation of vacant land in peripheral areas, and induces changes in the land-use structure. The main problems associated with urban sprawl include:

- construction and maintenance of transport networks the effectively meet the needs of inhabitants who commute between peripheral areas and the urban core;
- transfer of public funds to suburban zones;
- limited choice of environments in rapidly expanding metropolitan areas;
- increased spending on infrastructure development in urbanized areas;
- loss of biodiversity due to urban pressure;
- land-use conflict at the rural-urban interface resulting from conflicting views on land-use policies.

Street and road networks connect areas with different land-use types and consolidate urbanized space (UN HABITAT 2013). Streets play important social and economic roles in Asian cities. Transport networks also influence the market value of land, and they significantly contribute to the evolution of land prices in urbanized areas. The hypothetical relationship between street quality, which is determined by the street's status in the classification hierarchy and traffic volume, and the market value of adjacent land is shown in Fig. 3.3. This correlation is represented by a parabola, never by a straight line. It should be noted that the level of land value is strongly related to the quality of the street adjacent to it.

The shape of the curve in Fig. 3.3 is determined by the density of the street network, connections between streets, and the street's significance in the local transport network. The following factors significantly influence the value of land in urbanized areas (Alonzo 1964):

- a city's capability to finance development projects,
- expansion of urban infrastructure,
- standard of living,
- environmental sustainability.

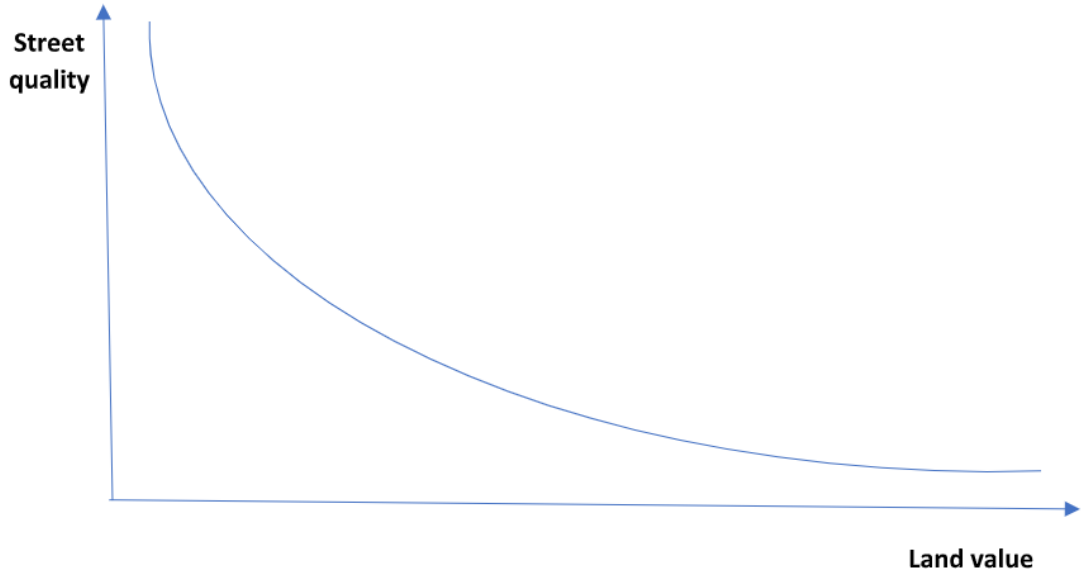


Fig. 3.3 The relationship between location (land plot with access to a higher-level street) and the market value of land.

Source: own elaboration based on UN HABITAT (2013).

Therefore, the value of land is a cost that is borne by both private and public investors. Due to differences in the scale and intensity of urbanization processes, the existing urban development models are becoming less suited for exploring these phenomena. Urban areas (cities, urban-rural interface, peripheral areas) are unique ecosystems **(**McDonnel et al. 2019; Sprisn 2012; Pickett and Grover 2009). Urban development has to be well planned and coordinated to promote the achievement of sustainable development goals. Urban ecosystems have social, topographic, biological components, as well as artificial elements related to urban structures. Urbanization is complex set of processes that influence the surrounding space to a varied extent. In Asia, the rapid population growth of the last two decades has led to unprecedented levels of urban expansion. The increase in the urban population can be attributed to:

- natural population growth,
- rural to urban migration,
- urban annexation of the surrounding villages and districts.

According to Montgomery (2008), rural to urban migration is the main cause of rapid urbanization in developing countries. They are also responsible for around 80% of greenhouse gas emissions (Newman et al. 2009; Grim et al. 2008). The laws of nature that contribute to the escalation of land-use conflicts at the urban-rural interface have not

yet been fully elucidated (Ostrom 2009). Despite the above, natural surroundings do not exert a clear impact on the general level of real estate prices in the developing countries of Southeast Asia. However, environmental factors (direct surroundings) have been found to influence the prices of individual transactions. Further research is needed to explore these dependencies. Land prices are lower in urban peripheries, which encourages developers to build residential estates even in the proximity of potentially hazardous facilities. In developing countries, suburbanization is closely linked with rural to urban migration. The following factors influence the development of urban areas:

1. access to land zoned for development,
2. availability of technical infrastructure (roads, water and power supply, sewers),
3. availability of public services (schools, hospitals, welfare centers),
4. legally protected property rights,
5. financial capacity of central and local governments to build public utility infrastructure and other facilities,
6. environmental protection laws.

The cost of building public utility systems exceeds the anticipated increase in land value, which poses a barrier to infrastructure development. Public land plays an important role in urban management. Public land is a capital reserve and a resource that enables the local authorities to finance the construction of technical infrastructure. Research has demonstrated that land prices and development costs decrease with increasing distance from the urban core (Roberts and Cohen 2020). Optimal solutions for land division and land conversion at the urban-rural interface are needed to minimize the risk of land-use conflict. Real estate management systems should also incorporate a land valuation module.

4. MAIN FACTORS THAT INFLUENCE THE MARKET VALUE OF URBAN LAND

4.1. Introduction

Intensified rural to urban migration has contributed to rapid urbanization in many countries, including in Vietnam after 1980. This process significantly affects the market value of urban land. Uncontrolled urbanization leads to negative phenomena, such as insufficient supply of land with the required infrastructure to support new functions (services, housing and public transport). Housing deficit directly contributes to a rise in land prices in cities and in the proximity of areas that serve different functions (Cakir and Sesli 2013). The value of urban land is also significantly influenced by the attributes of the surrounding space. This influence can be analyzed in various aspects, including in the context of the existing functions in the vicinity of the analyzed property. The value of land is also significantly determined by access to the evaluated property, the proximity of land-use types and functions indicated in the local zoning plan, interactions with the surrounding areas, and the local planning policy framework (Braimoh and Onishi 2007).

Land is a unique commodity because it has a fixed location and can be identified in geographic space based on the coordinates of plot boundaries and its location relative to other physiographic objects and direct surroundings. Therefore, the value of urban land is strongly correlated with its location in urban space. Land is a commodity that cannot be destroyed, and its prices are also determined by a plot's suitability for specific uses.

Land purchase transactions and the associated investments (such as the construction of a residential building) require considerable funding. However, land is also a material asset that can be mortgaged to secure a loan, and the equity in land can be used by the owner to apply for an investment loan. The loans provided by banks and mortgage institutions are an essential element of the real estate financial market. On highly developed markets, property owners pledge land as collateral against a mortgage loan from a mortgage bank. Mortgage institutions also issue covered bonds that are collateralized against land.

4.2. The characteristic features of urban real estate market

One of the characteristic features of the real estate market as a commodity is that the intensity and direction of demand for property are generally similar in the long term,

whereas the elasticity of real estate supply tends to be relatively low in the same period. Other factors that affect the behaviour and decisions of urban property buyers include:

1. most buyers have a conservative approach to real estate transactions;
2. neighbourhood and social trends affect land purchasing decisions;
3. buyers adapt to the phases of the real estate cycle (recession phase and expansion phase) and purchase land to protect their capital against inflation;
4. land purchases are influenced by the prices of materials and services.

Physical and environmental factors determine the influence of the neighborhood on the analyzed property. The market value of land can be also determined by a combination of factors. In this case, additional analyses are required to determine the combined impact of these factors on the market value or cadastral value of real estate. The attributes describing real estate have been long used in the valuation process. Land attributes have a universal character which is associated with typical investor behaviors and plays a key role in that process. These attributes are still critical in analyses of the urban property market. The following factors play the most important role in land valuation:

- land structure and its suitability for specific land-use types,
- local hydrological regime,
- risk of flooding in river valleys and in the proximity of large water bodies,
- microclimate,
- horizontal and vertical dimension of land surface (topography),
- tree cover and forests,
- access to water bodies.

These factors still play an important role in market analyses, but their impact can change over time. In the most extreme cases, the direction of the influence exerted by various land attributes can be reversed. Property valuers pay special attention to land attributes that are strictly connected with location. These attributes differentiate properties and significantly affect their market value.

4.3. Physical factors that influence the value of urban land

The value of urban land is influenced by numerous physical factors. The selection of physical attributes for land valuation is determined by the specificity of the local market and factors that are directly associated with location. According to Topcu (2009)

and Voss (2019), accessibility significantly affects the value of urban land. Research indicates that location and the immediate surroundings play a key role in the valuation process. Physical features influence investor decisions, but they also constitute a basis for the implementation of land use regulations. A city is a built environment where land zoned for residential construction and the accompanying services play an important role in investment decisions (Wejchert and Zerbst 1973). The availability of dedicated infrastructure, including transport networks, utility grids and recreational facilities, is also an important consideration. The quality of urban land is yet another feature that influences land prices in cities. Land availability is a meta-attribute that is strongly correlated with the supply of urban infrastructure (Tse and Love 2000). Therefore, the value of urban land is determined not only by physical factors, but also by other attributes that shape the urban environment and its surroundings. Factors that are directly associated with the real estate market (demand, supply, intensity, effectiveness) are also taken into consideration in analyses of land value in cities. The distance to the city center and urban subcenters in different districts also plays an important role. According to Topcu and Kubat (2009), the accessibility parameter can be analyzed with the use of two approaches:

1. as the Euclidean distance (in meters or kilometers) between a given street and public utilities in close vicinity to the appraised property,
2. with the use of the Space Syntax method based on spatial integration values (to evaluate the mutual relations between the analyzed properties).

The second approach is more complex, and the results of the analysis could be difficult to interpret for users who do not have specialist training or knowledge. The Space Syntax method is generally applied in advanced decision-making processes relating to urban planning and in research studies of the real estate market. This approach is rarely used in the land valuation process. The quality of local zoning plans and zoning regulations, such as maximum built-up area and the required proportions of green space in land plots zoned for residential construction, play an important role in the group of physical factors that influence the value of urban land. The extent to which a plot of land can be adapted to new uses (by lowering groundwater levels, land leveling, demolishing and removing the existing structures) is also an important consideration. The value of property is also influenced by the area (size) and shape of a land plot. Research indicates that rectangular plots whose length is two to three times greater than its width are more attractive for potential investors. The length of the boundary between a plot of land and the road onto which the plot fronts (frontage) is also an important consideration. In some

countries, including Vietnam and Japan, frontage length determines the value of land and its potential use. Frontage is also commonly used in mass appraisal to determine the property tax. Neighbourhood affects land value because it sets the directions for urban planning in the future. Buildable land area, namely the portion of land where construction is allowed, is yet another physical factor that influences the value of urban land. Other important attributes include street category and traffic noise on the street and in its immediate surroundings. The distance from the main sources of noise and the presence of sites or facilities that are permanent or seasonal sources of unpleasant odor have to be taken into account in the valuation process. Public utilities (water, power and gas supply, sewerage, telecommunications) significantly influence the value of land. Location plays the key role in the process of assessing the impact of various factors on property prices. The influence of attributes associated with location can differ on local markets, depending on the availability of land zoned for development (reconstruction, expansion or conversion of land-use types). In the comparative approach to land valuation, the attributes that influence the market value of land are compared with the attributes of properties that had been traded on the local market. These attributes are described in the next section.

4.4. Factors associated with the real estate market in cities and the surrounding areas

Market factors (real estate economics) should be taken into consideration in the land valuation process. The value of land in cities is also influenced by the attributes of the surrounding areas. Analyses of the local market play an important role because they enable the property valuer to:

1. identify local factors that are associated with the development of urban areas;
2. determine fluctuations in the demand for and supply of urban land and evaluate changes in land prices over time.

However, it should be noted that local factors are not the only parameters that drive land prices. The value of property is also shaped by the closest neighbourhood as well as the trends and processes observed on regional or even international markets. The demand for and supply of urban land is also determined by the phase of the development cycle in a given area or region. The following types of factors are generally identified at

different levels of market analysis (Kucharska-Stasiak 2016; Topcu and Kubat 2009; Źróbek 2001):

1. International level:
- relatively low or high prices,
- relatively stable or unstable economic performance of different countries,
- energy generation costs and the availability of natural resources in a given region,
- foreign trade balance,
- foreign rates of return on real estate investments,
- average prices and the price-to-income ratio.
2. National level:
- Gross Domestic Product,
- balance of payments, credit policy and tax policy,
- regulations governing the sale/lease of land to foreigners.
3. Regional level:
- regional prices and incomes,
- interest rates and rate of return on capital investments,
- employment and unemployment,
- housing policy and investment preferences,
- environmental protection regulations applicable to the regional market.
4. Local level (city, municipality):
- population structure and employment,
- incomes, return on investments,
- access to capital for investments, including loans and mortgages,
- competitive advantage relative to other cities and municipalities ,
- transport networks and technical infrastructure,
- percentage of land covered by zoning plans and possible changes in land-use.
5. Direct surroundings:
- availability of vacant land for construction projects,
- performance of the local real estate market,
- number of properties traded in a given year,
- motivation for buying and selling urban land,
- availability and accessibility of public utilities,
- socioeconomic status of land owners.

It should be noted that analyses of the real estate market and property valuations should rely on the current market values of real estate. The above applies particularly to analyses of demand and supply as well as price indices which measure changes in the value of urban land over time. Price indices are calculated for different types of real estate based on the prices of similar property after the influence of characteristic local attributes has been eliminated. A property that has been traded several times during the analyzed period is ideally suited for comparative purposes. In this scenario, it can be assumed that time is the only factor which affects the price of urban land. Property prices can both increase and decrease over time. On stagnant markets, time-dependent changes in real estate prices can be close to zero. As previously mentioned, the availability of information about the neighbourhood plays an important role in the valuation of urban land. The following neighbourhood characteristics significantly influence property prices:

- local population and changes in population in previous years,
- quality of land development in adjacent properties,
- effective land management and administration in areas surrounding the analyzed real estate market,
- public safety and absence of crime in the analyzed area.

The value of land is also significantly affected by economic factors, including current market performance as well as future trends and predictions concerning specific types of real estate. The following types of data should be analyzed in the valuation process:

- socioeconomic profile of the present and future residents on a given local market,
- availability of loans for land purchases and development projects,
- current prices and the anticipated rate and direction of changes in market prices,
- size of land plots for residential construction and the option of purchasing additional land for development.

Local planning and land management policies, including preferences in the management of urban land, significantly affect the real estate market. The following factors exert the greatest influence on property prices:

- preferences in the allocation of land-use rights,
- provisions of local zoning plans,
- location of public utilities and analyses of public development plans.

The types of real estate development projects that can be undertaken in a given area should be determined by the property appraiser. Socioeconomic factors should also be described on the analyzed market to identify competitive locations for potential investors.

Local planning policies and urban development projects also play an important role in real estate market analyses. The cohesiveness of the existing land-use types and the quality of the urban environment should be evaluated. The local authorities' plans concerning the development of suburban areas also play an important role in the valuation process. The national planning policy framework, urban development programs and detailed statistical data should be analyzed to determine the rate and direction of urban development. Building permits issued by the local authorities as well as partition permits that enable landowners to divide large parcels of land into smaller plots for private housing development should also be taken into consideration in the analysis. Factors relating to the natural environment as well as the built-up environment surrounding the analyzed property also play an important role in the valuation process. The following attributes exert the greatest influence on the prices of urban land:

a) presence of different land-use types and functions in the vicinity of the analyzed property,

b) transport systems and links between hubs in the existing transport network,

c) distribution of public utility networks, residential services and recreational facilities,

d) landform (topography) and the local microclimate,

e) land-use structure,

f) presence of degraded or polluted areas.

Social and economic factors on the local real estate market should be examined in successive stages of the analysis. Information about real estate transactions concluded on the local market should be aggregated, and significant parameters associated with demand and supply as well as other economic indicators describing the studied market should be analyzed. Local market trends should be identified and described. A general analysis of the local real estate market involves the following stages:

1) information about real estate prices is gathered, real estate transactions are described, and minimum, maximum and average prices are determined for different types of property;

2) the magnitude and direction of changes in property prices are determined based on the accumulated information about real estate prices;

3) demand and supply on the local real estate market are analyzed, and the main market trends are identified;

4) areas characterized by the highest number of transactions are identified and the reasons behind high levels of market activity in these areas are described;

5) time-dependent changes in property prices are determined, and the resulting information is used to update property prices for valuation purposes.

The attributes for comparing similar properties in the land valuation process should also be identified in an analysis of the local real estate market. It should be noted that every property is unique in terms of location and specific attributes. Therefore, property attributes that are characteristic of a given market should be analyzed in detail. The performance of a local real estate market is closely related to supply and demand in different periods of time. The date of the real estate transaction and the associated marketing activities also play an important role. The market environment and economic processes on the local market should be analyzed to identify areas with a high number of transactions involving properties that are similar to the valued property. Similar properties are used to assess other types of urban land in a comparative analysis. The basic principles of the comparative method for estimating the market value of land will be discussed in subsequent subsections. The selection of similar properties is a key stage of the valuation process, and it significantly affects the estimated market value of the analyzed property. The quality of the analysis is largely determined by the availability of valid and reliable information about the local market. The gathered data should accurately reflect the situation on the market because they directly influence the results of the valuation process. The assessed land plot, including its integral components, location and attributes, should be accurately described in the next step of the valuation process. The following parameters should be included in the description:

1) improvements relating to land-use and property components (type, function, wear);

2) physical factors:

- land plot area and dimensions,
- location in a specific development zone,
- landform and elevation,
- current land-use type,
- intended purpose in the local zoning plan,
- potential use of vacant or improved land that results in the highest value;

3) land improvements and availability of technical infrastructure:

- availability of public utilities for land development,
- physical and functional wear of technical infrastructure and other improvements that influence the value of land,
- direct access to public utilities or possibility of connecting a building to utility networks in the future,
- access to a public road and its quality.

A drawing or, if required, photographs of the assessed property should be attached to the description. The above information documents the process of urban land valuation and supports the acquisition of data necessary for the selected property valuation method. The value of urban land is most often assessed with the use of the comparative approach or a variant of this method that accounts for the specificity of the local real estate market. A detailed analysis of the local market plays an important role the process of estimating the market value of urban land. The key attributes that affect the value of urban land are considered in a detailed analysis.

4.5. Valuation process in urban areas

It is possible to say that valuation process is a systematic procedure developed to produce well-supported estimates of real property value. Typical process consist of a progressive series of steps (Fig. 4.1) is very important to property define the problem of value estimation at the beginning of the process. The definition of the valuation problem normally has some specific components:

1. identification and proper description of the real estate (a complete legal) description – various systems of identification);
2. inventory of the property rights to be valued (the ownership rights – the rights of absolute ownership and other rights);
3. date of the value estimate (a specific date of value);
4. purpose of real estate valuation (for various clients)
5. definition of value (market value, cost value, use value, investment value, assessed value and insurable value);
6. a detail description of the real estate of valuation (data are collected, confirmed and reported).

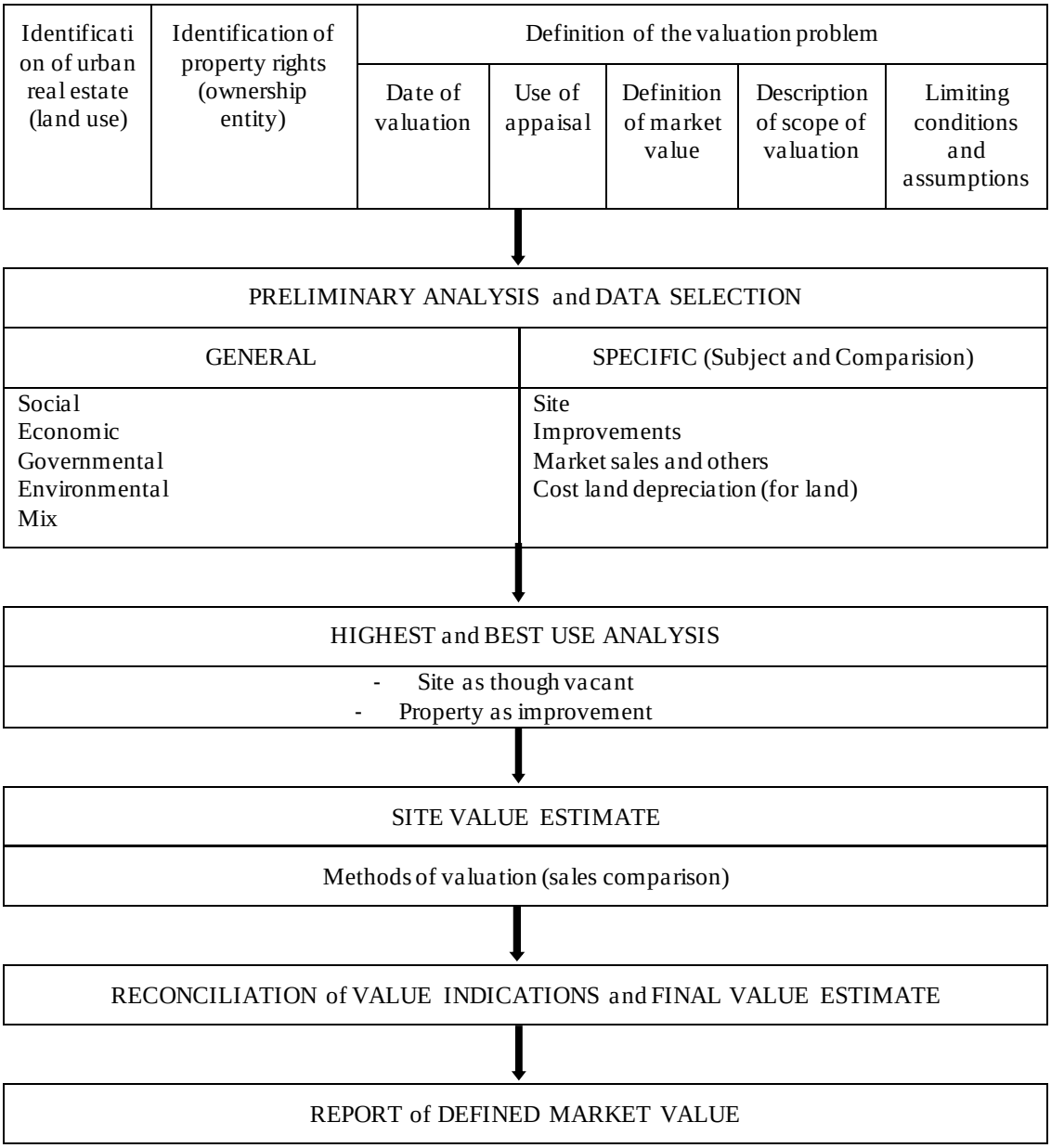


Fig. 4.1 The typical valuation process in of land urban areas

Source: based on Appraisal Institute, 1992. Appraising Residential Properties. App. Inst. USA)

Normally, the research phase of the valuation process consists of a preliminary analysis of the valuation problem. It consists collection of pertinent data. Important is detailed work plan. A work plan can also be useful and it includes a list of all general and specific data needed (Fig. 4.2).

In market economy highest and best use analysis is essential in the valuation process:

1. the site as vacant and avoidable for development,
2. the highest and best use of the property as improved is examined (the existing improvements are considered with respect to the some criteria).

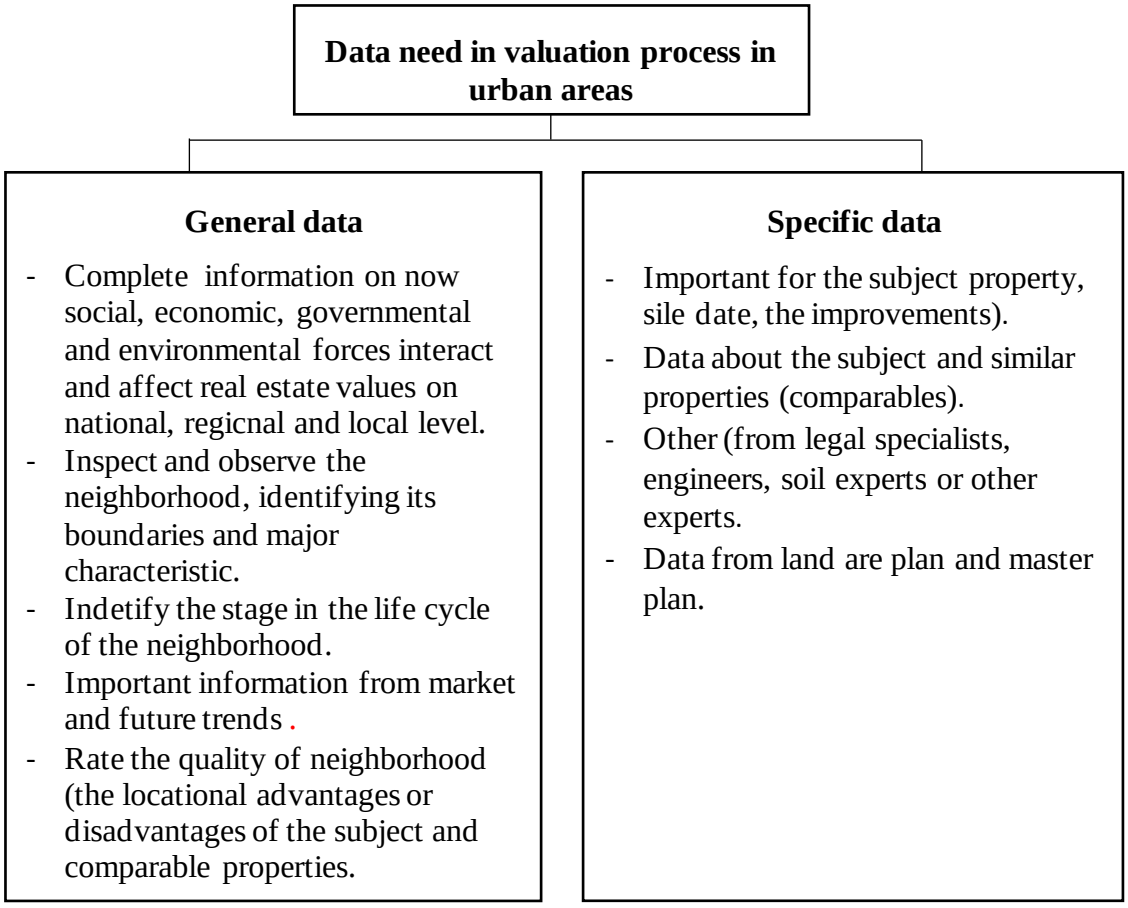


Fig. 4.2 Data sets needed in valuation process .

Source: own investigations

In valuation of urban land, the valuer is ready to apply sales comparison approach. This approach to valuation is most applicable when sufficient data can be collected on recent sales of comparable properties.

Sales comparison approach is direct and normally easy to understand for valuation recipients. The prices can indicate the value of the subject property once they are adjusted to reflect any differences between the subject and the comparable. Determining the influence of these factors on the value of the valued property is the most important task.

In this process it is important to correctly select the property for comparison. Prices must be derived from market transactions. The following steps are usually distinguished in the comparative approach (Fig. 4.1):

1. research and identify comparable properties that have been sold
2. examine each comparable sale to determine how it differs from the subject property and now these differences affect its value;
3. adjust the sale or unit price (e.g. $1m^2$, 1^3), of each comparable for observed differences between the subject and comparable;

4. reconcile the results of these comparisons into a single value indication or range of values.

In the end of valuation process there is reconciliation of value estimates and final value conclusion. It is the last analytic phase in the valuation of urban land. A valuer can review each stage of valuation process. The valuation process is a systematic procedure that results in a final value estimate. The data and analysis on which the value estimate is based are communicated to the client in a valuation project. The valuation is not complete until the conclusion and the reasoning behind it have been communicated to the valuation recipients a natural person or institution). It must be clear from the appraisal report what kind of land value has been estimated (based on the market data). These can be no errors and ambiguities in the valuation report. The individual steps at the valuation must be clearly presented and interrelated. An appraisal report, like any evidence in pending proceedings, may be analyzed and assessed by authorized persons. The value given in the report may be updated when situation on the local real estate market changes. Form reports are preprinted documents which valuers complete as they procced through the valuation process. The valuation process is a systematic procedure that results in a final value estimate.

5. URBAN LAND USE IN THE VALUATION PROCESS

5.1. Land as natural resource

The monograph concerns the estimation of the value of urbanized land. In this context, the structure of land use in these areas becomes of special importance. This allows for a uniform interpretation of the state of development of urbanized areas. After the Second World War, intensive research on this issue began, which forms the basis for the classification of urban land use. Land may be classified as fallows (Mather 1989; Rhind and Hudson 1980; Ratcliff 1949):

1. surface land

1.1. agricultural land

1.2. forest land

1.3. land for transportation and communication

1.4. recreational land

1.5. land for site purposes

a) urban – transportation, manufacturing, mercantile, residential, recreational, institutional

b) nonurban building sites

2. water resources
3. subsurface mineral rights
4. super surface air rights.

Urban land, then, is surface land of economic value as the location of various land uses within urban areas. Cities grow both extensively and intensively. One of the problem for this process is the absorption of agricultural land. Urban land use is determined by the various decisions made by firms, households and the government. Land is the basic natural resource and is the habitat of man and its wide use in crucial for the economic, social, and environmental advancement of all countries. Access to land is controlled by ownership patterns . Land is the foundation of all forms of human activity. The public regulation and registration of real estates is closely connected to the tenure and the land use. Land information is a prime requisite for making decisions related to land investment, development and management for urban areas. Economics is an important factor in land use. A key component in this research is that economic rent. Rent refers to the net value of the returns arising from the use of land. Economic rent is a major influence on land value. The urban point in the above diagram symbolizes the extent of direct urbanization

related to the development of a particular city. The problem of changing the value of land with the distance from the city centre is presented in Fig. 5.1. It is indicated that this change in value between site A and site B is not described by a straight line.

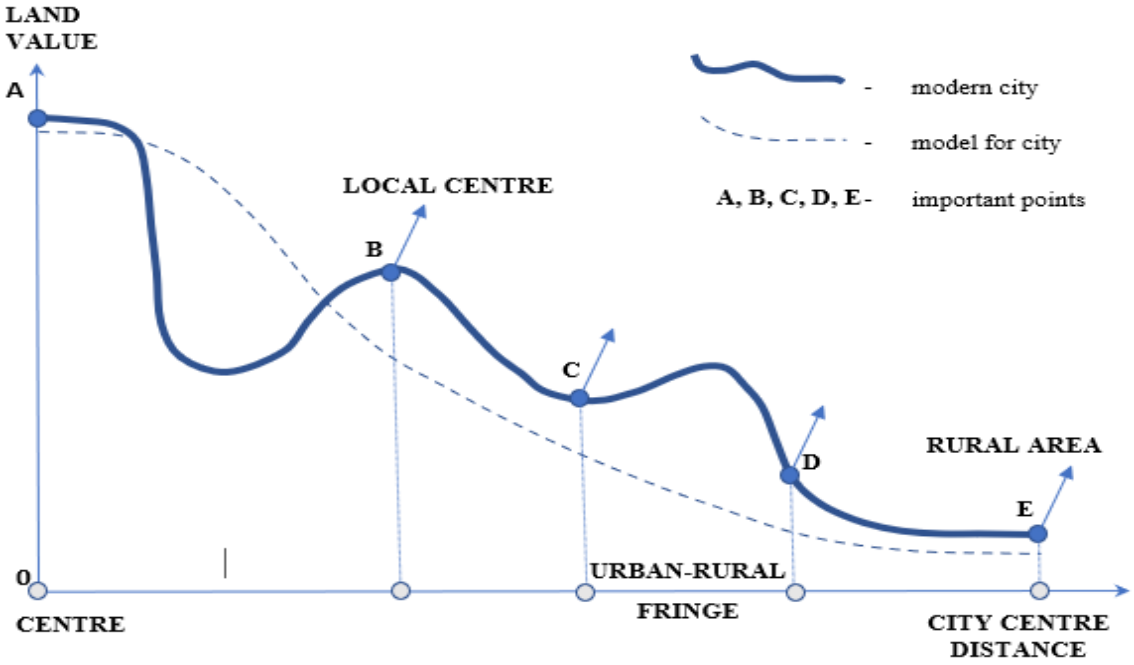


Fig. 5.1 Change in land price gradients

Source: own study.

Fig. 5.2 presents detailed changes in the value of urbanized land caused by the city border. The basic factors creating the value of urbanized land were also indicated. It is necessary to pay attention to the level of the achieved land value in this area due to the possibility of rent producing ability. The level of economic rent or rent-producing ability depends on both the location and the physical quality of land. Many cities have developed in areas with high-quality land. Urban land use is determined by the decisions made by firms, households and the local authorities. According to market economy principles (Harvey, 1996):

1. resources are allocated on the basic of prices, costs and profits;
2. firms and households have specific location preferences, and these preferences are reflected in the price/rent they are prepared to pay for the use of land;
3. owners sell/let land to the highest bidder;
4. buyers and sellers have a knowledge of market factors, which is sufficient to create competition;

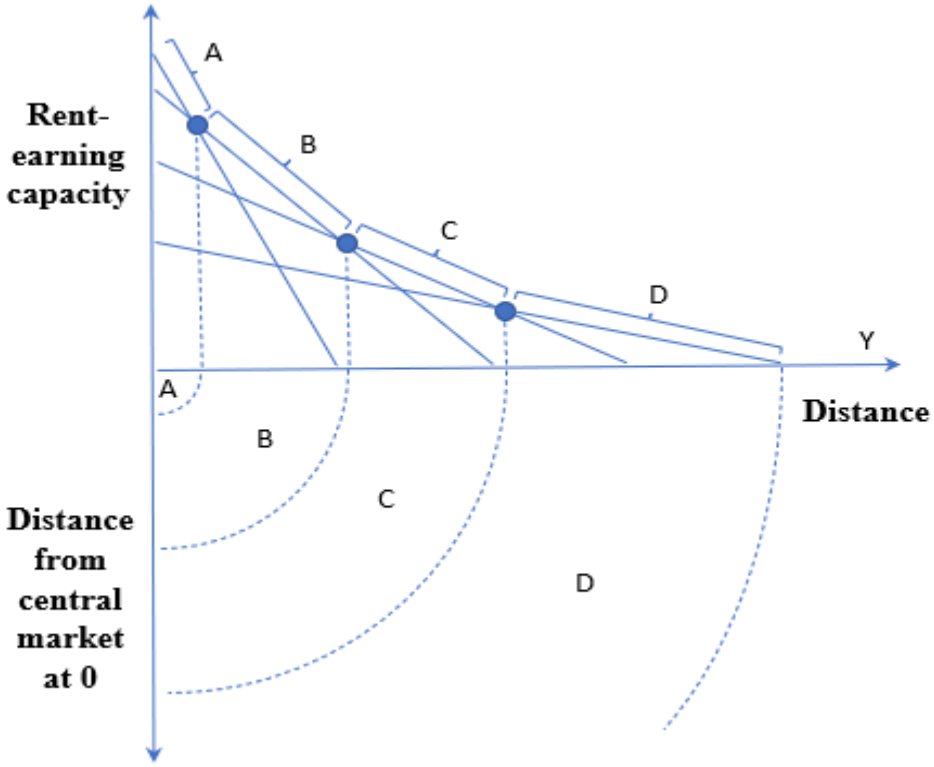


Fig. 5.2 Rent-earning capacity and land use

Source: Hervay 1996.

5. there are no dynamic changes on the market when the transport system, transport costs and technology remain unchanged;
6. there is no government interference in the real estate market.

Information about land use constitutes of the bulk of cadastral data for the valuation of real estate. In many cases, such data are unreliable, which affects the correct description of land for estimating its value. Land use data can be verified with the use of modern geospatial technologies.

5.2. Land use

The term "land use" has different definitions in various countries, and there are many different solutions for registering such data in cadastral systems or other real estate information systems. The importance of information concerning land use type has been repeatedly emphasized in the literature. Land use data constitute the basis for urban planning, real estate management, taxation and valuation procedures. Modern geospatial technologies may facilitate regular verification of land use data, thus generating economic benefits for local governments. Many European cities rely on information and communication technologies. In an era when information is the main strategic resource,

there is a growing need for comprehensive spatial information, including cadastral information, which necessitates continuous modernization of cadastral systems (Dawidowicz and Źróbek 2018). Land use structure defines the manner in which a given parcel of land is used, and it is one of the key components of cadastral data (UNECE 2004). Changes in land use and land cover have been recognized as the key components of global change and have attracted increasing attention in recent decades (Sun at ell. 2016). Processes that shape land use patterns are often poorly understood. The data on land use and the relevant changes play a significant role in the decision-making process, which is why these resources have to be effectively verified and updated for the needs of land valuation (Lisec et al. 2013). At least 50 member states of the United Nations Economic Commission for Europe, do not record existing land uses or are incapable of keeping such information up to date at all times (UNECE 2014, 2015). The definition of the term "land use" varies across countries, and various solutions for registering such data have been introduced. Each country decides which types of data best suit national needs and specific circumstances. Land use type is generally determined by vegetation cover and the activities carried out on land (UNECE 2015). Not all land use types are classified in the same manner across Europe. Several land use groups, including farmland, forests, built-up land and urbanised land, are registered in Poland. The data on land use in Poland constitute one category of cadastral data pertaining to land. Numerical descriptions of land use contours are prepared based on the results of site measurements. According to Polish legal regulations, cadastres are managed by district governors who are responsible for updating and modernizing the land and building register. Cadastral registers are updated by entering the documented changes into register databases. Land use is inherently related to the surface (an area). Land use mapping generates detailed information. There are two main approaches to land use mapping which differ primarily in the classification of land occupied by public highways and other transport networks, namely the method used to "map the reality on the ground". The above should be taken into account during land use planning and the relevant decision-making processes in urban areas. Cities develop land use plans covering their administrative areas in whole or in part. The attractiveness of urban areas for developers and residents can be enhanced by improving the effectiveness of land use and minimizing land waste. A modern nation must have adequate information on the complex and interrelated aspects of its activities to make decisions. Land use is only one of such aspects, but the knowledge about land use and land cover has become increasingly important. Land use data are needed to

analyse environmental process and problems. The information on the existing land use patterns and changes in land use over time is one of the prime prerequisites for better use of land (Anderson et al. 1976). Land use data are also essential for land management and valuation. An effective land use classification system supports unambiguous interpretation of land cover, and it plays an important role in the process of developing thematic maps as well as tables and lists of real estate attributes. Real estate registers can, therefore, serve both administrative and statistical purposes. Alphanumeric designation is an important consideration in real estate registers. The growing pressure on land and other natural resources increases the importance of accessible and adequate information about the attributes and value of natural resources as well as the relevant ownership claims. Real estate registers are increasingly often linked to create integrated systems such as multipurpose cadastres. Poland is currently in the process of creating an integrated property information system. The information about real estate market prices will be an important module of the developed system. The advantages stemming from data integration must also be considered in relation to the threat of data vulnerability and the demand for the protection of personal integrity. Statistical data on land use in urban areas and their immediate vicinity have been prepared with the use of map-aided plotting from aerial photographs. Land use patterns in urban areas can be determined by selective plotting from aerial images. Supplementary data from urban area maps and economic maps can also be added. The real estate appraisal system can be extracted from land and property databases. This system is generally highly useful for real estate valuation. Some data originate from tittle registers, and maps significantly contribute to the system's efficacy and accuracy. Modern techniques support the processing of large amounts of data and the integration of data from different registers. Modern tools facilitate estimations of the market value of land, they eliminate errors and speed up the process of determining the market value of land. Land use data can be classified in systems that distinguish various types of land cover. Such systems support an evaluation of changes in land use. Complete land use maps can be compared to develop contingency tables. Depending on which the maps and the tables are now available it is possible to present as:

1. land use map for year A,
2. land use map for year B,
3. change map presenting land use types that have disappeared,
4. change map presenting new land use types.

5. contingency table presenting the size of areas which have been transformed from one type of land cover to another and the size of areas remained unchanged.

The relevant resources are also useful for the land valuation process. The effects of the measures implemented in different periods of time can be studied, and the rate at which natural resources are used can be monitored. The answers to the following questions can be extrapolated from the analysed data (Gõran and Nordberg 1987):

- what is the extent of each land cover type?
- which cultivated areas are in the process of becoming overgrown and how large are they?
- how much forest has been felled, how have the felled areas been cleared, and what is their location?
- to what degree have small uncultivated patches disappeared during the change – over more rational farming methods.

Information on land use structure is one of the key information in the process of managing urban areas. this also applies to the procedures related to land value estimation.

5.3. Classification of land use for the land valuation process (urban areas)

It should be noted that there is no single land use classification for the purposes of real estate valuation. It is important that the classification is the same in a given country. It is important in terms of comparing real estate prices for a specific purpose. It is also important in a situation when it is necessary to evaluate estimates made at different times. In summary, it can be stated:

- there is no one ideal classification of land use and land cover,
- there are different perspectives in the classification process,
- the process trends to be subjective,
- each classification is made to suit specific land use needs (such as land valuation).

Here is one example of how to develop a land use classification system. It can also be used in Vietnam. DESIRABLE ATTRIBUTES OF A CLASSIFICATION SYSTEM (Hudson and Rhind 1980):

1. the classes must be mutually exclusive.
2. the system has to meet the detailed needs of the primary user.
3. the system should also meet the needs of secondary data users.
4. the system should be easy to understand and implement.

5. the system should produce repeatable results when different surveyors use the same survey technology.

6. the system should be exhaustive by classifying all geographic units.

7. the system's structure should guarantee the comparability of data collected with the use of different survey methods.

8. the system should be hierarchical, and it should support the agglomeration of survey data collected from various areas at different levels of resolution

9. the system should be sufficiently stable to enable comparisons of survey data collected in different periods of time.

10. the system should be sufficiently flexible to support new interests and operations without the need to develop a completely new classification.

11. the system should account for seasonal or other cyclic changes to ensure that aliasing does not affect the results.

12. wherever possible, the system should be based on quantitative criteria.

For classification an interesting characteristic is how may of the number of classed was used. Any classification is a compromise between conflicting anticipated needs. Below, a proposal for the classification of urban land use for the management of urban areas is presented in Table 5.1:

Table 5.1 Classification of urban land (partial)

Residential and commercial	- Continuous, mix of commercial and residential - Houses with gardens - Newly built areas - Public buildings - Caravan sites
Industry	- Processing of non-metalliferous mining products other than coal (glass, ceramics, cement, etc.) - Chemical and allied industries - Metallurgy - Engineering, shipbuilding and electric goods. - Vehicles - Metal goods, not specified elsewhere - Textiles - Clothing - Food - Wood - Paper - Other

Source: Central Statistical Office (Poland)

A few remarks related to the proposed land use classification presented above:

- the same plot of land may be used for more than one purpose on an on-going basis,
- one land use type can replace another on a semi-permanent or permanent basis,

- different but closely inter-dependent activities are carried out in selected locations.

In the efficient development of a land use classification system, it is important to obtain certain information from various sources. the quality of these sources is always assessed by the person who analyses the structure of land use. When starting to create a database on urbanized land, the above recommendations and guidelines should be used. This will enable logical organization of databases on urbanized land. This is especially important in mass appraisal processes.

6. URBAN LAND DEVELOPMENT AND VALUATION SYSTEM IN POLAND AFTER 1990

6.1. Urban land development

The countries of Eastern Europe face the task of transforming their centrally planned economies into decentralized and market-oriented systems. In October 1989, the Polish government announced a far-reaching plan to first to stabilize the economy and then rapidly progress towards a market-driven system. The plan called for a massive sale of State-owned enterprises, closure of inefficient plants, reduction of price subsidies, and the establishment of a real estate market. Various measures addressing urban areas were implemented based on data about land, buildings, infrastructure and human activities. The most important activities included urban renewal, administration of building permits, land acquisition for development, property taxation, and real estate valuation. Planning activities are inherently complex both in theory and in practice due to the interdependence of various land use types, location-specific advantages, transfer costs, social taboos and inhibitions, and other market imperfections, including the opportunities associated with land transactions which create the risk of corruption. Empirical data concerning the land market, prices and total transaction costs are highly inadequate.

Similarly, to small towns and settlements, every urban agglomeration is a social and demographic phenomenon. The urbanization process has to be managed within the framework of national and regional plans that considerably exceed the narrow bounds of local urban plans. Urban management should be linked with efforts to ensure a proper balance between urban areas and food-producing agricultural areas, forests, waters and other forms of land use. In Poland, the urbanization process was associated with technical progress, industrialization and, consequently, technology and the economy (including the real estate market). Local geography, social and legal systems, and general economic policies exert highly diverse effects on land, which prevents excessive generalization even when the relevant data are available. Land rights are deeply embedded in the social and legal structure and are source of family and community cohesion. In consequence, they can be developed and transformed only with difficulty. Urban land policies have the following general objectives which have to be considered within the dynamic process of urban expansion:

– to supply urbanized land for dwellings, community and recreational activities, as well as production, including the provision of basic urban services,

– to promote harmonious urban development that minimizes the use of resources, while maximizing economic and social benefits,

– to promote greater equity in wealth and income (to provide low-income families with access to adequate shelter),

– to ensure that the distribution of the population and human activities at the regional and national level is consistent with national priorities.

The value of land has three major components:

1. investments associated with land development, including the cost of preparatory work, land subdivision costs, provision of urban services and other services such as land clearing and resettlement,
2. changes in land zoning,
3. changes in location-specific advantages as towns and cities expand.

The last two elements do not result from capital investments specific to the plot, but are generally classified as "socially created".

On the demand side, market values are influenced by the availability and cost of financing the acquisition of land and buildings, as well as the availability of other forms of readily marketable securities for the alternative investments. The Polish government was committed to creating a market economy as soon as possible, and the following reforms were implemented for this purpose:

– property reform (law, land use, planning, restructuring, finance, retail, valuation),
– housing reform (social, market, finance),
– public service reform (organization, staffing and training).

In 1990-1992, there was no real estate market in Poland in the accepted Western sense of the term. The number of transactions on the Polish property market continued to increase, but professional services and data infrastructure were rudimentary. Efforts were made to establish advertising systems for the real estate market and the exchange of information. This period witnessed the emergence of a growing network of small local agencies that often collaborated with larger and more experienced groups of experts in exchange for information. Real estate prices fluctuated considerably, but certain stability was achieved on local markets over time. Initially, real estate prices were quoted in USD, but a gradual transition was made to the Polish zloty (PLN). Prices depended on location. Local real estate agencies were established in all Polish regions.

6.2. The goals and methods of real estate valuation

The market value of property is determined by comparing the value of the appraised real estate (object of valuation) with the prices (comparative prices) of real estate of comparable quality (Seele 1984). The results generated by the applied valuation method (comparative value, income value, real value) are used to establish the market value of property in urbanized areas based on the reliability of the quality appraisal and the valuation object as well as the adequacy of the applied valuation method. The value of real estate is most often determined with the market price assessment method which is based on a comparison of market prices. The Polish property market was not fully developed in the discussed period. This system had to be transformed into one built around saleable interests in land and the principle of unrestricted private ownership of land, including valuable urban development sites. Leaseholds had to be introduced to replace the existing usufruct rights in cities, and perpetual usufruct rights in urban areas had to be modified to provide tenants with similar rights to those enjoyed by rural land owners. Property values can only be determined on a free market. The State exercised full control over urban land; therefore, a free market had to be created where property values were shaped by the forces of supply and demand. Market value became the standard basis for appraising the value of real estate. Property value was generally based on market transactions involving similar types of property in urban areas. This valuation method was applied to properties zoned for development as well as surplus properties that were not allocated to ongoing development projects. Some authorities had expressed concern about the efficiency and effectiveness of land value and had advocated greater use of value-added taxes or local sales. The value of real estate depended upon a variety factors, including the use and enjoyment of land, the income generated by property, and the right to alienate or transform property. The value of property is partly dependent on the conditions inherent in the property and partly on extraneous factors. Inherent factors include topography, soil type, and the design and condition of buildings. Other factors include the local environment, proximity of other land resources, availability of transport and public services. In the discussed period, the value of land depended on the economic climate and the government's fiscal policy. The process of valuation may be described as a carefully considered estimate of the worth of landed property based on experience and judgement (Dale and McLaughlin 1988). In the analyzed period, market value represented the most probable price of property in a free market economy (Boyce and

Kinnard 1984). The value of property is usually derived from its market price, and it can be appraised based on:

- comparison with other properties,
- the income generated by the property,
- estimated costs of reconstruction or reinstatement,
- the value of a fully developed land plot.

A government program was introduced to foster the growth of the real estate market in Poland. The program had the following objectives:

1. to concentrate property development activities in the major cities as centers of economic growth,
2. to replace usufruct rights in major cities with long-term tenancy rights involving the payment of annual fees,
3. to establish the rights and responsibilities associated with tenancy and property ownership,
4. to introduce basic incentives for the construction of new buildings for rent or sale, and to encourage tenants to purchase the occupied property and obtain a regular return on the invested capital,
5. to assess capital value based on annual rents,
6. to enable the sale of proprietary interest in land and buildings,
7. to create a market for urban property,
8. to create registers of real estate value,
9. to create an urban property valuation system.

The private sector played a crucial role in the process of restructuring the Polish economy. Private developers required information about the expected market price of the developed property and construction costs in the process of negotiating the price of land. In some areas, the local authorities were keen on exercising greater control over the future pattern of development, for example in historical town centers. In such cases, developers acquired only long-term lease (perpetual usufruct) rights, and land remained the property of the local authorities who retained control over its future use and development. The establishment of a property market within an embryonic market economy and a relatively new political framework was a difficult process. A property market had never been created under such circumstances. The need for sweeping economic reform was pressing, and the property market had a vital role to play in the economic restructuring process.

6.3. Principal valuation method

Various methods were used to determine the value of fixed assets. In Poland, the choice of the optimal method was based the current stage of market evolution, property type, and the purpose of the valuation. The considered approaches involved the comparative method, contractors' method, depreciation method, investment method and the going concern method. The value of real estate was appraised by considering additional factors (Table 6.1): the unique attributes of valued property, factors describing the appraised property in relation to local, supralocal, social and economic structures.

Table 6.1 Explanatory variables used in the valuation process in 1990 – 1997

1. External factors	**Parameters**
1.1. Economic condition	Rent, rate, inflation, tax, economic and investment priorities
1.2. Income	Location, economic zone, urbanization
1.3. Location	Influence of an urban agglomeration, peripheral area with low levels of economic growth
1.4. Decision-making	Central or local government
2. Land attributes	**Parameters**
2.1. Soil	Quality of soil for use in agriculture or construction
2.2. Slope	Limitations and costs
2.3. Access	Road frontage, access to main road
2.4. Acreage	Size and number of plots
2.5. Distance	Distance to the city center, other buildings, supralocal centers
2.6. Neighbourhood	Quality of the neighbourhood
3. Other features	**Parameters**
3.1. Buyer characteristics	Subject to data availability
3.2. Expectations	Subject to data availability
3.3. Utility networks	Availability
3.4. Influence of urban area	Municipal policy
3.5. Special features	

Source: own elaboration

The first group of factors included plot area and shape, land-use type, topography, structure, technical condition, zoning requirements, property size, volume, functions and modification options. The second group of factors consisted of access, location, attractiveness of location, economic and investment priorities, distance from the city center, and location in special zones. The type and quantity of data depend on the adopted valuation method (comparative method, income method, real value method) and the type

of appraised property. The following factors were considered in the process of determining the market value of real estate:

- lower purchasing price when pre-emptive rights (right of first refusal) are exercised,
- compensation for expropriation,
- compensation for damages,
- price control and the development and redevelopment areas,
- compensation for the increase in land value resulting from redevelopment,
- consolidation of rural land when plots are located in developed areas.

For taxation purposes, the value of property can be estimated with the use of valuation models derived from statistical analyses (such as multiple regression). In field surveys and real estate valuation, price models are developed based on the estimated market value of property. In the strict sense, market value is defined as the statistically most probable market price of property in a standard transaction at a given point in time. In an econometric model, the market price of property can be determined with the use of the below formula:

$$\mathbf{p = f\,(x_{1,2,\ldots,n},\ b_{0,1,\ldots,n}) + E} \qquad (6.1)$$

where:

p – observed market price,

$X_{1, 2, \ldots, n}$ – price determinants,

$b_{0, 1, \ldots, n}$ – regression parameters.

E – residual.

The following formula is used in valuation methods that rely on regression analysis:

$$\mathbf{Y_i = b_0 + x_{i1}\,b_1 + x_{i2}\,b_2 + \ldots + x_{im}\,b_m + E} \qquad (6.2)$$

where:

Y_i – value or market price of property *i*,

$b_1, b_2, \ldots, b_m$ – regression coefficients,

$X_{i1}, x_{i2}, \ldots, x_{im}$ – attributes of property *i*,

b_0 – constant,

E – residual.

Linear models are most widely used in property appraisal because the relationships between property attributes and property value do not have to be

hypothesized in multiple linear regression analysis. Digital information concerning a given property can be acquired from many sources.

The valuation module can be a subsystem of the land information infrastructure, and it will cover properties at the local level (such as towns).

The types of information required for property valuation provide insights into the structure of the relevant datasets and their sources. Selected types of information can be obtained from repositories of processed market data and from statistical databases. The valuation system also generates relatively small datasets. The valuation process relies on the information on sold properties. Property values have to be updated on a regular basis. The land information system continues to evolve, and additional measures are needed to incorporate the register of sold properties into the system. Property valuation is the most complex process, but it had to be introduced to foster the development of the real estate market. The collection of basic data (land and building attributes, rents) was a very important process. The components of the valuation system can be used to test selected properties and valuation models based on the available knowledge about construction costs, rents and land prices.

6.4. Poland during the transitional period 1990 – 1997

We can say that in Poland "socialist system" ended on June 4, 1989. The Polish nation was ready to reject the one-party authoritarian system and the inefficient centrally planned economy (Gorzelak 1998). Market mechanisms were then expected to select the most efficient enterprises. It was recognized that this process would create unemployment, but that it was expected to generate a drive toward efficiency through competition. Complicating the macroeconomic situation was the structure of the Polish economy. More critical was the nature of decision – making in enterprises. Management and labor had merged into an explicit collision, with the government, the nominal owner of capital, having lost control of costs and production while it retained the ultimate obligation to fund the losses of these enterprises. Because of large subsidies to state enterprises and substantial fall in revenues, the fiscal deficit reached 29% of budget expenditures in the first half of 1989. Some economic variables from 1978 – 1988 are in Table 6.2.

Table 6.2 Some economic variables

Macro variables	Change (per capita) %
- gross domestic product	- 1,4
- domestic absorption	- 8,8
- consumption	0,7
- government expenditures	31,7
- gross fixed investment	- 29,3
- real income of all households	- 19,9

Source: own investigation based on statistical data GUS (in Polish)

Over 40 years of communist rule had culminated in a rigid economic structure in macroeconomic ruin. The new government decided to launch a eristical two - pronged attack on the unstable economy:

1. the government attempted to gain control over the budget and prepare for the next phase by making some institutional and legal changes,
2. the second phase of the program was launched on January 1, 1990. The crux of this phase of the government's program was a standard IMF – type stabilization package.

The stabilization package was designed to bring down inflation rapidly and put pressure on inefficient state enterprises. The government expected that the market would select inefficient state enterprises for bankruptcy and initiate the nationalization of the state sector.

It is generally accepted, that the economic adjustment will be difficult, with unemployment increasing and real incomes falling. Inflation has appeared to be the most serious obstacle in 1990 – 1997 and had a great impact on market development in Poland (e.g. in 1995 20 per cent and 13 per cent in 1997). The government introduced some measures in 1998 to cool down growth and stabilize the economy. Restoring local self – government to decentralize decisions was very important (for example regarding the real estate sector). The administrative structure of Poland has not changed since 1989. There were then 49 small and weak regions (voivodships). A process of centralization has been observed since 1990. In Poland a self – government system on the local level was reported in 1990 (about 2 500 communities). The state financial system was strongly centralized. Local taxes were very limited (about 14% of municipalities' own revenues from property

tax, Central Statistical Office 1995). Local governments were very critical in evaluating their financial situation. The second element of territorial unit during this period the voivodship become increasingly dependent on central government. There was a kind of a political vacuum between the commune and the region – until 1999, when another reform of the administrative division of the country was introduced. Now this gap is filled by the intermediate level of administrative division – poviat (district or county). 2 500 municipalities units (communities). The basic features of a centralized and decentralized system are shown below (Table 6.3):

Table 6.3 Centralized and decentralized system

CENTRALIZED	DECENTRALIZED
Government – territorial units	
• domination of government • domination of central government	• balance between "the centre" and the regions • rather weak role of the sectoral system
Territorial organization of the state	
• two – tier system • small "governmental" regions	• three – tier system • big self – governmental or self – governmental/ governmental regions
Public finances	
• domination of the centre over the territorial units	• deep decentralization of public financial system
• redistributive	• equalization of regional differences explicitly labelled as too great

Source: Gorzelak 1998

The data presented in Table 6.4 marks the year 1992 as a turning point in which most negative economic trends were reserved. Since then, the Polish economy has begun to grow. In 1996, the Polish economy grew by 6,1 per cent. By 1997 Poland was the only post – socialist country to attain the pre – transformation levels of GDP. It also had a significant impact on the development of the real estate market and the application of market principles for determining the value of value of urbanized land. It was the market value of land determined on the basis of data from the local market.

Table 6.4 Dynamics of basic economic categories 1989 – 1995 in Poland

previous year = 100

Categories	Year			
	1989	**1990**	**1992**	**1995**
Gross Domestic Product	100,2	88,4	102,6	106,5
Consumption	104,9	89,4	103,5	127,6
Exports	100,2	113,7	97,4	116,7

Imports	101,5	82,1	113,9	120,3
Foreign investment	-	-	233,0	195,0
Unemployment rate	-	6,3	13,6	14,9
Inflation*	351,0	686,0	142,4	126,8

*December – to – December basis

Source: Statistical Yearbooks

Determining the level of changes in real estate prices (market prices) based on market data was an important issue during this period. The rate of real estate price change did not coincide with the rate of change in inflation. In addition this indicator also depended on the specific market and the type of local market. This resulted "inter alia" in a significant increase in the supply of land in the market. This forced the development of market valuation methods for real estate valuation and education in the short term of many professional experts (valuers). In 1992 the possibility of obtaining state rights in this respect was introduced in Poland (valuer in Polish: "Rzeczoznawca Majątkowy"). The privatization process has gone through ups and downs. The peak in the pace of changes in the ownership structure came in the second half of 1991 (Gorzelak 1998). At the beginning of the Polish transformation it was seen as one of the most important factors of economic restructuring. Political factors have played big role in this process (World Bank 1996). The economic reforms have resulted in dramatic changes on the labor market too (Fitz 1997). It also had a big impact on the real estate market. Analyzing the real estate market in Poland should also be taken into account the Polish regional policy. Pay attention to:

- the need for restructuring many of the country's regions,
- the need for an active state policy towards old industrial regions and agricultural regions characterized by low income,
- the need for decentralization as a necessary condition for a region policy,
- the importance of creating a new efficient institutional infrastructure.

A crucial problem of Polish regional policy was its management and coordination in 1996 – 1997. Regional approach to state policy have been pursued under the pressure of political instability in the old industrial regions and in the regions endangered by structural unemployment (CUP 1993). The Polish transformation (1990 – 1997) appears to be proceedings positively.

6.5. The evolution of the urban property valuation system in Poland after 1990

Before 1990 (1985-1989), property valuations in Poland were performed by experts as part of a central administration system for determining real estate prices. From the legal point of view, the valuation of property was regulated by the Act of 29 April 1985 on land management and expropriation (Act 1985). The property valuation process involved mainly expropriated land and State-owned land that was leased to individuals and housing cooperatives under perpetual usufruct agreements. Property prices were set based on the tables and indicators published by the State administration (official prices), and they were not shaped by the forces of demand and supply. A free property market existed outside the centrally planned economy, and real estate prices were not officially registered. Official prices were significantly underestimated in relation to the prices quoted on the black market. However, the annual fees for State-owned land that was leased to perpetual usufruct holders were also low. Official prices were set by the State to facilitate the construction of new dwellings by individuals and housing cooperatives. Before 1990, the Polish system of land prices and fees in urban areas was regarded as a completely autonomous set of valuation rules (Mizera and Poczobutt-Odlanicki 1974). Land transactions were not regulated by the centralized pricing system, and they were governed by land management rules applicable to urban areas. The property pricing system was a mixed system that accounted for official prices and, in some cases, market prices. In urban areas, land transactions involving individuals were permitted. However, an official register of land prices in cities had never been developed. The prices quoted by notaries public were not reliable, and they were often significantly underestimated relative to black market prices. Poland witnessed radical social and economic changes in the late 1980s. The ensuing reforms affected the real estate market, including property valuation principles. The Act of 29 April 1985 on land management and expropriation was amended in 1991 (Journal of Laws, 1991, No. 30, item 127). The amendment introduced new and separate valuation rules for land and buildings. According to Article 38 of the above act:

- the value of land was determined based on:

a) current land prices,

b) land improvements,

c) land-use types and functions stipulated in the local zoning plan,

d) location,

e) availability of public utility infrastructure, including power and gas supply lines,

f) existing development and land-use type;

- the value of buildings, apartments and other premises was determined based on:

a) reinstatement costs,

b) degree of wear;

- the value of buildings and infrastructure destined for demolition was determined based on the value of salvaged materials.

The reinstatement value of developed land was calculated with the use of the below formula:

$$\mathbf{V_oN = VG + VB\ (VU)} \tag{6.3}$$

where:

$\mathbf{V_oN}$ – reinstatement value of property

$\mathbf{VG}$ – value of land (market value)

$\mathbf{VB}$ – reinstatement value of buildings

($\mathbf{VU}$) – reinstatement value of infrastructure

$$\mathbf{VB = VB_o\ (1 - DW)} \tag{6.4}$$

where:

$\mathbf{VB_o}$ – reinstatement value of buildings (new construction)

$\mathbf{DW}$ – degree of wear (determined by an expert)

Similar principles were applied in the valuation of apartments (excluding land).The preliminary provisions of a property valuation system were developed in the early 1990s (Hopfer red. 1990). The project was commissioned by the Ministry of Urban Planning and Construction, and it was conducted by the University of Agriculture and Technology in Olsztyn (presently the University of Warmia and Mazury in Olsztyn). The project was completed in May 1990, and efforts were made to develop a property valuation system based on free market principles. The initial value of land had to be determined in the process of appraising urban property. This solution was dictated by the scarcity of reliable data on property prices during Poland's transition from a centrally

planned to a free market economy (1989-1991). The initial value of land (V_o) was calculated as follows:

$$\mathbf{V_o = Bp * u * s} \quad (6.5)$$

where:

$\mathbf{V_o}$- base price (in quintals of rye per hectare) multiplied by the area of the valued plot

$\mathbf{B_p}$– base price

u, s- factors adjusting the price of land in an urban area.

The base price ($\mathbf{B_p}$) was regarded as a quasi-objective value of property that was based on standard estimates. Standard estimates were set forth by legal acts regulating the management of State-owned land. The proposed method of land valuation in urban areas accounted for the size of the city (population), distance from the city center, availability of utility networks, and other local factors that influenced the value of land. The influence of demand and supply on property prices was also considered. The following formula was ultimately proposed for determining the initial value of land in urban areas:

$$\mathbf{V_w = V_o * u * s} \quad (6.6)$$

where:

$\mathbf{V_o}$– base price (in quintals of rye per hectare) multiplied by the area of the valued plot

u – adjustment for population

s – adjustment for location, distance from the city center or the urban core.

The base price was determined based on the prices of class 1 land sold by the State Land Fund in the first tax zone (based on free-market prices of rye) stipulated by the Act of 12 March 1958 on the terms and mode of property expropriation. Reliable transaction prices were accumulated over time, and at the beginning of 1992, the base price was replaced by the average price of land in urban peripheries.

Threshold values were set for the population adjustment indicator **u** (1.0 to 5.0) and the location adjustment indicator **s** (1.0 to 3.0). The initial value of land (V_w) was adjusted with the use of several indicators, including:

$\mathbf{k_1}$ – adjustment for utility infrastructure (increase of 10-30%),

$\mathbf{k_2}$ – adjustment for geological conditions (10-30%),

$\mathbf{k_3}$ – adjustment for land-use type relative to public utility sites (0-30%),

$\mathbf{k_4}$ – adjustment for social and neighbourhood factors (-30% to +30%)

Expert appraisers could decrease or increase the value of land by up to 40% based on the influence of other local factors.

The following formula was ultimately adopted for determining the value of land in urban areas:

$$\mathbf{V} = \mathbf{V_w} * (\mathbf{1} + \sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{ki}) \pm \mathbf{E} \qquad (6.7)$$

where:

$\mathbf{V_w}$ – initial value of land (average price of land in the urban periphery)

$\sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{ki}$ – sum of adjusting indicators

$\pm\mathbf{E}$ – adjustments introduced by the expert, in the range of - 40% to + 40%.

This land valuation method was further elaborated in 1990 - 1992 (Hopfer red. 1992) to account for the evolution of local real estate markets. The factors that influence the value of land in urban areas were identified based on a review of the literature and own findings. The identified factors were divided into two groups:

1. **physical factors:**

- location (general, detailed, determined by adjoining land-use zones),
- plot size and shape,
- topography (slope),
- geological conditions,
- road access (width of road frontage),
- microclimate and environmental impact,
- access to public utility sites,
- environmental conditions and scenic value.

2. **legal and local factors:**

- provisions of the local zoning plan and the local development plan,
- restrictions in land management and reconstruction of buildings and structures,
- legal status of land and buildings,
- value and structure of local fees and taxes (including perpetual usufruct fees),
- alternative capital investments,
- confidence level (investment risk),
- local preferences and incentives offered by the local authorities,
- feasibility of public utility investments.

The indicator (index) method for determining the value of urban land was used only at the beginning of economic transformations in Poland (1990–1993). It was replaced by standard comparative methods which supported the acquisition of reliable data on the prices of land in urban areas and areas undergoing urbanization. In 1994, detailed rules for property valuation were developed by the Ministry of Urban Planning and Construction based on previous experiences and the amendment to the Act of 29 April 1985 on land management and expropriation (Provisional Rules for Property Valuation 1994). It was assumed that the market value of property represents the price that is most likely to be achieved on a free market. The legislators emphasized the specificity of the real estate market and noted that real estate constitutes a special type of marketable commodity, and that the real estate market is imperfect. The following factors were considered during the valuation of urban land:

- current prices of land on the market,
- location and land-use type indicated in the local zoning plan,
- availability of municipal infrastructure on the property or in the vicinity,
- existing condition, improvements and presence of buildings.

Comparative methods involve the price adjustment method (presently known as the pairwise comparison method). In this approach, factors that influence the value of land are taken into account, including: transaction prices, transaction dates, supply-demand ratio. The differences in the value of the appraised property and the compared property were adjusted. A relatively low number of reliable transactions on the local market, in particular transactions involving similar types of property, was the main limitation of the price adjustment method. Two approaches were used to determine price adjustment indicators: pairwise comparison, statistical analysis.

The expert adjustment indicator was also applied in the last stage of valuation. This indicator accounted for the inflation rate (which was high in the early 1990s) and its probable influence on the real estate market. The expert adjustment indicator was set at 0.85 to 1.15 (Provisional Rules for Property Valuation 1994) to minimize the effect of subjective expert opinions on valuation results. The adopted value of the expert adjustment indicator had to be justified in the valuation report. The valuation process was described in the report which constituted the official statement of a professional appraiser.

Beginning from 1991, the Act of 29 April 1985 on land management and expropriation had been amended many times in matters concerning real estate management and the relevant procedures. These amendments were introduced to keep up

with the rapid pace of social and economic changes in Poland. The amendment of 1995 (11 amendments had been introduced by 1995) confirmed that property valuations can be conducted by (Marmaj 1992):

- experts appointed by the voivodeship governor and placed on the list of voivodeship experts,
- other professionals with suitable qualifications for property valuation (including professions licensed under the provisions of the Geodetic and Cartographic Law).

In 1994, the value of land was recognized as an economic category. Experts concluded that the value of property is created by market forces and that real estate constitutes a special commodity. The emphasized that the market is governed by various forces, where demand and supply were the main forces that drive the responses of market participants (Hopfer et al. 1994). In 1990-1997, property valuation was strongly linked with real estate management. The value of real estate had to be determined for various property management procedures. This relationship is typical in periods of transition from a centrally planned to a free market economy because most property on the market was owned by State. In the discussed period, the State owned more than 60% of real estate in Poland (less than 40% at present). The following key legal acts were adopted in the analyzed period:

- Act of 29 April 1985 on land management and expropriation (Journal of Laws, 1991, No. 30, item 127),
- Act of 29 September 1990 amending the Act on land management and expropriation (Journal of Laws, 1991, No. 79, item 464; Journal of Laws, 1992, No. 83, item 373),
- implementing provisions to the Act of 29 April 1985 on land management and expropriation (Journal of Laws, 1991, No. 72, items 311-315; Polish Monitor, 1991, No. 21, item 148),
- implementing provisions to the Act of 29 September 1990 amending the Act on land management and expropriation (Journal of Laws, 1993, No. 23, item 97).

In property management processes, the fees and compensations for real estate expropriation were determined based on the market value of land. The comparative approach involved the price adjustment method which was later renamed to the pairwise comparison method. In 1991-1995, property prices had to be adjusted for time due to high inflation and its influence on the performance of the real estate market. The general scarcity of reliable information about the prices of transacted property and factors which affect real estate prices posed a considerable problem. The main tenets of the property

valuation system in urban areas were developed. The legislators noted that the price of land is determined mainly by its location and function indicated in the local zoning plant. The supply of land is inelastic, which intensifies the competition for land. In urban areas, the supply of land was largely regulated by the central administration system. The above also applied to the transfer of land from the public to the private sector. The market value of an area or district was influenced by its immediate neighborhood. Experts postulated the presence of correlations between the value of land and economic rent, between economic rent and location, between location and land-use type, and between land-use type and neighborhood (Hopfer et al. 1994). It was assumed that land prices in urban areas are correlated with the rate of urban development and population growth within a relatively short period of time. In the property valuation process, the value of land was closely associated with:

- demand for land that plays an important role in urban development,
- ground rent (land-use types and functions specified in the local zoning plan)

In 1990-1995, land valuations were performed mostly for the sale of land owned by the State and municipalities. The value of land also had to be calculated to adjust perpetual usufruct fees for inflation. Before 1993, the indicator method was gradually replaced by methods characteristic of the comparative approach. Comparative methods initially faced numerous limitations due to the scarcity of reliable information about transaction prices (Hopfer et al. 1995). The market price became the key determinant of land value (Bieniek and Marmaj 1995). Before 1990, property valuation in Poland could not be based on uniform economic indicators that are typically found in a free market economy. After the adoption of the Act of 29 April 1985 on land management and expropriation, research studies were undertaken to incorporate the rational urban planning concept into a set of synthetic criteria for evaluating the optimal planning solutions in urban development. However, a cohesive concept supporting the development of a land valuation system had not been put in place. Various attempts were made to change the rules applicable to land valuation. Before 1990, land prices were not regulated by the forces of demand and supply, and they were catalogued in a central register. Such registers were relatively easy to compile. However, property appraisals based on registered prices were removed from the reality of the real estate market and did not account for the performance of local markets. In 1985-1989, the prices of property in urban areas were set by the central administration on the assumption that the value of land can be determined by summing up the main determinants of property prices, in particular:

- land improvement costs,
- land-use types stipulated in the local zoning plan,
- location (general and detailed),
- availability of public utilities.

The following procedure was introduced to calculate the amount of compensation for agricultural land converted to urban use:

1. the base price of property was defined as part of an administrative procedure. The base price for high-quality agricultural land could by increased by 15% to 80%.
2. the base price was increased by up to 5% for every available public utility (road, sewer line, power line, mains water).

The base price could be increased by up to 30% for attractively located properties (in highly urbanized zones with infrastructure access). The base price could also be decreased on land with unfavorable geological conditions (marshes, sands, etc.). The relevant reduction in price could not exceed 20%. The need for comprehensive research focusing on the real estate market in Poland's transitioning economy was recognized in 1990. The aims of such research should be to:

- observe changes in the prices of urban land,
- determine the relationship between the prices of land and buildings (in analyses of developed land),
- analyze factors that influence the value of urban land (market value of land),
- determine the distribution of property prices and generate maps of property values,
- support the development of the register of real estate prices.

These efforts required a cohesive definition of the term "market value of property" and the determination of the relationships between ground rent, urban land rent, incomes and property prices. The indicator method (applied in 1990-1993) was replaced by comparative methods for appraising the value of urban land. It was assumed that the market value of land is influenced by numerous factors, including:

- external factors such as economic factors, degree of urbanization and legal regulations,
- characteristic attributes of the appraised property,
- present and future demand for land zoned for urban development and housing construction,
- provisions of the local zoning plan.

Hopfer et al. (1994) observed that the market value of urban land continued to increase steadily and that free market principles would have to be ultimately applied in property appraisals. Efforts were also made to develop a system for registering real property prices and the characteristic attributes of local property markets. The Register of Real Estate Prices and Values was established after 1997, and it was renamed to the Register of Real Estate Prices in 2020. Reliable valuation of commodities, including real estate, is essential for economic planning and indispensable for effective business operations.

7. CREATION OF THE REAL ESTATE VALUATION SYSTEM FOR URBAN AREAS IN POLAND

7.1. Some remakes

The analysis of future development of town urban areas consist of analysis of natural conditions of the area and market value of land, actual conditions of buildings and their values, public utilities system (water, sewage, gas, central heating, electricity) and the results of the simplified microregional planning, transformed in the town-planning scale.

The Government of Poland was committed to the creation of a market economy as soon as possible. Land reform in Poland was connected with:

- property (law, planning, regeneration, finance, retail, valuation),
- housing (social, housing, local market, finance),
- public service (organisation, staffing, training).

The most important is urban regeneration as promotion of economic and social activity. The price of a commodity is determined by the interaction of supply and demand in the market. Value is the price which willing buyers are prepared to pay for that commodity. There is evidence of previous transactions. There is competition between buyers. There are just some of the condition for the free real estate market. The most important is the computerized valuation system where indicators of the economic value of land and buildings and economic profitability will be merged and transformed to a proposed value.

7.2. The goals and methods of real estate valuation

The definition of a market value is subject to a valuation involving a comparison (price comparison) between the real estate to be valued (valuation object) and the prices (comparison prices) charged for real estate of comparable quality.

Following the results of the valuation methods used (comparison value, income value, cost value) the market value for urbanized areas has to be determined with due consideration being given to the reliability of the quality appraisal and the valuation foundation as well as the adequacy of the valuation method used. The method most commonly used to valuate real estate is the market price assessment method based on comparison of the market prices. This system must be transformed one built around

saleable interests in land and based on the principle of unrestricted private ownership of land, including valuable urban development sites. This requires the introduction of leaseholds to replace existing handling rights in cities, and the creation of terms of tenure for perpetual ownership in urban areas along the lines of the rights enjoyed by rural land owners. Given its monopoly control of urban development land, it must fall to initiate a property market and allow market forces to set property values in the fullness of time. Open market value is the normal basis of valuation used in preparing valuations of real estates. It is generally based on the evidence of open market transactions in similar property in the urban locality. It is the basis of valuation appropriate for properties held as investments, properties held for future development and properties declared surplus to the requirements of an undertaking. Some authorities have expressed concern about the efficiency and effectiveness of land value and have advocated the greater use of value-added taxes or local sales. The value of any tract of real estate depends upon a variety factors, which include the land use the income arising from it and the rights to alienate or transform it. The value depends in part upon conditions inherent in the property and in part upon factors are extraneous to it. The value of land depends upon the economic "climate" and government fiscal policies what is special important for "transition" market condition. The process of valuation may be described as the carefully considered estimate of the worth of landed property based on experience and judgement (Źróbek ed. 2020; Dale and McLaughlin 1988). For taxation purposed, the concept of market value is generally used. Market value is the most probable price in terms of money which a property should bring in a competitive market (Źróbek 2001; Boyce and Kinnard 1984).

There is following program to create and to develop real estate market based on Polish experience:

1. property development activity will be confined to major cities as centres of economic activity,
2. exchange handling rights in major cities for land tenure for a period of years, and for the occupier to make an annual payment,
3. establish the principle that property carries with it certain rights and costs,
4. provide the basic incentive for property companies to develop new buildings for rent or sale, and for investors to acquire occupied property which will provide a regular return on the capital invested,
5. provide annual rents as the basis for the assessment of capital value,
6. progress to the sale of perpetual interests in land and buildings,
7. create a market in urban land and buildings,

8. establish a market evidence of real estate values,
9. develop the urban valuation system.

Evidence of rents and capital values will assist developers in the later stages of the government's programme of property disposals when bare land suitable for development should be sold off. New development by the private sector will have a crucial part to play in the economic regeneration. It is very important to undertake the necessary work to preparate for the slae of its property holdings without delay.

7.3. Some aspects of creation of real estate valuation system

The real estate market system needs information about:

- collection of purchase prices,
- determination of market values,
- determination of standard (indicatory) land values,
- inference of essential data for valuation.

The information required to develop and maintain the real estate valuation system may be collected directly through experts and indirectly from other sources. There are following data:

1. site/location:
- topography, soil quality and soil characteristic, usable land area,
- building setback requirements, landscaping,
- general and corner location, street access, railroad and waterway access,
- available utilities,
- distance to shopping etc., nearby nuisance, zoning.
2. building size:
- area: ground floor, total floor, leasable,
- volume,
- height: building, ceiling,
- number: stories, apartments.
3. design:
- intended use,
- architectural style, shape of building, roof type,
- story height.
4. Shape:

– floor area/perimeter ratio,
– number of corners.

5. construction quality:
– quality of materials,
– workmanship,
– architecture.

6. construction materials:
– foundation, framing, floors, walls (exterior and interior),
– ceilings and roots.

7. other thematic building features:
– number of rooms by type,
– heating, ventilation and air condition,
– plumbing facilities,
– fireplaces and similar amenities,
– additions and remodelling,
– power equipment.

8. age/extent and depreciation.

The valuation process depends upon the availability of such site data as the frontage, depth, and width of the parcel, its topography, shape and area, the drainage and soil conditions, and details of any off-site improvements. More important in valuation process are: building cost table, the rate per square meter or cubic metre for different classes of building, and cost of construction for various parts of building. Much of data tends to be uniform in character, the processing is highly repetitive, and quite complex analyses are often required. Computers may be used to create a maintain valuation data bases, to analyse price and cost data, to determine general market trends, to carry out investment and statistical analysis, and to maintain departmental accounts and personnel records (Hamilton 1980). System of real estate valuation is used to assist various institutional planning and development initiatives. Registration of the real estate market is to provide updated information on prices. For the needs of land and building valuation in urban areas the data can be obtained from the following sources:

– the land cadastre (registers and maps) or geographic information system,
– the land and mortgage registers,
– the basic map along with overlaying maps concerning technical installations in the area,

– physical planning for city,
– cartographic and descriptive information about pollution of the environment,
– other data sources (administrative data, statistics, economics, documents, expertise, opinions).

If the collection of data package necessary to valuate land is not especially difficult, valuation of buildings may prove difficult. Analysis information on buildings that is held by various institutions one sees that the data collection usually are incomplete, fragmentary and with various degrees of detail. Frequently the information overlaps. Remaining information is collected selectively, depending on the scope of interest of the respective institution. When making valuation of buildings and structures it is very important to up to date the price lists of materials and building elements. It is important that input data are characterized by the some interpretation and the same units of reference. Designing a system of real estate valuation attention should also be paid to creating a cohesive system of reacting to changes in value of the area so that to be able to introduce a correction in time. In order to be able to work systematically in valuation the system should have at its disposal the following:

1. data base on real estate:
– land and buildings files, registers,
– technical installations files,
– local detailed plan of land development,
– land limitations for the needs of government bodies and local administration.
2. methods of valuation:
– methods to determine value of real estate,
– procedures, standards,
– official experts.

In the long term it should be expected that such a system – having at its disposal sets of various information on local objects – should become an element of a more general system of information about the locality. The valuation system would be just one subject system at a local level, apart from a multipurpose cadastre, other data bank, taxes and other duties, etc. The land value system will be further developed and will incorporate detailed information about planning regulations. The process of gathering the basic information (land and building characteristics, rents) is very important. Elements of the estimation of values could be a test valuation for selected properties and the use of valuation models based on the available knowledge about construction costs, rents and

land prices. The most pressing problem is create information system of market prices for land and buildings. It is not still clear how this problem could be solved in the future. This system may be viewed as a subsystem in the real estate market system.

7.4. Some aspects of real estate market in Poland

Poland covers the area of 31.269.000 ha, out of which ca. 38% belongs to the State Treasury, 60% constitutes private ownership and 2% - municipal, province ownership.

To estimate the activity of the land market in Poland is not so easy. The main factors i.e. total area of real estate yearly changing its owner was available. Some departments of the research sciences register the number of transactions on land transfer taking place every year. For the years 1990-1998 the table are presented below (Table 7.1):

Table 7.1 Land and property market in Poland for the years 1990–1998

Type of transaction	1990	1992	1994	1996	1998	Total 1990-1998	
						deeds	in %
Notarial deeds connected real estates (total 1 + 2)	446 043	408 796	612 973	646 001	633 535	4 964 415	100,0
- concerned agricultural land	230 021	149 748	191 704	199 276	182 387	1 718 697	34,6
1. market transaction – total (A+B+C)	220 618	248 012	422 999	450 727	453 232	3 260 585	65,7
A. sale by State Treasury and communes	42 472	30 507	107 188	87 758	115 987	681 240	13,7
B. letting on perpetual usufruct	75 481	55 567	78 983	75 279	70 894	613 887	12,4
C. sale by other persons (physical and legal)	102 665	161 938	236 828	287 690	266 351	1 965 458	39,6
- concerned agricultural land	66 455	58 710	78 479	99 586	99 586	91 437	14,7
2. out-of-market transaction - total	225 425	160 784	189 974	195 274	180 303	1 703 830	34,3
- concerned agricultural land	163 566	91 038	113 225	99 690	90 950	991 250	20,0
- other	61 859	69 746	76 749	95 584	89 353	712 580	14,4

Source: own investigation based on statistical data

The out - of market transaction means change of the owner without cash equivalents: gifts, inheritances, conveyance of reals estate for social insurance. There are some expectations concerning development of land market in Poland. One of them

is built on assumption that this development will be related to the development of the GNP what means an increase of number of transaction. The real estate market in Poland has been undergoing significant structural changes. Their prime source are legislates changes, which lead to establishing of new entities, including insurance companies, investment funds, mortgage banks or pension funds. Setting up of mortgage banks will lead to development of a new financial instrument for investor, which will make them more engaged in the market. We can to observe the following tendencies and major barriers in development of the land and property market:

1. tendencies:

- establishing the economic position of real estates as an important factor influencing profit.
- ordering and acknowledging titles of ownership concerning land and premises.
- a systematic increase in the scale of turnover on the domestic market of land and buildings.
- an increase in the marketing activity conducted by institutional owners (communes, district offices and enterprises), aimed at selling land and buildings or attracting investors.
- making part of the national resources of land and buildings available to foreign persons.
- a constant increase in the prices of real estates, especially in cities, big and economically active centers, recreation centers and health resorts.
- an increase in the number of estate agencies, property values, notary's offices, trading companies and other entities operating in the real estate market.
- structural changes resulting from the fact that new entities appear on the market (especially foreign ones, in the sector of banking and insurance).
- increasing interest in real estates as a form of capital investment.

2. major barriers:

- lack of a cadastral system (especially shortage of legal register).
- lack of data (or limited access to them) and problems with making forecasts; lack of specialized units offering their services connected with complex market monitoring.
- formal and legal constraints (e.g. in the case of real estate acquisition by foreign persons).
- law instability (concerning e.g. fiscal/tax acts).

- lack of sufficient understanding of liabilities/obligations imposed by property re-privatization.

7.5. Methods in real property valuation

The most pervasive general approach is related to the market value of real estate. These values form the basis of decisions has been taking by entities in market economy context. Market values are fundamentally different from administratively assessed values.

The reason for market valuation may be divided into those that are to fulfil market requirements, such for sale, purchase, mortgage, inheritance and those that are to fulfil requirements laid down for administrative purposes such for compulsory purchase compensation and taxation. Valuation for different purposes may follow different procedures and employ different attributes, criteria and methods. The classification of methods are as follows:

<table>
<tr><td colspan="6">The approaches in valuation</td></tr>
<tr><td colspan="2">Comparison</td><td colspan="2">Income</td><td>Cost</td><td>Mix</td></tr>
<tr><td colspan="6">Methods</td></tr>
<tr><td>paired sales comparison</td><td>statistical analysis</td><td>investment</td><td>profits</td><td>replacement cost
reproduction cost
liquidity cost</td><td>residual estimated rate of agricultural land</td></tr>
<tr><td colspan="2"></td><td colspan="3">Techniques</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2">direct capitalization
discounted cash flow</td><td>detailed
aggregated elements
index</td><td></td></tr>
</table>

Fig. 7.1 Classification of valuation methods in Poland according to Polish law and professional standards

Source: own investigation based on literature review

Valuation requires the use of direct and indirect methods and indicators, while a study of the relationship is often hampered by a lack of reliable data. The traditional residual valuation traditional technique can be applied to conditions in a developing land market. These techniques, however, raise several important questions:

a) how do the socio-economic conditions of an economy in transition affect the applicability of contemporary valuation techniques to the conditions of a thin

market?

b) which land valuation techniques and approaches are most suitable for the specific market conditions.

These questions can be discuss for solve specific problems of land valuation. A brief overview of the trends of socio-economic transformation during the period of transition from planned to a market economy is required. The more important are general changes in urban land valuers, practice of land allocation and land taxation (mass appraisal system), land use planning and cadaster information system. Some decisive elements in the process of real estate valuation include Fig. 7.2. There are some steps to in valuation process: description of property, research legal environment and state of property market, experience and knowledge of values, and choice methods of valuation,

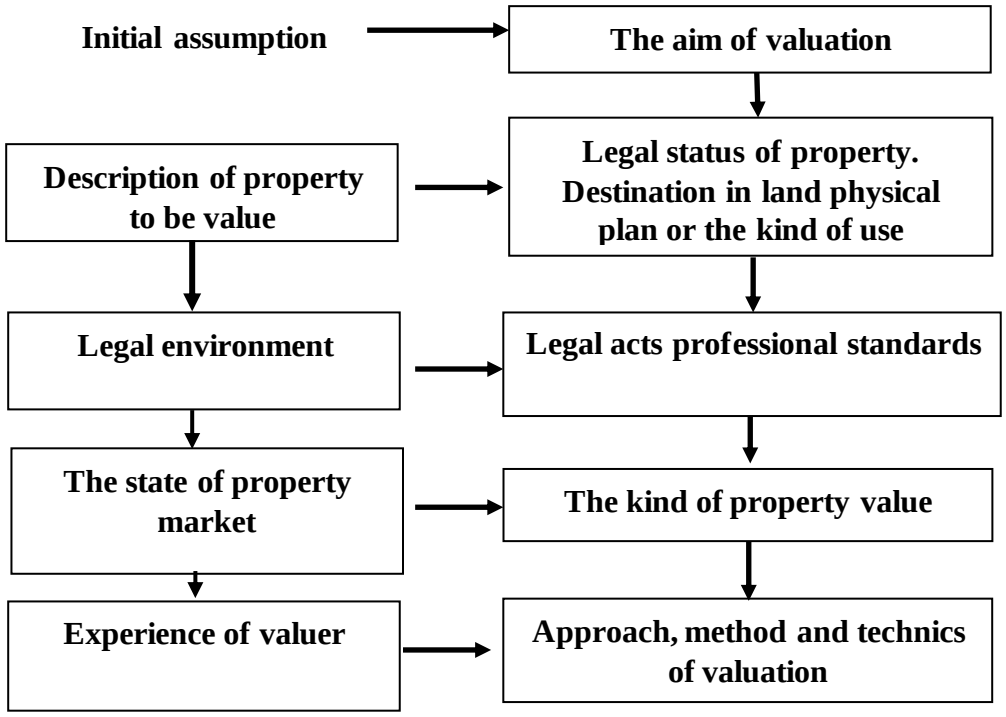


Fig. 7. 2 The decisive elements in the process of real estate valuation

Source: own investigation

The Fig.7.3 present some possibilities of appraisal of open market value. The two approaches can be use. In case of lack sufficient market data the cost approach can be use. In Poland valuation methodology is based upon British and American models adjusted to valuing within active markets and sub-markets. Where property development is the under consideration, the residual method is utilized for the project appraisal.

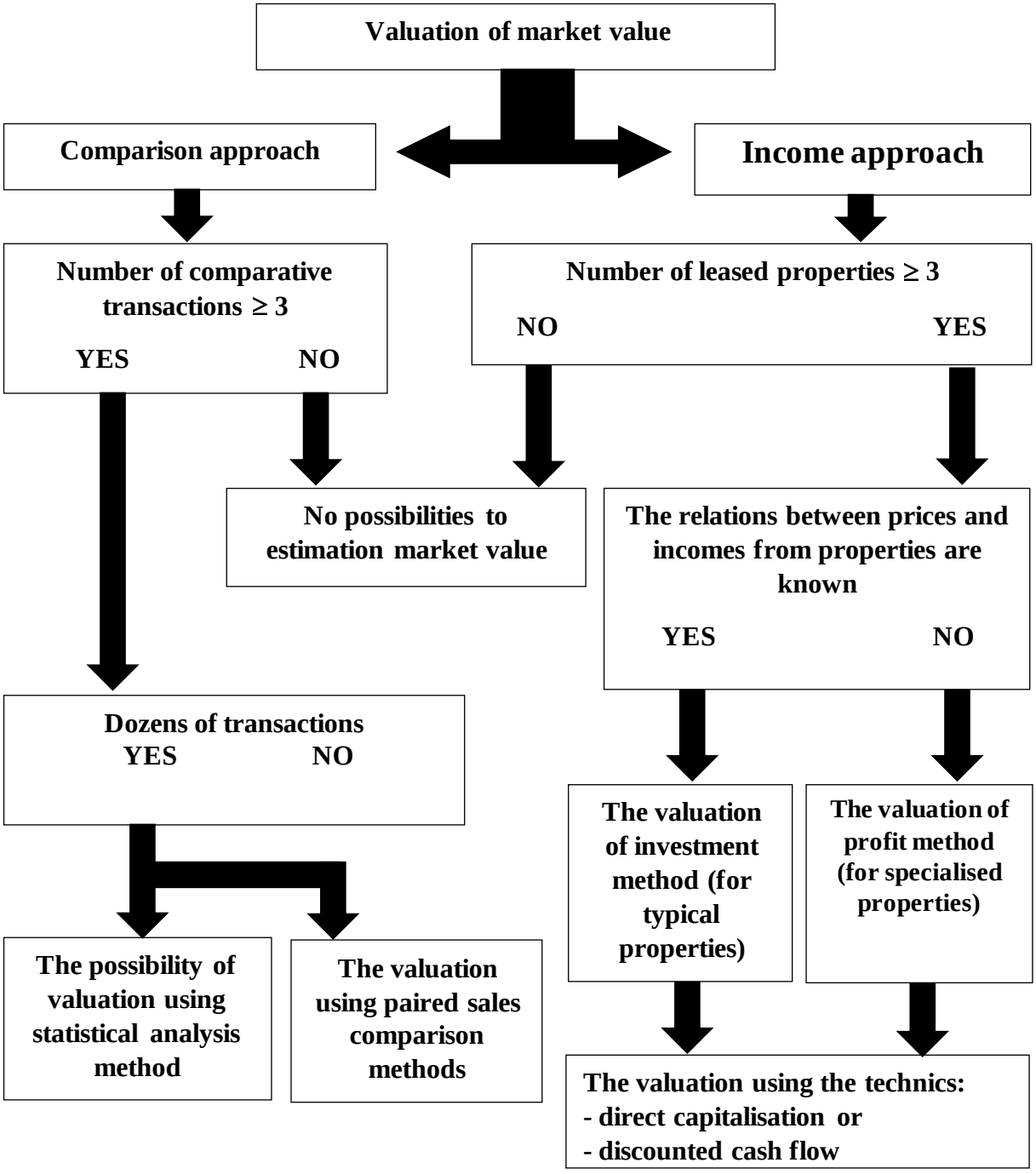


Fig. 7.3 The possibilities of appraisal of market value

Source: own investigation

In some market economy the state prescribes formal qualification requirements for valuers acting in the state valuation service and such a requirements are not necessarily when valuers undertaking appraisal in the private sector. In Poland exist well established valuation profession's, it performs all valuation cases, where the state, commune and private property are involved.

But some cases a formal institutional requirements or policy are needed - particularly for example in valuation for mortgage security purposes to account so called the mortgage lending value.

The mass appraisal for taxation purposes probably will employ licensed valuers or and especially trained officers from finance and tax departments on different levels. The legal acts concerned ad valorem tax of land and property is tender preparation

7.6. Intents concerning the system of mass appraisal of real property in Poland

In Poland, the concept of mass appraisal of real properties based on their values still under consideration. The Mass Appraisal of Real Properties (MARP) is understood as a set of technical-organizational activities and calculation procedures aiming at establishment and recording of the appraisal value of real properties. For the purposes of MARP, identification of the following types of real properties is planned:

1. land real properties (with or without buildings),
2. building real properties (land in perpetual usufruct),
3. unit real properties (with frictional parts of land).

For each type of the real property the value will be established separately. A real property can be included into a specific type and kind on the bases of, e.g. entries in the register of land and buildings, specifications of the local physical development plan and site inspection.

The following are to serve as basic sources of information for MARP:

1. register of land and buildings (cadaster of real properties),
2. register of land and mortgages,
3. notary deeds concerning transfer of ownership rights relative to real properties,
4. results of real properties market monitoring,
5. base map together with overlays,
6. local physical development plan,
7. records from appraiser's site inspection.

Taking into consideration the objectives of both mass appraisal and the appraisal of individual real properties the following groups of information have been established:

Group I - data relative to location:

- land survey and cadastral location,
- identification according to the register of land and mortgages,

- address and tax data.

Group II - data relative to the real property:

- name (of owner or administrator),
- addresses,
- specialist identifications,
- use of real property (type, kind, group),
- allocation according to the plan and resulting limitations,
- borders and area,
- how extensive is the use,
- potential.

Group III - data on buildings, structures and improvements.

- type of buildings,
- year built and construction,
- area (under building, usable and residential),
- number of floors,
- type of roof and walls,
- wear: technical, functional and external.

The above data may serve development of a data base for the purpose of appraisal.

One of the features of the system is establishment of mutual relations between sources of information contained in subject data bases and such processing of the information which allows generation of the appraisal value. The inputs into the system include obtaining data from other sources of information and collection of subject information relative to local market and type of appraised real property especially for the purpose of that system. The system permits generating value models using the package of statistical software and gives the basic characteristics for the individual value models. The outputs of the system include collective data, registers, specifications and subject drawings and maps. Market data should form the base for establishment of taxation value of each real property. As a consequence of market monitoring, a specific number of data necessary for development of a mathematical model of mass appraisal and verification of it should be generated. The data mentioned above should be representative for a given type and kind of real property and verified by an appraiser on the bases of a site inspection and credible documents. Market monitoring will form a continuous process implemented by teams for real property appraisal. Based on the collected data and information it will be possible to:

1. establish the borders of the appraisal zones, i.e. parts of areas of registration units identified for the requirements of development of the appraisal model and prepare the map of division of the registration unit into appraisal zones,
2. enter verified unit prices of land on the appraisal zones map.

It is expected that the values of all real properties within a given area will be established using the mathematical formula called the MARP model.

The mathematical model can be represented by the following general formula:

$$\mathbf{V = c_g\ v_g + c_b\ (v_b + v_{bg} + v_r)} \qquad (7.1)$$

where:

V - value of the real property,

v_g - value of land,

v_b - value of residential buildings,

v_{bg} - value of homestead buildings,

v_r - value of various structures,

c_g c_b - ratios of the value of land and buildings resulting from the location of the real property.

The value of land can be established according to the formula:

$$\mathbf{V_g = (a_1\ p + a_2\ f)\ x\ k_u} \qquad (7.2)$$

where:

p - area of land lot surface,

f - front of the lot defined as the fragment of the circumference of the lot going immediately along the street or streets,

a_1 a_2- constant factors of the model,

k_u - ratio of technical improvement of land lot.

The value of residential buildings may be established according to the formula:

$$\mathbf{V_b = a_b\ (P_z\ n_k)\ k_i\ k_z\ k_s} \qquad (7.3)$$

where:

P_z - area under building,

n_k - number of floors,

a_b - constant factor of the model,

k_i - ratio of equipment with media installations,

k_z - ratio of building wear,

k_s - ratio of building standard.

The taxation value of all real properties of a given type within a given appraisal zone would be determined by applying the data characteristic for the real property to an appropriate model. The data obtained from MARP should be subject to update from time to time. The staffing needs relative to the process of appraisal and the assessment of the tax itself can also be added, as an important though auxiliary issue. Not all of the above mentioned issues were subject to presentations and discussions based on examples of selected countries. The calculation of those elements alone allows a conclusion that there is a relation between the real properties market and MARP which may take the following forms:

a) a well-functioning market of real properties as a sufficient source of data for appraisal of standard" model or all real properties covered by the tax;

b) poorly (or poorer) developed market" i.e. the market characterized by a low number of infrequent transactions, which does not satisfy the requirements of mass appraisal results in the need for applying complementary appraisal, and as a consequence in higher costs of taxation data preparation procedure, a higher tax assessment base or a higher taxation level aimed at covering those costs;

c) developed but unstable market of real properties with a frequent fluctuation of market prices results in the necessity for frequent changes in the tax assessment base or in the amount of the tax itself.

In general it can be said that appraisal for taxation purposes and assessment of taxes based on the value may function as a factor stimulating changes in the market, e.g. high taxes - higher prices, or in general an increased supply of real properties; lower taxes - lower prices and a higher demand. This also means that such changes may result in both, either a sudden development or a total collapse of the real properties market, and a certain increase of revenues (of the State or municipalities) from the tax. It may also result in a significant decrease in such revenues as a consequence of increasing the number of people unable to meet the tax requirements. The conclusion is obvious - any change in principles, and in particular the in the volume of collected taxes must be preceded by an accurate and careful analysis of all possible outcomes of such a change.

The "mass" character of real properties appraisal is based on two principles:

– the values shall be appraised for all real properties encompassed by tax liabilities, which means that all real properties must be appraised,

– the values are estimated on the bases of average parameters characteristic for the properties and the local market using statistical formulas.

Implementation of the "mass" principle shall require analysis of many sets of information and collaboration in the area of collecting data concerning the prices of real properties. These shall include in particular the register of land and buildings, the register of land and mortgages, sector registers and lists of prices of real properties. Two variants of mass appraisal appear:

Variant I - to be applied in extreme conditions where a developed market of real properties is missing.

The value of real properties is given by their owners (so called self-appraisal). This also applies to supplementing the characteristics of the real property itself. This procedure (there are some doubts concerning the correctness of the results obtained) may be implemented according to the following outline:

1. the Internal Revenues Office announces the list of real properties which are subject to taxation.
2. for the purpose of tax assessment the Appraisal Agency establishes "groups" of real property values based on the analysis of data from the local market.
3. for each group the Appraisal Agency determines the parameters describing a "model" real property.
4. the value of "model" real property in each group is estimated using statistical methods (e.g. multiple regression method).
5. the value is used for comparison of the values of real properties reported by owners for verification.
6. the owners of real properties are supplied with forms containing the set of basic features of real property which are of significant bearing on its value. The applicant is to specify the value of these features according to specified principles and as a consequence he gives the value of the described property . The value is treated as an initial one, which will be included into a proper group (of values).
7. it is assumed that if the value given by the real property owner is within a specific range of deviations (e.g. model value ± 20%) then the value shall not be subject to verification.
8. verification of the value shall be performed by a person licensed for appraisal of real properties applying, depending on the type of real property, the following appraisal methods :

- comparative method (price - comparative),
- reconstruction costs method,
- replacement costs method,
- investment or profit method.

In case of price-comparative approach he value may be estimated using the following methods:

- comparison in pairs technique,
- indirect comparison method - in the environment of a limited market.

9. in case when the re-appraised value does not fit the range from point 7, the Appraisal Agency shall notify the owner about the changes made.
10. this value can be appealed to the Provincial Commission for Appeals.
11. the value forming the base for assessment of the tax shall be set when the final decision becomes absolute.
12. the Appraisal Agency shall prepare the list of values for tax assessment.
13. the Internal Revenue Office assesses the tax and maintains the register of taxpayers.

Variant 2 - to be used in developing real properties market. The value is estimated on the bases of statistical processing of market prices of real properties (mass appraisal). Stages of the process:

1. establishment of "appraisal zones" for individual types of real properties in municipalities based on analysis of data from the register of land and buildings, physical development plans and market information.
2. analysis of local real properties market data and programming (as the need may be) prices of selected real properties in individual appraisal zones.
3. selection of a statistical model e.g. based on multiple regression function.
4. estimation (programming) the values of an real properties in a given zone - using multiple regression formula.
5. direct verification of "regression" values using the comparative method (or another approach to real property appraisal).
6. analysis of results obtained.
7. recalculation of estimated values of real properties using the result of in site verification.
8. assessment of values estimated from the multiple regression model.

9. final estimation of the value.
10. preparation of the list of appraised real properties.
11. notice to taxpayers concerning the amount of tax assessed.
12. appeals.
13. verification of appeals.
14. final approval of the list of values for taxation.

7.7. Polish experience in real estate education

The concept of practice in the area of real estate appraisal is based on the economic and cultural principles characteristic for individual countries. Those factors supplemented by sociological relations influence also the system of education in that area. Numerous European countries are perceived as countries with "multi-cultural" societies which can be classified using three major theses:

1. ***duality*** - the reality is divided into two parts. The cultural factors are clearly separated and the interaction between them is difficult to specify. This interaction is usually negative (the principle of opposition).

2. ***relativity*** - the differences are accepted and relatively easy to describe. There are links between groups, but cultural barriers also appear.

3. ***evolving community*** - is characterized by unlimited acceptance of alternatives and coexistence based on integration at many levels.

The notion of evolving community forms a theoretical base for further considerations concerning the educational system in appraisal of real estates. This notion accepts the fact of the future integration of Poland with the countries of the European Union. The educational system should anticipate political and economic facts as it is its role to create theoretical and formal bases for the future integration. As a consequence of the above, the experience of other countries in that field was taken into consideration while developing the system. During the work on the real estate education system, the results of analyses of the systems of education in the United Kingdom, Germany and the US were presented and used.

Individual stages are linked to each other and they form the so called development cycle of a real estate. The educational system should permit and support the implementation of that cycle. In that process, appraisers play the role of support to taking

decisions concerning that land development. The market value (and sometimes the costs value) is one of the parameters permitting rational decisions within that process.

The statement that the knowledge relative to description of processes relative to real estates is a consequence of the level of social organization, relatively frequently formulated in studies by western experts, was accepted. The society, and more precisely, the real level of its development and transformation, dominates many aspects of development. This applies in particular to the process of communication between individuals forming a given professional group. Knowledge is developed by means of classification, which allows specification of individual groups, used for establishing the hierarchy of individual relations. Without such classification, the level of knowledge is usually limited. The system of classification results from social and economic conditions.

Competition among appraisers, development of technology, changes in legal regulations and development in capital and real estate markets, require upgrading the knowledge gathered during full time graduate and post graduate studies. The reasons here can be presented in the following way:

	Base	**Direction of change**
1.	demand	supply
2.	investing	control of expenditures
3.	advertising	marketing
4.	differences in specifications of technical expert opinions	differences in specifications of quality and level of services
5.	short time horizon	perspective
6.	appraiser	financial expert and advisor
7.	general knowledge	specialization
8.	individual work	team expert opinion
9.	development of skills	permanent education
10.	individual licenses	licenses in many areas

The assumptions concerning professional upgrading can be categorized into the following subject groups:

- **group 1 - Professional technical skill:** measurements, calculations, data processing, preparation of technical expert opinions
- **group 2 - Organization and management skills**: participation in decision taking processes, cross-section analyses, management

- **group 3 - Analytical skills:** analysis of options and option choice, calculation of parameters and interpretation of them
- **group 4 - Skills in expert teams management**: company management and organization, mediation in real estate trade, control of data flows. Professional upgrading may then be defined as a systematic maintenance of the level of knowledge, its development and improvement aiming at performance of technical, analytical and organizational tasks relative to real estates. The professional upgrading may be achieved through:

1. specialist lectures, the plan and program of which will be prepared in consultation with the professional associations.
2. active participation in scientific and scientific - technical seminars and conferences.
3. self-education, confirmed by taking an examination in front of a qualification commission.
4. preparation of publications on real estates.
5. presentation of lectures and running seminars.

The state of economy, changing employment pattern and varying demographic profile make up the general background for real estate market, which is a derivative of these changes. The number of people interested in buying attractive usable buildings for further rent and thus income, even at a high price, is growing.

8. PRINCIPLES FOR ASSESSING THE VALUE THE VALUE OF URBAN REAL ESTATE

8.1. Introduction

The value of real estate is determined by analyzing the relationships between the value and price of property. In this case, the transaction price is a regarded as a measure of real estate value that is expressed in a given currency on a given date. The aim of the property valuation process and the type of the analyzed value, for example the market value or the reproduction cost of real estate (cost-based value), also play an important role in the assessment. The market value of real estate usually denotes the capitalized value of the future income derived from land investments (Kucharska 2007, 2016; Źróbek 2009, 2011; Britton et al. 1989). In most cases, the valuer assesses the market value of real estate, although some appraisal procedures require the determination of the reproduction cost (cost-based value) or the book value of property. The determination of the cadastral value of real estate for taxation purposes is a separate problem. Some countries rely on official indicators as a substitute for the market value of real estate. This approach may be introduced for political reasons or due to a shortage of properties for comparative purposes. In countries with well-developed real estate markets, the value of undeveloped land is usually assessed based on its market value. Countries with emerging real estate markets tend to rely on official indicators that are sometimes referred to as the "administrative" value of real estate. In some cases, official indicators are imposed by the central authorities, and they reflect a given country's economic system. Many transition economies feature unofficial parallel markets where urban real estate is traded by individuals based on its market value. These markets are illegal, but they are sometimes tolerated by the local authorities. In countries with a transition economy, official indicators represent the quasi-market value of land.

8.2. Some problems in the process of determining the market value of urban land

The theoretical and practical problems encountered in the process of determining the market value of urban land result from:

- imperfect nature of the real estate market,
- heterogeneity of land,

– possible types of land use in the future (based on the provisions of the local zoning plan),
– legal restrictions (such as easement),
– quality of the surroundings, including the availability of public utilities,
– quality of land management in urban areas.

The unique location of land is a parameter that significantly affects land value. The value of real estate is also influenced by the availability of an effective information system covering urban areas. The system should register real estate transactions conducted on the local market, and it should support the determination of real estate's legal status. The real estate market is an imperfect market (Kucharska 2016; Źróbek 2009), and the degree of imperfection varies across markets. The imperfect character of the real estate market can also be attributed to its segmentation into different types of property with various future use. Various real estate markets can be identified, beginning from the local market, through the regional market, and ending in the international (global) market. Land zoned for development is usually traded on the local market. In such a case, the property's location relative to the urban core or other functions and facilities relating to work and recreation plays an important role. The market value of land is regarded as a capital investment (for example, an apartment that can be rented or sold in the future). Therefore, the market value of land does not represent its intrinsic value, and it is determined during an appraisal. Real estate appraisal is not an error-free process. It is burdened by many systemic and accidental errors that differ in character and occurrence probability. Systemic errors are easy to eliminate, but accidental errors pose a more complex problem. According to the error propagation theory, the final estimate is burdened by a mean squared error (MSE) that is calculated with the use of the below formula:

$$\mathbf{MSE} = \sqrt{\mathbf{x_1^2 + x_2^2 + x_3^2 + \cdots + x_i^2 + \xi}} \tag{8.1}$$

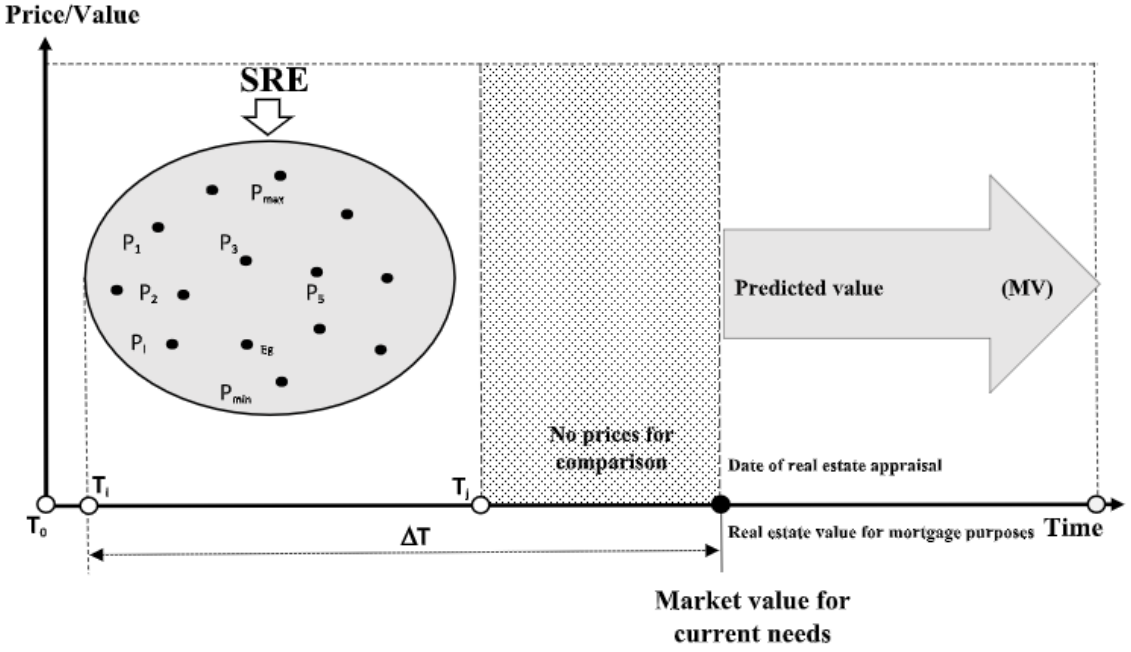
where:

x_1 – accidental errors in the land valuation process,

ξ – the influence of other accidental errors that were not included in the model.

Accidental errors can include the choice real estate that is ill-suited for comparison on the local market or errors during the measurement of parameters that affect land value. Subjective errors associated with a specific valuer can also occur. It should be noted that

the transaction price of land is a measure of its market value. The transaction price is a market fact that has been ascertained on a specific date. However, the transaction price has to be linked with the date of real estate appraisal (Fig. 8.1). This is usually accomplished by calculating the real estate price index which captures price changes on the local market. Such calculations are also burdened by mean squared error. The price index measures changes in real estate value over time, and it is often referred to as the real estate trend. The calculation of the real estate price index is an important step that precedes the assessment of the market value of property. This is illustrated by Fig. 8.1 The price index can be positive or negative, and in some cases, it equals or approximates zero. Therefore, market value is strongly rooted in a specific local market. The concept of market value is used interchangeably with the term "market price" by the main actors on a local market. The land valuation process relies on the concept of a potential, rather than a specific buyer. A valuer conducts detailed analyses and develops a specific model (ideation) of a potential buyer. It is assumed that a potential buyer has the required knowledge about the real estate market and a firm intention to conclude a transaction.



where:

PRE – prices of real estate similar to the appraised property (this dataset includes P_{max} – the maximum price of similar property, and P_{min} – the minimum price of similar property)

ΔT – initial time period of the analysis of real estate prices (usually around 2 years)

MV – mortgage value

Fig. 8.1 Analysis of changes in transaction prices over time in the process of appraising the market value of real estate

Source: own elaboration

Other requirements that have to be met in the process of assessing the value of urban land are described by the Polish Real Estate Management Law of 1997, International Valuation Standards and European Valuation Standards.

To guarantee the reliability of real estate appraisal, the vast majority of the analyzed market transactions in urban land should involve transactions conducted by individuals. This is not the case in countries with transition economies. In Poland, legal regulations supporting the evolution of the real estate market were introduced in the late 1990s, and property appraisal is based largely on private transactions (Źróbek 2020).

It is generally assumed that an effective real estate market requires numerous transactions between private entities. In the former socialist countries, including Poland, public entities such as the State Treasury, central government bodies, territorial self-governments (mainly municipalities) and local government bodies played an important role on the real estate market between 1990 and 2010. These entities have to follow specific procedures in the process of selling their property (Źróbek ed. 2020). Due to the public sector's involvement in real estate transactions, considerable differences are often noted between the value and price of real estate. In most cases, these differences are equivalent to ±30% of the average transaction price (Prusik and Źróbek 2016). In countries with well-developed market economies, these differences generally do not exceed ±10% of the transaction price, and they are even smaller in the Netherlands. The discrepancies between the transaction price and the previously determined market value of property affect real estate appraisals conducted by valuers. The elimination of outlying transactions that significantly deviate from the average transaction price on a given local market leads to a shortage of real estate for comparative purposes. This problem is also encountered on the market of land for residential construction. The transaction price of land is a product of supply and demand on the local market. Supply and demand were rarely in equilibrium on the market of residential property. Supply was determined by the availability of land put up for sale by public entities. The price elasticity of supply was not directly correlated with an increase in demand. The reverse was also noted, where property prices responded weakly to a significant increase in supply. The above was partly due to the shortage of funds for developing public utility networks and access roads to land plots. In rem rights to the traded property constituted a separate problem. In the first years that followed economic system reforms, the majority of real estate transactions in Poland involved perpetual usufruct rights. At the beginning of the 21st century, a much

larger proportion of the concluded transactions involved the transfer of ownership rights to land. Perpetual usufruct was usually established for a period of 99 years, and the usufructuary had to pay an initial fee (up to 25% of the transaction price) as well as an annual fee (1% of the transaction price) for each year of land use. If the transaction involved the transfer of ownership rights to land, the future owner was obliged to pay the entire price in a public tender. The prices of real estate transactions involving the acquisition of ownership rights were also difficult to compare with the prices of transactions involving the transfer of perpetual usufruct rights to property. The net present value (NPV) of real estate can be calculated with the use of the below formula:

$$\mathbf{NPV_I = Ff + \sum_{i=1}^{99} \frac{Afi}{(1+r)^i}} \tag{8.2}$$

where:

r – capitalization (discount) rate

Ff – fee for the first year of perpetual usufruct:

$Ff_{max} = 0.25$ TP

Af_i – annual fee for each year of perpetual usufruct, where

$Af_i = 0.1$ LV

LV – market value of land

on the assumption that:

$$\sum_{i=1}^{99} \frac{Afi}{(1+r)^i} = \frac{Af}{r} \tag{8.3}$$

$$\mathbf{NPV_I = Ff + \frac{Af}{r}} \tag{8.4}$$

The above formula is transformed on the assumption that r = 0.1:

$$\mathbf{NPV_I = 0.25\ TP + \frac{0.01\ TP}{0.1} = 0.35\ TP}$$

where:

TP – price at which perpetual usufruct rights to land are acquired from the owner (State Treasury or an agency of territorial self-government) .

The above transformations were performed on the assumption that the annual fee would not be updated (at present, the annual fee cannot be updated more frequently than every three years due to an increase in land prices). A fixed capitalization rate of 10%

was also applied. When changes in the value of the analyzed parameters (capitalization rate, updated market value) are taken into account, it can be assumed that the acquisition of perpetual usufruct rights is a cheaper option than the acquisition of ownership rights to land. The resulting difference in price can reach 30% to 50%. However, perpetual usufructuaries have to conclude an additional agreement with the owner of land (State Treasury or an agency of territorial self-government). The concluded agreement stipulates:

1. the period of perpetual usufruct, with a possibility of extension;
2. the purpose for which perpetual usufruct rights to land are granted, mostly residential construction;
3. annual fees that have to be paid by the perpetual usufructuary by 31 March of each year without an additional reminder.

From the land owner's perspective, the lower proceeds from the transfer of perpetual usufruct rights to land are partly compensated by the strict regulations concerning land use and the duration of development projects (beginning and end of construction). The market value of urban land zoned for residential construction is usually determined in a comparative approach. A comparative method is used in Great Britain, and a comparative approach is deployed in Poland to estimate the market value of land. This approach involves three methods (Źróbek et al. 2020; Zróbek 2011). It is generally assumed that the comparative method relies on a logical comparison of phenomena, actions, property, concepts or statements. Pursuant to the definition of rights *in rem* (Polish Civil Code 1964; Ignatowicz 2000), real estate is an item of property. In this case, the comparison relies on the characteristic features of real estate, including both sold and appraised property. The comparison is conducted on market principles. The valuer delivers an expert opinion on the market value of land by developing an appraisal report. The value of land is assessed based on the previous transactions conducted by potential buyers, and local trends and characteristic features of the local real estate market are taken into account. The valuer selects the parameters that affect property value, measures these parameters and determines their probable influence on future transaction prices. In Great Britain, the comparative method relies on a direct comparison approach. The properties selected for the comparison have to be similar to the appraised property (Britton et al. 1989). It is assumed that absolute similarity is not encountered on the land market. Land always differs in the following parameters:

1. location (direct, indirect, relative),

2. natural conditions (soil bearing capacity, topography, insolation, etc.),
3. rights to land (such as ownership or perpetual usufruct)
4. zoning regulations and possible types of land use,
5. date of transaction,
6. availability of public utility networks and access roads in the area,
7. land plot area (including the planned built-up area).

In this method, the compared land plots have to be similar to the appraised property. Market conditions, including the date of the transaction and the date of real estate appraisal, also have to be taken into account during the comparison.

9. LOCATION AND RESIDUAL NATURE OF LAND VALUE

Value of land is based on supply (of land) and demand (for land). The basic formula related to the value of urbanized land is written below:

"LAND" = "SPACE and LOCATION"

This means that the value of urbanized land mainly depends on its size and location. The location can be analyzed as general location and detailed location. On the other hand, the size of the area determines the possible way of development. The location on a specific local market also influences the value of land. Demand for land is derived demand. Land has value only because it enables production or consumption of goods and services.

Land provides space and location for:

- living (residential land use),
- industrial production of goods (industrial land use),
- storage and distribution of goods (warehouse and retail land uses),
- administration and control (office land use),
- provision of services (office and retail land uses),
- recreation and entertainment (retail and parkland uses),
- communication.

The result is each land parcel being used at its highest and best use (HBU). This means each site is used in the way that is most productive for the location. Each use prevails where its bid – rent curve is highest. Basic equilibrium land rent condition is the sum of annual housing rent and annual commuting cost must be the some for all residents. In simple model the land rent gradient equals the transportation cost per km per person times the number of people per ha (classic monocentric city model). Variables relevant to real estate opportunities:

- city size,
- pattern of location value within the city,
- trend in real rents over time for a given location.

The monocentric city model greatly simplifies the complexities of real word cities. This simplification enables the model to reveal some basic insights about urban form. There are economic casual forces:

- population changes,

– income changes,
– transport cost change (infra – structure, technology).

Other things equal, larges cities will have higher average rents.

The rent at the edge is fixed by the agricultural opportunity cost of the land and the construction cost of the houses. Land rents grow faster in peripheral locations. If a city grows by increasing area rather than density, property rent growth will be relatively greater closer to the periphery, but if a city grows by increasing density instead of area property rent growth will be relatively greater the closer to the center of the city. Declining transport cost holding population and income constant, will always reduce the absolute value of land rent in the center of the city, and always increase the relative value of land rent hear the periphery of the urban area. The effect on the absolute land rent near the periphery is generally ambiguous, depending on changes in density. Faster urban growth and greater uncertainty in the growth will tend to increase urban land values, with the uncertainty also suggesting that a smaller, denser city is optimal, as rational development is postponed longer than it otherwise would be. Real cities are polycentric not monocentric. All cities must be polycentric because different land uses have different and multiple central points. In additional to possible evaluation of neighborhood HBU over time, each individual property will experience a lite cycle related to the deterioration and rehabilitation (or redevelopment) of the structure on the site. Market analysis usually requires quantitative and qualitative understanding and prediction of demand side and supply side. There are five major market indicators:

1. vacancy rate,
2. market rent,
3. quantity of new construction starts,
4. quantity of new construction completions,
5. absorption of new space.

Some vacancy is normal and natural in a market, due to:

– search time and moving costs,
– overbuilding (impossible to perfectly predict demand growth, lumpy supply).

It is possible to recognize the natural vacancy rate:

a) rate around which vacancy tends to cycle,
b) rate that indicates supply/demand balance,
c) above which rent fall, below which rent rise,

d) tends to be higher in more volatile and faster – growth markets,

e) tends to be lower in more supply – restricted market.

This market indicator variables: vacancy, rent, construction, and absorption can be used to help characterize and understand the current market, and forecast how it may change relevant to real estate decisions.

The scope of the market analysis can be geographic/property type market segmentations (sub–markets), and time–frame of the study (historical, forecast to when). Important are:

1. trend extrapolation:

– take advantage of inertia in space market (past partly predicts the future),

– consider trends and cycles,

– potential to use statistical techniques (time – series analysis)

– potential to bring in capital market factors as predictors.

2. structural analysis:

– model of structure of the market (underlying determinants of supply and demand),

– forecast the underlying determinants, then use model to predict space market,

– formal analysis requires: demand model, supply model end equilibrium model,

– useful for gaining fundamental understanding of the market, and making long – term forecasts,

– used more in academic studies than business decisions.

Typical model used in business decision – making structural market analysis (short – term 1-3 yrs.).

On the basis of the literature review it is possible to determine the main factors influencing the demand in the urbanized real estate market. This is shown in the Table 9.1. It should be noted that:

– the real estate cycle be much more exaggerated in the construction and development industry than in other aspects of the real estate market, such as rents and vacancy,

– the vacancy cycle tends to slightly lend the rent cycle (vacancy peaks before rent bottoms),

– new construction completions tend to peak when vacancy peaks.

Table 9.1 Major drives of the demand side of the space market.

Major demand drives by property type	
Property type	**Demand drivers**
A. Residential single family (owner occupied)	• population • household formation (child rearing ages) • interest rates • employment growth (business and professional occupation)
B. Residential multifamily (apartment renters)	• population • household formation (non – childrearing ages) • local housing affordability • employment growth (blue collar occupations)
C. Retail	• aggregate disposable income • aggregate household wealth • traffic volume (specific sites)
D. Office	• Employment in office occupations: – finance, insurance, real estate – business and professional services – legal services
E. Industrial	• manufacturing employment • transportation employment • air freight volume, rail and truck volume
F. Hotel and convention	• air passenger volume • tourism receipts and number visitor

Source: own investigation

10. FOR DETERMINING THE MARKET VALUE OF URBANIZED LAND

10.1. Market value for purposes of rational urban land management

It is agreed that the basic guidelines for establishing market value are: International Valuation Standards European Valuation Standards, Royal Institute Standards Regulation (EU) of the European Parliament and of the Council 575/2013 of 16 June 2013, on prudential requirements for credit institutions and investment firms), Expert studies developed under the umbrella of the Federation of International Surveyors FIG (section 9), Basic monographs and course books concerning real estate appraisal, issued in 2000 - 2022.

In Poland, the formal definition of market value is contained in the Act on Real Estate Management (1997). It is also given in the professional standard for property valuers No 1; Valuation for Loan Security Purposes, which was developed by the Polish Federation of Valuers' Associations, in compliance with the mentioned law. Pursuant to the International (IVS 2021) and European (EVS 2020) Valuation Standards, market value is **„ the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion."** The above refers to the definition provided in the Regulation of the European Parliament and of the Council of the European Union. This definition, considering the legal character of the said Regulation, is an element of the applicable law in each EU member state. Based on this definition, a legal framework was developed in Poland to regulate the determination of a market value of real estate. It was comprised in the Act on Real Estate Management of 21 August 1997 (Art. 151.1 – Dz. U 2017 item 150). The formal wording of this definition refers to the implementing rules of the Parliament of the European Union: **"market value is an estimated amount which on the day of the valuation may be obtained for a real property in a selling contract drawn on market terms between the buyer and the seller who have a firm intention to conclude the contract, act knowledgably, prudently and without compulsion."** The provisions suggest that since 2017 there has been international harmonization of the notion of market value, especially among the European Union member states. The following interpretations of the basic terms in the market value concept are given according to the provisions of the European Professional Standard 1 (EVS1), included in the EVS 2020 and the International Valuation Standard

(IVS – Defined basis of Value – Market Value), which is contained in the IVS 2021. The explanations given below clarify precisely the individual concepts and terms used in the definition of market value. The term **estimated amount** stands for the amount that can be obtained reasonably in a market transaction on the day on which this market value was determined. This is the best price which the seller can obtain and the most favorable price that the buyer will agree to pay. This estimated amount is understood as the most probable, that is the most frequent price on a given local market. This is not a hypothesis of an average price, or the lowest or highest price on the analyzed market. This is not the price that will be paid in a given transaction, either. Rather, it is the hypothetical price which objectifies the market by showing the most common behavior of the market participants (potential buyers in a given market). The estimate excludes specifically an amount raised or lowered due to any specific circumstances or conditions associated with the transaction, such as:

- atypical financing, non-market arrangements concerning the sale or rental of a property,
- specific factors to take into account or for approval by anyone involved in the sale, or any other element of particular value.

Any value determined in such atypical situations cannot be treated as a market value. Therefore, such prices of real estate cannot be used in the procedure of valuation of a specific immovable property. Sometimes, this value can be very close to the market value, and in some countries, it is treated as such.

The term **a real property subject to valuation** refers to situations where the market value of an immovable property fully reflects its potential, if there is such potential on the market. It can therefore take into account other, alternative uses of the real property which could be possible once appropriate changes have been implemented, e.g. new planning permits that allow the development (expansion) of adequate infrastructure, market growth, or other opportunities. It is also assumed that the market value of a real property can reflect the so-called hope value, which the market can presume for the given potential changes, and should therefore be distinguished from the market value, limited only to the assumption of 'the optimal use of the property' In many cases, the current use of real estate could be considered to be the optimal one. Thus, the determination of the potential of real estate requires the completion of detailed analyses on the local market.

The condition connected with the date of valuation concerns the statement that **the market value is determined for a specific date, that is the date of valuation**. „The

value given in an appraisal report will reflect the actual market condition and the circumstances as of the date of valuation (the date of completing the appraisal report), and not a past or future date." The date of determining the transaction price of the appraised real property is therefore a historical fact, and the market value of the appraised real property is determined as of the date of making the valuation/date of completing the appraisal report. It is worth noticing that the preparation of an appraisal report (opinion on the value) will never take place before the date of the appraisal; otherwise, a report would consist of digressions on circumstances that have not occurred or cannot occur, while some important market data may still emerge. Such data can be contained in expert opinions or forecasts – which are not estimates. The amount which could be obtained from real estate is **an estimated amount**, and not a specific amount to be obtained from selling the estate. This is a hypothetical price that the market expects as a result of the transaction on the valuation date, when all the other conditions inherent to the definition of market value are satisfied. The presence of hypothetical, and not actual buyer and seller is assumed. This hypothetical buyer is a model concept related to a previous in-depth market analysis. Another significant condition is to ensure an adequate exposure of real estate on the market, its duration depending on **the market conditions**. Any specific transaction should be preceded by appropriate marketing techniques, which ought to be sufficient to attract an adequate number of potential buyers. The exposure period precedes the valuation date. Under typical conditions, the exposure period lasts from one to three months. Significantly, both parties are motivated, but not compelled to enter into a transaction under market conditions: the seller for the best price obtainable on the open market, after an adequate period of marketing the real property, regardless of what that price would be. The buyer concludes the transaction having taken into account all current market conditions and current market expectations. The requirement that both parties are willing to conclude the transaction creates a relation between them, such as arising from the buying-selling procedure. The transaction is concluded between unrelated parties acting independently of other conditions and reservations. The parties to a transaction do not act **under compulsion** – both parties are motivated but not compelled to conclude the transaction at any price. Each party, with no external pressure, approaches the transaction and fulfills its provisions until the notary deed ending the transaction is signed. The parties act knowledgably and prudently – both the buyer and the seller are well informed about the character and qualities of the real property, its actual and potential use and the market condition at the valuation date. Each party acts to the best of their knowledge and

carefully searches for the best price for themselves for the given property. Prudence stands for referring to the market condition on the valuation date, and not to any market information obtained afterwards. It is not necessarily imprudent to sell real estate on a market characterized by falling prices that are already lower than those identified under earlier market conditions. When making an appraisal of an immovable property, it is essential to take into account its attributes concerning the legal status as well as the physical condition and economic status, in addition to any other observable and interpretable characteristics of this property. The valuer should exclude elements not permanently affixed to the property, such as interior design elements or other movable items as well as occasional non-price incentives to purchase this property. According to the generally accepted valuation standards (IVS, EVS), the market value of real estate reflects the property's potential which would be considered by market participants on the valuation date. It can therefore take into account another, potential use of the property, including such uses that might become possible following the implementation of appropriate changes, for example new planning and building decisions, development of infrastructure, development of the market, and others. Thus, market value can take into account an additional element of the property, but only such an element that the buyer is willing to pay for, hoping that the property will acquire a new, better use or that there will be a possibility to develop the property so that it will attain a higher value than the one attainable under the current limitations. In the light of interpretations of the international valuation standards (IVS 2021), the most beneficial use (Highest & Best Use) means the use that is physically possible, adequately justified, legally allowed, financially feasible and resulting in the highest value of the appraised real estate. This principle reflects a typical, that is most commonly occurring behavior of market participants. This concept arises on the following premises:

– there is the most reasonable, possible use of a real property, which entails excluding some specialist uses that might be of interest to only few, specialist buyers, e.g. to purchase a detached residential house in order to convert it into office space;

– it is compliant with all legal requirements, i.e. excluding all future or possible (arising from the so-called hope) values that the market might create once certain hardly predictable permits for the development and management of a given property have been issued;

– the use is physically possible, and the evaluation of the property's attributes is made as of the valuation date, provided that the analysis does not include any possible

changes (such as a new road giving access to the property, and the impact the road will have on the surroundings);

– it is possible to provide market evidence for situations arising from the development of a property (reconstruction, refurbishment, extension or even a change of the current functional use);

– it is possible to conduct a feasibility study of the investor's activities, which will determine the highest possible value for the given property and will apply to future investment.

According to the European Valuation Standards (EVS 2020), the market value of a real property reflects the full potential of this property as long as it has such potential on the market, even when it is not allowed by law yet to be entirely untapped. This definition relates to a specific situation and an adequate forecast as of the valuation date. This potential is reflected by the so-called hope value, which the market assigns to possible future changes. Noteworthy, hope value does not exist as a separate value. Rather, it is an additional element within the market value of an appraised property. It serves to describe an increase in the value which the market is willing to assign to the property in the hope of it acquiring a higher value if an alternative use or development opportunity emerge. This can lead to an increase in the value of the property above the current one, under the existing constraints. Thus, hope value reflects an appraisal of the probability of attaining the expected, higher land use, while taking into account the costs incurred by doing so as well as the time needed to achieve the alternative use of the property. The future use of the property considered, which on the valuation date is not permitted yet, must be probable enough to substantiate making the assumption that reasonably acting market participants are able to perceive this possibility and are willing to take into consideration its existence in the selling price. There are specific relations between the value and the price of real estate on a developed market. Following the valuation, the value of an urban immovable property is determined. It is usually its market value. Price, on the other hand, is the external expression of this value. This value need not equal the price. In both economic theory and practice, value and price are two separate categories. The distinction also occurs in law. For example, the price of public real estate sold on tender may not be lower than its value (Act 1997). The value determined in the appraisal procedure typically differs from the transaction price. Many external and internal factors contribute to deviations between price and value. They are in particular:

- significant changes between the demand for and supply of the specific type of real estate induced by the fact that there is usually a difference between the valuation date and the date of concluding the purchase and sale transaction. The market situation tends of change, which is reflected in the level of the transaction price of a land property, agreed after the valuation date;

– the impact of price distortion factors, i.e. an intervention of the authorities (e.g. price discounts, monopolies, external regulations, etc.);

– form of trade – private transaction, tender, bailiff auction. The choice of the form of trade can have a considerable influence on the price obtained in the transaction;

– terms of a transaction, e.g. sale with a short payment term, a tied transaction, a barter transaction where the consideration is another real estate, etc.;

– quick sale – the price can be lower than the value (lack of proper exposure of the property for sale);

– the art of negotiation – value is the basis for negotiations. Good negotiation skills, an adequate strategy and implemented tactics can lead to the price being set on a level different from the value. The seller will strive to make the price exceed the value, unlike the buyer, who will try to make it much lower;

– irrational behaviors of the market participants, e.g. snobbish behavior encouraged by market paradoxes or the current fashion for a given type of real estate.

The value of real estate in urban areas is a product of the influences of several factors, including:

– a group of physical factors,

– a group of economic factors,

– a group of legal factors,

– a group of environmental factors,

– a group of political factors, such as regulations passed by the state and local authorities as well as those which arise from the adopted development strategies.

The roles played by each of these groups of factors vary depending on specific types of real estate, in addition to which they have been changing over time, for example the role of environmental factors has become more important in recent years, as manifested by the increasing sensitivity of the market to economic consequences of identified or predicted presence of toxic substances, soil contamination or related

potential or actual legal obligations. In this group of factors, the following gain importance:

- phenomena of the natural origin (e.g. radiation, gases, noise, air contamination),
- factors causing chemical pollution (processes occurring now or in the future in the given area or in adjacent areas),
- factors seen as harmful (e.g. an electromagnetic field, radiation),
- special preferences of investors concerning some construction elements, e.g. recyclable materials.

It is worth noting that value is not embedded in a given asset (real estate) but it is created in people's minds, in the minds of market participants. Relationships which create this value are complex. And the value changes when its determinants change. In determination of a value of real estate in an urban area, it is therefore essential to conduct a detailed analysis of the local market, including an evaluation of external factors and the surroundings of the analyzed land lot or lots. Thus, it is possible to set out the economic guidelines of real estate valuation and identify their role in the assessment of a value of real estate situated in an urban area. The meaning of value in economics is commonly interpreted as an estimated (most probable) price of a commodity that buyers and sellers agree on, reflecting the market participants' opinions about the economic benefits to be earned from owning this commodity. This applies to every situation when assets (including land) are appraised. Whenever the economic theory is excluded from real estate valuation practice, the value determined by the valuer is rarely confirmed by the real estate market. Typically, a large gap appears between this value and the likely price quoted on that market. Hence, the economic concept of valuation needs to be fully comprehended, and the American literature addressing this issue presents it as a set of principles of valuation (The Appraisal of Real Estate 2000; Kucharska-Stasiak and Źróbek 2015). Below, there is a list of the most important of these principles, the ones most often cited in relevant references: **Principles of anticipation, Principle of change, Principle of supply and demand, Principles of competition ,Principle of substitution, Principle of alternative cost ,Principle of balance, Principle of the highest and best use of an asset, Principle of surplus income, Principle of conformity (compliance), Principle of externalities.** A more detailed description of these principles is included in chapter 10.2 of this dissertation. The influence of these factors stems mostly from the basic attribute of real estate, such as its immovability in space. Noteworthy, basic economic principles for real estate valuation described in the literature are mostly

applicable in character. Some of these principles are reflected in the valuation methodology, while others are associated with good practice. Some are reflected in prices on the market, while others, for example the principle of external balance or the principle of the best and highest use, require the valuer to define appropriate assumptions more precisely. Many of the economic principles applied to real estate valuation reveal mutual relations. The anticipation principle is tightly linked to the principle of change because decisions on any transformation or conversion need to take into account forecasts. Most commonly, the future market conditions will not replicate the ones observed to this date. The harder and slower the rate of transformations (adjustments), the more the current decisions must consider both the ongoing and future conditions. The lack of balance between the value of land and value of buildings, between the inputs into a given property and the inputs into properties in the neighbourhood, should be a signal for the valuer to look for the most profitable use of the property. Knowledge of the economic principles underlying real estate valuation has an impact on how a valuation process is conducted, and allows the valuer to arrive at the correct interpretation of the result. Some of these principles are also directly applicable to the procedure involved in the assessment of the market value of land lots.

10.2. The comparative approach in the appraisal of land properties in urban areas

The worldwide development of real estate appraisal methods has led to the firm establishment of a division of different approaches to the determination of a real property value. This distinction also applies to valuations performed for various purposes in urban areas. The comparison approach is closely connected with an analysis of the local real estate market in the time period preceding a given valuation. The market value is invariably an outcome of such an appraisal. Elements of the comparative approach appear in other real estate valuation methods and techniques as well. The division into several types of appraisal methods has been confirmed by the analytical studies where basic parameters in a given approach were taken as the basis for estimating the value of real estate, as shown below:

- **the sales comparison approach**: the main set of factors based on which the value of a property is estimated consists of prices of similar properties sold relatively recently on a previously identified local market of comparable properties. Of

significance are the characteristics of real estate that make the analysed properties comparable.

- **The income approach:** the value of immovable property in this approach is estimated according to the income that can be generated by this property on a specific local market. The worth of this income is typically derived from an analysis of rents, and it reflects the economic situation of the analysed comparable properties. When this income is constant over time, a simple capitalisation technique is employed. If this income varies over years, then a discounting cash flow technique is needed. Apart from the determination of the level of annual incomes on a specific real estate market (comparative analysis), it is also necessary to calculate the capitalisation/discount rate with a DCF technique. These values, if determined in line with a market analysis, require an assessment of data such as prices and incomes obtained from similar properties. Hence, a comparative analysis is needed again.
- **The cost approach:** the value is obtained from an analysis of the costs of reproduction or replacement of a property and an estimate of the depreciation of the land plot elements (in particular, buildings, other structures and technical facilities). In this approach to real estate valuation, the (market) value of a land plot and the cost value of its components are estimated separately. The reproduction costs and replacement costs should reflect the situation on the local market (the level of costs in the local construction business). This applies to all costs of building materials, labour and the income earned by the builder. The estimation of the value of total depreciation of a specific object requires performing expert analyses and on-site inspection (measurements in the appraised building) of all component parts of the building, building structure or facility. When functional obsolesce of a building is diagnosed, it is important to identify standard objects for the given market – considered to be model objects. Here, a comparative analysis is applicable again.
- **A mixed approach:** contains elements of the three mentioned approaches. It is usually applied to make an appraisal of atypical objects or when requested by a client. It is being adopted in some countries with developed market economy (e.g. Germany). With the mixed approach, it is possible to obtain an approximation of a market value or even the market value of an appraised real estate.

The development of the real estate appraisal theory, supported by detailed analyses of the market conditions and by experience in appraisal of immovable property, has enabled researchers to distinguish several theoretical bases of valuation:

- **Anticipation:** a value is created by expected benefits which will be obtainable from an appraised property in the future. These are sometimes intangible benefits associated with owning a residential property (e.g. a revenue earned from renting or leasing it);
- **Change**: constant transformations (changes) involve the social, economic or physical factors that affect real estate. The concept of change is underlined by the cause and effect principle, e.g. a change in tax law is typically accompanied by a change in supply, or there is a correlation with the ageing of a building and its deteriorating usability. This effect is more evident on markets where the market economy principles are fully implemented;
- **Supply and Demand:** the price of goods or services undergoes changes parallel, although not necessarily proportionally, to a change in the demand for a given commodity or service. At an equilibrium of supply and demand, parameters like a market value, cost and price are equal. On the real estate market, such a balance tends to be transient or practically impossible to achieve. However, it is worth bearing in mind that in the presence of 'the rarity' of a given immovable property, prices and values grow regardless of values of these parameters. Then, so-called market paradoxes (e.g. Giffen or Weblan paradoxes) emerge.
- **Competition**: occurs when there is active demand of two or more market players for securing a commodity in short supply (e.g. a given real estate property lies in highly attractive location). For those who attempt to sell or lease/rent real estate, this entails concrete efforts of two or more subjects to sell or rent the subject property. There is also competition between buyers or lessees (e.g. when the seller organises unlimited tenders). Each property competes with other properties that can be used in the same way. This principle is also important when forecasting the income from immovable property.
- **Substitution**: when there are a few or more commodities, goods or services comparable or similar to each other available on the market, the highest demand and the greatest distribution are achieved by the one offered at the lowest price. The buyer will not pay more for a given immovable property than he would pay for a similar one. The assumption is that both the seller and the buyer have a choice, that is that there are properties available for a similar purpose. This principle plays a role in the practical application of any of the three approaches to appraise real estate in urban areas.

- **Alternative cost:** that is the cost borne due to rejecting other investment opportunities. By opting for a given type of investment, an investor discards other possibilities of allocating means in other ventures. This principle is linked to the principle of substitution. Alternative cost matters when determining the rate of return for the property submitted to an appraisal by analysing rates of return for alternative investment opportunities.
- **Equilibrium:** a value is created and maintained in a situation where opposite elements (land, buildings) mutually interacting and competing are in a state of equilibrium (often momentarily), e.g. there is the optimal combination of factors related to land and buildings, or the capital is increased in order to obtain additional benefits from raising the market value of the property under analysis. There is the so-called point of decreasing profits where further inputs do not stimulate an additional increase in value. This point sets a temporary balance on the analysed market. In practice, it is difficult to determine.
- **Principle of increasing profits:** this principle is connected with the formula which envisages that an increase in the number of factors will lead to an increase in profits up to a certain point on the value increase axis. It also applies to the determination of changeable relations of real estate with the surroundings, e.g. adequate differentiation of types and purposes of real estate for different purposes gives rise to an additional value of land in urban areas.
- **Marginal efficiency of investment outlays:** the value of a production factor or a component part of real estate depends on either the extent to which it contributes to the value of the whole property or the extent to which its absence would lead to a loss in the whole value, e.g. the cost of a given element does not equal its value, for instance the cost of refurbishment of a building does not cause the expected increase in the market value of this building. Also, the current use of land in an area with rapid land development changes may not be the optimal one. This is particularly true in areas exposed to strong urbanisation pressure. However, the current land use will continue until the developer (owner/perpetual usufructuary or lessee/user of a given property) will realise that it is economically justified to demolish or refurbish existing buildings up to the standards prevailing on a given real estate market. This happens, for example, when buildings are characterised by functional wear (functional obsolesce) at their relatively low physical depreciation. Such a property tends to generate less income than properties in the proximate surroundings.

- **Additional income:** the income remaining after the payment of all fees due to the economic activity and the repayment of the capital invested in a building or building structure. This surplus is classified as the income (rent) from the land and typically determines the basic level of the value of this land. The additional income principle serves as the basis for forecasting the rate of return of the capital, that is the land and value of the immovable property at the end of the investment period.
- **Conformity:** the value of real estate is created and sustained when the characteristics of a given property are adjusted to the requirements of the market. Each market determines specific standards, also in terms of prices, for example the value of high-standard property may fall to the value of another property nearby, while an underestimated price can increase and approximate the market level of prices of real estate with a slightly higher standard, typical for this market. Sometimes conformity standards are enforced by law, and sometimes preferences of owners or strong economic pressure come into play.
- **External factors**– external economic effects not associated with a given real property may have a positive or negative influence on its value. This arises mainly from the inherent characteristic of real estate such as its immobility in space. An increase in the population's purchasing power in a given area, for example the opening of a shopping centre, can significantly affect potential sale of real estate there. A rise in the local population's buying power induced by external factors can originate from the nearest environment, but it can also be rooted nationally or internationally, and not by necessity directly related to the real estate market (e.g. exchange rates on world stock exchanges).

A review and analysis of the major theoretical principles with significant influence on real estate values in urban areas were carried out on the basis of a literature perusal (including: RICS 2019; Ashaolu 2016; Adekunle and Eke 2014; Appraisal Institute 2008; Scarrett 2008; Isaac 2002; Williams 2004; Calhoun 2001). Some of these principles are directly related to the comparative approach used for the appraisal of land plots in urban areas. Some, on the other hand, concern the income approach and the cost approach, applicable to developed land plots. It is agreed (Scarrell 2008) that there are currently five basic methods for the valuation of immovable properties. They are broadly used in countries with developed real estate markets for appraisals of immovable property needed for different purposes, such as: sale and purchase, determination of the amount of compensation in expropriation proceedings, calculation of fees due because of an increase

in the value of real estate, estimating the value for accounting purposes, in a process of estimating the value of a collateral for receivables or concluding long-term lease contracts. The basic real estate valuation methods were developed in Great Britain and are nowadays used (sometimes with certain modifications) in many countries around the world. This is a consequence of ongoing globalisation processes and closer cooperation within certain groups of countries and international organisations. The main purpose of developing uniform guidelines for real estate appraisal internationally is to ensure deeper trust in the valuations presented in appraisal reports, which often serve as evidence in proceedings (e.g. validity of the market value of a property used in calculations of fees due to the enhanced value of urban land is frequently questioned). The applicability of classical real estate valuation methods depends on possibilities of securing reliable data from real estate markets. Of significance is also broad implementation of real estate information systems or establishment of other databases comprising such information as characteristics of specific immovable properties and basic data on real estate markets. Another important aspect is the available range of real estate market analyses. The comparative approach (method) is principally applied to evaluate the worth of undeveloped land plots in urban areas. The comparative approach is strongly connected with the procedure of comparing the real estate submitted to an appraisal to similar real estate properties sold on the same market (less often, on parallel markets). The date on which any other property was sold precedes the date on which a given valuation report was prepared but by no more than 3 years (in practice, this period can be extended or shortened). The basic step in the comparative approach is to evaluate differences between the compared properties and to make appropriate corrections to prices of the properties so as to eliminate differences in the attributes describing both the property being appraised and the properties selected for the comparison. In order to identify the influence of particular characteristics on the value of a real estate property and to assign adequate market values to differences in these characteristics, it is necessary to make an in-depth market analysis. The differences in the attributes identified in the course of such an analysis are treated as adjustments directly affecting the value of the real estate being evaluated. Activities involved in the determination of the market value of real estate according to the comparative approach usually follow the steps shown in the diagram Fig. 10.1.

In general, factors with an impact on the market value of land plots that are appraised fall into the these categories:

- factors formally connected with the legal status of real estate,
- economic factors related to the real estate market,
- physical factors concerning a real estate property, its location and links with the environment.

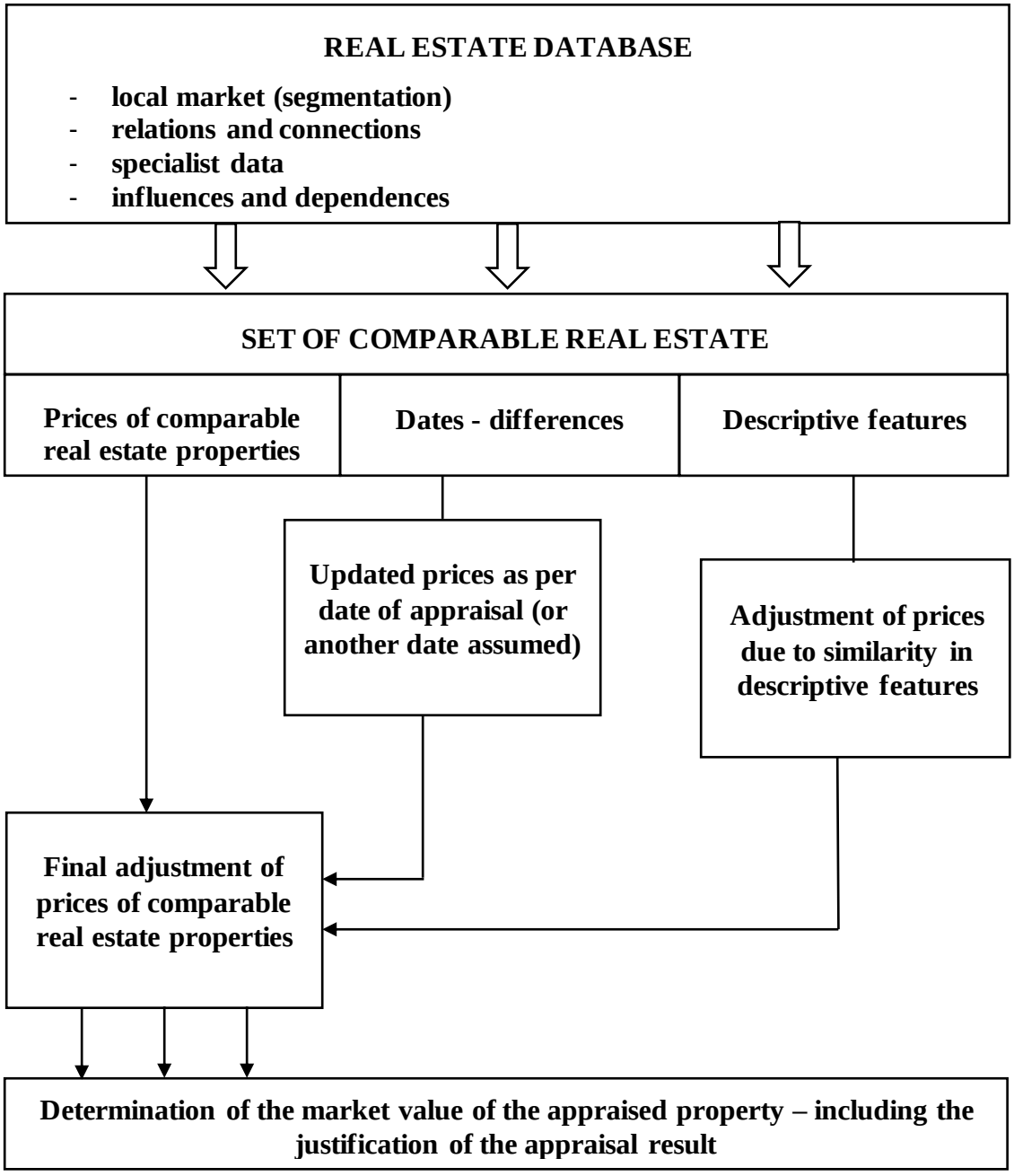


Fig. 10.1 Schematic presentation of basic steps in the comparative approach

Source: developed by the author

Physical factors of real estate are related to the concept of real estate per se, as a physical entity (immovable property), which is a determinate portion of the earth's surface in its various dimensions, having links with the near and distant surroundings. In

this group of factors, the location of real estate plays a significant role. Attention should also be drawn to factors arising from the vertical and horizontal shape of the ground (topography).

The availability of real estate is typically identified as the possibility to access the plot as well as the direct or indirect accessibility of a network of technical facilities. Another important step in the comparative approach comprises an analysis of transactions on the given real estate market. The following can be distinguished among the significant elements of such an analysis: prize per 1 m^3 of a land plot, price of a land plot of an area considered to be standard on this market (e.g. 700 m^2), etc. The records of real estate prices on the local marker should include both current and past transactions. Hence, the date of concluding a given buy-and-sell contract is significant as well as other circumstances such as the form of the transaction and other details of the contract. The following formula is applied in the comparative approach to real estate appraisal:

$$\mathbf{MV_i = S_c + ADJ_c} \tag{10.1}$$

where:

MV_i – market value of the i-th real estate property under appraisal,

S_c – a list (set) of prices of real estate properties similar to the one under appraisal,

ADJ_c – adjustments due to differences between the characteristics of the real estate under appraisal and the prices of the similar real estate properties taken for comparison (expressed in amounts).

The formula (10.1) serves for performing an analytical determination of the market value in a typical pairwise comparative procedure, but it can also be applied to determine values of these coefficients with the help of (linear or non-linear) regression analysis. A typical pairwise comparative technique is applicable to the appraisal of single real estate properties, whereas regression analysis is most often employed in valuation of multiple properties. The characteristics adopted for the comparison of real estate can be quantitative and qualitative in nature. In the analytical process, special attention should be paid to the characteristics describing the location of immovable properties. A multithreaded analysis of prices of comparable real estate properties as well as the updating of the set of these prices as new transactions are made is another important element of the approach. Calculations need to be made to demonstrate changes in the trends on the local market of urban land plots. Prices used for the calibration of a specific model applied to determine the market value, inclusive of the significant characteristics

of these real estate properties, should be typical of a given local market. This enhances the likelihood of obtaining better adjustment of the model to the specific market situation, thereby increasing the accuracy of the appraisal. The following steps can be distinguished in the above procedure:

1. acquisition, analysis and processing of prices of real estate properties typical of individual segments of the market;
2. analysis of trends on the market, and the identification and measurement of significant characteristics affecting the value of urban land plots;
3. determination of the influence of the previously selected characteristics of real estate properties on their value (assigning specific numerical values, that is the adjustments).

In all these analyses, it is crucial to determine coefficients of the correlations between the variables. Below, basic characteristics and their input descriptors are given in a Table 10.1.

Table 10.1 The basic characteristics

CHARACTERISTIC	EFFECT	DESCRIPTION
date of the transaction	very strong/strong/moderate	date of the notarial deed
restrictions on the use of real estate	strong/very strong	limited real rights, formal restrictions, zones, local restrictions
use in the local plan	very strong/strong	legally permitted land development, land-use structure
technical infrastructure facilities	moderate/strong	type of facilities, their technical description and function, possibilities for direct connection
location	very strong/strong/moderate	macro – location, close surroundings, more distant real estate
shape and area of a land plot	strong/moderate	specific shape, group according to the surface size, elongation of the plot, front facing side
topography	moderate/strong	slope angle, relative height, slopes, faults, ravines, floodplains

Source: own study based on literature review

To summarise the above considerations, it needs to be stated that the approach based on the comparison of real estate prices is the most direct assessment of the market value of urban land plots among all real estate appraisal methods. This approach relies on established steps and procedures, which include the following:

1. making an inventory and a tally of prices of real estate similar to the one under appraisal, selected out of all prices of land plots offered recently on the analysed real estate market; preparing a list of prices and characteristics of real estate properties.
2. performing a quality assessment and verification of the data related directly to the valuation of urban land plots, and making the final choice of parameters for the comparison.
3. selecting a unit for making comparisons with similar properties; the interpretation, guidelines for determination and measurements.
4. estimating the corrections for every characteristic previously selected for the comparison of real estate, description and interpretation, if necessary assignment of weights, calculation of ranges of the attributes.
5. procedures involved directly in making a comparison of the real estate under appraisal and comparable immovable properties selected for the similarity assessment, determination of the final amounts of adjustments for individual characteristics adopted for the comparison.
6. final determination of the value of the real estate being appraised, based on the results of the above analysis including the adjustments to the prices of similar real estate properties. In Poland, a legal definition of a similar real estate is provided in the Act on Real Estate Management of 1997). In many other countries, the interpretation of this concept is contained in professional standards or good practice guidelines for real estate valuation.

Thus, a significant step in valuation carried out according to the comparative method consists of the identification and adequate selection of the real estate properties sold previously on the local market. One of the strengths of this approach to the determination of a market value is the direct reference to the situation on the local market. Consequently, this approach openly implements the substitution principle, as it analyses directly a set of information on similar real estate. It rests on the assumption that a potential buyer will not pay more for a given real estate property than has been paid in previous transactions involving similar properties. Differences in prices of real estate properties are eliminated (to a large extent) by applying appropriate adjustments, which should be estimated on the basis of an analysis of data from the real estate market. Most of these corrections can be expressed in either amounts or percentages. It is important that the adjustments be updated as changes on the local market occur. This is thought to be a relatively simple approach provided that the valuer has extensive experience in real estate

appraisal and can interpret the local market tendencies correctly. The valuer should also take into account any links of the property with the formal, legal and economic background of this market. The valuer uses many methods and techniques, which allow them to identify real estate properties most similar to the one being appraised. This also applies to the selection of attributes which (in the valuer's opinion) affect the property's market value, and of the ways (principles) of measuring these attributes as well as determining their impact on the property's value. At this stage, the valuer can use methods based on statistical analyses and the ones which rely on direct interpretation of a variety of signals from the market. Below, there is a schematic presentation of the process of determination of real estate value (Fig.10.2). There are certain limitations concerning the accuracy of determining the market value of urban land plots using the comparative approach. One is due to the fact that comparative analyses are based on prices and attributes of the real estate properties sold prior to the date of making an appraisal. There may have been some changes with the passing of time, concerning the types of factors affecting the value of land as well as the power and directions of their effects. This calls for a thorough analysis of a multitude of data from the past and an assessment whether the data chosen for the comparison are still valid. Another difficulty in the comparative approach lies in the fact that for some types of real estate it is impossible to find a sufficient number of comparable properties and reliable data. This is particularly true about unique properties, which seldom appear on the market. In such situations, one can employ data from parallel markets, but then the utmost caution and much professional expertise are needed. It should also be borne in mind that results of an analysis carried out refer to the past time (Fig. 10.3). The conclusion that arises from the above considerations is that the comparative approach is specially predisposed to estimates of the market value of land plots situated in urban areas. The difficulties inherent in this approach as regards the appraisal of land plots are more evident in emerging markets, where formally there is insufficient information on prices of real estate similar to the one being appraised There is also a lack of an efficient system for logging market transactions and other data necessary for an effective use of this approach.

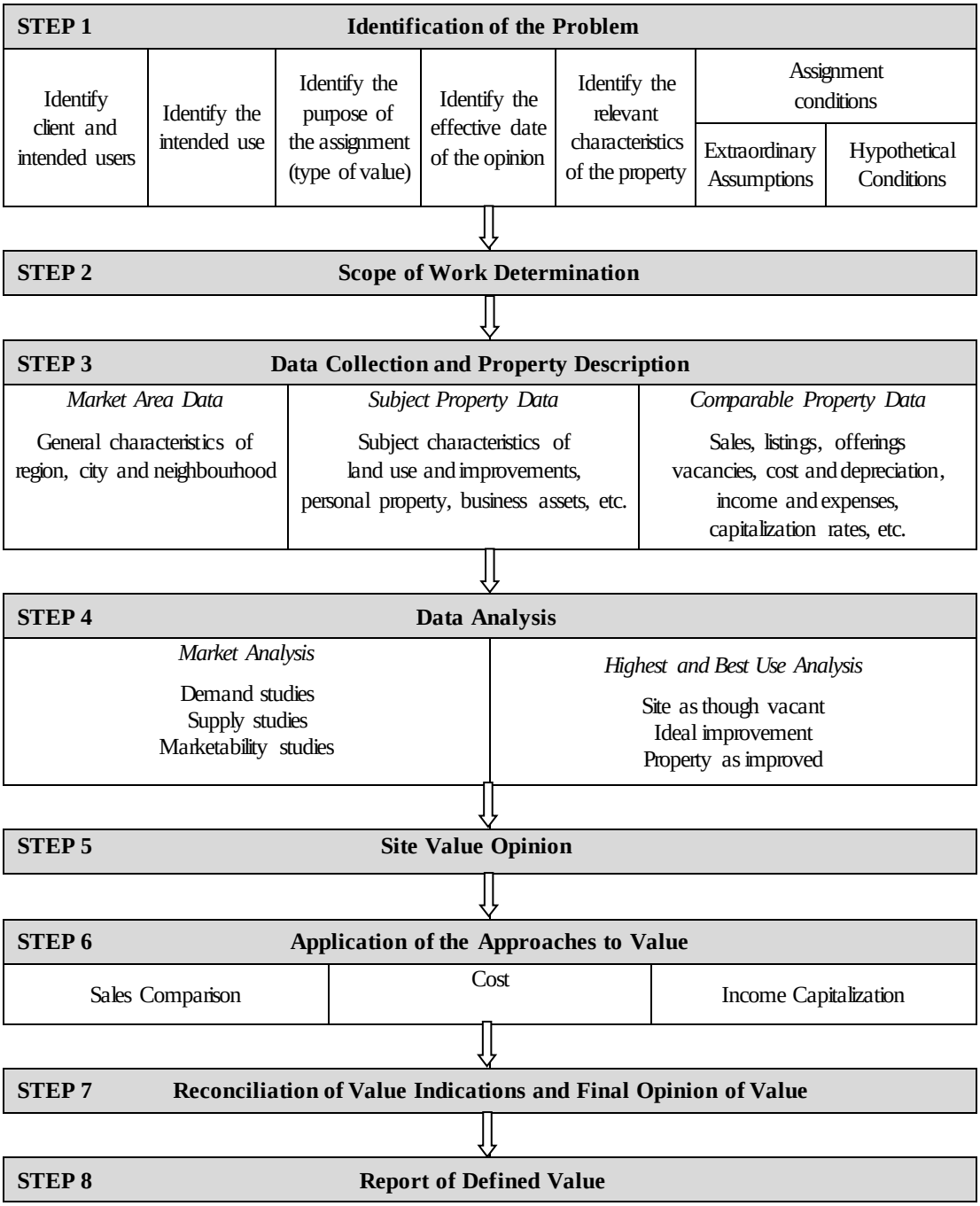
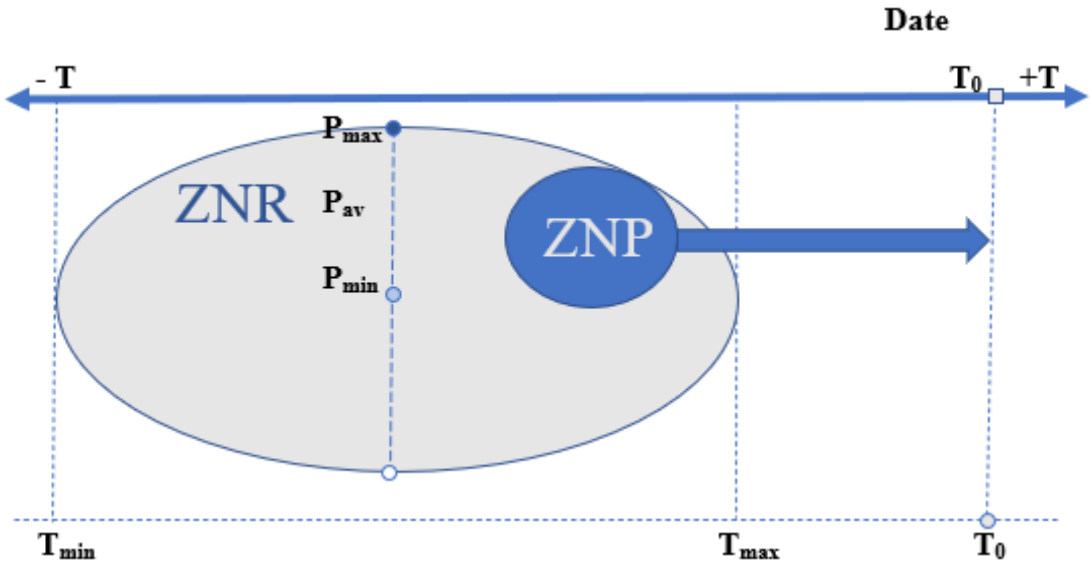


Fig. 10.2 Appraisal Process

Source: based on McKinley 2008.



where:

ZNR – a set of comparable real estate properties on the market (determination of attributes) ,

ZNP – a set of comparable real estate properties selected for the comparative analysis ,

P_{max}, P_{min}, $P_{av.}$ – attributes characterising the set of comparable real estate properties (min, max, average, …).

Fig. 10.3 Visual interpretation of the results of an analysis in the past time within the comparative approach

Source: developed by the author

However, the implementation of the comparative approach should be treated as a priority by the relevant authorities since the value estimated with this method has all attributes of a market value. During the transitional period, some of the principles underlying the comparative approach may be applied until a satisfactory amount of data is obtained. Another possibility is to use data form an informal market (not controlled by the authorities).

The real estate properties selected for the subsequent comparison must be competitive marketwise relative to the property being appraised, in line with the substitution principle. They should also represent the same market segment. Significantly, they must be similar to the property under appraisal as much as possible, having similar attributes and originating from the same real estate market. In practice, it

is also possible to apply the following procedure for the selection of properties sold earlier and now used for making direct comparisons:

1. searching for real estate properties potentially similar to the one submitted to an appraisal according to the previously adopted model;
2. inspection (on site) of the property under appraisal and the properties chosen for making direct comparisons;
3. analysis of significant characteristics attributed to the evaluated property and its surroundings;
4. evaluation of the way each property is used including an analysis of the highest and the best (optimal use);
5. application and execution of a procedure designed for the verification of all collected data about similar real estate properties, including the exclusion of the ones which do not fully satisfy the condition of similarity;
6. determination of the basic characteristics used in the process of comparing real estate properties, their identification and specification, including the explanation how they are measured (their gradation);
7. determination of amounts of adjustments needed in the absence of complete similarity (adopting scales for measurements; detailed calculations, determination of average values of adjustments for the analysed urban land market;
8. determination of the adjustment for a given market due to the passage of time from the selling date of each real estate property selected for the comparison to the date of the valuation of the appraised real state. The latter is usually the date on which the valuer prepares an opinion (report) on the value and delivers it as an appraisal report.
9. an analysis of the differences between the property being appraised and the ones selected for the comparison (e.g. a pairwise analysis or multiple regression analysis);
10. entering the adjustments due to differences in the characteristics of the properties, including the final outcome of the valuation process;
11. an analysis of the valuation result by referring it to the situation on the local market of similar real estate.

It is worth mentioning that the price of every real estate selected for the comparison is a historical fact that occurred on the analysed market. In many European countries, this fact is recorded in purchase and sale agreements (in Poland, this agreement is in the form of a notarial deed and the information about the price is stored in the Price Register).

In many countries with developed market economy, there are specialised databases on transactions completed on the real estate market. In Poland, such information is disclosed in the register of land and buildings (real estate cadastre) and this database is called the Register of Real Estate Prices. There are other specialised databases on transactions on the real estate market, where the following data are available:

a) the transaction price, including the date of the transaction;

b) financial conditions underlying the transactions and the form of payment for the given real estate (e.g. payment of the entire amount in cash or split into interest-bearing instalments),

c) legal factors, information on the area and land use of real estate,

d) attributes of the location of the real estate sold,

e) description of the physical attributes of the real estate (area, shape of the land plot, length of the plot's border adjacent to a road), c

f) the use of the real estate property in the local land use plan or in other documents related to land management,

g) any formal restrictions concerning the use of land due to legal regulations or other administrative provisions,

h) other parameters characterising given real estate which can be used when making its appraisal.

Another significant component in the process of acquiring the information about real estate under appraisal consists of a field inspection. All the information obtained during the analytical process should be submitted to verification in terms of its usefulness for the comparative approach. It is particularly important to verify whether the transaction prices previously selected for the comparison were obtained on an open market and if there were any special circumstances related to the conclusion of every transaction (e.g. enforced transactions or transactions between family members). Obtaining a good result regarding the accuracy of the appraisal of a real estate property's value is greatly helped by a properly conducted analysis of the characteristics of the real estate properties submitted to comparison. In terms of the real estate valuation principles, it is most significant to select these characteristics of an immovable property which have a considerable (significant) contribution to the value of this real estate. It is also important to measure properly the differences between the characteristics describing the property being appraised and the ones taken for comparison (elements of comparison). These are in particular:

– differences in the right to real estate (including limited rights in rem established under the main right),

– factors related to the assessment of the real estate's location,

– conditions underlying the conclusion of the transaction and obtaining specific transaction prices,

– dates on concluding transactions,

– market factors (demand, supply) changing with the passage of time in response to changes on the real estate market,

– differences in physical factors characterising every real estate property (e.g. shape of the plot or the slope angle).

It is also important to identify the main motivation behind every transaction, both the buyer's and the seller's. Another aspect that needs to be analysed is how long a real estate property had been offered for sale. Another fact that needs to be considered is that all factors related to the real estate market undergo changes in time. Such changes can be determined with the help of a change coefficient achieved from an analysis of prices in particular time periods distinguished for the development of the market. Other aspects associated with a market analysis include changes in the supply and demand for real estate as well as changes in the level of inflation. All necessary corrections related to the analysed differences in the characteristics of real estate properties can be expressed both in amounts and as relations expressed in percentages. Out of the three basic approaches to real estate appraisal, it can be claimed that the comparative approach is best predisposed to the valuation of land plots in urban areas. This especially applies to undeveloped land or land plots under typical buildings or building structures. A preliminary comparison of the three approaches to real estate appraisal is presented in Table 10.2. Attention should be drawn to the characteristics, benefits and limitations of these approaches.

Table 10.2 Comparison of the basic approaches to real estate appraisal

REAL ESTATE APPRAISAL APPROACHES	BASIC SCOPE OF APPLICATION	ADVANTAGES	DISADVANTAGES
The approach based on an analysis of real estate selling prices – the sales comparison approach	Vacant land (planned for development), real estate for residential housing, commercial properties, retail commerce, agricultural properties within administrative borders of towns or within the scope of spatial development plans.	It reflects the current situation on the real estate market provided there are enough transactions in a given market segment.	It may not account for delays in the conclusion of transactions due to protracted negotiations regarding the sale – market conditions can change by the time the contract is officially concluded. The value is determined for a typical market buyer.
The income approach	Homes (residential properties), commercial and industrial real estate, warehouses and storage facilities.	A real estate is appraised based on potential revenues earned from similar real estates. The capitalization rate is most often determined on the basis of prices and revenues of similar properties.	Problems that may occur are related to the quality of information on revenues and maintenance costs. There are also difficulties transforming revenues to profits. The capitalization rate or discount rate are applied. Problems estimating the risk. Lack of sufficient market evidence to determine with sufficient accuracy the future revenues from the property. DFC is largely based on forecasts, which are not reliable enough.
The cost appraoch	Homes (residential houses and flats), other buildings and facilities, industrial buildings, warehouses. Retail commercial buildings. Farms and specialist use buildings and facilities.	Costs or replacing or reconstructing buildings are estimated – taking into account the depreciation value. Needed in the valuation carried out for insurance purposes (construction costs).	It requires in-depth knowledge of the costs of every type of building. It requires knowledge of the basic cost breakdown. It requires knowledge of estimating various forms of the depreciation of buildings.

Source: developed by the authors – based on the literature perusal

Noteworthy, the comparative approach directly refers to the real estate theoretical principle of substitution. Data from the real estate market are employed when making an appraisal of a real estate property according to this approach. The basis for the comparative approach consists of an analytical processing of data from the local market including analyses of the market's environment. These parameters are directly employed in the process of an appraisal of land in urban areas. A significant step in the

implementation of this approach is the formation of own database from the information obtained from land and mortgage registers, land cadastre, land price register and other relevant sources of information on the given local market. The consecutive step is to make a specification of properties that satisfy the condition of similarity in the process of evaluation the market value of real estate being appraised (Fig 10.4). Several distinct stages can be distinguished in the qualitative and quantitative analyses of collected information which are performed during an application of the comparative approach. Hence, there are these stages in the estimation of a market value which are relatively objective and ones which are relatively subjective. The elements of this analytical process that present a certain degree of subjectivity include the selection of real estate for comparison based on an analysis of the input database . Objective elements pertain to an analysis of the amounts of specific corrections, expressed in a monetary value or as a percentage of another parameter. It is worth mentioning that the comparative approach in its classical form cannot be applied when there are not enough real estate properties on the market similar to the one under appraisal. It is worth reviewing the market conditions in the time period when particular transactions were concluded. This is due to possible changes in the supply and demand for real estate and the changeable inflation rate. The comparative approach requires the user to determine an unambiguous comparative unit. It could be whole real estate properties if the size of an appraised property is a standard one on a given market, or it could be one square meter ($1m^2$). Sometimes, a cubic meter ($1\ m^3$) or a meter (1m) are taken as a comparative unit. A successful application of the comparative approach to the assessment of market values of land plots in urban areas, in terms of the accuracy of appraisals, requires that the valuer thoroughly understands the comparative procedure and has adequate experience in making market analyses. They should also have sufficient analytical and logical skills engaged in the determination of effects of particular factors on the real estate's value. Procedures involved in the updating of real estate databases are of great importance as well.

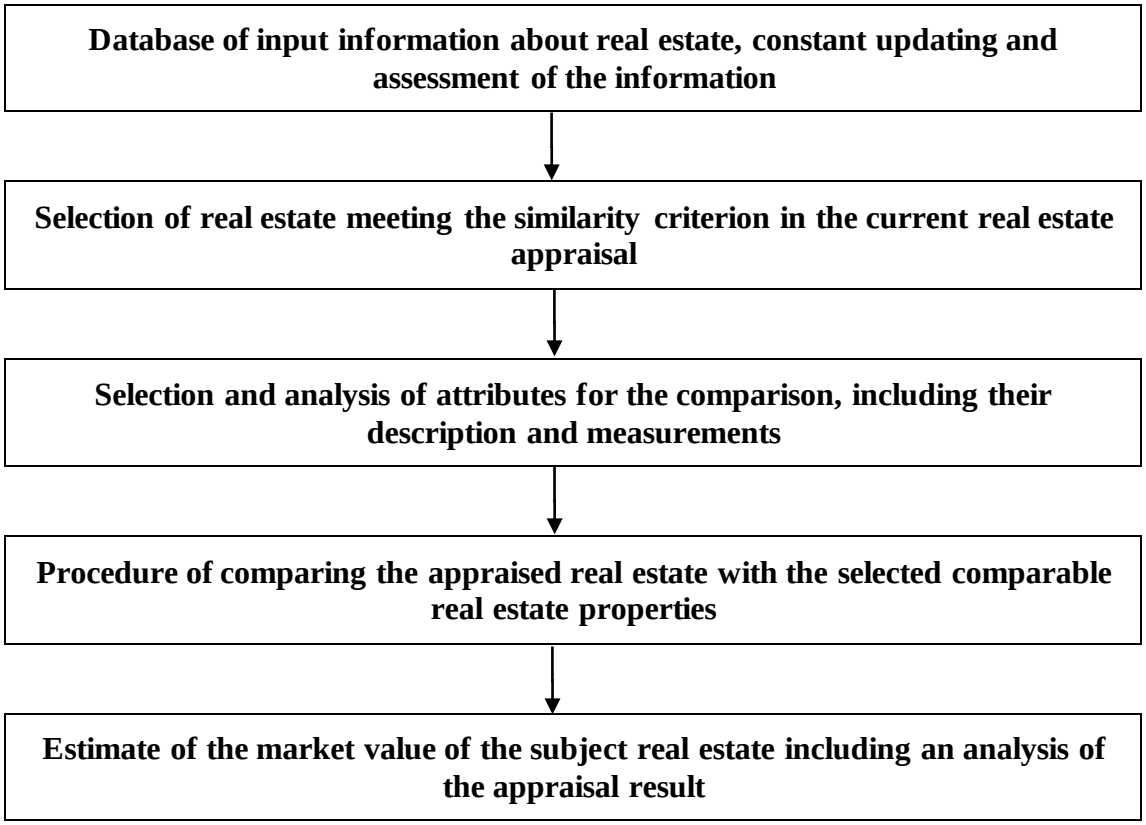


Fig. 10.4 Diagram of the steps in a typical procedure applied in the comparative approach

Source: developed by the author

10.3. Data and information in the process of valuation of urban real estate

Management and valuation of real estate require taking numerous decisions relative to physical space. During the decision-making process the data sets on the real estate contained in the cadaster and other subject registers are used. This part presents the systematics of information used in real estate management and a review of data sources on real estates. Characteristics of selected data sets were presented and their use in the process of real estate appraisal was assessed. In each organized activity, an in particular an activity dealing with physical space, information is one of the basic elements in the decision-making process. Lack of data or their insufficient quality may lead to mistaken conclusions and as a consequence, mistaken decision. In the process of land valuation, this applies in particular to up to date and certain information from real estate market. In the process of real estate management, information on landforms a significant component of the process understood as the entire set of issues relative to activities aimed at determination of principles for use and management of public owned land. The land may

be allocated in physical development plans to either development by construction or purposes of agriculture and forestry (land use forms in future). These issues of land management encompass in particular the activities relative to:

- sale of real estates (handing over of land for use);
- transfer of land for management, lease and tenancy and lending for use;
- sale of land to the current holders of use (in Vietnam) to them;
- expropriation of real estates for justified social and public purposes;
- granting land which is managed by the State to legal entities or cooperatives;
- burdening the real estates of the State Treasury with limited property rights;
- appraisal of the real property required to levy adjacent fees, yearly management fees, fees for perpetual usufruct, use rents, etc.;
- sale of premises occupied by lessees or tenants to them;
- appraisal of real property for taxation purposes in mass appraisal process.

In each above specified instance of real property management determination of the value of the real property is inevitable. In most cases (e.g. Poland) this is represented by the market value defined as the most probable price that could be developed under conditions of property operating local market. The value is determined by a valuer/appraiser. Appraising the property he should have available numerous data permitting characterization of the subject real property and listing significant features describing the land. The data should include the attributes of the real property that are of significance to its value. Such features encompass in particular:

- location of the real property;
- functions allocated to it in the local physical development plan;
- degree of improvement with technical infrastructure;
- degree of development;
- the contents of ownership rights and the limitations to them;
- possibilities of use and possibilities of disposal;
- level of market prices in the vicinity of the subject real property;
- data concerning the local market relative to the supply – demand aspect of it.

The level of detail of data obtained in the process of real property appraisal depends on the purpose of appraisal, type of real property, approach used and method of appraisal – according to the legal regulations allowing a choice of the approach, method and technique of appraisal usually used in each country. During the process of appraisal the general information characterizing the local market and detail information describing

the subject real property is taken into consideration. The general information is gathered based upon a thorough analysis of the local market and in particular:

- analysis of social conditions i.e. number of population resident within a given area, level of employment, income generated, unemployment ratio;
- analysis of natural and environmental conditions, i.e.. Location relative to natural and environmental objects, access to technical equipment and public utility objects, presence of sources of pollution and contamination and their scope;
- analysis of economic conditions, i.e. availability of loans, their value and interest rate, local preferences and tax reductions, land ownership structure;
- analysis of factors relative to administration and development, i.e. local taxes, quality of services provided, projected development of the area.

The detailed information characterizes directly the appraised property. The following types of information can be singled out here:

- initial information- which mean specification of: the purpose of appraisal, type of real property and characteristics of persons: seller and buyer of the real property;
- legal information- allonging determination of: the identity of owner (administrator), form of administration or use;
- identification of the property, indications resulting from the local physical development plan (land use plan);
- localization information – concerning positioning of the property (general and detailed), access to transportation (road, railway, air, water, etc.), characteristics of the surroundings;
- technical information – which depending on the type property applies to:

+ land (land real property) – area, shape of the lot, morphology type of land use and fertility class, strength of land, technical improvement, etc.;

+ building (building real property) – age, number of floors, dimensions, area (total, usable), volume, structure, construction material, technique of construction, equipment with network installations, technical and functional wear, etc.;

+ land and building (built up real property) – the information should be collected as above for the land and the building or buildings and structures that are components of the real property as well as others elements of the real property composition (such as standing timber);

+ comparative information – information concerning the local market characterizing similar real properties which were subject to market transactions. This group includes

the list of transaction prices and transaction dates, rents obtained from similar real properties at the given local market.

The information should be first collected from obligatory sources and if it is required supplemented from auxiliary sets (optional).The register of land and mortgages entries are established for individua real properties. There are official registers maintained to reveal the legal status and burdens on real properties. The major function of the register of land and mortgages is providing a reasonably credible legal – organizational base for providing mortgage loans and trading in real properties.

The register of land and mortgages is maintained in Poland by District Courts and established on application by the owner for a given real property. The register is characterized by its open nature, assumed truth of information and reliability of the register of land and mortgages. The list of information characterizing real properties was presented in Table 10.3.

Table 10.3 Information relative to a real property

<table>
<tr><th>Place and location</th><th>Quality of construction</th></tr>
<tr><td rowspan="3">- Topography
- Characteristics of soils
- Possibility for construction
- Landscape and surroundings
- Access to a street (font of the lot)
- Spread and course of borders
- Technical improvement
- Distance form public utility objects
- Allocation in the physical development plan
- Degree of development</td><td>- quality of materials
- workmanship
- architecture
- defects of construction</td></tr>
<tr><td>- Construction materials</td></tr>
<tr><td>- foundations
- construction walls
- ceilings
- floors
- internal walls
- window and door woodwork
- roof, structure and cover</td></tr>
<tr><td>Dimensions of buildings</td><td>- Particular features</td></tr>
<tr><td>- Area on ground level (building)
- Total area
- Usable area
- Volume
- Height of buildings
- Height of each floor
- Number of units, rooms
- Number of floors under and above the ground</td><td>- number of rooms depending on type of heating, ventilation
- inside installations, sewage removal
- fireplace
- terraces and patios
- lifts
- extensions and supplements
- functionality, standard</td></tr>
<tr><td>- Shape and use of buildings</td><td>- Age and wear</td></tr>
<tr><td>- Kind and type of building
- Current use
- Style of architecture
- Shape of building
- Type of roof
- Type of stairs
- Relation between the area on ground level to circumference
- Number of bends</td><td>- Age of use
- Target age (normative)
- Period of economic use
- Dates of overhauls and repairs
- Technical wear
- Functional wear
- Economic wear</td></tr>
</table>

Source: own study based on cadastral data base

The Register of land and mortgage files are established and maintained based upon legally allowed documents including abstract and graph from register of land and buildings, notary deeds, etc.

In appraisal of real properties, and in particular in the process of determining its price, it is necessary to investigate whether there are any registered mortgages which are transferred onto the buyer together with the property. As a consequence the register of land and mortgages file for the appraised property should be investigated each time to show the rights limiting the right to dispose ownership right to the property, personal rights as well as claims and mortgages. Register of land is a uniform for the entire country set of data and entries of official nature concerning data on land, owners and administrators of land, maintained according to the Law- land survey and cartographic law. The register of land encompasses data concerning location of land, its borders area, type of use, fertility class (pedological classification of soils), number of the Register of land and mortgages files or of the set of documents file if they were established for the property which includes the land. The Register of land also shows the name of the owner (user) and his address (name and official address of a legal entity) and the data of a person administering the land. The basic documents of the register of land are: registers of land and register maps which together with documents justifying entry into the register form operational files of the registers of land. The data contained in that set is public abstract drawings and descriptions from the set are issued on request by owners, natural persons or legal entities who administer the land and other persons possessing a legal interest in the documents. The following principles apply to maintenance of the register of land: universality, uniformity, publicity and credibility. This means that the data from that system form the base for projection of tax volumes, determination of fees and charges and entries in the register of land and mortgages. According to provisions on maintenance of the register of land is within the authority of local bodies of government administration of the basic level and bodies of local self-government (communities) on consent of the above-mentioned bodies of government administration. Register of buildings forms an integral part of the register of land. So far a universal register of buildings effective all over the country has not been established. It finished at tests and fragmentary implementation. The first post-war attempt in that area was the decree of 24 September 1947 on cadastre of land and buildings remaining in force until 1955. The provisions of the decree did not come into effect for a number of reasons. That unfavourable situation

was to come to an end with the decree of 2 February 1955 on register of land and buildings (Journal of Laws No. 6, item 32), in which the provisions of the 1947 decree on, inter alia, uniform register of land and buildings for the entire country were repeated almost with no changes. In the law of 17 May 1989 "Land survey and cartographic law" (J.L. No. 20, item 163 with later amendments) the provision was repeated however the register of buildings has not been established. The expert or appraiser, while appraising a built up real property is also obliged to collect data on buildings or structures that constitute elements of the given property. As a consequence, he must use data from auxiliary sources of information, e.g. The industry systems (managed by residential houses administration companies, associations of private owners, insurers and statistical offices). Also, much valuable data on buildings is incorporated into the base map and set of documentation of the register of land. The data should be obtained each time. Together with the inventory of the appraised property at the locality (so called field review). The register forms another set of information structured as a uniform system according to cadastral requirements, and serves investment, design and construction activities as well as control and negotiation of future development and redevelopment of individual networks.

The basic land survey and type data on land improvement including other data can be obtained from the base map or the subject overlay to the base map ("U"- land improvement) maintained at the centers for land survey and cartographic documentation. The technical, geometric (descriptive) characteristics can be obtained from owners of the given type of network (e.g. water supply and sewerage systems – water and sewerage utility, gas network- gas utility, etc.) who maintain their own industry systems. Physical development specifies the scope and procedure in cases of allocating land to specific purposes and determines the principles of development assuming ecological development for the base of these activities. The principles and procedures applicable to local physical development plans are developed by the management of the community in a general form, simplified form or detailed form depending on the local features of the area covered by the plan and the opinion of the local self – government. It is a community regulation and its preparation is determined by the community council in the resolution. The local physical development plan is a set of data concerning allocation and development of the area included in the plan. The basic documents in that set are decisions and drawing of the plan as well as the documentation of the plan and auxiliary materials. The plan determinations form the content of the resolution by the community council and take shape proper for administrative decisions. The local detailed plan, most useful for the

purpose of real property appraisal, specifies allocation of land, establishes the lines separating land of different function, determines the improvement of land and land development. The indications of the local physical development plan are among the main attributes, next to location, land improvement and investment made, that the appraiser has to consider appraising the property. Organization and maintenance of the database on transactions executed on real properties require gathering information on the market price level under compatible circumstances. Fully useful set of information on executed transactions could be achieved as relational database. The database should collect the comparative information such as:

a) lists of current real property transactions,
b) rents obtained for similar real properties,
c) net/gross income generated from real properties,
d) characteristics of similar features of objects according to specified models.
e) costs relative to maintenance and management of real properties.

A draft for such a database was developed. It allows development of database containing information on prices and values of real properties and features that influence them. The system consists of relational databases in which information on real properties that were subject of transactions in the given local market is collected, processed and made available to appraisers. The system is a supporting tool in selection of similar properties using the comparative approach to appraisal of real properties. The basic system was developed in data base management system. The positive aspect of the system is its compatibility with other system. The basic unit of reference in the offered system is a real property that may be defined as lots of land, lots of land and buildings (built up real property), and lot, building and units singled out within it (unit real property). Quality of both the initial material used for process of appraisal as well as the appraisal set of documents, which also is a piece of information, is an important attribute in gathering data for appraisal of real properties. The appraiser really cannot influence the quality of data gathered and obtained from compulsory sources of information. However, he may influence the quality of the final product reaching appropriate sources of information, property selecting the information, choosing and collecting current and reliable data. Collecting data in the process of appraisal the appraiser should secure to himself access to reliable sources of information, including adequate quality land survey and cartographic data and use the most up to date achievements of science, including EDP which may be of significant influence to quality and currency of data obtained. Improving

the quality of data used in the decision taking processes, and in particular their currency and reliability, they should be ultimately included in an integrated information system (e.g. Land information system). Such linkage of a number of systems makes the procedure of obtaining data significantly more efficient, increases the currency and reliability of the data and allows decreasing the operational costs of the system. Under Polish conditions the register of land and buildings (the register of buildings is inoperative) and the register of land and mortgages form the base information on real properties. Supplementary information is provided by local information systems and data bases a classic form, by appraisers themselves. High level of demand for information in the process of real properties management forces the need for modernization of the existing system and acceleration of work on development of an integrated Land Information System to satisfy local and regional needs adjusting them to the most current achievements of science in the area of EDP using modern techniques of data collections, processing and presentation, securing at the same time their accuracy, precision, currency, credibility, availability and completeness.

11. GENERAL INFORMATION ABOUT VIETNAM AND AN ANALYSIS OF THE VIETNAMESE REAL ESTATE SECTOR

11.1. General description

The Socialist Republic of Vietnam is a one-party socialist republic. All land in Vietnam is owned by the state. The prices of state-owned land are determined by the authorities, but selected free market principles are taken into consideration in the land valuation process. Vietnam has an area of around 33.1 million hectares and a population of more than 97 million (2020). Vietnam is situated in South-East Asia. It borders China in the north, and Laos and Cambodia in the west. Vietnam has direct access to the South China Sea in the east and south. Services (41% of the GDP), industry (33% of the GDP) and agriculture (16% of the GDP) are the primary sectors of the Vietnamese economy. Vietnam is characterized by relatively stable economic growth, relatively cheap labour (in comparison with other South-East Asian countries), rapidly developing special economic zones, growing domestic demand, and increased focus on global economic integration.

Various modernization and digital transformation programs have been initiated in the Vietnamese public sector, and similar efforts have been made on the real estate market. Since Vietnam is a socialist country, private land ownership does not exist. Land is owned by the Vietnamese people (state), and it may be used by various entities, including individuals – natural persons and organizations – legal persons. The authorities allocate land to private and institutional users by issuing land-use right certificates and concluding tenure and (in exceptional cases) lease contracts. At present, Vietnam is one of the most promising markets in South-East Asia. The Vietnamese real estate market has attracted the interest of European investors despite legal barriers and limitations (land-use rights instead of land ownership). The economic reforms (Doi-Moi) initiated in Vietnam have led to rapid and often uncontrolled urban expansion. The shift to a socialist market economy proceeds relatively quickly. Rapid economic growth has generated new problems and undermined the sustainable development of different economic sectors. The highest growth rate is noted in the main sectors of the Vietnamese economy. These are: the state sector, the collective sector, the private sector, the private – free market sector, the state sector with elements of a market economy, and the foreign investment sector.

In line with the national economic strategy, Vietnam has been divided into six economic regions and three special economic zones. Each economic region receives

additional funds that stimulate the development of infrastructure, agriculture, industry and tourism. The national economic strategy emphasizes the significance of local initiatives and sustainable urban development. In 2020, Vietnam implemented the Urban Development Strategy aiming to improve the effectiveness of real estate management in urban areas. The strategy relies on the following key assumptions:

- urban development should proceed in a harmonious manner, and it should be consistent with the level of development in each region,
- an urban development hierarchy should be established for Vietnamese cities, and the economic growth of Vietnamese regions should be balanced by promoting rural development and sustainable urban-rural linkages,
- the provisions of the Urban Development Strategy as well as medium- and long-term urban development plans should be incorporated into the urban planning process,
- socioeconomic factors should play an important role in urban development.

One of the key goals of the Urban Development Strategy is to prevent the allocation of high-quality farmland, in particular rice fields, to development projects in rapidly growing cites. In turn, fallow land and land that is not suitable for agricultural (in particular rice) production should be dedicated to urban development projects. For these goals to be met, the information about soil quality and land-use types has to be regularly updated. Environmental protection requirements and sustainable planning principles should be taken into consideration in the land valuation process. The Urban Development Strategy should set the directions for future development projects and minimize the risk of land-use conflict. Reliable land valuation plays a very important role in urban development and land management. The above applies particularly to regions where large investment projects accelerate the urbanization process. Land valuation also constitutes a reliable basis for calculating property taxes. The general real estate taxation method is applied on highly developed markets. Statistical models are built with the use of the mass appraisal method to determine the value of real estate. This solution requires an effective system for registering property prices and values, such as the real estate cadaster. In this respect, the Vietnamese authorities can rely on Polish experiences and solutions. In Poland, the Register of Real Estate Prices has been incorporated into the cadaster (Land and Building Register). According to the Constitution of the Social Republic of Vietnam, the National Assembly is the highest organ of state power. The National Assembly

appoints the President, the Prime Minister and government ministers. Vietnam is divided into 58 provinces and five municipalities which are centrally controlled cities. The provinces are further subdivided into districts (counties), and each district is divided into communes. Provinces and municipalities occupy eight administrative regions. In the provinces, the People's Councils are the local organs of state power that are elected democratically in direct elections. The People's Councils appoint the People's Committees which wield considerable influence in the process of allocating state-owned land to different types of users and determining "administrative" land prices. There are four levels of public administration and governance in Vietnam: (1) central, (2) provincial (including municipalities), (3) district (county), (4) commune. The People's Committees play an important role in real estate management at the local level. The Committees supervise local development projects and the transfer of land-use rights to individuals. Political and economic reforms have significantly contributed to the rapid growth of the Vietnamese economy. Infrastructure and road construction projects have improved access to and the use of urban land. As previously mentioned, the state owns and manages all land in Vietnam. The state allocates land-use right certificates to various users (natural and legal persons). The Land Law regulates the relationship between the state (land owner) and land users. The Land Law was introduced in 2003 and substantially amended in 2013. Several implementing regulations to the Land Law have also been enacted, and detailed provisions concerning land use are specified in other regulations (including the Planning Law). State ownership, including land ownership, is regulated by the provisions of the Civil Code. Land-use rights certificates constitute formal proof of land user's right to property. Long-term land-use rights certificates are issued to users of land occupied by residential buildings. Land under residential buildings is used collectively, and this type of tenure is similar to the right of perpetual usufruct in Poland. Land-use rights certificates can also be issued to foreign investors who contribute capital to local business organizations. In cities, land can be leased from organizations that have acquired land-use rights certificates. State institutions (legal entities) also have land-use rights. Land can also be leased directly from the state administration without the need to obtain land-use rights certificates. Urban land can be leased from business organizations, private joint-stock companies and limited liability companies. Land can be leased for a maximum period of 50 years which can be prolonged to 70 years in special cases (e.g. specified investments). Upon expiry, the lease contract can be extended by the People's Committee.

Land-use and lease fees are set based on the "administrative" prices of land which are determined:

a) by the competent People's Committee ("administrative" price),

b) by way of tender,

c) directly during negotiations concerning the transfer of land-use rights or land lease.

Land prices can also be determined with the use of conversion tables and formulas that have been approved by the government. A similar system of "administrative" property prices had existed in Poland before 1990 (Źróbek ed., 2020). Vietnam has a socialist-oriented market economy, including in the real estate sector, which is characterized by excessive government intervention and preferential treatment of state institutions. Centrally imposed land prices are used to determine:

- property taxes for users of state-owned land,
- income taxes associated with the transfer of land-use rights,
- asking prices in tenders during which land-use rights are acquired for development projects,
- the value of land when land-use rights are allocated without the obligation to pay annual land-use fees.

Land prices can also be set by the state based on the real (quasi-market) value of land. This method of land valuation is an exception to the general procedure where land prices are imposed centrally by the state. According to the Vietnamese law, agreements documenting the transfer of land-use rights have to be registered by a public notary. This requirement does not apply to land lease. Centrally imposed land prices constitute the basis for the calculation of land-use fees. They are also used to calculate the amount of compensation due to owners of property that was seized by the government for urban development projects. Land-use rights can also be revoked by the government because all land in Vietnam is owned by the state. Confiscated land is allocated to other users. In Poland, land that is held in perpetual usufruct can also be appropriated by the state for public purposes (Real Estate Management Act, consolidated text, 2021). In Vietnam, a relatively stable compromise exists between socialist ideals and free market principles in the real estate sector. The Vietnamese real estate market is regulated by the provisions of the Land Law of 2013. The Doi-Moi economic reforms were initiated already in the 1980s

with the goal of creating a socialist-oriented market economy. These reforms increased the role of selected market mechanisms, including in urban development processes (Hansen 2013). According to the Land Law (2013), land is owned by the Vietnamese people and is managed by the state. The terms "people's ownership" and "state management" are characteristic of a socialist economy, and they are frequently used to describe economic activities in Vietnam. Therefore, land used by individual citizens is owned by the collective and controlled by the state. Land-use rights can be transferred to natural persons - individuals, communities and selected social organizations for a specified period of time, depending on the provisions of the local zoning plan or the decisions made by the competent authorities. The land-use system and the implemented solutions have evolved in the course of complex political processes in Vietnam (French colonization, reunification war, post-war era, Doi-Moi reforms). In Vietnam, land is regarded as a valuable natural resource that contributes to economic growth. Land management processes are controlled by the state, and land-use rights certificates are allocated to individuals and institutions who have been approved by the state. The land-use process itself is also controlled by the state. In recent years, the holders of land-use rights certificates began to push for the introduction of free market principles in the procedure of determining the prices of urban land due to considerable differences between "administrative" prices and the actual market value. Before 1993, land had been regarded as an asset that belongs to the collective and, in line with socialist principles, does not have market value. Beginning in 2003, selected elements of a market economy were introduced on the Vietnamese real estate market. At present, the prices of land are set by the authorities based on selected free market rules. It should be emphasized that state ownership of land and land-use rights are the fundamental tenets of Vietnamese property law. The scope of land-use rights is described in detail in the relevant regulations. In many respects, land-use rights resemble ownership rights (real right to use the land, right to swap and transfer land-use rights, right to place a mortgage on land, right to inherit land-use rights). However, land-use rights are awarded for a specific period which can be extended. According to the Vietnamese Constitution, private land ownership does not exist in Vietnam. In a sense, land ownership has been replaced by land-use rights. Land-use fees are set by the state administration. Land-use rights are informally traded on the secondary market. The prices that are quoted on the market differ (sometimes significantly) from the "administrative" prices. Objective information about the factors and processes that influence real estate market prices in Vietnam is difficult to acquire.

In practice, the compensation paid by the state for land that has been seized for public development projects also deviates considerably from the prices quoted on the informal market. Compensation is paid only to individuals who have legally acquired land-use rights certificates. A survey conducted by the authors among expropriated land users revealed that compensatory payments account for around 50% of the market price of land on average. The difference between compensatory payments and informal land prices is highest in the rapidly developing areas around large cities (Tran 2021). A property valuer should participate in the process of calculating compensation for urban land appropriated by the authorities. The value of land-use rights traded on the informal secondary market should be considered in the calculation process. Therefore, the observation that the value of land is shaped by the law of supply and demand as well as specific local factors should be taken into account in this process. Land management in rapidly growing cities and in areas subjected to strong urbanization pressure also poses a considerable problem on the Vietnamese real estate market. The existing planning system should be extensively reformed to decentralize the decision-making process and establish clear rules for the distribution of decision-making powers at different levels of governance. The market value of land plays an important role at the local level. Local zoning plans should be developed with the assistance of experts, and they should be subjected to public consultation. Local community members should also be provided with access to information about the land-use plan. The urban land valuation system in Vietnam should be modified and upgraded to account for the influence of social, economic and external factors. Clear rules governing land ownership rights and land valuation principles should be introduced to improve the performance of the Vietnamese real estate market. The existing approach to determining land value should also be revised by incorporating free market principles and creating a reliable price registration system. Despite the fact that land in Vietnam is owned by the state, land-use rights are not effectively managed. This problem can be addressed by introducing long-term land lease options. In urban areas, land-use rights are frequently traded on the informal market outside of state control. Some transactions are based on ownership deeds dating back to French colonial rule. Urban land is often built up without administrative permits or the local authorities' consent. As a result, reliable information about market prices is very difficult to obtain and requires local expert knowledge. The absence of a central register of real estate prices drives land speculation in urban areas. These problems have been recognized by the Vietnamese government which has announced new reforms aiming to create a more open and

competitive real estate market. These reforms will also address land management principles and public administration efficiency.

11.2. Real estate market in Vietnam

The transition from a socialist economy to a market-based mixed economy led to significant changes in the Vietnamese real estate sector in 2000-2020. Considerable changes were also noted in planning principles and policy directions in urban areas. In certain respects, the changes in the Vietnamese real estate sector were similar to the processes that had been observed in Poland between 1990 and 2000 (Foryś and Nguyen 2016; Źróbek ed. 2020). Beginning in 1986, selected elements of a market economy were incorporated into the central planning system in Vietnam. These measures initiated the process of transformations in the national economy, including in the real estate sector. A new approach to managing urban areas was introduced in 1996 to address the problems associated with rapid urbanization. An urban development plan was implemented in 1998. The plan was amended in the following years to account for changes in Vietnam's socioeconomic development. The urban development plan has introduced many positive changes in urban planning (National Report, 2016). It also significantly influenced the transformation of the real estate sector in Vietnamese cities after 2000.

Urban planning policies have undergone considerable change in the last 20 years. However, rapid population growth and urban expansion led to new problems in the management of cities and the surrounding areas. Urban planning and management policies had to be urgently revised to address these challenges. These processes also affected the real estate sector in urban areas. Between 1996 and 2020, Vietnam made significant progress in the transition from a centrally planned economy to a mixed system with elements of a free market economy. These changes improved the standard of living, promoted the development of housing and created better access to urban services. Private sector companies became more involved in residential construction. Urban planning decisions were decentralized, and decision-making powers were shifted to the local level. Planning decisions and legal regulations require further modification, and the quality of decision-making in land management needs to be improved to enhance the performance of the real estate market. The land valuation system should also be reformed to support the implementation of free market principles in the real estate sector. Legal restrictions as well as political and economic changes are the main barriers to the development of the

Vietnamese real estate market. The performance of the real estate sector can be improved by adapting solutions that have been implemented on well-developed markets, including in European countries (such as Poland) that have transitioned from a centrally planned system to a free market economy. The economic system of the Socialist Republic of Vietnam has been visibly transformed in the last 25 years. The Doi-Moi reform policies were launched in 1986, and they gave impetus to economic transformations at different levels of management and the transition to a market economy. Competitive mechanisms were introduced to liberalize the market. Vietnam embarked on a unique path towards economic development by seeking a compromise between socialist planning and free enterprise. Attempts were made to incorporate free market principles into a socialist institutional framework. A market-oriented socialist economy promotes the coexistence of various forms of ownership (state, collective and private). The economic reforms initiated in 1986 were carried out in four stages:

- **land reforms** have expanded the scope of land-use rights and led to decollectivization in agricultural production in rural areas,
- **limited private property rights were introduced**,
- **the export market was liberalized,**
- **economic freedoms were introduced and many barriers to business performance were eliminated.**

Local markets are regarded as the building blocks of the Vietnamese economy. A growing number of microbusinesses became involved in unofficial transactions on the gray market. The Land Law of 2013 reiterated that all land is owned by the Vietnamese people. However, land-use rights are awarded to natural and legal persons under specific implementing regulations. In the Housing Act of 2005, the Vietnamese government undertook to improve access to affordable housing with the assistance of private investors. The National Housing Development Strategy up to 2020 (including the perspective up to 2030) was implemented in 2011, and it led to the establishment of thousands of state-owned and private housing development companies. These changes have significantly increased the demand for land in cities and the surrounding areas. The value of privately traded land (informal transactions in land-use rights certificates) increased significantly. Land for housing construction is still traded in the informal sector, which generates numerous problems in urban land management, including:

– land for residential projects is often purchased on the informal market (outside state control). This is usually accomplished by converting farmland to residential use. Such transactions are not officially registered, and information about land-use changes is not available;

– buildings are erected by individuals or private developers (for sale or rent) without construction permits,

– the local authorities are burdened with the task of providing utility infrastructure to informal residential complexes.

The growth of the Vietnamese real estate sector is also impeded by the absence of an effective system for financing development projects. In recent years, Local Housing Development Funds were created in cities, which somewhat alleviated this problem. Private investors became significantly involved in housing construction after 2020. The prices of land and housing projects should be decreased to improve investment efficiency in the residential sector. The relevant regulations and procedures should be revised and modified (The World Bank 2014). The Urban Development Agency plays an important role in the development of Vietnamese cities. As previously mentioned, land is owned by the Vietnamese people, and it is managed by the state organizations. Land-use rights certificates (LURCs) are issued to land users, and the state guarantees general protection to LURC holders. The allocation of LURCs became the priority goal of administrative units. To obtain a certificate, land users have to document their right to a given parcel of land. However, owners who purchased their land on the informal market are unable to register their property in the official register of land-use rights. Comprehensive laws have been adopted to regulate the complex legal status of land acquired on the grey market. Special funds have been also allocated to land surveys, boundary (cadastral) measurements, cadastral maps and land registration. Transaction prices on the real estate market are registered by four agencies:

1. Land-Use Rights Registration Office,
2. Tax Office,
3. State Treasury,
4. Public Notary's Office.

The land registration process has been considerably decentralized. The land registration system covers two administrative levels:

1. provincial level,

2. district level.

Cadastral data are gathered mainly at the provincial level. Cadastral databases are updated and digitized, subject to the availability of public funds earmarked for this purpose. In 2003, two types of land-use conversion schemes were introduced by the Land Law:

- expropriation (the state pays compensation for confiscated land),
- voluntary donation of land for public projects (negotiations).

These conversion schemes can also be applied when land is acquired for urban development projects, in particular housing construction programs in urban peripheral areas. According to the Land Law, the compensation paid to the expropriated owners should be equivalent to the prices of land quoted on the free market. However, detailed regulations and procedures relating to the above have not been implemented. Therefore, the compensation payment for land seized by the state is more or less equivalent to its market value. Licensed real estate appraisers can participate in the process of calculating the amount of compensation. The Land Law of 2013 also introduced numerous changes in urban land management, including:

- detailed regulations concerning the state's rights in land management as well as land users' rights were adopted,
- the period covered by agricultural land-use rights certificates was extended,
- reference limits for appraising land value were introduced, and the permitted types of land use were specified in detail,
- the access of foreign investors to the real estate market was increased,
- detailed regulations concerning the acquisition of land for public development projects (expropriation), including the principles of calculating the amount of compensation due to the owners of confiscated property, were introduced,
- regulations concerning the acquisition and accumulation of real estate market data were introduced.

The Urban Planning Law of 2009 laid down the principles for planning and land management policies. This legal act was amended in 2014 by updating planning regulations and introducing detailed provisions. Land management policies in urban areas are gradually evolving towards free market principles. The above also applies to land valuation. However, some regulations that account for the specificity of the socioeconomic environment in Vietnam have been retained. Vietnamese decision-

makers are becoming increasingly aware that transaction prices lay the foundations for a robust real estate market. Land valuation is an essential process that contributes to effective land management and planning. The value of urban land is a reflection on the socioeconomic relations in the entire real estate sector. However, an effective database of property transaction prices in urban areas (local level) has not yet been established in Vietnam. According to the Land Law of 2013, land prices are still set by the central administration which issues the relevant procedures and publishes conversion tables. These rules and regulations are applied to set arbitrary (administrative) prices that are not based on the prices quoted on the free market. In Vietnam, numerous research studies have been undertaken to propose models that describe the correlations between real estate prices and the factors influencing land value and ultimate prices. Multiple regression models have been widely used for this purpose (Hoa and Duong 2016). These models relied on location (distance) and other provisions of local zoning plans in cities. The value of urban land is also significantly influenced by street category. The results of Vietnamese research studies were analyzed by the authors to propose changes aiming to improve the effectiveness of the real estate valuation system (land module) in urban areas.

11.3. Planning policies in the real estate market in view of land ownership rights – a historical overview

The Land Nationalization Act was passed in 1953 to reform the Vietnamese real estate sector. This legal act was adopted as part of the socialist model introduced by North Vietnam at the time, and it enabled the state to confiscate land that had been owned by influential landlords. Land in North Vietnam was proclaimed as the property of all Vietnamese people. The Constitution of the Democratic Republic of Vietnam (North Vietnam) was adopted in 1959. This document defined the following types of property rights:

- state ownership,
- collective ownership,
- workers' private ownership,
- ownership of national property.

An amended version of the Constitution was enacted in by the Socialist Republic of Vietnam (North Vietnam) in 1980. This document affirmed that land in Vietnam was

owned by the Vietnamese people and was managed by the state (central government). The Vietnamese Constitution was revised in 1992, and it introduced new provisions under which land could be allocated by the state to natural persons for long-term use. The Land Law of 2003 and the amendments introduced in 2013 reasserted the fundamental tenets of the land ownership system in Vietnam:

- land is owned by all Vietnamese people (society),
- real estate is owned by the state,
- land is managed by the central government,
- land users (natural and legal persons) may not own land, but are entitled to special land-use rights that are allocated in the form of land-use rights certificates.

Therefore, the state exercises the following rights and decision-making powers relating to land ownership:

- the state can pass laws relating to land ownership,
- the state has the right to use land and derive profits from land use,
- the state has the legal right to manage land.

Government policies relating to the real estate market were modified by the Land Law of 1987. Real estate valuation is an important element of these policies. Despite the fact that land may not be officially traded outside the centrally controlled economy, an informal real estate market (grey market) exists in Vietnam. Land-use rights are traded on the informal market. Attempts are being made to eliminate administrative barriers and promote the development of the mechanisms that are consistent with the principles of a market economy. These changes had been officially introduced by the 1993 amendment to the Land Law. The revised document laid down new rules that enabled the Vietnamese real estate sector to move in the direction of a free market economy. The Land Law of 2013 provided land users with new rights, including the right to swap and inherit land-use rights, the right to lease and place a mortgage on the used land. Land-use rights are still accorded for a specified term, but the period covered by land-use rights certificates can be extended from 20 to 50 years. The above applies particularly to farmland and selected types of land development. Successive amendments to the Land Law brought new changes to real estate policies. Land users were presented with the option of donating their land to the state, and additional guarantees protecting the interests of LURC holders were introduced. These measures provided an impetus for the growth of the real estate market in urban areas. The introduced changes also decreased the difference between the

official prices of land set by the central and local administration and the transaction prices of land-use rights certificates quoted on the informal market. The Land Law and successive amendments to the act have significantly contributed to the development of the Vietnamese real estate market. Decree 87 introduced detailed provisions for calculating the prices of urban land. In separate regulations, urban areas were divided into five categories for the purpose of determining land value. Each identified urban area was further divided based on the land parcel's location relative to three-four street categories (quarters). The resulting urban land units were subdivided based on the detailed location of land subunits. The following attributes were considered in the process of dividing urban areas into quarters:

- location relative to the city center (urban agglomeration or its part),
- income levels in a given street quarter,
- availability of utility infrastructure,
- current prices of land-use rights certificates.

The above procedure was applied to determine the value of land in the identified quarters. However, the prices of land set by provincial authorities are still lower than those quoted on the informal market. The valuation of land situated along the boundaries of different region poses an additional challenge. Similar pricing methods should be applied in such cases, and regional authorities should quickly address this problem by appointing experts and developing clear land valuation guidelines.

The evolution of legal regulations pertaining to the management of urban land in Vietnam, including land-use rights and the prices and land-use rights certificates, is presented in Table 11.1.

Table 11.1 Legal regulations pertaining to the management of urban land in Vietnam

Date	**Legal regulations setting the foundations for planning and land management policies**	**Provisions concerning land valuation in urban areas**
1987	Land Law (1987)	In line with the basic tenets of a socialist economic system, land is owned by the state, and property rights cannot be sold or transferred. Land does not have official market value, and it does not constitute means of production.
1993	Land Law (1993)	Land is still owned by the state, but land-use rights can be accorded to individuals (natural persons). Land-use rights can be transferred between individuals. Land-use rights can also be mortgaged and inherited (subject to certain requirements).
2003	Land Law (2003)	Additional guarantees were introduced to protect the interests of holders of land-use rights certificates. Land users who were expropriated by the state were entitled to compensation. The amount of compensation was set based on land prices calculated

		by the authorities. Agreements documenting the transfer of land-use rights in urban areas were implemented. The option of leasing and sub-leasing urban land was introduced. Land could be used to make a capital contribution to a commercial partnership. The obligatory land-use types prescribed by local administration were eliminated.
2013	Land Law (2013)	The rules for calculating the value of land allocated to natural and legal persons for long-term use were significantly modified. The following factors should be taken into consideration in the land valuation process: 1. The existing and officially prescribed land-use types, 2. The period covered by the land-use rights certificate (20-50 years), 3. The prices of land quoted on the free market (including in tenders), 4. The price of land should closely match the predominant price quoted in a given urban quarter, 5. Land parcels with similar attributes should have similar official prices.

Source: own study , based on literature review and Vietnamese acts

It should be stressed that the measures initiated by the central government create new opportunities for further modifications of the land valuation system in Vietnam. The introduced legal solutions were analyzed by the authors to develop an effective system for determining the value of urban land. The proposed system relies on the prices of land-use rights certificates quoted on the informal market, and it will assist the Vietnamese authorities in the process of moving towards a market-based economy in the real estate sector. An urban land information system will also play an important role in this process. The system was designed based on a detailed analysis of the regulations introduced by countries which have implemented real estate cadasters, as well as the Integrated Real Estate Information System (IREIS) in Poland. In successive stages, real estate experts were consulted, and the results of research were analyzed in different test fields to optimize the performance of the proposed system. A retrospective analysis of land valuation principles in Poland, in particular in the period of political and economic transformations when information about market prices was scarce, also generated highly valuable inputs.

11.4. Introducing research sites

A number of detailed analyzes related to the determination of the value of urban land were carried out in a test field located on the outskirts of Hanoi (Gia Lam district, Hanoi). These were both my own field research and an analysis of plans and other studies

related to the real estate market. Interviews with experts operating on this local market were also carried out.

11.4.1. Natural conditions

Geographical location:

Gia Lam district is located at the northeast gateway to Hanoi, the capital of Vietnam. It has many important traffic connections, e.g. waterways such as the Red River and the Duong River, a railway and roads such as national highways 5 and 1, and Gia Lam airport. Gia Lam district borders with: Bac Ninh and Bac Giang provinces to the east and northeast; Hung Yen province to the south, Dong Anh district, Hanoi, to the north, and Long Bien district, Hanoi, to the west.

Gia Lam district covers an area of 111.71 km^2 Gia Lam district is divided into 22 administrative units, including 2 towns: Trau Quy and Yen Vien. The other 20 communes are: Bat Trang, Da Ton, Co Bi, Dang Xa, Dong Du, Phu Thi, Duong Ha, Duong Quang, Duong Xa, Kim Lan, Kieu Ky, Le Chi, Van Duc, Ninh Hiep, Phu Dong, Dinh Xuyen, Trung Mau, Yen Vien, Yen Thuong and Kim Son.

Gia Lam district has an important geographical and political position in the capital city Hanoi. It has advantages for developing foreign relations and, along with Hai Phong and Quang Ninh, it forms the triangular centre of Hanoi's economic growth. Gia Lam is the centre of many important traffic hubs located along a traffic route. Transportation to districts inside and outside the capital is very convenient owing to several large bridges. This is a very favourable condition that enables promotion of trade and bonds between provinces and other localities in the country.

Topography

Most Gia Lam district and the surroundings lie on a plain area, descending from west to southeast, following the general inclination in the city's topography, and leaning towards the Red River. The delta is flat, filled with alluvial deposits from the Red River reaching the average thickness of 90 - 120 cm. Hence, the district has many advantages for the development of agricultural production as well as infrastructure, civil engineering and industries.

Climate

The climate of Gia Lam district is similar to the climate of the Hanoi area, typical of the northern climate with some characteristics of a humid tropical monsoon climate, having hot summers with abundant rains and cold winters with little rain. Located in the

tropics, it receives ample solar radiation all year round and has high temperatures. The average annual temperature is 24.3 ^{o}C. Exposed to the influence of the sea, Gia Lam district has plentiful rainfalls and high air humidity. The average annual rainfall is 1585.5 mm, with about 144 rainy days per year. The average annual relative humidity is 80%.

The most obvious climate feature of Gia Lam district is the occurrence of two seasons, summer and winter. Summer lasts from April to September and is characterised by a lot of sunshine and rain. Winter begins in October and continues until March of the following year. It brings cold, dry weather with little rain and prevalent north-easterly winds. January is the month with the lowest average temperature of 17.2 ^{o} C and the lowest average rainfall at 6.1 mm.

Hydrological conditions

Gia Lam district in the Hanoi city area has a fairly dense network of rivers, with many large rivers flowing through the Red River basin in the south of the city, the Duong and Nhue rivers and the Cau river basin in the north of the city, and the Ca Lo River as well as many rivers and canals for drainage.

These conditions are conducive to building irrigation systems which maintain agricultural production. Furthermore, if the network of waterways is used wisely, there will be potential for tourism development.

Cultural heritage

Located in the east of Hanoi, at the crossroads between Kinh Bac and Thang Long cultural regions, Gia Lam district possesses a wealth of cultural heritage. This is the resource for the district to develop typical tourism products in line with the its developmental trend. Gia Lam is a land of rich culture, a cradle of many types of intangible cultural heritage that have been preserved and sustained for many centuries, such as the Giong Festival, which has been inscribed on the UNESCO list of intangible cultural heritage. Other examples of non-material culture are Nguyen Phi Y Lan Temple Festival, Nanh Pagoda Festival, and Chu Xa Village Festival. This district also has many traditional craft villages with folk knowledge passed from generation to generation, such as gold and silver inlaid techniques in Kieu Ky craft village, ceramic production in Bat Trang and Kim Lan, or traditional medicine and textiles in Ninh Hiep. In addition, there are 318 historical and cultural objects in the district, of which 169 have been ranked as national and city treasures, especially Phu Dong temple, which has been classified as a special national monument. Many historical buildings have become popular destinations for tourists, e.g. Ba Tam temple, Dai Bi pagoda, Linh Ung pagoda, Hiep Phu communal

house. Along the wealth of historical buildings, Gia Lam also owns many valuable antique works of art, particularly national treasures such as a pair of stone statues of lions, two ancient artifacts of the Mac Dynasty at the temple Ba Tam pagoda (Duong Xa commune), or Quan Am statue at Thanh An pagoda (Dao Xuyen village, Da Ton commune). With such rich heritage, Gia Lam is one of the top sites in Hanoi in terms of cultural and historical resources. These are favourable conditions for the development of tourism in the district.

11.4.2. Land use plan (physical plan, directions of development)

The land use in the district, as of the year 2021, is as follows: agricultural land covers 5,063 hectares (accounting for 43.39% of all land); non-agricultural land 6,537 ha (56.01%); unused land 69.62 ha (0.6%).

The non-agricultural land includes the land area for industrial zones (39.02 ha), an industrial cluster land (109.68 ha), commercial and service land (228.74 ha), and land for infrastructure development (1,935 ha).

Regarding the list of projects included in the Land Use Plan in 2021, Gia Lam district has 105 projects covering a total area of 893.03 hectares.

There are a number of notable projects in the Land Use Plan of 2020 transitioning to 2021, which will continue to acquire land for implementation: construction of the Huu Duong dike route from Doc Loi - Dang Xa in Le Chi commune, recovers 44.5 hectares; ground clearance for construction of the auction area for implementation of a new urban area, urban embellishment in Dinh Xuyen commune, recovers 13.8 ha; building the Vinpearl Golf Course, recovers 182.3 ha.

In 2021, Gia Lam district added 23 new projects, notably a residential land project, a counterpart to the Hanoi - Hung Yen road project with the recovery of 63 hectares; ground clearance for construction of technical infrastructure in Lam Giang Small and Medium Industrial Park, Kieu Ky Commune, recovered 23.67 ha.

11.4.3. Real estate market in urban land

Gia Lam’s real estate in recent years has been considered "well-timed" thanks to the convergence of many outstanding advantages in infrastructure planning, economic

and social development. This place is a fertile land, attracting a lot of attention from investors to exploit the potential of ecological real estate development.

Possessing the advantage of abundant land resource, methodical planning orientation, and strategic location at the eastern gateway of Hanoi, Gia Lam district is transforming day by day, taking on the appearance of a suitable location and modern urban area. The image of Gia Lam is foreseen to change even more profoundly owing to the general planning scheme of Hanoi Capital, where the East is envisaged to become a new administrative center in 2030 - 2050. In particular, Gia Lam is expected to be upgraded to a district in 2025. The real estate market in this area is increasingly exciting.

In fact, over the past year, the Gia Lam market has witnessed much prosperity in both the number and scale of projects. According to statistics, Hanoi city has implemented up to 414 projects in the area with a capital of nearly 1,700 billion VND. With the prospect of being turned into a new administrative center, Gia Lam is becoming a fertile land, attracting many real estate giants such as Vingroup, Eurowindow Holding, Masterise Homes, etc., who desire to invest in the development of megacities according to the ecological and smart model. In the future, this will be a promising area with a lot of potential for development and investment.

"Opening the way to increase prices" is an inevitable rule for the real estate market. With no exception, real estate in Gia Lam heated up as soon as Hanoi city announced the plan to construct 4 bridges crossing the Red River, thereby shortening the travel time and distance to the city centre (Vinh Tuy bridge in the second phase of construction, Tran Hung Dao Bridge, Ngoc Hoi Bridge, Me So Bridge).

Along with that, the planning of two key projects, Co Linh intersection and Metro line 8, also attracted the attention of the market. At the present time, a section of the route from the Cau Bay river connects to 40m Dong Du - Duong Xa road, an extension of Thanh Trung street past the side of Gia Lam General Hospital, helping to shorten the travel time for residents in Trau Quy town area. And yet, there are roads under construction which already give rise to predictions of real estate price increases in the future, such as the intersection of Ngo Xuan Quang to An Lac, or the road from National Highway 5 to Vinhomes Ocean Park. Gia Lam's real estate value is expected to increase parallel to the infrastructure development. According to the survey, house prices in the district have increased by an average of 10-15% compared to the end of 2019 and by about 30% in the areas where large projects are to be implemented. The most sought-after

areas lie near some main roads and near urban "super" projects in Da Ton, Dang Xa, Duong Xa and Trau Quy communes.

While transport infrastructure is a guiding factor for the economic growth of Gia Lam, the development of social amenities and landscaped environments has been creating new living values, attracting rational investors and directly affecting the trend of urban development. At a time when air pollution worsens and the capacity in the inner city is increasingly overloaded, Gia Lam is considered an ideal destination, having a "green shield" of the Red River. Moreover, this is also a liveable area with fresh climate, a good AQI index of 15 to 26, a large density of trees, yet located near the city centre and having convenient transportation links with the provinces Bac Ninh, Hung Yen , Hai Duong, and Hai Phong. Along with planning projects that are about to be implemented, such as the first Vinpearl Land amusement park in the North, the largest 210 ha public park (opposite Vinpearl Land) in Hanoi, the largest system of lakeside parks in Hanoi, a park system with an area of 29 ha (next to Gia Lam General Hospital), Giam Lam will be a desirable destination for many investors.

12. LAND VALUES ESTIMATED WITH THE USE OF DIFFERENT METHOD

12.1. Introduction

Real estate values estimated with the use of different method were analyzed in detail in the experimental part of the study. Several attempts were made to adapt these methods to different stages of real estate market evolution between 1990 and 2020. Detailed research objectives were formulated and a research hypothesis was postulated to achieve the main research aim.

The values of the same real estate estimated with the use of various methods that have been adapted to different stages of market evolution are similar with a tolerance margin of around ± 30%.

12.2. Research methods adapted for the needs of the study

The following analytical methods were applied to achieve detailed research objectives:

– inferential data analysis based on a review of the literature. The following studies on the evolution of real estate valuation methods in Poland were analyzed:

- real estate valuation methods: indicator method (*Hopfer, ed., 1990, Wycena nieruchomości. Przewodnik metodyczny. ART Olsztyn*);
- sales comparison approach (*Hopfer, Krawczyk, Źróbek and Źróbek, 1995, ZCO Zielona Góra; Tymczasowe Zasady Wyceny nieruchomości. Zeszyt 1. Zasady ogólne, 1994, Ministerstwo Gospodarki Przestrzennej i Budownictwa Warszawa*);
- pairwise comparison method (*Źróbek, ed., 2006, Metodyka określenia wartości rynkowej nieruchomości. Educaterra Olsztyn*);
- mean price adjustment method (*Źróbek ed. 2006, Metodyka określenia wartości rynkowej nieruchomości, Educaterra Olsztyn; Prystupa 2001, Wycena nieruchomości przy zastosowaniu podejścia porównawczego - omówienie standardu wraz z przykładami zadań. Polska Federacja Stowarzyszeń Rzeczoznawców Majątkowych, Warszawa*);

- statistical analysis of the real estate market with an adaptation of multiple regression analysis (*Źróbek, ed., 2006, Metodyka określenia wartości rynkowej nieruchomości. Educaterra Olsztyn*);
- stepwise and backward regression (*Kuryj, Kuryj–Wysocka, 2015, Metody doboru cech diagnostycznych przy wyznaczaniu pól cenności i modelowaniu wartości. Acta Scientiarum Polonarum. Administratio Locorum, No. 14 (4) pp. 49-64. Wydawnictwo UWM w Olsztynie, Olsztyn*).
- mass appraisal with a model for determining the cadastral value of real estate (*Adamczewski, Bojar, Telegra, 2002, Wytyczne przeprowadzenia powszechnej taksacji nieruchomości – projekt, Przegląd Geodezyjny No. 6. SIGMA. Warszawa; Kuryj, 2007b. Metodyka wyceny masowej nieruchomości na bazie aktualnych przepisów prawnych. Wycena. No. 4 (81). Educaterra Olsztyn*).

The above publications were selected for the study based on the opinions of experts dealing with the evolution of real estate valuation methods in Poland after 1990. The selected papers comprehensively describe different valuation methods and facilitate their application in detailed analyses. The following market analysis methods were used to achieve the research goal:

- simple linear regression analysis;
- correlation analysis;
- scatter analysis;
- descriptive statistics: measures of location and dispersion.

The choice of the most suitable statistical method is largely dependent on the type of the analyzed statistical data. Numerical data have to be analyzed statistically due to considerable variations in real estate market data. Distribution curves describing these variations differ in skewness, which affects the results of statistical analyses. These differences are characteristic of the real estate market, and they are frequently observed in detailed analyses. The choice of explanatory variables for the multiple regression model is an important consideration in statistical analyses. The explained variable is the transaction price of land. In some cases, the market value of real estate can be adopted as the explained variable. The transaction price of land is a specific variable because it applies to a specific moment in time in a process that transforms real estate value into the transaction price. The price can be set during a public auction or it can be negotiated by selected market participants. The final transaction price is also influenced by other

factors, such as the form of payment or other mutual settlements. In statistical analyses of the real estate market, experienced analysts can identify these factors and eliminate outliers. The selection of explanatory variables that influence the prices of urban land on a given real estate market is also an important consideration. Explanatory variables that are significantly correlated with the explained variable (price of land) are generally preferred. At the same time, pairs of explanatory variables should not be bound by significant correlations (Adamczewski 2006a, b; Luszniewicz and Słaby 2003; Hozer et al. 2002; Podgórski 1995). The presence of such correlations is usually verified with the use of a matrix of correlations between specific pairs of variables. This approach supports the elimination of explanatory variables that:

- are not significantly correlated with the explained variable,
- are significantly correlated with other explanatory variables.

As a result, a large number of explanatory variables can be eliminated, and only statistically significant variables are adopted for further analysis. When the final number of explanatory variables for the multiple regression model has been determined, statistical procedures are applied to estimate the model's structural and stochastic parameters. The model is also evaluated for consistency and predictive ability.

12.3. Research procedure

The following procedure was applied to achieve detailed objectives and the main research aim:

1. the real estate market was analyzed, and the accumulated data were evaluated:
   a. land transactions were accumulated, subjected to a preliminary analysis and divided into sets with similar attributes.
   b. land was described with the use of selected attributes (explanatory variables).
   c. land transactions were verified (explained variable) and atypical transactions (outliers) were eliminated.
   d. the price index was calculated, and land prices were converted to prices valid for the end of the 2020 calendar year.
   e. explanatory variables were transformed onto a uniform scale.
   f. market attributes were selected based on the results of the correlation analysis, and their potential effects on the value of land were determined.

2. the value of real estate was determined with the use of various approaches, and the significance of different valuation methods during the evolution of the real estate market was considered. Ultimately, the following methods were applied to determine the value of land (the original name of each method on the date it was proposed):

a. indicator method involving a legal valuation standard implemented before 1990;

b. sales comparison method;

c. pairwise comparison method;

d. mean price adjustment method;

e. multiple regression analysis (statistical analysis of the real estate market);

f. stepwise regression analysis (statistical analysis of the real estate market);

g. mass appraisal.

3. the values of the reference real estate were compared with their transaction prices, and the results were analyzed.

4. the values of the reference real estate were compared with their market value determined in the pairwise comparison approach.

5. the results were summarized and conclusions were formulated.

12.4. Market monitoring, description of the study area and the analyzed real estate

12.4.1. Study area – a test field covering the city of Olsztyn

Olsztyn, the capital city of Warmia and Mazury Voivodeship, is located in the Region of Warmia in north-eastern Poland. The city occupies an area of 8,800 ha, and it is divided into 140 cadastral units and 17 structural units, mostly in residential estate (Fig. 12.1) Olsztyn has a population of 171,000. The land-use structure within Olsztyn's administrative boundaries differs from land-use patterns that are typically encountered in similarly sized cities. Developed land accounts for 32.2% and land under roads and railways – for 9.6% of the city's area. Olsztyn abounds in lakes and rivers (9.9% of the city's area), forests (22.8%) and arable land (25.6%), and all three land-use categories account for more than 50% of the area within Olsztyn's administrative boundaries. Residential functions are predominant in the city. Industrial and storage facilities are located in the eastern part of the city (structural units V, XVI and XVII). Recreational areas are distributed in the proximity of lakes and the municipal forest (structural units IV, VI and XIV). Single-family homes dominate in the north-western, western and

southern parts of the city (structural units I, III, VII, IX, X and XV). The city center is characterized by dense development, with a predominance of apartment blocks and retail outlets. The test field was the residential district of Jaroty in south-eastern Olsztyn (structural unit XV).

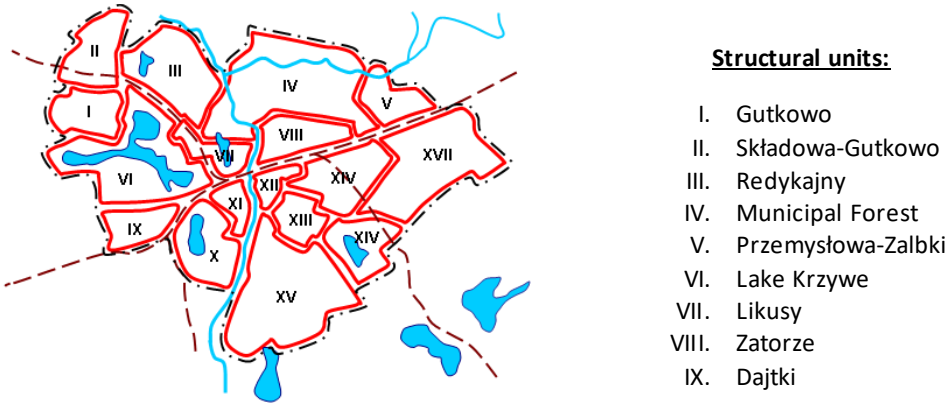


Fig. 12.1 Structural units in the city of Olsztyn.
Source: https://olsztyn.eu/gospodarka/planowanie-przestrzenne/plany-zagospodarowania-przestrzennego/mpzp-obowiazujace.html

The second test field comprised the villages of Bartąg and Bartążek in the municipality of Stawiguda. This test field is adjacent to structural unit XV, but it is located outside Olsztyn's administrative boundaries. Bartąg and Bartążek belong to the same urban planning district; they are functionally linked and connected by transport routes. The rate of urbanization and urbanization trends in Olsztyn influence urban planning solutions in Bartąg and Bartążek. Land-use types and planning decisions are coordinated by Olsztyn city and Stawiguda municipality. Arable land and forests occupy more than 30% of the area in the test field.

12.4.2. Analysis of the land market and description of the analyzed real estate

The prices of the analyzed real estate transactions were obtained from the Register of Real Estate Prices kept by the Municipal Center for Geodesic and Cartographic Documentation of the Olsztyn City Office (for real estate transactions conducted in Olsztyn) and the County Center for Geodetic and Cartographic Documentation of the Olsztyn County Office (for real estate transactions conducted in Bartąg and Bartążek).

The real estate transactions selected for the analysis were divided into two data sets. The first set comprised real estate in Bartąg and Bartążek in the suburban (transitional) zone that is directly adjacent to the administrative boundaries of Olsztyn.

The second set comprised real estate within the administrative boundaries of Olsztyn (Olsztyn's peripheral zone) directly adjacent to the test field in Bartąg and Bartążek. The analyzed test fields are separated by Olsztyn's administrative boundary. A total of 93 transactions involving undeveloped land zoned for residential construction (single-family homes and apartment buildings) and the accompanying facilities were analyzed. The analysis involved land transactions conducted in both test fields between November 2017 and June 2020, including 56 transactions in Olsztyn's peripheral zone (test field 1), and 37 transactions in Olsztyn's suburban zone in Bartąg (test field 2). The real estate transactions conducted in both test fields are characterized in Appendixes 1 and 2

Land transactions were described with the use of 12 diagnostic attributes (explanatory variables) selected based on a review of the literature and the results of a survey involving local real estate experts. The diagnostic attributes, the applied measurement methods and the scales for scoring each attribute are presented in Appendix 3. In research studies of the type, the analyzed data are generally scored with the use of the four fundamental measurement scales proposed by Stevens: nominal, ordinal, interval and ratio scales (Kuryj 2007a; Wasiak 1996):

1. *the nominal scale* is the simplest of the four measurement scales, and it is used only to determine whether the analyzed variables are identical or different. The attributes are ordered based on qualitative evaluations of the analyzed phenomena. The only mathematical operations that can be performed on nominal data are = and $\neq$. Data are not quantified, and they are only labeled for the purpose of classification. Only the relative frequency, absolute frequency and dominant variables are determined in each class of data.

2. *the ordinal scale* is a more complex measurement scale. The following mathematical operations can be performed on ordinal data: $=$, $\neq$, $<$, $>$. Attributes are measured similarly to the nominal scale, but they are also sorted based on their characteristic features of, for example "higher – lower", "larger – smaller". The rank order scale is a variation of the ordinal scale which is used to measure preferences. Attributes are ranked on a scale, for example 1 to 10. In addition to data frequency, dominant values, median values, quartiles and rank correlation coefficients are also determined.

3. *the interval scale* assigns real numbers to attributes, and the differences between real numbers on a scale (intervals) are used to arrange variables in an order. The following mathematical operations can be performed on interval data: $=$, $\neq$, $<$, $>$,

- , +. The zero point and units of measurement on an interval scale are assigned arbitrarily. The interval scale is widely applied in descriptive and inferential statistics.

4. *the ratio scale* is the highest of the four hierarchical levels of measurement. It features an a true zero and natural units of measurement. The following mathematical operations can be performed: =, ≠, <, >, -, +, ×, ÷. The results of the measurements performed on a ratio scale can be analyzed with the use of descriptive and inferential statistical methods. Nominal and ordinal scales are classified as weak measurement scales, whereas interval and ratio scales are regarded as strong scales. Nearly all attributes can be measured with the use of different scales. It is generally assumed that variables measured on weak scales are qualitative attributes, including nominal and ordinal attributes. Variables measured on strong scales are quantitative attributes, including discrete and continuous attributes. The analyzed attributes were measured on the appropriate scale, and the values measured on each scale were transformed onto a uniform scale with the use of the method described in subsection Verification of transactions and elimination of atypical transactions

The Register of Real Estate Prices contains information about the prices of real estate transactions that were concluded on a given real estate market on a given date and were evidenced in notarial deeds. Due to the complex nature of the phenomena on the real estate market, transaction prices can be burned by measurement error, which is why these data need to be carefully selected for analytical purposes. According to Kramer (Kramer 1994), transactions are selected to verify whether the applied theoretical formula effectively describes the analyzed market under specific economic conditions, and to ensure greater objectivity during the initial selection of observations. In the applied procedure, observations are selected from the data set and atypical observations (outliers) are eliminated. For the needs of this study, atypical transactions were defined as observations where the frequency and probability of a given transaction price in the data set was low, and where the distribution of a given diagnostic attribute differed considerably from the remaining transactions.

The following criteria were used to compare observations and eliminate atypical transactions: price per 1 m^2 of urban land, distance from the city center and public utilities, distance from recreational sites, and total land area. The distribution of prices per 1 m^2 of urban land (dependent variable) was analyzed (Fig. 12.2); measures of location of diagnostic attributes and transaction prices were determined for each of the two data sets

(Appendixes 4 and 5); and the probability of a given transaction within the adopted range of values of selected variables, i.e. price per 1 m^2 of urban land, land area, and distance from the city center, was evaluated. The results are presented in Appendixes 6 and 7.

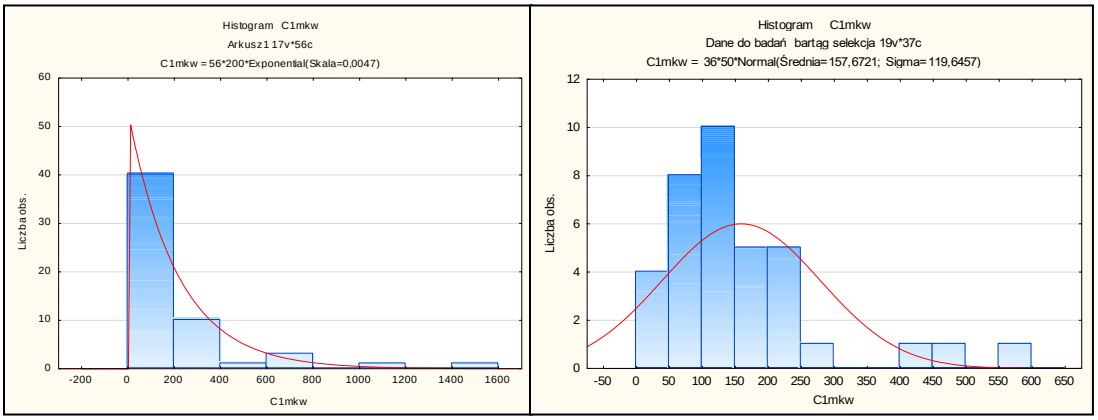


Fig. 12.2. The distribution of prices per 1 m^2 of urban land (dependent variable) for Bartąg and Bartążek test field (right) and Olsztyn test field (left).

Source: own elaboration.

12.4.3. Determination of the price index and calculation of time-adjusted prices

Real estate prices change over time. These changes have to be taken into consideration and their characteristics have to be determined in market analyses (Cellmer 1999). Two methods are generally used to determine changes in real estate prices:

- pairwise (group) comparison,
- simple linear regression analysis.

A pairwise comparison relies on the assumption that if similar properties were sold within a given time interval, the observed changes in price were caused by the lapse of time. In this study, the adopted similarity criterion was the value of the main diagnostic attributes, excluding transaction date. In an ideal scenario, the comparison would be based on the prices of repeated transactions involving the same property (Źróbek ed. 2020).

The magnitude and direction of changes in transaction properties per unit of time are determined by comparing transaction prices and calculating the price index with the use of the following equation:

$$\mathbf{r} = \frac{\mathbf{C_m - C_s}}{\mathbf{C_s \cdot \Delta t}} \cdot \mathbf{100} \qquad (12.1)$$

where:

C_m and C_s – price per 1 m^2 of similar real estate,

Δt – time between the compared transactions.

In turn, **simple linear regression analysis** relies on the assumption that differences in the prices of the compared properties resulted only from the lapse of time. This approach requires a large set of transactions involving similar objects. The linear regression model is developed by fitting a linear equation to the set of points that correspond to the values of both variables. The parameters of the linear regression model are determined by the least squares method. In a classical regression model, the linear equation for calculating the price index has the following form:

$$\mathbf{P_{1m^2} = C_0 + \alpha \cdot x + \varepsilon} \quad \Rightarrow \quad \mathbf{r = \frac{\alpha}{C_0} \cdot 100} \tag{12.2}$$

where:

$P_{1m}{}^2$ – unit price per 1 m^2 of land area;

R – price index, i.e. percent change in price within a given time interval [one month];

x – date of transaction expressed on the interval scale (date code);

C_o and α – diagnostic attributes (constant terms) determined based on the general population;

ε – random variable.

The linear equation was fitted to the distribution of unit prices on different transaction dates, and constant terms were selected for the linear regression model (Fig. 12.3). The transaction date was described by a code corresponding to the number of months since the oldest transaction for which code value was set at 1. Code value increased by the +1 interval in each successive month. The following linear regression equations were derived for undeveloped land in each data set:

- for test field 1: Bartąg Bartążek: $C = 135.3323 + 4.3941 * x + \varepsilon$;
- for test field 2: Olsztyn's peripheral zone: $C = 145.0459 + 3.9410 * x + \varepsilon$;

where: x – transaction date (code).

Equation 12.2 was used to calculate the price index (%) which was expressed on a monthly basis:

- for Bartąg and Bartążek: r = 100 * 4.3941/135.3323 = 3.25%/month;
- for Olsztyn: r = 100 * 3.9410/145.0459 = 2.72%/month.

Transaction prices were adjusted to the date of the analysis with the use of a price index of 3.25%/month for the suburban zone of Bartąg and Bartążek and 2.75%/month for Olsztyn's peripheral zone.

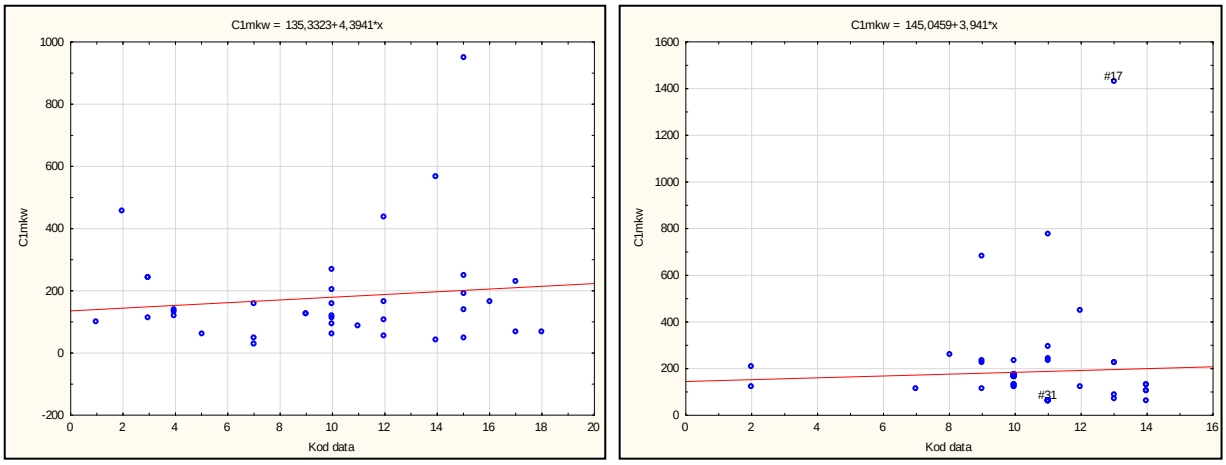


Fig. 12.3 Calculation of the price index (percent change in price within a given time interval) for Bartąg and Bartążek test field (left) and Olsztyn test field (right).

Source: own elaboration.

Transaction prices were adjusted to the date of the analysis with the use of the following equation:

$$\mathbf{P_{(sk)} = P_{1m}^2 * [1+ r * (t_o - t_i)]} \quad (12.3)$$

where:

$P_{(sk)}$ – unit price in PLN/m^2 adjusted for the date of the analysis;

P_{1m}^2 – unit price in PLN/m^2 on the date of the real estate transaction;

r – price index in %/month;

t_o – date code for adjusting unit prices of real estate;

t_i – date code on the date of the real estate transaction.

The time-adjusted prices of real estate from both data sets are presented in Appendixes 1 and 2.

12.4.4. Transformation of attributes onto a uniform measurement scale

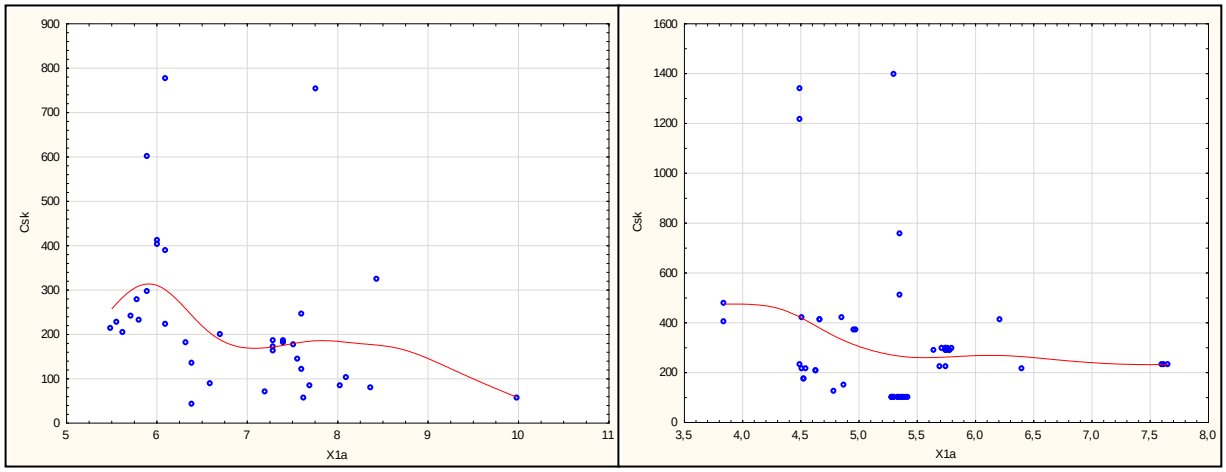
Data do not have to be transformed if the diagnostic attributes in the analyzed data sets were measured on a single scale. However, if the data set contains attributes (variables) that were measured on different scales, the attributes have to be transformed (Walesiak 1996). In this case, the attributes have to be transformed onto a common scale. In line with the main principle of measurement theory, the attributes describing all observations have to be coded on the weakest scale. The diagnostic attributes describing

real estate transactions in Bartąg – Bartążek test field and in Olsztyn test field were measured on the ratio scale and on the ordinal scale. Therefore, data were transformed from the stronger scale (ratio scale) onto a weaker scale (ordinal scale). Data can be transformed with the use of two methods:

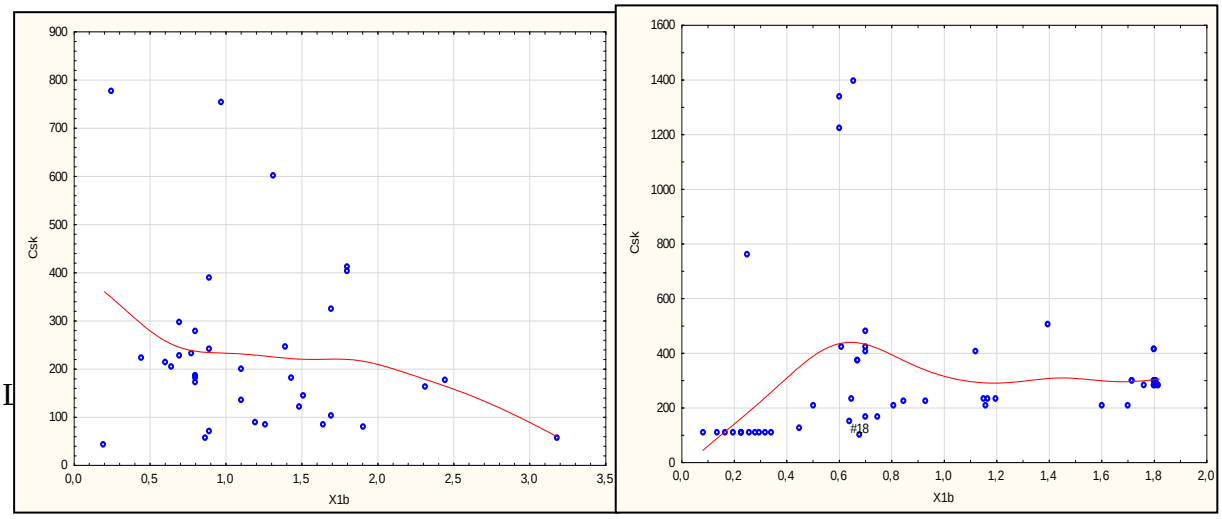
- data are divided into separate intervals, and ordered categories are assigned to different intervals;
- the line simulating the distribution of prices relative to a given attribute is smoothed with the distance-weighted least squares method, where the analyzed attribute's influence on the price is considered.

The second method was used in this study. Curve fitting by the distance-weighted last squares method is presented in scatter plots in Fig. 12.4.

Distance from the city center – X_{1a}



Distance from retail and service outlets – X_{1b}



Land area – X_8

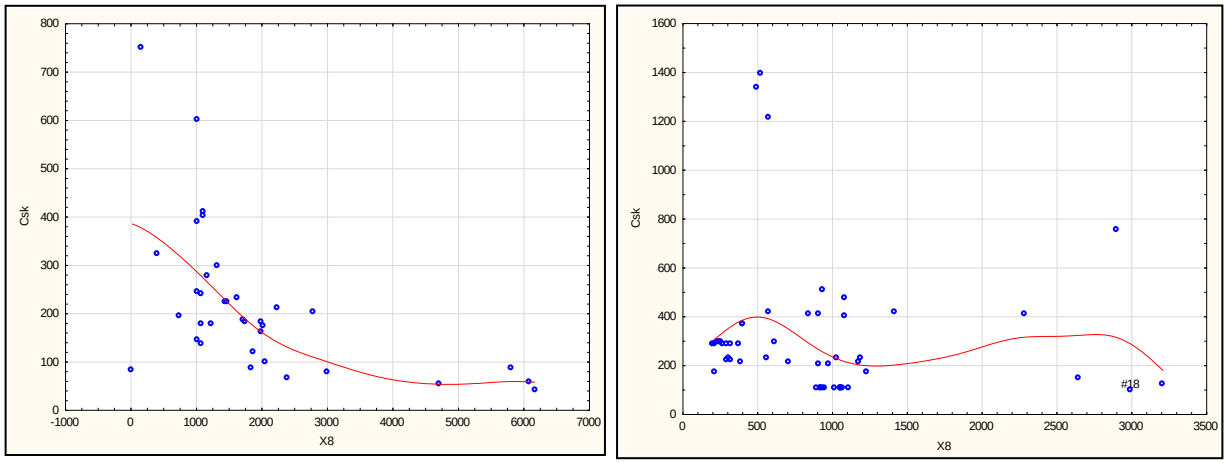


Fig. 12.4 Smoothing of the line simulating the distribution of prices relative to attributes X_{1a}, X_{1b} and X_8 by the distance-weighted least squares method. The data set for Bartąg and Bartążek is presented on the left, and the data set for Olsztyn is presented on the right.

Source: own elaboration.

The intervals for transforming measurements from the ratio scale onto the ordinal scale are presented in Appendix 3. The transactions involving similar real estate that were used in further analysis and were valued with the sales comparison method and the pairwise comparison method are presented in Appendix 8. The transformation of measurements from the ratio scale onto the ordinal scale is presented in Appendix 9.

The complexity of the analyzed phenomenon is influenced by numerous factors that explain that phenomenon. These factors can be bound by a direct (variables can be observed or measured) or an indirect (variables cannot be observed) relationship, but their influence can only be inferred. Indirect factors often disrupt the analyzed phenomenon and contribute to errors in its description (Kuryj 2007a). In natural, economic and technical sciences (Kowal 1998; Walesiak 1996) and in research on real estate valuation, statistical methods play an important role in explaining the complexity of phenomena that are described by a large number of attributes (Czaja and Parzych 2015; Cellmer 2014; Bitner 2010; Kuryj 2007a; Adamczewski 2006a). In this study, the correlation analysis method proposed by Czaja and and Parzych (2015). Kuryj and Kuryj-Wysocka (2015) was used to select market attributes and determine their influence on the value of real estate. According to the cited authors, the proposed method can be applied to determine statistical relationships between explanatory variables (attributes) and the explained variable (transaction price). The strength of these relationships is measured with

Pearson's linear correlation coefficient (*r*) which is calculated with the use of the following algorithm:

$$\boldsymbol{r} = \frac{\boldsymbol{cov(X,Y)}}{\boldsymbol{S_X \cdot S_Y}} = \frac{N\sum_{i=1}^{N} x_i y_i - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{\sqrt{\left[N\sum_{i=1}^{N} y_i^2 - \left(\sum_{i=1}^{N} y_i\right)^2\right] \cdot \left[N\sum_{i=1}^{N} x_i^2 - \left(\sum_{i=1}^{N} x_i\right)^2\right]}} \quad (12.4)$$

where:

cov (X, Y) – covariance of variables X and Y;

S_X and S_Y – standard deviations of variables X and Y, respectively;

x_i, y_i – value of the i^{th} observation of variables X and Y, respectively;

N – sample size.

The value of the correlation coefficient ranges from –1 to 1. The sign of the correlation coefficient indicates the direction of the relationship, and its absolute value denotes the strength of the relationship between two variables. According to Czaja and Parzych (2015), the strength of correlations can be described at four levels in the process of determining real estate value and developing mass appraisal models:

$|r| \leq 0.3$ - weak correlation,

$0.3 < |r| \leq 0.6$ - moderate correlation,

$0.6 < |r| \leq 0.9$ - strong correlation,

$0.9 < |r|$ - very strong correlation.

In a study by Kuryj and Kuryj-Wysocka (2015), the scale proposed by Czaja and Parzych (2015) was modified and adapted to the analyzed real estate market. The values of Pearson's *r* denoting intervals on the scale were modified as follows:

$|r| \leq 0.2$ - weak correlation; attributes are not significant,

$0.2 < |r| \leq 0.5$ - moderate correlation; attributes can be regarded as significant,

$0.5 < |r| \leq 0.8$ - strong correlation; attributes are significant and influence prices,

$0.8 < |r|$ - very strong correlation; attributes are highly significant.

Significant (market) attributes that affect real estate value were presented in a correlation matrix. The correlations between real estate attributes and transaction prices were analyzed based on the values of Pearson's *r*, where the explanatory variables were not correlated or were bound by weak correlations. Correlation coefficients were calculated in the Statistica (StatSoft) program. The strength of the relationships between attributes and time-adjusted transaction prices and the strength of the relationships

between attributes is presented in the correlation matrix (Table 12.1 for Bartąg and Bartążek; Table 12.2 for Olsztyn).

Tablem12.1 Correlation analysis and the influence of attributes on time-adjusted prices in the suburban zone of Bartąg and Bartążek

N=27 (correlation coefficients are significant at p < 0.05)								**Time-adjusted price**	
Variable	**X1a**	**X_6**	**X_8**	**X_{10}**	**P_{sk}**	**| r |**	**Weight [%]**	**Total** [PLN/m^2]	**per 1 unit on the scale** [PLN/m^2]
X_{1a}	1.0000	0.4447	0.2500	0.4904	0.5440	0.5440	30.00	97.22	97.22
X_6	0.4447	1.0000	0.3264	0.2286	0.4305	0.4305	25.00	81.02	27.00
X_8	0.2500	0.3264	1.0000	0.1260	0.5418	0.5418	30.00	97.22	32.41
X_{10}	0.4904	0.2286	0.1260	1.0000	0.2749	0.2749	15.00	48.61	16.20
P_{sk}	0.5440	0.4305	0.5418	0.2749	1.0000	1.7912	100.00	324.07	

Source: own elaboration

Table 12.2 Correlation analysis and the influence of attributes on time-adjusted prices in the peripheral zone of Olsztyn city

N=49 (correlation coefficients are significant at p < 0.05)								Time-adjusted price	
Variable	Total [PLN/m^2]	Total [PLN/m^2]	X_8	X_{10}	P_{sk}	| r |	Weight [%]	Total [PLN/m^2]	per 1 unit on the scale [PLN/m^2]
X_{1a}	1.0000	0.0275	-0.2979	0.0932	0.2999	0.2999	20.00	75.16	25.05
X_2	0.0275	1.0000	0.4348	0.1121	0.5169	0.5169	36.00	135.28	45.09
X_8	-0.2979	0.4348	1.0000	0.4268	0.3392	0.3392	23.00	86.43	43.22
X_{10}	0.0932	0.1121	0.4268	1.0000	0.3109	0.3109	21.00	78.92	78.92
P_{sk}	0.2999	0.5169	0.3392	0.3109	1.0000	1.47	100.00	375.79	-

Source: own elaboration

An analysis of the correlation matrix shows that in the data set for Bartąg and Bartążek, time-adjusted transaction prices were bound by strong and moderate correlations with the following attributes: distance from the city center (X_{1a}), land-use type and soil class (X_6), land area (X_8), neighborhood nuisances (X_{10}). In the data set for

Olsztyn, strong and moderate correlations were noted between time-adjusted transaction prices and the following attributes: distance from the city center (X_{1a}), zoning designation (X_2), land area (X_8), neighbourhood nuisances (X_{10}).

The analysis of variance revealed a close correlation between Pearson's *r* and the reliability of the predicted values of the dependent variable (transaction price). Therefore, the absolute value of the correlation coefficient can be used as a measure of predictive accuracy and, consequently, the percent influence of a given attribute on real estate prices (Kuryj and Kuryj-Wysocka 2015). The following algorithm was used to determine an attribute's influence on real estate prices:

$$\mathbf{weight_i} = \frac{|\mathbf{r_i}|}{\sum_{\mathbf{j=1}}^{\mathbf{n}} |\mathbf{r_j}|} \cdot \mathbf{100} \tag{12.5}$$

where:

$weight_i$ - an attribute's influence on real estate value,

$|r_i|$ - absolute value of the correlation coefficient

J - number of selected diagnostic attributes.

The percent influence of a given attribute on real estate values is presented in Tables 12.1 and 12.2. Time-adjusted prices for real estate valuation by the pairwise comparison method (comparative approach) are included in the above tables. The following unit prices were determined for this purpose: minimum, maximum, mean and the difference between the maximum and the minimum price. In the set of transactions involving similar real estate in the suburban zone of Bartąg and Bartążek, the analyzed parameters were determined at: P_{mean}=214.32 PLN/m^2 ; P_{min}=85.34 PLN/m^2; P_{max}=409.41 PLN/m^2; ΔC=324.07 PLN/m^2.

In the set of transactions involving similar real estate in the peripheral zone of Olsztyn city, the analyzed parameters were determined at: P_{mean}=231.69 PLN/m^2; P_{min}=100.78 PLN/m^2; P_{max}=476.57 PLN/m^2; ΔC=375.79 PLN/m^2.

12.5. Determination of real estate value with the use of various valuation methods

The value of real estate is determined in the property valuation process, and the relevant procedures are referred to collectively as real estate appraisal (Źróbek et al. 2012, Źróbek 2009). These types of values are also used in other European Union countries and in other countries of the world (International Valuation Standards, 2011, 2017; European

RICS 2010, 2017; Valuation Standards 2009; Adair 2005; Pagourtzi 2004; Waters and Wooton 1997; Finch and Casavant 1996). The real estate valuation process can be divided into the following stages (Źróbek et al. 2012):

- identification of the appraised property;
- acquisition of data that are necessary for property appraisal, and the identification of data sources;
- analysis of the acquired data and application of the selected valuation method;
- analysis and interpretation of the results;
- adjustment of the results of detailed analyses, if necessary;
- determination of real estate value, including the rationale behind the selected valuation method.

In the Polish legal system, the optimal valuation approach, method and technique are selected by property valuers. The purpose of property appraisal, the type and location of real estate, the permitted use of property in the local zoning plan, the availability of technical infrastructure, maintenance standards, and the availability of real estate prices are taken into consideration in the valuation process (Dydenko 2020; Źróbek et al. 2012). In this study, the market value of land was determined with the use of various methods that had been applied in different stages of real estate market evolution when Poland was transitioning from a centrally planned (socialist) economy to a market economy. The valuation methods and algorithms applied during that period were considered in the analysis.

12.5.1. Real estate valuation by the indicator method with the standard valuation rate

The principal rate for 1 m^2 of land was calculated by multiplying the standard valuation rate expressed in decitons (dt) of rye per 1 ha of land (S_{VR}) and the price of 1 dt of rye (P) with the use of the following formula:

$$\mathbf{Po} = \mathbf{Svr} \cdot \frac{\mathbf{P}}{\mathbf{10000m^2}} \tag{12.6}$$

where:

P_O – principal land rate,

S_{VR} – standard valuation rate expressed in decitons (q) of rye per 1 ha of land,

P – price of 1 dt (q) of rye (this parameter was also used to calculate land tax).

According to the methodological guidelines developed by Hopfer et al. (1990), two variants of the standard valuation rate (S_{VR}) could be applied to urban land:

Variant I: S_{VR} = 145 q of rye, i.e. 0.0145 q/m^2 ,

Variant II: S_{VR} = 75 q of rye, i.e. 0.0075 q/m^2 .

In justified cases, the standard valuation rate could be increased even five-fold, **and this approach was used in the present study**.

The price (P) of 1 dt of rye was based on the average market price or the price used to calculate land tax. In 2021, the average market price calculated based on the prices quoted in 11 preceding quarters was **PLN 58.55 per 1 dt (q) of rye**. Land tax amounted to **PLN 292.75/ha for non-agricultural land and PLN 146.38/ha for agricultural land** (per 1 standard hectare). The average prices of rye in the last five years are presented in Table 12.3.

Table 12.3 Average prices of rye in the last 11 quarters (2015-2020)

Year	**Agricultural tax**		
	Average price of 1 dt of rye in the previous 11 quarters (used in calculations of agricultural tax)	Per 1 ha of agricultural land (equivalent to 2.5 q of rye)	Per 1 ha of non-agricultural land (equivalent to 5 q of rye)
2015	PLN 61.37	PLN 153.43	PLN 306.85
2016	PLN 53.75	PLN 134.80	PLN 268.75
2017	PLN 52.44	PLN 131.10	PLN 262.20
2018	PLN 52.49	PLN 131.23	PLN 262.45
2019	PLN 54.36	PLN 135.90	PLN 271.80
2020	PLN 58.46	PLN 146.15	PLN 292.30

Source: https://stat.gov.pl

The value of developed land or land zoned for development was determined with the use of the indicator method to evaluate the economic efficiency of various land-use types in the local zoning plan. In urban areas, the following parameters were considered in the valuation process: city area, population, and distance from the city center. Other determinants of property value were also analyzed in large urban agglomerations. The principal land rate was adjusted to account for the above parameters, and the initial value of property (Vw) was calculated with the following formula:

$$\mathbf{Vw = Vo * u * s} \qquad (12.7)$$

where:

V_O – principal land rate (in q of rye/ha) multiplied by the area of the appraised land plot,

u – adjustment coefficient based on city area,

s – adjustment coefficient based on the distance between the appraised property and the city center or the center of an urban agglomeration.

In view of the coefficients proposed by the *Real Estate Valuation* methodological guidelines (*1990*), the following adjustment coefficients based on city area (*u*) and property location (*s*) were adopted in the process of appraising of the analyzed property:

– the adjustment coefficient based on city area was set at ***u* = 3.0** for both data sets. In cities with a population of 100,000 to 500,000, coefficient *u* generally adopts the following range of values: *u* = <2.5; 3>;

– the adjustment coefficient based on property location (*s*) was set at:

- ***s* = 1.2** for real estate in the peripheral zone,
- ***s* = 1.0** for real estate in the suburban zone.

The value of the adjustment coefficient based on property location ranged from s=1.0 to s=1.2 in the analyzed site.

Initial property values (Vw) calculated with the use of above method are presented in Appendix 10 for Bartąg and Bartążek and in Appendix 11 for Olsztyn.

In the next step, the following formula was applied to adjust initial property values with the use of detailed coefficients:

$$\mathbf{V} = \mathbf{Vw} * (\mathbf{1} + \sum \mathbf{ki}) \pm \mathbf{E} \qquad (12.8)$$

Detailed coefficients for adjusting initial property value (*ki*) were calculated according to *Real Estate Valuation* methodological guidelines (*1990*):

k_1 – coefficient based on the availability of public infrastructure:

- paved road – maximum 30%,
- power, water and gas supply grids, telecommunications and cable TV networks – 10% is added per each network,
- sewerage and central heating networks: 30% is added per each network;

k_2 – coefficient based on the quality class of agricultural land:

- class I – 40%;
- class II – 30%;
- class IIIa – 25%;
- class IIIb – 20%;
- class IVa – 15%;

- class IVb – 10%.

k_3 – coefficient based on the existing land-use type:

- arable land – 30%;
- meadows and pastures – 10%.

k_4 – coefficient based on a plot's suitability for development:

- highly suitable – 30%;
- suitable – 10-20%;
- moderately suitable – 0%;
- unsuitable – from -10% to -20%.

k_5 – coefficient based on distance from public facilities:

- proximity to transport routes – up to 30%;
- proximity to commercial outlets, cultural facilities and public administration buildings – up to 20%;

k_6 – coefficient based on natural features, social factors and neighborhood:

- natural features and location – 30%;
- social factors – up to 30%;
- neighborhood – up to 20%.

The expert coefficient which can increase initial property value by up to 40% was applied between 1990 and 1995. This parameter was adopted to adjust the initial values of land in both data sets. A conversion factor of 1.4 V was applied to increase the initial value of real estate by 40%. The results for both data sets are presented in Appendixes 10 and 11.

12.5.2. Real estate valuation by the sales comparison method

The value of real estate was determined with the use of the sales comparison method based on the guidelines of the Ministry of Spatial Planning and Construction (*Provisional guidelines for real estate valuation. Volume I. General principles; TZWN 1994*). In this approach, real estate is appraised based on the transaction prices of similar properties. The prices of comparable properties should be minimally adjusted to account for the differences between the analyzed real estate and similar properties.

The sales comparison approach relies on the following procedure (TZWN 1994):

1. a list of the required data is complied, and sources of data are identified;
2. the required data are gathered, registered and verified;

3. differences are adjusted;
4. the value of real estate is determined with the use of the sales comparison method.

In the literature (Kłopociński 1995, TZWN 1994), the following attributes have been recommended for appraising land with the use of the sales comparison method: location, neighbourhood, natural features, type and method of land development, type and size of buildings, and availability of technical infrastructure. In this study, the attributes suggested in the literature were applied to determine the value of real estate with the use of the sales comparison method and to describe the traded properties as well as randomly selected test properties. The attributes for the sales comparison method were described with the use of variables X_{1a}, X_{1c}, X_7, X_2, X_4, X_8 and X_3. Two data sets were used to analyze the market and estimate the market value of test properties with the use of the sales comparison method: real estate in the Bartąg - Bartążek suburban zone and real estate in Olsztyn's peripheral zone. Outlying transactions had been eliminated previously in the market analysis. The analyzed data sets are presented in Appendixes 8 and 9. Test properties were selected randomly. The weights and quantitative adjustments for the adopted attributes (X_{1a}, X_{1c}, X_2, X_3, X_4, X_7, X_8) were calculated with the use of correlation analysis and the procedure described. The calculations were performed in the Statistica program (StatSoft). The results are presented in Tables 12.4 and 12.5 for the Bartąg-Bartążek suburban zone, and in Tables 12.6 and 12.7 for Olsztyn's peripheral zone.

Table 12.4 The influence of the adopted attributes on the value of real estate in the Bartąg-Bartążek suburban zone

Correlations (Bartąg, Bartążek)

N=31 (the correlation coefficient is significant at $p < 0.05000$)

Attribute	**X_{1a}**	**X_{1c}**	**X_2**	**X_3**	**X_4**	**X_7**	**X_8**	**P_{adj}**
X_{1a}	1.00	0.79	-0.02	0.26	0.25	0.59	0.25	0.54
X_{1c}	0.79	1.00	0.01	0.47	0.30	0.47	0.26	0.45
X_2	-0.02	0.01	1.00	0.15	0.36	0.12	0.29	0.10
X_3	0.26	0.47	0.15	1.00	0.37	0.05	0.02	0.21
X_4	0.25	0.30	0.36	0.37	1.00	0.11	0.12	0.31
X_7	0.59	0.47	0.12	0.05	0.11	1.00	0.29	0.44
X_8	0.25	0.26	0.29	0.02	0.12	0.29	1.00	0.39
P_{adj}	0.54	0.45	0.10	0.21	0.31	0.44	0.39	1.00

Source: own elaboration

Table 12.5 Quantitative adjustments for the Bartąg-Bartążek suburban zone

Attribute	| r |	Weight [%]	Quantitative adjustments	
			Total [PLN/m^2]	Per unit of measurement [PLN/m^2]
X_{1a}	0.540	22	71.30	71.30
X_{1c}	0.448	18	58.33	58.33
X_2	0.103	4	12.96	4.32
X_3	0.210	9	29.17	9.72
Attribute	**| r |**	**Weight [%]**	**Quantitative adjustments**	
			Total [PLN/m^2]	**Per unit of measurement** [PLN/m^2]
X_4	0.312	13	42.13	21.06
X_7	0.441	18	58.33	19.44
X_8	0.390	16	51.85	17.28
	2.444	100.00	324.07	

Source: own elaboration

Table 12.6 The influence of the adopted attributes on the value of real estate in Olsztyn's peripheral zone - Correlations (Olsztyn city)

N=50 (the correlation coefficient is significant at p < 0.05000)

Attribute	X_{1a}	X_{1c}	X_2	X_3	X_4	X_7	X_8	P_{adj}
X_{1a}	1	0.54	0.03	-0.28	0.30	-0.48	-0.29	0.26
X_{1c}	0.54	1	-0.29	0.04	-0.03	0.23	-0.69	-0.13
X_2	0.03	-0.29	1	-0.17	0.06	-0.20	0.44	0.46
X_3	-0.28	0.04	-0.17	1	-0.08	0.47	-0.31	-0.18
X_4	0.30	-0.03	0.06	-0.08	1	-0.31	0.24	0.24
X_7	-0.48	0.23	-0.20	0.47	-0.31	1	-0.26	-0.51
X_8	-0.29	-0.69	0.44	-0.31	0.24	-0.26	1	0.29
P_{adj}	0.26	-0.13	0.46	-0.18	0.24	-0.51	0.29	1

Source: own elaboration

Table 12.7 Quantitative adjustments for Olsztyn's peripheral zone

Attribute	| r |	Weight [%]	Quantitative adjustments	
			Total [PLN/m^2]	Per unit of measurement [PLN/m^2]
X_{1a}	0.26	12	45.09	15.03
X_{1c}	0.13	6	22.55	7.52
X_2	0.46	22	82.67	27.56
X_3	0.18	9	33.82	11.27
X_4	0.24	12	41.34	15.03
X_7	0.51	25	93.95	46.97
X_8	0.29	14	52.61	26.31
	2.06	100	375.79	

Source: own elaboration

The MV of each test property was determined based on three measures of location:

– **arithmetic mean** of the adjusted unit prices of the compared properties, calculated with the use of the below formula:

$$\mathbf{Vmean} = \frac{\mathbf{P_1 + P_2 + \ldots + P_n}}{\mathbf{n}} \tag{12.9}$$

– **weighted average 1** of the adjusted unit prices of the compared properties. In this case, the weights were calculated as the multiplicative inverse of the number of adjustments for the compared properties:

$$\mathbf{Vmean(v1)} = \frac{\mathbf{P_1 \cdot {}^{1}/_{lw1} + P_2 \cdot {}^{1}/_{lw2} + \cdots + P_n \cdot {}^{1}/_{lwn}}}{\mathbf{{}^{1}/_{lw1} + {}^{1}/_{lw2} + \cdots + {}^{1}/_{lwn}}} \tag{12.10}$$

– **weighted average 2** of the adjusted unit prices of the compared properties. In this case, the weights were calculated as the additive inverse of the value of adjustments for the compared properties:

$$\mathbf{Vmean(v2)} = \frac{\mathbf{P_1 \cdot {}^{1}/_{\sum w1} + P_2 \cdot {}^{1}/_{\sum w2} + \cdots + P_n \cdot {}^{1}/_{\sum wn}}}{\mathbf{{}^{1}/_{\sum w1} + {}^{1}/_{\sum w2} + \cdots + {}^{1}/_{\sum wn}}} \tag{12.11}$$

The values of the appraised properties are presented in Tables 12.8 and 12.9, respectively.

Table 12.8. Estimated values of test properties in the suburban zone

Zone 1: Bartąg and Bartążek						Arithmetic mean		Weighted average 1		Weighted average 2	
No.	Cadastral (tax) district	Plot No.	Area [m^2]	P_{adj} [PLN/m^2]	P_{adj} [PLN]	Vmean [PLN/m^2]	V [PLN]	Vmean [PLN/m^2]	Vmean [PLN/m^2]	V [PLN]	Vmean [PLN/m^2]
29	Bartąg	205/19	2070	101.46	210022	72.55	150179	70.88	146722	71.36	147715
23	Bartąg	362/47	1073	135.47	145359	164.92	176959	171.89	184438	169.58	181959
13	Bartąg	135/19	1014	143.81	145823	178.95	181455	175.62	178079	179.89	182408
37	Bartążek	30/18	2021	172.71	349047	198.44	401047	198.44	401047	198.44	401047
5	Bartążek	362/82	1228	178.80	219566	251.04	308277	248.76	305477	228.04	280033
35	Bartążek	30/19	2000	183.16	366320	192.96	385920	187.9	375800	175.6	351200
4	Bartąg	333/33	2789	204.34	569904	260.07	725335	260.07	725335	251.46	701322
31	Bartążek	291/21	1473	223.76	329598	237.66	350073	233.65	344166	230.79	339954
17	Bartąg	329/25	1622	230.77	374309	212.22	344221	204.03	330937	230.58	374001
3	Bartąg	706	1170	277.29	324429	192.24	224921	198.92	232736	217.65	254651
Average				185.16		196.11		195.02		195.34	

Source: own elaboration

Table 12.9 Estimated values of test properties in the peripheral zone

Zone 2: Olsztyn city						Arithmetic mean		Weighted average 1		Weighted average 2	
No.	Cadastral (tax) district	Plot No.	Area [m^2]	P_{adj} [PLN/m^2]	P_{adj} [PLN]	V_{mean} [PLN/m^2]	V [PLN]	V_{mean} [PLN/m^2]	V_{mean} [PLN]	V_{mean} [PLN/m^2]	V_{mean} [PLN]
30	Olsztyn 160	39/32	902	103.32	93195	139.81	126109	139.81	126109	131.95	119019
36	Olsztyn 160	39/38	1050	103.32	108486	134.8	141540	126.93	133277	106.80	112140
8	Olsztyn 118	38/51	2642	146.24	386366	145.43	384226	127.5	336855	153.68	406023
3	Olsztyn 118	34/55	218	169.28	36903	235.86	51417	225.02	49054	215.02	46874
1	Olsztyn 118	34/42	909	207.55	188663	257.59	234149	251.6	228704	220.93	200825
10	Olsztyn 118	38/64	1173	210.29	246670	144.66	169686	136.79	160455	137.85	161698
44	Olsztyn 161	59/6	294	220.85	64930	243.26	71518	234.22	68861	222.61	65447
49	Olsztyn 161	60/9	274	284.29	77895	288.99	79183	288.99	79183	288.99	79183
56	Olsztyn 161	60/16	376	284.29	106893	246.40	92646	246.40	92646	246.40	92646
51	Olsztyn 161	60/11	242	298.38	72208	288.99	69936	288.99	69936	288.99	69936
21	Olsztyn 160	2/141	2291	407.53	933651	403.00	923342	414.95	950650	416.64	954522
16	Olsztyn 125	165/1	1411	418.34	590278	389.00	549077	392.01	553126	408.04	575744
		Average		237.81		243.16		239.43		236.49	

Source: own elaboration

12.5.3. Real estate valuation by the pairwise comparison method

The pairwise comparison method is a variant of the comparative approach, and it is used to appraise individual properties with a given purpose in the local zoning plan. Therefore, the transaction prices and attributes of similar properties have to be known (Dydenko 2020; Źróbek et al. 2012). This method is suitable for appraising properties that are less frequently or rarely traded on the market, and where transaction prices do not directly influence average market prices (Adamczewski 2006b; Adair 2005).

The selected market attributes and their impact on property value and quantitative adjustments are presented in Table 12.1 for the Bartąg-Bartążek suburban zone and in Table 12.2 for Olsztyn's peripheral zone. The market value of land was determined based on the test properties that were selected randomly from the data sets . Test properties were selected to compare the market value of real estate appraised by the sales comparison method and the pairwise comparison method with the transaction prices of the analyzed real estate. According to Czaja and Parzych (2015); Źróbek et al. (2012); Dydenko (2006); Hozer (2006), and there are no strict guidelines for selecting properties for comparative purposes or for market analyses. Valuers should rely on logic and local market data in the process of selecting real estate. In the present study, this approach was used to ensure that the selected comparative properties were most similar to the appraised property.

According to the procedure described above the unit value of real estate was calculated as the arithmetic mean of adjusted property prices with the use of the following formula:

$$\mathbf{V} = \frac{\sum_{i=1}^{n} \mathbf{P_{adj_i}}}{\mathbf{n}} \tag{12.12}$$

where:

V - market value of real estate

P_{adj_i} - adjusted price of comparative property

N - number of comparative properties.

For comparative purposes, the market value of real estate was also expressed by two weighted values: the multiplicative inverse of the number of adjustments (formula 12.10) and the additive inverse of the absolute value of all adjustments (formula 12.11). The values of the analyzed real estate are presented in Tables 12.10 and 12.11, respectively.

Table 12.10 Estimated values of test properties in the suburban zone, determined by the pairwise comparison method

Bartąg-Bartążek suburban zone						**Arithmetic mean**		**Weighted average 1**		**Weighted average 2**	
No.	Cadastral (tax) district	Plot No.	Area [m^2]	P_{adj} [PLN/m^2]	P_{adj} [PLN]	A_{mean} [PLN/m^2]	V [PLN]	V_{mean} [PLN/m^2]	V_{mean} [PLN/m^2]	V [PLN]	V_{mean} [PLN/m^2]
29	Bartąg	205/19	2070	**101.46**	210022	105.05	217454	105.05	217454	105.05	217454
23	Bartąg	362/47	1073	**135.47**	145359	167.76	180006	167.76	180006	167.76	180006
13	Bartąg	135/19	1014	**143.81**	145823	174.2	176639	174.81	177257	176.4	178870
37	Bartążek	30/18	2021	**172.71**	349047	164.93	333324	163.68	330797	160.74	324856
5	Bartążek	362/82	1228	**178.8**	219566	215.09	264131	209.34	257070	229.67	282035
35	Bartążek	30/19	2000	**183.16**	366320	165.84	331680	166.03	332060	166.26	332520
4	Bartąg	333/33	2789	**204.34**	569904	202.62	565107	196.9	549154	219.66	612632
31	Bartążek	291/21	1473	**223.76**	329598	206.10	303585	209.13	308048	212.86	313543
17	Bartąg	329/25	1622	**230.77**	374309	224.55	364220	224.55	364220	236.12	382987
3	Bartąg	706	1170	**277.29**	324429	256.68	300316	292.70	342459	392.11	458769
		Average		185.16		188.28		191.00		206.66	

Source: own elaboration

Tab 12.11 Estimated values of test properties in the peripheral zone

Olsztyn's peripheral zone						**Arithmetic mean**		**Weighted average 1**		**Weighted average 2**	
No.	Cadastral (tax) district	Plot No.	Area [m^2]	P_{adj} [PLN/m^2]	P_{adj} [PLN]	V_{mean} [PLN/m^2]	V [PLN]	V_{mean} [PLN/m^2]	V_{mean} [PLN]	V_{mean} [PLN/m^2]	V_{mean} [PLN]
30	Olsztyn 160	39/32	902	103.32	93195	97.64	88071	100.89	91003	103.25	93132
36	Olsztyn 160	39/38	1050	103.32	108486	122.93	129077	111.72	117306	103.50	108675

8	Olsztyn 118	38/51	2642	146.24	386366	123.5	326287	122.73	324253	120.57	318546
3	Olsztyn 118	34/55	218	169.28	36903	236.87	51638	230.27	50199	212.24	46268
1	Olsztyn 118	34/42	909	207.55	188663	206.43	187645	207.18	188327	208.16	189217
10	Olsztyn 118	38/64	1173	210.29	246670	180.41	211621	180.41	211621	161.38	189299
44	Olsztyn 161	59/6	294	220.85	64930	221.16	65021	221.04	64986	220.71	64889
49	Olsztyn 161	60/9	274	284.29	77895	288.99	79183	288.99	79183	288.99	79183
No.	Cadastral (tax) district	Plot No.	Area [m^2]	P_{adj} [PLN/m^2]	P_{adj} [PLN]	W_{mean} [PLN/m^2]	W [PLN]	W_{mean} w_1 [PLN/m^2]	W_{mean} w_1 [PLN]	W_{mean} w_2 [PLN/m^2]	W_{mean} w_2 [PLN]
56	Olsztyn 161	60/16	376	284.29	106893	243.9	91706	243.9	91706	243.9	91706
51	Olsztyn 161	60/11	242	298.38	72208	288.99	69936	288.99	69936	288.99	69936
21	Olsztyn 160	2/141	2291	407.53	933651	387.55	887877	387.55	887877	419.47	961006
16	Olsztyn 125	165/1	1411	418.34	590278	398.19	561846	403.14	568831	410.14	578708
				237.81		233.05		232.23		231.78	

Source: own elaboration

12.5.4. Real estate valuation by the mean price adjustment method

In the mean price adjustment method, the value of real estate is determined based on a set of more than ten similar properties on the assumption that comparative properties have been traded on the market and are similar to the analyzed real estate (Źróbek 2006, TZWN 2004, Prystupa 2001). This is accomplished with the use of the following formula:

$$\mathbf{V_{1sq.m.} = P_{mean} \cdot \sum_{i=1}^{n} u_i} \tag{12.13}$$

where:

P_{mean} – mean transaction price of similar properties

u_i – value of the i^{th} adjustment coefficient

n – number of market attributes.

In the mean price adjustment method, the market value of real estate was determined based on the transactions concluded in the Bartąg-Bartążek suburban zone and Olsztyn's peripheral zone. These transactions were previously used to estimate the market value of real estate with the sales comparison method and the pairwise comparison method. The following procedure was adopted in the mean price adjustment method:

1. transaction prices were time-adjusted to the day of the analysis based on the price index with the use of formula 12.3.
2. the market attributes describing both data sets were determined by a correlation analysis.
3. the influence of market attributes on real estate values was determined based on the values calculated in the market analysis (Tables 12.1 and 12.2).
4. mean (P_{mean}), minimal (Pmin) and maximum (Pmax) prices were calculated for both data sets. Properties with minimum (Pmin) and maximum (Pmax) prices were

characterized and ranked on the adopted attribute scale. These properties are presented in Tables 12.12 and 12.13.

Table 12.12 Properties with minimum and maximum prices in the Bartąg-Bartążek suburban zone

No.	**Cadastral (tax) district**	**Plot No.**	$\mathbf{X_{1a}}$	$\mathbf{X_6}$	$\mathbf{X_8}$	$\mathbf{X_{10}}$	**Area**[m^2]	$\mathbf{P_{adj}}$ [PLN/m^2]
29	Bartąg	205/19	1	1	2	1	2070	**101.46**
22	Bartążek	345/32	2	3	3	3	1323	**296.65**

Source: own elaboration

Table 12.13 Properties with minimum and maximum prices in Olsztyn's peripheral zone

No.	**Cadastral (tax) district**	**Plot No.**	$\mathbf{X_{1a}}$	$\mathbf{X_6}$	$\mathbf{X_8}$	$\mathbf{X_{10}}$	**Area**[m^2]	$\mathbf{P_{adj}}$ [PLN/m^2]
8	Olsztyn 118	38/51	2	1	2	4	2642	**146.24**
12	Olsztyn 118	4/26	3	4	4	3	570	**416.67**

Source: own elaboration

5. The sum of adjustment coefficients was determined by calculating lower and upper boundary values on the assumption that the sum of adjustment coefficients should fall within the following range:

$$\frac{\mathbf{P_{min}}}{\mathbf{P_{mean}}} \leq \sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{u_i} \leq \frac{\mathbf{P_{max}}}{\mathbf{P_{mean}}} \tag{12.14}$$

- boundary values for the Bartąg-Bartążek suburban zone:

$P_{min}/P_{mean} = 0.5206$; $P_{max}/P_{mean} = 1.5223$;

- boundary values for Olsztyn's peripheral zone:

$P_{min}/P_{mean} = 0.5262$; $P_{max}/P_{mean} = 1.4992$.

6. A ranking scale was developed for market attributes and adjustment coefficients. The ranked values are presented in Tables 12.14 and 12.15.

Table 12.14 Adjustment coefficients for real estate in the Bartąg-Bartążek suburban zone

Attribute	**Weight** [%]	**Adjustment coefficients on the ranking scale** [PLN/m^2]			
		1	**2**	**3**	**4**
X_{1a}	30	0.1562	0.4567		
X_6	25	0.1302	0.2554	0.3806	0.5058
X_8	30	0.0059	0.1562	0.3064	0.4567
X_{10}	15	0.0781	0.1532	0.2283	0.3035

Source: own elaboration

Table 12.15 Adjustment coefficients for real estate in Olsztyn's peripheral zone

Attribute	Weight [%]	Adjustment coefficients on the ranking scale [PLN/m^2]			
		1	2	3	4
X_{1a}	20	0.0000	0.1052	0.2998	0.4050
X_2	36	0.1894	0.3062	0.4230	0.5398
X_8	23		0.1210	0.2329	0.3448
X_{10}	21			0.3148	0.1106

Source: own elaboration

The results of the valuation are presented in Appendixes 12 and 13.

12.5.5. Real estate valuation by multiple regression analysis in a statistical analysis of the real estate market

In the discussed approach, statistical tools are used to identify trends on the local real estate market. Models are developed to describe cause-effect relationships between transaction prices and factors that influence transaction prices. Both linear and non-linear models are recommended in this approach, but linear models are more widely used in practice (Bełej and Źróbek 2000; Czaja 1999; Źróbek 1998; Sawiłow 1997).

Linear models for appraising real estate with the use of regression analysis have the following functions:

$$\mathbf{Y = \alpha_0 + \alpha_1 X} \tag{12.15}$$

and generalized models involve a larger number of variables:

$$\mathbf{Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + ... + \alpha_k X_k} \tag{12.16}$$

where:

Y – explained variable (transaction price)

$\alpha_1, \alpha_2, ..., \alpha_k$ – modelled parameters

$X_1, X_2, ..., X_k$ – explanatory variables (market attributes of property).

The model's structural parameters are estimated with the use of the following formula:

$$\mathbf{A = (X^T X)^{-1} X^T Y} \tag{12.17}$$

where:

A – unknown parameter vector of population α

X – matrix of observations on explanatory variables

Y – matrix of observations on the explained variable.

The constant values in the model were calibrated by the least squares method in the Statistica program (StatSoft). The estimated values of model constants for both data sets are presented in Table 12.16 for the Bartąg-Bartążek suburban zone and in Table 12.17 for Olsztyn's peripheral zone.

Table 12.16 Multiple regression model based on market attributes in the suburban zone

Regression model summary for dependent variable P_{adj} (Bartąg-Bartążek) R= 0.74156334; R^2= 0.54991619; Adj. R2= 0.44989756 F(4.27)=5.4981; p<0.00451; SEE: 41.79						
N=23	b*	SEE	b	SEE	t(27)	p
Y-intercept			3.45	44.56596	0.077457	0.939114
X_{1a}	0.278219	0.199711	30.92	22.19929	1.393107	0.180555
X_6	0.233707	0.181147	18.66	14.46237	1.290153	0.213326
X_8	0.282786	0.171171	23.95	14.49490	1.652067	0.115858
X_{10}	0.243219	0.185309	11.05	8.42005	1.312506	0.205840

Source: own elaboration

Table 12.17 Multiple regression model based on market attributes in the peripheral zone

Regression model summary for dependent variable P_{adj} (Olsztyn city) R= 0.75547271; R^2= 0.57073901; Adj. R2= 0.52985701 F(4.49)=13.961; p<0.00000; SEE: 74.692						
N=47	b*	SEE	b	SEE	t(49)	p
Y-intercept			-393.03	94.62349	-4.15366	0.000157
X_{1a}	0.453615	0.109947	70.11	16.99297	4.12577	0.000171
X_2	0.389759	0.127556	47.14	15.42675	3.05560	0.003894
X_8	0.215740	0.151298	40.72	28.55979	1.42593	0.161279
X_{10}	0.218539	0.120210	44.24	24.33573	1.81797	0.076205

Source: own elaboration

The following econometric models were used to determine the value of real estate in both data sets:

- for the Bartąg-Bartążek suburban zone:

$V = 3.4 + 30.92\ X_{1a} + 18.66X_6 + 23.95X_8 + 11.05X_{10}$;

R^2=0.55; SEE: PLN 41.79/m^2;

- for Olsztyn's peripheral zone:

$V = -393.03 + 70.11\ X_{1a} + 47.14X_2 + 40.72X_8 + 44.24X_{10}$;

R^2=0.57; SEE: PLN 74.69/m^2;

The adequacy of the multiple regression model was checked by comparing the modeled market values with transaction prices. Estimation results and mean deviation are presented in Appendixes 14 and 15.

To check the model's adequacy, percentage deviation between the estimated value and transaction price was calculated with the following formula:

$$\boldsymbol{\Delta = 100 * \frac{Pa - Wm}{Pa}}; [\%] \qquad (12.18.)$$

and mean percentage deviation in both data sets was calculated with the below formula:

$$\mathbf{s} = \sqrt{\frac{[\Delta\Delta]}{\mathbf{n}}} \qquad (12.19.)$$

where:

Δ – percentage deviation between the estimated value and price,

S – mean percentage deviation,

Pa – time-adjusted price of real estate in PLN

W_m – estimated market value of real estate in PLN.

Percentage deviation and mean percentage deviation are used for tax purposes to evaluate the adequacy of the models for calculating the cadastral (tax) value of real estate (Telega et al. 2002).

12.5.6. Real estate valuation by stepwise regression in a statistical analysis of the real estate market

Analyses involving numerous market variables (attributes) and numerous property transactions pose a certain challenge:

– the largest possible number of independent variables should be incorporated in the model to guarantee the model's reliability and to fully describe the analyzed phenomenon;
–however, the characterization of numerous variables is a difficult and costly process, and when the number of variables is very high, estimation procedures are complex or even impossible to perform, and the results are increasingly difficult to interpret.

Stepwise regression can resolve these problems. The two main approaches for stepwise regression are (Kuryj and Kuryj-Wysocka 2015):

– forward selection – explanatory variables that exert the most significant effect on the dependent variable are added to the model and tested. This process is repeated until the fit of the model is significantly improved;

– backward elimination – the reverse procedure is applied. Variables that exert the least significant effect on the dependent variable are removed from the model in successive iterations. This process is also repeated until the fit of the model is significantly improved.

The selected explanatory variables (property attributes) and the regression model are presented in Tables 12.18 and 12.19 for the Bartąg-Bartążek suburban zone and in Tables 12.20 and 12.21 for Olsztyn's peripheral zone.

Tab 12.18 Model 1 developed in the backward stepwise regression procedure for real estate in the Bartąg-Bartążek suburban zone

Regression model summary for dependent variable P_{adj} (regression statistics for Bartąg-Bartążek) R= 0.74235100; R^2= 0.55108500; Adj. R2= 0.44420048 F(5.21)=5.1559 p<0.00306; SSE: 66.097						
N=27	b*	SEE	b	SEE	t(21)	p
Y-intercept			74.21	95.35	0.78	0.4451
X_{1a}	0.8128	0.27	141.54	46.53	3.04	0.0062
X_{1c}	-0.5553	0.30	-100.05	54.25	-1.84	0.0793
X_2	-0.1740	0.16	-13.02	12.24	-1.06	0.2997
X_3	0.2592	0.18	23.35	16.61	1.41	0.1744
X_8	0.4466	0.16	57.06	19.84	2.88	0.0091

Source: own elaboration

Table 12.19 Model 2 developed in the forward stepwise regression procedure for real estate in the Bartąg-Bartążek suburban zone

Regression model summary for dependent variable P_{adj} (regression statistics for Bartąg-Bartążek) R= 0.72952691; R^2= 0.53220952; Adj. R2= 0.44715670; F(4.22)=6.2574 p<0.00161; SEE: 65.921						
N=27	b*	SEE	b	SEE	t(22)	p
Y-intercept			88.30	95.73	0.92	0.3663
X_{1a}	0.6519	0.25	113.51	43.46	2.61	0.0159
X_8	0.3987	0.15	50.95	19.45	2.62	0.0156
X_9	-0.1769	0.15	-27.17	22.50	-1.21	0.2399
X_{1c}	-0.2737	0.24	-49.30	43.83	-1.13	0.2727

Source: own elaboration

Table 12.20 Model 1 developed in the backward stepwise regression procedure for real estate in Olsztyn's peripheral zone

Regression model summary for dependent variable P_{adj} (regression statistics for Olsztyn) R= 0.78258445; R^2= 0.61243842; Adj. R2= 0.58660099; F(3.45)=23.704; p<0.00000; SEE: 71.522						
N=49	b*	SEE	b	SEE	t(45)	p
Y-intercept			68.65	66.70	1.03	0.3088
X_{1b}	0.3516	0.098	34.35	9.55	3.60	0.0008
X_2	0.3852	0.101	48.16	12.60	3.82	0.0004
X_9	-0.4012	0.105	-47.32	12.36	-3.83	0.0004

Source: own elaboration

Table 12.21 Model 1 developed in the forward stepwise regression procedure for real estate in Olsztyn's peripheral zone

Regression model summary for dependent variable P_{adj} (regression statistics for Olsztyn) R= 0.84693556; R^2= 0.71729985; Adj. R2= 0.67691411; F(6.42)=17.761; p<0.00000; SEE: 63.229						
N=49	b*	SEE	b	SEE	t(42)	p
Y-intercept			209.71	121.62	1.72	0.0920
X_9	-0.6733	0.12	-79.41	14.07	-5.64	0.0000
X_{1a}	0.1905	0.11	28.99	16.61	1.75	0.0882
X_2	0.3562	0.09	44.53	11.56	3.85	0.0004
X_{1b}	0.4361	0.13	42.61	13.01	3.28	0.0021
X_{10}	-0.3128	0.12	-64.80	24.35	-2.66	0.0110
X_3	0.2229	0.10	23.22	10.42	2.23	0.0312

Source: own elaboration

The results of real estate valuation and the model's adequacy (percentage deviation and mean percentage deviation calculated with formulas 12.18 and 12.19, respectively) are presented in Appendixes 16 and 17.

12.5.7. Real estate valuation by the mass appraisal method (Polish model)

The mass appraisal method is applied to calculate the cadastral value of property for tax purposes (Adamczewski et al. 2002). In the present study, the value of real estate was estimated by the mass appraisal method based on market attributes, rather the characteristic parameters of property because the results had to be compared with the outcomes of the remaining valuation methods in both test fields. In the GRET approach, the influence of characteristic attributes on property value is estimated with the use of adjustment coefficients. These coefficients account for differences in the attributes of representative properties and taxable properties (such as land plots) in a given cadastral

(tax) district. The algorithm for the GRET approach was proposed by Z. Adamczewski in General Real Estate Taxation Guidelines (Adamczewski et al. 2002; Adamczewski 2006b; Kuryj 2007b). In this model, the unit value of real estate (W_a) is equivalent to the sum of products of the coefficients adjusting the attribute values of the analyzed real estate (k_i) and the parameters (X_i) corresponding to the attributes of that real estate:

$$\mathbf{V_C} = (\mathbf{k_1} + \mathbf{k_2} + \ ... \ + \mathbf{k_m}) \cdot \mathbf{V_r} \cdot \mathbf{P} \qquad (12.20)$$

where:

V_c - cadastral (tax) value of real estate in PLN

k_i - coefficients adjusting the values of characteristic attributes of property

V_r - unit value of representative property in PLN/m^2

P - land plot area in m^2.

The unit value of representative property (W_r) was calculated with the use of the below algorithm as the sum of products of adjustment coefficients a_i and the parameters describing the attributes of that property:

$$\mathbf{V_r} = \mathbf{a_1} \cdot \mathbf{X_{r1}} + \mathbf{a_2} \cdot \mathbf{X_{r2}} + \ ... \ + \mathbf{a_m} \cdot \mathbf{X_{rm}} \qquad (12.21)$$

where:

V_r - unit value of representative property in PLN/m^2

a_i - model constants for characteristic attributes

X_i - parameters describing the characteristic attributes of representative property.

In the process of estimating the value of representative property, model constants are determined by maximum likelihood estimation with the use of the following formula:

$$\boldsymbol{a_i} = \frac{\boldsymbol{p_i}\ [\boldsymbol{v}]}{[\boldsymbol{p}]\ [\boldsymbol{X_i}]} \qquad (12.22)$$

where:

$\mathbf{p_i}$ – weight of the ith property attribute

[v] – sum of adjusted transaction prices determined in an analysis of the real estate market

[p] – sum of weights for the selected characteristic attributes of property

$\mathbf{[X_i]}$ – sum of parameters for the ith property attribute determined in an analysis of the real estate market.

The weights (p_i) for each characteristic attribute are determined with the use of an empirical constant (q_i) calculated for each attribute with formula 12.23 and the inverse empirical constant calculated with formula 12.24:

$$\mathbf{q_i} = \frac{[\mathbf{v}\ \mathbf{X_i}]^2}{[\mathbf{v}\ \mathbf{v}]\ [\mathbf{X_i}\ \mathbf{X_i}]} \tag{12.23}$$

$$\mathbf{p_i} = \frac{\mathbf{q_i}}{\mathbf{1} - \mathbf{q_i}} \tag{12.24}$$

where:

[vX$_i$] – sum of products of transaction prices and parameters of the ith attribute

[vv] – sum of squares of transaction prices

[X$_i$X$_i$] – sum of squares of the parameters of the ith attribute.

The coefficients adjusting the parameters of each characteristic attribute (ki) and the attributes of representative property (kr$_i$) were calculated with the use of the following algorithms:

$$\mathbf{k_i} = \mathbf{k_{r_i}} \frac{\mathbf{X_i}}{\mathbf{X_{r_i}}} \tag{12.25}$$

$$\mathbf{k_{r_i}} = \frac{\mathbf{a_i}\ \mathbf{X_{r_i}}}{\mathbf{v_r}} \tag{12.26}$$

where:

X_i - value of the parameter for the ith attribute describing the analyzed property

X_{ri} - value of the parameter for the ith attribute describing representative property

a_i - model constant calculated with the maximum likelihood estimation method

V_r - unit value of representative property

The following procedure was adopted to estimate the value of the analyzed real estate with the use of the mass appraisal method.

Representative property was chosen from a group of 10 properties that were selected randomly from each set, and the values of the parameters describing the representative property (Xr$_i$) were expressed as the arithmetic means of candidate parameters that were applied in the process of selecting the representative property: $\boldsymbol{X_{ri}} = \frac{[X_i]}{n}$. The candidate parameters for selecting representative properties in both test fields are presented in Tables 12.22 and 12.23.

Tab 12.22 Selection of representative property in the Bartąg-Bartążek suburban zone

Candidate parameters for selecting representative property							
No.	**Cadastral (tax) district**	**Plot No.**	**X_{1a}**	**X_6**	**X_8**	**X_{10}**	**P_{adj}**
16	Bartąg	135/17	1	3	2	1	121.28
23	Bartąg	362/47	2	3	3	3	135.47
37	Bartążek	30/18	1	3	2	1	172.71
24	Bartążek	30/27	1	3	2	2	181.12
25	Bartążek	30/26	1	3	2	2	186.18
32	Bartążek	16/39	1	3	4	2	196.97
30	Bartążek	329/23	2	4	2	4	211.19
12	Bartąg	329/21	2	4	3	4	225.08
3	Bartąg	706	2	3	3	1	277.29
22	Bartążek	345/32	2	3	3	3	296.65
	Sum of attribute values		15	32	26	23	2003.94
	Attributes		X_{r1a}	X_{r6}	X_{r8}	X_{r10}	P_{mean}
	Attributes of representative property		**1.5**	**3.2**	**2.6**	**2.3**	**200.40**

Source: own elaboration

Table 12.23 Selection of representative property in Olsztyn's peripheral zone

Candidate parameters for selecting representative property							
No.	**Cadastral (tax) district**	**Plot No.**	**X_{1a}**	**X_2**	**X_8**	**X_{10}**	**P_{adj}**
8	Olsztyn 118	38/51	2	1	2	4	146.24
1	Olsztyn 118	34/42	3	4	3	4	207.55
14	Olsztyn 118	4/45	3	4	4	4	210.48
41	Olsztyn 161	59/3	1	4	4	4	232.36
11	Olsztyn 118	4/23	4	4	3	3	232.39
54	Olsztyn 161	60/14	2	4	4	4	284.29
51	Olsztyn 161	60/11	2	4	4	4	298.38
19	Olsztyn 160	2/129	4	4	3	4	404.3
2	Olsztyn 118	34/45	3	4	3	3	412.36
45	Olsztyn 161	59/7	2	4	4	4	298.38
	Sum of attribute values		26	37	34	38	2726.73
	Attributes		X_{r1a}	X_{r2}	X_{r8}	X_{r10}	P_{mean}
	Attributes of representative property		2.6	3.7	3.4	3.8	272.67

Source: own elaboration

1) Calculation of model constants for both data sets with the use of formulas 12.22, 12.23 and 12.24.

- for the Bartąg-Bartążek suburban zone

Constant	q_1	q_6	q_8	q_{10}	
Q_i	0.9243	0.9312	0.9213	0.8056	
Weight	p_1	p_6	p8	p_{10}	Sum [p_i]
P_i	12.20813	13.54276	11.69965	4.143357	41.5939
Model constant	a_1	a_6	a_8	a_{10}	
A_i	39.2115	20.3898	21.6798	8.6792	

Model: V_r= 39.2115*Xr_{1a}+20.3898*X6+21.6798*X8+8.6792*X10 = PLN 200.40/m^2

- for Olsztyn's peripheral zone

Constant	q_1	q_6	q_8	q_{10}	
Q_i	0.8725	0.9340	0.9019	0.8915	
Weight	p_1	p_6	p8	p_{10}	[pi]
P_i	6.842614	14.15354	9.190778	8.212957	38.39989
Model constant	a_1	a_6	a_8	a_{10}	
A_i	18.6879	27.1629	19.1949	15.3472	

Model: $V_r = 18.6879Xr_{1a}+27.1629X_2+19.1949X_8+15.3472X_{10}$ = PLN 272.67/m^2

2) Calculation of adjustment coefficients for the attributes describing representative property in both zones:

- for the Bartąg-Bartążek suburban zone:

	k_1	k_6	k_8	k_{10}
k_{ri}	0.2935	0.3256	0.2813	0.0996

- for Olsztyn's peripheral zone:

	k_1	k_6	k_8	k_{10}
k_{ri}	0.1782	0.3686	0.2393	0.2139

12.6. Analysis of convergence between real estate values determined with the tested valuation methods

The analysis was conducted in two stages. The convergence between the estimated real estate values and time-adjusted transaction prices was evaluated in the first stage. The convergence between the real estate values calculated with the use of the presented methods (applied in different stages of real estate market evolution) and the market values determined by the pairwise comparison method was determined in the second stage. Formulas 12.18 and 12.19 proposed by the General Real Estate Taxation Guidelines (Telega et al. 2002) were applied in the first stage of the analysis. In the second stage, these formulas were modified, and percentage deviation was calculated with the following equation:

$$\boldsymbol{\Delta = 100 * \frac{Vr - V}{Vr}} \tag{12.27}$$

Mean percentage deviation was calculated with the following formula:

$$\boldsymbol{s = \sqrt{\frac{[\Delta\Delta]}{n}}} \tag{12.28}$$

where:

Δ – percentage deviation between estimated value and market value [%]

s – mean percentage deviation [%]

v – real estate value calculated with the use of a given valuation method [PLN]

v_r – estimated market value of real estate determined with the pairwise comparison method [PLN].

12.6.1. Comparative validity of real estate values estimated by the indicator method relative to transaction prices

Real estate values were analyzed based on the assumptions described in subsection 12.4. The analysis relied on the results of real estate valuation presented in Appendixes 10 and 11. To assess the validity of the estimated real estate values, the convergence between the estimated values and transaction prices was determined by calculating percentage deviation and mean percentage deviation for the entire data set. The convergence between transaction prices and real estate values estimated by the indicator method with the standard valuation rate is presented in Tables 12.24 and 12.25.

Table12.24 Percentage deviation between real estate values estimated by the indicator method and adjusted transaction prices in the Bartąg-Bartążek suburban zone

Cadastral (tax) district	Plot No.	Price P_a [PLN]	Value V [PLN]	Deviation Δ [%]
1	2	3	4	5
Bartąg	135/44	157708	110372	30.01
Bartąg	706	324429	60492	81.35
Bartąg	333/33	569904	188950	66.85
Bartążek	362/82	219566	73343	66.60
Bartąg	248/5	348713	260581	25.27
Bartąg	311/3	258319	59137	77.11
Bartąg	270/34	132555	21616	83.69
Bartąg	89/1	258147	260258	-0.82
Bartąg	329/21	326366	86602	73.46
Bartąg	135/19	145823	54234	62.81
Bartąg	206/7	236098	144796	38.67
Bartąg	135/17	227400	100285	55.90
Bartąg	329/25	374309	93983	74.89
Bartąg	30/285	188973	61998	67.19
Bartąg	30/20	319800	115885	63.76
Bartąg	299/38	392468	50269	87.19
Bartążek	16/2	501468	248172	50.51
Bartążek	345/32	392468	63685	83.77
Bartąg	362/47	145359	47825	67.10
Bartążek	30/27	319496	92776	70.96
Bartążek	30/26	319485	90251	71.75
Bartąg	283/1	258400	264004	-2.17
Bartąg	135/28	251233	61398	75.56
Bartążek	30/24	162827	121489	25.39
Bartąg	205/19	210022	81191	61.34

Bartążek	329/23	469687	114986	75.52
Bartążek	291/21	329598	94541	71.32
Bartążek	16/39	148318	33562	77.37
Bartążek	345/49	450351	47067	89.55
Bartążek	345/57	443630	49340	88.88
Bartążek	30/19	366320	108754	70.31
Bartążek	30/18	349047	109896	68.52
			s =	**66.73%**

Source: own elaboration

Table12.25 Percentage deviation between real estate values estimated by the indicator method and adjusted transaction prices in Olsztyn's peripheral zone

Cadastral (tax) district	**Plot No.**	**Price - P_a [PLN]**	**Value -V [PLN]**	**Deviation Δ [%]**
1	2	3	4	5
Olsztyn 118	34/42	188663	42784	77.32
Olsztyn 118	34/45	345145	39395	88.59
Olsztyn 118	34/55	36903	12593	65.88
Olsztyn 118	34/57	209061	71339	65.88
Olsztyn 118	38/110	150907	19929	86.79
Olsztyn 118	38/111	149789	19781	86.79
Olsztyn 118	38/31	386364	219692	43.14
Olsztyn 118	38/51	386366	169570	56.11
Olsztyn 118	38/82	371163	48565	86.92
Olsztyn 118	38/64	246670	67757	72.53
Olsztyn 118	4/23	237503	54662	76.98
Olsztyn 118	4/26	237502	30487	87.16
Olsztyn 118	4/38	200987	43805	78.21
Olsztyn 118	4/45	149441	41013	72.56
Olsztyn 118	4/47	81666	22413	72.56
Olsztyn 125	165/1	590278	81505	86.19
Olsztyn 126	3/3	301836	173004	42.68
Olsztyn 160	2/129	438261	71893	83.60
Olsztyn 160	2/133	517555	65055	87.43
Olsztyn 160	2/141	933651	151944	83.73
Olsztyn 160	39/28	477462	64491	86.49
Olsztyn 160	39/29	98361	57028	42.02
Olsztyn 160	39/30	94951	55051	42.02
Olsztyn 160	39/31	95158	57142	39.95
Olsztyn 160	39/32	93195	55963	39.95
Olsztyn 160	39/33	114789	68930	39.95
Olsztyn 160	39/34	115098	66733	42.02
Olsztyn 160	39/35	97224	56369	42.02
Olsztyn 160	39/36	110449	64037	42.02
Olsztyn 160	39/37	108486	65145	39.95
Olsztyn 160	39/38	108486	65145	39.95
Olsztyn 160	39/39	108486	65145	39.95
Olsztyn 160	39/40	108486	65145	39.95
Olsztyn 160	39/41	104870	60802	42.02
Olsztyn 161	59/3	129889	26311	79.74
Olsztyn 161	59/4	69940	14167	79.74
Olsztyn 161	59/5	69789	15549	77.72
Olsztyn 161	59/6	64930	14467	77.72
Olsztyn 161	59/7	76684	12096	84.23
Olsztyn 161	59/8	182907	28852	84.23
Olsztyn 161	59/14	275788	50790	81.58

Olsztyn 161	60/8	81876	16636	79.68
Olsztyn 161	60/9	77895	15827	79.68
Olsztyn 161	60/10	76684	14845	80.64
Olsztyn 161	60/11	72208	13979	80.64
Olsztyn 161	60/12	67136	12997	80.64
Olsztyn 161	60/13	59985	12188	79.68
Olsztyn 161	60/14	58564	11899	79.68
Olsztyn 161	60/15	90404	17689	80.43
Olsztyn 161	60/16	106893	19306	81.94
			s =	**70.63%**

Source: own elaboration

As demonstrated by Table12.24, the percentage deviation between the estimated property values and transaction prices was below 10% in only two plots (6.2%) in the Bartąg-Bartążek suburban zone. These observations suggest that real estate values estimated by the indicator method with the standard valuation rate poorly reflect transaction prices at the current stage of market evolution. Mean percentage deviation was determined at 66.73% in the Bartąg-Bartążek suburban zone and at 70.63% in Olsztyn's peripheral zone. Mean percentage deviation for both data sets was estimated at 69%.

12.6.2. Comparative validity of real estate values estimated by the sales comparison method

The convergence between the market values of real estate estimated by the sales comparison method and the transaction prices of properties selected randomly in the Bartąg-Bartążek suburban zone and Olsztyn's peripheral zone was evaluated. The arithmetic means of the adjusted unit prices of comparative properties, weighted average 1 (calculated with formula 12.10) and weighted average 2 (calculated with formula 12.11) were used in the analysis. The estimated values are presented in Tables 12.8 and 12.9. The convergence between the estimated values and transaction prices was also assessed by calculating percentage deviation (Δ) and mean percentage deviation (s). The results of the comparative analysis are presented in Tables 12.26 and 12.27.

Table12.26 Percentage deviation between real estate values estimated by the sales comparison method and adjusted transaction prices in the Bartąg-Bartążek suburban zone

Bartąg-Bartążek suburban zone				**Values calculated with the sales comparison method**					
No.	**Cadastral (tax) district**	**Plot No.**	**Price P_a [PLN]**	**Arithmetic mean [PLN]**	**Deviation Δ [%]**	**Weighted average 1 [PLN]**	**Deviation Δ [%]**	**Weighted average 2 [PLN]**	**Deviation Δ [%]**
29	Bartąg	205/19	210022	126109	-35.32	126109	-35.32	119019	-27.71
23	Bartąg	362/47	145359	141540	-30.47	133277	-22.85	112140	-3.37

13	Bartąg	135/19	145823	384226	0.55	336855	12.81	406023	-5.09
37	Bartążek	30/18	349047	51417	-39.33	49054	-32.93	46874	-27.02
5	Bartążek	362/82	219566	234149	-24.11	228704	-21.22	200825	-6.45
35	Bartążek	30/19	366320	169686	31.21	160455	34.95	161698	34.45
4	Bartąg	333/33	569904	71518	-10.15	68861	-6.05	65447	-0.80
31	Bartążek	291/21	329598	79183	-1.65	79183	-1.65	79183	-1.65
17	Bartąg	329/25	374309	92646	13.33	92646	13.33	92646	13.33
3	Bartąg	706	324429	69936	3.15	69936	3.15	69936	3.15
				s=	**23.56%**	**s=**	**23.61%**	**s=**	**20.36%**

Source: own elaboration

Table12.27 Percentage deviation between real estate values estimated by the sales comparison method and adjusted transaction prices in Olsztyn's peripheral zone

Olsztyn's peripheral zone				**Values calculated with the sales comparison method**					
No.	**Cadastral (tax) district**	**Plot No.**	**Price P_a [PLN]**	**Arithmetic mean [PLN]**	**Deviation Δ [%]**	**Weighted average 1 [PLN]**	**Deviation Δ [%]**	**Weighted average 2 [PLN]**	**Deviation Δ [%]**
30	Olsztyn 160	39/32	93195	126109	-35.32	126109	-35.32	119019	-27.71
36	Olsztyn 160	39/38	108486	141540	-30.47	133277	-22.85	112140	-3.37
8	Olsztyn 118	38/51	386366	384226	0.55	336855	12.81	406023	-5.09
3	Olsztyn 118	34/55	36903	51417	-39.33	49054	-32.93	46874	-27.02
1	Olsztyn 118	34/42	188663	234149	-24.11	228704	-21.22	200825	-6.45
10	Olsztyn 118	38/64	246670	169686	31.21	160455	34.95	161698	34.45
44	Olsztyn 161	59/6	64930	71518	-10.15	68861	-6.05	65447	-0.80
49	Olsztyn 161	60/9	77895	79183	-1.65	79183	-1.65	79183	-1.65
56	Olsztyn 161	60/16	106893	92646	13.33	92646	13.33	92646	13.33
51	Olsztyn 161	60/11	72208	69936	3.15	69936	3.15	69936	3.15
21	Olsztyn 160	2/141	933651	923342	1.10	950650	-1.82	954522	-2.24
16	Olsztyn 125	165/1	590278	549077	6.98	553126	6.29	575744	2.46
				s =	**21.64%**	**s =**	**20.33%**	**s =**	**15.72%**

Source: own elaboration

The validity of the estimated real estate values was assessed based on 10 randomly selected property transactions in the Bartąg-Bartążek suburban zone (31% of transactions in the data set) and 12 randomly selected property transactions in Olsztyn's peripheral zone (25% of transactions in the data set). The following values were analyzed:

–values calculated based on the arithmetic mean of the adjusted prices of comparative properties to account for the differences in attribute values,

–values calculated based on the weighted average. In the first case, weights were calculated based on the number of adjustments (weighted average 1), and in the second case – based on the total value of quantitative adjustments for the compared properties (weighted average 2). Weights were calculated with the use of formulas 12.10 and 12.11 in subsection 12.4.

As demonstrated in Table12.26, mean percentage deviation between the estimated values and time-adjusted transaction prices approximated:

–22% for real estate in the Bartąg-Bartążek suburban zone,

–19% for real estate in Olsztyn's peripheral zone (Table12.27).

In both data sets, the estimated real estate values most closely approximated transaction prices when weighted average 2 was used. In this approach, mean percentage

deviation reached 20.26% in the suburban zone and 15.72% in the peripheral zone. When the arithmetic mean was used in calculations, mean percentage deviation was 3.2% higher in the suburban zone and 5.9% higher in the peripheral zone. Regardless of the adopted valuation approach, percentage deviation did not exceed 50%. In the suburban zone, percentage deviation did not exceed 10% in 30% of the properties whose value was appraised based on the arithmetic mean and weighted average 1, and in 60% of the properties whose value was estimated based on weighted average 2. In Olsztyn's peripheral zone, percentage deviation did not exceed 10% in 42% of the properties whose value was appraised based on the arithmetic mean and weighted average 1, and in 68% of the properties whose value was estimated based on weighted average 2.

12.6.3. Comparative validity of real estate values estimated by the pairwise comparison method

The pairwise comparison method and the process of estimating real estate values are presented above. The validity of the pairwise comparison method was assessed by comparing the values of randomly selected properties that were estimated in three approaches: based on the arithmetic mean of the adjusted prices of comparative properties, based on weighted average 1 (formula 12.10), and based on weighted average 2 (formula 12.11). The values adopted for the analysis are presented in Tables 12.10 and 12.11. The validity of market values estimated by the pairwise comparison method was assessed based on property transactions that were randomly selected in the previous subsection. The following values were analyzed:

- values calculated based on the arithmetic mean of the adjusted prices of comparative properties to account for the differences in the values of market attributes,
- values calculated based on the weighted average. In the first case, weights were calculated based on the number of adjustments (weighted average 1), and in the second case – based on the total value of quantitative adjustments for the compared properties (weighted average 2). Weights were calculated with the use of former formulas.

The convergence between the estimated market values and transaction prices was determined based on percentage deviation (Δ) and mean percentage deviation (s). The results of the analysis are presented in Tables 12.28 and 12.29.

Table12.28 Percentage deviation between real estate values estimated by the pairwise comparison method and adjusted transaction prices in the Bartąg-Bartążek suburban zone

Bartąg-Bartążek suburban zone				Values calculated with the pairwise comparison method					
No.	Cadastral (tax) district	Plot No.	Price P_a [PLN]	Arithmetic mean [PLN]	Deviation Δ [%]	Weighted average 1 [PLN]	Deviation Δ [%]	Weighted average 2 [PLN]	Deviation Δ [%]
29	Bartąg	205/19	210022	217454	-3.54	217454	-3.54	217454	-3.54
23	Bartąg	362/47	145359	180006	-23.84	180006	-23.84	180006	-23.84
13	Bartąg	135/19	145823	176639	-21.13	177257	-21.56	178870	-22.66
37	Bartążek	30/18	349047	333324	4.50	330797	5.23	324856	6.93
5	Bartążek	362/82	219566	264131	-20.30	257070	-17.08	282035	-28.45
35	Bartążek	30/19	366320	331680	9.46	332060	9.35	332520	9.23
4	Bartąg	333/33	569904	565107	0.84	549154	3.64	612632	-7.50
31	Bartążek	291/21	329598	303585	7.89	308048	6.54	313543	4.87
17	Bartąg	329/25	374309	364220	2.70	364220	2.70	382987	-2.32
3	Bartąg	706	324429	300316	7.43	342459	-5.56	458769	-41.41
				s =	**12.94%**	s =	**12.43%**	s =	**19.59%**

Source: own elaboration

Tab 12.29 Percentage deviation between real estate values estimated by the pairwise comparison method and adjusted transaction prices in Olsztyn's peripheral zone

Olsztyn's peripheral zone				Values calculated with the pairwise comparison method					
No.	Cadastral (tax) district	Plot No.	Price P_a [PLN]	Arithmetic mean [PLN]	Deviation Δ [%]	Weighted average 1 [PLN]	Deviation Δ [%]	Weighted average 2 [PLN]	Deviation Δ [%]
30	Olsztyn 160	39/32	93195	88071	5.50	91003	2.35	93132	0.07
36	Olsztyn 160	39/38	108486	129077	-18.98	117306	-8.13	108675	-0.17
8	Olsztyn 118	38/51	386366	326287	15.55	324253	16.08	318546	17.55
3	Olsztyn 118	34/55	36903	51638	-39.93	50199	-36.03	46268	-25.38
1	Olsztyn 118	34/42	188663	187645	0.54	188327	0.18	189217	-0.29
10	Olsztyn 118	38/64	246670	211621	14.21	211621	14.21	189299	23.26
44	Olsztyn 161	59/6	64930	65021	-0.14	64986	-0.09	64889	0.06
49	Olsztyn 161	60/9	77895	79183	-1.65	79183	-1.65	79183	-1.65
56	Olsztyn 161	60/16	106893	91706	14.21	91706	14.21	91706	14.21
51	Olsztyn 161	60/11	72208	69936	3.15	69936	3.15	69936	3.15
21	Olsztyn 160	2/141	933651	887877	4.90	887877	4.90	961006	-2.93
16	Olsztyn 125	165/1	590278	561846	4.82	568831	3.63	578708	1.96
				s =	**14.97%**	s =	**13.17%**	s =	**11.97%**

Source: own elaboration

As demonstrated in Table12.28, mean percentage deviation between the estimated values and time-adjusted transaction prices approximated:

- 15% for real estate in the Bartąg-Bartążek suburban zone,
- 13% for real estate in Olsztyn's peripheral zone (Table12.29).

In the suburban zone, the estimated real estate values most closely approximated transaction prices when weighted average 1 was used. In this approach, percentage deviation reached 12.43%, and it was similar to percentage deviation calculated based on the arithmetic mean (s = 12.94%). In the peripheral zone, mean percentage deviation was smallest (11.97%) when weighted average 2 was used, and it was 3% higher when the arithmetic mean was used in the calculations. The presented results point to high convergence between the real estate values estimated by the pairwise comparison method

and transaction prices. In the discussed approach, mean percentage deviation ranged from 12% to 15%. The only exception was the market value of plot No. 706 in Bartąg estimated based on weighted average 2, which significantly contributed to an increase in mean percentage deviation. Mean percentage deviation reached 15% when this outlier was eliminated from the data set. Mean percentage deviation for both data sets was approximated at 14%.

12.6.4. Comparative validity of real estate values estimated by the mean price adjustment method

The application of the mean price adjustment method in the process of estimating the market value of real estate was presented bow. The comparative validity of this approach was tested based on all examined plots in the Bartąg-Bartążek suburban zone and Olsztyn's peripheral zone. The market values of property adopted for the analysis are presented in Tables 12.10 and 12.11. The convergence between the estimated real estate values and transaction prices was also assessed based on percentage deviation (Δ) and mean percentage deviation (s). The results of the comparative analysis are presented in Tables 12.30 and 12.31 .

Tab 12.30 Percentage deviation between the real estate values estimated by the mean price adjustment method and adjusted transaction prices in the Bartąg-Bartążek suburban zone

No.	Cadastral district	Plot No.	Price P_a [PLN]	Value V_M [PLN]	Deviation Δ [%]
29	Bartąg	205/19	210022	210043	-0.01
16	Bartąg	135/17	227400	281751	-23.90
23	Bartąg	362/47	145359	286888	-97.36
13	Bartąg	135/19	145823	182054	-24.85
19	Bartąg	30/20	319800	300520	6.03
37	Bartążek	30/18	349047	303675	13.00
18	Bartąg	30/285	188973	192097	-1.65
5	Bartążek	362/82	219566	292375	-33.16
24	Bartążek	30/27	319496	290884	8.96
35	Bartążek	30/19	366320	300520	17.96
25	Bartążek	30/26	319485	282968	11.43
32	Bartążek	16/39	148318	168265	-13.45
4	Bartąg	333/33	569904	650451	-14.13
30	Bartążek	329/23	469687	616359	-31.23
31	Bartążek	291/21	329598	393821	-19.49
12	Bartąg	329/21	326366	444295	-36.13
17	Bartąg	329/25	374309	409961	-9.52

7	Bartąg	311/3	258319	301761	-16.82
27	Bartąg	135/28	251233	229717	8.56
3	Bartąg	706	324429	278565	14.14
22	Bartążek	345/32	392468	353717	9.87
				s =	**27.86%**

Source: own elaboration

Table12.31 Percentage deviation between the real estate values estimated by the mean price adjustment method and adjusted transaction prices in Olsztyn's peripheral zone

No.	**Cadastral district**	**Plot No.**	**Price P_a [PLN]**	**Value V_M [PLN]**	**Deviation Δ [%]**
8	Olsztyn 118	38/51	386366	386366	0.00
3	Olsztyn 118	34/55	36903	78460	-112.61
4	Olsztyn 118	34/57	209061	285804	-36.71
13	Olsztyn 118	4/38	200987	320590	-59.51
1	Olsztyn 118	34/42	188663	298888	-58.42
10	Olsztyn 118	38/64	246670	385694	-56.36
14	Olsztyn 118	4/45	149441	255536	-70.99
15	Olsztyn 118	4/47	81666	101858	-24.72
43	Olsztyn 161	59/5	69789	96639	-38.47
44	Olsztyn 161	59/6	64930	89911	-38.47
47	Olsztyn 161	59/14	275788	214325	22.29
41	Olsztyn 161	59/3	129889	154608	-19.03
42	Olsztyn 161	59/4	69940	83254	-19.04
11	Olsztyn 118	4/23	237503	423926	-78.49
48	Olsztyn 161	60/8	81876	88076	-7.57
49	Olsztyn 161	60/9	77895	83795	-7.57
53	Olsztyn 161	60/13	59985	64528	-7.57
54	Olsztyn 161	60/14	58564	62999	-7.57
55	Olsztyn 161	60/15	90404	97251	-7.57
56	Olsztyn 161	60/16	106893	90578	15.26
45	Olsztyn 161	59/7	76684	78596	-2.49
46	Olsztyn 161	59/8	182907	187468	-2.49
50	Olsztyn 161	60/10	76684	78596	-2.49
51	Olsztyn 161	60/11	72208	74008	-2.49
52	Olsztyn 161	60/12	67136	68810	-2.49
5	Olsztyn 118	38/110	150907	145764	3.41
6	Olsztyn 118	38/111	149789	144684	3.41
19	Olsztyn 160	2/129	438261	388115	11.44
21	Olsztyn 160	2/141	933651	688171	26.29
9	Olsztyn 118	38/82	371163	350088	5.68
2	Olsztyn 118	34/45	345145	322712	6.50
12	Olsztyn 118	4/26	237502	237496	0.00
				s =	**36.07%**

Source: own elaboration

As demonstrated by Table12.30, percentage deviation did not exceed 10% in 7 transactions that accounted for only 33% of the examined transactions.

In Olsztyn's peripheral zone (Table12.31), percentage deviation was below 10% in the largest group of 16 property transactions (50% of the total number of transactions).

These results indicate that real estate values estimated by the mean price adjustment method diverged more considerably from adjusted transaction prices than the values calculated with the pairwise comparison method. Percentage deviation reached 28% in plots located in the suburban zone, and it was higher (36%) in Olsztyn's peripheral zone. Mean percentage deviation was estimated at 32% for both data sets.

12.6.5. Comparative validity of real estate values estimated in a statistical analysis of the real estate market

The differences between market values calculated in the statistical analysis and the adjusted transaction prices were determined based on the results of forward and backward stepwise regression which are presented in Appendix 16 for the Bartąg-Bartążek suburban zone and Appendix 17 for Olsztyn's peripheral zone. These tables also present the percentage deviation of the values estimated for each property and the mean percentage deviation for both data sets. As demonstrated by Appendix 16, the mean percentage deviation of the values estimated by both forward and backward stepwise regression was similar at 35%. Percentage deviation was below 10% in 22% of the properties valued by forward stepwise regression and in 18% of the plots valued by backward stepwise regression. Percentage deviation reached 10-20% in around 15% of the properties valued by forward stepwise regression and in 44% of the plots valued by backward stepwise regression. The largest number of plots (56% in forward and 30% in backward stepwise regression) were characterized by percentage deviation of 20-50%. Percentage deviation exceeded 50% in only two plots estimated by forward stepwise regression and in two plots valued by backward stepwise regression (7%).

In Olsztyn's peripheral zone (Appendix 17), percentage deviation was below 10% in the largest number of plots valued by forward (26 properties) and backward stepwise regression (22 properties), and these properties accounted for 26% and 22% of all transactions, respectively. Percentage deviation ranged from 20% to 50% in 18% and 12% of the plots valued by the respective methods. In 5-6% of the examined properties, percentage deviation exceeded 50%. Mean percentage deviation in Olsztyn's peripheral zone reached 30% for the values modeled by forward stepwise regression and 28% for the values modeled by backward stepwise regression. The differences between the

estimated market values and adjusted transaction prices were greater in stepwise regression than in the pairwise comparison method and the mean price adjustment approach. Mean percentage deviation approximated 29% in forward and backward stepwise regression, and it reached 32% for both data sets and was similar to that noted in the mean price adjustment method.

12.6.6. Comparative analysis of the validity of the cadastral (tax) value of real estate estimated by the mass appraisal method

The comparative validity of the mass appraisal method recommended by the General Property Taxation Guidelines (Adamczewski et al. 2002) was analyzed, and the convergence between the calculated cadastral (tax) values and time-adjusted transaction prices was examined. The differences between the calculated cadastral (tax) values and adjusted transaction prices were expressed by percentage deviation (formula 12.18) and mean percentage deviation (formula 12.19) for both data sets. The results are presented in Tables 12.32 and 12.33.

Table12.32 Percentage deviation between cadastral (tax) values and transaction prices in the Bartąg-Bartążek suburban zone

No.	Cadastral district	Plot No.	Price [PLN]	Value [PLN]	Deviation Δ [%]
29	Bartąg	205/19	210022	231095	-10.03
16	Bartąg	135/17	227400	285788	-25.68
23	Bartąg	362/47	145359	247498	-70.27
13	Bartąg	135/19	145823	176537	-21.06
19	Bartąg	30/20	319800	304840	4.68
37	Bartążek	30/18	349047	308041	11.75
18	Bartąg	30/285	188973	186287	1.42
5	Bartążek	362/82	219566	261945	-19.30
24	Bartążek	30/27	319496	284180	11.05
35	Bartążek	30/19	366320	304840	16.78
25	Bartążek	30/26	319485	276448	13.47
32	Bartążek	16/39	148318	153951	-3.80
4	Bartąg	333/33	569904	591324	-3.76
30	Bartążek	329/23	469687	529423	-12.72
31	Bartążek	291/21	329598	339762	-3.08
12	Bartąg	329/21	326366	376609	-15.39
17	Bartąg	329/25	374309	353045	5.68
7	Bartąg	311/3	258319	256094	0.86
27	Bartąg	135/28	251233	205744	18.11
3	Bartąg	706	324429	249573	23.07
22	Bartążek	345/32	392468	305163	22.25
				s =	**20.80%**

Source: own elaboration

As demonstrated by Table12.32, the mean percentage deviation between cadastral (tax) values and transaction prices calculated by the mass appraisal method did not exceed 21% in the Bartąg-Bartążek suburban zone.

As demonstrated by Table12.33, mean percentage deviation between cadastral (tax) values and time-adjusted transaction prices reached 26% in Olsztyn's peripheral zone, and it was only somewhat higher than in the suburban zone. As demonstrated by Tables 12.32 and 12.33., the mean percentage deviation of cadastral (tax) values calculated by the mass appraisal method was relatively low at 21% and 26% in the analyzed data sets, respectively. The mean percentage deviation for both data sets was estimated at 24%.

Table12.33 Percentage deviation between cadastral (tax) values and transaction prices in Olsztyn's peripheral zone

No.	Cadastral district	Plot No.	Price [PLN]	Value [PLN]	Deviation Δ [%]
8	Olsztyn 118	38/51	386366	434133	-12.36
3	Olsztyn 118	34/55	36903	66028	-78.92
4	Olsztyn 118	34/57	209061	249717	-19.45
13	Olsztyn 118	4/38	200987	276588	-37.62
1	Olsztyn 118	34/42	188663	257865	-36.68
10	Olsztyn 118	38/64	246670	310845	-26.02
14	Olsztyn 118	4/45	149441	215045	-43.90
15	Olsztyn 118	4/47	81666	85899	-5.18
43	Olsztyn 161	59/5	69789	89804	-28.68
44	Olsztyn 161	59/6	64930	83552	-28.68
47	Olsztyn 161	59/14	275788	227880	17.37
41	Olsztyn 161	59/3	129889	148415	-14.26
42	Olsztyn 161	59/4	69940	79916	-14.26
11	Olsztyn 118	4/23	237503	293345	-23.51
48	Olsztyn 161	60/8	81876	81847	0.04
49	Olsztyn 161	60/9	77895	77868	0.04
53	Olsztyn 161	60/13	59985	59964	0.04
54	Olsztyn 161	60/14	58564	58543	0.04
55	Olsztyn 161	60/15	90404	90372	0.04
56	Olsztyn 161	60/16	106893	106855	0.04
45	Olsztyn 161	59/7	76684	73037	4.76
46	Olsztyn 161	59/8	182907	174208	4.76
50	Olsztyn 161	60/10	76684	73037	4.76
51	Olsztyn 161	60/11	72208	68774	4.76
52	Olsztyn 161	60/12	67136	63943	4.76
5	Olsztyn 118	38/110	150907	122666	18.71
6	Olsztyn 118	38/111	149789	121758	18.71
19	Olsztyn 160	2/129	438261	328322	25.09
21	Olsztyn 160	2/141	933651	527984	43.45
9	Olsztyn 118	38/82	371163	243653	34.35
2	Olsztyn 118	34/45	345145	224601	34.93
12	Olsztyn 118	4/26	237502	163892	30.99
				s =	**26.07%**

Source: own elaboration

12.6.7. Comparative analysis of the market value of property determined by the pairwise comparison method and the values determined by the remaining real estate valuation methods

In the second stage of the comparative analysis, an attempt was made to determine the percentage deviation between the market value estimated by the pairwise comparison method and the values that had been determined previously by the remaining valuation methods, i.e.:

- indicator method with the standard valuation rate,
- sales comparison method,
- mean price adjustment method,
- statistical analysis of the real estate market with stepwise regression,
- mass appraisal method with the GRET model.

The values of properties selected randomly in the Bartąg-Bartążek suburban zone and Olsztyn's peripheral zone were examined in the last step of the analysis. A total of 10 properties in the suburban zone and 12 properties in Olsztyn's peripheral zone were selected for the analysis. The values of these properties had been previously estimated by the sales comparison method and the pairwise comparison method . Percentage deviation and mean percentage deviation between the estimated values and the market value determined by the pairwise comparison method were calculated with the use of formulas 12.33 and 12.34.

Due to differences in the parameters describing the market attributes of comparative properties, the baseline value for the comparison was the market value of real estate estimated based on the arithmetic mean of unit adjusted prices, even though the market values calculated with the use of weighted average 2 (additive inverse of the value of adjustments for the compared properties) better approximated transaction prices. The above baseline value was adopted on the assumption that this method of calculating the market value of real estate is widely applied in practice. The results of the comparative analysis are presented in Appendixes 18 and 19.

As demonstrated by Appendix 18, the market values of land plots in the Bartąg-Bartążek suburban zone estimated by the pairwise comparison approach were most similar to the values estimated by the mass appraisal approach (mean percentage deviation was only 14.28%) and the sales comparison method (s=19.04%). The mean price adjustment method also produced satisfactory results, and mean percentage

deviation reached 22.62%. The percentage deviation of the values estimated in the statistical analysis exceeded 30% (s=33.35%). It should also be noted that the analyzed values of individual plots estimated with the use of the compared methods were characterized by very low percentage deviation. In the suburban zone, a comparison of the market values of real estate estimated by the pairwise comparison method and the values determined by the remaining valuation methods revealed that the indicator method with the standard valuation rate produced least satisfactory results. In can be concluded that the indicator method does not meet expectations at the current stage of market development in Poland. As demonstrated in Appendix 19, the percentage deviation between the values estimated by the indicator method and the market value exceeds 70%. However, this result can be improved by modifying the initial value of real estate (V_w). This can be accomplished by calculating parameter V_w based on transaction prices in suburban and peripheral zones, in the private sector. When the above modification was introduced, the simulation revealed that the percentage deviation of the values estimated by the indicator method decreased and was similar to that noted in the sales comparison method. In Olsztyn's peripheral zone, the comparison of the estimated market values and the values determined with the use of the examined methods produced less satisfactory results than in the Bartąg-Bartążek suburban zone. Mean percentage deviation was lowest (s=17%) when the value calculated by the sales comparison method was compared with the market value. Deviation exceeded 30% when the values were estimated by the remaining methods, and it exceeded 50% in the mass appraisal approach and the mean price adjustment method. Plot No. 39/32 in cadastral district 160 (Olsztyn) considerably influenced the results in the peripheral zone. The percentage deviation between the market value of the above plot and its values estimated by the mean price adjustment method and the mass appraisal method exceeded 100% and 200%, respectively. An improvement was noted in the results when the above property was eliminated from the data set, and the mean percentage deviation was found to:

- decrease from 17% to 11% in the sales comparison approach; from 81% to 57% in the mean price adjustment method; and from 52% to 38% in the mass appraisal approach;
- increase by around 2% in the indicator method and in the statistical analysis.

In several cases, the values estimated by the tested methods were similar to the market value. The values estimated by the pairwise comparison method were identical to the market value. The values calculated in the statistical analysis deviated from the market

value by only 1.3%, and the values estimated by the mass appraisal method (GRET) diverged from the market value only by around 1.7%. Percentage deviation was higher at 5.8% in the mean price adjustment method. In Olsztyn's peripheral zone, the values calculated by the sales comparison method most closely approximated the market value, and mean percentage deviation reached 12% when plot No. 39/32 (cadastral district 160) was eliminated from the data set. Mean percentage deviation exceeded 30% in the remaining cases. The obtained results were influenced by the following factors:

- choice of comparative properties for estimating the market value of real estate,
- application of quantitative adjustments to modify the prices of comparative properties in the market analysis,
- use of the arithmetic mean or the weighted average in calculations of the unit value of real estate based on the adjusted prices of comparative properties.

13. DISCREPANCIES BETWEEN THE MARKET VALUE OF A REAL PROPERTY AND THE STATORY SALE PRICE IN VIETNAM. PROPOSED IMPROVEMENTS TO SYSTEM

As mentioned in previous chapters of this monography, Vietnam maintains the statutory (administrative) system of establishing prices for real estate in urban areas. The price determination procedure is inscribed in law. Regardless of the state regulations, there is a land real estate market where prices are determined in free circulation, based on market value. This trade takes places outside the official procedure for sale of rights to land properties and is not covered by the official registration of changes in land ownership. This gives rise to tensions on the market of land lots in urban areas, and is one of the obstacles to the rational management of cities and towns. Recently, the Vietnamese authorities have acknowledged the problem and have been making efforts to prevent or at least to minimize discrepancies between market price and statutory price of land lots. This new approach is confirmed by the ongoing adjustment of regulations concerning the management of state-owned real estate to subsequent steps in the transition of the state economy to a model based on some market economy principles. Changes include the amendment of the law governing the real estate markets in Vietnam. An example is the passing of Land Law in 2003, where natural and legal persons as well as some foreign entities were granted more options in terms of using state land. Land Law 2003 contains provisions regulating the functioning of real estate market, which allow the conclusion of certain land ownership transactions on the free market. However, the law sustains some formal restrictions imposed on this type of real estate market. Typical market transactions are concluded more and more often, involving the sale of urban land use rights. Prices obtained in such transactions are higher than the ones determined by the state (regulated prices for rights to land use). In 2001, new guidelines for the assessment of real estate value were developed (Vo et al. 2001), yet considerable differences between market value of land lots and their statutory value are still noted. These differences lead to a number of negative behaviors on the restricted market, such as:

- speculative trading of land use rights,
- lack of transparency in dealings between offices and natural or legal persons,
- distortions in the land demand and supply relations (market distortions),

– difficulties in maintaining the principles of sustainable development of urban areas,

– shortage of cash inflows to the state central and local budgets as revenues from active real estate management measures (prices, fees, receivables),

– tensions in the system of fees and receivables linked to the value of a real property (valuation, updating),

– cases of discretion in the opinion-making process, inducing the risk of corruption in the real estate sector,

– difficulties in the optimal development of urban areas (structural tensions) and the occurrence of breaching the law when implementing changes in the land use of land lots for purposes connected with urban development,

– lack of complete and generally accessible information about concluded transactions (lack of transparency).

The development of a new system for determining prices of land in urban areas used by central and local administration is one of the basic measures to eliminate or considerably reduce the above negative phenomena. The system should incorporate the basic principles of market economy and employ procedures of mass appraisal, taking advantage of price quotations on the free market (informal real estate trade). The procedures and detailed actions proposed in this monograph lead in this direction. It seems, taking into consideration the political and economic background, that it is advisable to leave the control over the real estate market in the hands of the state authorities, which is due to the basic assumptions underlying the management of land resources owned by the country's society. Any additional measures, proven to be effective in practice, which contribute to minimizing the gap between market prices for land properties and ones determined by the state administration can support substantially a more balanced development of this sector in Vietnam. Positive outcomes of such efforts in the development real estate market have been implicated by Wolf (1978, 1979), Dale et al. (1988, 1999), Źróbek et al. (2020), Munro – Faure (1999), Grad, (1999), Chinh (2020) and others. The application of market economy rules in land real estate trade calls for complex and interrelated procedures. Their implementation into practice takes time and experience. The main purpose of the system for valuation of land lots in urban areas in Vietnam proposed in this dissertation is to reduce substantially the discrepancy between statutory prices of real properties and their market value, thereby to implement

principles for the regulation of this market. This is explained schematically in Fig. 13.1, which highlights the crucial role of this new land appraisal system according to market value, which should benefit groups of natural and legal persons. An GIS-based integrated information system is a significant element of the new system for the valuation of land lots in urban setting. An important component of this system should consist of maps of vector values of land resources. Another significant element is the efficient land right registration sub-system, based on the assumptions defining a contemporary cadastre. It is essential to register data related to a specific local market when acquiring information. Such an integrated approach should enable significant reduction of the gap between market prices (P_M) and statutory prices (P_A) on a local land estate market. The significantly diminished discrepancy between these two prices will make it possible to adhere to the following formal requirement:

$$\mathbf{P_M - P_A \rightarrow min} \tag{13.1}$$

It appears that the acceptable discrepancy between these two prices should not exceed +/- 30% P_M. Studies carried out on test fields (OLSZTYN) confirmed that this target is achievable in practice. However, it is worth noting that Poland is in a different stage of economic development than Vietnam. Looking back at some historical appraisal methods, dating to 1990-1995 and presented earlier in this work, we were able to confront the results obtained here with the current situation on this market in 2020. This attested to the legitimacy of the methods used to appraise land lots in urban areas. At the same time, it enabled us to amend these procedures according to the current experience in how the real estate market functions, and to eliminate some inaccuracies in the procedures applied back then. Because Vietnam, unlike Poland, does not have an integrated system of real estate data including the module **Register of Real Estate Prices**, data on informal market transactions ought to be obtained from other, indirect sources and supplemented with the information acquired from surveys addressing this issue.

When the real estate market is not yet sufficiently developed (and this is the situation in Vietnam among other countries), there are certain disturbances in the functioning of this market, reflected in the process of determining market prices for land lots. Such disruptions can arise from:

a) the lack of sufficient competition among investors in access to urban space,
b) the shortage of detailed information on the mechanisms shaping the local market,

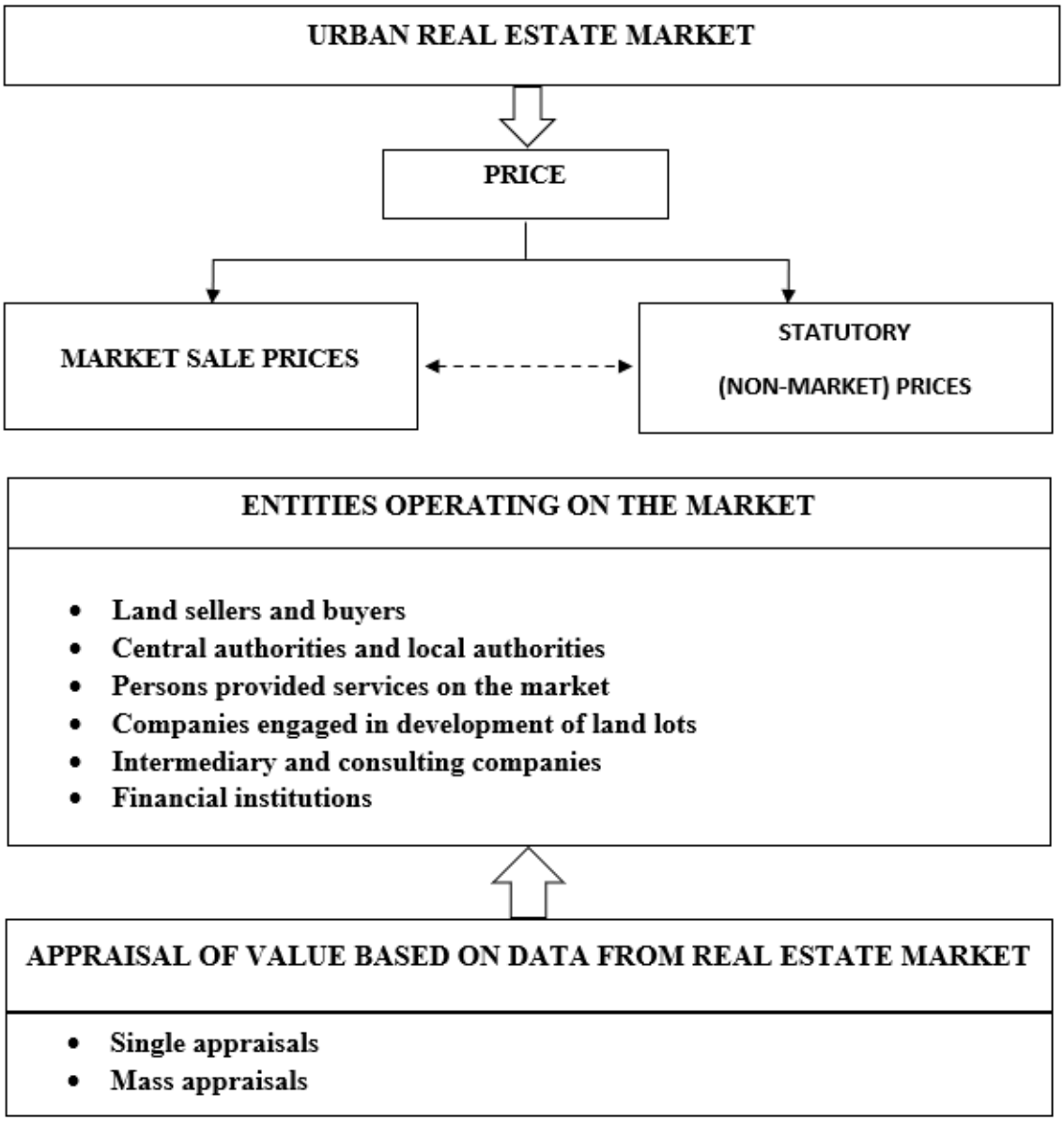


Fig. 13.1 Diagram illustrating the real estate market in Vietnam

Source: developed by the author

c) the procedure of improperly determined real estate prices based on component criteria inadequately chosen in relations to the market (irrational actions),

d) the object of an analysis (real property) being immovable in space – while the environment of the appraised land being changeable,

e) the market being artificially shaped and excessively influenced by the government agencies, due to external regulations affecting the urban land supply and demand,

f) time wasted because of the formalized decision-making system involved in the implementation of detailed procedures applied to selling public land to natural and legal persons,

g) making decisions on the management of urban areas based on considerations which are not completely connected to economic factors (including the market value of land lots),

h) increase in public costs incurred by the development of infrastructure grids necessary for the development of land for housing and services purposes,

i) difficulties in the application of profitability analyses regarding investments in urban areas,

j) an ineffective land taxation system, reducing revenues to municipal budgets,

k) difficulty stimulating the management of urban areas,

l) excessive interventionism of public authorities in the processes occurring on real estate markets.

It is worth underlining that a properly elaborated system of valuation of land resources in urban areas makes it possible to eliminate or at least largely restrain problems arising in the real estate sector. As mentioned earlier, the market value of urban land depends on several factor, which in general can be put in the following groups (Table13.1.). In such situations, the model approach to the real estate market displayed in Fig. 13.2 is applicable.

Table 13.1. Group of factors influencing value of land

GROUP OF FACTORS INFLUENCING VALUE OF LAND	EXAMPLES OF DETAILED FACTORS
I. Social factors	– population and its structure including an analysis of changes in the time period analyzed, – urban lifestyle (urban, urban-rural, rural, other), – education (distribution of schools, level of education), – local customs and habits.
II. Economic factors	supply/demand and mutual relations, – employment (including the unemployment rate), – average incomes of the population in the analyzed market, – real estate taxation system.
III. Government factors – policy in the real estate sector (central and local level)	– law on the real estate sector, procedures and model proceedings, – spatial planning and management, – formal restrictions on purchase of land, – decisions related directly to the real estate sector, – statutory assumptions related to land ownership, rent and use.
IV. Environmental factors	– microclimate and local conditions (ground, air, water), – the natural land relief (topography), – flood threat or occurrence of other atmospheric phenomena.

Source: developed by the author

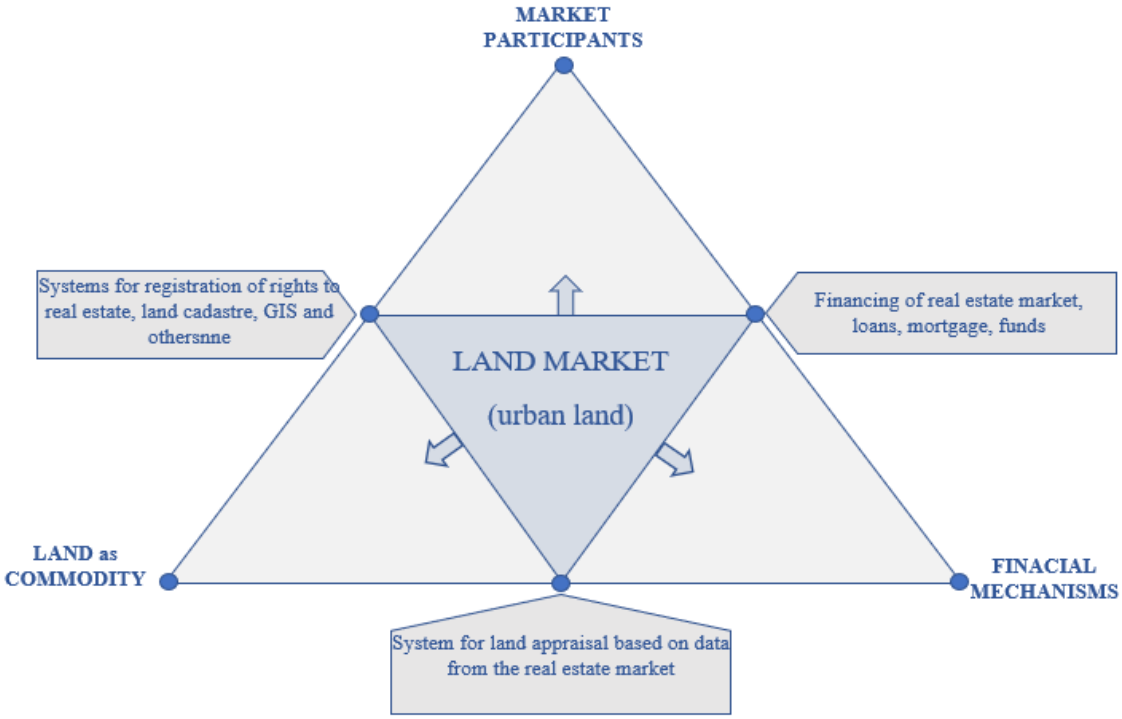


Fig. 13.2 A model approach to real estate market

Source: developed by the author, based on Dale and Baldwin 2000.

With respect to the principles underpinning the real estate markets in Poland and in Vietnam, and differences between both countries, it can be concluded that the major difference lies in how real estate prices are established. In Poland, the administrative approach to real estate (land) price determination has been abandoned completely, and the chief market economy rules are employed. Meanwhile, Vietnam continues to adhere to the statutory price determination system, as had been done in Poland prior to 1990. Analysis of both systems makes it possible to outline the possibilities of taking advantage of Polish experiences from the decades 1990-2020 to improve the urban land valuation system in Vietnam. The developed assumptions and suggestions presented herein take into account the fact that the Vietnamese land valuation system relies on the statutory price determination for land lots. This fact has been considered by others, for example Tam (2008), in a report written for the ITC needs in Holland. For a modern real estate market to function properly, it is necessary to possess a system for storing information about transaction prices, including ones which have been paid outside the official land ownership rights trade. The real market estate is the main place where allocation and exchange of land ownership rights take place, with different aims in mind, including residential housing. According to the diagram shown in Fig. 13.2, operations connected

to the real estate market need support in the form of land lot registers, appraisal of real estate value, and the participation of the financial sector.

In principle, the foundations laid to support the urban real estate market require proper legal regulations and appropriate preparation of persons engaged in providing services to this market. The latter concerns both officials dealing with real estate management and with special planning and development, and consultants operating on the real estate market (e.g. valuers, realtors, real estate administrators, financial advisors, etc.). To this end, it is worth taking advantage of the Polish experience from the 1990s, when the foundations of the contemporary real estate market were created. The experience gained by other countries in this scope has been highlighted by Adlington at al. (2000), Grover and Elia (2011) or Źróbek et al. (2020). The articles and reports published in the FIG Proceedings in 1990-2020 reveal a clearly declared view that all actions related to the proper functioning of a real estate market were based on the key assumptions, such as the guidelines for maintaining a register of rights to real properties, system of real estate appraisal, and a system financing the real estate market. It is essential to constantly research the situation on the real estate market, and to compile the research results so as to make them available to experts. In this monograph, special attention has been paid to improving the system of urban land appraisal, in the context of the specific situation in Vietnam. Assessment of the market value of land lots (or another value approximate to the market value) is the basis for many actions on the real estate markets. This value can be used for general taxation purposes, and to regulate and intensify the development of urban areas. The research presented in this work and conducted in selected test fields proved that the assessment of a value could be successfully made using relatively simple statistical tools (e.g. multiple regression function). In such studies, the character and accuracy of data entered into this model should be borne in mind. When dealing with prices of real properties, of significance is the understanding that a price is a specific fact on a given local real estate market, which took place on a specific date. There is no certainty that the same price shall be obtained in another transaction for the same property as achieved earlier even in the absence of evident changes in the functioning of the market in the near future (e.g. 2-3 months). It is so because a price is affected by numerous factors, of different direction and size of impact. They tend to be the result of the basic market elements, such as supply and demand on the real estate market. The market value of land is also affected by behavioral factors, extremely difficult to identify, measure and evaluate. Application of sophisticated

statistical methods to determine the effect of particular factors on the value of a real property does not always result in a more accurate estimate, in particular of the strength and direction of this impact. Hence, the suggestion to use the multiple regression model seems to be a correct and fully justified solution, considering the research aim and results. Another problem is the selection and then measurement of explanatory variables (Table13.1.) influencing prices of real properties in urban areas. This selection requires sound knowledge of the local market. Such techniques as correlation and cluster analysis are helpful in eliminating an excessively large set of explanatory variables, and in properly selecting these factors that shape the market value of urban land lots.

The data collected from our research, when making analyses of the impact of factors on market prices in the selected experimental fields, demonstrate that the number of such factors only exceptionally, at the initial stage of analysis, exceeds 10. Occasionally, when there are more factors and pre-selection is needed, this can be achieved with the help of correlation analysis. Results of survey studies addressed to groups of real estate market experts can also be helpful.

Measurement of the size of explanatory variables is made using direct techniques (e.g. distance in kilometers and indirect techniques, which call for the compilation of different parameters and their inscription on different scales (e.g. 0-1 or 0-10). Descriptive scales are possible as well, for example qualitative one: very good, good, average, poor, or other specialist scales. A sale comparison approach is worth recommending for determination of a value of urban land lots. This solution has been mentioned earlier, in this dissertation, inclusive of the formal conditions underlying its application (Fig. 13.3). An essential step in the analysis is to acquire data on transaction prices for land lots. The figure below shows schematically the process of appraising vacant land lots, from a description of the real property submitted to appraisal, to the interpretation of the appraisal's outcome. The following Fig. 13.4 relates to significant actions dedicated to the acquisition of information on the analyzed real market estate. In Vietnam, a significant role is played by interviews with experts and results of surveys addressed to this market's participants engaged in the informal trade. During field interviews, the level of speculation on urban land lots over the past two years and possible corruption present during these transactions should also be addressed. However, these are difficult to determine due to the lack of official data and therefore require particular care.

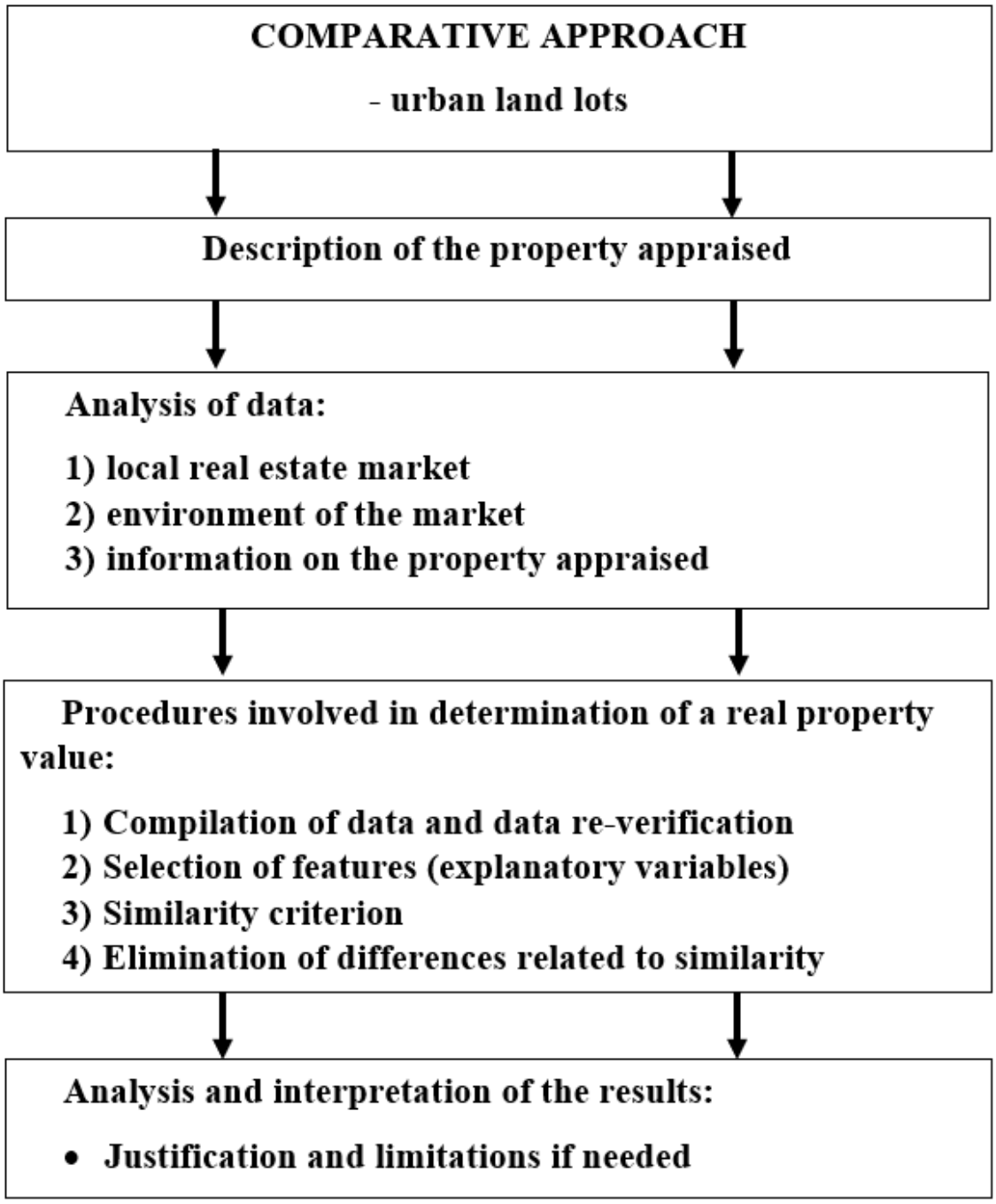


Fig. 13.3. Process of determining the value of urban land in the sale comparative approach

Source: developed by the author

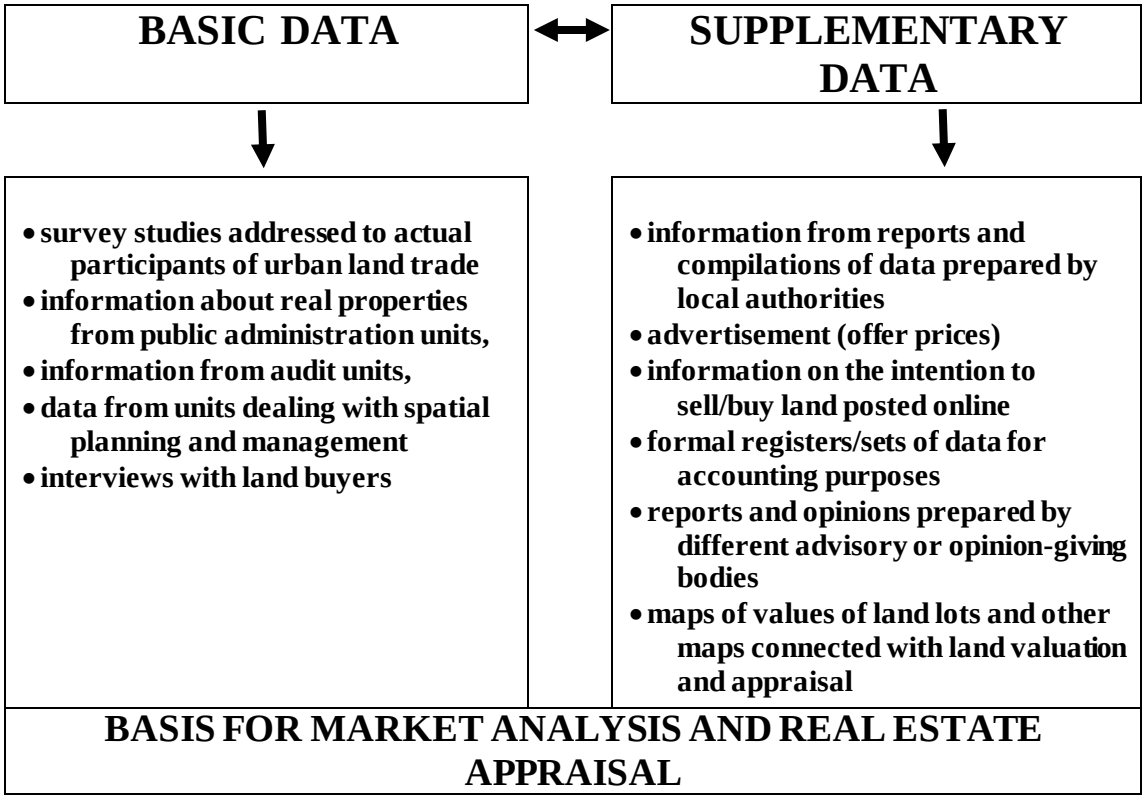


Fig. 13.4. Schematic presentation of data acquisition in the process of urban land appraisal in Vietnam
Source: developed by the author

Experience with surveying real estate market participants shows that questions contained in a survey should be carefully considered and worded so as to obtain interpretable answers. Questions should also enable respondents to express their feelings and observations. Considering the subject of the study, it is essential to ensure full anonymity of the respondents. Then, we are more likely to obtain truthful answers. It is also worth selecting around 10 to 20 real estate market experts and first explaining to them the purpose of the survey study. Their answers to the questionnaire will be particularly important because they will enable one to create a professional structure of the analyzed market and to acquire significant data for further research. The survey system has certain drawbacks, related to the difficult interpretation of some answers regarding real property prices. Often, such behaviors have a psychological background or result from the mentality of a respondent. It is recommended to take into consideration the worries that the respondents may have due to acting outside the formal trade of urban land lots. However, until a coherent and efficient system of real property price registration is developed in Vietnam, survey studies remain a tool for expanding our knowledge about the local market. Surveys also create an opportunity to make an appropriate selection of

features explaining particular transactions. However, we need to mention that a large number of permitted land use rights transactions occur outside the official registration. They are written agreements, and are stored only by the interested parties (buyer and seller) following negotiations on the sale of rights to land. Information on such transactions is difficult to collect because they do not give rise to official consequences, such as paying taxes. On the other hand, these data refer to specific prices for land lots and are essential to build a model for mass appraisal of urban land properties. The acquisition of data about the real estate market in an urban area is also hindered by the lack of transparency and the associated land speculation. Eliminating or at least reducing these phenomena is possible only if a unit is set up that will be responsible for monitoring the real estate market dealing with land resources in urban areas. A system like this already exists in Poland (Register of Real Estate Prices). The Register of Real Estate Prices provides basic data about concluded transactions and is updated all the time. The other essential data for an appraisal of the market value of land lots can be obtained by the valuer from other sources, such as: a real estate cadastre, land and mortgage register, base map, topographic map, local spatial development plan, theme maps, specialist compilations of data related to city management and other sources. In addition, the valuer carries out an inspection of the appraised land property, where they verify the relevance and completeness of the information about the real estate in question. If necessary, new data which could not have been acquired before can be added at this stage. Such actions should be undertaken in Vietnam as well, so as to increase the transparency of land property valuation and accuracy of the determined market value of real estate.

14. METHOD FOR ESTIMATING THE VALUE OF URBAN LAND IN VIETNAM'S TRANSITION ECONOMY BASED ON POLISH EXPERIENCES

The indicator method for appraising land value, which had been used in Poland in the early stages of the transition process from a centrally planned economy to a market economy, was discussed in the previous chapters. In successive stages of market evolution, the indicator method was gradually replaced by approaches that are deployed on well-developed real estate markets. Reliable information about property prices and real estate transactions became available in 1993-1995, and real estate valuations in Poland were increasingly often performed with the use of methods characteristic of the comparative approach. However, the indicator-based approach continued to be applied when the information about transaction prices was insufficient to perform standard comparative analyses. In this chapter, an attempt was made to determine whether the indicator method can be modified to generate reliable information for property assessment in countries where real estate transactions are not fully based on market principles. Vietnam is one of such countries where real estate prices are set by the State authorities. However, land-use rights in Vietnam are also traded on the informal market, and the resulting data are not entered into official registers. Therefore, the objective of this stage of the study was to validate the following research hypothesis: the indicator method can be modified to appraise property in different stages of real estate market evolution, in particular in transition economies. A detailed analysis was performed based on the previously examined test fields in the vicinity of the Polish city of Olsztyn. The results of the analysis were used to formulate general recommendations for applying the modified indicator method in countries with a rapidly evolving commercial environment. The choice of properties for the study was also determined by the availability of real estate market data. Property attributes for the analysis could be unambiguously defined and measured in each examined case. The information about the Vietnamese real estate market was acquired from real estate experts who monitor changes in the real estate sector. The Vietnamese real estate market was also analyzed based on a review of the literature. The results of our previous study (2018-2020) investigating test fields in Hanoi were also used. Official (statutory) prices were significantly underestimated relative to the prices quoted on the informal market, which enabled the State to decrease the value of compensation for requisitioned land. The question that remained to be answered was whether the indicator method (applied in Poland in the early 1990s) could be modified for use in mixed economies and on emerging markets. Two variants for modifying the

indicator method were described. The first variant relied on the method of successive approximations involving fixed variables (stimulants) that changed the parameters of the output equation. The second variant involved a statistical analysis based on multiple regression analysis. The results were validated in test fields (Olsztyn and Bartążek) based on the previously gathered information about land prices and transactions. Real estate valuations (in particular in the comparative approach) require sufficient quantities of information about the property and the neighbourhood. The formal requirements regarding data quality and quantity vary across valuation methods (Gnat, 2021). A sufficient number of reliable market transactions is needed to appraise property in the comparative approach. These data include transaction prices and price-forming factors (attributes that affect land prices). Large data sets improve the reliability of real estate market analyses, but they are not always easy to acquire. The reliability of property valuations may be compromised by a small number of reliable transactions (similar properties) on the local market. Similar properties traded in other areas or on neighboring local markets can be included in the analysis, but there is no guarantee that the compared markets will generate reliable information about the analyzed transactions. Considerable differences in property prices and attributes also constitute a problem in the process of acquiring information about real estate. This problem is encountered when the variability of property attributes is limited, or when many properties are traded in a single transaction. In such a situation, a given market could be characterized by the absence of price monotonicity. As a result, the availability of data for real estate valuation could be limited. According to Kucharska-Stasiak (2007), reliable real estate appraisals can be problematic on dynamically changing markets. The risk of underestimation or overestimation is higher in the comparative approach than in other methods of land appraisal.

For the needs of this study, a weakly developed market was defined as a market that is characterized by considerable fluctuations, where the traded properties do not provide sufficient information about reliable transaction prices or attributes that influence real estate prices. On such markets, accurate property appraisal could be problematic. On weakly developed markets, this risk could be minimized by applying a modified indicator method to ensure greater convergence between valuation results and average property prices on local markets. A modified indicator method would thus increase the accuracy of land appraisal in countries with transition economies. This observation was confirmed by real estate experts in both Poland and Vietnam. The initial value of urban land (in indicator method) had to be determined in the first stage of the appraisal process. This

solution was dictated by the scarcity of reliable information about property prices during Poland's transition from a centrally planned to a free market economy (1989-1991).

Modification of the indicator method

The value of real estate determined in the appraisal process is an economic variable that cannot be obtained through direct measurement, but is derived based on observations of consumer behaviors in the economic arena. The estimated value is based on the results of analyses and an assessment of consumer behaviors. The market value of property is most often used in the urban management process. A procedure for modifying the indicator method was proposed in this study. Several modification variants and approaches were tested on a set of properties in the examined test fields. The procedure consisted of several stages. In the first stage, the number of transactions and transaction prices were analyzed in both test fields. The analysis covered 250 vacant land plots that were traded on a free market between 2017 and 2020. The traded land plots were described with the use of attributes characteristic of the indicator method, based on the previously discussed measurement methods. The land plots for validating the modified indicator method are described in Tables 14.1 and 14.2.

Table 14.1 Description of real estate transactions in the suburban zone of Bartąg and Bartążek, including the base price, initial land value, and real estate value determined with the indicator method

No.	Price [PLN]	Area [m^2]	Psk [PLN/m^2]	Vo [PLN]	u	s	Vw [PLN]	k1	k2	k3	k4	k5	k6	V [PLN]	V [PLN/m^2]
1	324 429	1170	277.29	4966.50	3	1	14899.51	0.5	0	0.3	0.3	0.5	0.3	43209	36.93
2	569 904	2789	204.34	11838.96	3	1	35516.87	0.9	0.2	0.3	0.3	0.5	0.6	134964	48.39
3	219 566	1228	178.80	5212.71	3	1	15638.12	0.7	0.15	0.3	0.3	0.4	0.5	52388	42.66
4	319 496	1764	181.12	7487.96	3	1	22463.88	0.5	0.15	0.3	0.3	0.5	0.2	66268	37.57
5	258 319	1070	241.42	4542.02	3	1	13626.05	0.9	0	0.3	0.3	0.2	0.4	42241	39.48
6	132 556	411	322.52	1744.64	3	1	5233.93	0.4	0.25	0.3	0.3	0.4	0.3	15440	37.57
7	326 366	1450	225.08	6155.07	3	1	18465.21	0.9	0.15	0.3	0.3	0.2	0.5	61858	42.66
8	145 823	1014	143.81	4304.30	3	1	12912.91	0.8	0.2	0.1	0.3	0.4	0.2	38739	38.20
9	319 485	1716	186.18	7284.21	3	1	21852.62	0.5	0.15	0.3	0.3	0.5	0.2	64465	37.57
10	227 400	1875	121.28	7959.14	3	1	23877.42	0.8	0.2	0.1	0.3	0.4	0.2	71632	38.20
11	374 309	1622	230.77	6885.19	3	1	20655.56	0.9	0.15	0.3	0.3	0.2	0.4	67131	41.39
12	188 973	1070	176.61	4542.02	3	1	13626.05	1	0.15	0.3	0.3	0.3	0.2	44285	41.39
13	251 233	1028	244.39	4363.73	3	1	13091.19	0.9	0.15	0.3	0.3	0.2	0.5	43856	42.66
14	319 800	2000	159.90	8489.75	3	1	25469.25	1	0.15	0.3	0.3	0.3	0.2	82775	41.39
15	210 022	2070	101.46	8786.89	3	1	26360.67	0.3	0	0.1	0.2	0.4	0.2	57993	28.02
16	469 687	2224	211.19	9440.60	3	1	28321.81	0.9	0	0.1	0.2	0.2	0.5	82133	36.93
17	392 468	1007	389.74	4274.59	3	1	12823.77	0.9	0.1	0.1	0	0.2	0.5	35907	35.66
18	392 468	1323	296.65	5615.97	3	1	16847.91	0.7	0	0.1	0	0.2	0.7	45489	34.38
19	329 598	1473	223.76	6252.70	3	1	18758.10	0.9	0.1	0.1	0.3	0.5	0.7	67529	45.84
20	148 318	753	196.97	3196.39	3	1	9589.17	0.4	0	0.1	0.3	0.5	0.2	23973	31.84
21	450 351	1100	409.41	4669.36	3	1	14008.09	0.4	0	0.1	0.2	0.4	0.3	33619	30.56
22	443 630	1107	400.75	4699.08	3	1	14097.23	0.4	0	0.1	0.2	0.4	0.4	35243	31.84
23	366 320	2000	183.16	8489.75	3	1	25469.25	0.5	0.15	0.3	0.3	0.5	0.3	77681	38.84
24	145 359	1073	135.47	4554.75	3	1	13664.25	0.3	0	0.1	0.2	0.2	0.7	34161	31.84
25	349 047	2021	172.71	8578.89	3	1	25736.68	0.5	0.15	0.3	0.3	0.5	0.3	78497	38.84

Source: own elaboration

Table 14.2 Description of real estate transactions in the Olsztyn peripheral zone, including the base price, initial land value, and real estate value determined with the indicator method

No.	Price [PLN]	Area [m^2]	Psk [PLN/m^2]	Vo [PLN]	u	s	Vw [PLN]	k1	k2	k3	k4	k5	k6	V [PLN]	V [PLN/m^2]
1	246 670	1173	210.29	4979.24	3	1.2	17925.26	0.6	0	0.1	0.2	0.2	0.6	48398	41.26
2	371 163	908	408.77	3854.35	3	1.2	13875.65	0.5	0	0.1	0.2	0.1	0.6	34689	38.20
3	98 361	952	103.32	4041.12	3	1.2	14548.04	1	0	0.1	0.1	0	0.6	40734	42.79
4	345 145	837	412.36	3552.96	3	1.2	12790.66	0.2	0	0.1	0.2	0.1	0.6	28139	33.62
5	129 889	559	232.36	2372.88	3	1.2	8542.39	0.2	0	0.1	0.1	0.2	0.6	18793	33.62
6	275788	1187	232.34	5038.67	3	1.2	18139.20	0.2	0	0.1	0	0.1	0.6	36278	30.56
7	933 651	2291	407.53	9725.01	3	1.2	35010.03	1	0	0.1	0.2	0.2	0.6	108531	47.37
8	438 261	1084	404.30	4601.44	3	1.2	16565.20	1	0	0.1	0.2	0.2	0.6	51352	47.37
9	188 663	909	207.55	3858.59	3	1.2	13890.93	0.2	0	0.1	0.2	0.1	0.6	30560	33.62
10	590 278	1411	418.34	5989.52	3	1.2	21562.27	0.7	0	0.1	0.1	0.2	0.6	58218	41.26
11	200 987	975	206.14	4138.75	3	1.2	14899.51	0.1	0	0.1	0.2	0.1	0.6	31289	32.09
12	517 555	1086	476.57	4609.93	3	1.2	16595.76	0.7	0	0.1	0.2	0.2	0.6	46468	42.79
13	209 061	1235	169.28	5242.42	3	1.2	18872.71	0.5	0	0.1	0.3	0.2	0.6	50956	41.26
14	149 441	710	210.48	3013.86	3	1.2	10849.90	0.5	0	0.1	0.3	0.2	0.6	29295	41.26
15	150 907	405	372.61	1719.17	3	1.2	6189.03	0.1	0	0.1	0.3	0.2	0.6	14235	35.15
16	386 364	3209	120.40	13621.80	3	1.2	49038.49	1	0	0.1	0.3	0.2	0.6	156923	48.90
17	386 366	2642	146.24	11214.96	3	1.2	40373.86	0.9	0	0.1	0.2	0.2	0.6	121122	45.84
18	477 462	942	506.86	3998.67	3	1.2	14395.22	1	0	0.1	0.3	0.2	0.6	46065	48.90
19	69789	316	220.85	1341.38	3	1.2	4828.97	0.2	0	0.1	0.2	0.2	0.6	11107	35.15
20	182907	613	298.38	2602.11	3	1.2	9367.59	0.2	0	0.1	0.1	0.2	0.6	20609	33.62
21	81876	288	284.29	1222.52	3	1.2	4401.09	0.6	0	0.1	0.3	0.1	0.6	11883	41.26
22	76684	257	298.38	1090.93	3	1.2	3927.36	0.6	0	0.1	0.3	0.1	0.6	10604	41.26
23	106893	376	284.29	1596.07	3	1.2	5745.86	0.6	0	0.1	0	0.1	0.6	13790	36.68
24	237 503	1022	232.39	4338.26	3	1.2	15617.74	0.3	0	0.1	0.3	0.2	0.6	39044	38.20
25	237 502	570	416.67	2419.58	3	1.2	8710.48	0.5	0	0.1	0.1	0.2	0.6	21776	38.20

Source: own elaboration

Data for analysis were selected with the use of the method proposed by Kramer to determine whether the applied theoretic formula effectively describes the examined market. This procedure was applied to ensure greater objectivity during the initial selection of input observations. Observations were selected from the data set, and atypical observations in each test field (outliers) were eliminated (Kramer 1994). For the needs of this study, atypical transactions were defined as observations where the frequency and probability of a given transaction price in the data set was low ($p < 0.05$), and where the distribution of a given diagnostic attribute differed considerably from the remaining transactions. In the second stage, transaction prices were adjusted to the date of the analysis (31 December 2021). The changes in real estate prices over time were determined with the use of simple regression analysis (Cellmer 1999a, 1999b) The following linear equation is used in the classical regression model:

$$\boldsymbol{C_{1m^2} = b + a \cdot x + \varepsilon} \quad \Rightarrow \quad \boldsymbol{r = \frac{a}{b} \cdot 100\%} \tag{14.4}$$

where:

C_{1m^2} – price per 1 m^2 of land area;

a, b – constant terms in the model, calculated with the least squares method;

x – date of transaction expressed on an interval scale;

r – price index denoting the percent change in price within a given time interval;

ε – random variable.

Based on the prices of vacant land (per 1 m^2), the following linear regression equations were derived for each data set:

- for Bartąg and Bartążek suburban zone-> $C_{1m}^2 = 135.3323 + 4.3941 * x_3 + \varepsilon$
- for Olsztyn's peripheral zone: -> $C_{1m}^2 = 145.0459 + 3.941 * x_3 + \varepsilon$

The prices of undeveloped land changed at a rate of 3.2%/month in Bartąg and Bartążek suburban zone and at 2.7%/month in Olsztyn's peripheral zone. These values were applied to adjust unit prices in both test fields to the date of the analysis. In the next stage, the base price (V_O) of vacant land in Bartąg and Bartążek suburban zone and in Olsztyn's peripheral zone was determined to calculate property value using the indicator method. In justified cases, the standard valuation rate could be increased even five-fold. Both test fields met the requirements for increasing the standard valuation rate, and this parameter was increased five-fold in the analyzed areas.

The base price (Vo), initial land value (V_W), and the value of land estimated with the use of the modified indicator method are presented in Tables 14.1 and 14.2, and in Figures (Fig. 14.1a and Fig. 14.1b) for both test fields. Twenty-five land plots were randomly selected in each test field to evaluate the accuracy of valuation. These data were used to validate and compare the results. Based on these observations, a method that generated the smallest differences between the modelled prices and real-world prices was selected.

The data presented in Fig. 14.1 indicate that the value of land estimated with the original indicator method was significantly lower than the transaction prices of land plots in the test fields. The estimated values differed by 80-90% from real-world prices; therefore, they are not acceptable. The greatest deviations were noted in the suburban zone (> 90%; 81.2% on average). In Olsztyn's suburban zone, the maximum difference between the estimated values and real-world prices also exceeded 91%. Transactions where the estimated values approximated transaction prices at a level of ± 30% were not noted.

a) suburban zone, s = 81.2% *b) peripheral zone, s = 84.1%*

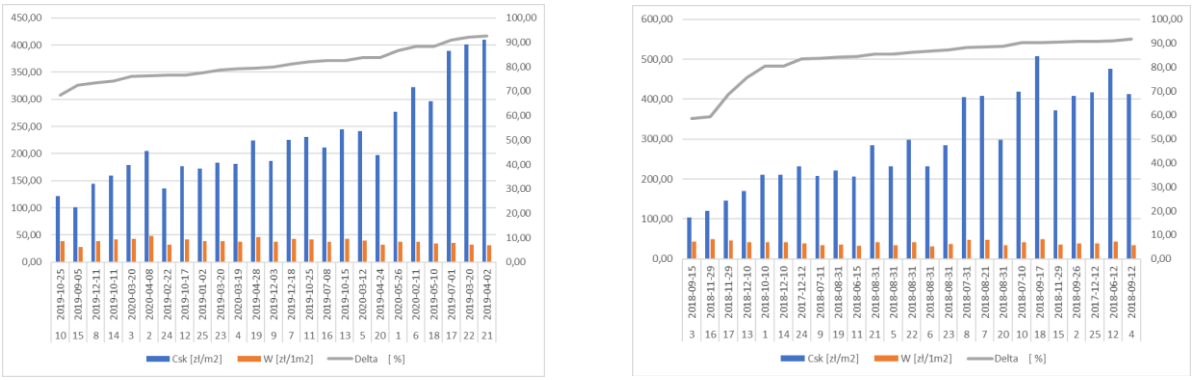


Fig. 14.1 Comparative analysis of estimated land values (PLN/m^2) and transaction prices in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

Four variants for modifying the standard indicator method were proposed in the fourth stage of the study. Initial land value (V_W) and the indicators adjusting land value (k_i) were modified in each variant. In the first variant, time-adjusted initial land value (V_W) was replaced with the average land price in both test fields. The arithmetic mean of adjusted transaction prices was calculated for the properties in each test field. Two approaches were used to determine initial land value (V_W). Adjusted transaction prices were averaged in the first approach, whereas adjusted unit prices per m^2 of land were averaged in the second approach. The results generated by the first and the second approach are presented in Fig.14.2 and Fig. 14.3, respectively.

a) suburban zone, s = 158.5% *b) peripheral zone, s = 211.4%*

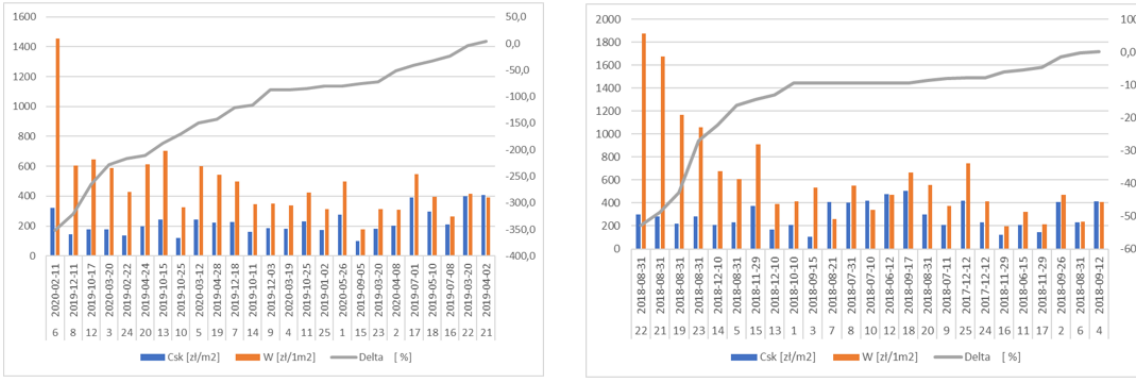


Fig. 14.2 Variant I, first approach. Comparative analysis of estimated land values and transaction prices in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

a) suburban zone, s = 144.4% *b) peripheral zone, s = 149.4*

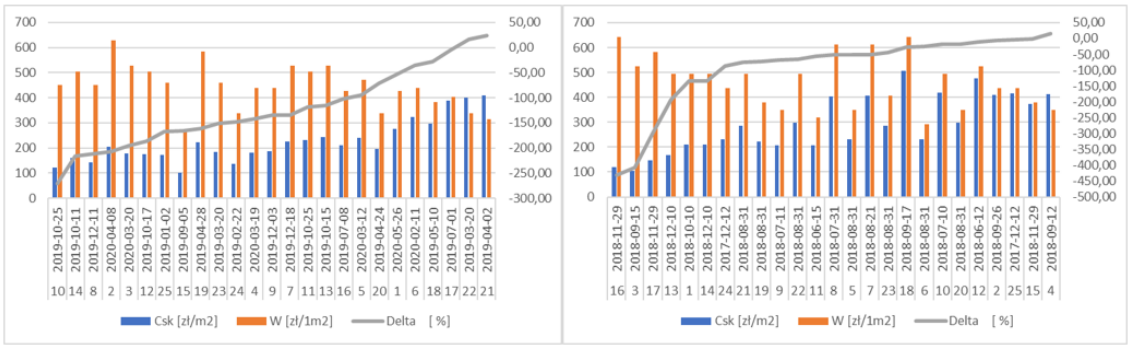


Fig. 14.3 Variant I, second approach. Comparative analysis of unit prices per 1 m^2 of land in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

As shown by the results in Fig. 14.2 and Fig. 14.3 both approaches to modifying the indicator method in the first variant led to the overestimation of land values relative to the adjusted transaction prices. The values estimated in the first approach (Fig. 14.2) exceeded the adjusted transaction prices, excluding land plot No. 4 (peripheral zone). Percentage deviation ranged from od +4% to -351.6%. Percentage deviation did not exceed ±50% in only 24% of the tested land plots, and it reached ≤ 30% in only one-half of these properties. In the Bartąg and Bartążek suburban zone, percentage deviation exceeded 300% in 8% of the tested properties, and it ranged from 200% to 300% in 16% of the analyzed land plots. In 48% of the tested properties, percentage deviation exceeded 100%, and mean percentage deviation in this zone reached -158.5%. In Olsztyn's peripheral zone, mean percentage deviation was determined at -211%. In the studied data set, percentage deviation exceeded 200% in 25% of the examined objects. The percent difference between estimated land values and adjusted transaction prices reached ≤ 30% in only 12% of the analyzed properties, and it ranged from 30% to 50% in 4% of the studied objects. Land values were also overestimated relative to adjusted transaction prices in the second approach in variant I (Fig. 14.3). Mean percentage deviation was lower than in the first approach, and it was determined at 144.4% and 149.4% in the suburban zone and the peripheral zone, respectively. In this data set, percentage deviation exceeded 100% in 68% of the properties. The percent difference between the estimated land values and adjusted transaction prices reached ≤ 50% in only 20% of the analyzed properties, and it was determined at ≤ 30% in 16% of the objects in this group. In 24% of the examined cases, percentage deviation exceeded 100%.

In the second variant, initial land value (V_W) was replaced with the average land price, and the sum of coefficients for adjusting initial land value was decreased by ¼. The results generated by the same two approaches that were described in variant I are presented in Fig. 14.4 and Fig. 14.5.

a) suburban zone, s = 49.0% *b) peripheral zone, s = 57.4%*

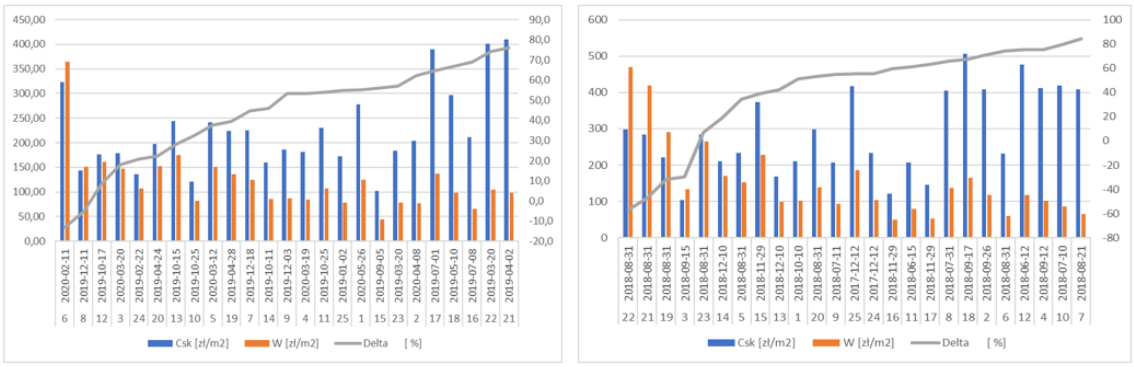


Fig. 14.4 Variant II, first approach. Comparison of estimated land values and transaction prices in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

a) suburban zone, s = 48.1% *b) peripheral zone, s = 59.6%*

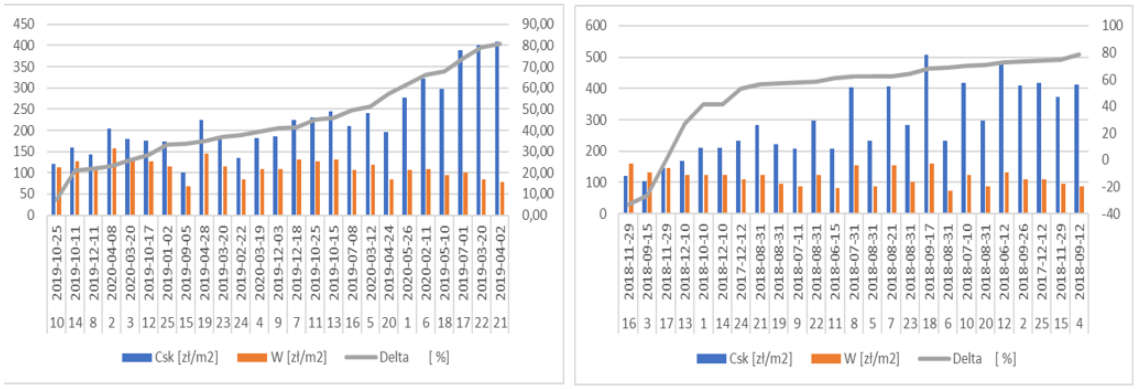


Fig. 14.5 Variant II, second approach. Comparison of transaction prices per 1 m^2 of land in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

The data presented in Fig. 14.4 and Fig. 14.5 indicate that land values were underestimated relative to transaction prices. The values estimated in the first approach (Fig. 14.4) were 57.4% lower (peripheral zone) and 49.0% lower (suburban zone) than the corresponding transaction prices. Percentage deviation ranged from -12.9% to 76.1% in the suburban zone. This parameter did not exceed 50% in 32% of the tested land plots, and it was determined at ≤ 30% in 12% of the objects in this group. Land values were also underestimated in the second approach (Fig. 14.5), and mean percentage deviation reached 48.1% in the suburban zone and 59.6% in the peripheral zone. In the suburban

zone, percentage deviation did not exceed 50% in 68% of the tested properties, and it was determined at ≤ 30% in 48% of these properties. In the peripheral zone, percentage deviation did not exceed 50% in 24% of the examined land plots, and it was determined at ≤ 30% in one-half of these properties.

In the third variant, the arithmetic mean of adjusted transaction prices was decreased by ½, but the indicators for adjusting initial property value were not modified. The two approaches described in variant I were also applied in the third variant. The results of the analysis and the estimated values of the tested properties in both zones are presented in Fig. 14.6 and Fig. 14.7.

a) suburban zone, s = 48.8% *b) peripheral zone, s = 82.6%*

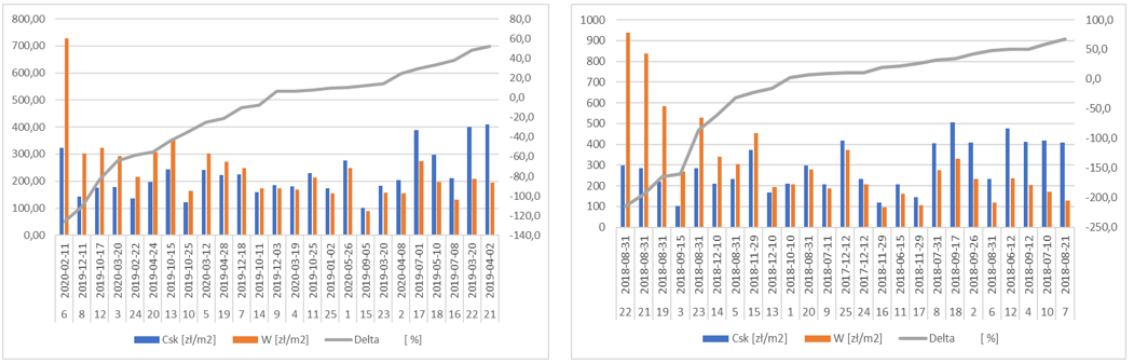


Fig. 14.6 Variant III, first approach. Comparative analysis of estimated land values and transaction prices in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

a) suburban zone, s = 39.4% *b) peripheral zone, s = 58.7%*

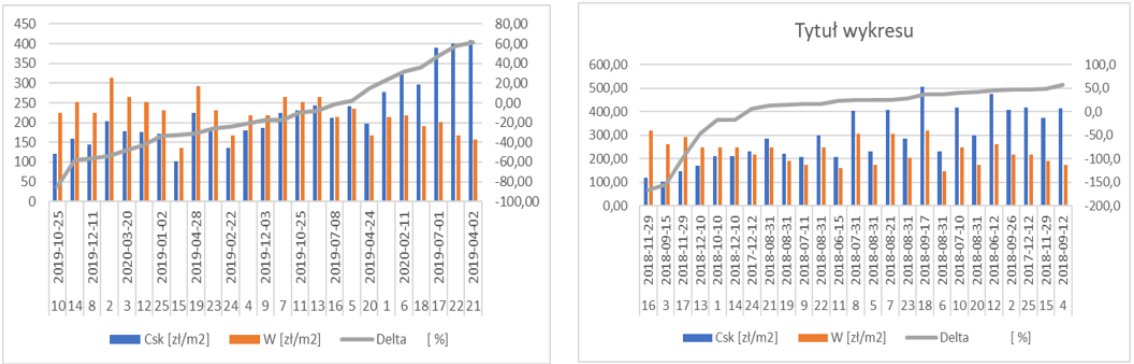


Fig.14.7 Variant III, second approach. Comparative analysis of transaction prices per 1 m^2 of land in: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

The land values estimated in the first approach (Fig. 14.6) differed from the corresponding transaction prices. In the suburban zone, nearly 50% of the estimated

values (12 properties) exceeded transaction prices, whereas the values estimated for 13 land plots were below transaction prices. Mean percentage deviation between the estimated values and transaction prices was 48.8% in the suburban zone and 82.6% in the peripheral zone. Percentage deviation ranged from -125.8% to 52.3% in the suburban zone. Minimum deviation was 6.3% (land plots No. 4 and 9), whereas maximum deviation was 125.8% (land plot No. 6). Percentage deviation did not exceed ±50% in 18 land plots (72%), and it was determined at ≤ 30% in 52% of these properties. In Olsztyn's peripheral zone, percentage deviation ranged from -214.3% to -68.1%. Minimum deviation was determined at 2.3% (land plot No. 1), and maximum deviation was determined at -214.3% (land plot No. 22). Percentage deviation did not exceed 50% in 60% of the tested land plots, and it at was determined at ≤ 30% in 40% of these properties. Percentage deviation exceeded 100% in four land plots in the peripheral zone and in two land plots in the suburban zone.

In comparison with variants I and II, the second approach in variant III (Fig. 14.7) generated values that more closely approximated transaction prices. In this approach, mean percentage deviation was determined at 39.4% in the suburban zone and 58.7% in the peripheral zone. In the peripheral zone, minimum deviation was determined at 6.0% (land plot No. 24), and maximum deviation was determined at -166.1% (land plot No. 16). Percentage deviation did not exceed 50% in 84% of the tested land plots, and it remained below 30% in 48% of the estimated values. Despite the above, the percentage difference between the estimated values and transaction prices considerably exceeded 100% in two properties, which influenced mean percentage deviation. In the fourth variant, the following non-linear regression equation was used to develop an econometric model for estimating land value:

$$\mathbf{V_{1\,m2} = V_{sr} \cdot (1 + a_1 \cdot k_1 + a_2 \cdot k_2 + a_3 \cdot k_3 + a_4 \cdot k_4 + a_5 \cdot k_5 + a_6 \cdot k_6)} \quad (14.5)$$

where:

$V_{1\,m^2}$ – unit value of land per 1 m^2 [PLN/m^2];

V_{mean} – mean unit value of land [PLN/m^2];

a_i – model constants;

k_i – indicators for adjusting initial land value in the indicator method.

The indicators for adjusting initial land value were set based on the data presented in Tables 14.1 and 14.2. The arithmetic mean of the unit value of land was calculated based on time-adjusted unit prices of land (per 1 m^2) for the properties in both test fields.

The constants in the econometric model were calibrated in the StatSoft Statistica program with the use of the Gauss-Newton algorithm for solving least squares problems. The calibrated regression models for each test field are presented below:

a) Econometric model for Bartąg and Bartążek suburban zone:

$$\mathbf{V_{1m}^2 = 224.59\ PLN/m^2\ (1 + 0.454k_1 - 1.333k_2 + 1.182k_3 - 2.634k_4 + 0.507k_5 - 0.021k_6)}$$

Explained sum of squares – 0.6832; R = 0.8266;

b) Econometric model for Olsztyn's peripheral zone:

$$\mathbf{V_{1m}^2 = 264.58\ PLN/m^2\ (1 - 0.397k_1 + 0.100k_2 + 2.121k_3 + 0.08k_4 - 2.133*k_5 + 0.438k_6)}$$

Explained sum of squares – 0.6642; R = 0.8150;

The land values determined by econometric models for both test fields are presented in Fig. 14.8

a) suburban zone, s = 30.9% *b) peripheral zone, s = 52.1%*

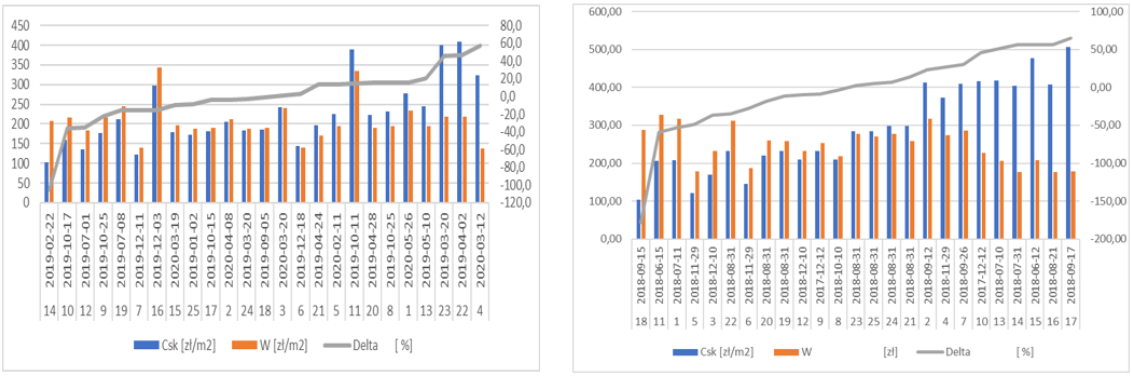


Fig. 14.8 Variant IV, first approach. Comparative analysis of land values estimated by the econometric model and transaction prices: a) Bartąg and Bartążek suburban zone, b) Olsztyn's peripheral zone.

Source: own elaboration

The results presented in Fig. 14.8 clearly indicate that land values estimated by econometric models more accurately reflect adjusted transaction prices. In the suburban zone, percentage deviation between land values and adjusted transaction prices did not exceed 50% in 23 land plots, and it was determined at ≤ 30% in 19 of these properties. Mean percentage deviation was 30.9% in the suburban zone and 52.1% in the peripheral zone. Percentage deviation ranged from -105.1% to 57.6% in the suburban zone. Minimum deviation reached 0.8% (land plot No. 3), and maximum deviation reached 105.1% (land plot N. 14).

In the last stage of the study, the land values estimated in each variant and approach were compared with time-adjusted transaction prices. The percentage deviation (Δ - delta)

between the estimated unit value of each tested property (Vr) and the corresponding unit prices (Pa) of the examined transactions adjusted to the date of the analysis was calculated with the use of the following formula:

$$\boldsymbol{\Delta = \frac{Pa - Vr}{Pa} 100\%} \tag{14.6}$$

where:

Δ – (delta) percentage deviation between the estimated value and adjusted price [%];

Pa – time-adjusted price of property [PLN/m^2];

Vr – estimated unit value of property [PLN/m^2].

Based on the General Real Estate Taxation Guidelines (Telega et al. 2002), it was assumed that the modified indicator method should be rejected if mean percentage deviation (s) significantly exceeds ±50%. If mean percentage deviation does not exceed ±50%, the modified method could be suitable for land valuation if the delta values for each examined property are satisfactory. If mean percentage deviation does not exceed 30%, the modified indicator method can be reliably used for land valuation. Mean percentage deviation was calculated with the following formula:

$$\boldsymbol{s = \sqrt{\frac{\sum_{k=1}^{n} \Delta^2}{n}}} \tag{14.7}$$

where:

s – mean percentage deviation [%];

Δ – (delta) percentage deviation between the estimated value and adjusted price [%];

n – number of analyzed properties.

The presented variants for modifying the indicator method were tested based on historical (market) data in two test fields: Bartąg and Bartążek suburban zone and Olsztyn's peripheral zone. According to Allen and Austin (2001), two approaches that rely on market data or consumer preferences, expectations, beliefs, and attitudes can be used to search for market information, in particular on rapidly changing markets. Approaches that rely solely on historical data may not produce reliable results on weakly developed real estate markets, mainly because such markets are imperfect and characterized by low effectiveness. In view of the above, this study was undertaken to verify the suitability of the modified indicator method for determining the value of real estate on weakly developed and rapidly changing markets. The relationship between land

values estimated in each variant and approach and the corresponding transaction prices was investigated in test fields. The conducted analyses and the procedure of modifying the indicator method were described in detail. The results of the study are summarized in Tables 14.3 and 14.4, and they support a comparison of the following parameters in both test fields:

– average transaction prices adjusted to the date of the analysis, calculated for selected land plots in test fields, and the average values calculated for these properties in each variant and approach to modifying the indicator method;

– mean unit price adjusted to the date of the analysis, calculated for selected land plots in test fields, and the mean unit value of these properties calculated in each variant and approach to modifying the indicator method;

– convergence between average estimated values and average prices of the examined land plots;

– deviation between mean unit values and mean unit prices;

– mean percentage deviation between estimated land values and adjusted transaction prices;

– number of land plots where percentage deviation between the estimated values did not exceed 50%.

Table 14.3 Summary of the results for Bartąg and Bartążek suburban zone

Compared indicators	**Indicator method**	**Variant I**		**Variant II**		**Variant III**		**Variant IV**
		S1	**S2**	**S1**	**S2**	**S1**	**S2**	
Average transaction price [PLN]	306997	306997	306997	306997	306997	306997	306997	306997
Average value [PLN]	56059	609696	662062	152424	165510	304848	331020	302009
Convergence between average estimated values and average prices [%]	18	199	216	50	54	99	108	98
Price per 1 m^2 [PLN/m^2]	224.59	224.59	224.59	224.59	224.59	224.59	224.59	224.59
Value per 1m^2 [PLN/m^2]	38.03	483.58	446.04	120.9	111.51	241.79	223.02	207.07
Deviation between mean unit values and mean unit prices [per 1 m^2]	83	-115	-99	46	50	-8	1	8
Mean percentage deviation [%]	**81**	**158**	**144**	**49**	**48**	**49**	**39**	**31**
Number of land plots with percentage deviation≤50%	0	5	5	12	17	17	19	23

Source: own elaboration

Table 14.4 Summary of the results for Olsztyn's peripheral zone

Compared indicators	Indicator method	Variant I		Variant II		Variant III		Variant IV
		S1	S2	S1	S2	S1	S2	
Average transaction price [PLN]	283566	283566	283566	283566	283566	283566	283566	283566
Average value [PLN]	43234	451438	521584	112859	130396	225719	260792	238960
Convergence between average estimated values and average prices [%]	15	159	184	39	46	80	92	84
Price per 1 m^2 [PLN/m^2]	291.24	291.24	291.24	291.24	291.24	291.24	291.24	281.24
Value per 1m^2 [PLN/m^2]	39.61	621.01	463.65	155.25	115.91	310.50	231.83	248.03
Deviation between mean unit values and mean unit prices [per 1 m^2]	86	-113	-59	47	60	-7	20	12
Mean percentage deviation [%]	**81**	**211**	**149**	**57**	**59**	**82**	**58**	**52**
Number of land plots with percentage deviation≤ 50%	0	3	10	8	6	15	21	17

Source: own elaboration

The results presented in Tables 14.4 and 14.5 suggest that the original indicator method and both approaches in variant I are not suitable for property appraisal on the examined market, and, therefore, should not be used to estimate real estate value on emerging markets. In these approaches, average land values were significantly underestimated or overestimated. The degree of convergence determined with the indicator method in both test fields (zones) reached only 18% and 15% of the average price. In the first variant, prices were significantly overestimated – by 159% in the first approach and by 183% in the second approach in the peripheral zone, and by 199% and 215%, respectively, in the suburban zone. In the first variant, percentage deviation between the estimated unit value of land and the mean adjusted unit price was also high at 113% in the first approach and 59% in the second approach in the peripheral zone, and at 115% and 99%, respectively, in the suburban zone. Mean percentage deviation did not exceed ±50% only in individual land plots, which provides additional evidence that both approaches in variant I failed to generate reliable results. The third variant generated the most satisfactory results in both approaches. The convergence between the average estimated values and adjusted transaction prices reached 80% and 92% in the first approach, and 99% and 107% in the second approach, for the peripheral zone and the suburban zone, respectively. Percentage deviation was determined at 8-20% in the peripheral zone and 1-7% in the suburban zone. Similar results were noted in a comparison of the estimated mean unit values of land and mean adjusted unit prices,

where difference reached 7-20% in the peripheral zone and 1-8% in the suburban zone. Particular attention should be paid to mean percentage deviation in the peripheral zone, which was relatively high. In this test field, percentage deviation between the estimated values and unit prices exceeded 100% or even 200% in individual land plots (Figs. 14.2-14.8). In this variant, percentage deviation between the estimated values and land prices in both test fields did not exceed 50% in the vast majority of cases. The high discrepancies noted in individual cases could be explained by several factors.

Similar results were noted in the fourth variant that relied on an econometric model. The convergence between average estimated values and average prices reached 84% in the peripheral zone and 98% in the suburban zone. In turn, the difference between mean unit values and mean unit prices was determined at 12% and 8% in the above zones, respectively. Percentage deviation between the estimated values and prices did not exceed 50% in 17 land plots in the peripheral zone and in 23 land plots in the suburban zone. In this group of properties, percentage deviation was determined at ≤ 30% in 70% of the cases in the peripheral zone and in 80% of the cases in the suburban zone. The present findings suggest that the indicator method can be modified and used in real estate valuation on weakly developed and rapidly changing markets. However, historical data (transaction prices) are not reliable on emerging markets, whereas information about market trends and sentiments provides valuable insights into market performance. According to International Valuation Standards, the market value of real estate can be replaced with other types of values to increase the reliability of property appraisals on such markets. The current study demonstrated that the indicator method can be modified to appraise the value of urban land in emerging market economies. However, information about the prices quoted on the informal market (market transactions) is required in the discussed procedure. The results generated by the econometric model can facilitate the management of urban land in countries transitioning from a centrally planned economy to a market economy, such as Vietnam. As a result, these countries can depart from a system where real estate prices are imposed centrally by the State. It is also possible to determine differences between the official prices of urban land and the values estimated by the modified indicator method (econometric model).

The results of detailed analyses indicate that informal land prices in Vietnam should be registered to generate a reliable dataset for estimating the initial value of land on local markets. The attributes that influence the value of urban land should be identified. The proposed method for appraising land value bridges the gap between official land

prices determined by traditional methods applied in Vietnam and the prices quoted on the informal market (transfer of rights to State-owned land).

The replacement of administrative prices with real-world prices can facilitate urban planning and management, and it can contribute to an improvement in land-use structure and rational land use in cities. The local authorities can also increase their revenues by calculating land fees and taxes based on market values. A central register of real estate prices would increase market transparency, decrease land speculation and minimize corruption. The following procedure is recommended for implementing the modified indicator method for estimating the value of urban land in Vietnam:

1. the prices of urban land quoted on the informal market should be analyzed at the local level;
2. the attributes that influence the value of urban land should be identified, and the principles for measuring and standardizing these attributes should be established;
3. additional information about local markets should be gathered;
4. an econometric model should be selected and tested;
5. the value of land should be appraised, and the results should be validated;
6. the results should be interpreted, and recommendations for improving the model's accuracy should be formulated;
7. the differences between official land prices and the values estimated by the modified indicator method should be evaluated;
8. the results should be summarized, and further recommendations for updating the generated databases should be made.

15. ASSUMPTIONS OF SYSTEM FOR APPRAISAL OF LAND IN URBAN AREAS

Real estate appraisal comprises complex procedures and multidimensional actions related to an analysis and processing of many factors that have an impact on the property's value. They are acquired, analyzed and evaluated on the basis of data from the local real estate market. Worth noticing is that many data crucial for the correct determination of the (market) value of land lots in urban areas can be obtained from the Geographical Information System (GIS) and other systems as well as dispersed sources of data maintained by the government and local administration. Such information is typically associated with the planning and management of the development of urban areas. Others relate to land use and monitoring of land use. Of importance are also data concerning environmental protection. When the value of a real property is appraised for the purposes of public administration in countries with developed market economy, a mass appraisal procedure is most often implemented. Procedures characteristic for single appraisals are used less often. Databases employed for the needs of an appraisal are typically optimized with statistical procedures (e.g. cluster analysis, Pearson's correlation coefficient analysis). Testing the correctness of a model is carried out on selected (smaller) research fields. This enables the user to introduce corrections and amendments into the procedure's initial algorithm. An efficient system for the appraisal of real estate in urban areas should enable an assessment of the value of land lots in urban areas (all types of value, e.g. market, tax, administrative value) as objectively as possible, with the help of criteria that are characteristic for a given local market and were previously verified in terms of their impact on the value of distinguished groups of real properties, Another important aspect is maintaining constantly updated records of buy-sale transactions and other significant parameters characterizing the local market (e.g. describing the demand and supply). Using modern GIS technologies creates good opportunities for processing the information about the real estate market. This is especially true about the data related to the market's structure, social and demographic situation, topography, natural environment and socio-economic factors (Bovkir and Aydinoglu 2018). When an appraisal procedure requires the processing of a large amount of data about the market, it is useful to employ solutions used in mass appraisal processes. A mass appraisal is a procedure of the valuation of specific groups of homogenous real properties (e.g. vacant land lots located in urban areas). The value of real properties assessed in a mass appraisal process is usually valid

as of a set date (e.g. 1 January the following year), and achieved using the same standardized features in addition to selected statistical analysis methods. The latter are most often the Multiple Regression Analysis and Hedonic modelling. Two other methods with a wide range of applications in mass appraisal are the Artificial Neural Network method (Yaulpur 2018) and Multi Criteria Decision Analysis (Bencure et al., 2021). A data processing method needs to be selected so as not to miss important information about the power of impact of selected factors on the market value of land. It is also necessary to take into account the accuracy of data acquired from the market with the use of different methods (e.g. surveys, or direct measurements). These data are often standardized to enable comparisons. The multiple regression analysis method was employed in this research. According to the outcome of field studies, it was concluded that this method yields good results related to the determination of real estate values in a given area. Such a value is relatively easily interpretable and explainable to both the local authorities and land users. The same applies to the basic assumptions underlying a mass appraisal process. The Pearson's correlation analysis has been used as an auxiliary solution for identifying the features that affect the value of land. This question was dealt with more broadly in the assumptions to the research on selected test fields while testing the accuracy of appraising values of land lots in the early transformation years in Poland. What matters in this type of studies is the ability to determine boundaries of ranges of the local markets and boundaries of zones containing similar real properties. Within the procedure applied, both data related to the geographical location and the ones connected to various spatial circumstances (descriptive data) are processed. This requires verifying detailed data and deleting the ones which are not considered to be typical for the analyzed market, e.g. lack of sufficient similarity to the real property considered as the standard one in the analyzed group. A schematic diagram illustrating the procedure arising from the adopted research methods is shown in Fig. 15.1 Noteworthy is the fact that the previously adopted solutions are submitted to the process of evaluation and verification. It also needs to be borne in mind that data acquired with the help of GIS procedures have specific locations, which facilitates their processing. Geographical relationships between data and their location can be assessed with the help of different methods and techniques. The applicability of the graph analysis technique is worth underlining (Anselin 1995; Anselin et al. 2007). At this stage of research, an analysis based on the Pearson's correlations yield good results (Kalautor et al. 2020). According to Bujang et al. (2010) and Hu et al. (2016), the Pearson's correlation is useful in studies involving an analysis

of the value of land in connection with the criteria which significantly influence this value. The Pearson's correlation analysis was also used in this study when investigating the impact of different factors on the value of land lots in urban areas in the previously selected test fields. The Multiple Regression Analysis (MRA) is a good approach for estimating the value of a real property in a mass appraisal procedure. This method enables the user to determine the strength of the relationship between specific explanatory variables and the price of real estate in an urban area (Yalpier et al. 2021). The MRA technique is based on the determination of the minimum value of the sum of squares of deviations from the mean value. Thus, it allows one to capture typical tendencies on the analyzed real estate market. It can also be applied to determine changes in values and to search new explanatory variables on a specific market (regression residual analysis).

Recapitulating, it should be concluded that many research centers continue studies on the application of selected statistical methods in the determination of real estate values in a mass appraisal procedure. As new results are shared, a given method can be improved and adjusted to the situation in a particular local market. This particularly applies to the processing of data contained in large databases, including the possibility of updating the models adopted earlier., which is significant in the planning of sustainable economic development of urban areas. It is also of key importance in the functioning of an efficient land taxation system. Progress in technologies dedicated to the processing of large sets of data acquired from different primary sources opens up opportunities for creating a comprehensive approach to an appraisal of the value of land in urban areas at a relatively low cost. The results obtained in this study are satisfactory considering the objectives of this research and the nature of data employed in this type of studies.

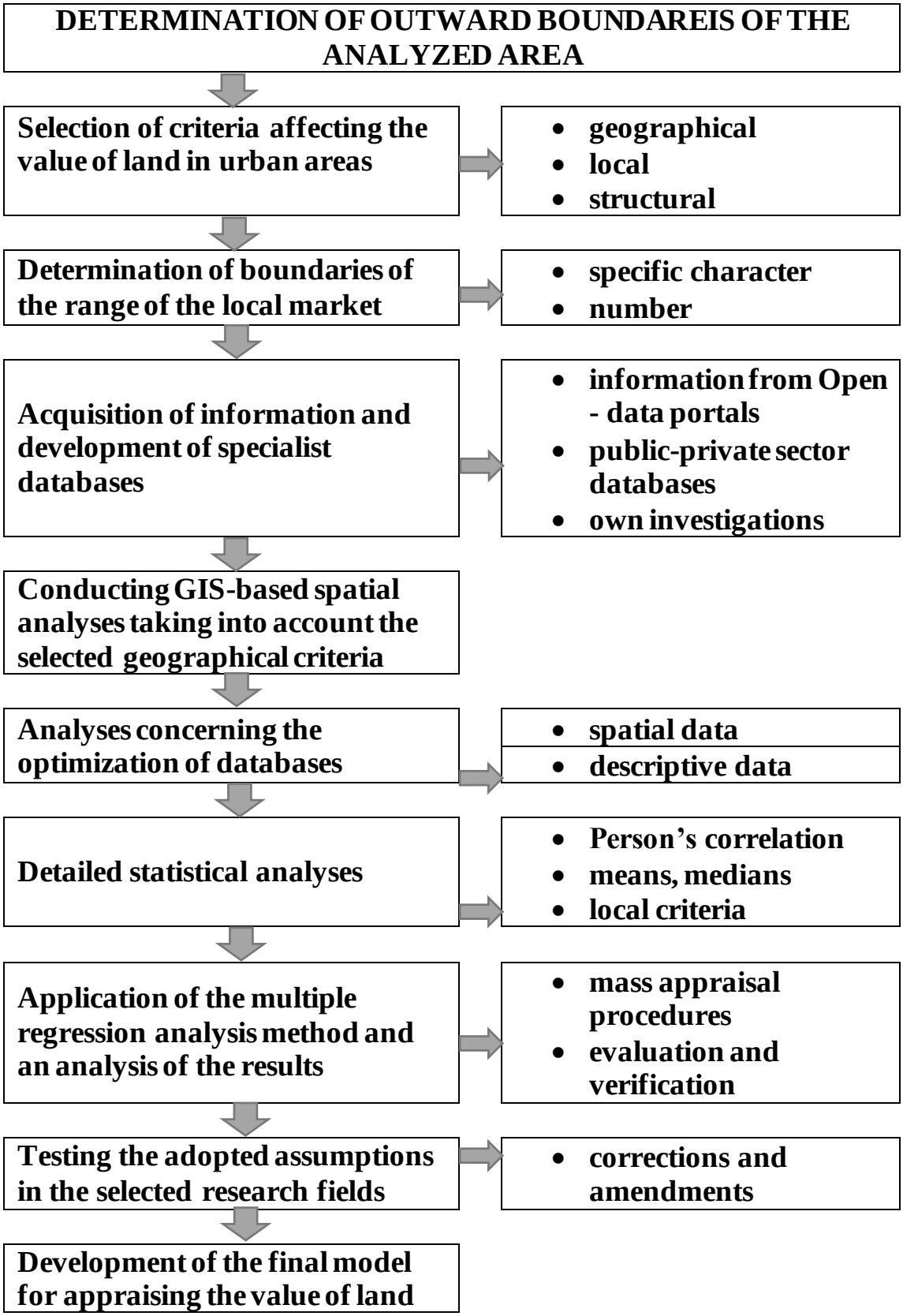


Fig. 15.1 A diagram of the procedure of estimating value of land in urban areas in Vietnam

Source: developed by the author

16. A SYSTEM FOR APPRAISING URBAN LAND IN VIETNAM BASED ON POLISH EXPERIENCES FORM 1990-2020

16.1. Introduction

An analysis of the existing land valuation methods in Vietnam should account for the fact that all land in Vietnam is owned by the state. Individuals and legal entities can receive land-use rights, and land-use rights certificates are alternative forms of land ownership in Vietnam. Land-use rights can be awarded to various groups of land users pursuant to Vietnamese law. The prices of land-use right certificates are set based on the prices of urban land which are calculated according to the provisions of the Land Law (2013) and Decree 44 enacted in 2017. These legal acts are amended to account for the evolution of the Vietnamese real estate market and the growth of the Vietnamese economy. However, land-use rights are also traded by individuals on the informal market, and the official guidelines for calculating the prices of land-use rights certificates are largely disregarded in this process. These transactions rely on the prices of land quoted on the informal (grey) market. A similar mechanism had existed on the Polish real estate market before 1990. Official property prices were set based on the tables and indicators published by the State administration, but an informal property market existed outside the centrally planned economy. The prices of property traded on the informal market were not officially registered. The value of land was compared with the corresponding market prices of property in the examined test fields in Bartąg and Olsztyn. During Poland's transition from a centrally planned economy to a market economy (1990-1995), the value of urban land was calculated with the use of the indicator method which was described in previous chapters. This approach relied on the initial value of land ($V_w = V_o$ v u) which was adjusted with the use of several indicators to account for attributes that could influence the value of the appraised property. As previously mentioned, the indicator method can be considerably modified for use on the Vietnamese real estate market. The main modification involves the introduction of new principles for calculating the initial value of land V_o. In the proposed approach, the initial value of land is not determined based on the parameters which are used in land tax calculations (standard estimates in Poland), but based on the prices of land transactions concluded by individuals on the informal (mixed) market. Specific solutions for modifying the indicator method for the needs of the Vietnamese market will be presented in this chapter.

16.2. The existing land valuation principles in Vietnam

Pursuant to the provisions of the Land Law (2013), the following factors have to be considered in the process of appraising the value of land in Vietnam:

- the existing land-use type has to be identified on the date of the appraisal,
- the permitted types of land use in land-use rights certificates have to be verified,
- land prices quoted during official tenders for the sale of land-use right certificates on the same market can be used in the valuation process.

The principles for calculating the prices of urban land in Vietnam are set forth by Decree 44/2014 and the amendments introduced in 2017. The Decree stipulates that in justified cases, the prices of land-use right certificates traded by individuals can be based on market prices. The provisions of Decree 44 govern real estate transactions conducted between the Socialist Republic of Vietnam, as the sole owner of all land in Vietnam, and other entities. The Decree introduces the following types of land prices:

1. land price brackets,
2. land price tables,
3. specific land prices.

The Vietnamese government publishes land price brackets which are used by local People's Committees to develop tables of mandatory land prices in a given province. The prices specified in the tables apply to defined types of properties, whereas specific land prices can be used to appraise properties that were not included, for whatever reason, in land price tables. Specific land prices are set by the Provincial Department of Natural Resources and are approved by the People's Committee in a given province. The approved prices remain in force for five years, but they may be modified earlier if significant changes take place in the local economy.

A system for appraising the value of urban land in Vietnam was proposed in the next stage of the study. The developed solutions are based on a detailed analysis of real estate valuation principles that had been applied during Poland's transition from a centrally planned economy to a market economy (1990-1995) and in the following years. More than ten Polish real estate experts were surveyed, and the resulting information was generalized. The present situation on the Vietnamese real estate market was analyzed by examining the principles for calculating land value that were introduced by the Land Law (2013) and implementing regulations. The results of the real estate expert survey were taken into consideration. The results of the analyses performed in test fields in Poland and

Vietnam were used to propose detailed solutions, including the selection of factors for adjusting land value. The recommendations formulated in FIG, FAG, and Tonkin reports published between 2000 and 2020 were also considered.

The proposed approach to appraising urban land in Vietnam relied on the indicator method that was described in the previous chapters. In this method, the initial value of land (V_w) is determined in the first stage of the appraisal process. In successive stages, initial land value is adjusted by considering attributes that influence the prices of reference properties. As demonstrated in chapter 12. the procedure of calculating initial land value V_w is the main weakness of the indicator method. In 1990-1995, due to the scarcity of reliable information about property prices in Poland, initial land value was calculated based on farmland productivity. Initial land value was then adjusted based on two factors: degree of urbanization (u) and distance from the city center (s). This method of appraising the value of urban land was analyzed in detail, and a new approach for calculating the value of V_w was proposed based on the prices quoted on the informal market. The adjusted value of V_w represents a directional value of land that is based on market principles. This parameter was based directly on local market data (prices of urban land and attributes which affect land value). When reliable information about private transactions is scarce (mainly in small towns), V_w can be rescaled based on the prices of similar property traded on other (larger) markets. The value of V_w can be rescaled with the use of an adjustment coefficient (k_u) based on differences in population in the compared locations. The two markets could be also compared based on the degree of urbanization or other parameters. The initial value of land was rescaled with the use of the following formula:

$$\mathbf{V_{wk} = V_w * k_u} \qquad (16.1)$$

where:

V_{wk} - rescaled value of land on a local market where reliable information about private land transactions is scarce,

V_w - initial value of urban land in selected homogeneous areas (urban areas),

k_u – adjustment coefficient based on differences in the degree of urbanization on the compared real estate markets. The analysis revealed that the value of k_u can take values in the range of 0.1 to 1.5.

The directional value of land in selected homogeneous areas was determined, and adjustment coefficients specific to a given area were calculated relative to the directional value. It was assumed that the directional value of land in a given area represents the

mean values of adjustment factors. This operation can be described with the following equation:

$$\mathbf{V_{N_i}} = \mathbf{V_w} + \sum_{\mathbf{k=1}}^{\mathbf{n}} \mathbf{V_w}\,\mathbf{K_i} \tag{16.2}$$

where:

V_{Ni} – value of the i^{th} land plot in the analyzed area for which directional value V_w was calculated,

n – number of adjustment coefficients in the analyzed area (usually not more than 10),

k_i - coefficient for adjusting the value of analyzed land, applied to each property attribute.

The proposed method for appraising urban land involves the following operations:

1) the boundaries of homogeneous urban areas characterized by similar land attributes and land prices on the informal market are determined.

2) the directional value of land in each homogeneous urban area is determined based on the average prices quoted on the analyzed real estate market.

3) attributes that significantly influence the value of land in each homogeneous urban area are identified, and the methods for measuring these attributes are defined.

4) the values of attributes describing the referenced properties are calculated in each homogeneous urban area.

5) the number and values of the attributes describing the appraised land plot are determined.

6) the values of the attributes describing the referenced property and the appraised property are compared, and deviations from average values are calculated in each homogeneous urban area.

7) the combined influence of differences in property attributes on the value of the appraised land plot is determined ($\sum_{k=1}^{n} V_w K_i$).

8) the value of land in the analyzed urban area is calculated.

Previously determined land values can be modified with the use of the expert adjustment indicator (E) which accounts for the specificity of the local land market. According to detailed analyses, the value of E should range from 0.8 to 1.2, which indicates that the calculated value can deviate by around +- 20% from the previously determined value of urban land. The following formula was used in the final calculations:

$$\mathbf{V_{N_i}} = \mathbf{V_w} + \sum_{\mathbf{k=1}}^{\mathbf{n}} \mathbf{V_w}\,\mathbf{K_i} + \mathbf{E_i} \qquad (16.3)$$

where:

E_i – expert adjustment indicator which is applied when the value of land in the analyzed urban area could be affected by other factors that are difficult to quantify (such as prestige, risk of flood, local zoning plans, buyer preferences, neighborhood, etc.).

The remaining symbols were explained previously.

A real estate appraiser should develop a list of factors that adjust the directional value of land which was applied in the process of determining the value of the appraised property in a given urban area. The list should include coefficients K_i as well as detailed principles for measuring these coefficients, or a list of scores assigned to property attributes on the adopted measurement scale. The list can be expanded to include other coefficients that significantly influence land value. Additional coefficients should be selected based on a detailed analysis of the local market. All additions to the list should be justified and preceded by detailed analyses. Residual values from the regression analysis can be also used for this purpose, as demonstrated by Reniger and Źróbek (2000). The procedure of calculating the value of urban land with the use of the proposed method is presented in Fig. 16.1.

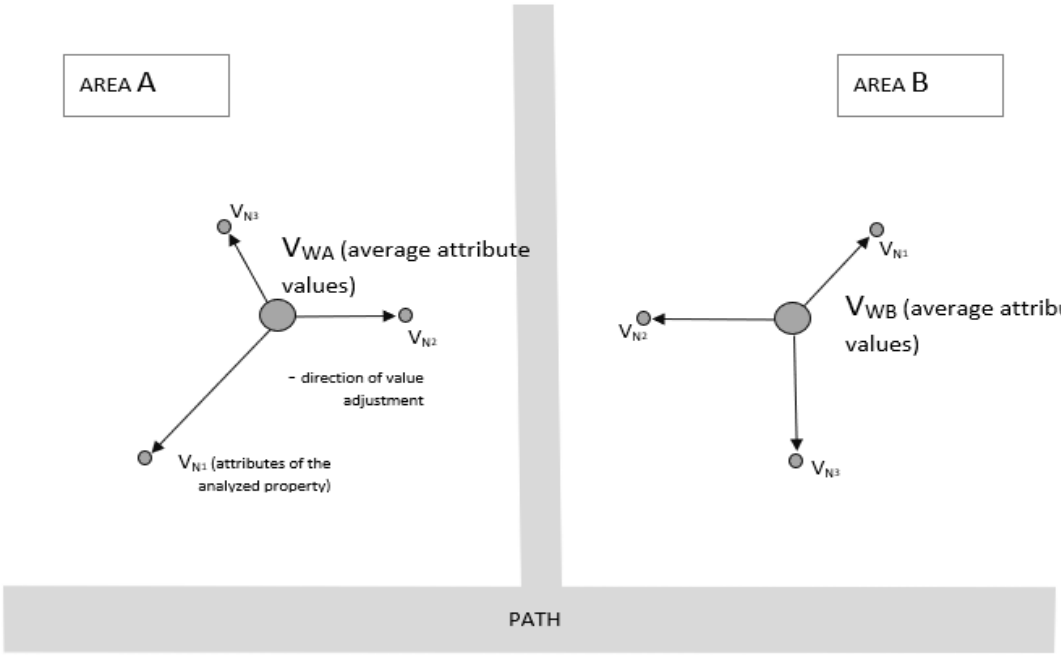


Fig. 16.1 Graphic presentation of the principles for determining land value based on a comparison with the directional value of land in the analyzed urban area.

Source: own elaboration

The same adjustment coefficients can be applied to similar urban areas. In this case, the expert selects the most pertinent coefficients from the list and performs a series of comparisons to determine the value of a specific land plot. The resulting value is similar to the prices quoted on the informal market, and it reliably approximates the market value of urban land. The proposed method for determining the value of urban land can also be applied in mass appraisal. The results of the analyses conducted in test fields indicate that the developed method is sufficiently accurate, and the results are easy to interpret.

17. SUMMARY AND CONCLUSIONS

A general hypothesis postulating that Polish experiences relating to urban land appraisal in the period between 1990 and 2020 could be used to improve the Vietnamese land valuation system was formulated at the beginning of this dissertation. Poland's transition from a centrally planned economy to a market economy between 1989 and 1995 was examined. The aim of this analysis was to identify and eliminate errors in the land appraisal methodology. These experiences proved to be highly useful in the process of designing a land valuation system for Vietnam. The valuation methods deployed in Poland between 1990 and 2020 were applied to calculate the value of land in selected test fields in Olsztyn (within and outside the city's administrative boundaries). Reliable information about transaction prices was available in the examined area, and historical prices were adjusted to 2020 levels. The results were compared with the prices calculated using different methods that had been applied in Poland between 1990 and 2020. Standard statistical methods were used to determine the accuracy of the results. Atypical transactions (outliers) were eliminated, and time-adjusted prices of urban land were regarded as market prices. The differences between land prices calculated with the use of the examined methods and time-adjusted (market) prices were determined. The main aim of these analyses was to identify the strengths and weaknesses of the examined land valuation methods and to assess their applicability in the Vietnamese real estate sector which does not fully abide by market principles. Detailed theoretical studies and practical analyses were conducted to develop an algorithm for assessing the value of land in a mixed economy, including:

- analysis of the results obtained in a previous study of the Vietnamese land valuation system,
- collection, analysis and assessment of information about the prices and attributes of urban land, including expert opinions,
- evaluation of the results obtained in selected test fields and validation of the selected valuation method (modified indicator method for appraising urban land).

The process of developing a land valuation system for Vietnam based on the results obtained in test fields and expert opinions is summarized in Table 17.1. The procedure of calculating the market value of urban land consists of three key stages. Recommendations for further research should be formulated at the end of each stage. The proposed model can be modified to suit the needs of real estate markets in different stages

of evolution. Based on the results obtained in test fields and expert opinions, multiple regression analysis was selected as the optimal tool for the modeling process. The choice of this statistical tool was confirmed by the calculated deviations from transaction prices for control sets of land prices, both in the urban core and in the surrounding areas that are experiencing strong urbanization pressure (rural/urban transition area.

Table 17.1 Process of developing a land valuation system for Vietnam.

CONCEPTUAL FRAMEWORK	**PREPARATORY WORK**	**ANALYSES AND RESULTS**
ALGORITHM	GATHERING INFORMATION ABOUT THE REAL ESTATE MARKET	DETAILED ANALYSES AND CALCULATIONS
– implementation of theoretical principles relating to the development of the real estate market, – development of basic principles for land valuation based on market prices, – proposing changes to real estate market regulations, – training programs, development of standards and instructions.	– analysis of the existing data sources, – additional measurements and local inspections, – survey of market participants, – selection of data for analysis, – development of measuring principles.	– analysis of the existing data sources, – determination of land value based on market prices, – generation of directional land values for the analyzed urban areas, – generation of land value maps, – final validation.

Source: own elaboration.

The calculated land prices can be used to establish annual land-use fees and to set directions for urban development in local zoning plans. The resulting price lists can be used in the process of planning urban development, including public development projects. The calculated values can be also applied to determine compensation for land appropriated for public development projects and to set property tax rates based on the market value of land (*ad valorem* tax). The Vietnamese land valuation system should be reformed, and urban land should be appraised based on directional prices that are quoted on the informal market. To implement this approach, the initial value of land has to be calculated in homogeneous urban areas. The study demonstrated that the Vietnamese real estate sector is only beginning to evolve towards free market principles. Therefore, the Vietnamese legal system should be reformed to facilitate the introduction of market principles in the real estate sector. The existing property tax system is not highly effective, and it is not resistant to corruption. These factors drive land speculation in urban areas. These problems are exacerbated by the absence of a transparent system for registering transaction prices. Land management policies in urban areas should be reformed to facilitate transactions between land users and real estate developers. In many respects,

Vietnamese real estate policies lack cohesion and clarity. Property prices are imposed centrally by the state, which leads to conflict and prevents developers from investing in urban land. There are two main approaches to calculating real estate prices in Vietnam:

1) based on market value – during negotiations between the buyer and the seller,
2) based on official prices that are set by the authorities and are used to calculate property taxes and other fees.

The existing regulations are a source of conflict on local land markets. Official prices differ considerably from the prices quoted on the informal market, which undermines the stability and transparency of the Vietnamese real estate sector and generates additional problems. Official property prices remain fixed during statutory intervals (e.g. 5 years). In contrast, the prices quoted on the informal market change dynamically. The difference between official and informal prices should be reduced to stabilize the real estate sector and increase the effectiveness of urban land management. Excessive differences between administrative and informal prices compromise the effectiveness of land management policies and exert a negative influence on the decisions made by individual land users. These observations further accentuate the need for reforms in the Vietnamese land valuation system. The results of the presented analyses indicate that modified indicator method, where the initial value of land is calculated based on transaction prices quoted on the informal market, is well suited for this purpose. The multiple regression model can be easily applied to minimize the difference between official and market prices of urban land. The key elements of the proposed system for appraising the value of urban land are presented in Fig. 17.1 The proposed system supports sustainable development of urban areas. The calculated values can be used by the central and local authorities to determine the amount of compensation for legal seizure of land, calculate property taxes and fees, and set asking prices in real estate transactions. The dataset for the property valuation process is presented in Table 17.1 The developed database should contain information about the main attributes that influence property prices, the methods and principles for measuring these attributes, and the relevant sources of data.

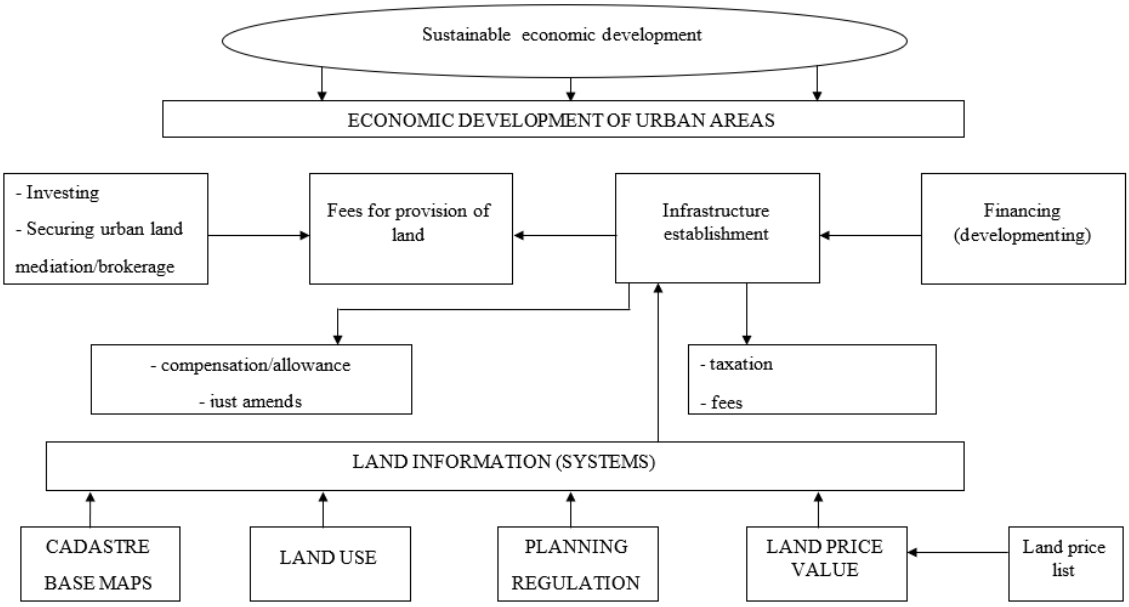


Fig. 17.1 Urban land valuation system

Source: own elaboration

It should also be noted that land valuation processes based on market prices are essential for effective land management and contribute to the sustainable development of the real estate sector. The availability of reliable information about the real estate market promotes investments and facilitates land development in urban areas. This approach to land appraisal should also enable the Vietnamese government to modify its real estate policies.

Table 17.2 The datasets used in the valuation process

DATA CATEGORY	CRITERIA	DESCRIPTION	DATA SOURCES
STRUCTURAL	plot area (m^2), landscape, road access, parking areas, schools	Characteristic attributes of a land plot	- price lists, real estate agencies, - land users
GEOGRAPHIC	facilities, transportation, shopping centers, public services, entertainment and sports facilities, green space, environmental factors, topographic factors	Rate of changes in urban areas	- local databases, - real estate cadaster
LOCAL	neighbourhood, incomes, population and population structure, education levels, marital status, socio-economic development, market information	Rate of changes in urban areas	- socio-demographic data, - socio-economic data, - land values

Source: own elaboration

The results of the present study indicate that a central database containing information about real estate prices and attributes should be urgently developed in Vietnam. Information about land availability and location plays a particularly important role in Vietnam. In the analyzed country, the value of land is affected by the plot's location relative to a street (road), as well as distance to major road junctions, shopping centers, and local government facilities. Therefore, a list of attributes that influence property value should be developed already in the initial stage of market analysis. In Vietnam, urban areas are divided into groups. Land parcels in each homogeneous group are classified based on their location relative to 3-4 main street categories. This system can be used in the proposed method of appraising urban land. This approach will speed up system implementation and decrease the costs associated with the acquisition of data for determining the attributes of land plots in urban areas.

The implementation of the proposed land appraisal method does not require a specific time schedule. New valuation principles can be introduced on 1 January of the following year. The proposed method responds directly to changes on the real estate market. The initial value of land can be regularly updated based on validated transaction prices. The remaining parameters of the model do not change significantly over time. Attributes that influence land values can be revised and modified every two to three years. The extent to which average land values calculated in the indicator method diverge from transaction prices on the local market should be also examined in the corresponding time intervals. The calculated deviations should not exceed 20-30% of the average price in homogeneous urban areas. The proposed model does not have to be modified when the difference between the initial value of land and current transaction prices does not exceed 25%. The model should be adjusted when the compared values differ by more than 25%. The proposed approach will stabilize the real estate market by decreasing the gap between official prices of land and the prices quoted on the informal market. The described method is an effective tool for managing public land resources and reducing corruption. The proposed approach will support the Vietnamese government's efforts to harmonize official land prices with market prices. As a result, the developed model can be used in mass appraisals to calculate the value of real estate for taxation purposes.

A reliable real estate information system significantly influences the quality of land management in urban areas. An information system based on Polish experiences was discussed in the previous chapters. In Vietnam, all land, including urban land, is owned by the state. State-owned land can be used by individuals and legal entities who acquire

land-use rights certificates. In many respects, this type of tenure is similar to perpetual usufruct in Poland, which is a right granting long-term use of real estate belonging to the central government or local governments. However, unlike in Vietnam, private land ownership exists in Poland. At present, the vast majority of real estate in Poland is privately owned. Perpetual usufruct is established for a period of 99 years (minimum 40 years in exceptional cases), and it can be extended.

Vietnam has transitioned from a centrally planned economy to a mixed system with elements of a free market economy, including in the real estate sector, and land is appraised in two separate systems. The proposed method will minimize the differences between official prices and the prices quoted on the informal market, which will stabilize the real estate sector, generate new streams of revenue for the central budget and local budgets, and improve land management in urban areas. The described approach will increase the transparency of real estate transactions and facilitate the mass appraisal process. The land management system in Vietnamese cities should be reformed. The system should be upgraded, and clear land appraisal rules should be introduced to support decision-making in the real estate sector and promote sustainable development of urban areas. To achieve this goal, real estate management regulations should be revised and improved, new technologies should be introduced to enhance decision-making in urban management, and real estate appraisers and planning experts should improve their skills and qualifications. The process of urban land valuation should be analyzed in the context of legal, political, technical and organizational regulations in a given country. The laws and regulations applicable to land valuation should be examined in the first stage of the analysis. Any attempts to create a new model cannot ignore the regulatory content in Vietnam. Polish experience can be used as the starting point for further conceptual work. The specificity of the analyzed country should always be taken into consideration in the process of developing a system for appraising the value of urban land. The similarities and differences in the examined property attributes should be identified in the next step of the urban land valuation process.

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Appendix 1 Monitoring of real estate transactions in Bartąg i Bartążek

No.	Cadastral unit	Plot No.	Date	Price	X_{1a}	X_{1b}	X_{1c}	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Unit price PLN/m^2	Psk PLN/m^2
1	2	3	4	5	6	7	8	10	12	13	15	16	17	18	19	20	21	22
1	Bartąg	267/28	2020-06-03	130 000,00	8,03	1,26	2	4	2	2	4	3	0,30	21	4	1	69,56	**83,08**
2	Bartąg	135/44	2020-05-23	130 000,00	7,70	1,64	2	4	3	4	4	3	0,10	1848	2	1	69,56	**85,34**
3	Bartąg	706	2020-05-26	264 450,00	5,78	0,80	3	4	3	3	4	3	0,10	1170	1	1	226,03	**277,29**
4	Bartąg	333/33	2020-04-08	452 600,00	5,64	0,64	3	4	4	4	2	4	0,64	2789	2	1	162,28	**204,34**
5	Bartążek	362/82	2020-03-19	170 000,00	6,32	1,43	3	4	2	4	4	3	1,43	1228	4	1	138,44	**178,8**
6	Bartąg	248/5	2020-03-20	270 000,00	9,98	3,19	1	1	2	2	4	3	0,04	6090	2	4	44,33	**57,26**
7	Bartąg	311/3	2020-03-16	200 000,00	5,71	0,89	3	1	3	4	4	3	0,13	1070	2	4	186,92	**241,42**
8	Bartąg	270/37	2020-03-12	246 510,00	8,45	1,70	2	4	2	4	4	3	0,24	260	2	1	948,12	**1224,58**
9	Bartąg	270/34	2020-03-12	102 630,00	8,45	1,70	2	4	2	4	4	3	0,25	411	2	1	249,71	**322,52**
10	Bartąg	89/3	2020-02-11	97 500,00	7,76	0,98	2	3	2	4	4	3	0,15	172	2	1	566,86	**750,52**
11	Bartąg	89/1	2020-02-05	195 000,00	7,62	0,87	2	3	2	4	4	3	0,02	4709	2	1	41,41	**54,82**
12	Bartąg	329/21	2019-12-18	235 000,00	5,57	0,70	3	4	3	4	4	4	0,28	1450	2	4	162,07	**225,08**
13	Bartąg	135/19	2019-12-18	105 000,00	7,56	1,51	2	4	3	4	4	3	0,11	1014	2	1	103,55	**143,81**
14	Bartąg	206/7	2019-12-11	170 000,00	8,37	1,91	2	4	1	1	4	3	0,09	3008	2	1	56,52	**78,49**
15	Bartążek	295/13	2019-12-03	440 000,00	5,89	1,32	3	4	4	4	4	3	0,80	1014	2	4	433,93	**602,64**
16	Bartąg	135/17	2019-11-15	160 000,00	7,60	1,49	2	3	3	4	4	3	0,18	1875	4	1	85,33	**121,28**
17	Bartąg	329/25	2019-10-25	257 500,00	5,81	0,77	3	4	4	4	4	3	0,16	1622	2	4	158,75	**230,77**

18	Bartąg	30/285	2019-10-25	130 000,00	7,52	2,45	2	4	4	4	4	3	0,07	1070	2	1	121,50	**176,61**
19	Bartąg	30/20	2019-10-25	220 000,00	7,28	2,32	2	4	4	4	4	3	0,13	2000	2	1	110,00	**159,90**
20	Bartąg	299/38	2019-10-17	270 000,00	6,10	0,90	3	1	4	3	4	3	0,20	1007	2	4	268,12	**389,74**
21	Bartążek	16/2	2019-10-09	345 000,00	6,60	1,20	2	1	2	3	4	1	0,10	5800	2	2	59,48	**86,46**
22	Bartążek	345/32	2019-10-15	270 000,00	5,90	0,70	3	1	2	3	4	3	0,40	1323	2	3	204,08	**296,65**
23	Bartąg	362/47	2019-10-11	100 000,00	6,40	1,10	2	4	1	3	4	3	0,40	1073	2	3	93,20	**135,47**
24	Bartążek	30/27	2019-09-05	215 000,00	7,40	0,80	2	4	2	4	4	3	0,10	1764	2	2	121,88	**181,12**
25	Bartążek	30/26	2019-09-05	215 000,00	7,40	0,80	2	4	2	4	4	3	0,10	1716	2	2	125,29	**186,18**
26	Bartąg	283/1	2019-07-01	166 616,00	6,40	0,20	2	1	1	2	4	3	0,90	6170	2	2	27,00	**41,88**
27	Bartąg	135/28	2019-07-05	162 000,00	7,60	1,40	2	4	4	2	4	3	0,30	1028	2	4	157,59	**244,39**
28	Bartążek	30/24	2019-07-08	105 000,00	7,20	0,90	2	4	2	3	4	3	0,10	2391	4	1	43,91	**68,10**
29	Bartąg	205/19	2019-05-10	130 000,00	8,10	1,70	2	1	1	2	4	1	0,10	2070	2	1	62,80	**101,46**
30	Bartążek	329/23	2019-04-28	285 000,00	5,50	0,60	3	4	4	4	3	4	0,20	2224	2	4	128,15	**211,19**
31	Bartążek	291/21	2019-04-24	200 000,00	6,10	0,45	3	4	4	4	4	3	0,70	1473	2	3	135,78	**223,76**
32	Bartążek	16/39	2019-04-02	90 000,00	6,70	1,10	2	4	2	4	4	3	0,10	753	2	2	119,52	**196,97**
33	Bartążek	345/49	2019-03-20	268 000,00	6,02	1,80	2	4	2	4	4	4	0,30	1100	2	2	243,64	**409,41**
34	Bartążek	345/57	2019-03-20	264 000,00	6,02	1,80	2	4	2	4	4	3	0,30	1107	2	1	238,48	**400,75**
35	Bartążek	30/19	2019-03-01	218 000,00	7,30	0,80	2	4	2	4	4	3	0,30	2000	2	1	109,00	**183,16**
36	Bartąg	295/22	2019-02-22	520 000,00	6,10	0,25	3	4	3	4	3	4	0,75	1149	4	2	452,57	**775,16**
37	Bartążek	30/18	2019-01-02	200 000,00	7,30	0,80	2	4	2	4	4	3	0,30	2021	2	1	98,96	**172,71**

Appendix 2 Monitoring of real estate transactions in Olsztyn

No.	Cadastral unit	Plot No.	Date	Price	X_{1a}	X_{1b}	X_{1c}	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Unit price PLN/m^2	Psk PLN/m^2
1	Olsztyn 118	34/42	2018-07-11	105 470,00	4,63	1,70	4	4	2	3	4	4	1,75	909	1	4	116,03	**207,55**
2	Olsztyn 118	34/45	2018-09-12	199 000,00	4,67	1,80	4	4	2	3	4	4	1,75	837	1	3	237,75	**412,36**
3	Olsztyn 118	34/55	2018-12-10	139 700,00	4,53	0,75	2	4	2	4	4	3	1,85	218	2	4	102,42	**169,28**
4	Olsztyn 118	34/57	2018-12-10	139 700,00	4,53	0,70	2	1	2	4	4	3	1,78	1235	2	4	102,42	**169,28**
5	Olsztyn 118	38/110	2018-11-29	230 000,00	4,96	0,67	2	4	1	4	4	2	1,23	405	1	4	221,79	**372,61**
6	Olsztyn 118	38/111	2018-11-29	230 000,00	4,97	0,67	2	4	1	4	4	2	1,25	402	1	4	221,79	**372,61**
7	Olsztyn 118	38/31	2018-11-29	230 000,00	4,78	0,45	4	1	4	4	4	3	1,23	3209	2	4	71,67	**120,4**
8	Olsztyn 118	38/51	2018-11-29	230 000,00	4,87	0,64	4	1	4	3	4	3	1,27	2642	2	4	87,05	**146,24**
9	Olsztyn 118	38/82	2018-09-26	214 000,00	4,66	1,80	4	4	3	3	4	3	1,01	908	1	3	235,68	**408,77**
10	Olsztyn 118	38/64	2018-10-10	144 480,00	6,41	1,16	3	4	4	3	4	3	0,95	1173	1	4	123,17	**210,29**
11	Olsztyn 118	4/23	2017-12-12	120 000,00	4,50	0,65	4	4	1	4	4	3	1,97	1022	2	3	117,42	**232,39**
12	Olsztyn 118	4/26	2017-12-12	120 000,00	4,52	0,61	4	4	2	2	4	3	1,93	570	2	3	210,53	**416,67**
13	Olsztyn 118	4/38	2018-06-15	109 040,00	4,64	1,60	4	4	3	3	4	3	1,70	975,00	1	4	111,84	**206,14**
14	Olsztyn 118	4/45	2018-12-10	139 700,00	4,51	0,81	4	4	2	4	4	3	1,87	710	2	4	127,35	**210,48**
15	Olsztyn 118	4/47	2018-12-10	139 700,00	4,54	0,51	4	1	2	4	4	3	1,88	388	2	4	127,35	**210,48**
16	Olsztyn 125	165/1	2018-07-10	330 000,00	4,85	0,70	3	4	4	2	4	3	1,58	1411	1	3	233,88	**418,34**
17	Olsztyn 125	347	2017-11-03	450 000,00	5,12	0,32	4	4	4	4	3	3	0,26	315	4	4	1428,57	**2400,00**
18	Olsztyn 126	3/3	2018-12-03	182 622,00	3,71	0,68	3	4	2	2	4	4	0,37	2995	4	4	60,98	**100,78**
19	Olsztyn 160	2/129	2018-07-31	245 000,00	3,85	0,70	3	4	4	3	4	4	1,17	1084	3	4	226,01	**404,30**
20	Olsztyn 160	2/133	2018-06-12	285 000,00	3,85	0,70	3	4	4	3	4	4	1,17	1086	1	4	262,43	**476,57**
21	Olsztyn 160	2/141	2018-08-21	530 000,00	6,21	1,12	4	4	4	3	4	4	0,71	2291	3	3	231,34	**407,53**
22	Olsztyn 160	2/143	2018-10-12	220 000,00	5,51	0,56	4	4	4	4	4	3	0,61	199	2	4	1105,52	**1887,40**
23	Olsztyn 160	2/196	2018-07-30	395 000,00	4,50	0,60	4	4	4	3	3	3	0,85	580	3	3	681,03	**1218,20**
24	Olsztyn 160	2/197	2018-09-07	385 000,00	4,50	0,60	4	4	4	3	3	4	0,85	499	3	3	771,54	**1338,20**
25	Olsztyn 160	2/198	2017-11-23	359 000,00	5,30	0,66	4	4	4	4	3	3	0,90	516	4	3	695,74	**1395,90**
26	Olsztyn 160	39/28	2018-09-17	550 000,00	5,35	1,40	3	3	4	4	3	4	1,50	942	3	4	292,24	**506,86**
27	Olsztyn 160	39/29	2018-09-15	7 770 000,00	5,28	0,23	3	3	4	2	3	4	0,99	952	3	3	59,57	**103,32**
28	Olsztyn 160	39/30	2018-09-15	7 770 000,00	5,31	0,20	3	3	4	2	2	4	0,97	919	3	3	59,57	**103,32**
29	Olsztyn 160	39/31	2018-09-15	7 770 000,00	5,34	0,17	3	3	4	3	3	4	0,95	921	3	3	59,57	**103,32**

30	Olsztyn 160	39/32	2018-09-15	7 770 000,00	5,37	0,14	3	3	4	3	3	4	0,93	902	3	3	59,57	**103,32**
31	Olsztyn 160	39/33	2018-09-15	7 770 000,00	5,40	11,00	3	3	4	2	4	4	0,91	1111	3	3	59,57	**103,32**
32	Olsztyn 160	39/34	2018-09-15	7 770 000,00	5,43	0,08	3	3	4	2	4	4	0,89	1114	3	3	59,57	**103,32**
33	Olsztyn 160	39/35	2018-09-15	7 770 000,00	5,28	0,23	3	3	4	2	4	4	0,87	941	3	2	59,57	**103,32**
34	Olsztyn 160	39/36	2018-09-15	7 770 000,00	5,39	0,34	3	3	4	2	4	4	0,98	1069	3	3	59,57	**103,32**
35	Olsztyn 160	39/37	2018-09-15	7 770 000,00	5,37	0,32	3	3	4	3	4	4	0,96	1050	3	3	59,57	**103,32**
36	Olsztyn 160	39/38	2018-09-15	7 770 000,00	5,35	0,30	3	3	4	3	4	4	0,94	1050	3	3	59,57	**103,32**
37	Olsztyn 160	39/39	2018-09-15	7 770 000,00	5,33	0,28	3	3	4	3	4	4	0,92	1050	3	3	59,57	**103,32**
38	Olsztyn 160	39/40	2018-09-15	7 770 000,00	5,31	0,26	3	3	4	3	4	4	0,90	1050	3	3	59,57	**103,32**
39	Olsztyn 160	39/41	2018-09-15	7 770 000,00	5,28	0,23	3	3	4	2	4	4	0,87	1015	3	3	59,57	**103,32**
40	Olsztyn 160	39/71	2018-10-17	1 286 300	5,35	0,25	1	3	4	4	3	4	0,22	2894	4	3	444,47	**758,80**
41	Olsztyn 161	59/3	2018-08-31	270 000,00	7,62	1,17	1	4	2	2	4	4	1,02	559	1	4	131,9	**232,36**
42	Olsztyn 161	59/4	2018-08-31	270 000,00	7,60	1,15	1	4	2	2	4	4	1,00	301	1	4	131,9	**232,36**
43	Olsztyn 161	59/5	2018-08-31	270 000,00	5,70	0,93	1	4	2	3	4	3	1,90	316	1	4	125,37	**220,85**
44	Olsztyn 161	59/6	2018-08-31	270 000,00	5,75	0,85	1	4	2	3	4	3	1,85	294	1	4	125,37	**220,85**
45	Olsztyn 161	59/7	2018-08-31	270 000,00	5,72	1,72	1	4	2	3	4	3	1,80	257	1	4	169,38	**298,38**
46	Olsztyn 161	59/8	2018-08-31	270 000,00	5,80	1,72	1	4	2	2	4	3	1,90	613	1	4	169,38	**298,38**
47	Olsztyn 161	59/14	2018-08-31	270 000,00	7,65	1,20	1	2	2	1	4	4	1,05	1187	1	4	131,9	**232,34**
48	Olsztyn 161	60/8	2018-08-31	270 000,00	5,75	1,80	1	4	4	4	4	3	1,85	288	1	4	161,38	**284,29**
49	Olsztyn 161	60/9	2018-08-31	270 000,00	5,75	1,80	1	4	4	4	4	3	1,83	274	1	4	161,38	**284,29**
50	Olsztyn 161	60/10	2018-08-31	270 000,00	5,75	1,80	1	4	4	4	4	3	1,83	257	1	4	169,38	**298,38**
51	Olsztyn 161	60/11	2018-08-31	270 000,00	5,75	1,80	1	4	4	4	4	3	1,83	242	1	4	169,38	**298,38**
52	Olsztyn 161	60/12	2018-08-31	270 000,00	5,76	1,81	1	4	4	4	4	3	1,83	225	1	4	169,38	**298,38**
53	Olsztyn 161	60/13	2018-08-31	270 000,00	5,77	1,81	1	4	4	4	4	3	1,83	211	1	4	161,38	**284,29**
54	Olsztyn 161	60/14	2018-08-31	270 000,00	5,78	1,82	1	4	4	4	4	3	1,83	206	1	4	161,38	**284,29**
55	Olsztyn 161	60/15	2018-08-31	270 000,00	5,79	1,82	1	4	4	3	4	3	1,82	318	1	4	161,38	**284,29**
56	Olsztyn 161	60/16	2018-08-31	270 000,00	5,64	1,76	1	3	4	1	4	3	1,76	376	1	4	161,38	**284,29**

Appendix 3 Description of diagnostic attributes

Atttibute	Name	Measurement Sale	Method measurement
X_{1a}	Location from center of Olsztyn city	Quotient	Distance in a straight line in km
		4 3 2 1	Scale transformation: Very good < 4,5 km; good 4,5 – 5,0 km; average 5,1 – 6,5 km; weak >6,5 km.
X_{1b}	Location in relations to public utility and commercial and service facilities	Quotient	The mean straght line distance form objects in km
		4 3 2 1	Scale transformation: Very good from 0,4 – 08 km; Good from 0,8 – 1,4 km; average 1,4 – 2 weak < 0,4 km and >2,0 km.
X_{1c}	Detailed location	4 3 2 1	very favorable location in the center of the estate; favorable location within the estate; average, location near the border of the estate; poor location on the edge of a housing estate.
X_2	Designation of the property in the local plan or SUiKZP	4 3 2 1	single-family housing (MN); multi-family high-rise housing (MW); housing with service admission (M+U+H+P); purposes other than those mentioned above.
X_3	Equipment with technical infrastructure devices	4 3 2 1	four networks and more (w,e,k,g, and others); three networks; two networks; one and barrack net.
X_4	Suitability for installation	4 3 2 1	a plot similar in shape to a square or rectangle; a plot similar in shape to a polygo, a trapezoid; plot irregular, excessively elongated;
X_5	Building intensity	quotient scale	The ratio of the total building area on the plot to the plot area
		4 3	Scale transformation: area ratio buildings up to the area plots 0.20 - 0.40; area ratio buildings up to the area plots 0.41 - 0.60;

		2 1	area ratio buildings up to the area plots < 0.20; area ratio buildings up to the area plots > 0.60
X_6	Type of use and valuation class of the land	4 3 2 1	land excluded from agricultural production: B, Bp, Ba; agricultural land class: V and VI; agricultural land class: I, II, IIIa, IIIb, IVa, IVb; other land use.
X_7	Location in relation to natural and recreational facilities	quotient scale	Średnia odległość w linii prostej do lasu i jeziora
		4 3 2 1	Scale transformation: quite good: 0.40 - 1.00 km; good: > 1.00 km; average; 0.20 - 0.40 km; weak < 0.20 km
X_8	Land area	quotient scale	Plot area shown in the real estate cadaster in m2.
		4 3 2 1	Scale transformation: single-family and semi-detached houses < 800 m^2; residential buildings from 800 - 1500 m^2; large, from 1500 to 3500 m^2; excessively large > 3500 m^2;
X_9	Access to the property	4 3 2 1	paved road inside the housing estate; local (municipal) paved road; paved voivodeship and poviat roads; dirt roads or no direct access.
X_{10}	Neighbor nuisance, excessive noise	4 3 2 1	noise below 45dB, no nuisance; noise below 46-55dB, away from transit roads; noise below 56-65dB, proximity to a transit road; Noise above 65dB, on transit roads;

Appendix 4 Measures of location of diagnostic attributes and transaction prices in Bartąg i Batążek

Variable	Number of observations	Mean	Confidence	Confidence	Median	Mode	Cardinality	Minimum	Maximum	Lower	Upper	STDEV	Standard.
X_{1a}	37	6,951	6,602	7,300	7,200	6,100000	3	5,50000	9,980	6,020	7,600	1,047	0,1721
X_{1b}	37	1,213	1,003	1,423	1,100	0,800000	5	0,20000	3,190	0,800	1,640	0,630	0,1036
X_{1c}	37	2,297	2,124	2,471	2,000	2,000000	24	1,00000	3,000	2,000	3,000	0,520	0,0855
X_2	37	3,351	2,957	3,746	4,000	4,000000	27	1,00000	4,000	3,000	4,000	1,184	0,1946
X_3	37	2,568	2,238	2,897	2,000	2,000000	17	1,00000	4,000	2,000	3,000	0,987	0,1623
X_4	37	3,486	3,207	3,766	4,000	4,000000	25	1,00000	4,000	3,000	4,000	0,837	0,1377
X_5	37	3,811	3,591	4,031	4,000	4,000000	34	1,00000	4,000	4,000	4,000	0,660	0,1085
X_6	37	3,027	2,827	3,227	3,000	3,000000	30	1,00000	4,000	3,000	3,000	0,600	0,0987
X_7	37	0,294	0,196	0,392	0,200	0,100000	8	0,02000	1,430	0,100	0,300	0,295	0,0484
X_8	37	1864,595	1358,738	2370,451	1450,000	Wielokr.	2	21,00000	6170,000	1070,000	2021,000	1517,191	249,4246
X_9	37	2,243	2,002	2,484	2,000	2,000000	31	1,00000	4,000	2,000	2,000	0,723	0,1188
X_{10}	37	2,000	1,592	2,408	1,000	1,000000	19	1,00000	4,000	1,000	3,000	1,225	0,2013
P_{1spm}	37	179,035	120,517	237,554	125,291	69,56000	2	27,00421	948,115	85,333	204,082	175,511	28,8538

Appendix 5 Measures of location of diagnostic attributes and transaction prices in Olsztyn

Variable	Number of observations	Mean	Confidence	Confidence	Median	Mode	Cardinality	Minimum	Maximum	Lower	Upper	STDEV	Standard.
X_{1a}	56	5,3007	5,2443	5,1899	5,3350	5,750000	5	3,7100	7,650	4,6650	5,750	0,8003	0,10695
X_{1b}	56	1,0987	0,7373	0,5011	0,7000	1,800000	6	0,0800	11,000	0,3950	1,710	1,4727	0,19680
X_{1c}	56	2,6964	2,3399	1,9707	3,0000	4,000000	23	1,0000	4,000	1,0000	4,000	1,2638	0,16888
X_2	56	3,4643	3,2960	3,0135	4,0000	4,000000	35	1,0000	4,000	3,0000	4,000	0,8520	0,11386
X_3	56	3,3571	3,0974	2,7206	4,0000	4,000000	39	1,0000	4,000	3,0000	4,000	1,0690	0,14286
X_4	56	3,0536	2,9095	2,7317	3,0000	3,000000	21	1,0000	4,000	2,0000	4,000	0,8617	0,11515
X_5	56	3,8036	3,7723	3,7333	4,0000	4,000000	46	2,0000	4,000	4,0000	4,000	0,4439	0,05932
X_6	56	3,4107	3,3621	3,3103	3,0000	3,000000	29	2,0000	4,000	3,0000	4,000	0,5649	0,07549
X_7	56	1,2964	1,1799	1,0179	1,2000	1,830000	6	0,2150	1,970	0,9250	1,830	0,4915	0,06568
X_8	56	883,6250	674,1233	520,5181	905,0000	1050,000	4	199,0000	3209,000	317,0000	1059,500	706,2093	94,37118
X_9	56	2,0536	1,8009	1,5775	2,0000	1,000000	23	1,0000	4,000	1,0000	3,000	1,0166	0,13585
X_{10}	56	3,5714	3,5286	3,4819	4,0000	4,000000	33	2,0000	4,000	3,0000	4,000	0,5345	0,07143
P_{1spm}	56	212,2151	146,2981	115,3633	131,9000	59,57000	13	59,5700	1428,571	66,3228	221,790	255,9942	34,20867

Appendix 6 Number in terms of unit price, area and distance from the city center for transactions located in the peripheral zone of the city of Olsztyn

Unit price [PLN/m²] P1m²; K-S d=0,31741, p<0,01 ; Lilliefors p<0,01

Class	Number	Cumulative	Percent	Cum. %	% of total	Cum. %
0,000000<x<=200,0000	40	40	71,42857	71,4286	71,42857	71,4286
200,0000<x<=400,0000	10	50	17,85714	89,2857	17,85714	89,2857
400,0000<x<=600,0000	1	51	1,78571	91,0714	1,78571	91,0714
600,0000<x<=800,0000	3	54	5,35714	96,4286	5,35714	96,4286
800,0000<x<=1000,000	0	54	0,00000	96,4286	0,00000	96,4286
1000,000<x<=1200,000	1	55	1,78571	98,2143	1,78571	98,2143
1200,000<x<=1400,000	0	55	0,00000	98,2143	0,00000	98,2143
1400,000<x<=1600,000	1	56	1,78571	100,0000	1,78571	100,0000
shortcomings	0	56	0,00000		0,00000	100,0000

area in sqm [m²] X8; K-S d=0,21142, p<0,05 ; Lilliefors p<0,01

Class	Number	Cumulative	Percent	Cum. %	% of total	Cum. %
-500,000<x<=0,000000	0	0	0,00000	0,0000	0,00000	0,0000
0,000000<x<=500,0000	20	20	35,71429	35,7143	35,71429	35,7143
500,0000<x<=1000,000	16	36	28,57143	64,2857	28,57143	64,2857
1000,000<x<=1500,000	15	51	26,78571	91,0714	26,78571	91,0714
1500,000<x<=2000,000	0	51	0,00000	91,0714	0,00000	91,0714
2000,000<x<=2500,000	1	52	1,78571	92,8571	1,78571	92,8571
2500,000<x<=3000,000	3	55	5,35714	98,2143	5,35714	98,2143
3000,000<x<=3500,000	1	56	1,78571	100,0000	1,78571	100,0000
hortcomings	0	56	0,00000		0,00000	100,0000

Distance from the center [km] X1a; K-S d=0,17707, p<0,10 ; Lilliefors p<0,01

shortcomings	Number	Cumulative	Percent	Cum. %	% of total	Cum. %
3,000000<x<=3,500000	0	0	0,00000	0,0000	0,00000	0,0000
3,500000<x<=4,000000	3	3	5,35714	5,3571	5,35714	5,3571
4,000000<x<=4,500000	3	6	5,35714	10,7143	5,35714	10,7143
4,500000<x<=5,000000	14	20	25,00000	35,7143	25,00000	35,7143
5,000000<x<=5,500000	17	37	30,35714	66,0714	30,35714	66,0714
5,500000<x<=6,000000	14	51	25,00000	91,0714	25,00000	91,0714
6,000000<x<=6,500000	2	53	3,57143	94,6429	3,57143	94,6429
6,500000<x<=7,000000	0	53	0,00000	94,6429	0,00000	94,6429
7,000000<x<=7,500000	0	53	0,00000	94,6429	0,00000	94,6429
7,500000<x<=8,000000	3	56	5,35714	100,0000	5,35714	100,0000
Shortcomings	0	56	0,00000		0,00000	100,0000

Appendix 7 frequency in terms of unit price, area and distance from the city center for transactions located in the suburban area (Bartąg and Bartążek)

Unit price [PLN/m²]						
Class	P1m²; K-S d=0,24073, p<0,05 ; Lilliefors p<0,01					
	Number	Cumulative	Percent	Cum. %	% of total	Cum. %
-200,000<x<=0,000000	0	0	0,00000	0,0000	0,00000	0,0000
0,000000<x<=200,0000	27	27	72,97297	72,9730	72,97297	72,9730
200,0000<x<=400,0000	6	33	16,21622	89,1892	16,21622	89,1892
400,0000<x<=600,0000	3	36	8,10811	97,2973	8,10811	97,2973
600,0000<x<=800,0000	0	36	0,00000	97,2973	0,00000	97,2973
800,0000<x<=1000,000	1	37	2,70270	100,0000	2,70270	100,0000
Braki	0	37	0,00000		0,00000	100,0000
area in [m²]						
Class	X8 K-S d=0,22994, p<0,05; Lilliefors p<0,01					
	Number	Cumulative	Percent	Cum. %	% of total	Cum. %
-1000,00<x<=0,000000	0	0	0,00000	0,0000	0,00000	0,0000
0,000000<x<=1000,000	5	5	13,51351	13,5135	13,51351	13,5135
1000,000<x<=2000,000	22	27	59,45946	72,9730	59,45946	72,9730
2000,000<x<=3000,000	5	32	13,51351	86,4865	13,51351	86,4865
3000,000<x<=4000,000	1	33	2,70270	89,1892	2,70270	89,1892
4000,000<x<=5000,000	1	34	2,70270	91,8919	2,70270	91,8919
5000,000<x<=6000,000	1	35	2,70270	94,5946	2,70270	94,5946
6000,000<x<=7000,000	2	37	5,40541	100,0000	5,40541	100,0000
Shortcomings	0	37	0,00000		0,00000	100,0000
Distance from centrum[km]						
Class	X1a; K-S d=0,14315, p>0,20; Lilliefors p<0,10					
	Number	Cumulative	Percent	Cum. %	% of total	Cum. %
5,000000<x<=6,000000	8	8	21,62162	21,6216	21,62162	21,6216
6,000000<x<=7,000000	10	18	27,02703	48,6486	27,02703	48,6486
7,000000<x<=8,000000	13	31	35,13514	83,7838	35,13514	83,7838
8,000000<x<=9,000000	5	36	13,51351	97,2973	13,51351	97,2973
9,000000<x<=10,00000	1	37	2,70270	100,0000	2,70270	100,0000
Shortcomings	0	37	0,00000		0,00000	100,0000

Appendix 8 Summary of transactions with a description reduced to a uniform type of scale for the suburban zones of Bartąg and Bartążek

No.	Cadastral unit	Number of plot	X_{1a}	X_{1b}	X_{1c}	X_2	X_3	X_4	X_5	X_6	X_7	Surface [m^2]	X_8	X_9	X_{10}	Psk [PLN/m^2]
2	Bartąg	135/44	1	2	2	4	3	4	2	3	1	1848	2	2	1	85,34
3	Bartąg	706	2	4	3	4	3	3	2	3	1	1170	3	1	1	277,29
4	Bartąg	333/33	2	4	3	4	4	4	1	4	4	2789	2	2	1	204,34
5	Bartążek	362/82	2	2	3	4	2	4	2	3	3	1228	3	4	1	178,8
7	Bartąg	311/3	2	3	3	1	3	4	2	3	1	1070	3	2	4	241,42
9	Bartąg	270/34	1	2	2	4	2	4	2	3	2	411	4	2	1	322,52
12	Bartąg	329/21	2	4	3	4	3	4	2	4	2	1450	3	2	4	225,08
13	Bartąg	135/19	1	2	2	4	3	4	2	3	1	1014	3	2	1	143,81
14	Bartąg	206/7	1	2	2	4	1	1	2	3	1	3008	2	2	1	78,49
16	Bartąg	135/17	1	2	2	3	3	4	2	3	1	1875	2	4	1	121,28
17	Bartąg	329/25	2	4	3	4	4	4	2	3	1	1622	2	2	4	230,77
18	Bartąg	30/285	1	1	2	4	4	4	2	3	1	1070	3	2	1	176,61
19	Bartąg	30/20	1	1	2	4	4	4	2	3	1	2000	2	2	1	159,9
20	Bartąg	299/38	2	3	3	1	4	3	2	3	2	1007	3	2	4	389,74
21	Bartążek	16/2	1	3	2	1	2	3	2	1	1	5800	1	2	2	86,46
22	Bartążek	345/32	2	4	3	1	2	3	2	3	4	1323	3	2	3	296,65
23	Bartąg	362/47	2	3	2	4	1	3	2	3	4	1073	3	2	3	135,47
24	Bartążek	30/27	1	4	2	4	2	4	2	3	1	1764	2	2	2	181,12
25	Bartążek	30/26	1	4	2	4	2	4	2	3	1	1716	2	2	2	186,18
27	Bartąg	135/28	1	3	2	4	4	2	2	3	2	1028	3	2	4	244,39
29	Bartąg	205/19	1	2	2	1	1	2	2	1	1	2070	2	2	1	101,46
30	Bartążek	329/23	2	4	3	4	4	4	1	4	2	2224	2	2	4	211,19
31	Bartążek	291/21	2	4	3	4	4	4	2	3	4	1473	3	2	3	223,76
32	Bartążek	16/39	1	3	2	4	2	4	2	3	1	753	4	2	2	196,97
33	Bartążek	345/49	2	2	2	4	2	4	2	4	2	1100	3	2	2	409,41
34	Bartążek	345/57	2	2	2	4	2	4	2	3	2	1107	3	2	1	400,75
35	Bartążek	30/19	1	4	2	4	2	4	2	3	2	2000	2	2	1	183,16
37	Bartążek	30/18	1	4	2	4	2	4	2	3	2	2021	2	2	1	172,71

ΔP = 324,07 PLN/m^2

P_{min} = 85,34 PLN/m^2

P_{max} = 409,41 PLN/m^2

$P_{average}$ = 214,32 PLN/m^2

Appendix 9 Summary of transactions with a description reduced to a uniform type of scale for the peripheral zone of Olsztyn

No.	Adress	Number of plot	X_{1a}	X_{1b}	X_{1c}	X_2	X_3	X_4	X_5	X_6	X_7	Surface [m^2]	X_8	X_9	X_{10}	Psk [PLN/m^2]
1	Olsztyn 118	34/42	3	2	4	4	2	3	2	4	3	909	3	1	4	207,55
2	Olsztyn 118	34/45	3	2	4	4	2	3	2	4	3	837	3	1	3	412,36
3	Olsztyn 118	34/55	3	4	2	4	2	4	2	3	3	218	4	2	4	169,28
4	Olsztyn 118	34/57	3	4	2	1	2	4	2	3	3	1235	3	2	4	169,28
5	Olsztyn 118	38/110	3	4	2	4	1	4	2	2	3	405	4	1	4	372,61
6	Olsztyn 118	38/111	3	4	2	4	1	4	2	2	3	402	4	1	4	372,61
7	Olsztyn 118	38/31	3	4	4	1	4	4	2	3	3	3209	2	2	4	120,40
8	Olsztyn 118	38/51	3	4	4	1	4	3	2	3	3	2642	2	2	4	146,24
9	Olsztyn 118	38/82	3	2	4	4	3	3	2	3	3	908	3	1	3	408,77
10	Olsztyn 118	38/64	2	3	3	4	4	3	2	3	4	1173	3	1	4	210,29
11	Olsztyn 118	4/23	4	4	4	4	1	4	2	3	3	1022	3	2	3	232,39
12	Olsztyn 118	4/26	3	4	4	4	2	2	2	3	3	570	4	2	3	416,67
13	Olsztyn 118	4/38	3	2	4	4	3	3	2	3	3	975	3	1	4	206,14
14	Olsztyn 118	4/45	3	3	4	4	2	4	2	3	3	710	4	2	4	210,48
15	Olsztyn 118	4/47	3	4	4	1	2	4	2	3	3	388	4	2	4	210,48
16	Olsztyn 125	165/1	3	4	3	4	4	2	2	3	3	1411	3	1	3	418,34
18	Olsztyn 126	3/3	4	4	3	4	2	2	2	4	2	2995	2	4	4	100,78
19	Olsztyn 160	2/129	4	4	3	4	4	3	2	4	3	1084	3	3	4	404,30
20	Olsztyn 160	2/133	4	4	3	4	4	3	2	4	3	1086	3	1	4	476,57
21	Olsztyn 160	2/141	2	3	4	4	4	3	2	4	4	2291	2	3	3	407,53
27	Olsztyn 160	39/29	2	1	3	3	4	2	4	4	4	952	3	3	3	103,32
28	Olsztyn 160	39/30	2	1	3	3	4	2	1	4	4	919	3	3	3	103,32
29	Olsztyn 160	39/31	2	1	3	3	4	3	4	4	4	921	3	3	3	103,32
30	Olsztyn 160	39/32	2	1	3	3	4	3	2	4	4	902	3	3	3	103,32
31	Olsztyn 160	39/33	2	3	3	3	4	2	2	4	4	1111	3	3	3	103,32
32	Olsztyn 160	39/34	2	1	3	3	4	2	2	4	4	1114	3	3	3	103,32
33	Olsztyn 160	39/35	2	1	3	3	4	2	2	4	4	941	3	3	2	103,32
34	Olsztyn 160	39/36	2	1	3	3	4	2	2	4	4	1069	3	3	3	103,32
35	Olsztyn 160	39/37	2	1	3	3	4	3	2	4	4	1050	3	3	3	103,32
36	Olsztyn 160	39/38	2	1	3	3	4	3	2	4	4	1050	3	3	3	103,32
37	Olsztyn 160	39/39	2	1	3	3	4	3	2	4	4	1050	3	3	3	103,32
38	Olsztyn 160	39/40	2	1	3	3	4	3	2	4	4	1050	3	3	3	103,32
39	Olsztyn 160	39/41	2	1	3	3	4	2	2	4	4	1015	3	3	3	103,32
41	Olsztyn 161	59/3	1	3	1	4	2	2	2	4	3	559	4	1	4	232,36
42	Olsztyn 161	59/4	1	3	1	4	2	2	2	4	4	301	4	1	4	232,36
43	Olsztyn 161	59/5	2	3	1	4	2	3	2	3	3	316	4	1	4	220,85
44	Olsztyn 161	59/6	2	3	1	4	2	3	2	3	3	294	4	1	4	220,85
45	Olsztyn 161	59/7	2	2	1	4	2	3	2	3	3	257	4	1	4	298,38
46	Olsztyn 161	59/8	2	2	1	4	2	2	2	3	3	613	4	1	4	298,38
47	Olsztyn 161	59/14	1	3	1	2	2	1	2	4	3	1187	3	1	4	232,34
48	Olsztyn 161	60/8	2	2	1	4	4	4	2	3	3	288	4	1	4	284,29
49	Olsztyn 161	60/9	2	2	1	4	4	4	2	3	3	274	4	1	4	284,29
50	Olsztyn 161	60/10	2	2	1	4	4	4	2	3	3	257	4	1	4	298,38
51	Olsztyn 161	60/11	2	2	1	4	4	4	2	3	3	242	4	1	4	298,38
52	Olsztyn 161	60/12	2	2	1	4	4	4	2	3	3	225	4	1	4	298,38
53	Olsztyn 161	60/13	2	2	1	4	4	4	2	3	3	211	4	1	4	284,29
54	Olsztyn 161	60/14	2	2	1	4	4	4	2	3	3	206	4	1	4	284,29
55	Olsztyn 161	60/15	2	2	1	4	4	3	2	3	3	318	4	1	4	284,29
56	Olsztyn 161	60/16	2	2	1	3	4	1	2	3	3	376	4	1	4	284,29

Appendix 10 Determining the value of real estate using the index method - using the estimated rate

for real estate located in the suburban area of Bartąg and Bartążek

No.	Adress	**Number of plot**	Price [PLN/m^2]	Surface [m^2]	P_{sk} [PLN/m^2]	V_o [PLN]	**u**	**s**	**V_w** [PLN]	**k_1**	**k_2**	**k_3**	**k_4**	**k_5**	**k_6**	**Value** [PLN]	**1,4V_r** [PLN]	**V** [PLN/m^2]
2	Bartąg	135/44	130 000,00	1848	85,34	7844,53	3	1	23533,59	0,8	0,25	0,3	0,3	0,4	0,3	78838	110372,52	59,73
3	Bartąg	706	264 450,00	1170	277,29	4966,50	3	1	14899,51	0,5	0	0,3	0,3	0,5	0,3	43209	60492,02	51,70
4	Bartąg	333/33	452 600,00	2789	204,34	11838,96	3	1	35516,87	0,9	0,2	0,3	0,3	0,5	0,6	134964	188949,74	67,75
5	Bartążek	362/82	170 000,00	1228	178,8	5212,71	3	1	15638,12	0,7	0,15	0,3	0,3	0,4	0,5	52388	73342,78	59,73
6	Bartąg	248/5	270 000,00	6090	57,26	25851,29	3	1	77553,87	0,4	0	0,3	0,3	0	0,4	186129	260580,99	42,79
7	Bartąg	311/3	200 000,00	1070	241,42	4542,02	3	1	13626,05	0,9	0	0,3	0,3	0,2	0,4	42241	59137,05	55,27
9	Bartąg	270/34	102 630,00	411	322,52	1744,64	3	1	5233,93	0,4	0,25	0,3	0,3	0,4	0,3	15440	21616,13	52,59
11	Bartąg	89/1	195 000,00	4709	54,82	19989,12	3	1	59967,35	0,7	0,1	0,3	0,3	0,5	0,2	185899	260258,30	55,27
12	Bartąg	329/21	235 000,00	1450	225,08	6155,07	3	1	18465,21	0,9	0,15	0,3	0,3	0,2	0,5	61858	86601,82	59,73
13	Bartąg	135/19	105 000,00	1014	143,81	4304,30	3	1	12912,91	0,8	0,2	0,1	0,3	0,4	0,2	38739	54234,22	53,49
14	Bartąg	206/7	170 000,00	3008	78,49	12768,58	3	1	38305,75	0,3	0,2	0,3	0,3	0,4	0,2	103426	144795,74	48,14
15	Bartążek	295/13	440 000,00	1014	602,64	4304,30	3	1	12912,91	0,9	0,15	0,3	0,3	0,2	0,7	45841	64177,16	63,29
16	Bartąg	135/17	160 000,00	1875	121,28	7959,14	3	1	23877,42	0,8	0,2	0,1	0,3	0,4	0,2	71632	100285,17	53,49
17	Bartąg	329/25	257 500,00	1622	230,77	6885,19	3	1	20655,56	0,9	0,15	0,3	0,3	0,2	0,4	67131	93982,81	57,94
18	Bartąg	30/285	130 000,00	1070	176,61	4542,02	3	1	13626,05	1	0,15	0,3	0,3	0,3	0,2	44285	61998,52	57,94
19	Bartąg	30/20	220 000,00	2000	159,9	8489,75	3	1	25469,25	1	0,15	0,3	0,3	0,3	0,2	82775	115885,09	57,94
20	Bartąg	299/38	270 000,00	1007	389,74	4274,59	3	1	12823,77	0,9	0,1	0,1	0	0,2	0,5	35907	50269,17	49,92

21	Bartążek	16/2	345 000,00	5800	86,46	24620,28	3	1	73860,83	0,5	0	0,1	0	0,5	0,3	177266	248172,37	42,79
22	Bartążek	345/32	270 000,00	1323	296,65	5615,97	3	1	16847,91	0,7	0	0,1	0	0,2	0,7	45489	63685,10	48,14
23	Bartąg	362/47	100 000,00	1073	135,47	4554,75	3	1	13664,25	0,3	0	0,1	0,2	0,2	0,7	34161	47824,88	44,57
24	Bartążek	30/27	215 000,00	1764	181,12	7487,96	3	1	22463,88	0,5	0,15	0,3	0,3	0,5	0,2	66268	92775,82	52,59
25	Bartążek	30/26	215 000,00	1716	186,18	7284,21	3	1	21852,62	0,5	0,15	0,3	0,3	0,5	0,2	64465	90251,31	52,59
26	Bartąg	283/1	166 616,00	6170	41,88	26190,88	3	1	78572,64	0,3	0	0,1	0	0,5	0,5	188574	264004,06	42,79
27	Bartąg	135/28	162 000,00	1028	244,39	4363,73	3	1	13091,19	0,9	0,15	0,3	0,3	0,2	0,5	43856	61397,70	59,73
28	Bartążek	30/24	105 000,00	2391	68,1	10149,50	3	1	30448,49	0,5	0,15	0,3	0,3	0,4	0,2	86778	121489,47	50,81
29	Bartąg	205/19	130 000,00	2070	101,46	8786,89	3	1	26360,67	0,3	0	0,1	0,2	0,4	0,2	57993	81190,88	39,22
30	Bartążek	329/23	285 000,00	2224	211,19	9440,60	3	1	28321,81	0,9	0	0,1	0,2	0,2	0,5	82133	114986,53	51,70
31	Bartążek	291/21	200 000,00	1473	223,76	6252,70	3	1	18758,10	0,9	0,1	0,1	0,3	0,5	0,7	67529	94540,84	64,18
32	Bartążek	16/39	90 000,00	753	196,97	3196,39	3	1	9589,17	0,4	0	0,1	0,3	0,5	0,2	23973	33562,10	44,57
33	Bartążek	345/49	268 000,00	1100	409,41	4669,36	3	1	14008,09	0,4	0	0,1	0,2	0,4	0,3	33619	47067,17	42,79
34	Bartążek	345/57	264 000,00	1107	400,75	4699,08	3	1	14097,23	0,4	0	0,1	0,2	0,4	0,4	35243	49340,30	44,57
35	Bartążek	30/19	218 000,00	2000	183,16	8489,75	3	1	25469,25	0,5	0,15	0,3	0,3	0,5	0,3	77681	108753,70	54,38
37	Bartążek	30/18	200 000,00	2021	172,71	8578,89	3	1	25736,68	0,5	0,15	0,3	0,3	0,5	0,3	78497	109895,61	54,38

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Signs:

P_{sk} – unit price adjusted for the passage of time;

V_o – basic estimated rate;

V_w – output value;

V – estimated value of the property;

$1.4V_r$ - estimation of the value of the property increased by the expert's index b

Appendix 11 Determining the value of real estate using the index method - using the estimated rate for properties located in the peripheral zone of the city of Olsztyn

No.	Adress	**Number of plot**	Price [PLN/m^2]	Surface [m^2]	P_{sk} [PLN/m^2]	V_o [PLN]	**u**	**s**	**V_w** [PLN]	**k_1**	**k_2**	**k_3**	**k_4**	**k_5**	**k_6**	**Value** [PLN]	**1,4V_r** [PLN]	**V** [PLN/m^2]
1	Olsztyn 118	34/42	105 470,00	909	207,55	3858,591	3	1,2	13890,93	0,2	0	0,1	0,2	0,1	0,6	30560,04	42784,06	47,07
2	Olsztyn 118	34/45	199 000,00	837	412,36	3552,96	3	1,2	12790,66	0,2	0	0,1	0,2	0,1	0,6	28139,45	39395,22	47,07
3	Olsztyn 118	34/55	139 700,00	218	169,28	925,3828	3	1,2	3331,38	0,5	0	0,1	0,3	0,2	0,6	8994,72	12592,61	57,76
4	Olsztyn 118	34/57	139 700,00	1235	169,28	5242,421	3	1,2	18872,71	0,5	0	0,1	0,3	0,2	0,6	50956,33	71338,86	57,76
5	Olsztyn 118	38/110	230 000,00	405	372,61	1719,174	3	1,2	6189,03	0,1	0	0,1	0,3	0,2	0,6	14234,76	19928,67	49,21
6	Olsztyn 118	38/111	230 000,00	402	372,61	1706,44	3	1,2	6143,18	0,1	0	0,1	0,3	0,2	0,6	14129,32	19781,05	49,21
7	Olsztyn 118	38/31	230 000,00	3209	120,4	13621,8	3	1,2	49038,49	1	0	0,1	0,3	0,2	0,6	156923,18	219692,45	68,46
8	Olsztyn 118	38/51	230 000,00	2642	146,24	11214,96	3	1,2	40373,86	0,9	0	0,1	0,2	0,2	0,6	121121,57	169570,19	64,18
9	Olsztyn 118	38/82	214 000,00	908	408,77	3854,347	3	1,2	13875,65	0,5	0	0,1	0,2	0,1	0,6	34689,12	48564,77	53,49
10	Olsztyn 118	38/64	144 480,00	1173	210,29	4979,238	3	1,2	17925,26	0,6	0	0,1	0,2	0,2	0,6	48398,20	67757,48	57,76
11	Olsztyn 118	4/23	120 000,00	1022	232,39	4338,262	3	1,2	15617,74	0,3	0	0,1	0,3	0,2	0,6	39044,36	54662,10	53,49
12	Olsztyn 118	4/26	120 000,00	570	416,67	2419,579	3	1,2	8710,48	0,5	0	0,1	0,1	0,2	0,6	21776,21	30486,69	53,49
13	Olsztyn 118	4/38	109 040,00	975	206,14	4138,753	3	1,2	14899,51	0,1	0	0,1	0,2	0,1	0,6	31288,97	43804,56	44,93
14	Olsztyn 118	4/45	139 700,00	710	210,48	3013,861	3	1,2	10849,90	0,5	0	0,1	0,3	0,2	0,6	29294,73	41012,62	57,76
15	Olsztyn 118	4/47	139 700,00	388	210,48	1647,012	3	1,2	5929,24	0,5	0	0,1	0,3	0,2	0,6	16008,95	22412,53	57,76
16	Olsztyn 125	165/1	330 000,00	1411	418,34	5989,519	3	1,2	21562,27	0,7	0	0,1	0,1	0,2	0,6	58218,12	81505,37	57,76
18	Olsztyn 126	3/3	182 621,95	2995	100,78	12713,4	3	1,2	45768,24	0,7	0	0,1	0,1	0,2	0,6	123574,25	173003,96	57,76
19	Olsztyn 160	2/129	245 000,00	1084	404,3	4601,445	3	1,2	16565,20	1	0	0,1	0,2	0,2	0,6	51352,12	71892,97	66,32

20	Olsztyn 160	2/133	285 000,00	1086	476,57	4609,934	3	1,2	16595,76	0,7	0	0,1	0,2	0,2	0,6	46468,14	65055,39	59,90
21	Olsztyn 160	2/141	530 000,00	2291	407,53	9725,009	3	1,2	35010,03	1	0	0,1	0,2	0,2	0,6	108531,10	151943,53	66,32
26	Olsztyn 160	39/28	550 000,00	942	506,86	3998,672	3	1,2	14395,22	1	0	0,1	0,3	0,2	0,6	46064,70	64490,59	68,46
27	Olsztyn 160	39/29	7 770 000,00	952	103,32	4041,121	3	1,2	14548,04	1	0	0,1	0,1	0	0,6	40734,50	57028,30	59,90
28	Olsztyn 160	39/30	7 770 000,00	919	103,32	3901,04	3	1,2	14043,74	1	0	0,1	0,1	0	0,6	39322,48	55051,48	59,90
29	Olsztyn 160	39/31	7 770 000,00	921	103,32	3909,53	3	1,2	14074,31	1	0	0,1	0,2	0	0,6	40815,49	57141,69	62,04
30	Olsztyn 160	39/32	7 770 000,00	902	103,32	3828,877	3	1,2	13783,96	1	0	0,1	0,2	0	0,6	39973,48	55962,87	62,04
31	Olsztyn 160	39/33	7 770 000,00	1111	103,32	4716,056	3	1,2	16977,80	1	0	0,1	0,1	0,1	0,6	49235,63	68929,88	62,04
32	Olsztyn 160	39/34	7 770 000,00	1114	103,32	4728,791	3	1,2	17023,65	1	0	0,1	0,1	0	0,6	47666,21	66732,70	59,90
33	Olsztyn 160	39/35	7 770 000,00	941	103,32	3994,427	3	1,2	14379,94	1	0	0,1	0,1	0	0,6	40263,83	56369,36	59,90
34	Olsztyn 160	39/36	7 770 000,00	1069	103,32	4537,771	3	1,2	16335,98	1	0	0,1	0,1	0	0,6	45740,74	64037,03	59,90
35	Olsztyn 160	39/37	7 770 000,00	1050	103,32	4457,119	3	1,2	16045,63	1	0	0,1	0,2	0	0,6	46532,32	65145,25	62,04
36	Olsztyn 160	39/38	7 770 000,00	1050	103,32	4457,119	3	1,2	16045,63	1	0	0,1	0,2	0	0,6	46532,32	65145,25	62,04
37	Olsztyn 160	39/39	7 770 000,00	1050	103,32	4457,119	3	1,2	16045,63	1	0	0,1	0,2	0	0,6	46532,32	65145,25	62,04
38	Olsztyn 160	39/40	7 770 000,00	1050	103,32	4457,119	3	1,2	16045,63	1	0	0,1	0,2	0	0,6	46532,32	65145,25	62,04
39	Olsztyn 160	39/41	7 770 000,00	1015	103,32	4308,548	3	1,2	15510,77	1	0	0,1	0,1	0	0,6	43430,17	60802,23	59,90
41	Olsztyn 161	59/3	270 000,00	559	232,36	2372,885	3	1,2	8542,39	0,2	0	0,1	0,1	0,2	0,6	18793,25	26310,55	47,07
42	Olsztyn 161	59/4	270 000,00	301	232,36	1277,707	3	1,2	4599,75	0,2	0	0,1	0,1	0,2	0,6	10119,44	14167,22	47,07
43	Olsztyn 161	59/5	270 000,00	316	220,85	1341,381	3	1,2	4828,97	0,2	0	0,1	0,2	0,2	0,6	11106,63	15549,28	49,21
44	Olsztyn 161	59/6	270 000,00	294	220,85	1247,993	3	1,2	4492,78	0,2	0	0,1	0,2	0,2	0,6	10333,38	14466,74	49,21
45	Olsztyn 161	59/7	270 000,00	257	298,38	1090,933	3	1,2	3927,36	0,2	0	0,1	0,2	0,1	0,6	8640,19	12096,26	47,07
46	Olsztyn 161	59/8	270 000,00	613	298,38	2602,108	3	1,2	9367,59	0,2	0	0,1	0,1	0,2	0,6	20608,70	28852,18	47,07

47	Olsztyn 161	59/14	270 000,00	1187	232,34	5038,667	3	1,2	18139,20	0,2	0	0,1	0	0,1	0,6	36278,40	50789,76	42,79
48	Olsztyn 161	60/8	270 000,00	288	284,29	1222,524	3	1,2	4401,09	0,6	0	0,1	0,3	0,1	0,6	11882,93	16636,11	57,76
49	Olsztyn 161	60/9	270 000,00	274	284,29	1163,096	3	1,2	4187,14	0,6	0	0,1	0,3	0,1	0,6	11305,29	15827,41	57,76
50	Olsztyn 161	60/10	270 000,00	257	298,38	1090,933	3	1,2	3927,36	0,6	0	0,1	0,3	0,1	0,6	10603,87	14845,41	57,76
51	Olsztyn 161	60/11	270 000,00	242	298,38	1027,26	3	1,2	3698,14	0,6	0	0,1	0,3	0,1	0,6	9984,96	13978,95	57,76
52	Olsztyn 161	60/12	270 000,00	225	298,38	955,0969	3	1,2	3438,35	0,6	0	0,1	0,3	0,1	0,6	9283,54	12996,96	57,76
53	Olsztyn 161	60/13	270 000,00	211	284,29	895,6686	3	1,2	3224,41	0,6	0	0,1	0,3	0,1	0,6	8705,90	12188,26	57,76
54	Olsztyn 161	60/14	270 000,00	206	284,29	874,4443	3	1,2	3148,00	0,6	0	0,1	0,3	0,1	0,6	8499,60	11899,44	57,76
55	Olsztyn 161	60/15	270 000,00	318	284,29	1349,87	3	1,2	4859,53	0,6	0	0,1	0,2	0,1	0,6	12634,79	17688,70	55,62
56	Olsztyn 161	60/16	270 000,00	376	284,29	1596,073	3	1,2	5745,86	0,6	0	0,1	0	0,1	0,6	13790,07	19306,10	51,35

Signs:

P_{sk} – unit price adjusted for the passage of time;

V_o – basic estimated rate;

V_w – output value;

V – estimated value of the property;

$1.4V_r$ - estimation of the value of the property increased by the expert's index

Appendix 12 Determining the market value of the real estate located in the suburban area of Barąg and Bartążek

Data for valuation using the average price adjustment method									Determination of the market value					
No.	**Unit**	**No. plot**	**X_{1a}**	**X_6**	**X_8**	**X_{10}**	**$P_{ow.}$** [m^2]	**P_{sk}** [PLN/m^2]	**u_{1a}**	**u_6**	**u_8**	**u_{10}**	**$P_{aver.}$** [PLN/m^2]	**V** [PLN/m^2]
29	Bartąg	205/19	1	1	2	1	2070	**101,46**	0,1562	0,1302	0,1562	0,0781		**101,47**
16	Bartąg	135/17	1	3	2	1	1875	**121,28**	0,1562	0,3806	0,1562	0,0781		**150,27**
23	Bartąg	362/47	2	3	3	3	1073	**135,47**	0,4567	0,3806	0,3064	0,2283		**267,37**
13	Bartąg	135/19	1	3	3	1	1014	**143,81**	0,1562	0,3806	0,3064	0,0781		**179,54**
19	Bartąg	30/20	1	3	2	1	2000	**159,90**	0,1562	0,3806	0,1562	0,0781		**150,26**
37	Bartążek	30/18	1	3	2	1	2021	**172,71**	0,1562	0,3806	0,1562	0,0781		**150,26**
18	Bartąg	30/285	1	3	3	1	1070	**176,61**	0,1562	0,3806	0,3064	0,0781		**179,53**
5	Bartążek	362/82	2	3	3	1	1228	**178,80**	0,4567	0,3806	0,3064	0,0781		**238,09**
24	Bartążek	30/27	1	3	2	2	1764	**181,12**	0,1562	0,3806	0,1562	0,1532		**164,90**
35	Bartążek	30/19	1	3	2	1	2000	**183,16**	0,1562	0,3806	0,1562	0,0781		**150,26**
25	Bartążek	30/26	1	3	2	2	1716	**186,18**	0,1562	0,3806	0,1562	0,1532	**194,87**	**164,90**
32	Bartążek	16/39	1	3	4	2	753	**196,97**	0,1562	0,3806	0,4567	0,1532		**223,46**
4	Bartąg	333/33	2	4	2	1	2789	**204,34**	0,4567	0,5058	0,1562	0,0781		**233,22**
30	Bartążek	329/23	2	4	2	4	2224	**211,19**	0,4567	0,5058	0,1562	0,3035		**277,14**
31	Bartążek	291/21	2	3	3	3	1473	**223,76**	0,4567	0,3806	0,3064	0,2283		**267,36**
12	Bartąg	329/21	2	4	3	4	1450	**225,08**	0,4567	0,5058	0,3064	0,3035		**306,41**
17	Bartąg	329/25	2	3	2	4	1622	**230,77**	0,4567	0,3806	0,1562	0,3035		**252,75**
7	Bartąg	311/3	2	3	3	4	1070	**241,42**	0,4567	0,3806	0,3064	0,3035		**282,02**
27	Bartąg	135/28	1	3	3	4	1028	**244,39**	0,1562	0,3806	0,3064	0,3035		**223,46**
3	Bartąg	706	2	3	3	1	1170	**277,29**	0,4567	0,3806	0,3064	0,0781		**238,09**
22	Bartążek	345/32	2	3	3	3	1323	**296,65**	0,4567	0,3806	0,3064	0,2283		**267,36**
							$P_{average}$	**194,87**	PLN/m^2				**$V_{average}$**	**212,77**

Appendix 13 Determining the market value of the real estate located in the peripheral zone of the city of Olsztyn

The peripheral zone of the city of Olsztyn									Determination of the market value					
No.	**Unit**	**No. plot**	**X_{1a}**	**X_2**	**X_8**	**X_{10}**	**Surface** [m^2]	**P_{sk}** [PLN/m^2]	**u_{1a}**	**u_6**	**u_8**	**u_{10}**	**$P_{average}$** [PLN/m^2]	**V** [PLN/m^2]
8	Olsztyn 118	38/51	2	1	2	4	2642	146,24	0,1052	0,1894	0,1210	0,1106		146,24
3	Olsztyn 118	34/55	3	4	4	4	218	169,28	0,2998	0,5398	0,3448	0,1106		359,91
4	Olsztyn 118	34/57	3	1	3	4	1235	169,28	0,2998	0,1894	0,2329	0,1106		231,42
13	Olsztyn 118	4/38	3	4	3	4	975	206,14	0,2998	0,5398	0,2329	0,1106		328,81
1	Olsztyn 118	34/42	3	4	3	4	909	207,55	0,2998	0,5398	0,2329	0,1106		328,81
10	Olsztyn 118	38/64	2	4	3	4	1173	210,29	0,2998	0,5398	0,2329	0,1106		328,81
14	Olsztyn 118	4/45	3	4	4	4	710	210,48	0,2998	0,5398	0,3448	0,1106		359,91
15	Olsztyn 118	4/47	3	1	4	4	388	210,48	0,2998	0,1894	0,3448	0,1106		262,52
43	Olsztyn 161	59/5	2	4	4	4	316	220,85	0,1052	0,5398	0,3448	0,1106		305,82
44	Olsztyn 161	59/6	2	4	4	4	294	220,85	0,1052	0,5398	0,3448	0,1106	**277,92**	305,82
47	Olsztyn 161	59/14	1	2	3	4	1187	232,34	0,0000	0,3062	0,2329	0,1106		180,56
41	Olsztyn 161	59/3	1	4	4	4	559	232,36	0,0000	0,5398	0,3448	0,1106		276,58
42	Olsztyn 161	59/4	1	4	4	4	301	232,36	0,0000	0,5398	0,3448	0,1106		276,59
11	Olsztyn 118	4/23	4	4	3	3	1022	232,39	0,4050	0,5398	0,2329	0,3148		414,80
48	Olsztyn 161	60/8	2	4	4	4	288	284,29	0,1052	0,5398	0,3448	0,1106		305,82
49	Olsztyn 161	60/9	2	4	4	4	274	284,29	0,1052	0,5398	0,3448	0,1106		305,82
53	Olsztyn 161	60/13	2	4	4	4	211	284,29	0,1052	0,5398	0,3448	0,1106		305,82
54	Olsztyn 161	60/14	2	4	4	4	206	284,29	0,1052	0,5398	0,3448	0,1106		305,82

55	Olsztyn 161	60/15	2	4	4	4	318	284,29	0,1052	0,5398	0,3448	0,1106		305,82
56	Olsztyn 161	60/16	2	3	4	4	376	284,29	0,1052	0,3062	0,3448	0,1106		240,90
45	Olsztyn 161	59/7	2	4	4	4	257	298,38	0,1052	0,5398	0,3448	0,1106		305,82
46	Olsztyn 161	59/8	2	4	4	4	613	298,38	0,1052	0,5398	0,3448	0,1106		305,82
50	Olsztyn 161	60/10	2	4	4	4	257	298,38	0,1052	0,5398	0,3448	0,1106		305,82
51	Olsztyn 161	60/11	2	4	4	4	242	298,38	0,1052	0,5398	0,3448	0,1106		305,82
52	Olsztyn 161	60/12	2	4	4	4	225	298,38	0,1052	0,5398	0,3448	0,1106		305,82
5	Olsztyn 118	38/110	3	4	4	4	405	372,61	0,2998	0,5398	0,3448	0,1106		359,91
6	Olsztyn 118	38/111	3	4	4	4	402	372,61	0,2998	0,5398	0,3448	0,1106		359,91
19	Olsztyn 160	2/129	4	4	3	4	1084	404,30	0,4050	0,5398	0,2329	0,1106		358,04
21	Olsztyn 160	2/141	2	4	2	3	2291	407,53	0,1052	0,5398	0,1210	0,3148		300,38
9	Olsztyn 118	38/82	3	4	3	3	908	408,77	0,2998	0,5398	0,2329	0,3148		385,56
2	Olsztyn 118	34/45	3	4	3	3	837	412,36	0,2998	0,5398	0,2329	0,3148		385,56
12	Olsztyn 118	4/26	3	4	4	3	570	416,67	0,2998	0,5398	0,3448	0,3148		416,66
								$P_{average}$	**277,92**	PLN/m^2		$V_{average}$	**311,62**	PLZ/m^2

Appendix 14 Determining the value of real estate using multiple regression for the suburban zones of Bartag and Bartążek

No.	Unit	Plot number	X_{1a}	X_6	X_8	X_{10}	Surface [m^2]	P_{sk} [PLN/m^2]	Price corrected [PLN]	V [PLN/m^2]	Value [PLN]	Δ [%]	Δ^2
2	Bartąg	135/44	1	3	2	1	1848	85,34	**157708**	149,30	**275906**	-74,95	5617,09
21	Bartążek	16/2	1	1	1	2	5800	86,46	**501468**	99,08	**574664**	-14,60	213,05
29	Bartąg	205/19	1	1	2	1	2070	101,46	**210022**	111,98	**231799**	-10,37	107,51
16	Bartąg	135/17	1	3	2	1	1875	121,28	**227400**	149,30	**279938**	-23,10	533,77
23	Bartąg	362/47	2	3	3	3	1073	135,47	**145359**	226,27	**242788**	-67,03	4492,47
13	Bartąg	135/19	1	3	3	1	1014	143,81	**145823**	173,24	**175665**	-20,46	418,80
19	Bartąg	30/20	1	3	2	1	2000	159,9	**319800**	149,30	**298600**	6,63	43,95
37	Bartążek	30/18	1	3	2	1	2021	172,71	**349047**	149,30	**301735**	13,55	183,72
18	Bartąg	30/285	1	3	3	1	1070	176,61	**188973**	173,24	**185367**	1,91	3,64
5	Bartążek	362/82	2	3	3	1	1228	178,8	**219566**	204,17	**250721**	-14,19	201,33
24	Bartążek	30/27	1	3	2	2	1764	181,12	**319496**	160,35	**282857**	11,47	131,50
35	Bartążek	30/19	1	3	2	1	2000	183,16	**366320**	149,30	**298600**	18,49	341,75
25	Bartążek	30/26	1	3	2	2	1716	186,18	**319485**	160,35	**275161**	13,87	192,48
32	Bartążek	16/39	1	3	4	2	753	196,97	**148318**	208,24	**156805**	-5,72	32,74
4	Bartąg	333/33	2	4	2	1	2789	204,34	**569904**	198,88	**554676**	2,67	7,14
30	Bartążek	329/23	2	4	2	4	2224	211,19	**469687**	232,04	**516057**	-9,87	97,47
31	Bartążek	291/21	2	3	3	3	1473	223,76	**329598**	226,27	**333296**	-1,12	1,26

12	Bartąg	329/21	2	4	3	4	1450	225,08	**326366**	255,98	**371171**	-13,73	188,47
17	Bartąg	329/25	2	3	2	4	1622	230,77	**374309**	213,38	**346102**	7,54	56,79
7	Bartąg	311/3	2	3	3	4	1070	241,42	**258319**	237,32	**253932**	1,70	2,88
27	Bartąg	135/28	1	3	3	4	1028	244,39	**251233**	206,40	**212179**	15,54	241,64
3	Bartąg	706	2	3	3	1	1170	277,29	**324429**	204,17	**238879**	26,37	695,35
22	Bartążek	345/32	2	3	3	3	1323	296,65	**392468**	226,27	**299355**	23,72	562,87
9	Bartąg	270/34	1	3	4	1	411	322,52	**132556**	197,19	**81045**	38,86	1510,07
20	Bartąg	299/38	2	3	3	4	1007	389,74	**392468**	237,32	**238981**	39,11	1529,45
34	Bartążek	345/57	2	3	3	1	1107	400,75	**443630**	204,17	**226016**	49,05	2406,20
33	Bartążek	345/49	2	4	3	2	1100	409,41	**450351**	233,88	**257268**	42,87	1838,17
							$P_{average}$ =	**214,32**	V aver. =	**190,25**		$\Delta^2_{average}$ =	801,91
												s =	**28,32 %**

Appendix 15 Determining the value of real estate using multiple regression for the peripheral zone of the city of Olsztyn

No.	Unit	Plot number	X_{1a}	X_2	X_8	X_{10}	Surface [m^2]	P_{sk} [PLN/m^2]	Price corrected [PLN]	V [PLN/m^2]	Value [PLN]	Δ [%]	Δ^2
27	Olsztyn 160	39/29	2	3	3	3	952	103,32	98361	143,50	136612	-38,89	1512,35
28	Olsztyn 160	39/30	2	3	3	3	919	103,32	94951	143,50	131877	-38,89	1512,35
29	Olsztyn 160	39/31	2	3	3	3	921	103,32	95158	143,50	132164	-38,89	1512,35
30	Olsztyn 160	39/32	2	3	3	3	902	103,32	93195	143,50	129437	-38,89	1512,35
31	Olsztyn 160	39/33	2	3	3	3	1111	103,32	114789	143,50	159429	-38,89	1512,35
32	Olsztyn 160	39/34	2	3	3	3	1114	103,32	115098	143,50	159859	-38,89	1512,35
33	Olsztyn 160	39/35	2	3	3	2	941	103,32	97224	99,25	93394	3,94	15,52
34	Olsztyn 160	39/36	2	3	3	3	1069	103,32	110449	143,50	153402	-38,89	1512,35
35	Olsztyn 160	39/37	2	3	3	3	1050	103,32	108486	143,50	150675	-38,89	1512,35
36	Olsztyn 160	39/38	2	3	3	3	1050	103,32	108486	143,50	150675	-38,89	1512,35
37	Olsztyn 160	39/39	2	3	3	3	1050	103,32	108486	143,50	150675	-38,89	1512,35
38	Olsztyn 160	39/40	2	3	3	3	1050	103,32	108486	143,50	150675	-38,89	1512,35
39	Olsztyn 160	39/41	2	3	3	3	1015	103,32	104870	143,50	145653	-38,89	1512,35
7	Olsztyn 118	38/31	3	1	2	4	3209	120,4	386364	122,85	394226	-2,03	4,14
8	Olsztyn 118	38/51	3	1	2	4	2642	146,24	386366	122,85	324570	15,99	255,82
3	Olsztyn 118	34/55	3	4	4	4	218	169,28	36903	345,71	75365	-104,22	10862,59
4	Olsztyn 118	34/57	3	1	3	4	1235	169,28	209061	163,57	202009	3,37	11,38
13	Olsztyn 118	4/38	3	4	3	4	975	206,14	200987	304,98	297356	-47,95	2299,01
1	Olsztyn 118	34/42	3	4	3	4	909	207,55	188663	304,98	277227	-46,94	2203,64

10	Olsztyn 118	38/64	2	4	3	4	1173	210,29	246670	234,88	275514	-11,69	136,74
14	Olsztyn 118	4/45	3	4	4	4	710	210,48	149441	345,71	245454	-64,25	4127,85
15	Olsztyn 118	4/47	3	1	4	4	388	210,48	81666	204,30	79268	2,94	8,62
43	Olsztyn 161	59/5	2	4	4	4	316	220,85	69789	275,60	87090	-24,79	614,57
44	Olsztyn 161	59/6	2	4	4	4	294	220,85	64930	275,60	81026	-24,79	614,57
47	Olsztyn 161	59/14	1	2	3	4	1187	232,34	275788	70,50	83684	69,66	4852,03
41	Olsztyn 161	59/3	1	4	4	4	559	232,36	129889	205,49	114869	11,56	133,72
42	Olsztyn 161	59/4	1	4	4	4	301	232,36	69940	205,49	61852	11,56	133,72
11	Olsztyn 118	4/23	4	4	3	3	1022	232,39	237503	330,85	338129	-42,37	1795,08
48	Olsztyn 161	60/8	2	4	4	4	288	284,29	81876	275,60	79373	3,06	9,34
49	Olsztyn 161	60/9	2	4	4	4	274	284,29	77895	275,60	75514	3,06	9,34
53	Olsztyn 161	60/13	2	4	4	4	211	284,29	59985	275,60	58152	3,06	9,34
54	Olsztyn 161	60/14	2	4	4	4	206	284,29	58564	275,60	56774	3,06	9,34
55	Olsztyn 161	60/15	2	4	4	4	318	284,29	90404	275,60	87641	3,06	9,34
56	Olsztyn 161	60/16	2	3	4	4	376	284,29	106893	228,46	85901	19,64	385,67
45	Olsztyn 161	59/7	2	4	4	4	257	298,38	76684	275,60	70829	7,63	58,29
46	Olsztyn 161	59/8	2	4	4	4	613	298,38	182907	275,60	168943	7,63	58,29
50	Olsztyn 161	60/10	2	4	4	4	257	298,38	76684	275,60	70829	7,63	58,29
51	Olsztyn 161	60/11	2	4	4	4	242	298,38	72208	275,60	66695	7,63	58,29
52	Olsztyn 161	60/12	2	4	4	4	225	298,38	67136	275,60	62010	7,63	58,29
5	Olsztyn 118	38/110	3	4	4	4	405	372,61	150907	345,71	140013	7,22	52,12
6	Olsztyn 118	38/111	3	4	4	4	402	372,61	149789	345,71	138975	7,22	52,12
19	Olsztyn 160	2/129	4	4	3	4	1084	404,3	438261	375,09	406598	7,22	52,20

21	Olsztyn 160	2/141	2	4	2	3	2291	407,53	933651	149,91	343444	63,21	3996,13
9	Olsztyn 118	38/82	3	4	3	3	908	408,77	371163	260,74	236752	36,21	1311,42
2	Olsztyn 118	34/45	3	4	3	3	837	412,36	345145	260,74	218239	36,77	1351,95
12	Olsztyn 118	4/26	3	4	4	3	570	416,67	237502	301,47	171838	27,65	764,40
16	Olsztyn 125	165/1	3	4	3	3	1411	418,34	590278	260,74	367904	37,67	1419,23
20	Olsztyn 160	2/133	4	4	3	4	1086	476,57	517555	375,09	407348	21,29	453,43
							$P_{average}$ =	**234,41**	$V_{average}$ =	**229,05**		$\Delta^2_{average}$ =	1174,87
												s =	**34,28**

Appendix 16 Determining the value of real estate using step regression for the suburban zones of Bartag and Bartążek

										Stepwise Backward Regression Model 1			Stepwise Progressive Regression Model 2		
No.	**Unit**	**Plot number**	**X_{1a}**	**X_6**	**X_8**	**X_{10}**	**Surface [m^2]**	**P_{sk} [PLN/m^2]**	**Price correc. [PLN]**	**V [PLN/m^2]**	**Value [PLN]**	**delta [%]**	**V [PLN/m^2]**	**Value [PLN]**	**delta [%]**
2	Bartąg	135/44	1	3	2	1	1848	**85,34**	**157708**	147,75	273048	-73,13	150,75	278595	-76,65
21	Bartążek	16/2	1	1	1	2	5800	**86,46**	**501468**	106,40	617110	-23,06	99,81	578880	-15,44
29	Bartąg	205/19	1	1	2	1	2070	**101,46**	**210022**	140,10	290015	-38,09	150,75	312062	-48,59
16	Bartąg	135/17	1	3	2	1	1875	**121,28**	**227400**	160,77	301447	-32,56	96,41	180771	20,51
23	Bartąg	362/47	2	3	3	3	1073	**135,47**	**145359**	299,64	321515	-121,19	315,21	338220	-132,68
13	Bartąg	135/19	1	3	3	1	1014	**143,81**	**145823**	204,81	207679	-42,42	201,70	204526	-40,26
19	Bartąg	30/20	1	3	2	1	2000	**159,9**	**319800**	171,11	342212	-7,01	150,75	301509	5,72
37	Bartążek	30/18	1	3	2	1	2021	**172,71**	**349047**	124,40	251414	27,97	150,75	304675	12,71
18	Bartąg	30/285	1	3	3	1	1070	**176,61**	**188973**	228,16	244136	-29,19	201,70	215822	-14,21
5	Bartążek	362/82	2	3	3	1	1228	**178,8**	**219566**	222,95	273778	-24,69	211,56	259798	-18,32
24	Bartążek	30/27	1	3	2	2	1764	**181,12**	**319496**	124,40	219443	31,32	150,75	265931	16,77
35	Bartążek	30/19	1	3	2	1	2000	**183,16**	**366320**	124,40	248801	32,08	150,75	301509	17,69
25	Bartążek	30/26	1	3	2	2	1716	**186,18**	**319485**	124,40	213472	33,18	150,75	258695	19,03
32	Bartążek	16/39	1	3	4	2	753	**196,97**	**148318**	238,52	179603	-21,09	252,65	190246	-28,27
4	Bartąg	333/33	2	4	2	1	2789	**204,34**	**569904**	212,59	592923	-4,04	214,96	599517	-5,20
30	Bartążek	329/23	2	4	2	4	2224	**211,19**	**469687**	212,59	472808	-0,66	214,96	478066	-1,78
31	Bartążek	291/21	2	3	3	3	1473	**223,76**	**329598**	269,65	397197	-20,51	265,91	391679	-18,84

12	Bartąg	329/21	2	4	3	4	1450	**225,08**	**326366**	246,30	357134	-9,43	265,91	385563	-18,14
17	Bartąg	329/25	2	3	2	4	1622	**230,77**	**374309**	212,59	344826	7,88	214,96	348661	6,85
7	Bartąg	311/3	2	3	3	4	1070	**241,42**	**258319**	285,35	305330	-18,20	265,91	284519	-10,14
27	Bartąg	135/28	1	3	3	4	1028	**244,39**	**251233**	228,16	234553	6,64	201,70	207350	17,47
3	Bartąg	706	2	3	3	1	1170	**277,29**	**324429**	246,30	288170	11,18	293,08	342900	-5,69
22	Bartążek	345/32	2	3	3	3	1323	**296,65**	**392468**	262,00	346629	11,68	265,91	351793	10,36
9	Bartąg	270/34	1	3	4	1	411	**322,52**	**132556**	238,52	98031	26,05	252,65	103839	21,66
20	Bartąg	299/38	2	3	3	4	1007	**389,74**	**392468**	308,71	310868	20,79	265,91	267767	31,77
34	Bartążek	345/57	2	3	3	1	1107	**400,75**	**443630**	322,99	357555	19,40	315,21	348937	21,34
33	Bartążek	345/49	2	4	3	2	1100	**409,41**	**450351**	322,99	355294	21,11	315,21	346731	23,01
							$P_{average}$	214,32		214,32	Vr_1	s = 35,43%	214,32	Vr_2	s =35,68%

Appendix 17 Determining the value of real estate by means of statistical analysis of the market with the use of stepwise regression for the peripheral zone of the city of Olsztyn

						Value calculated with backward regression model 1			Value calculated with model 2 - progressive regression		
No.	**Unit**	**Plot number**	**Surface [m²]**	**P_{sk} [PLN/m²]**	**$P_{average}$ [PLN]**	**V [PLN/m²]**	**Value [PLN]**	**Δ [%]**	**V [PLN/m²]**	**Value [zł]**	**Δ [%]**
18	Olsztyn 126	3/3	2995	100,78	301836	209,41	627196	-107,79	143,843	430811	-42,73
27	Olsztyn 160	39/29	952	103,32	98361	105,52	100451	-2,13	104,156	99157	-0,81
28	Olsztyn 160	39/30	919	103,32	94951	105,52	96969	-2,13	104,156	95719	-0,81
29	Olsztyn 160	39/31	921	103,32	95158	105,52	97180	-2,13	104,156	95928	-0,81
30	Olsztyn 160	39/32	902	103,32	93195	105,52	95175	-2,13	104,156	93949	-0,81
31	Olsztyn 160	39/33	1111	103,32	114789	174,22	193563	-68,63	189,378	210400	-83,29
32	Olsztyn 160	39/34	1114	103,32	115098	105,52	117545	-2,13	104,156	116030	-0,81
33	Olsztyn 160	39/35	941	103,32	97224	105,52	99290	-2,13	168,960	158991	-63,53
34	Olsztyn 160	39/36	1069	103,32	110449	105,52	112796	-2,13	104,156	111343	-0,81
35	Olsztyn 160	39/37	1050	103,32	108486	105,52	110792	-2,13	104,156	109364	-0,81
36	Olsztyn 160	39/38	1050	103,32	108486	105,52	110792	-2,13	104,156	109364	-0,81
37	Olsztyn 160	39/39	1050	103,32	108486	105,52	110792	-2,13	104,156	109364	-0,81
38	Olsztyn 160	39/40	1050	103,32	108486	105,52	110792	-2,13	104,156	109364	-0,81

39	Olsztyn 160	39/41	1015	103,32	104870	105,52	107099	-2,13	104,156	105718	-0,81
7	Olsztyn 118	38/31	3209	120,4	386364	159,58	512096	-32,54	186,528	598569	-54,92
8	Olsztyn 118	38/51	2642	146,24	386366	159,58	421613	-9,12	186,528	492807	-27,55
3	Olsztyn 118	34/55	218	169,28	36903	304,06	66286	-79,62	273,673	59661	-61,67
4	Olsztyn 118	34/57	1235	169,28	209061	159,58	197083	5,73	140,079	172997	17,25
13	Olsztyn 118	4/38	975	206,14	200987	282,68	275612	-37,13	291,087	283810	-41,21
1	Olsztyn 118	34/42	909	207,55	188663	282,68	256955	-36,20	267,862	243487	-29,06
10	Olsztyn 118	38/64	1173	210,29	246670	317,03	371880	-50,76	327,930	384661	-55,94
14	Olsztyn 118	4/45	710	210,48	149441	269,71	191493	-28,14	231,062	164054	-9,78
15	Olsztyn 118	4/47	388	210,48	81666	159,58	61917	24,18	140,079	54350	33,45
43	Olsztyn 161	59/5	316	220,85	69789	317,03	100183	-43,55	281,480	88948	-27,45
44	Olsztyn 161	59/6	294	220,85	64930	317,03	93208	-43,55	281,480	82755	-27,45
47	Olsztyn 161	59/14	1187	232,34	275788	220,71	261985	5,00	163,424	193984	29,66
41	Olsztyn 161	59/3	559	232,36	129889	317,03	177222	-36,44	252,487	141140	-8,66
42	Olsztyn 161	59/4	301	232,36	69940	317,03	95427	-36,44	252,487	75998	-8,66
11	Olsztyn 118	4/23	1022	232,39	237503	304,06	310752	-30,84	344,245	351818	-48,13
48	Olsztyn 161	60/8	288	284,29	81876	282,68	81412	0,57	285,318	82172	-0,36
49	Olsztyn 161	60/9	274	284,29	77895	282,68	77454	0,57	285,318	78177	-0,36
53	Olsztyn 161	60/13	211	284,29	59985	282,68	59645	0,57	285,318	60202	-0,36
54	Olsztyn 161	60/14	206	284,29	58564	282,68	58232	0,57	285,318	58776	-0,36
55	Olsztyn 161	60/15	318	284,29	90404	282,68	89892	0,57	285,318	90731	-0,36

56	Olsztyn 161	60/16	376	284,29	106893	234,52	88179	17,51	240,787	90536	15,30
45	Olsztyn 161	59/7	257	298,38	76684	282,68	72649	5,26	238,869	61389	19,94
46	Olsztyn 161	59/8	613	298,38	182907	282,68	173282	5,26	238,869	146427	19,94
50	Olsztyn 161	60/10	257	298,38	76684	282,68	72649	5,26	285,318	73327	4,38
51	Olsztyn 161	60/11	242	298,38	72208	282,68	68408	5,26	285,318	69047	4,38
52	Olsztyn 161	60/12	225	298,38	67136	282,68	63603	5,26	285,318	64197	4,38
5	Olsztyn 118	38/110	405	372,61	150907	351,39	142312	5,70	329,860	133593	11,47
6	Olsztyn 118	38/111	402	372,61	149789	351,39	141258	5,70	329,860	132604	11,47
19	Olsztyn 160	2/129	1084	404,3	438261	256,74	278305	36,50	269,704	292360	33,29
21	Olsztyn 160	2/141	2291	407,53	933651	222,38	509483	45,43	233,910	535888	42,60
9	Olsztyn 118	38/82	908	408,77	371163	282,68	256673	30,85	355,890	323148	12,94
2	Olsztyn 118	34/45	837	412,36	345145	282,68	236602	31,45	332,666	278441	19,33
12	Olsztyn 118	4/26	570	416,67	237502	304,06	173316	27,03	338,476	192932	18,77
16	Olsztyn 125	165/1	1411	418,34	590278	351,39	495808	16,00	464,337	655180	-11,00
20	Olsztyn 160	2/133	1086	476,57	517555	351,39	381607	26,27	428,527	465381	10,08
				231,69		231,69		s=30,47	231,69		s=27,78

Appendix 18 Comparative analysis of the values determined by the tested methods with the market value determined by the comparison method for the suburban zones of Bartag and Bartążek

Valuation using the pairwise comparison method from a comparative approach				Valuation using the ratio method		Valuation using the price-comparative method		Valuation using the average price adjustment method		Valuation using the statistical analysis of the market		Valuation using the mass valuation method (PTN)	
No.	**Adress**	**Plot number**	**Market value [PLN]**	**Value**	**Δ [%]**	**Value [PLN]**	**Δ [%]**	**Value [PLN]**	**Δ [%]**	**Value from the average [PLN]**	**Δ [%]**	**Value [PLN]**	**Δ [%]**
29	Bartąg	205/19	217454	81191	62,66	150178	30,94	210043	3,41	312062	-43,51	231095	-6,27
23	Bartąg	362/47	180006	47825	73,43	176959	1,69	286888	-59,38	338220	-87,89	247498	-37,49
13	Bartąg	135/19	176639	54234	69,30	181455	-2,73	182054	-3,07	204526	-15,79	176537	0,06
37	Bartążek	30/18	333324	109896	67,03	401047	-20,32	303675	8,89	304675	8,59	308041	7,59
5	Bartążek	362/82	264131	73343	72,23	308277	-16,71	292374	-10,69	259798	1,64	261945	0,83
35	Bartążek	30/19	331680	108754	67,21	385920	-16,35	300520	9,39	301509	9,10	304840	8,09
4	Bartąg	333/33	565107	188950	66,56	725335	-28,35	650450	-15,10	599517	-6,09	591324	-4,64
31	Bartążek	291/21	303585	94541	68,86	350073	-15,31	393821	-29,72	391679	-29,02	339762	-11,92
17	Bartąg	329/25	364220	93983	74,20	344221	5,49	409960	-12,56	348661	4,27	353044	3,07
3	Bartąg	706	300316	60492	79,86	224921	25,11	278565	7,24	342900	-14,18	249573	16,90
				s=	70,287	s=	19,04	s=	22,69	s=	33,35	s=	14,24

Δ – percentage deviation
s – average percentage deviation
red – plots for which the percentage deviation of the estimated values is the smallest

Appendix 19 Comparative analysis of specific values using the methods tested with the market value determined using the comparison method for the peripheral zone of the city of Olsztyn

Valuation using the pairwise comparison method from a comparative approach				Valuation using the ratio method		Valuation using the price-comparative method		Valuation using the average price adjustment method		Valuation using the statistical analysis of the market		Valuation using the mass valuation method (PTN)	
No.	**Adress**	**Plot number**	**Market value [PLN]**	**Value**	**Δ [%]**	**Value [PLN]**	**Δ [%]**	**Value [PLN]**	**Δ [%]**	**Value from the average [PLN]**	**Δ [%]**	**Value [PLN]**	**Δ [%]**
30	Olsztyn 160	39/32	88071	55963	36,46	126109	-43,19	269711	-206,24	93949	-6,67	200684	-127,87
36	Olsztyn 160	39/38	129076	65145	49,53	141540	-9,66	313965	-143,24	109364	15,27	233612	-80,99
8	Olsztyn 118	38/51	326287	169570	48,03	384226	-17,76	386366	-18,41	492807	-51,03	434133	-33,05
3	Olsztyn 118	34/55	51638	12593	75,61	51417	0,43	78460	-51,94	59661	-15,54	66028	-27,87
1	Olsztyn 118	34/42	187645	42784	77,20	234149	-24,78	298888	-59,28	243487	-29,76	257865	-37,42
10	Olsztyn 118	38/64	211621	67757	67,98	169686	19,82	385694	-82,26	384661	-81,77	310845	-46,89
44	Olsztyn 161	59/6	65021	14467	77,75	71518	-9,99	89911	-38,28	82755	-27,27	83552	-28,50
49	Olsztyn 161	60/9	79183	15827	80,01	79183	0,00	83795	-5,82	78177	1,27	77868	1,66
56	Olsztyn 161	60/16	91706	19306	78,95	92646	-1,03	90578	1,23	90536	1,28	106855	-16,52
51	Olsztyn 161	60/11	69936	13979	80,01	69936	0,00	74008	-5,82	69047	1,27	68774	1,66
21	Olsztyn 160	2/141	887877	151944	82,89	923342	-3,99	688170	22,49	535888	39,64	527984	40,53
16	Olsztyn 125	165/1		81505	85,49	549076	2,27	544023	3,17	655180	-16,61	378626	32,61
					s= 71,68		s = 16,84		s= 80,84		s= 33,28		s= 51,78

Δ – percentage deviation

s – average percentage deviation

red – plots for which the percentage deviation of the estimated values is the smallest

Source: own elaboration

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ABSTRACT IN ENGLISH

A proposal to improve the system of valuating urbanized land in Vietnam based on Polish experience.

Key words: urbanization, land use, valuation, statutory prices, market value, proposal improvements of system.

The PhD thesis explores the relationships between land use, land price, and urban land value. It draws on the value model with explaining and analyzing the relationship between land market value and land statutory value, especially for urbanized land in Poland and Vietnam. The monograph starts with an overview of a limited number of economic theories on the land market and subsequently introduce some well-known land use models of economic theories on the principles. The shift from centrally regulated real estate prices (Vietnam) to market prices in property appraisal is one of the most important processes in the period of transition from a centrally planned economy to a free market economy in the future. As a result, real estate became a market commodity, and investors began to compete for land in the urban-rural continuum that is influenced by the urban core. In a market economy, trade in urban land is governed by the law of supply and demand. The Polish experience of economic liberalization in the real estate sector can be effectively used to modify the principles for determining the value of urban land in Vietnam. A comparative approach was proposed and the applicability the multiple regression model for determining the value of urban land was verified with the use of scientific methods. The results of this study have numerous practical applications for managing urban land. The study described in this dissertation also expands the existing body of knowledge about land valuation. In the experimental part of the research, the value of land determined with the use of the proposed methods was compared with real-world transaction prices on the free market. Thesis in this dissertation is: **the Polish experience of economic liberalization in the real estate sector after 1990 can be used after modification to propose a system for urban land valuation in Vietnam.**

The following **research hypotheses** were formulated and tested in this study:

1. Polish experiences relating to urban land valuation during the transition from a centrally planned (socialist) economy to a market economy can be harnessed to develop a modern land valuation system for Vietnam.

2. the proposed method (improvement index method) for assessing the value of urban land in Vietnam as well as other transition economies will support rational land management in urban areas, create objective access to State-owned land, and generate new streams of revenue from the real estate sector.

The main research objective was to determine the extent to which the land valuation methods that had been deployed in Poland during the economic transition period can be applied to improve the principles of calculating the value of urban land in Vietnam.

Various methods were used to achieve the main research aim and specific objectives. Research methods were selected based on a review of the literature and own experiences and knowledge of various markets, including real estate markets. Urbanization processes and their impact on the market value of land were analyzed by deductive reasoning and descriptive and comparative analyses based on the reviewed literature. The collected research materials were analyzed by inferential reasoning with the use of descriptive and heuristic methods. The results of an in-depth literature review as well as analyses of urbanization pressure and other factors that influence land use in urban areas were used to conduct detailed analyses in selected test fields with the use of the developed algorithms and detailed procedures. Statistical methods were selected and applied to process market data and describe the cause-effect relationships between the prices of urban land and the previously identified factors that significantly influence the value of land in urban areas. In the first stage of the study, the cause-effect relationships between the examined variables were determined in a correlation analysis. In the following stage, a multiple regression model was built to validate the cause-effect relationships between variables that affect the value of urban land. . Real estate valuation is a process that relies on the experience and opinions of individual appraisers; therefore, the stepwise regression procedure was selected for further analyses. Detailed conclusions were formulated by deductive reasoning based on own experiences and the opinions of the surveyed real estate experts. In Vietnam, the test field for detailed analyses was the Gia Lam District of Hanoi. The rapidly evolving economic and demographic reality of contemporary Vietnam has significantly contributed to the development of the Gia Lam District in recent years. Basic analyzes were carried out in test fields in Poland. This was related to, inter alia, access to data on the real estate market. In the case of Vietnam, recommendations of real estate experts were used. Own research on the real estate market in Hanoi was also used. The replacement of statutory prices with real-world prices can facilitate urban planning and management, and it can contribute to

an improvement in land-use structure and rational land use in cities. The local authorities can also increase their revenues by calculating land fees and taxes based on market values. A central register of real estate prices would increase market transparency, decrease land speculation and minimize corruption. The Vietnamese land valuation system should be reformed, and urban land should be appraised based on directional prices that are quoted on the informal market. To implement this approach, the initial value of land has to be calculated in homogeneous urban areas. The study demonstrated that the Vietnamese real estate sector is only beginning to evolve towards free market principles. Therefore, the Vietnamese legal system should be reformed to facilitate the introduction of market principles in the real estate sector. The proposed system supports sustainable development of urban areas. The calculated values can be used by the central and local authorities to determine the amount of compensation for legal seizure of land, calculate property taxes and fees, and set asking prices in real estate transactions. Vietnam has transitioned from a centrally planned economy to a mixed system with elements of a free market economy, including in the real estate sector, and land is appraised in two separate systems. The proposed method will minimize the differences between official prices and the prices quoted on the informal market, which will stabilize the real estate sector, generate new streams of revenue for the central budget and local budgets, and improve land management in urban areas. The described approach will increase the transparency of real estate transactions and facilitate the mass appraisal process.

ABSTRACT IN POLISH

Propozycja usprawnienia systemu szacowania gruntów zurbanizowanych w Wietnamie w oparciu o Polskie doświadczenia

Słowa kluczowe: urbanizacja, użytkowanie, ziemi cena urzędowa, wartość rynkowa, propozycja usprawnienia systemu.

W niniejszej rozprawie doktorskiej zbadano niktóre relacje między użytkowaniem gruntów, ceną gruntów i wartością gruntów miejskich. Oparto się na ogólnym modelu wartości z wyjaśnieniem i analizą relacji między wartością rynkową gruntów a ceną ustawową gruntów, szczególnie dla gruntów zurbanizowanych w Polsce i Wietnamie. Dysertacja rozpoczyna się od przeglądu ograniczonej liczby teorii ekonomicznych funkcjonujących na rynku gruntów, a następnie wprowadza kilka znanych modeli użytkowania gruntów opartych na zasadach teorii ekonomicznych. Przejście od centralnie regulowanych cen nieruchomości (Wietnam) do ich cen rynkowych jest jednym z ważniejszych procesów w okresie przejścia od gospodarki centralnie planowanej do gospodarki wolnorynkowej w przyszłości. W rezultacie nieruchomości stały się towarem rynkowym, a inwestorzy zaczęli konkurować o ziemię w kontinuum miejsko-wiejskim, na które wpływa zespół miejski. W gospodarce rynkowej handel gruntami miejskimi podlega prawu podaży i popytu. Polskie doświadczenia liberalizacji gospodarczej w sektorze nieruchomości można więc skutecznie wykorzystać do modyfikacji zasad ustalania wartości gruntów miejskich w Wietnamie. Zaproponowano podejście porównawcze i zweryfikowano możliwość zastosowania modelu regresji wielokrotnej do określania wartości gruntów miejskich za pomocą metod naukowych. Wyniki tego badania mają wiele praktycznych zastosowań w zarządzaniu gruntami miejskimi. Badania opisane w tej rozprawie poszerzają również istniejący zasób wiedzy na temat wyceny gruntów. W eksperymentalnej części badań porównano wartość gruntów ustaloną przy użyciu proponowanych metod z faktycznymi cenami transakcyjnymi na wolnym rynku.

Teza badawcza postawiona w niniejszej rozprawie brzmi: **polskie doświadczenia liberalizacji gospodarczej w sektorze nieruchomości po 1990 r. można wykorzysta, po ich modyfikacji, do usprawnienia systemu wyceny gruntów miejskich w Wietnamie.**

Następujące **hipotezy badawcze** zostały sformułowane i przetestowane w przeprowadzonych w ramach rozprawy doktorskiej badaniach :

1. Polskie doświadczenia związane z wyceną gruntów miejskich w okresie przechodzenia od gospodarki centralnie planowanej (socjalistycznej) do gospodarki rynkowej można wykorzystać do opracowania nowoczesnego systemu wyceny gruntów dla Wietnamu.

2. Proponowana metoda (udoskonalona metoda wskaźnikowa) szacowania wartości gruntów miejskich w Wietnamie oraz innych gospodarkach w okresie przejściowym będzie wspierać racjonalne gospodarowanie gruntami na obszarach miejskich, stwarzać obiektywny dostęp do gruntów państwowych oraz generować nowe strumienie dochodów z sektora nieruchomości .

Głównym celem badawczym było określenie, w jakim stopniu metody wyceny gruntów stosowane w Polsce w okresie transformacji gospodarczej mogą być wykorzystane do doskonalenia zasad określania wartości gruntów miejskich w Wietnamie.

Zastosowano różne metody badawcze, aby osiągnąć główny cel badawczy i zrealizować cele szczegółowe. Metody badawcze dobrano na podstawie przeglądu literatury oraz własnych doświadczeń i znajomości różnych rynków, w tym rynków nieruchomości. Procesy urbanizacyjne i ich wpływ na wartość rynkową gruntów analizowano metodą wnioskowania dedukcyjnego oraz analiz opisowych i porównawczych na podstawie analizy literatury. Zebrany materiał badawczy poddano analizie metodą wnioskowania inferencyjnego z wykorzystaniem metod opisowych i heurystycznych. Wyniki pogłębionego przeglądu literatury oraz analizy presji urbanizacyjnej i innych czynników wpływających na użytkowanie gruntów na terenach zurbanizowanych posłużyły do przeprowadzenia szczegółowych analiz na wybranych polach testowych z wykorzystaniem opracowanych algorytmów i szczegółowych procedur. Wybrano i zastosowano metody statystyczne do przetwarzania danych rynkowych oraz opisu związków przyczynowo-skutkowych pomiędzy cenami gruntów miejskich a wcześniej zidentyfikowanymi czynnikami istotnie wpływającymi na wartość gruntów na terenach miejskich. W pierwszym etapie badań określono za pomocą analizy korelacji związki przyczynowo-skutkowe pomiędzy badanymi zmiennymi. W kolejnym etapie zbudowano model regresji wielokrotnej, aby zweryfikować związki przyczynowo-skutkowe między zmiennymi wpływającymi na wartość gruntów miejskich. . Wycena nieruchomości to proces, który opiera się na doświadczeniu i opiniach poszczególnych rzeczoznawców majątkowych; w związku z tym do dalszych analiz wybrano procedurę regresji krokowej. Szczegółowe wnioski

zostały sformułowane na drodze wnioskowania dedukcyjnego na podstawie własnych doświadczeń oraz opinii ankietowanych rzeczoznawców majątkowych. W Wietnamie poligonem doświadczalnym do szczegółowych analiz był dystrykt Gia Lam w Hanoi. Szybko zmieniająca się rzeczywistość gospodarcza i demograficzna współczesnego Wietnamu znacząco przyczyniła się do rozwoju dystryktu Gia Lam w ostatnich latach. Podstawowe analizy przeprowadzono na polach doświadczalnych w Polsce. Wiązało się to m.in. z dostępem do danych o rynku nieruchomości. W przypadku Wietnamu skorzystano z rekomendacji ekspertów rynku nieruchomości. Przeprowadzono również własne badania rynku nieruchomości.