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LAND VALUE PATTERNS IN THE WARSAW METROPOLITAN AREA

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September 2009

Statement of Authorship

I hereby testify that this paper and the work it presents are entirely my own. When it has been necessary to draw from the work of others, published or unpublished, I have acknowledged such work in accordance with accepted scholarly and editorial practice. I give this testimony freely, out of respect for the scholarship of other professionals in the field and in the hope that my own work, submitted here, will earn similar respect.

Anna Kaźmierska

Abstract

This dissertation investigates the land value patterns in Warsaw Metropolitan Area. The research hypothesis states: The price of residential land decreases with distance from the centre of Warsaw. The paper is divided into six chapters: in the first, there is an introduction and the main purpose of the study presented, in the second, literature review about the subject of study is conducted, in the third, the main characteristic of Warsaw Metropolitan Area is presented, in the fourth chapter, the research design and method of analysis are described, in the fifth chapter, the analysis of the results of the research is presented, in the sixth the conclusions are made.

The data was gathered from 72 municipalities from districts: Grodziski, Legionowski, Piaseczyński, Pruszkowski, Warszawski zachodni, Żyrardowski and some chosen parts of districts: Grójecki, Miński, Nowodworski, Otwocki, Sochaczewski, Wołomiński and Wyszkowski. The statistical test shows correlation between land prices and distance from city centre, distance from centre of district and plot area.

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Chapter 1- Introduction

Rationale of the research

According to various research, a large city has a large impact on the surrounding areas. They create a metropolis, in which the main city is strongly connected to the surroundings areas. In the majority of cases, in centre, there is a Central Business District, with places of work, in the suburbs there are residential areas. Both parts are connected by transport links, which are often insufficient for the number of cars existing nowadays. Every day, a lot of time is spent travelling to work. Therefore, the prices of land generally decreases with the distance of the centre.

The impact of the metropolis on the surrounding areas was studied in numerous pieces of research. Many researchers have proved that the distance from a city centre has a significant, negative effect on land value.

The distance variable plays an important role in many theories of residential location. The choice of distance measures is very wide: linear distance (Brigham, 1965), the logarithm of distance (Anderson and Crocker, 1971 ; Evans, 1973), travel time (Ridker and Henning, 1968 ; Wabe, 1971), multiple accessibility, job accessibility or other accessibility measures (Wendt and Goldner, 1966 ; Lane, 1970 ; Apps, 1971) .

Alonso (1964) and Muth (1969) modelled the residential location decision by income in terms of the conflicting desires for a low price of housing and access to a Central Business District. In that model, the additional amount of money that buyer can pay per square meter of plot is equal to the sum of the marginal savings in transport costs to CBD. Diamond (1980) expanded that model by proving that other amenities such as access to railway station, air quality, public safety and hilliness, were important determinants of land prices and location by income.

Aims and hypothesis of the study

The main aim of this study is to investigate and analyse the spatial patterns of the residential land price in the Warsaw metropolitan area. The specific objectives of the study are: to analyse spatial patterns of residential land values around the metropolis, investigate the distribution, maximum, minimum and median of sales, to investigate if land prices decrease with distance from city centre and the intensity of this correlation, to find out the scale of influence of the metropolis on the surrounding area, to identify directions of changes in the Warsaw Metropolitan Area and predict some future scenarios of development, to compare residential land prices on each side of the Vistula river and to investigate in which districts and municipalities the land prices are highest and in which they are the lowest and for what reason. Why are some locations more popular than an other ? The research hypothesis states: The price of residential land decreases with distance from the centre of Warsaw. The null hypothesis states: There is no significant effect of distance on land prices.

Outline methodology of the research

The data were collected using secondary data collection. The data was gathered from 72 municipalities from districts: Grodziski, Legionowski, Piaseczyński, Pruszkowski, Warszawski zachodni, Żyrardowski and some chosen parts of districts: Grójecki, Miński, Nowodworski, Otwocki, Sochaczewski, Wołomiński and Wyszkowski.

The data was analyzed using SPSS software. First of all, the general characteristics of the sample were prepared with the use of the descriptive statistic method. The next step was to analyse the variables: area of plot, price, price per 1 sqm; distances from Warsaw were measured according to central tendency. The maximum, minimum, mean and standard deviation of each variable were calculated. Afterwards, the One-Sample Kolmogorov-Smirnov Test was used to test if variables were normally distributed, which determinates if the parametric or non-parametric test could be used. Then, research was made as to how the price per 1 sqm variable varies according to other variables: district, municipality, side of Vistula river, railway station, plot area and distance to centre of Warsaw and a centre of a district. The next step of analysis was to check the correlation between price per 1 sqm variable and other variables: distance from Warsaw, distance from the centre of district, railway station and a plot area. It was done with use the of the Pearson Correlation test.

Dissertation contents

The paper proceeds as follows. Firstly, the literature review is displayed. Secondly, some background material on Warsaw Metropolitan Area is presented. Thirdly, the research design and method of analysis is described, fourthly the analysis of results of research is presented, and finally the conclusions from the study are presented.

Chapter 2 – Literature review

In standard valuation textbooks there are many factors, affecting the value of a property, such a location, site characteristic and usage of the property. The empirical research (Colwell and Sirmans 1980) revealed the connection between distance of the property and main centres and amenities, such as the central business district, regional centres, parks and schools with its market value. Another group of factors influencing a property value are site characteristics; for example physical infrastructure and attributes of neighbourhood (Walsh and Stenejhem (1975)).

Richardson, Vipond and Furbey (1974) studied the determinants of urban house prices in Edinburgh. They presented indirect tests of alternative residential location theories (namely accessibility, spatial, environmental or area preference and housing characteristics, for example, locationally insensitive models). The approaches were as follow: the location insensitive model in which the only determinant of price is the characteristic of the property itself, location or neighbourhood had no baring. Second, was the pure spatial model where the approach to the determinants of urban house prices was expressed in spatial and topographical terms. The variables used in this study (apart from individual house characteristics) were distance from the CBD, direction, i .e. division of the city into eight radial segments and above sea level. Third were, the accessibility models, in which households trade-off housing costs against transport (travel-to-work) costs are analyzed. Fourth, were environmental or area preference models, in which the neighbourhood quality was the most important factor affecting prices. Favourable attributes of neighbourhood were the absence of industry, access to open space and parks, the presence of good local schools, and the attraction of high socio-economic status areas. The least wanted attributes include noise, pollution, overcrowding, poor quality and old dilapidated neighbourhoods, closeness to heavy industry and proximity to council housing. The results of that study did not lend strong support to any of the above residential location theory. Instead, they suggest that the determinants of relative urban house prices include housing characteristics, general spatial variables, accessibility and environmental quality considerations. The residential site choice and the price-quality trade-off is a much more complex decision than the conventional theories suggest .

The distance variable plays an important role in studies of relative house prices and in many theories of residential location. The choice of distance measures is very wide: linear distance (Brigham, 1965), the logarithm of distance (Anderson and Crocker, 1971 ; Evans, 1973), travel time (Ridker and Henning, 1968 ; Wabe, 1971), multiple accessibility, job accessibility or other accessibility measures (Wendt and Goldner, 1966 ; Lane, 1970 ; Apps, 1971) .

Theoretical Models of Land Use

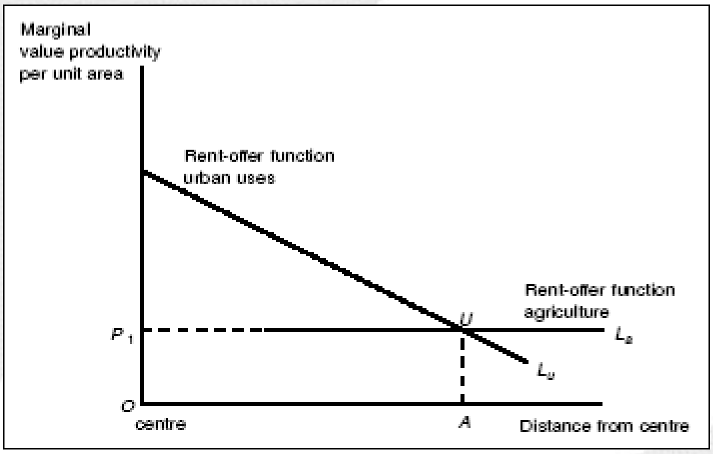

Figure 1. Allocation of land between urban and agricultural uses.

Winger (1977) the simplest two-industry model comparing rent-offer function in agriculture and urban (offices, housing and industry) land uses. In that function for agriculture, “La” is flat, as its product is sold on regional or national market, not need to be located close to cities. On the other hand, for urban uses, “Lu” is declining with distance from centre. According this model, in developed countries, under a free, unregulated market, the land between the centre and “A” will go to urban uses and all further land will go to agriculture. “A” represents the socially optimum demarcation where the “Lu” intersects “La” at “U”.

In figure 2, a more complex model is presented, with some negative externalities impacting on land uses. Externalities such as pollution and congestion influence have a negative influence on urban land use, whereas it is assumed that there are no externalities associated with agricultural production.

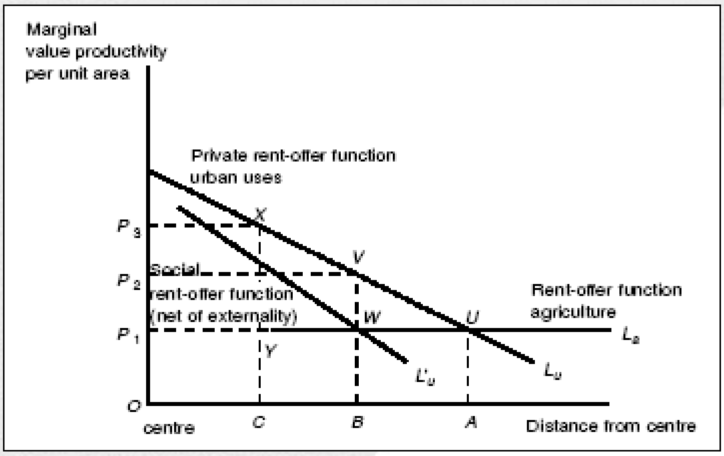

Figure 2. Allocation of land between different uses when (negative) externalities are present.

According to Mori (1998) the socially optimum allocation between urban and agricultural uses can be achieved either by levying a `Pegovian tax’ equal to V - W or P2 - P1 on land to be developed for urban uses or planning controls, such as planning permission in the case of Great Britain, zoning in the US and Japan, and planned development by the municipalities in the Netherlands.

The impact of the metropolis on surrounding areas was studied in numerous pieces of research. Many researchers have proved that the distance from the city centre has a significant negative effect on land value. Ingram (1998) has described patterns of metropolitan development in industrial and developing countries. A strong effect of economic development on the level of city urbanisation has been proved. With a rise in economic specialization, population density increases. There has been a significant trend of decentralization. Population density decreases with distance from a city centre. The direction of a city's expansion is towards the less-developed and urban-fringe areas. There are differences in population distribution in small and large cities. Whereas large cities tend to have a polycentric development pattern, with an established city centre or central business district (CBD) and a lot of sub-centres. Small cities are rather monocentric with one strongly defined city centre.

In literature, there are two main city development patterns: monocentric and polycentric. The monocentric city model of Alonso (1964), Muth (1985) and Mills (1970), implies that there is a close correlation between density and land prices. The monocentric pattern was common in first half of twentieth century in US and Western countries and it is still current in developing countries.

The polycentric pattern developed in second half of twentieth century, especially in US cities. Sivitanidou (1997) proved the weakening connection between land value and the distance from central districts.

Alonso (1964) and Muth (1969) modelled the residential location decision by income in terms of the conflicting desires for a low price of housing and access to a Central Business District. In that model, the additional amount of money that buyer can pay per square meter of plot is equal to the sum of the marginal savings in transport costs to CBD. Diamond (1980) expanded that model by proving that other amenities such as access to railway station, air quality, public safety and hilliness were important determinants of land prices and location by income.

NELSON (1993) researched how American exurban land market behaves near the edge of cities. Three relationships between the value of exurban land and these landscape features were empirically supported. First, as exurban households are dependent upon dispersed employment opportunities and rely on the urban area for many services, the value of residential land falls in relation to distance from the boundary of urban development. Secondly, since exurban households view the edge of cities as sources of congestion, pollution, noise and other factors associated with perceived ills of suburbia, the value of exurban land rises with respect to distance from edge cities. Thirdly, since downtowns are the dominant centre of reference for many metropolitan regions, exurban land values fall with respect to distance from downtowns.

The relationship between central city dominance in metropolitan areas, restrictive land use controls, and the availability of affordable housing in metropolitan areas in United States was studied by Ottensmann (1992). There are differences in land use planning, in metropolitan areas with dominating central city and with strong suburban municipalities. Suburban municipalities have incentives to engage in restrictive land use controls that reduce the supply of land available for new housing and increase the costs of such housing. Central cities, on the other hand, have a greater interest in assuring the availability of affordable housing for their residents with more modest incomes. The hypotheses of the study were that central city dominance in metropolitan areas affect the extent to which land use controls restrict development and that the restrictiveness of land use controls affect the affordability of housing. It was tested with the use of multiple regression.

An examination of housing prices in 46 of the 100 largest metropolitan areas of the United States shows that the dominance of metropolitan areas in the central cities results in less restriction on development, which in turn, leads to greater affordability of housing.

Gober and Burns (2002) explored annual changes in the amount and location of residential fringe development in metropolitan Phoenix, based on local records of housing completions from 1990 to 1998. The data was gathered from the local council for government MAG. For the purpose of the study the Phoenix metropolitan area was divided into almost even quadrants: Southeast, Northeast, Northwest, and Southwest. Each quadrant has local conditions that affect the extent and form of recent residential development: the Southeast with agricultural lands are available for rapid conversion to urban uses; the Northeast includes Indian lands and mountainous terrain where public open spaces have been reserved; the Northwest, with readily available agricultural lands and the Southwest with the nation's largest municipal park (the 18,000-acre South Mountain Park). The Geographic Information System (GIS) was used to measure the distance between each of 235,122 housing completions and a central reference point in downtown Phoenix. Afterwards, the measured distances were presented in graphs, which represented the number of new housing completions at each one-mile distance from the city center in each quadrant for each year between 1990 and 1998. To smooth out the graphs, the five-mile running means for one-mile sectors and the mean distance from the city center for each of the four quadrants on an annual basis between 1990 and 1998 were calculated. The results revealed that in 1990, new development covered a wide geographic area, but with time it became more geographically concentrated. The study showed that

Metropolitan Phoenix is organized into five belts: an outer rural zone, an area of pioneer settlement where the construction of single-family housing began in 1990, a peak zone of intensive development, a zone of infill, and a built-up area where little new construction occurs. Multiple-family housing construction occurs primarily in the infill zone. Between 1995 and 1998, new home construction moved outward at the pace of almost one-half mile per year to an average distance of 18.94 miles from the metropolitan centre.

Lee and Leigh (2007) examined the impact of metropolitan growth patterns on intrametropolitan spatial differentiation and inner-ring suburban decline in the four US metropolitan areas of Atlanta, Cleveland, Philadelphia, and Portland, using longitudinal census data from 1970 to 2000. They have been selected for analysis as a example of a metropolitan region from each of the country's four major regions (the Midwest or the Northeast, the South and the West), based on relatively similar population sizes. The primary data source for the analysis was the Neighbourhood Change Database (NCDB), produced by GeoLytics. This database contains longitudinal census long and short form data for 1970, 1980, 1990, and 2000. The research had three research issues : intrametropolitan spatial differentiation, the general decline of inner-ring suburbs, and intermetropolitan disparities within and between sub-areas. To test the research hypotheses, a descriptive analysis, a factor analysis, and a random-effect generalized least squares (GLS) regression model were used. The research applied advanced regression models such as pooled OLS, random-effect GLS regression, and fixed-effect GLS regression. Because of the data structure of the census from the four time periods, random-effect and fixed-effect regression models were useful methods for dealing with longitudinal data (Wooldridge 2001).

The findings of this study revealed that despite differences in their metropolitan growth patterns and policies, the four metropolitan regions examined in this research exhibited increased intrametropolitan spatial differentiation as well as inner-ring suburban decline between 1970 and 2000. In contrast to the inner-ring suburbs, the downtown and inner city sub-areas exhibited a gradual recovery from their decades-long patterns of distress.

Wheeler (2008) analyzed the evolution of built landscapes in six United States metropolitan regions with use of a historic maps, aerial photographs, and GIS software. The regions studied were Boston (the Northeastern), Atlanta (the Southeast), Minneapolis (the Midwest), Albuquerque and Las Vegas (the Southwest), and Portland, Oregon (the Northwest). The analysis identified seven main historic patterns of urban form and nine types created in the 1980-2005 period.

Another research on United States market was in California. Cervero and Duncan (2004) investigated the impact of land-use and racial composition for residential land values in Santa Clara County. In research hedonic price models were used, which specify factors that, consistent with traditional real estate and location theory, influence residential land values. Separate hedonic price models were estimated for single-family and multi-family housing (including rental apartments and for-sale condominiums) using data on residential sales transactions that took place during the first half of 1999.There were 7098 data gathered for conducting the analysis— representing 5364 single-family and 1734 multi-family housing sales transactions. The findings showed that neighbourhood land-use diversity was positively associated with residential land values. The land-use diversity increased the value of single-family parcels in Santa Clara County, particularly wanted was land-use mix. On the other hand, racial diversity had a negative impact on land value (the plot in a maximally racially diverse neighbourhood could be expected to sell for $5.14 less per square foot than one in a purely homogeneous one). The analysis also revealed that good access to jobs translated into higher land values for multi-family parcels. This held for both the highway and transit network. The new housing construction are situated along the county's three rail systems.

In the UK market, residential location choice behaviour was studied in the case study in Oxford (Kim, Pagliara and Preston (2005)). It investigates the impacts of the current dwelling, household characteristics and alternative properties on the probability of moving. It also highlights the trade-off between access, space and other attributes in residential location choice. A nested logit model was applied to estimate the indirect random utility functions of the intention to move and residential location choice based on gathered data. The estimation results show the trade-off process between house price, transport and neighbourhood amenities in that individuals prefer a residential location with a combination of shorter commuting time, lower transport costs, lower density, higher quality of school and lower price. The results also indicate that both accessibility and neighbourhood amenities are significant in housing location choice behaviour. In order to test the impact of transport on residential location choice, the monetary units of transport related variables with regard to the house price were calculated based on the ratios of the estimated coefficients in the residential location choice model. The value of time was calculated as the ratio of the travel time coefficient to the travel cost coefficient has the estimated value of travel time is 7.05 pence per minute (or £4.23 per hour). The findings showed that 1 minute of travel time to work is estimated as £7449 with regard to house price (3 per cent of the average house price) and that £1 of travel cost to work is equivalent to £105 623 in terms of house price (49 per cent of the average price). According to the travel cost to supermarket one pound was estimated as equivalent to £38 884 with regard to house price (18 per cent of the average price). These findings were coherent with steep housing price gradient appears to be common over the whole of Oxfordshire, where for example the average price of a semi-detached house in North Oxford is £292 953 while that in Kidlington, which is located only 5 miles to the north (but crucially outside the Oxford Ring Road), is only £145 666 (www. proviser.com; data refer to July–September 2002). This kind of steep housing price gradient appeared to be common over the whole of Oxfordshire.

There has been a lot of research, which studied spatial patterns in metropolitan area in developing countries. Lewis (2007) and Han (2001) studied the Jakarta metropolitan area.

Lewis (2007) used the basic urban land price model to explain appraised unit prices of land in Jakarta in 1997 as a function of distance from the central business district, road class, environmental conditions and land tenure. He proved that the value of land decreases by 5,4 percent by 1 km distance from central business district. The coefficient of different variables such as road class and land title for land price was positive and also statistically significant; The price increases by 18.1 per cent given a one unit change in the category of road on which the property sits and by 26.9 percent with land title change. The results indicated that environmental conditions do not significantly affect the appraised unit price of land. Lewis also compared impacts of the market prices and evaluated prices for land prices. The analysis revealed that the use of market prices instead of appraised prices did not have much effect on the estimated land value gradient. For market prices the correlation between the prices and distance from the central business district was also negative on a similar level to appraised price (5,0 percent versus 5,4 percent). On the other hand, the employment of market prices had significant impact on the estimated influence of other determinants of land value. Afterwards, Lewis compared Basic models and non-linear price model. It revealed that in the Jakarta model, the land value is not proportional to plot size.

Han (2001) identified that the distance from the central business district is the most important factor impacting on land prices, but it declines over time. The other factors impacting on land prices were distance to commercial establishments, distance to the nearest highway entrance and shopping mall, flood risk and commercial land-use zoning. Among them the most important was the flood risk. There were three hypothesis of this study: land parcels in central regions of Jakarta had higher value than that in non-central regions, there were no difference in average land value between various non –central regions and that land value was a function of physical factors. There were these following findings: land values were not distributed evenly in the non-central regions, they were more expensive in west and south Jakarta than in north and east Jakarta. By using stepwise regression analysis, it was shown that the main physical factors shaping land values in Jakarta were distance and flood risk.

Han (2002) explored the dynamics of the spatial distribution of residential property values in Singapore. The study also analysed the impact of government planning on land prices. The study revealed that higher values were concentrated in prime housing area land and were lower in the non-prime area. The spatial distribution did not support either the polycentric or the monocentric model, neither did it support the connection between the distance of the property to the central area and its market value. The last findings were the large impact of government on land prices, especially through "the sales of site" program, development charge and land use zoning.

Hui (2004) analyzed the relations between land supply, development conditions, and the property market in Hong Kong metropolis. Two models were developed: one was an aggregate market model (housing price and land supply) and the other was the housing supply function (lease conditions and housing supply).

Tokyo Metropolitan Area was investigated by Sorensen (1999). He examined the role of one of the most important urban planning methods in Japan, the land readjustment (LR) projects for suburban planning and land development. The study examined the patterns of development and infrastructure provision in the Tokyo Metropolitan Area during the period from 1968 to 1992, with particular attention paid to comparison between the location and rate of building activity in LR and non-LR areas. The analysis was based on a GIS mapping of patterns of land-use change and building activity in the three case-study areas.

Yamazaki (2000) investigated real option pricing models using Land Price Index in Japan. The purpose of this research was to verify that the option-based investment models can better explain the pricing of land markets in Japan than neo-classical models. Land prices are determined by both macro economic environment and micro, lot-specific attributes. The model in the research analyzed micro land prices in central Tokyo, which are provided by the individual lot data of the Land Price Index, which provided prices for each address listed, accompanied by other lot-specific ``amenity variables.'' These amenity variables are classified according to two characteristics: lot characteristics such as lot size, the situation of streets attached to the lot, zoning, and floor area ratio; and location characteristics such as its ward and its distance from the closest train station. Afterwards, the hedonic models including the amenity variables were estimated, Next, economic variables, such as government bond yield, rent yield rate, stock price index for the real estate industry, covariance of daily changes of TPREAL and the comprehensive stock price index, and construction costs, were added for the model based on the real option theory. Then, the cross-sectional amenity variables, the cross-sectional uncertainty variable, and the economic time-series variables were arithmetically combined.

There haven't been any studies on the connection between the distance from central Warsaw and residential land prices. Also the spatial patterns in the Warsaw Metropolitan Area haven't been studied. Lisowski, Wilk (2002) have done some research about the spatial distribution of services in Warsaw. According to this study, development of the Warsaw Metropolitan Area was significantly different from the sequence of phases proposed by the standard urbanization model. Whereas most western countries in the 1970s were in the phase of decentralization of population, Warsaw was in a phase of centralization. The decentralization of Warsaw started in 1980s and has been lasted until now. There has been an outflow of inhabitants from the city centre to suburban areas.

Chapter 3 - Main characteristic of the Warsaw Metropolitan Area

In this chapter the brief characteristic of Warsaw Metropolitan Area will be made. Firstly, the area of Warsaw Metropolitan Area is described. Secondly, the main indices, like area, population, population density, birth-rate and unemployment rate, yearly income and expenses per one inhabitant of municipalities are presented. Thirdly, the directions of potential development of Warsaw Metropolitan Area is presented according to Study of the Mazovian Office of Regional Development based on planning directives of municipalities. Fourthly, the proportions of arable and built up area is displayed. Lastly, the past and current trends in the real estate market in Warsaw Metropolitan Area are described.

Main statistical data about Warsaw Metropolitan Area

According to the Mazovian Office of Regional Planning, the Warsaw Metropolitan Area consists of Warsaw and neighbouring municipalities, influenced by the capital city. The plan of the Metropolitan Area was determined by the Mazovian Office of Regional Planning in Warsaw taking into consideration the administrative division (it was made on an assumption that the delimitation process is based on the community unit boundaries). It was analysed from the perspective of elements such as: functional, socio-economical and spatial connection and problems, as well as instrument needs and plans.

The Warsaw Metropolitan Area consists of districts: Grodziski, Legionowski, Piaseczyński, Pruszkowski, Warszawski zachodni, Żyrardowski and some chosen parts of districts: Grójecki, Miński, Nowodworski, Otwocki, Sochaczewski, Wołomiński and Wyszkowski. To sum up, it is made up of thirteen districts and seventy two municipalities with 2,943,600 population.

The area of the Warsaw Metropolitan Area is showed on the map below:

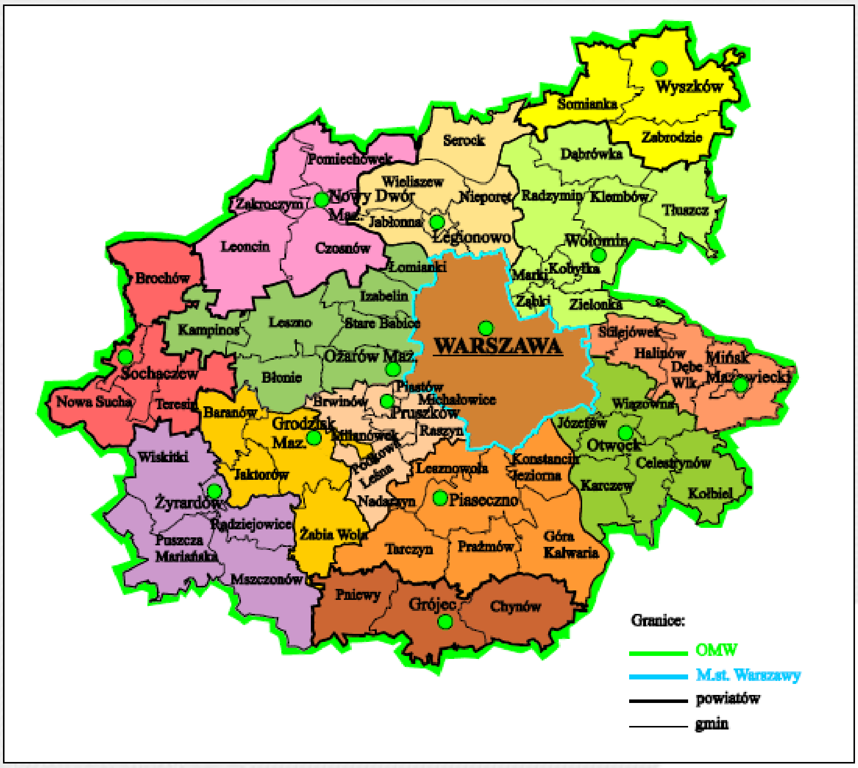

Figure 3. Map of Warsaw Metropolitan Area. source: Warsaw Metropolitan Area September 2008

The Warsaw Metropolitan Area covers 6205 square km area, what is 17 % of Mazovian voivodeship. The area of municipalities varies from 6 sqm kilometres to164 sqm kilometres, with an average of 80 square km. The smallest municipalities are Piastów, Podkowa Leśna and Ząbki. On the other hand, the municipality with the largest area are Wyszków, Leoncin, Mszczonów and Wiskitki. In comparison, the area of Warsaw is 517 sqm kilometres.

The population of Warsaw Metropolitan Area is 2,943,600 people, whereas the population of Warsaw is 1,702,100 people. The average population of municipality is 17,485. The largest municipalities are simultaneously the district centre (Piaseczno, Pruszków, Legionowo, Wołomin and Otwock), the smallest are Podkowa Leśna, Kampinos and Brochów). The density of population per 1 sq km in Warsaw Metropolitan Area is 474 people per 1 sq km, whereas in Warsaw city it is 3,291 people per 1 sq km. The municipality with the highest density population is Piastów with 4,032 people per 1 sq km which is at the same time the smallest. The one with the lowest density is Leoncin with 32 people per 1 sq km. In two municipalities: Piastów and Legionowo the population density is higher than in Warsaw.

The birth-rate in Warsaw Metropolitan Area is positive: 0,21 per 1000 people, whereas in Warsaw negative with -0,57 per 1000 people. The municipality with the highest birth-rate are Jabłonna with 8,07 per 1000 people, Ząbki with 7,95 and Marki 7,17. These municipalities are built up with buildings with inexpensive apartments in which young couples live. On the other hand, the municipalities with the lowest birth –rate are Kampinos with -5,4 per 1000 sqm, Wiskitki with -4,5, and Czosnów with -3,3.

The unemployment rate in Warsaw Metropolitan Area is 5,4 percent , with comparison to Warsaw, where the unemployment rate is 4,4 percent. The highest unemployment rate are in Zabrodzie with 11,8 percent , Wyszków with 11,4 percent, Somianka with 10,9 percent (all from Wyszkowski district) and Radzymin with 11,5 percent from Wołomiński district. The lowest unemployment rates are in Stare Babice with 3,3 percent, Podkowa Leśna with 3,4 percent and Baranów with 3,5 percent.

The average income of municipalities per inhabitant is in Warsaw Metropolitan Area is 3,912 PLN, in comparison with Warsaw where it is 5042 PLN per inhabitant per year. The highest income per 1 inhabitant is in Lesznowola municipality with 7,220 PLN. On the other hand, the municipalities with the lowest income per inhabitants: Dębe Wielkie with 1,650 PLN, Pomiechówek with 1,651 PLN and Wyszków with 1,675 PLN. The similar situation is in expenditure per inhabitants. The highest is in Lesznowola (4,925 PLN) and lowest in Karczew (1,520), Kobyłka (1,575). Average expenditure of municipalities in Warsaw Metropolitan Area is 3,737 PLN, whereas in Warsaw, it is 4,755 PLN.

The directions of potential development

On the picture below the directions of potential development of Warsaw Metropolitan Area based on the Study of the Mazovian Office of Regional Development based on planning directives of municipalities. The area intended for housing and services (shaded in brown) are situated mainly in neighbourhoods close to Warsaw and along main roads. The areas intended for agricultural and forestry, marked in beige, occupy more than half of area of Warsaw Metropolitan Area.

The large part of it also a protected area (marked in green). In 1997 the Mazovian voivode created The Warsaw Area of Protected Landscape, the aim of which was to protect the most precious natural area. It occupies 148 409,1 ha, mostly in areas of the valleys of the Vistula and Odra river and near-by forest area. The forest grounds belonging to the Warsaw Area of Protected Landscape are the Chotomowskie Forest, the Legionowskie Forest and smaller forest area near Zegrze and Nieporęt (in Legionowski district), the Otwockie Forest, Mazovian Landscape Park and the Celestynowskie Forest (in Otwocki district), the Chojnowski Landscape Park and the Chojnowskie Forest (in Piaseczyński district), the Sękocińskie Forest, the Nadarzyńskie Forest, the Młochowskie Forest (in Pruszkowski district). The largest of the protected area is Kampinoski National Park, occupies 38 476 ha at the north-western part direction from Warsaw. It lies in three districts: Warszawski-zachodni, Nowodworski and Sochaczewski and in eight municipalities.

The Warsaw Area of Protected Landscape creates an ecological protection system for the Warsaw agglomeration, keeping a balance between built-up and green areas. It creates an appropriate climate and health conditions for the inhabitants of Warsaw; it also creates popular places for leisure and recreation.

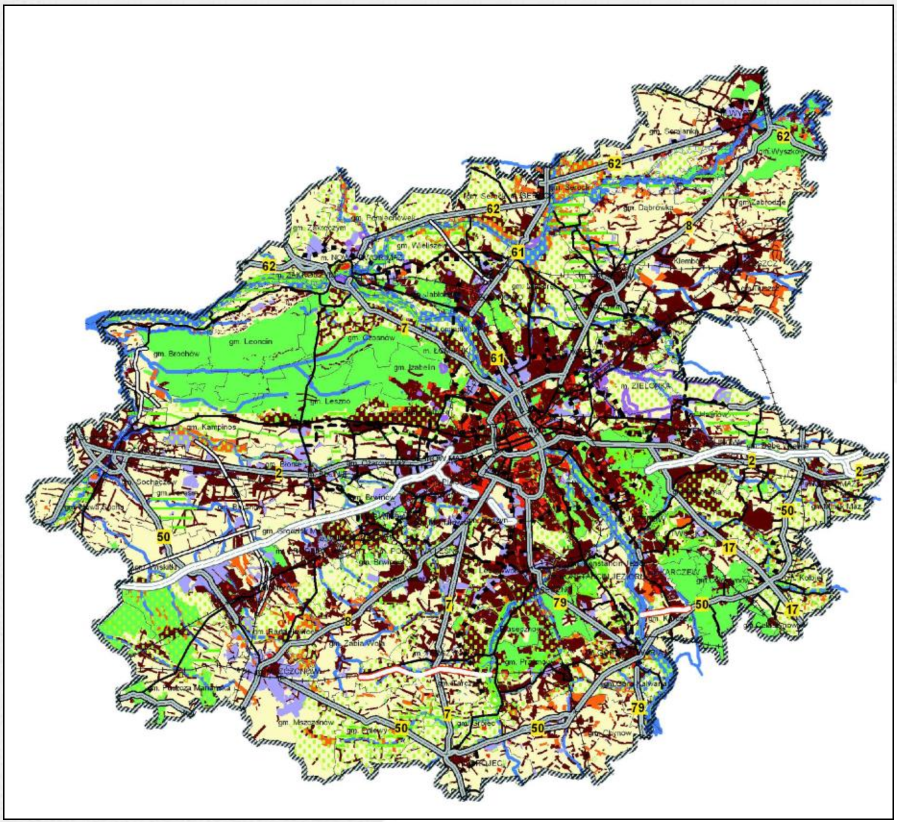

Figure 4. Map of direction of future development of Warsaw Metropolitan Area.
source: Study of Mazovian Office of Regional Development based on planning directives of municipalities.

The proportions of arable and built up areas

On the picture below the proportion of arable and built up areas in each municipalities are shown. In the left picture, the proportion of arable land is displayed. The municipality shaded with darker colours are characterized with the higher share of arable land (above 75 %). In that group there are cluster of municipalities on the west side of Warsaw (Błonie, Ożarów Mazowiecki, Baranów, Jaktorów, Teresin, Sochaczew, Nowa Sucha, Mszczonów), on the south (Grójec, Chynów and Tarczyn) and one on the north (Somianka). The districts with the highest share of arable land are Sochaczewski, Grodziski and Grójecki district. On the other hand, the lowest percent of arable land (below 25 %) are in municipalities: Izabelin, Legionowo, Piastów and Podkowa Leśna on the left part of Vistula river, and on right a range of municipalities on east part of Warsaw: Marki, Ząbki and Zielonka in wołomiński district, Mińsk Mazowiecki and Józefów and Otwock in Otwocki district.

In most municipalities the proportion of built up arable land are poopsite to each other. There are some exceptions: the municipality with high proportion of built up land, but not the lowest with arable land are Nowy Dwór Mazowiecki, Sochaczew, Żyrardów, Pruszków, which all are districts centres. Another interesting feature is that the majority of municipalities (45) have not more than 10 % of built up area.

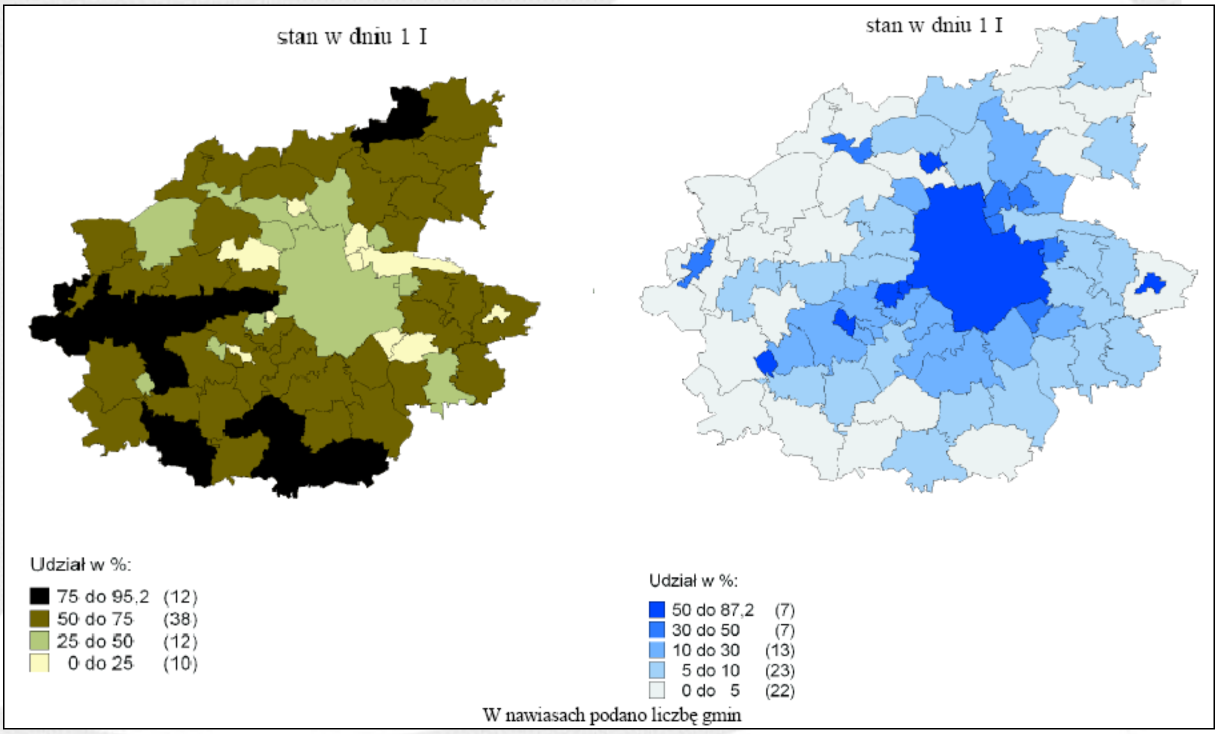

Figure 5. The participation of arable land (on the left) and built-up land (on the right) in Warsaw Metropolitan Area.
source: Study of Mazovian Office of Regional Development .

Real estate market in Warsaw Metropolitan Area – the past and present trends

The Warsaw metropolitan area development was significantly disturbed by destruction during the Second World War. In the postwar period in 1950s, there was extension of the administrative boundaries of the city (from 135 sq. km to 425 sq. km). In following years the administrative controls on immigration from other parts of Poland were introduced (1954–1983). All of these facts influenced the spatial patterns of Warsaw and its surroundings. The evolution of the city displayed significant differences from the sequence of phases proposed by the standard urbanization model.

In the 1970s, while most Western European cities were experiencing relative decentralization of population, Warsaw was in a phase of relative centralization. The population of Warsaw has been decreasing since 1987. During the 1990s, the city lost more than 2 percent of its population, while that of the suburbanzone increased by more than 3 percent.

The political and economic transformations of the 1990s brought along changes in land-use structure in Warsaw Between 1989 and 1995, the industrial area in the city was reduced by more than 20 percent. In contrast, the dynamism of the service sector resulted in an increase in retail and office space, especially in the second half of the 1990s (Jałowiecki, 2000).

Typically, in the city centre, land prices are higher, which is the consequence of unregulated ownership and the limited amount of land available for sale and rent. As a result of these pressures, areas outside the centre became more attractive locations for building activity. The other reasons for this, were increasing car ownership and the spatial extension of technical infrastructure (energy, water and sewage networks). Most suburban areas have become available for the construction of dwelling units, offices and shops. As a result, there was a growing perception of the 'peripheral development' of Warsaw, and of the 'island-like development' of the centre in the second half of the 1990s (Korcelli, 1997: 9–10). The most attractive locations near the centre were extensively used areas, with clearly defined legal status and local authorities with positive attitudes to investors in strongly decentralized town-management systems.

The Vistula constituted an important barrier, limiting the scale of population movements. Population migrations within the limits of the town mostly take place within its eastern or western parts (Potrykowska and Sleszynski, 1999).

In recent years, Warsaw was expanding in all directions, but some are more popular than others. Historically, the people settled along the railway. On the left side of Warsaw, there are WKD (Warsaw Suburban Rail), which joins Warsaw with Grodzisk Mazowiecki. It is thirty six kilometers long with 24 stops. It was settled in the beginning of the XX century. In 2008, the WKD transported more than 7 millions of passengers; it around 26 thousand per day. It served the inhabitants of six municipalities: Michałowice, Pruszków, Brwinów, Podkowa Leśna, Grodzisk Mazowiecki and Milanówek and 3 district of Warsaw : Śródmieście, Ochota and Włochy.

On the right part of Warsaw, there is the so called "Otwocka Line", which runs across south part of Warsaw and municipalities: Józefów, Otwock and Karczew.

The newest concept of the Warsaw rail system is Szybka Kolej Miejska SKM (Fast City Rail), which is supposed to join the center of Warsaw with suburbs from Pruszków on the west side of Warsaw to Sulejówek on the east. There are plans to expand of SKM, with the opening of new lines to Otwock, Grodzisk

Mazowiecki, Legionowo, Piaseczno, Błonie, Wołomin, Mińsk Mazowieckieg, Okecie Airport and planned new built Modlin Airport.

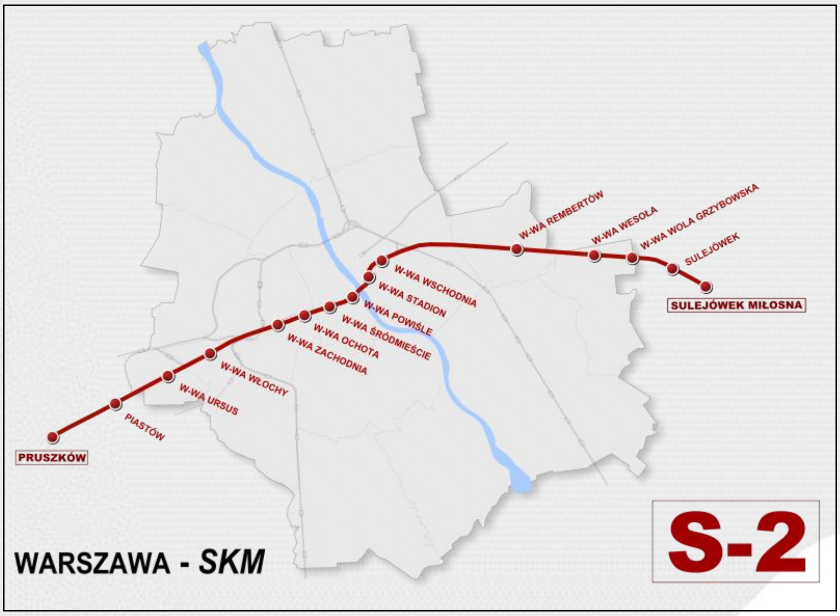

Figure 6. The Map of SKM.

With the increase in car ownership, areas also without good transport connections to Warsaw became more popular. The Warsaw agglomeration was expanding in every direction along the following main roads:

- In the north direction on the left side of Vistula river, along the national road number 7 to Gdańsk, there is the highly urbanized areas of the Łomianki municipality.
- On the right side of the river, road number 61 to Augustów leading to Legionowo and Nowy Dwór Mazowiecki district.
- In the north-eastern direction, along the road number 18 to Białystok, are rapidly developing in recent years Wołomiński district, with higly populated Marki and Ząbki municipalities.
- In east direction, road number 30 to Siedlce leads to Mińsk Mazowiecki district.

- In south direction, on the right part of river, road number 17 to Lublin runs across Otwock and Józefów municipalities.
- On the left side of Warsaw the south part of city suburbs are very much developed, along the road no 724 to Góra Kalwaria, road no 722 to Prażmów, road no 722 to Prażmów there are Piaseczno, Konstanicin-Jeziorna and Góra Kalwaria municipalities.
- In the north-west direction there are national roads: number 8 to Kraków and number 7 to Katowice there are less developed area of municipalities Nadarzyn, Żabia Wola and Tarczyn.
- In the west direction, the road number 2 tom Poznań leads to Błonie and Sochaczew municipalities.

The main problem of all metropolises is heavy traffic. The Warsaw Metropolitan Area traffic system is also insufficient for present number of cars. Moreover, Warsaw does not have a ring road, and the transit traffic comes through the centre of Warsaw. The another big problem is an inadequate number of bridges over the Vistula river. At the moment in Warsaw there are seven crossing over the river, which is much fewer than are needed. There are plans to build three more bridges by 2020. The building of Most Północny (The North Bridge) has already started and should be a relief for inhabitants of the northern part of Warsaw.

The another factor influencing land prices around Warsaw is the existence of green areas. The largest area of forest is Kampinoski National Park on west boarder of Warsaw. On the borders of Kampinoski Park there are popular and expensive municipalities: Izabelin, Łomianki and Stare Babice. In these regions plots have larger areas (above 2000 sqm meters) and have low built up density. The other large forest area are on the south part of Warsaw – the Kabacki Park and Chojnicki Landscape Park. In these areas there are also popular Lesznowola, Piaseczno and Konstancin-Jeziorna municipality. On the east part of Warsaw, there the Celestynowskie Forrest, with nearby Józefów, Otwock and Celestynów municipalities and Legionowskie Forrest with nearby Legionowo, Jabłonna and Nieporęt municipalities.

In the Warsaw Metropolitan Area there are also a few towns which historically used to be known as more prestigious and expensive. Among them, is Konstancin-Jeziorna, which is a health-resort and a place of residence for the richest Poles. Another popular location is Józefów, which is also a health-resort and Podkowa Leśna, a so called "garden-town". In all of these locations, prices of land are high, which only small proportion of people can afford, and they are therefore seen as exclusive.

The last, but not least factor, is planning policy of municipalities. In the Polish system, there are two main planning instruments: the master plan, which defines the directions of municipality development and decision of land management. The decision of land management is given for a specific plot to a specific investor. The master plan takes into consideration larger areas of municipalities, it is an act of local law. The municipalities are not obligated to pass masters plans, but the municipalities with the larger areas of existing masters plans are undergoing faster development. In these cases, the investor could ask for building permission straight away, whereas, in cases without a master plan, the investor firstly has to be given a decision of land management before applying for a building permission.

Chapter 4 - Research design and method of analysis

The aim of this chapter is to present research design and method of analysis. In the first part the procedure of data gathering will be explained; afterwards the research sample and chosen methods of analysing the results will be described.

The purpose of this study is to investigate and analyse the spatial patterns of the residential land price in the Warsaw metropolitan area.

The specific objectives of the study are:

1) To analyse spatial patterns of residential land values around the metropolis, investigate the distribution, maximum, minimum and median of sales,

2) To find out the scale of influence of the metropolis on the surrounding area,

3) To investigate if land prices decrease with distance from city centre and the intensity of this correlation,

4) To identify directions of changes in the Warsaw Metropolitan Area and predict some future scenarios of development,

5) To compare residential land prices on each side of the Vistula river. The Vistula river, which is effectively spatial barrier, because of insufficient number of bridges connecting two sides. It divides the city into western and eastern zones, with higher land prices on the left side

6) To investigate in which districts and municipalities the land prices are highest and in which they are the lowest and for what reason. Why are some locations more popular than other ?

Data collection

This stage was be based on secondary data collection. In order to investigate if the land prices in the Warsaw metropolitan area decrease with distance from the centre, the data from municipalities around, were collected. The Warsaw

Metropolitan Area consists of districts: Grodziski, Legionowski, Piaseczyński, Pruszkowski, Warszawski zachodni, Żyrardowski and some chosen parts of districts: Grójecki, Miński, Nowodworski, Otwocki, Sochaczewski, Wołomiński and Wyszkowski. To sum up, it is made up of 72 municipalities.

In the Polish legal system, every transaction of sale, donation or exchange of real estate has to be signed in form of deed in presence of a notary. The transactions completed under different circumstances are invalid. According to Article 23 of the Act of Geodesy and Cartography from 17 May 1989, every notary has an obligation to send a copy of every deed signed in his office to an appropriate administrative subdivision within thirty days of signing this deed. The main purpose of this is to enter changes in record of land and buildings. These records for each municipalities are led by the Geodesy Department in every district. According to Polish law, these departments have an obligation to provide access to these data to appraisers for valuation purpose. There are various ways of leading these record in every district; in some there are databases where every transaction is entered, in others the data from deeds are not entered in any system and to get needed information, appraiser need to look through every single document. The main problem in this system is that there is not any central database, where all data is gathered, every districts has its unique procedure of data collecting and access providing.

The data was collected from the Geodesy departments in Grodziski, Grójecki, Legionowski, Miński, Nowodworski, Otwocki, Piaseczyński, Pruszkowski, Sochaczewski, Warszawski zachodni, Wołomiński, Wyszkowski, Żyrardowski districts. Only four of the districts above provide a database with every transaction sold (Miński, Otwocki, Pruszkowski, Żyrardowski), the rest provide access to deeds only.

This data was from title deeds, particularly contracts of sale, the other types of changing real estate owner like donation or exchange were excluded.

The period of dates of sales was limited between beginning of 2008 and March of 2009. Any transactions before 2008 and after March 2009 were excluded.

From deeds gathered in districts, the contracts of sales of unbuilt plots were selected, the contracts of sales of built up plots and apartments were excluded. From the unbuilt plots, only residential land-use property were chosen, commercial land-use and rural land-use were excluded. Another factor, on which attention was paid was the exclusion of transactions in which some extraordinary circumstances happened, for example, transactions between related parties such as family or related companies. In that kind of transactions, the price couldn't be treated as market price.

The collected dataset contains a date of transaction, the property price, the plot area and address (town or village, municipality and district).

The collected sample consist of 3283 items.

After collecting data there were labelled according various variables. The variables were as follows: district, municipality, area of plot, global price, price per 1 sqm, distance from Warsaw in kilometres, distance from centre of district in kilometres, presence of railway station, side of Vistula river.

Land area is the size of the parcel in square metres. Distance of the property to the centre of Warsaw and to the central district is measured to the nearest kilometre. Railway station is proxied by a simple nominal variable denoting its existence (or not).

The district, municipality, global price and area of a plot variable were taken from contract of sales. Afterward, for every transaction distance in kilometres from the centre of Warsaw and district centre were measured. Every transaction was also categorized depending on which side of the Vistula river it was situated on and if there was railway station into the city. To make the analysis clearer some variables were categorized into ranges. The area of plot variable was divided into groups: under 1000 sqm, 1000-2000 sqm and so on. The price per sqm was divided into groups: under 100 PLN/sqm, 100-200 sqm/PLN and so on. The distance from centre of Warsaw and district was divided into groups every 10 km.

The gathered data created following research sample: 3283 transaction of sale from thirteen districts, 72 municipalities and few hundred towns and villages. The range of global prices were very large from 12 000 PLN and 2,8 mln, similar the range of prices per 1 sqm from 8 PLN/sqm to 985 PLN/sqm. Also the plots area varied from 200 sqm and 19000 sqm.

Methods of analysis

The data was analyzed using SPSS software. First of all, the general characteristics of the sample was prepared with the use of the descriptive statistic method. The following variables: district, municipality, side of Vistula river and railway station were analyzed according frequency distribution. The findings were presented in tables and charts. The other variables, like area of a plot, price per 1 sqm, distance from the centre of Warsaw were distributed into categories and also distribution of frequency was done.

The next step was to analyse the variables: area of plot, price, price per 1 sqm; distances from Warsaw were measured according to central tendency. The maximum, minimum, mean and standard deviation of each variable were calculated. Afterwards, the One-Sample Kolmogorov-Smirnov Test was used to test if variables were normal distributed, what determinate if the parametric or non-parametric test could be used.

Then, research was made as to how the price per 1 sqm variable varies according to other variables: district, municipality, side of Vistula river, railway station, plot area and distance to centre of Warsaw and a centre of a district. Again, the mean, maximum and minimum were calculated and the means of different categories were compared. For example, in municipality variable the municipality with the highest and the lowest mean and the potential causes of these difference were fund .

The next step of analysis was to check correlation and regression between price per 1 sqm variable and other variables: distance from Warsaw, distance from the centre of district, railway station and a plot area. It was done with use of Pearson Correlation test.

Biases of the study

The chosen methodology may have been affected by a number of biases. Specification bias may have arisen due to omitted variables, such as those related to characteristic of the property itself such as arrangement of a plot or infrastructure or neighbourhood . Another important issue is that the chosen period, property prices were changing rapidly what was caused by credit crunch. The number of transactions on the market were reduced and the prices decreased by 5-15 percent according to location.

Chapter 5 - Analysis of results

The scope of this chapter is to present result of data collecting. Firstly, the frequency distribution is presented. Secondly, the central tendency and dispersion were measured. Data were also tested for normality with use of One-Sample Kolmogorov-Smirnov Test. To test hypothesis that the price of residential land decreases with distance from the centre of Warsaw the correlation tests were used.

Frequency distribution

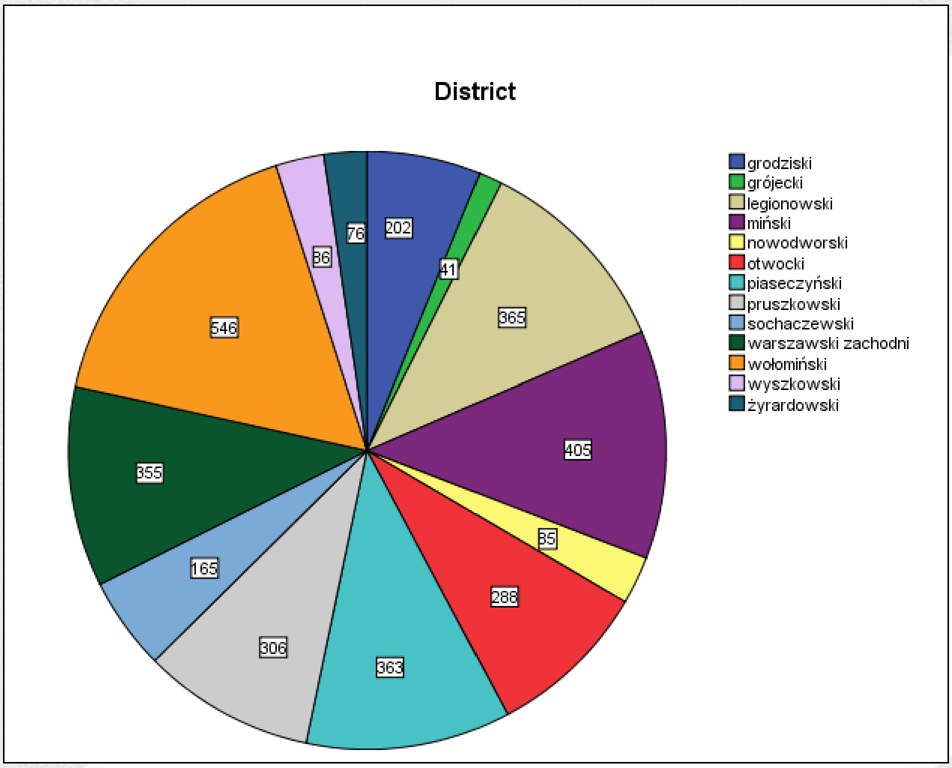

Figure 7.Proportions of transactions in different districts in Warsaw Metropolitan Area.

The above chart shows the proportions of sales of unbuilt plots in thirteen districts in Warsaw Metropolitan Area. The district with the largest number of transactions is wołomiński district with 546 transactions (16,6 %), the second is miński district with 405 transactions (12,3 %), then legionowski (365 – 11,1 %), piaseczyński

(363 – 11,1 %) and warszawski zachodni (355- 10,8 %). On the other hand, the smallest number of transactions was observed in grójecki with 41 transactions (1,2 %), żyrardowski with 76 transations (2,3 %), nowodworski and wyszkowski (both 2,6 %). It is interesting, that five districts with larger value of transactions represent more than 60 % of sample, when four districts with smallest number of transactions make up less than 10 % of sample.

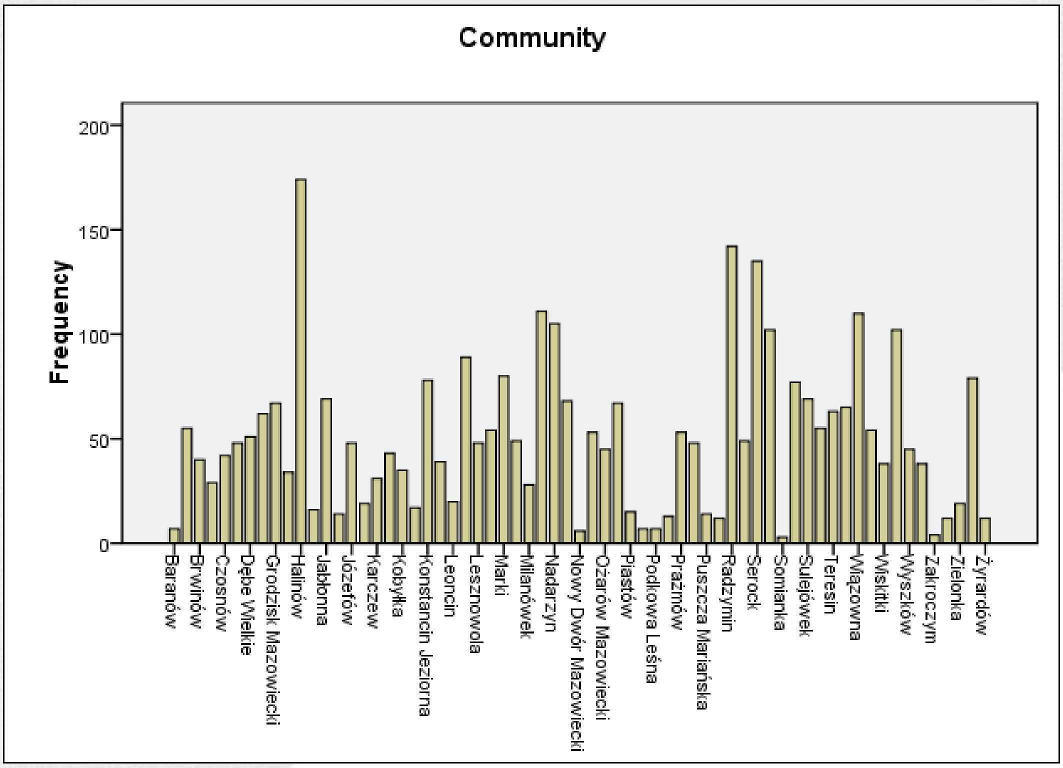

Figure 8. Proportions of transactions in different communities in Warsaw Metropolitan Area.

Taking into consideration a smaller administrative subdivision such as municipality, the one with the largest number of transaction is Halinów from the Miński district with 174 transactions (5,3 %), the one with smallest Somianka from Wyszkowski district with 3 transactions. These results are consistant with results above, where the Miński district is one of the largest and the Wyszkowski district is one of the smallest.

Side of Vistula river

	Frequency	Percent
Left	1574	47,9
Right	1709	52,1
Total	3283	100,0

Table 1. Proportions of transactions in both sides of Vistula river.

The above table shows the division of transaction among two sides of Vistula river. Both groups are more or less equal with a small dominance of right side of the river.

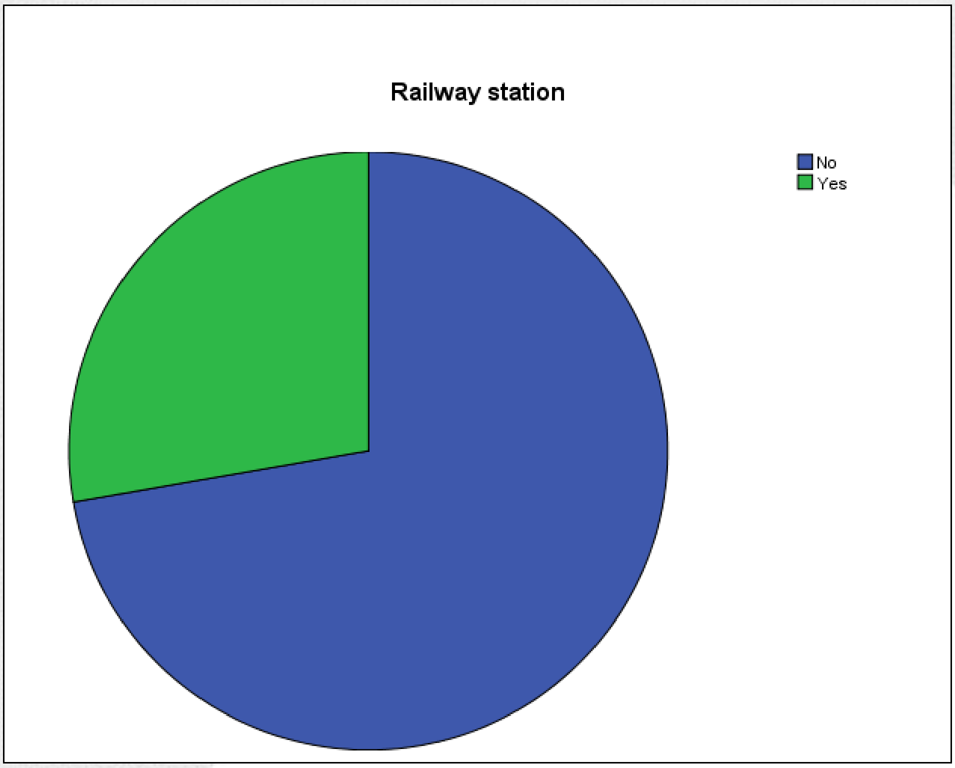

Figure 9. Proportions of transactions in city with railway station.

As shown above, most of the transactions were in villages or town without railway stations (above 70 %).

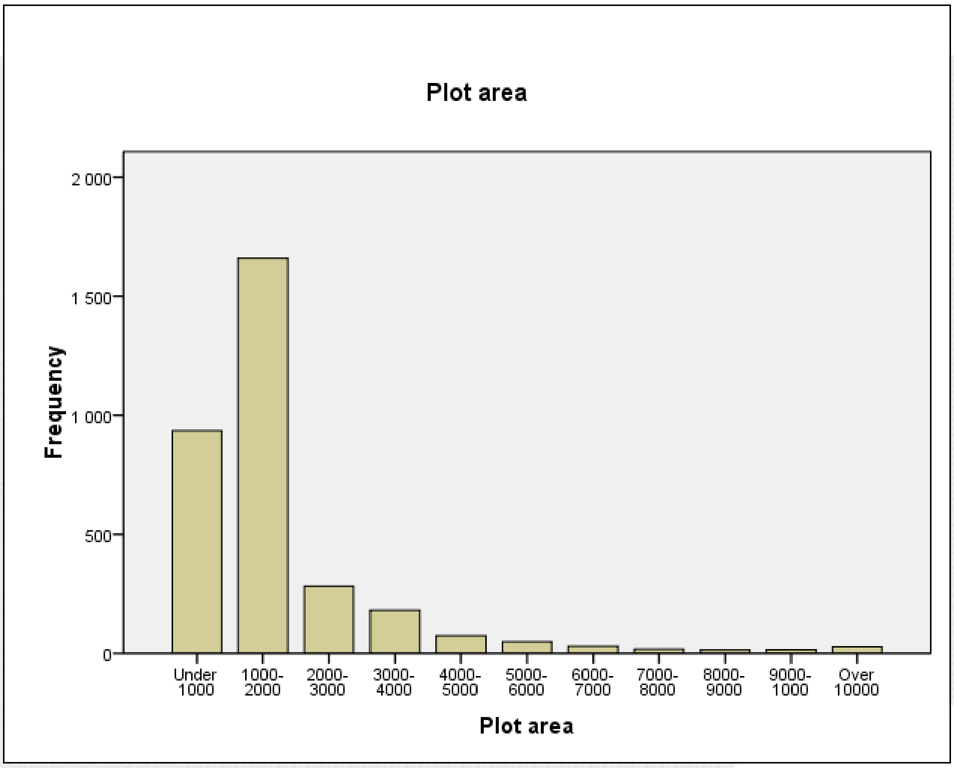

Figure 10. Proportions of transactions according to plot area

According to plot area, the majority of transactions had an area between 1000 and 2000 sqm (more than 50 %), the second most popular were plot of areas under 1000 sqm (nearly 30%). The transactions of plots larger than 2000 sqm were far less popular and in total make up less than 20 % of sample.

	Frequency	Percent
Under 100	1007	30,7
100-200	1045	31,8
200-300	579	17,6
300-400	281	8,6
400-500	159	4,8
500-600	112	3,4
600-700	55	1,7
700-800	26	0,8
800-900	13	0,4
900-1000	6	0,2

	Frequency	Percent
Under 100	1007	30,7
100-200	1045	31,8
200-300	579	17,6
300-400	281	8,6
400-500	159	4,8
500-600	112	3,4
600-700	55	1,7
700-800	26	0,8
800-900	13	0,4
900-1000	6	0,2
Total	3283	100,0

Table 2. Proportions of transactions according to price per 1 sqm.

According to price per sqm, in the majority of transactions prices per sqm were between 100 and 200 PLN and under 100 PLN per sqm (together, these groups make up 60 % of a total sample).

These two findings show the general tendency is that potential buyers look for plots of small area (under 2000 sqm) and low prices per 1 sqm under 200 PLN.

	Frequency	Percent
Under 20	488	14,9
20-30	1193	36,3
30-40	932	28,4
40-50	443	13,5
50-60	198	6,0
60-70	29	0,9
Total	3283	100,0

Table 3. Distance to center of Warsaw in kilometers.

As can be shown, the majority of transactions are located in distance 20-30 km from the center of Warsaw (36 %) and 30-40 km (28 %). Only a few transactions are further than 60 km from the center.

Measurement of central tendency and dispersion

The next step of analyzes was the measurement of minimum, maximum, mean and standard deviation of variables.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Area of plot	3283	200	19000	1715,96	1699,265
Price	3283	12000	2888400	286239,18	301197,452
Price per 1 sqm	3283	8	985	198,52	157,812
Distance from Warsaw	3283	11	67	30,85	10,940
Valid N (listwise)	3283				

Table 4. Descriptive statistic.

One-Sample Kolmogorov-Smirnov Test

		Price per 1 sqm	Distance from Warsaw	Area of plot	Price
N		3283	3283	3283	3283
Normal Parameters[a]	Mean	198,52	30,85	1715,96	286239,18
	Std. Deviation	157,812	10,940	1699,265	301197,452
Most Extreme Differences	Absolute	,134	,104	,242	,186
	Positive	,134	,104	,242	,186
	Negative	-,120	-,053	-,207	-,185
Kolmogorov-Smirnov Z		7,700	5,966	13,880	10,643
Asymp. Sig. (2-tailed)		,000	,000	,000	,000

Table 5. One-Sample Kolmogorov-Smirnov Test

According to price of plot, the minimum is 12 000 PLN, maximum 2 888 400 PLN, mean 286 239,28 PLN and standard deviation 301 197,45. The sample is widely spread.

According to price per 1 sqm of plot the minimum is 8 PLN, maximum 985 PLN, mean 198,52 PLN and standard deviation 157,812.

According to distance from Warsaw the minimum is 11 km, maximum 16 km, mean and standard deviation 10,940.

The finding proves that sample are widely spread. None of variables are normally distributed. This led to choosing non-parametric test as a method to data analysis.

In further analysis, it was measured how price per 1 sqm vary according different variables.

District	Mean	Minimum	Maximum	Std. Deviation
żyrardowski	87,88	13	373	66,041
grójecki	116,51	18	370	84,982
grodziski	163,74	23	720	118,605
legionowski	201,12	20	875	123,405
miński	185,30	20	838	128,452
nowodworski	123,79	19	308	72,318
otwocki	199,98	13	753	143,396
piaseczyński	209,00	27	783	135,389
pruszkowski	303,19	40	985	176,890
sochaczewski	80,59	15	513	61,816
warszawski zachodni	289,38	23	950	208,787
wołomiński	186,72	8	853	164,276
wyszkowski	46,70	10	199	38,242
Total	198,52	8	985	157,812

Table 6. Price per 1 sqm according to district

As can be seen from the above table, the district with the highest mean occurred in Pruszkowski district, second was Warszawski-zachodni district, then Piaseczyński. The lowest mean was in Wyszkowski district, it was almost seven times smaller than highest mean. Three district of the highest mean were situated on left side of Vistula river, which led to the conclusion that the higher prices are seen on this side. These findings are also shown on the next table. The mean prices on left side is 30 PLN per sqm higher than on right side.

Side of Vistula river	Mean	Minimum	Maximum	Std. Deviation
Left	214,91	13	985	170,847
Right	183,43	8	875	143,173
Total	198,52	8	985	157,812

Table 7. Price per 1 sqm according to side of river.

Community	Mean	Minimum	Maximum	Std. Deviation
Łomianki	521,20	103	950	223,118
Żabia Wola	132,42	23	433	58,630
Żyrardów	159,36	60	373	88,928
Błonie	124,65	36	325	57,963
Baranów	66,67	27	114	26,435
Brwinów	244,13	46	575	137,716
Celestynów	127,62	40	225	43,359
Czosnów	167,43	51	308	61,204
Dąbrówka	59,01	18	161	32,884
Dębe Wielkie	80,62	20	160	41,398
Góra Kalwaria	129,01	27	463	70,493
Grójec	132,58	24	370	83,718
Grodzisk Mazowiecki	146,36	34	408	78,071
Halinów	189,86	32	643	89,239
Izabelin	559,67	171	867	205,353
Józefów	436,03	193	753	136,947
Jabłonna	242,80	40	875	119,285
Jaktorów	95,04	36	160	37,775
Kampinos	61,27	23	128	29,699
Karczew	117,55	35	252	65,398
Klembów	79,57	8	198	42,757
Kołbiel	45,36	13	129	26,098
Kobyłka	290,53	125	465	82,494
Konstancin Jeziorna	274,61	42	783	171,105
Legionowo	348,80	100	824	151,347
Leoncin	85,62	27	292	60,556

Leszno	185,31	53	486	77,323
Lesznowola	281,56	84	652	151,965
Marki	394,24	40	655	145,911
Mińsk Mazowiecki	126,72	24	440	105,411
Michałowice	432,72	150	985	182,725
Milanówek	267,99	58	720	165,320
Nadarzyn	182,49	40	380	70,617
Nieporęt	238,29	38	794	106,105
Nowy Dwór Mazowiecki	125,97	78	200	40,223
Ożarów Mazowiecki	288,42	61	801	133,167
Otwock	218,08	62	565	108,395
Piaseczno	251,09	29	700	133,989
Piastów	457,19	112	700	205,764
Pniewy	38,44	18	100	32,001
Podkowa Leśna	501,07	357	701	104,730
Pomiechówek	54,37	22	145	36,810
Prażmów	163,05	30	305	58,218
Pruszków	368,43	73	771	179,201
Puszcza Mariańska	64,68	15	108	35,240
Radziejowice	104,63	13	202	45,983
Radzymin	138,09	19	613	97,267
Raszyn	369,45	47	823	165,445
Serock	142,89	20	500	84,797
Sochaczew	81,20	20	513	66,464
Somianka	43,14	20	61	20,564
Stare Babice	365,43	70	899	188,331
Sulejówek	345,43	55	838	136,527
Tłuszcz	73,53	10	638	83,253
Tarczyn	135,81	39	294	47,375
Teresin	79,61	15	288	53,943
Wiązowna	154,47	18	340	69,637
Wieliszew	139,98	39	370	70,491
Wiskitki	68,56	16	264	55,586
Wołomin	157,67	20	641	110,647
Wyszków	53,70	10	199	48,810
Ząbki	458,08	150	853	218,354

Zabrodzie	38,69	12	80	19,425
Zakroczym	78,81	19	158	62,741
Zielonka	422,09	88	850	215,822
Total	198,52	8	985	157,812

Table 8. Price per 1 sqm according to municipality.

The interesting findings arise from above table. The municipalities with highest mean are Izabelin (559,67 PLN/sqm), Łomianki (521,20 PLN/sqm) and Podkowa Leśna (501,07 PLN/sqm), all of them are located close to forest areas (Izabelin and Łomianki next to Kampinoski National Park) and Podkowa Leśna creating "garden city". The municipality with the lowest mean are Zabrodzie (38,69 PLN/sqm), Somianka (43,14 PLN/sqm), Pniewy (38,44 PLN/sqm).

Plot area	Mean	Minimum	Maximum	Std. Deviation
Under 1000	258,22	19	985	191,319
1000-2000	188,42	14	875	135,747
2000-3000	171,03	13	850	147,423
3000-4000	137,57	10	700	127,977
4000-5000	115,77	8	500	103,942
5000-6000	117,35	14	500	97,704
6000-7000	88,84	20	276	73,152
7000-8000	125,97	41	239	67,168
8000-9000	84,37	13	185	46,993
9000-1000	92,84	15	217	68,491
Over 10000	110,84	20	261	77,673
Total	198,52	8	985	157,812

Table 9. Price per 1 sqm according to area of plot

The analysis of the findings shown above generally confirmed that prices per 1 sqm decrease with area of a plot. It is caused by fact, that smaller plots are more available for potential buyers and create a lower global price, therefore the higher price per 1 sqm is more acceptable.

Railway station	Mean	Minimum	Maximum	Std. Deviation
No	178,09	8	950	147,622
Yes	251,70	15	985	170,653
Total	198,52	8	985	157,812

Table 10. Price per 1 sqm according to railway station.

The above table shows that the mean price of plots located in city with a railway station is 70 PLN higher than in those without it.

Distance to centre of Warsaw	Mean	Minimum	Maximum	Std. Deviation
Under 20	400,04	28	985	189,478
20-30	230,96	18	875	136,006
30-40	131,05	15	575	72,205
40-50	97,63	8	638	81,747
50-60	71,90	15	513	58,398
60-70	46,77	10	199	44,717
Total	198,52	8	985	157,812

Table 11. Price per 1 sqm according to distance from centre of Warsaw.

Distance to Centre of district	Mean	Minimum	Maximum	Std. Deviation
Under 10	221,17	10	985	167,523
10-20	175,48	8	867	136,280
20-30	211,53	13	950	180,807
30-40	67,71	32	136	30,568
40-50	34,83	30	40	7,316
Total	198,52	8	985	157,812

Table 12. Price per 1 sqm according to distance from centre of a district.

The initial analysis of mean price per 1 sqm shows, it decrease with the increasing distance to Warsaw. Also, according to distance to centre of a district, the mean price decreases.

Correlation

The next step of analysis is to check correlation and regression between price per 1 sqm variable and other variables.

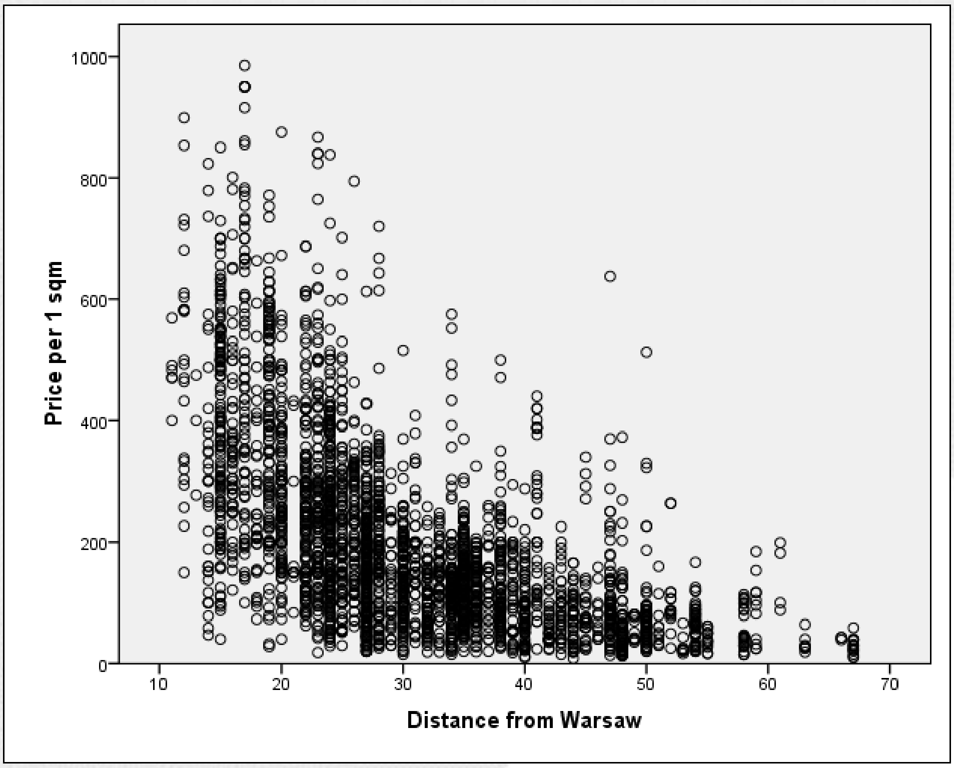

Figure 11. Association between distance from Warsaw and price per 1 sqm

		Price per 1 sqm	Distance from Warsaw
Price per 1 sqm	Pearson Correlation	1,000	-,592**
	Sig. (2-tailed)		,000
	N	3283,000	3283
Distance from Warsaw	Pearson Correlation	-,592**	1,000
	Sig. (2-tailed)	,000	
	N	3283	3283,000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 13. Correlation between price per 1 sqm and distance from centre of Warsaw.

From the above chart and table, it can be seen that the variable price per 1 sqm and distance from Warsaw showed a negative correlation of -0,592, which is statistically significant at 0.01 level.

		Price per 1 sqm	Distance from center of district
Price per 1 sqm	Pearson Correlation	1,000	-,101**
	Sig. (2-tailed)		,000
	N	3283,000	3283
Distance from center of district	Pearson Correlation	-,101**	1,000
	Sig. (2-tailed)	,000	
	N	3283	3283,000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 14. Correlation between price per 1 sqm and distance from centre of district.

Correlation between variable price per 1 sqm and distance from centre of district is smaller and shows a negative correlation of -0,101, which is statistically significant at 0.01 level.

		Price per 1 sqm	Plot area
Price per 1 sqm	Pearson Correlation	1,000	-,228**
	Sig. (2-tailed)		,000
	N	3283,000	3283
Plot area	Pearson Correlation	-,228**	1,000
	Sig. (2-tailed)	,000	
	N	3283	3283,000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 15. Correlation between price per 1 sqm and plot area.

Also, the negative correlation of -0,228 is seen between variable price per 1 sqm and plot area, which is statistically significant at 0.01 level.

		Price per 1 sqm	Railway station
Price per 1 sqm	Pearson Correlation	1,000	,209**
	Sig. (2-tailed)		,000
	N	3283,000	3283
Railway station	Pearson Correlation	,209**	1,000
	Sig. (2-tailed)	,000	
	N	3283	3283,000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 16. Correlation between price per 1 sqm and railway station.

A positive correlation can be seen between the variable price per 1 sqm and railway station, which is statistically significant at 0.01 level.

Chapter 6 - Conclusion

The main aim of this work was to investigate and analyse the spatial patterns of the residential land price in the Warsaw metropolitan area. To achieve that the data about 3283 sold plots from 72 municipalities around Warsaw were collected.

The research hypothesis stated: The price of residential land decreases with distance from the centre of Warsaw. The null hypothesis states: There was no significant effect of distance on land prices.

The specific objectives of the study were: to analyse spatial patterns of residential land values around the metropolis, investigate the distribution, maximum, minimum and median of sales, to investigate if land prices decrease with distance from city centre and the intensity of this correlation, to find out the scale of influence of the metropolis on the surrounding area, to identify directions of changes in the Warsaw Metropolitan Area and predict some future scenarios of development, to compare residential land prices on each side of the Vistula river and to investigate in which districts and municipalities the land prices are highest and in which they are the lowest and for what reason.

The data was analyzed using SPSS software. The research was made as to how the price per 1 sqm varies according to other variables: district, municipality, side of Vistula river, railway station, plot area and distance to centre of Warsaw and a centre of a district. The results is consistent with previous findings, it showed that price per 1 sqm decrease with area of a plot, what is caused by fact, that smaller plots are more available for potential buyers and create a lower global price, therefore the higher price per 1 sqm is more acceptable. It also showed that in town with railway stations got higher prices, what is connected with better transport links.

It also confirmed that price per 1 sqm decrease with distance from the centre of Warsaw and centre of district. The correlation test proved that price per 1 sqm is inversely proportional to distance from Warsaw centre. Therefore, the hypothesis is proved.

The findings of the research could be used by developers or investors to find out the most popular residential areas or on the other hand the potential directions of future development.

In further research, the deeper analysis of Warsaw Metropolitan Area could be done. It also could be useful to test spatial patterns of land value during past years.

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