A R T Y K U Ł Y

Agnieszka Bieda

AGH University of Science and Technology, Department of Geomatics , ul. Mickiewicza 30, 30-059 Kraków; e-mail: agnieszka.bieda@agh.edu.pl

Urban renewal and the value of real properties*

Abstract: The article aims to verify the relationship between the value of real estate and urban renewal. The analysis was conducted for undeveloped land properties traded between 2006 and 2014. In that period, a time trend was set for the real estate from the areas covered by the Local Revitalization Programmes and the areas located in their immediate vicinity. The observed trends of the changes were compared with those occurring at the same time throughout Krakow, as well as in the areas specified in the Urban Revitalization Programme for Krakow as potential revitalization complexes, for which no local revitalization programmes were eventually prepared. In addition, the author analyzed how transaction prices were distributed in space over the specific years. The obtained land value maps were compared with the records of the documents which formed the basis for the urban renewal of Krakow.

Keywords: Local Revitalization Programme, land value map, Urban Revitalization Programme for Krakow, urban renewal, real estate value, time series

Rewitalizacja przestrzeni miejskiej a wartość nieruchomości

Streszczenie: Celem artykułu jest sprawdzenie istnienia zależności pomiędzy wartością nieruchomości a działaniami rewitalizacyjnymi. Analizę przeprowadzono dla nieruchomości gruntowych niezabudowanych, które były przedmiotem obrotu w latach 2006–2014. W przyjętym okresie ustalono trend czasowy dla nieruchomości z obszarów objętych lokalnymi programami rewitalizacji oraz terenów położonych w ich bezpośrednim sąsiedztwie. Zaobserwowane tendencje zmian porównano z tymi, jakie zachodziły w tym samym czasie w całym Krakowie oraz na obszarach opisanych w Miejskim Programie Rewitalizacji Krakowa jako potencjalne zespoły rewitalizacyjne, dla których ostatecznie nie sporządzono lokalnych programów rewitalizacji. Dodatkowo sprawdzono, jak w wybranych latach ceny transakcyjne rozkładały się w przestrzeni. Otrzymane mapy cenności porównano z zapisami dokumentów, na podstawie których wykonywana jest rewitalizacji Krakowa.

Słowa kluczowe: Lokalny Program Rewitalizacji, mapa cenności, Miejski Program Rewitalizacji Krakowa, rewitalizacja przestrzeni miejskiej, wartość nieruchomości, szeregi czasowe

1. Introduction

It is stated in (Herbst 2008) that "*revitalization is a word with a long history*". The concept of revitalization originated in the United States of America in the mid-twentieth century, and it was primarily concerned with the activities undertaken by the local administration cooperating with private companies. This cooperation was aimed at economic revitalization of specific areas and increasing the income therefrom (Petersen et al. 2002). The example of the United States was followed by many countries where urban renewal became a standard for managing neglected neighbourhoods (Herbst 2008). The most famous examples of the European redevelopments include the regeneration of the London docks (Kaczmarek 1991) and the Kreuzberg district in Berlin (Małkowski, Woźniak 2004).

The concept of revitalization has recently been making a sudden career also in Poland. However, there is a shortage of basic frameworks or instruments that would facilitate good redevelopment (Herbst 2008). The first normative act on revitalization in the rank of a law entered into force at the end of 2015 (Act 2015). This, however, does not decrease the importance of the urban renewal carried out in Poland earlier.

Revitalization is a process undertaken in the public interest. It concerns spatial, technical, social and economic changes in a regenerated area (Chmielewski 2016). Its purpose is to increase the attractiveness of this area for its residents and potential investors (Jadach-Sepioło 2016).

Its aim is to save an area affected by recessionary conditions by restoring old functions or introducing new ones, which will create conditions for further development of the revitalized area using its current development (Chmielewski 2016). In the latter case, degraded areas are usually subject to revitalization, especially industrial areas and warehouses, post-industrial waste landfill sites, post-mining areas, as well as former railway and military areas.

Taking into account frequent changes of legislation related to broadly understood spatial economy and the pace of civilization development, it seems natural that the same area often changes its intended purpose and function (Adamczyk, Bieda 2014). From the financial point of view, degraded areas are the best sites to initiate such ventures, as the main motivating factor for post-industrial projects is the low value of land resulting from relatively high revitalization costs (Konowalczuk, Ramian 2008) as well as low liquidity in the real estate market (Jadach-Sepioło 2016).

The main measure of revitalization's effects is primarily an increase in the number of workplaces in the regenerated area. In addition, conclusions can be drawn from the behaviour of the people residing in the revitalized space (Chmielewski 2016) and from the aesthetization of urban spaces (Palicki et al. 2015). It may be stated that urban renewal is effective if there are people in the revitalized space who want to stay there, and together with changes in their appearance, commercial and service offers, standards improve and the space becomes more diverse, acts of vandalism are scarce, there is order, the surroundings are taken care of,

and the area is more aesthetic and seems safer. However, measuring the effects of revitalization is very complex (Sztando 2008). Therefore, the article aims to verify whether there is a relationship between real estate value and urban renewal, which could be used as a measure of the results of revitalization.

Although recognized studies point to various indices which should be taken into account for real estate market analysis (Dąbrowski 2009), the relationship between real property value and the process of revitalization has previously been analyzed on individual examples by (Emery 2006), (Palicki 2013) (Olbińska 2014) (Palicki, Rącka 2016). These studies do not cover whole cities, however. The influence of activities related to the establishment of local law, which is the basis on which the process of urban renewal is carried out, has not been verified either.

The analyzed research studies cover undeveloped real estate intended for residential development, subject to property laws. It has been stated that the analysis using land information will be sufficient because the value of this type of real estate usually changes in time and space, analogously to other types of real estate (c.f. research studies – Żelazowski 2008).

2. Urban renewal in Krakow

The issue of urban renewal was already tackled in Krakow in the 1990s (Świerczewska-Pietras 2008). The first revitalization programme was prepared in the years 1993–1994 for Kazimierz, the historical part of Krakow, in cooperation with Edinburgh and Berlin under the European Union programme ECOS (European Environmental Citizens Organisation for Standardisation). Subsequent projects concerned the revitalization of the following post-industrial areas:

− Branice, for many years located within the boundaries of the protection zone of Tadeusz Sendzimir Steelworks,
− the so-called "White Seas", which is the Krakow Soda Factory "Solvay" located between two districts of Krakow: Borek Fałęcki and Łagiewniki,
− Zabłocie, degraded both socially (reduced number of workplaces) and spatially (dilapidated empty buildings) after the shutdown of many of its businesses.

Of these three areas, only Zabłocie was granted a revitalization programme. It was adopted on October 25, 2006 (Resolution 2006).

The current revitalization activities in the city are based on Resolution No. XCII/926/05 of the Krakow City Council of 26 October 2005 on the elaboration of the Urban Revitalization Programme – the Local Revitalization Programme (LPR). According to the terms contained therein, the revitalization programme in question covers the entire city. Therefore, as a result of the resolution, a document was prepared which was called the Urban Revitalization Programme for Krakow (MPRK). The schedule for its implementation is shown in Table 1.

Tab. 1. Planned implementation schedule of the Resolution on the elaboration of the Urban Revitalization Programme for Krakow – the Local Revitalization Programme

Date	Task
28 February 2006	Presentation of the premises for the Revitalization Programme to the City Council
31 July 2006	Conducting social consultations
30 September 2006	Presentation of the project of the Revitalization Programme to the City Council

Source: own study based on (Resolution 2005).

Following the schedule, a team of experts developed the premises for the Urban Revitalization Programme for Krakow and then selected eight areas which should be included in the urban renewal in the first place (Świerczewska-Pietras 2008). These areas were selected using the criteria taken directly from the Integrated Regional Development Operational Programme for the years 2004–2006. The areas qualified for revitalization were characterized by at least three of the following traits, verified for the whole country:

− high unemployment rate among the inhabitants,
− high level of poverty and difficult living conditions,
− high level of crime,
− low level of education of the inhabitants,
− low level of entrepreneurship of the inhabitants,
− high level of technical degradation of the infrastructure and buildings,
− high level of environmental pollution.

