

SPATIAL AND TEMPORAL DIVERSIFICATION OF THE INCOME AFFORDABILITY OF HOUSING IN POLAND

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Abstract

The paper presents the results of research aimed at assessing the geographic diversification of the income affordability of flats on both the primary and secondary markets in Poland in the years 2012 – 2016. It analyzes the differences in the income affordability of flats: 1) in voivodeship cities, 2) between voivodeship cities, 3) between voivodeship capitals and other major cities located in counties in the voivodeship. Measures of differentiation and the Shapiro-Wilk, Fisher-Snedecor and t-Student tests were used. The source of the data used to conduct the study was the AMRON system. The results of the study indicate that: 1) changes in the income affordability of flats in voivodeship cities were small during the analyzed period, 2) the average diversification in voivodeship cities in terms of the income affordability of flats was small, however the differences in the extreme values of housing affordability indicators were high, 3) the maximum differences in the income affordability of flats between counties in the same voivodeship were high, 4) in a majority of voivodeships (11 out of 16), the income affordability of flats in a voivodeship city was lower (not always statistically significantly) than in the remaining counties of the voivodeship.

Key words: *housing market, income affordability, voivodeship cities, counties, Poland.*

JEL Classification: *R20, R30.*

Citation: Dittmann I., 2018, *Spatial and Temporal Diversification of the Income Affordability of Housing in Poland*, Real Estate Management and Valuation, vol. 26, no. 4, pp. 54-67.

DOI: 10.2478/remav-2018-0036

1. Introduction

The affordability of housing is an important socio-economic problem. It is a factor which significantly influences how households function. In the long run, it determines economic development and the economic and demographic stability of cities, regions or the entire country. There exist various definitions of housing affordability in the literature on the subject matter (see STONE 2006; JEWKES, DELGADILLO 2010, STONE et al. 2011). For this reason, different indicators of housing affordability are used to enable analyses aimed at studying its various aspects (cf. WHITEHEAD et al. 2009; JEWKES, DELGADILLO 2010). Housing affordability is an interdisciplinary area of scientific research. The topic is addressed, among others, in banking, social policy, economics and finance.

2. The concept of housing affordability, measures and the most important research

GAN and HILL (2009) undertook an effort to systematize the concept of housing affordability by pointing out three main concepts of affordability: *purchase affordability*, *repayment affordability* and *income affordability*. Purchase affordability refers to the possibility of acquiring a home by a household in light of the regulations in force at the given moment on the mortgage market as well as the credit policies applied by banks. These include, inter alia, the maximum loan repayment period, max. LTV¹,

¹ LTV (loan to value) – the ratio of the loan amount to the value of the property.

max. Dtl², loan currency. Changes in purchase affordability result from a relaxation or a tightening of these criteria (cf. MCCORD et al. 2011). In Poland, recommendations of the Polish National Supervision Authority (*Komisja Nadzoru Finansowego*) – recommendation S, formerly also recommendation T) – influence purchase affordability (cf. CHINOWSKI et al. 2013). Repayment affordability refers to the household's burden of mortgage repayment and is linked to the Dtl index calculated for the specific loan granted to the household. Income affordability refers to the ratio of the price of a home (flat) to the household's income. It should be emphasized, however, that the affordability of a home (flat) is often examined more broadly than stated by GAN and HILL (2009), for example by taking into account the aspect of expenses incurred that are related to maintaining the house or flat (*housing costs*) (see, e.g. HULCZANSKI 1995).

Appropriate measures are used to measure and monitor the different types of housing affordability. They are calculated by various institutions (real estate analysts, appraisers, government agencies, banks). For example, in the United States, three main measures are listed: 1.) the NAR index (the ratio of 25% of average monthly income to the monthly mortgage payment at a fixed interest rate for an average-priced home, at current interest rates); 2.) the HUD indicator (the ratio of the average income of a household to the income required in order to obtain a standard mortgage for an average-price home); 3.) the NAHB indicator (which measures the percentage of flats sold that could have been purchased by a family with an average income) (GAN, HILL 2009). A comparison of the construction of these various measures as well as their advantages and disadvantages was presented by COMBS et al. (1994); BOGDON, CAN (1997); JEWKES, DELGADILLO (2010), among others.

It is worth noting that, due to the financial crisis in the USA between 2007 – 2008 (related to *subprime* loans), there appeared a postulate to define other measures which could be used to determine a household's ability to purchase a home (JEWKES, DELGADILLO 2010). For example, GAN and HILL (2009) proposed a measure of *Affordability at Risk* (AaR), which measured the probability that homes available on the market at a given time would be unaffordable for a household with a given income level. They took advantage of the AaR concept to construct a new measure of housing affordability related to the Lorenz curve and the Gini index. In turn, PADLEY, MARSHALL (2016) attempted to define and measure the affordability of housing in the United Kingdom in the context of the minimum wage.

In Poland, two institutions systematically monitor the affordability of housing: the Polish Banks Association (*Związek Banków Polskich* - ZBP) and the National Bank of Poland (NBP). ZBP calculates the so-called M3 index on a quarterly basis. This is the ratio of the average disposable income (net income of a family of three, minus the social minimum) to the loan installment necessary to purchase a 50 m² flat. The index is calculated for Poland in general. NBP estimates the quarterly affordability of flats in 7 Polish cities. The indicator informs us about the number of square meters of housing that can be purchased using a housing loan with an average monthly salary in the enterprise sector on a given market, taking into account the loan requirements of banks and the loan parameters, assuming the average transaction price for a flat (40% on the primary market and 60% on the secondary market) on the given market.

The most popular measure, often used in comparative analyses (including international ones), is an indicator referring to income availability – *price to income ratio* (P/I, PIR). It is usually calculated as the median of the home price to the median annual household income (MM – *Median Multiple*). The possibility of generalizing this measure by converting the median into another quantile has been indicated in literature (Cf. GAN, HILL 2009). This concept was applied in research on the differences in the income affordability of flats for various income groups (upon adoption of the 10th percentile, 25th percentile, 75th percentile and 90th percentile of income distribution) (inter alia, the *14th Annual...* 2018). In practice, the first quartile of income distribution is often used (Cf. JONES et al. 2011). It is worth noting that MM is widely used to rate cities with regards to housing affordability. Its use has been recommended by the World Bank and the United Nations, and it is used by the Joint Center for Housing Studies at Harvard University. MM and other P/I indicators are used by the Organization for Economic Cooperation and Development, the International Monetary Fund, The Economist, etc. (*13th Annual...* 2017).

The issue of the geographic diversification of housing affordability has been the subject of in-depth

² Debt to income (Dtl) – ratio of monthly repayment of liabilities to monthly income.

studies of the housing market in the United Kingdom (BRAMLEY, KARLEY 2005; BRAMLEY et al. 2006; WILCOX 2006; WILCOX, BRAMLEY 2010; JONES et al. 2011). JONES et al. (2011) measured income affordability and the differences in affordability between local housing markets (HMA – *local housing market areas*). It is worth emphasizing that they investigated affordability at the local level on the basis of functional areas, and not administrative boundaries; moreover, they measured income affordability with regards to several types of houses.

As mentioned earlier, systematic monitoring of the affordability of housing in the largest cities in Poland is conducted by ZBP and NBP. However, scientific research on the income affordability of flats in Poland should be considered insufficient. The few studies which have been conducted relate only to a few of the largest Polish cities. TROJANEK (2013, 2014) studied the development of housing affordability in five cities in Poland in the years 1997 – 2012 using the ratio of the annual income of a 2-person household to the average value of a 55m² flat as an indicator. DITTMANN (2012) investigated the similarity of changes in housing affordability for eight of the largest voivodeship cities within the time period 1Q2006 – 2Q2011. Interesting studies on the Poznan housing market were conducted by STRĄCZKOWSKI and MAZURCZAK (2015); using the “house price to annual household income” ratio, they examined the affordability of flats on the primary and secondary markets according to: the neighborhood in Poznan, the number of rooms and the overall flat size. RADZIMSKI (2014) studies the relationship between the geographic diversity of subsidized mortgage loans and the degree of housing affordability in Poland.

As a result of a review of research found in literature, a research gap has been identified regarding the diversity of housing affordability in voivodeship cities and counties in Poland. The current study partially fills this gap. The research goal was to assess the spatial and temporal diversification of the income affordability of flats on the primary and secondary housing markets in Poland between the years 2012 – 2016. Four research questions were formulated:

1. Have changes in the income affordability of housing in voivodeship cities in Poland been large during the time period considered?
2. Was the diversity of voivodeship cities, in terms of the income affordability of flats, large and did it undergo significant changes during the analyzed time period?
3. Was the diversity of income affordability of flats large in individual voivodeships?
4. Was the income affordability of flats on the primary (PM) and secondary (SM) markets in the voivodeship cities lower or higher than in the remaining major cities (with county rights) and counties in that voivodeship?

The contribution of this article to the literature regarding the income availability of housing is:

1. conducting research with a wide geographic range. The study covered all Polish voivodeship cities, counties and cities with county rights. It was, therefore, a comprehensive study with a high degree of detail. To the author’s best knowledge, there had not been any research previously done in Poland with such a wide geographic range.
2. comparison of the income affordability of flats in a voivodeship city with the affordability in other cities with county rights and with counties in the given voivodeship. This allows for the determination of whether the purchasing power of residents of voivodeship cities with regards to housing is at a similar level as that of the inhabitants of the counties. To the author’s best knowledge, no such research question had been formulated before.
3. conducting the study: 1) for five years – which allowed for an analysis of changes in affordability; 2) separately for the primary and the secondary markets.

3. Data and Methods

The source of data used in conducting the study was the AMRON system. The system provided the average transaction prices for 1m² of residential space based on sales contracts from all counties in Poland, as well as from all cities with county rights. Data on average monthly gross salaries in individual cities with county rights and in counties was also obtained from this system. The study was conducted for specific years throughout the time period 2012 – 2016, and was conducted separately for the primary market (PM) and the secondary market (SM). Using Formula (1), indicators of income affordability of flats (D) for each county and city with county rights in Poland were calculated for specific years. The D indicator can be interpreted as the average number of square meters which could be acquired for the average gross monthly salary in the given county. The indicators were calculated separately for the primary and secondary markets.

$$D_{c,y} = \frac{\text{average monthly gross salary}_{c,y}}{\text{average price of } 1m_{c,y}^2} \quad (1)$$

$D_{c,y}$ – income affordability of flats in county (c) in year (y).

The use of this indicator in the study allowed us to conduct a geographic and temporal analysis covering all counties and spanning a 5-year research period. In particular, it made it possible to obtain answers to the research questions which had been previously formulated. The use of other indicators (e.g. MM) was impossible due to the lack of access to relevant data (see TROJANEK 2014).

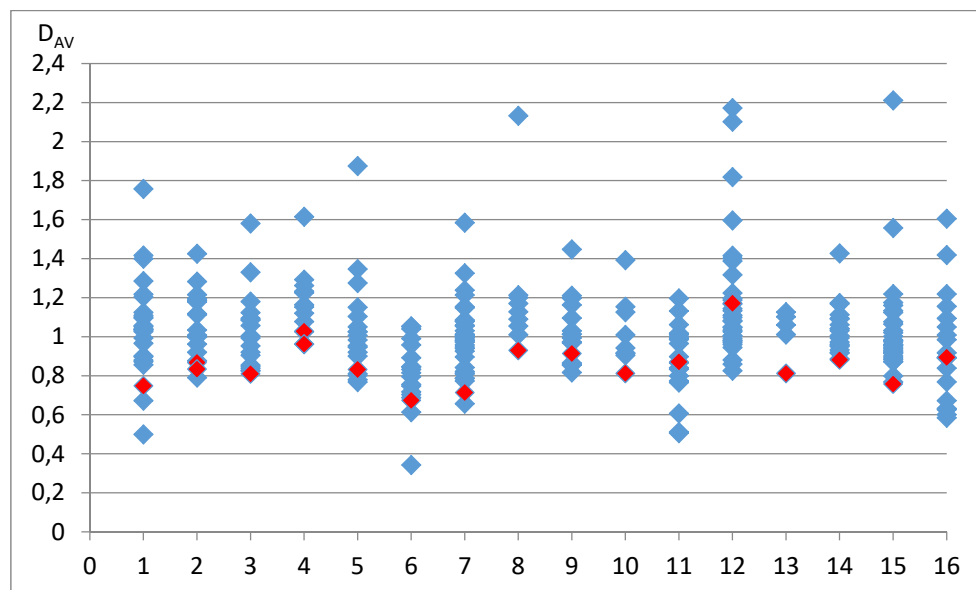
In order to answer the postulated research questions, two measures of differentiation were used: the coefficient of variation (standard deviation to the mean) and the ratio of the maximum to the minimum value (MAX/MIN). Furthermore, in order to obtain the answer to the fourth question regarding whether the average income affordability of flats in the studied period in a voivodeship city (\bar{x}_v) was lower (higher) than the average income affordability of flats in the studied period in the remaining counties (\bar{x}_c) of the voivodeship, two appropriate pairs of statistical hypotheses were formed:

$$\begin{aligned} H_0: \bar{x}_v &= \bar{x}_c & H_1: \bar{x}_v < \bar{x}_c \\ H_0: \bar{x}_v &= \bar{x}_c & H_2: \bar{x}_v > \bar{x}_c \end{aligned}$$

After testing the normality of the distributions and the equality of variances³, Student's t-test with a one-sided critical area was used to verify the above hypotheses. A significance level of $\alpha = 0.05$ was assumed.

4. Empirical results

The calculated average values⁴ of income affordability for housing (D_{AV}) for individual counties and cities with county rights, divided into 16 voivodeships, are shown in Figure 1 (PM) and Figure 2 (SM).



Voivodships (abscissa) were marked with the numbers: 1-Dolnośląskie, 2-Kujawsko - pomorskie, 3-Lubelskie, 4-Lubuskie, 5-Łódzkie, 6-Małopolskie, 7-Mazowieckie, 8-Opolskie, 9-Podkarpackie, 10-Podlaskie, 11-Pomorskie, 12-Śląskie, 13-Świętokrzyskie, 14-Warmińsko - Mazurskie, 15-Wielkopolskie, 16-Zachodniopomorskie.

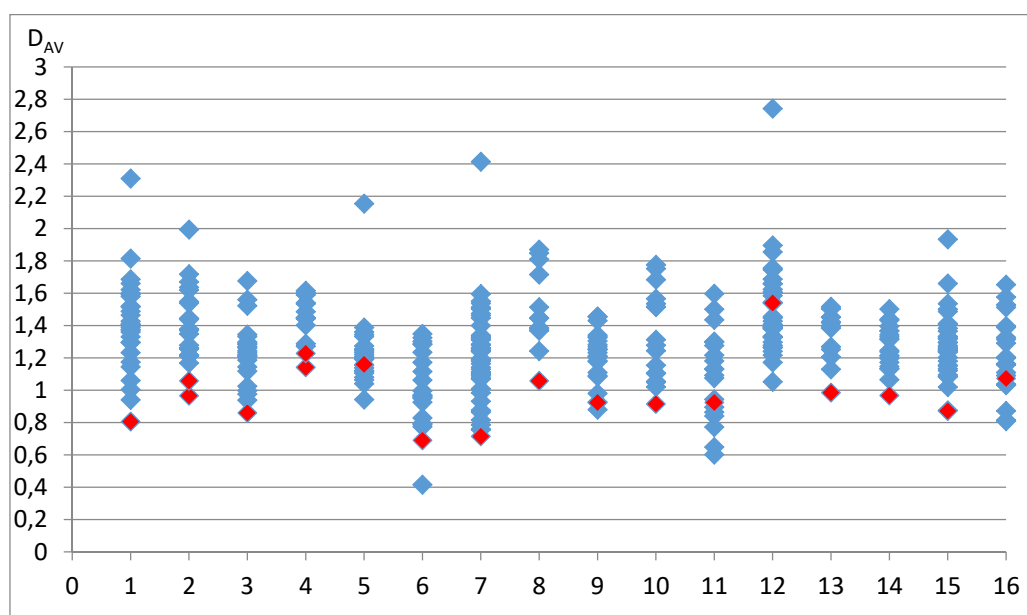
Fig. 1. Average values of income affordability indicators for flats on the primary market. *Source:* own calculations based on data from the AMRON system.

The voivodeship cities are marked in red. In the case of two voivodeships, two voivodeship cities

³ To verify the hypothesis of the normality of distributions, the Shapiro-Wilk test was used, and the Fisher-Snedecor test was used to verify the equality of variance hypothesis.

⁴ Due to the volume limitation of this article, the figures show the average value of the indicators from the five analyzed years (2012 - 2016).

were taken into account: Bydgoszcz and Toruń (Kujawsko-Pomorskie Voivodeship) and Gorzów Wielkopolski and Zielona Góra (Lubuskie Voivodeship).



Markings on the abscissa as in Figure 1.

Fig. 2. Average values of income affordability indicators for flats on the secondary market. *Source:* own calculations based on data from the AMRON system.

4.1. Income affordability of flats in voivodeship cities

To answer the first and the second research question, the coefficients of variation (CV) and the ratios of the maximum value to the minimum indicators of affordability (MAX/MIN) were calculated. The results are shown in Table 1 (primary market - PM) and Table 2 (secondary market - SM).

Table 1

Indicators of income affordability of flats in voivodeship cities and measures of differentiation (PM)

City	2012	2013	2014	2015	2016	average	CV
Wrocław	0.68	0.69	0.76	0.79	0.82	0.75	7.4%
Toruń	0.79	0.84	0.85	0.90	0.96	0.87	6.7%
Bydgoszcz	0.81	0.83	0.82	0.85	0.86	0.83	2.2%
Lublin	0.81	0.84	0.81	0.81	0.78	0.81	2.3%
Zielona Góra	0.91	0.89	0.94	1.01	1.06	0.96	6.6%
Gorzów Wielkopolski	0.99	1.02	1.01	1.07	1.04	1.03	2.7%
Łódź	0.80	0.75	0.85	0.87	0.89	0.83	6.1%
Kraków	0.63	0.67	0.68	0.69	0.70	0.67	3.6%
Warszawa	0.64	0.72	0.73	0.72	0.75	0.71	5.3%
Opole	0.81	0.94	0.93	0.99	0.98	0.93	6.9%
Rzeszów	0.86	0.91	0.92	0.95	0.93	0.91	3.3%
Białystok	0.77	0.85	0.82	0.77	0.84	0.81	3.9%
Gdańsk	0.78	0.87	0.89	0.91	0.91	0.87	5.5%
Katowice	1.23	1.32	1.14	1.10	1.07	1.17	7.7%
Kielce	0.75	0.76	0.84	0.87	0.84	0.81	5.6%
Olsztyn	0.83	0.88	0.87	0.90	0.94	0.88	4.1%
Poznań	0.73	0.76	0.76	0.75	0.79	0.76	2.8%
Szczecin	0.82	0.90	0.90	0.90	0.94	0.89	4.2%
average	0.81	0.86	0.86	0.88	0.90		
CV	16.1%	16.6%	12.0%	12.6%	11.5%		
MAX/MIN	1.95	1.97	1.68	1.59	1.54		

Source: own calculation.

Table 2

Indicators of income affordability of flats in voivodeship cities and measures of differentiation (SM)

City	2012	2013	2014	2015	2016	average	CV
Wrocław	0.72	0.78	0.80	0.83	0.90	0.81	7.3%
Toruń	0.86	0.90	0.99	1.04	1.04	0.97	7.6%
Bydgoszcz	1.01	1.04	1.07	1.09	1.08	1.06	2.8%
Lublin	0.81	0.84	0.87	0.88	0.90	0.86	3.7%
Zielona Góra	1.07	1.06	1.15	1.22	1.21	1.14	5.9%
Gorzów Wielkopolski	1.13	1.15	1.27	1.30	1.29	1.23	5.9%
Łódź	1.01	1.10	1.13	1.27	1.29	1.16	9.1%
Kraków	0.63	0.71	0.71	0.67	0.73	0.69	5.2%
Warszawa	0.67	0.72	0.71	0.73	0.74	0.71	3.6%
Opole	1.00	1.00	1.05	1.10	1.14	1.06	5.2%
Rzeszów	0.87	0.88	0.93	0.94	1.00	0.92	5.1%
Białystok	0.90	0.85	0.90	0.95	0.97	0.92	4.5%
Gdańsk	0.87	0.92	0.94	0.96	0.94	0.92	3.3%
Katowice	1.52	1.63	1.52	1.50	1.53	1.54	2.9%
Kielce	0.88	0.92	0.94	1.07	1.11	0.99	9.1%
Olsztyn	0.90	0.94	0.97	1.02	1.01	0.97	4.5%
Poznań	0.83	0.86	0.85	0.90	0.92	0.87	3.6%
Szczecin	0.97	1.03	1.09	1.13	1.15	1.07	6.1%
average	0.93	0.96	0.99	1.03	1.05		
CV	20.9%	20.9%	19.3%	19.5%	18.4%		
MAX/MIN	2.4	2.3	2.1	2.2	2.1		

Source: own calculation.

Changes in the income affordability of flats on the primary market in individual voivodeship cities were relatively small; the coefficients of variation ranged from 2.7% to 7.7%. On the secondary market, the affordability variability was slightly higher - the coefficients of variation ranged from 2.8% to 9.1%.

The average diversification of voivodeship cities in terms of the income affordability of housing on the primary market was small (the coefficient of variation did not exceed 17%). However, differences between the outlying cities, in terms of affordability, were large (in Katowice, the income affordability of flats was almost twice as high as in Kraków in the years 2012 and 2013, in subsequent years it was higher by about 50%). It was also found that the diversity of cities was reduced due to the income affordability of flats on the primary market in the analyzed period. The average diversification of voivodeship cities in terms of the income affordability of flats on the secondary market can be considered small, albeit a bit higher than on the primary market (the coefficient of variation assumed values from 20.9% to 18.4%). These values decreased slightly over time, thus it can be concluded that there was a minor decrease in the diversification of cities in the analyzed time period. Differences in the cities which were at the extreme ends in terms of housing affordability on the secondary market, as on the primary market, can be considered large (in Katowice, the affordability of flats was more than twice as high as in Kraków).

4.2. Diversification of voivodeships in terms of income affordability of flats

In order to answer the third research question, the coefficient of variation and the ratio of the maximum to the minimum value were also used. The results are shown in Table 3.

Table 3

Measures of diversification of income affordability of flats indicators

Voivodeships	Measure	PRIMARY MARKET						SECONDARY MARKET					
		2012	2013	2014	2015	2016	average	2012	2013	2014	2015	2016	average
Dolnośląskie	CV	33%	22%	21%	25%	26%	26%	23%	19%	21%	20%	20%	21%
	max/min	3.2	3.7	3.6	3.4	4.8	3.7	3.2	2.9	2.9	2.9	2.5	2.9
Kujawsko - Pomorskie	CV	21%	34%	17%	18%	13%	21%	18%	18%	21%	18%	16%	18%
	max/min	2.3	3.3	2.0	1.9	1.5	2.2	2.1	2.0	2.2	2.2	1.9	2.1
Lubelskie	CV	58%	24%	14%	15%	19%	26%	18%	17%	16%	15%	23%	18%
	max/min	5.7	2.5	1.6	1.7	1.8	2.7	2.0	2.1	1.9	1.9	2.3	2.0
Lubuskie	CV	17%	25%	17%	7%	8%	15%	12%	11%	12%	10%	10%	11%

	max/min	1.7	2.3	1.9	1.3	1.3	1.7	1.6	1.5	1.5	1.4	1.5	1.5
	CV	26%	32%	28%	26%	17%	26%	19%	21%	19%	19%	20%	20%
Łódzkie	max/min	2.5	2.7	2.6	2.4	1.7	2.4	2.3	2.5	2.2	2.4	3.0	2.5
	CV	24%	21%	22%	28%	27%	24%	25%	23%	25%	24%	27%	25%
Małopolskie	max/min	3.3	3.3	3.1	4.1	3.3	3.4	4.0	3.0	3.9	3.3	3.6	3.6
	CV	25%	20%	12%	22%	15%	19%	28%	29%	23%	23%	25%	26%
Mazowieckie	max/min	3.1	2.2	1.7	4.2	1.7	2.5	3.2	3.8	2.6	3.0	2.9	3.1
	CV	16%	31%	41%	42%	8%	27%	14%	16%	17%	16%	21%	17%
Opolskie	max/min	1.7	2.4	2.9	3.0	1.3	2.3	1.7	1.9	2.0	1.9	1.9	1.9
	CV	28%	49%	38%	10%	13%	28%	14%	19%	16%	18%	16%	17%
Podkarpackie	max/min	2.6	4.0	3.4	1.5	1.5	2.6	2.1	2.1	2.0	2.3	1.9	2.1
	CV	21%	19%	18%	16%	8%	16%	22%	28%	36%	15%	29%	26%
Pomorskie	max/min	1.8	1.7	1.7	1.7	1.3	1.7	2.0	2.6	3.3	1.7	2.5	2.4
	CV	25%	22%	26%	23%	19%	23%	28%	22%	22%	27%	29%	26%
Pomorskie	max/min	3.0	3.0	2.9	3.3	2.8	3.0	3.4	2.3	2.5	3.3	3.6	3.0
	CV	23%	33%	31%	26%	33%	29%	20%	19%	20%	20%	19%	20%
Śląskie	max/min	2.5	3.5	3.8	2.7	2.8	3.1	2.9	2.9	2.8	2.4	2.5	2.7
	CV	90%	13%	18%	12%	23%	31%	20%	16%	13%	11%	18%	15%
Świętokrzyskie	max/min	6.9	1.5	1.8	1.4	1.8	2.7	2.3	1.7	1.7	1.5	1.9	1.8
	CV	22%	13%	10%	10%	10%	13%	10%	15%	14%	9%	15%	13%
Warmińsko - Mazurskie	max/min	2.2	1.7	1.5	1.4	1.4	1.6	1.6	1.9	1.7	1.5	2.1	1.7
	CV	13%	79%	28%	20%	13%	31%	22%	19%	16%	18%	16%	18%
Wielkopolskie	max/min	1.6	7.7	3.3	2.7	1.9	3.4	2.4	2.5	2.0	2.5	2.5	2.4
	CV	30%	62%	22%	40%	26%	36%	20%	18%	19%	21%	26%	21%
Zachodnio-pomorskie	max/min	3.8	8.7	2.6	6.6	2.6	4.9	2.3	1.9	2.2	2.5	2.6	2.3

Source: own calculation.

Using the variability coefficient as a measure, it was found that the diversity of the income affordability of flats in individual voivodeships was small or average. The smallest differences were in the following voivodeships: Kujawsko-Pomorskie, Lubelskie (SM), Lubuskie, Łódzkie (SM), Podlaskie (PM), Śląskie (SM), Świętokrzyskie (except for 2012), and Warmińsko-Mazurskie. The largest differentiation occurred in the following voivodeships: Dolnośląskie (PM), Łódzkie (PM), Mazowieckie (SM), Podkarpackie (PM, 2012-2014), Podlaskie (SM), Pomorskie (SM), Śląskie (PM), and Zachodniopomorskie (PM). The study of individual voivodeships in terms of the lowest and highest values of income affordability indicators indicates the existence of significant differences between counties in a given voivodeship. The highest differences were recorded in the following voivodeships: Dolnośląskie, Małopolskie, Mazowieckie (SM), Pomorskie, Śląskie, and Zachodniopomorskie (PM). In these voivodeships, affordability in the best counties was around three times higher than in the worst counties. The smallest differences were noted in the: Lubuskie, Podlaskie (PM), Świętokrzyskie and Warmińsko-Mazurskie voivodeships.

4.3. Voivodeship city compared to other cities in the voivodeship

The last research question concerned the income affordability of flats in the voivodeship city as compared to other cities in the same voivodeship. On the basis of Figures 1 and 2, it can be initially stated that, for 11 of the voivodeships, the results were in line with the expectations, or namely that, in voivodeship cities, the income affordability of flats is the lowest or almost the lowest, as compared with the rest of the voivodeship. This especially concerned the secondary market. Exceptions with lower affordability were, among others, counties which are particularly attractive for tourists, e.g. located in mountainous areas (Dolnośląskie voivodeship – Jelenia Góra and Kłodzko counties, Małopolskie Voivodeship – counties: Tatrzański, Nowotarski). In the capitals of the remaining five voivodeships, the affordability of flats was not the lowest within the given voivodeship. These were: 1) Pomorskie and Zachodniopomorskie – located on the Baltic sea with tourist destinations, ports, etc., 2) Śląskie – with: the largest number of cities with county rights (19), the Upper Silesian conurbation (Górnośląska-Zagłębiowska metropolis) and the highest population density, 3) Łódzkie and 4) Podkarpackie. For the Łódzkie and Podkarpackie voivodeships, rankings of flat affordability were prepared separately for the individual years. In Łódzkie Voivodeship, small changes in counties characterized by lower flat affordability than the city of Łódź were observed. For example, in some years, Łódź was ahead of the Łowicki County (PM) and the Tomaszowski, Zgierski, Pajęczański, Radomski and Łaski counties (SM) in terms of flat affordability. A similar phenomenon was observed in the Podkarpackie voivodeship. In some years, Rzeszów was ahead of the following counties on the

PM: Sanocki, Tarnobrzeg, Jasielski, Mielecki, Jaroslowski, Ropczycko-Sędziszowski, and on the SM: Rzeszowski, Ropczycko-Sędziszowski and Krośnieński in terms of flat affordability. It is worth noting that, in many cases, the differences in the income affordability of flats were insignificant, hence, among others, the changes in place in the prepared rankings can be observed. Next, it was checked whether the differences in the income affordability of flats in the voivodeship city and the other counties were statistically significant (the test procedure is described in the "Data and Methodology" section). The test results are presented in Table 5 (PM) and Table 6 (SM)⁵.

In most counties (or cities with county rights) of the Dolnośląskie Voivodeship, the income affordability of flats was statistically significantly higher than in the voivodeship city. An exception was the primary market in the Jeleniogórski County (where the income affordability of flats was statistically significantly higher than for Wrocław) and the primary market in Kłodzki county (for which the null hypothesis of the equality of averages was not rejected). In the case of some counties, the rejection of the hypothesis of the equality of variances or the hypothesis of the normality of distributions did not allow for a test of two averages.

In the case of the Kujawsko-Pomorskie voivodeship, the study was conducted for two voivodeship cities: Bydgoszcz and Toruń. As a result of the comparison of the counties with Bydgoszcz (PM), the H_1 hypothesis was accepted in the case of 7 counties. The comparison made for the secondary market showed that, in 5 counties, the affordability of housing was statistically significantly higher than in Bydgoszcz. Comparing the counties to Toruń (PM) allowed for the acceptance of H_1 in the case of 7 counties, and in the case of 2 counties there were no grounds for rejecting H_0 . The comparison on the SM allowed for the acceptance of H_1 for almost all counties in the voivodeship.

In the Lubelskie Voivodeship, it was found that, in 7 counties, the housing affordability on the PM was statistically significantly higher than in Lublin; for 2 counties it was determined that there were no grounds for rejecting hypothesis H_0 . In the case of the SM, a statistically significant higher affordability of flats than in Lublin was found in 12 counties.

In the case of the Lubuskie Voivodeship, the study was conducted for two voivodeship cities: Gorzów Wielkopolski and Zielona Góra. As a result of the comparison of the counties with Gorzów Wielkopolski (PM), hypothesis H_1 was accepted in the case of 3 counties; in the case of 1 county - hypothesis H_2 was accepted, and in the case of 1 county - H_0 was not rejected. The comparison conducted for the secondary market demonstrated that, in the case of 10 counties, hypothesis H_1 was accepted. In the case of 1 county, H_0 was not rejected. A comparison of the counties with Zielona Góra (PM) allowed for the acceptance of H_1 in the case of 6 counties. In the case of 2 counties, H_0 was not rejected. An analysis for the SM allowed for the acceptance of H_1 for all counties.

In the Łódzkie Voivodeship, it was found that, in 7 counties, the affordability of flats on the PM was statistically significantly higher than in Łódź; for 5 counties, no grounds were found for rejecting hypothesis H_0 . In the case of the SM, H_0 was not rejected for 15 counties, for 4 counties, there was a statistically significant higher housing affordability than in Łódź, while for 2 counties, a statistically significant lower affordability of flats was found than in Łódź.

In the Małopolskie Voivodeship it was found that, in 3 counties, the affordability of flats on the PM was statistically significantly higher than in Kraków; in 2 counties the affordability of flats on the PM was statistically significantly lower than in Kraków; for 2 counties, there were no grounds for rejecting the H_0 hypothesis. In the case of SM, for 11 counties, a statistically significant higher affordability of flats was found than in Kraków, while in 1 county, the affordability of apartments on the SM was statistically significantly lower than in Kraków.

In the Mazowieckie Voivodeship, it was found that, in 23 counties, the affordability of flats on the PM was statistically significantly higher than in Warsaw; there were no grounds to reject the H_0 hypothesis for 1 county. In the case of the SM, a statistically significant higher affordability of flats than in Warsaw was found for 6 counties; for 1 county, there were no grounds for rejecting the H_0 hypothesis.

In the Opolskie Voivodeship, it was found that, in 5 counties, the affordability of flats on the PM was statistically significantly higher than in Opole. In the case of the SM, for 7 counties, a statistically significant higher affordability of flats was found than in Opole.

⁵ The tables do not include counties for which data was incomplete.

Table 5

Comparison of the income affordability of flats in voivodship cities and counties - test results (PM)

Voivodship and its capital	Counties - no grounds to reject the hypothesis H_0	Counties - H_1 accepted	Counties - H_2 accepted	Counties - the test was not carried out (different variances or lack of normality of the distribution)
Dolnośląskie (Wrocław)	Kłodzki	Bolesławiecki, Dzierżoniowski, Głogowski, Jaworski, Legnicki, Lubański, Lubiński, Milicki, Oleśnicki, Oławski, Polkowicki, Średzki, Świdnicki, Wałbrzyski, Wołowski, Wrocławski, Ząbkowicki, Zgorzelecki, Jelenia Góra, Legnica	Jeleniogórski	Złotoryjski, Wałbrzych, Strzeleński, Trzebnicki
Kujawsko – Pomorskie (Bydgoszcz)	-	Brodnicki, Golubsko-Dobrzyński, Inowrocławski, