SOCIO-ECONOMIC FACTORS AS A CRITERION FOR THE CLASSIFICATION OF HOUSING MARKETS IN SELECTED CITIES IN POLAND

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Abstract

Property prices, including, in particular, residential properties, vary across local markets. For example, according to the National Bank of Poland, in late 2018, the average unit price of an apartment on the secondary market stood at PLN 8,700 in Warsaw, 6,100 in Poznań, 4,800 in Szczecin, and 3,800 in Kielce and Zielona Góra. The level of prices on particular markets is affected by a variety of factors, primarily those of a social and economic nature. Earlier research work on the influence of such factors on the level of apartment prices was carried out on a random basis, and their results were also published in the *Real Estate Management and Valuation* journals (Kokot 2018). This article presents study results that help deepen and broaden such analyses, seeing as how the research work:

- covers a period of 12 years (2006-2018),
- proposes and then applies a city wealth synthetic measure (SMZM) in the analyses,
- classifies cities according to the criterion of socio-economic factors and of average housing prices,
- examines relationships within the groups of cities identified via classification.

The obtained results indicate that it is justified to consider the impact of socio-economic factors on housing prices precisely in the context of their appropriate classification. Moreover, they may be an indicative tool of identifying so-called comparable or parallel real property markets.

Key words: *property market, apartment prices, factors of apartment prices.*

JEL Classification: *R30, R31.*

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1. Introduction

The article addresses the problem of the degree of similarity of local real estate markets in the context of determinants from the area of socio-economic factors. Empirical research was carried out, in which a group of factors affecting apartment prices in the micro perspective was specified for 17 large cities in Poland. The factors comprised the size of the local population, unemployment rate, city budget income, number of apartments, average salary and the number of local businesses. Next, their correlation with the level of average unit prices of residential properties in those cities was examined in a statistical manner. As a result, a hypothesis was proposed concerning a general scheme of the relation between apartment prices and a dedicated variable illustrating the broadly understood wealth of the local real property market. The study applied methods of correlation analysis and elements of taxonomic analysis. The undertaken research fits the research trend focused on finding an answer to the question of how the differences in the socio-economic conditions in cities affect the prices of listed flats. The existing studies do not provide grounds for formulating explicit conclusions in this respect.

2. Literature review

The prices of real properties listed on the market are the effect of a combination of multiple factors. Besides such typical permanent factors that determine real property prices, particularly those in the housing sector, as construction costs, there are factors of an economic and social nature, such as household income, population, employment and interest rates (Hwang & Quigley, 2006). The very concept of the real estate market is also defined in different ways, with individual definitions emphasizing different perspectives for recognising and observing the phenomena taking place there and accentuating diverse aspects of market functioning, e.g.: subjective, objective, economic, legal, geographical, institutional, economic, technical or technological (see more in: Ball et al., 1998; Kucharska-Stasiak, 2006; Stachura, 2007; Wiśniewska, 2011). One of the common approaches applied when trying to organize and classify real estate markets is to outline three main categories: macro, micro and ultra. Each category operates in its appropriate environment, which contains relevant factors (Mach, 2014). Such a classification allows for the better definition of the area under investigation. The real property market (or its given sector - e.g. a residential property sector), in a macro perspective, is a market referring to the national economy. The essential elements of its environment will be: gross domestic product, inflation, average unemployment rate, the legal system, bank lending and deposit rates, availability of credit, average income of the population, taxes on real property and real property trade, freedom of real property trade, government programmes to support construction, state schemes to secure the housing needs of the population (housing cooperatives, municipal housing, etc.), certain cultural elements (e.g. average age of leaving home by young people, cohabitation of multi-generational families, etc.), economic situation and economy cycles, etc. (see e.g.: Wiśniewski, 2007; Iacoviello & Minetti, 2008; Taipalus, 2006; Harding et al., 2007). These are elements common to the whole national economy, to the whole domain of the State. When investigating the real estate market in the macro-economic perspective, we actually compare certain aspects of the functioning of real property markets in different countries (Egert & Mihaljek, 2007), with macroeconomic effects (e.g. economic crises) playing a major role here (Brzezicka et al., 2019; Strobel et al., 2018). By their very nature, such analyses are rough, and operate with averaged parameters. When we perceive the property market in micro terms, it means taking into account its local characteristics which are typical for a particular, specifically designated area. Such features include: the size of local population (e.g. in cities), the income of the population in the region, the unemployment rate in the region, the widely recognised attractiveness of the region including, e.g., tourist attractions, the availability and quality of cultural and sporting facilities, the quality of transport services (quality and density of road network, railway connections, public transport network, bicycle paths), and other factors reflecting the economic development of the region, such as the revenue of the city budget, the number of businesses, the number of dwellings in the region, etc. Among local markets understood in this way, we usually observe considerable differences in property prices (Lai & Order, 2017; Black et al., 2006). On the other hand, when we think about the property market in ultra-terms, we focus on its very local features and factors, such as the fads for locations in particular districts (fashionable and unfashionable parts of the city), the quality of access to the property and transport from the property to the city centre, the type of building, the technical condition of the building, the surroundings and neighbourhood of the property, the functional arrangement of flats, the position of the property in the building and its sun exposure, the finishing standard of the apartment, surface areas of apartments, etc. Therefore, these are mainly the factors that are taken into account when valuing a property. We thus base on the assumption that, in a given local market, factors classified as macro and micro are constant. An example of a relevant study is the analysis of price differentiation between, e.g., the inner city and suburbs. (See: Rącka et al., 2017).

Keeping the above-described perspectives for perceiving the real estate market in mind, the article further specifies a group of residential property price factors in the micro approach and examines their relation to average unit prices of apartments in cities under study in statistical terms. The present study is part of a research trend focused on answering the question of how differences in the socio-economic conditions of the cities influence the prices of apartments listed on the local market. The research conducted so far does not provide grounds for formulating firm conclusions in this respect (e.g. Capozza et al., 2002; Forýs, 2013; Kokot 2018). Attempts to classify local urban real estate markets from the point of view of their social and economic conditions in the years 2006-2010 indicate that it is justified to identify four groups of cities. However, significant migrations of those cities between the

groups were observed throughout the analysed period of time (Gdakowicz & Hozer, 2012). Studies on similarities between selected local markets - cities in Poland - prove that such similarities can be observed when we compare pairs of some cities in regards to changes in recorded average prices and to the availability of residential properties, especially when time delays are taken into account, which gives grounds for distinguishing the so-called leading, imitating and convergent markets (Dittmann, 2012). Other studies have in turn shown that in the fifteen Polish urban markets there are three groups of cities distinguished by the convergence of residential prices on the primary market that tend to approach the respective common price levels in these groups, but are not geographically distributed (Matysiak & Olszewski, 2019). Similar conclusions, though referring to both the primary and secondary markets, have also been drawn from other independent studies (Tomal, 2019). Some similarities and convergence in housing prices can also be observed between voivodeships; however, studies using this approach do not give unambiguous results and should be interpreted with caution (Żelazowski, 2019). Moreover, there are works confirming the diversity and classification of residential markets by voivodeship in static terms, i.e. according to data from 2012 (Mach, 2014). Other published studies deal with the translocality of real estate markets (Brzezicka & Wiśniewski, 2016) or evaluate the development potential of local housing markets (Foryś, 2009). Similarly to the study presented herein, some of the research referred to the above used taxonomic analysis (Gdakowicz & Hozer, 2012; Foryś 2009). The first to propose such a method was Z. Hellwig when comparing the development levels of national economies (Hellwig, 1968). Since then, such analyses have been widely used in various fields of economic research for such purposes as evaluation, classification, ranking, normalisation or object development analysis, and can employ various detailed methodological solutions, depending on the conditions of the research they concern (e.g. Cieślak, 1974; Bartosiewicz, 1975; Strahl, 1978; Zeliaś & Malina, 1997; Krakowiak-Bal, 2005). Generally speaking, what is characteristic of them is the construction of a certain synthetic meter usually based on several so-called diagnostic variables.

3. Statistical data and research methods

The extent of the study was largely determined by the availability of statistical data. The survey was conducted using data from two sources:

1. the National Bank of Poland: average transaction prices per square meter of flats on the secondary market for 16 cities being capitals of voivodeships and for Gdynia, in the fourth quarters of 2006, 2008, 2010, 2012, 2014, 2016, 2018 in PLN/m² [SC].
2. Central Statistical Office, through the Local Data Bank for 2006, 2008, 2010, 2012, 2014, 2016, 2018 with regard to:
 - population by actual place of residence in cities as of December 31 [LL],
 - registered unemployment rate in cities as percentage [SB],
 - total revenues of city budgets in PLN [DB],
 - number of apartments in cities as of 31 December [LM],
 - average gross monthly remuneration in cities without business entities with up to 9 employees, in PLN [PW],
 - number of national economic entities [LP].

As can be seen, the study covered every other year in the period 2006-2018. This was due to the relatively low dynamics of the variables and length constraints of the paper. A full-length analysis of the period would have taken much more space, and would probably have contributed little to the framework conclusions of the study.

Considering some of the specified variables, e.g. revenues of municipal budgets, as apartment price factors may seem questionable; it is, however, justified to use them in the study not only as factors in their own right but as general measures of the economic development of a city. Therefore, the underlying thought is not that the city's budget directly affects the price level, but that the budget, being a result of many different factors, is a component of the generally understood city's wealth.

The study covered cities with powiat rights: Białystok, Bydgoszcz, Gdańsk, Gdynia, Katowice, Kielce, Kraków, Lublin, Łódź, Olsztyn, Opole, Poznań, Rzeszów, Szczecin, Warsaw, Wrocław and Zielona Góra.

The specified variables represent three groups of partially intertwined factors that can potentially determine the apartment prices in individual cities:

1. factors of the size of an urban area (population, number of apartments, budget revenues, number of entities),
2. factors of economic development and wealth of the urban area (budget revenues, number of entities),
3. factors of inhabitants' wealth (unemployment rate, average salary).

The study used statistical and econometric methods, in particular:

1. Pearson's correlation coefficient with statistical significance assessment in the Statistica package,
2. Tschuprow's T-coefficient,
3. Author's own City Wealth Synthetic Measure (SMZM):

$$SMZM = \frac{\sum_{k=1}^n X_Z}{n}, \quad (1)$$

where:

X_Z – normalized variables incorporated in SMZM,

n – number of variables,

SMZM was determined basing on the above mentioned variables LL, SB, DB, LM, PW, LP. They were normalized according to the formula:

$$X_{kZ} = \frac{X_k}{X_{max}} \quad (2)$$

Adopting this formula results in normalizing the variables formally in the interval $(0; 1)$, but in practice, a zero value is not assumed because the actual values of the variables do not assume zero values. A normalized variable takes a value of one only for an object (a city) with the maximum value of the real variable. The formula, in a way, automatically weighs the observed values of variables as well, in the sense that the normalized values of variables depend on the space of their real values. After normalization, the only variable being a destimulant [SB] is converted into a stimulant using the formula:

$$X_{iZ}^S = -(X_{iZ}^D - 1) + X_{iZ}^{D_{min}} \quad (3)$$

(upper indices S and D denote the variables that are a stimulant and a destimulant respectively).

The same formula of normalising the variables is also used to normalise average apartment prices in cities.

4. for the classification of cities in terms of apartment prices [SC] and City Wealth Synthetic Measures [SMZM], the k-means method was applied using the Statistica package;
5. part of the results was presented using diagrams (correlograms). On the correlograms, straight lines corresponding to the regression equations estimated by the least squares method were plotted in order to better illustrate the direction of the relations under consideration. The correlograms were generated by means of the Statistica package

The applied methods are referenced later in the presentation of research results. The research was conducted independently for the individual years under study.

4. Results of research

In the first phase of the study, Pearson's correlation coefficients were calculated between average unit apartment prices and specified variables characterizing the individual cities in the years under consideration (Table 1). Statistically significant coefficients at the significance level of 0.05 are marked in red (the same applies to the coefficients shown further in the paper). As can be seen, such an approach to the problem indicates significant and, in most cases, strong statistical relations between the surveyed variables and average apartment prices in cities over the entire period under study. Therefore, it seems reasonable to conclude that prices of dwellings are directly determined by the size and development level of a city and by the wealth of its residents.

Table 1
Pearson's correlation coefficients between average unit apartment prices in cities and individual variables in years 2006-2018

	2006	2008	2010	2012	2014	2016	2018	/min/	/max/
LL	0.73	0.82	0.83	0.75	0.81	0.77	0.74	0.73	0.83
SB	-0.62	-0.53	-0.52	-0.60	-0.57	-0.53	-0.55	0.52	0.62
DB	0.74	0.83	0.84	0.77	0.82	0.78	0.74	0.74	0.84
LM	0.71	0.81	0.81	0.73	0.80	0.77	0.73	0.71	0.81
PW	0.55	0.70	0.56	0.55	0.62	0.73	0.82	0.55	0.82
LP	0.74	0.83	0.84	0.77	0.84	0.80	0.75	0.74	0.84

Source: own study.

The data presented in Table 1, however, do not fully reflect the actual relationships because the correlation coefficients are overestimated by the outlier unit which, in this case, is the city of Warsaw. This phenomenon is illustrated in Fig. 1 on the example of the 2018 population variable. It is clearly visible that the strength of the relationship under consideration is, to a large extent, the effect of relatively high values of both the population and the average price of housing in Warsaw. In the case of other variables and in the remaining years, the situation was similar. Hence, Pearson's correlation coefficients were recalculated for the data excluding Warsaw (Table 2). As can be seen, two out of the six variables taken into consideration showed a permanent, statistically significant relationship with apartment prices (DB and LP) with such an approach. The remaining four variables showed a statistically significant relationship with apartment prices in some years, while, in the other years, the relationship was insignificant (LL, SB, LM and PW). It should also be noted that the values of the correlation coefficients clearly decreased, which indicates that the relationships under consideration were indeed weaker than one might think after analysing the data from Table 1.

Fig.1. Correlogram of average prices to population in 2018. Source: own study.

Due to the fact that each of the variables, even after Warsaw had been excluded, showed (at least in some years) a statistically significant relationship with the average apartment prices, the absolute values of individual variables were no longer used in the following section in order to simplify and improve the readability and comparability of analyses and conclusions. Instead, their synthetic measure, hereinafter referred to as the City Wealth Synthetic Measure [SMZM], was determined for individual cities in individual years. In constructing this measure, the commonly accepted recommendations for diagnostic variables concerning their variability and low correlation were deliberately disregarded. However, all variables showed sufficiently high variability - Vs above 0.1. The correlation coefficients between diagnostic variables were sporadically <0.3 . Nonetheless, it was

decided not to eliminate the diagnostic variables, which was justified by the applied construct of the synthetic measure based on the arithmetic mean of standardized diagnostic variables. As a result, each of these variables adds a certain amount of information to the synthetic measure. The essence of the study was to analyze the impact of specified socio-economic factors on the level of apartment prices in cities, rather than to attempt to model those prices in relation to a properly constructed measure. The use of a synthetic variable was only a way to simplify the analyses and to interpret the conclusions drawn from them. The application of classical rules for the selection of diagnostic variables would lead to eliminating most of the diagnostic variables and, at the same time, raise the question of whether the individual factors are actually properly represented in the synthetic variable. Likewise, the specific nature of the study, also going against common recommendations, justifies the use of absolute values, e.g. LL, DB or LM, as some diagnostic variables. In such a case, it was considered that the use of relative values, such as population density, budget income per capita and the number of dwellings per 1,000 inhabitants, does not appropriately reflect the factors constituting the city's wealth as defined in the survey. The SMZM was theoretically normalized in the range from 0 to 1, with a value of 0 assumed for the object (city) whose value of all variables included in it was 0, and a value of 1 when all variables assumed the maximum value in a given year. In practice, the SMZM never takes the value 0, as all variables, by their very nature, do not take zero values, and takes on a value of 1 (or close to 1) for the city with the highest values of all variables, i.e. Warsaw. As already mentioned, the SMZM was determined for individual years as the arithmetic mean of similarly normalized individual variables. For the same reasons, the subsequent studies similarly used normalized average apartment prices [ZSCM] for the individual years.

Table 2

Pearson's coefficients of correlation between average unit prices of apartments in cities excl. Warsaw and individual variables in 2006-2018

	2006	2008	2010	2012	2014	2016	2018	/min/	/max/
LL	0.47	0.62	0.49	0.56	0.56	0.53	0.51	0.47	0.62
SB	-0.54	-0.41	-0.53	-0.54	-0.54	-0.48	-0.48	0.41	0.54
DB	0.56	0.73	0.60	0.63	0.63	0.58	0.58	0.56	0.73
LM	0.43	0.58	0.46	0.53	0.53	0.51	0.50	0.43	0.58
PW	0.21	0.24	0.26	0.36	0.36	0.56	0.69	0.21	0.69
LP	0.52	0.70	0.60	0.66	0.66	0.64	0.60	0.52	0.70

Source: own study.

Table 3 shows the values of Pearson's correlation coefficients between normalized average apartment prices in cities and the synthetic measures of the city's wealth for the complete data (with Warsaw) and after eliminating Warsaw.

Table 3

Pearson's correlation coefficients between the normalized average price of apartments in cities and City Wealth Synthetic Measure in 2006-2018

	2006	2008	2010	2012	2014	2016	2018	/min/	/max/
All cities	0.79	0.86	0.85	0.80	0.86	0.82	0.79	0.79	0.86
Excl. Warsaw	0.62	0.66	0.69	0.65	0.71	0.66	0.65	0.62	0.71

Source: own study.

The normalized average price of apartments shows a statistically significant correlation with the City Wealth Synthetic Measure in all the analyzed years, both for the complete data and after the elimination of Warsaw, although in the latter case, the values of correlation coefficients are noticeably lower. The obtained results give grounds for the conclusion that the generally understood level of development and wealth of an urban centre has an impact on the level of recorded apartment prices. However, the correlation coefficients presented in Table 3 for data without Warsaw, ranging between 0.62-0.71, despite being statistically significant, indicate that a certain, rather considerable number of

the conditions of apartment price formation remain unexplained. In order to establish the nature of this relationship in more detail, cities were classified using the k-means method for both ZSCM and SMZM. First, a classification into two groups was assumed. It turned out that, as a result of such classification, only Warsaw fell into the first group each time, while all the other cities fell into the second group. Hence, another classification was made - into three groups, the results of which have been presented in Table 4. Warsaw was qualified in the first group (A) each year in terms of ZSCM and SMZM. In terms of prices in 2006 and 2012, Krakow also fell into this group. None of the other cities fell into group A in any year, neither in terms of prices nor in terms of the city's wealth. Among the remaining cities which were qualified to group B or C, 11 remained in the given group over all the years. Cities that moved from one group to another in terms of prices were: Kraków (three times), Lublin and Rzeszów (twice) and Olsztyn (once). As regards the city's wealth, Szczecin changed groups three times and Olsztyn once. The transitions between groups in the Table are marked in red. Such results gave grounds for eliminating Warsaw from the group of cities that were examined together in terms of the effect of social and economic conditions on apartment prices. In such an approach, Warsaw should probably be compared with such cities as Prague, Budapest and Bratislava. However, this needs to be confirmed in the course of further analyses.

Table 4

Classification of cities by normalized average apartment prices (ZSCM) and by City Wealth Synthetic Measures (SMZM) in 2006-2018

	ZSCM							SMZM						
	2006	2008	2010	2012	2014	2016	2018	2006	2008	2010	2012	2014	2016	2018
Białystok	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Bydgoszcz	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Gdańsk	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Gdynia	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Katowice	C	C	C	C	C	C	C	B	B	B	B	B	B	B
Kielce	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Kraków	A	B	B	A	B	B	B	B	B	B	B	B	B	B
Lublin	C	C	B	B	B	C	C	C	C	C	C	C	C	C
Łódź	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Olsztyn	B	C	C	C	C	C	C	B	C	C	C	C	C	C
Opole	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Poznań	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Rzeszów	C	C	C	B	B	C	C	C	C	C	C	C	C	C
Szczecin	C	C	C	C	C	C	C	C	B	C	C	C	B	B
Warszawa	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Wrocław	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Ziel. Góra	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Source: own study.

In further analyses, in all years under study, Kraków was treated as a city qualified to group B in terms of apartment prices. Given the information about cities classified in this way, the question can be posed: does the city's membership in a given group in terms of SMZM determine the level of apartment prices? A simple answer to this question can be obtained by calculating Tschupuirow's T-coefficients. It is a coefficient that can be calculated for qualitative data, as opposed to previously obtained Pearson's linear correlation coefficient. The results are shown in Table 5.

Table 5

Tschuprow's T-coefficients of correlation between apartment price classes excl. Warsaw and city wealth classes in 2006-2018

2006	2008	2010	2012	2014	2016	2018	/min/	/max/
0.85	0.73	0.73	0.63	0.63	0.83	0.83	0.63	0.85

Source: own study.

The obtained Tschuprow's T-coefficients were high, ranging from 0.63 to 0.85, depending on the year, and indicated a clear correlation between the apartment price class and the city wealth class. Their values cannot be directly compared to Pearson's correlation coefficients from Tables 2 and 3 due to their different structure. Table 6 shows Pearson's correlation coefficients between normalised average apartment prices in cities and the City Wealth Synthetic Measures calculated separately for the identified city classes in terms of price levels. It turned out that those coefficients took very different values, usually pointing to a lack of statistical significance between the variables under consideration. However, for class B, such statistical significance occurred in the years 2010, 2012 and 2014, although in other years (2008 and 2018), even negative coefficients were obtained. This justifies a conclusion that, within city classes, the correlation between apartment prices and the city's wealth is not a rule, not to say that it does not occur at all or occurs sporadically. Therefore, the issue of determining the type of relationship between the prices of housing in cities and their broadly understood wealth turns out to be more complicated than preliminary studies (Tables 1 and 3) would suggest. It is by no means possible to say that such a relationship exists within specified groups of cities, even though the general rule is that the richer the city, the more expensive the apartments. This finding is illustrated with the use of correlograms (Fig. 2-8) that show the distribution of ZSCM values against SMZM in individual years. In these diagrams, points corresponding to cities belonging to different classes are marked with different colours. The directions of correlations are also plotted as lines with equations determined by the least squares method. Moreover, individual groups are outlined in ellipses embracing all towns in the group. Additionally, each graph is divided into 3 areas (vertical dashed black lines) separating the parts with cities belonging only to Group C, cities belonging only to Group B and those belonging to Groups C or B.

Table 6

Pearson's coefficients of correlation between normalized average apartment price in cities and City Wealth Synthetic Measure in 2006-2018 as divided into city classes

	2006	2008	2010	2012	2014	2016	2018	/min/	/max/
Class B	0.64	-0.11	0.81	0.77	0.88	0.66	-0.36	0.11	0.88
Class C	-0.59	0.06	-0.18	-0.33	-0.12	-0.25	-0.05	0.05	0.59

Source: own study.

The graphs show that, each year, the cities included in the survey were clearly divided into two groups: more expensive (in terms of apartment prices) and wealthier, and cheaper and less wealthy. Both groups consist of cities permanently classified in them and cities migrating between the groups. The cities permanently belonging to the more affluent group include Gdańsk, Gdynia, Kraków, Poznań and Wrocław, while cities belonging to the less wealthy group were: Białystok, Bydgoszcz, Katowice, Kielce, Łódź, Opole, Szczecin and Zielona Góra. Cities migrating between the groups in individual years were: Lublin, Olsztyn and Rzeszów. Looking at the graphs from another perspective, one can also conclude that there were cities always exhibiting high SMZM values - Gdańsk, Kraków, Poznań and Wrocław, as well as low SMZM values, such as Białystok, Kielce and Zielona Góra. The remaining cities reached average values of the measure either on a permanent or periodic basis, and yet they belonged to a given group. In conclusion, the level of apartment prices was, to a greater extent, determined by the city belonging to a given group than directly by the City Wealth Synthetic Measure.

Fig. 2. Correlogram of normalized prices to city wealth measure in 2006. *Source:* own study.

Fig. 3. Correlogram of normalized prices to the city wealth measure in 2008. *Source:* own study.

Fig. 4. Correlogram of normalized prices to city wealth measure in 2010. *Source:* own study.

Fig. 5. Correlogram of normalized prices to city wealth measure in 2012. Source: own study.

Fig. 6. Correlogram of normalized prices to city wealth measure in 2014. Source: own study.

Fig. 7. Correlogram of normalized prices to city wealth measure in 2016. Source: own study.

Fig. 8. Correllogram of normalized prices to city wealth measure in 2018. *Source:* own study.

5. Discussion

An attempt to illustrate the regularities identified in the course of the tests is made in a general manner in Fig. 9. The blue area represents cities with relatively low apartment prices and relatively low city wealth, whereas the red area represents cities with relatively high apartment prices and high city wealth. The section between the black dotted lines is where the blue and red areas overlap. The chart also shows the characteristic shape of the correlation of the normalized average price of apartments in cities with the City Wealth Synthetic Measure (a green line in bold). The shape of this correlation line resembles a logistic function. Generally speaking, logistic regression is a mathematical model to describe the impact of an independent variable (or several independent variables) on a dependent variable that is dichotomous in nature. It is also used to model data relating to monotonous growth during the observed phenomenon, with the growth rate decreasing to zero (Purczyński & Bednarz-Okrzyńska, 2016). The logistic shape of the dependence in question indicates that there is a clear correlation between the price level of apartments in cities and the degree of city development, but this correlation is not fully proportional. Both in terms of apartment prices and wealth, cities fall into several groups. The affiliation of a given city to a given group representing a certain range of values of city wealth measure makes it highly likely to simultaneously belong to an adequate group of cities selected in terms of local apartment prices. Interestingly, in a given group of cities, the relation between apartment prices and the city's wealth is weak.

Fig.9. Pattern of correllogram of normalized prices in relation to city wealth measure in 2006-2018. *Source:* own study.

When referring the obtained results to other studies in this area found in literature, it should be pointed out that they confirm a rather clear division of local residential property markets concentrated in large Polish cities into quite clearly defined groups or so-called clubs. The paper also proves that the membership of individual cities in the identified groups is characterised by a certain instability, although it is not as significant as in other studies. Local residential property markets can be classified according to both socio-economic factors and property prices alone. The results of such classifications can be described as relatively similar, which indicates the correlation of socio-economic factors in micro perspective with apartment prices.

The observations herein, based on a relatively small sample of Polish cities, leads to another research hypothesis, namely that such a relationship is characteristic of all or at least the majority of local markets. In other words, if a larger number of local markets were to be covered by the study, it would probably turn out that these markets are divided into groups that can be identified in terms of apartment prices and wealth. The affiliation of a given local market to a given group distinguished by wealth would very likely also determine its affiliation to a given group separated by the level of apartment prices. Fig. 10 shows a hypothetical example of such a dependence. Nevertheless, extensive empirical research is required to verify such a hypothesis. Undoubtedly, the shape of this relation will be determined by the number of identified groups of similar objects and by their internal diversity.

Fig.10. Hypothesis of a general pattern of correlogram of apartment prices and local market wealth.
Source: own study.

6. Conclusion

The article shows the relationship between the recorded unit price levels of traded apartments and the socio-economic factors in the micro perspective, which include local population, unemployment rate, city budget revenues, the number of apartments in housing stock, average salary and the number of business entities. Over the period of 2006-2018 the correlations among individual factors were not stable, although usually, but not always, statistically significant. The constructed City Wealth Synthetic Measure reveals high correlation with apartment prices, with this correlation being much lower within the specified groups of cities than for all the cities in general. Therefore, a conclusion can be drawn that the city's membership to a given group due to its wealth determines the price level of apartments to a greater extent than the value of the City Wealth Synthetic Measure as such.

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