Figure 1 illustrates the boundaries of the areas selected by the experts. Their characteristics are demonstrated in Table 2.
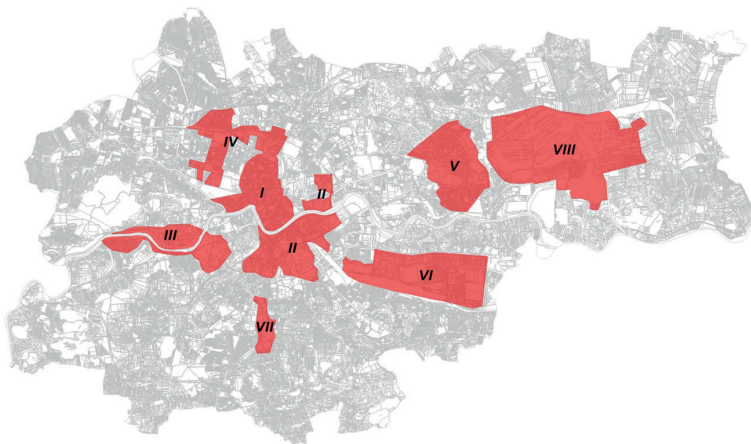

Fig. 1. Revitalization areas selected in the Urban Revitalization Programme

Source: own study based on the data provided by the Geodetic and Cartographic Documentation Centre in Krakow and the City Development Department of the City of Krakow.

Tab. 2. Revitalization areas selected in the Urban Revitalization Programme

Designation	Range
I	Old Town, Kleparz, Piasek, Nowy Świat, Stradom, Wesoła Zachód, Kazimierz, part of Grzegórzki Zachód and Półwsie Zwierzynieckie
II	Stare Podgórze, Zabłocie, Mateczny, Bonarka, Krakus Mound, Heltmana, part of Grzegórzki Wschód and Grzegórzki Północ, Plaszow Pond (Płaszów)
III	Zakrzówek, Dębniki Zachód, Przegorzały Wschód and Przegorzały Południe (Polnych Kwiatów/Ks. Józefa)
IV	Krowodrza Południe, southern part of Krowodrza Wschód and Północ, Azory Wschód, northern part of Bronowice Małe Wschód, Krowodrza Nowa Wieś (western part), Nowa Wieś Południe (western part), Małe Błonie (north-eastern part), Czarna Wieś (western part)
V	All urban units of the old part of Nowa Huta, Na Skarpie (Nowa Huta Meadows), Mogiła (eastern part)
VI	Płaszów (Bagry Lake), industrial and railway areas (Zarzecze, Rybitwy, Podgaje)
VII	Borek Fałęcki Wschód, Łagiewniki (Sanctuary of Divine Mercy/White Seas)
VIII	Tadeusz Sendzimir Steelworks, Mogiła Wschód (north-eastern part), Pleszów-Kujawy (northern part), Branice (northern part)

Source: (Urban Revitalization Programme 2008).

The revitalization areas occupy a total of about 5 677 ha, which is about 17.4% of the area of Krakow.

In October 2006, the competition for a concept of the Urban Revitalization Programme was settled. The draft version of the Urban Revitalization Programme for Krakow was presented for consultation in August 2007. Unfortunately, it coincided with the publication by the Małopolska Province Office of "Methodology of preparation and evaluation of the revitalization program under the Regional Operational Program for Małopolska for the years 2007–2013" (Świerczewska-Pietras 2008). This document called for the identification of degraded areas in cities with more than 20 000 inhabitants, for which separate revitalization programmes should be developed. As a result, the Urban Revitalization Programme served as a basis for the preparation of Local Revitalization Programmes for selected areas of Krakow (Urban Revitalization Programme 2008). Priority was given to the area of the Old Town within the so-called Second Ring Road and Stare Podgórze, the old part of Nowa Huta with the neighbouring green areas, as well as Zabłocie. The other complexes were evaluated as equal. Appropriate resolutions were adopted on October 8, 2008 (Local Revitalization Programme for the Old Town and Local Revitalization Programme for the old part of Nowa Huta) and on January 13, 2010 (Local Revitalization Programme for Zabłocie).

The boundaries of the current Local Revitalization Programmes in Krakow are shown in Figure 2. Table 3 demonstrates their characteristics.
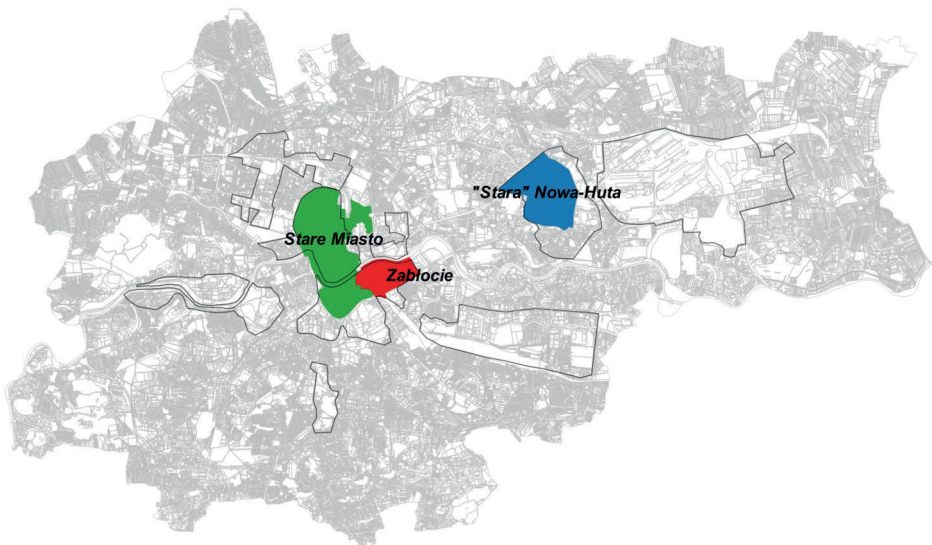
Fig. 2. Boundaries of the Local Revitalization Programmes in Krakow

Source: own study based on the data provided by the Geodetic and Cartographic Documentation Centre in Krakow and the City Development Department of the City of Krakow.

Table 3. Local Revitalization Programmes in Krakow

Local Revitalization Programme	Percentage of the area of Krakow	Number of projects included in the Local Revitalization Programmes
Old Town	2.03%	92
Old part of Nowa Huta	1.04%	36
Zabłocie	0.53%	20

Source: own study based on (Resolution 2008b), (Resolution 2008c) and (Resolution 2010).

Almost all of the projects which were included in local revitalization programmes were either of spatial or of ecological type. Interestingly, social projects accounted for merely 12% of all the projects proposed for implementation.

At the end of 2014, as part of a monitoring procedure, all the projects entered into local revitalization programmes were analyzed (Report 2014). By December 31, 2014, 29 projects included in the Local Revitalization Programme for the Old Town, eight in the Programme for "old" Nowa Huta, and six in the Programme for Zabłocie were implemented. They concerned various types of construction processes. None of them referred to the social sphere.

The currently binding resolutions for the municipality of Krakow are as follows:

- Urban Revitalization Programme for Krakow of October 8, 2008 (Resolution 2008a),
- Local Revitalization Programme for the Old Town of October 8, 2008 (Resolution 2008b),
- Local Revitalization Programme for the old part of Nowa Huta of October 8, 2008 (Resolution 2008c),
- Local Revitalization Programme for Zabłocie of January 13, 2010 (Resolution 2010).

These documents are constantly updated. Following the changes to the Urban Revitalization Programme for Krakow of 2014 (Resolution 2014), 2016 (Resolution 2016) and 2017 (Resolution 2017), works are being carried out on updating all the Local Revitalization Programmes. Their planned new boundaries are shown in Figure 3 (in the background, there are the contours of the Local Revitalization Programmes which are currently in force).
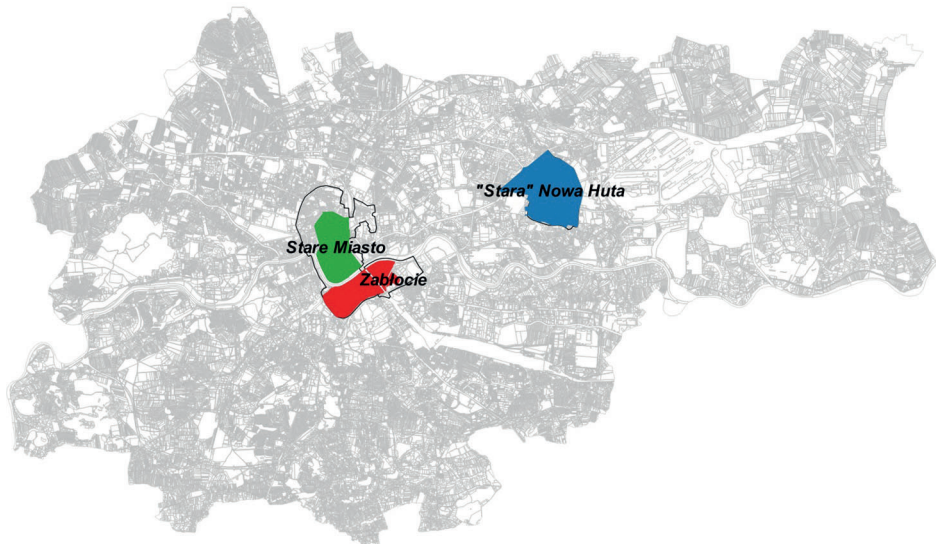

Fig. 3. Updated boundaries of the Local Revitalization Programmes in Krakow

Source: own study based on the data provided by the Geodetic and Cartographic Documentation Centre in Krakow and the City Development Department of the City of Krakow.

In Krakow, investors' preferences have not changed over the years. Despite the elaboration of various planning documents, some parts of the city have not managed to become attractive (Bieda, Parzych 2013). Legislative actions of the Krakow City Council concerning the urban renewal, however, have resulted in more and more manifestations of the revitalization process being noticeable in the city. The adopted resolutions have brought about a significant renewal of the degraded areas. Figure 4 shows an example of revitalization as part of the Local Revitalization Programme for Zabłocie.

<div align="center">2006   2014</div>

Fig. 4. An example of revitalization – closed down mills and cosmetic plant converted into residential buildings

Source: (Resolution 2010) and (Google Street View 2014).

3. Data and Methods

The analyses presented in this article were carried out on the basis of data provided by Geodetic and Cartographic Documentation Centre in Krakow and the City Development Department of the City of Krakow. The data necessary to determine the relationship between revitalization of urban space in Krakow and the value of its real estate include:

− Registry of Property Prices and Values, which includes data on all types of real properties traded between January 2006 and December 2014,
− spatial data on cadastral parcels within the administrative boundaries of the city of Krakow,
− spatial data on revitalization areas specified in the Urban Revitalization Programme for Krakow,
− spatial data on the boundaries of the Local Revitalization Programmes in force in Krakow.

It was verified whether there was (or not) a relationship at specific points in time between unit transaction prices and location of a property in the area potentially or practically devoted to revitalization. Thus, revitalization was treated as one of the attributes that could describe the real estate market for statistical analysis of volatility of transaction prices. Due to the fact that such attributes are assumed to be independent (Parzych, Czaja 2015), other attributes that may appear relevant to a potential buyer have been omitted in the presented analyses. The influence of other attributes has already been studied, and the results of such studies can be found e.g. in (Bieda, Brzozowski 2007).

The discussed research studies cover undeveloped land properties intended for residential development, subject to property law. These properties were to the object of free market transactions. Special legal entities were never parties thereto. In the analyzed period (January 1, 2006 – December 31, 2014), there were 4 505 transactions involving this type of real estate in Krakow. The distribution of the recorded unit transaction prices in time is shown in Figure 5, while the basic descriptive statistics of the collected database are contained in Table 4.
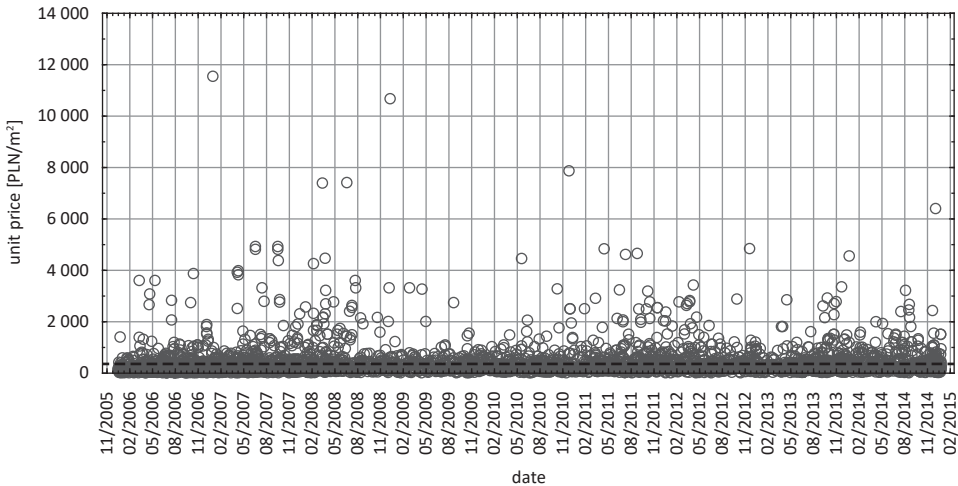

Fig. 5. Distribution of unit transaction prices for undeveloped land properties intended for residential development in Krakow in 2006–2014

Source: own study.

Tab. 4. Basic descriptive statistics of the database of unit transaction prices for undeveloped land properties intended for residential development in Krakow in 2006–2014

Average	Median	Minimal	Maximal	Standard deviation
389.38	237.77	20.00	11556.60	582.64
Coefficient of variation	Skewness	Kurtosis	Percentile 10%	Percentile 90%
1.49	6.96	81.65	79.04	771.60

Source: own study.

In its original form, the information collected is completely useless. This is proven by e.g. the coefficient of variation, from which it follows that the analyzed base is completely inconsistent (Parzych, Czaja 2015).

However, due to the small Pearson's correlation coefficient ($r = 0.05$) of unit transaction prices and time, which suggests no effect of time on transaction prices, the author decided to create a land value map of the analyzed land, taking into account all the real properties (Fig. 6).
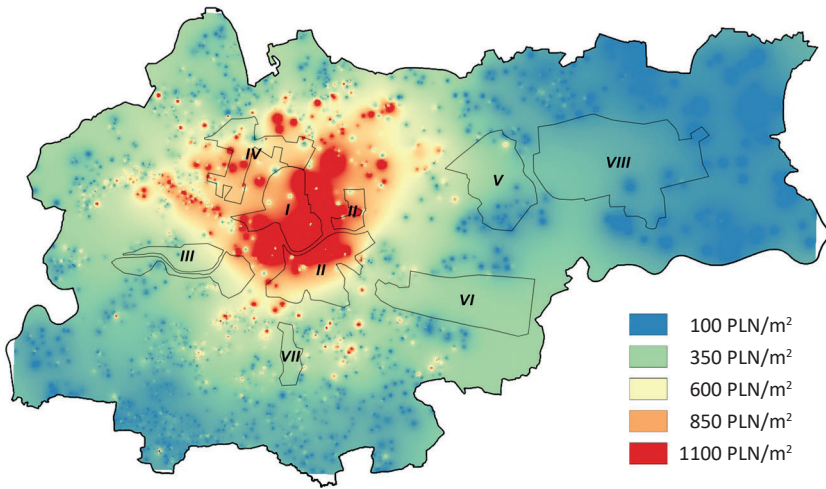
Fig. 6. Land value map of undeveloped real properties intended for residential development in Krakow, 2006–2014

Source: own study.

The map was created using the spatial interpolation method. This is a solution which has been tested in the studies of the real estate market by e.g. (Kulczycki, Ligas 2007), (Cichociński 2011), (Montero, Larraz 2011), (Walacik et al. 2013), (Cellmer et al. 2014), (Ogryzek, Kurowska 2016) and (Polny, Wójciak 2017). All of the land value maps presented in this article were created using the Inverse Distance Weighting method (IDW). The author decided not to insert a line of discontinuity, which undoubtedly is the Vistula River. It is associated with the fact that some of the areas defined as revitalization areas in the Urban Revitalization Programme for Krakow and in the Local Revitalization Programmes are located on both sides of the Vistula River. The individual parts of the revitalization areas which look separated by the river are undoubtedly connected. Over the years, many road and pedestrian crossings over the Vistula River have been created.

For easier interpretation, the boundaries of the revitalization areas from the Urban Revitalization Programme for Krakow were plotted on the generated raster. On the prepared land value map, it can be noted that the highest transaction prices in Krakow are obtained for land properties located in the historic centre and in its immediate vicinity.

Since long-term analysis was applied, the conducted study was additionally based on the time series of average monthly unit transaction prices. Such an approach can be found in real estate research studies contained in the works such as (Żelazowski 2008), (Dittmann 2013), (Trojanek 2013) and (Bełej, Kulesza 2015). The time series created on the basis of all the collected data is shown in Figure 7, and its basic descriptive characteristics in Table 6.
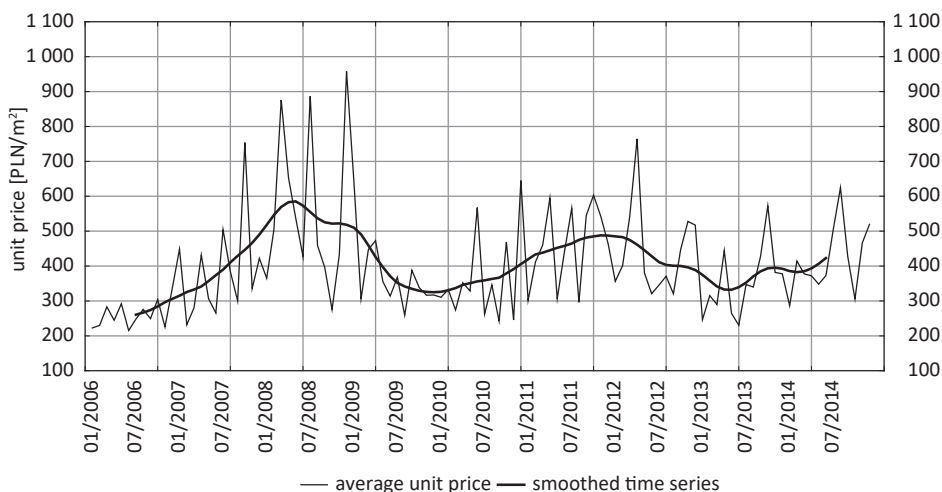
Fig. 7. Time series of average monthly unit transaction prices for undeveloped land properties intended for residential development in Krakow in 2006–2014

Source: own study.

According to the values illustrated in the graph in Fig. 7, the lowest average monthly unit transaction price was recorded in June 2006 (215 PLN/m²), and the highest in December 2008 (958 PLN/m²).

The same time series was also presented against the background of the series of average monthly transaction prices obtained for undeveloped land properties in Krakow, 2006–2014, smoothed by means of moving averages for five neighbouring periods. It was necessary to carry out three iterations for such a series. A description of the method can be found e.g. in the works by (Box, Jenkins 1983), (Hamilton 1994) and (Brockwell, Davis 1996).

Based on the smoothed time series, the analyzed market can be defined as characterized by a constant price level and cyclical fluctuations (Adamczyk, Bieda 2015). After the smoothing, the maximum of the analyzed series is in May 2008 (586 PLN/m²), and the minimum in July 2006 (261 PLN/m²).

Tab. 5. Basic descriptive statistics of the time series of average monthly unit transaction prices for undeveloped land properties intended for residential development in Krakow in 2006–2014

Average	Median	Minimal	Maximal	Standard deviation
403.26	369.39	215.25	957.94	147.07
Coefficient of variation	Skewness	Kurtosis	Percentile 10%	Percentile 90%
0.36	1.45	2.55	248.24	595.17

Source: own study.

However, analysing the whole set does not seem reasonable. The interpretation of the above results only proves that it is necessary to divide the data into smaller parts in order to:

1. Compare the land value map of the entire Krakow at the beginning of the urban renewal process with the boundaries of the areas which should be revitalized, selected in the Urban Revitalization Programme for Krakow, to determine whether there is a relationship between the value of land properties and their location in the areas recognized as being in a recessionary condition.

2. Compare the time series of average monthly unit transaction prices for the real estate located within the revitalization areas and in their immediate vicinity between the individual areas, and with the time series of the average monthly transaction prices for the real properties located throughout the city, in order to verify whether defining the area as being in the recessionary condition, and then the possible implementation of a recovery plan in the form of the Local Revitalization Programme, has caused price fluctuations in local real estate markets.

4. Empirical results

In order to properly divide the analyzed data set into smaller ones, and to determine the dates of the events that could have had an effect on transaction prices, a timeline was presented which depicts the course of creating the legal basis for the urban renewal in Krakow (Fig. 8).
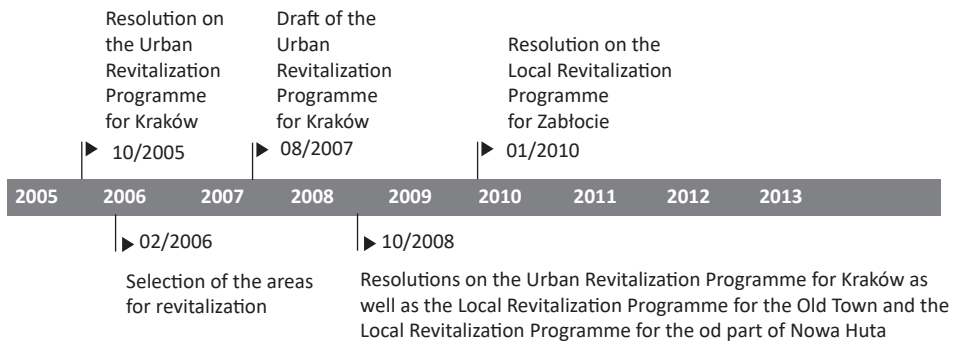

Fig. 8. Timeline of creating the legal basis for urban renewal in Krakow

Source: own study.

On the basis of the above timeline, it was found that, at the beginning of the process of urban renewal, the land value map of the whole Krakow should have been prepared according to the data from 2006. The public consultations carried out later in order to create a project of the Urban Revitalization Programme for Krakow could have significantly influenced real estate transaction prices by pointing out a quality which would positively affect their value – possible future revitalization of the area.

The timeline also helped to determine the dates around which average monthly unit transaction prices for the real properties located within the revitalization areas and in their immediate vicinity should be compared. In order to see if urban renewal affects the value of real estate, the points from the above timeline will be confronted with the dates at which the time series reach their minima and maxima.

4.1. The influence of property values on determining revitalization areas

In order to determine the dependence between transaction prices obtained for land properties and the location of the properties in the areas meant to be revitalized, a sample of 820 was analyzed. Their distribution is shown in Fig. 9.
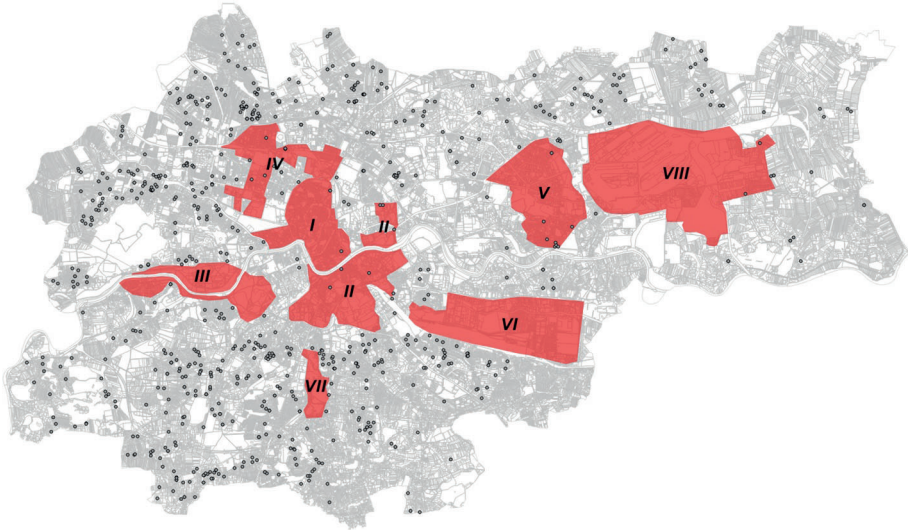
Fig. 9. Distribution of undeveloped land properties intended for residential development which were traded in 2006

Source: own study.

It is evident that most of the real properties sold in 2006 are located outside of the areas which were considered to be degraded and requiring renewal in the Urban Revitalization Programme. The reasons behind the lack of transactions recorded in degraded areas vary depending on the area. In the city centre (areas I, II and IV) demand for land properties surpasses their supply. In other areas, the situation is reversed. Owners of properties located in degraded areas put them on sale readily, but unfortunately not many people are interested in buying them. Therefore, in order to determine the relationship between the transaction prices and the location in a revitalization area, price interpolation was repeated once more using the Inverse Distance Weighting method (Fig. 10).

A map was prepared based on transaction prices without time correction. Pearson's correlation coefficient between the unit transaction prices and the transaction date in 2006 was 0.04.
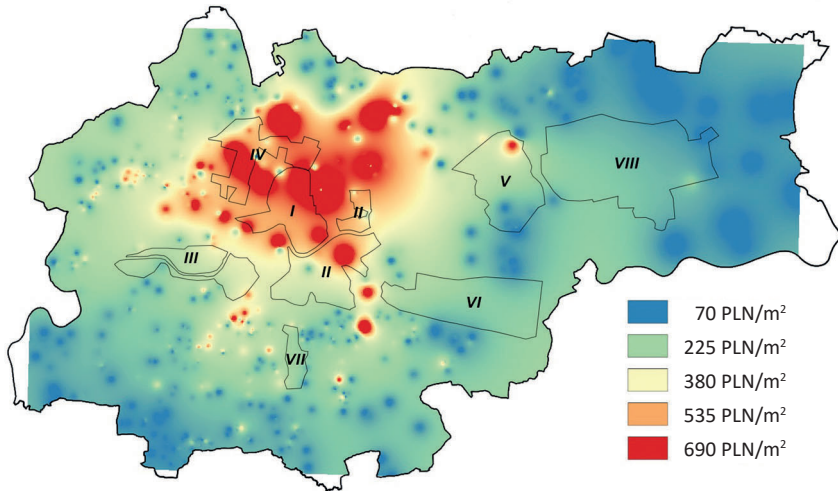

Fig. 10. Land value map of undeveloped land properties intended for residential development in 2006

Source: own study.

Based on the land value map with boundaries of revitalization areas, it can be noted that, contrary to expectations, they are not always located in those areas of the city where real estate is inexpensive. The highest unit transaction prices can be noted in the vicinity of the communications centre[1] and in fashionable locations, mainly on the representative streets of Krakow. These areas frequently neighbour those later identified as being in a recessionary condition in the Urban Revitalization Programme for Krakow and denoted as I, II and IV.

Other revitalization areas (III, V, VI, VII and VIII) are located outside the city centre. The transaction prices recorded in their influence zones do not differ from those recorded outside the revitalization areas.

4.2. The influence of urban renewal on the value of real estate

In order to verify whether price changes on the local market of undeveloped land properties intended for residential development were the result of defining an area as being in recessionary condition, and then possibly implementing a recovery plan in the form of the Local Revitalization Programme, the author decided to build a time series of average monthly unit transaction prices for the properties

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[1] The communications centre is a big investment aimed at improving communication in the centre of Krakow. It encompasses an underground hall of a railway station, a bus station, a fast tram tunnel, a road tunnel and two new streets.

located within the revitalization areas. However, since in the years 2006–2014, land property transactions in the majority of the revitalized areas were reported to be extremely rare (cf. Fig. 11), information on property sales in the immediate vicinity of these areas was added to the transactions in the revitalization areas.
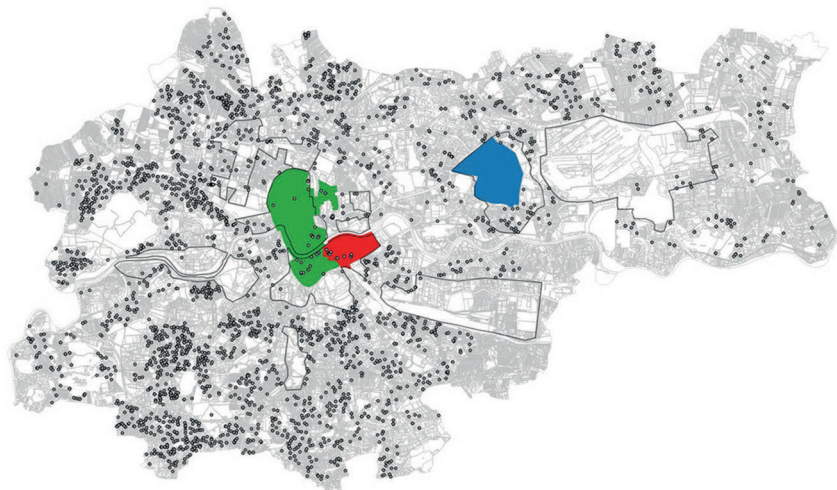

Fig. 11. Distribution of undeveloped land properties intended for residential development which were traded between 2006 and 2014

Source: own study.

Tab. 6. Basic descriptive statistics of the time series of average quarterly unit transaction prices for undeveloped land properties intended for housing development in individual revitalization areas in 2006–2014

Area	Average	Median	Minimal	Maximal	Standard deviation	Coefficient of variation	Skewness	Kurtosis
I	2223.97	1719.78	210.08	10682.49	2179.25	0.98	2.37	7.06
II	1151.16	840.60	292.10	3329.15	828.12	0.72	1.17	0.88
III	430.19	354.27	142.83	1158.73	204.95	0.48	1.46	3.21
IV	903.72	806.03	46.82	2915.45	575.88	0.64	1.46	3.66
V	328.94	281.57	61.46	1127.71	210.34	0.64	1.89	5.06
VI	313.33	237.20	97.18	1120.14	195.78	0.62	2.40	7.97
VII	359.56	362.70	104.82	946.16	173.11	0.48	1.01	3.05
VIII	113.44	108.47	35.99	260.23	55.58	0.49	1.16	1.17
Kra-kow	403.26	393.64	245.23	581.67	98.27	0.24	0.17	−1.03

Source: own study.

Each of the time series was built with several hundred transactions recorded in the analyzed period. Due to data gaps, the author decided to determine average quarterly unit prices. All the series were smoothed using moving averages (for

three neighbouring periods, in three iterations). The characteristics of the series are contained in Table 6. The time series are shown in Fig. 12 and 13.
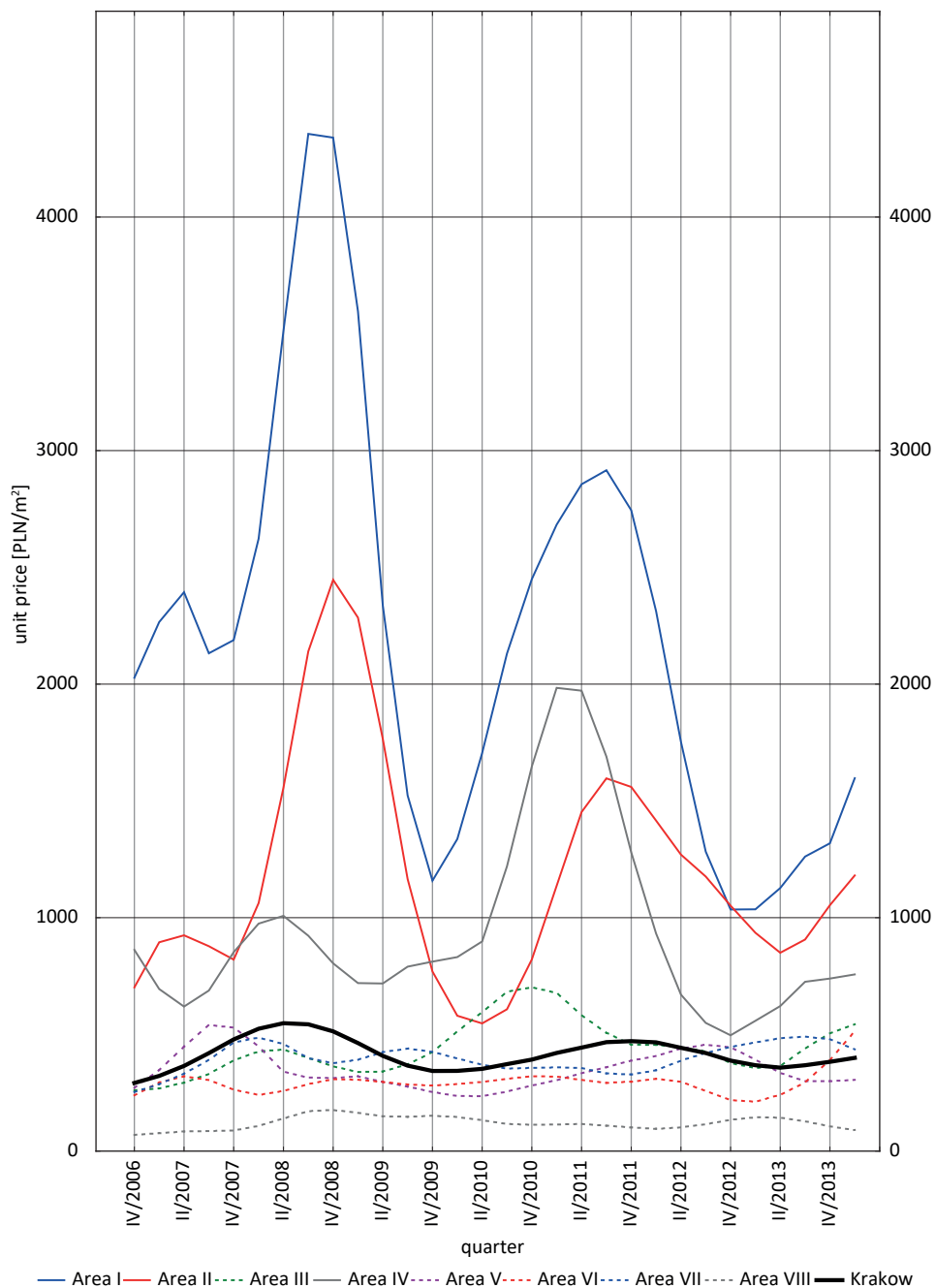

Fig. 12. Smoothed time series of average monthly transaction prices for undeveloped land properties in the areas selected for revitalization in the Urban Revitalization Programme for Krakow in the years 2006–2014

Source: own study.

The time series of average quarterly unit prices in all revitalization areas, as well as the series of average monthly prices for the whole of Krakow, are stable and are characterized by cyclical or seasonal fluctuations. Their extremes are summarized in Table 7.

Tab. 7. Extremes of the time series of average quarterly unit transaction prices for undeveloped land properties intended for residential development in individual revitalization areas in the years 2006–2014

Area	Maximal		Minimal	
	quarter	unit price [PLN/m²]	quarter	unit price [PLN/m²]
I	III/2008	4 356	IV/2012	1 035
II	IV/2008	2 446	II/2010	547
III	IV/2010	702	IV/2006	260
IV	I/2011	1 984	IV/2012	496
V	III/2007	541	III/2010	236
VI	I/2013	513	I/2013	212
VII	III/2013	491	IV/2006	253
VIII	IV/2008	177	IV/2006	69
Krakow	II/2008	548	IV/2006	292

Source: own study.

In all the areas selected for the Urban Revitalization Programme for Krakow, transaction prices began to increase after the urban renewal had started. The prices in area V reached their maxima first, with the average transaction price of PLN 541/m² in the third quarter of 2007. The buyers' euphoria, however, dropped quite rapidly and when the Local Revitalization Plan for the old part of Nowa Huta was adopted, transaction prices plummeted to circa PLN 300/m², and then continued to decrease until the third quarter of 2010. When they reached the minimum, the prices in area V started to go up again. The local maximum of the second cycle was 456 PLN/m².

In areas I and II, the maxima of the time series occurred in the second half of 2008 (for area I – 4 356 PLN/m², for area II – 2 446 PLN/m²), which coincided with the adoption of the Urban Revitalization Programme for Krakow. At the turn of 2009 and 2010, the minima could be observed in both cases (for area I – the local minima amounting to 1 158 PLN/m², for area II – the global minima amounting to 547 PLN/m²). Other local extremes were the maxima in the third quarter of 2011 (for area I – 2 916 PLN/m², for area II – 1 596 PLN/m²). The maximum value for the time series of area IV (1 984 PLN/m²) was about half a year ahead of them. Earlier, when the price series for areas I and II reached their maxima, the series for area IV reached the value of PLN 1 007/ m² (in the second quarter of 2008).

The time series demonstrated in Fig. 13 are the same as in Fig. 12. However, they were selected and scaled to make it easier to analyze the values for the areas with lower average transaction prices.
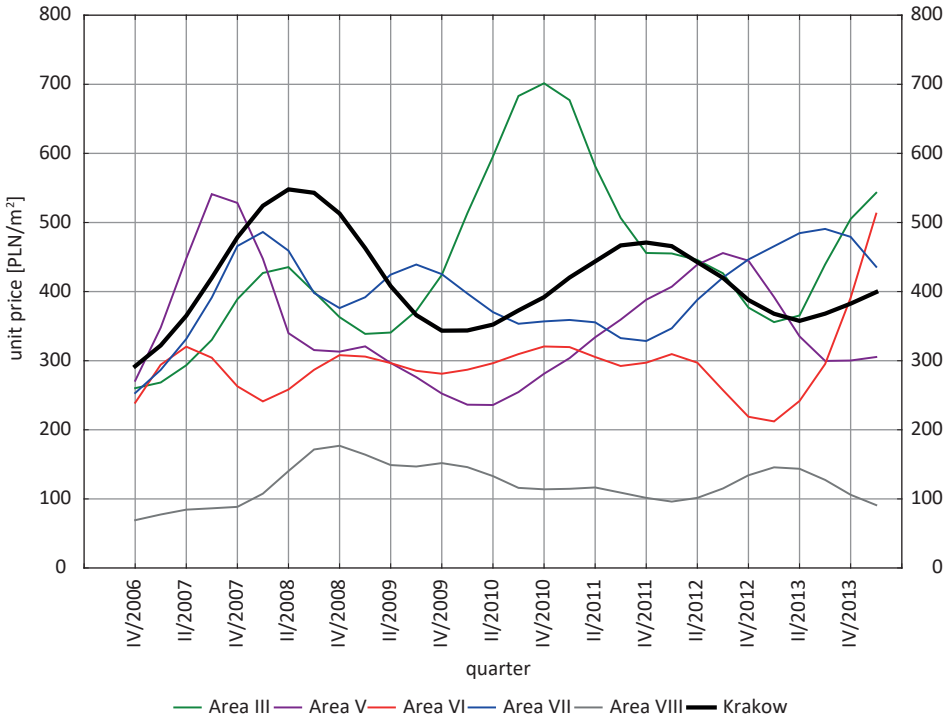

Fig. 13. Smoothed time series of average monthly unit transaction prices for undeveloped land properties in specific areas selected for revitalization in the Urban Revitalization Programme for Krakow in 2006–2014

Source: own study.

The series of quarterly average transaction prices in areas III, V, VI, VII and VIII are significantly lower than in areas I, II and IV. This is associated with the location of the latter in the very centre of Krakow.

In area VI, the influence of urban renewal on transaction prices is negligible. The series of average quarterly transaction prices for this area does not exhibit any explicit extremes which could be linked to the dates important for revitalization in Krakow.

The prices in area VII increased significantly after the Urban Revitalization Programme for Krakow had been introduced, i.e. at the turn of 2007 and 2008, soaring to PLN 486/m². In area VIII, it occurred only a year later, i.e. after the adoption of the Urban Revitalization Programme for Krakow (177 PLN/m²).

The extreme of the transaction price series in area III was observed in the fourth quarter of 2010 (702 PLN/m²). This is a completely unexpected value and

it is most likely related to the inclusion of real properties from the influence zone of area III, also affected by areas I and II, into the calculations.

For comparison, average unit prices for land properties in provincial cities remained at a constant level from the end of 2007 to the beginning of 2010 (cf. Report 2016). Well-visible maxima of the time series of average quarterly unit prices in all revitalization areas suggest that legislative actions resulted in an increase of the prices which had already been high. Their level in Krakow rose even higher than in other provincial cities, however, the lack of actions leading to the realization of the Urban Revitalization Programme brought Krakow prices down to the level of the whole country.

Finally, to see how the market reacted to the creation of the Local Revitalization Programmes, a land value map was prepared based on the data from the years 2010–2014 (Fig. 14). The raster, as before, was generated using the Inverse Distance Weighting method. 2 278 transaction prices located throughout Krakow were used for the calculations. Due to the lack of any relationship between the transaction date and the unit transaction price, the prices were not adjusted for the time elapsed.

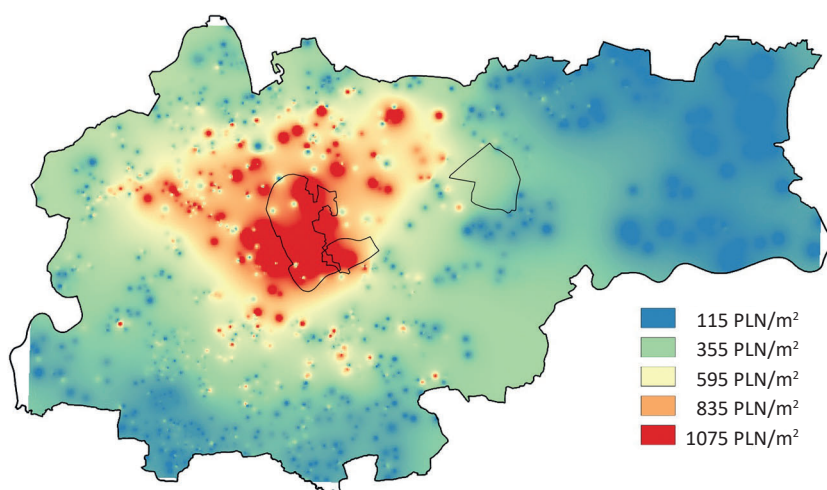115 PLN/m²
355 PLN/m²
595 PLN/m²
835 PLN/m²
1075 PLN/m²

Fig. 14. Land value map of the undeveloped land properties intended for residential development in 2010–2014

Source: own study.

The above land value map proves that urban renewal affected the distribution of transaction prices in Krakow. As a result of the revitalization of Zabłocie, the transaction prices in this area have increased significantly (cf. Fig. 10 and 14).

5. Discussion and conclusions

Based on the analyses carried out in Krakow in the years 2006–2014, it may be concluded that the value of undeveloped land intended for residential development is associated with urban renewal. This is due to the fact that revitalization has a positive effect on qualities such as "standard", "environment" and "fashion", which are typically used by property appraisers to describe real properties in their valuation process (cf. Parzych, Czaja 2015).

As it has already been noted earlier, in all the areas identified as being in a recessionary condition and intended for revitalization, transaction prices began to increase as soon as the procedure for the Urban Revitalization Programme for Krakow commenced. The real estate market began to discount future gains in space. The time series of the quarterly unit transaction prices for these areas, however, reached their maxima at different times.

The maxima were reached first in area V (later: the Local Revitalization Programme for the old part of Nowa Huta), just after the creation of the Urban Revitalization Programme for Krakow, i.e. in the third quarter of 2007. In areas I (later: the Local Revitalization Programme for the Old Town) and II (later: the Local Revitalization Programme for Zabłocie), for which adoption Local Revitalization Programmes had been decided, an increase in transaction prices was noted only after the Urban Revitalization Programme for Krakow was introduced, i.e. in the second half of 2008. Additionally, a price increase in area II also occurred after the update of the Local Revitalization Programme for Zabłocie in January 2010. In the second quarter of 2010, the prices in this area began to rise again.

Urban renewal of Krakow resulted in increased transaction prices in the city centre. As a result of the regeneration of post-industrial areas, Zabłocie became a fashionable, and thus expensive, place to live (Bieda et al. 2017). Therefore, the introduction of the Local Revitalization Programme for Zabłocie resulted in a shift of the centre of gravity of transaction prices from the vicinity of the communication centre to the south, towards the Kazimierz and Podgórse districts.

It is also noticeable that failure to revitalize area IV (Krowodrza) had no visible effect on transaction prices. Despite the fact that the Local Revitalization Programme had not been implemented for this particular district, in the years 2010–2014 the prices there were equal to the prices in the areas covered by the Local Revitalization Programme for the Old Town and the Local Revitalization Programme for Zabłocie. Spatial variations, related mainly to a decrease in railway areas, which influenced the perception of the market potential, contributed to this phenomenon.

However, Krakow's urban renewal did not stimulate the land market. The number of transactions in the areas identified as revitalization areas remained low over the years when compared to the rest of the city (cf. Fig. 9 and 11). In some areas (II, VI, VII and VIII) there were hardly any land property transactions.

Although in the areas located in the very centre of Krakow (areas I, II and IV) unit transaction prices were very high, they did not significantly affect average city prices.

It should be remembered that the performed analyses serve exclusively to describe the phenomenon of urban renewal. The real estate databases based on the transactions conducted over a period of nine years cannot be used for valuation in general.

References

Adamczyk, T., Bieda, A., 2015, "The applicability of time series analysis in real estate valuation," *Geomatics and Environmental Engineering*, 9(2): 15–25.

Adamczyk, T., Bieda, A., 2014, "Intended use of real estate as a time changeable attribute for determining compensation for nationalized and expropriated lands," *Real Estate Management and Valuation*, 22(4): 35–50.

Bieda, A., Brzozowski, Ł., 2007, "Analiza krakowskiego rynku nieruchomości gruntowych (Analysis of market of ground estates in Cracow)," *Geomatics and Environmental Engineering*, 1(4): 21–30.

Bieda, A., Magoń, K., Siudem, B., 2017, "Wpływ lokalnych planów rewitalizacji na wartość nieruchomości na przykładzie krakowskiego Zabłocia" [Impact of local revitalization plans on the value of real estate based on the Cracow Area of Zabłocie], in: Przemiany przestrzeni publicznej miasta [Transformation of public space in the city], Kalisz: Wydawnictwo Państwowej Wyższej Szkoły Zawodowej im. Prezydenta Stanisława Wojciechowskiego w Kaliszu, pp. 157–183.

Bieda, A., Parzych, P., 2013, "Development of spatial politics of monumental towns based on Krakow example," International Multidisciplinary Scientific GeoConference: 16–22, June, 2013, Albena, Bulgaria, conference proceedings. Surveying Geology & Mining Ecology Management, vol. 2, pp. 143-150.

Bełej, M., Kulesza, S., 2015, "The dynamics of time series of real estate prices," *Real Estate Management and Valuation*, 23(4): 35–43.

Box, G.E.P., Jenkins, G.M., 1983, *Analiza szeregów czasowych. Prognozowanie i sterowanie* [Time Series Analysis. Forecasting and Control], Warszawa: PWN.

Brockwell, P.J., Davis, R.A., 1996, *Introduction to Time Series and Forecasting*, New York: Springer-Verlag.

Cellmer, R., Bełej, M., Źróbek, S., Bubic-Kovac, M., 2014, "Urban land value maps – a methodological approach," *Geodetski Vestnik*, 58(3): 535–551.

Cichociński, P., 2011, "Porównanie metod interpolacji przestrzennej w odniesieniu do wartości nieruchomości" [Comparison of spatial interpolation methods for real estate values], *Studia i Materiały Towarzystwa Naukowego Nieruchomości*, 19(3): 120–125.

Chmielewski, J.M., 2016, *Teoria i praktyka planowania przestrzennego. Urbanistyka Europy* [Theory and practice of spatial planning. Urbanism of Europe]. Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej.

Dąbrowski, J., 2009, "Zastosowanie metod i algorytmów statystycznych do wyznaczenia parametrów globalnych dla potrzeb badania rynku i wyceny nieruchomości" [Real estate market analysis and estimating market value carried out based on statistical models built on the basis of global attributes], *Studia i Materiały Towarzystwa Naukowego Nieruchomości*, 17(1): 31–47.

Dittmann, I., 2013, "Primary and secondary residential real estate markets in Poland – analogies in offer and transaction price development," *Real Estate Management and Valuation*, 21(1): 39–48.

Emery, J., 2006, "Bullring: A case study of retail-led urban renewal and its contribution to city centre regeneration," *Journal of Retail and Leisure Property*, 5(2): 121–133.

Jadach-Sepioło, A., 2016, "Warunki ograniczające i stymulujące inwestycje w nieruchomości na obszarach rewitalizacji w miastach objętych projektami pilotażowymi (Bytom, Wałbrzych, Łódź)" [Conditions limiting and stimulating investment in regeneration areas in cities included in pilot projects (Bytom, Wałbrzych, Łódź)], *Świat Nieruchomości*, 3(97): 5–8.

Hamilton, J.D., 1994, *Time Series Analysis*, Princeton: Princeton University Press.

Herbst, K., 2008, *Społeczny sens rewitalizacji* [Social sense of revitalization], Ekonomia Społeczna Teksty, nr 3, http://www.ekonomiaspoleczna.pl/files/ekonomiaspoleczna.pl/public/Biblioteka/2008.39.pdf (access: 1.04.2017).

Google Street View, 2014, https://www.google.pl/maps/@50.0501878,19.9613341,3a,75 y,193.79h,80.23t/ data=!3m6!1e1!3m4!1sijSnZVSYM5pUah4fT1gPLw!2e0!7i13312 !8i6656 (access: 1.04.2017).

Kaczmarek, S., 1999, "Przekształcenia przestrzenne i funkcjonalne obszarów przemysłowych w miastach brytyjskich. Przykład doków w Londynie" [Spatial and functional changes of industrial areas in british cities: The case of London docklands], *Acta Universitatis Lodziensis. Folia Geographica Socio-Oeconomica*, 2: 125–134.

Konowalczuk, J., Ramian, T., 2008, "Motywacje uczestników procesu rewitalizacji nieruchomości poprzemysłowych" [The motivations of participants in the brownfield redevelopment proces], *Świat Nieruchomości*, 4(66): 60–65.

Kulczycki, M., Ligas, M., 2007, "Regresja ważona geograficznie jako narzędzie analizy rynku nieruchomości" [Geographically weighted regression as a tool for real estate market analysis], *Geomatics and Environmental Engineering*, 1(2): 59–68.

Małkowski, A., Woźniak, P., 2004, "Rewitalizacja Berlina (Revitalization of Berlin)", *Przegląd Zachodni*, 1: 127–141.

Montero, J., Larraz, B., 2011, "Interpolation methods for geographical data: Housing and commercial establishment markets," *Journal of Real Estate Research*, 33(2): 233–244.

Ogryzek, M., Kurowska, K., 2016, "Opracowanie map średnich cen transakcyjnych gruntów rolnych niezabudowanych zbywanych z zasobu ANR OT Olsztyn z wykorzystaniem interpolacji metodą IDW" [Preparation of average transaction prices maps for undeveloped agricultural lands from Agricultural Real Estate Agency Resources in Olsztyn using interpolation IDW method], Studia i Prace WNEiZ US, 45, vol. 2: 355–365.

Olbińska, K., 2014, "The influence of real estate on its surroundings based on the example of the Manufaktura complex in Lodz," *Real Estate Management and Valuation*, 22(4): 5–16.

Palicki, S., Rącka, I., 2016, "Influence of urban Renewal on the Assessment of Housing Market in the Context of Sustainable Socioeconomic City Development," in: *Smart City 360°*, Springer International Publishing, pp. 851–860.

Palicki, S., 2013, "Rewitalizacja a rynek nieruchomości mieszkaniowych. Przypadek poznańskiej Śródki [Revitalization and the housing market. A case study of the Poznań district of Śródka], *Ruch Prawniczy, Ekonomiczny i Socjologiczny*, 75(3): 209–228.

Palicki, S., Rącka, I., Kostov, I., 2015, "Aesthetic dimension of urban revitalisation in Polish and Bulgarian cities," *Świat Nieruchomości*, 10(94): 67–72.

Parzych, P., Czaja, J., 2015, *Szacowanie rynkowej wartości nieruchomości* [Estimation of real estate market value], Kraków: Wydawnictwa AGH.

Petersen, P., Frank, K., Frank, K., 2002, *Historic Preservation in the USA*, Berlin: Springer Verlag.

Polny, L., Wójciak, E., 2017, "The conception theory pseudo-radiation local emitters value of properties with a differential propagation of prices wave," *Geomatics and Environmental Engineering*, 11(2): 49–59.

Register of Real Estate Prices and Values kept by the Kraków City Office (access: 15.06.2016).

Report – realization of revitalization projects as of 31 December 2014, http://rewitali-zacja.krakow.pl/zalacznik/241047 (access: 15.07.2017).

Report – the land market in 2016, http://www.pkobp.pl/media_files/70b956eb-e72b-4b33-934f-2f52c3637471.pdf (access: 15.07.2017).

Sztando, A., 2008, "Pomiar rezultatów programu rewitalizacji miasta" [Measurement of the results of a city revitalization programme], *Samorząd Terytorialny*, 9: 41–57.

Świerczewska-Pietras, K., 2008, "Serce miasta" [The heart of the city], *Czasopismo Techniczne. Architektura*, 105(4-A): 175–179.

Trojanek, R., 2013, "An attempt to identify the seasonality of housing prices in selected Polish cities in 1996–2012," *Real Estate Management and Valuation*, 21(4): 96–109.

Uchwała Nr XCII/926/05 Rady Miasta Krakowa z dnia 26 października 2005 r. w spra-wie przystąpienia do opracowania Miejskiego Programu Rewitalizacji Krakowa – Lokalnego Programu Rewitalizacji [Resolution No. XCII/926/05 of the Krakow City Council of 26 October 2005 on the elaboration of the Urban Revitalization Programme for Krakow – the Local Revitalization Programme].

Uchwała Nr CXIX/1284/06 Rady Miasta Krakowa z dnia 25 października 2006 r. w spra-wie przyjęcia Lokalnego programu rewitalizacji i aktywizacji poprzemysłowego obszaru Zabłocia [Resolution No. CXIX/1284/06 of the Krakow City Council of 25 October 2006 on the adoption of the Local Revitalization and Activation Programme for the post-industrial area of Zabłocie].

Uchwała Nr LIII/672/08 Rady Miasta Krakowa z dnia 8 października 2008 r. w sprawie przyjęcia Miejskiego Programu Rewitalizacji Krakowa [Resolution No. LIII/672/08 of the Krakow City Council of 8 October 2008 on the adoption of the Urban Revitalization Programme for Krakow].

Uchwała Nr LIII/673/08 Rady Miasta Krakowa z dnia 8 października 2008 r. w spra-wie przyjęcia Lokalnego Programu Rewitalizacji Starego Miasta [Resolution No. LIII/673/08 of the Krakow City Council of 8 October 2008 on the adoption of the Local Revitalization Programme for the Old Town].

Uchwała Nr LIII/674/08 Rady Miasta Krakowa z dnia 8 października 2008 r. w sprawie przyjęcia Lokalnego Programu Rewitalizacji „starej" Nowej Huty [Resolution No. LIII/673/08 of the Krakow City Council of 8 October 2008 on the adoption of the Local Revitalization Programme for the old part of Nowa Huta].

Uchwała Nr XC/1193/10 Rady Miasta Krakowa z dnia 13 stycznia 2010 r. w sprawie przyjęcia aktualizacji Programu rewitalizacji i aktywizacji poprzemysłowego obszaru Zabłocia [Resolution No. XC/1193/10 of the Krakow City Council of 13 January 2010 on the adoption of the update of the Revitalization and Activation Programme for the post-industrial area of Zabłocie].

Uchwała Nr CXXI/1906/14 Rady Miasta Krakowa z dnia 5 listopada 2014 r. w sprawie przyjęcia Miejskiego Programu Rewitalizacji Krakowa [Resolution No. CXXI/1906/14

of the Krakow City Council of 5 November 2014 on the adoption of the Urban Revitalization Programme for Krakow].

Uchwała Nr LIX/1288/16 Rady Miasta Krakowa z dnia 7 grudnia 2016 r. w sprawie przyjęcia aktualizacji Miejskiego Programu Rewitalizacji Krakowa [Resolution No. LIX/1288/16 of the Krakow City Council of 7 December 2016 on the adoption of the update of the Urban Revitalization Programme for Krakow].

Uchwała Nr LXII/1373/17 Rady Miasta Krakowa z dnia 11 stycznia 2017 r. w sprawie przyjęcia aktualizacji Miejskiego Programu Rewitalizacji Krakowa [Resolution No LXII/1373/17 of the Krakow City Council of 11 January 2017 on the adoption of the update of the Urban Revitalization Programme for Krakow].

Ustawa z dnia 9 października 2015 r. o rewitalizacji, Dz. U. z 2015 r., poz. 1777, z pózn. zm. [Act of 9 October 2015 on revitalization, Journal of Laws, 2015, item 1777, as amended].

Walacik, M., Cellmer, R., Źróbek, S., 2013, "Mass appraisal – international background, Polish solutions and proposal of new methods application," *Geodetski List*, 67(90): 255–269.

Żelazowski, K., 2010, "Statystyczna analiza łódzkiego rynku nieruchomości" [Statistical analysis of the real estate market in Łódź], *Journal of the Polish Real Estate Scientific Society*, 18(1): 133–144.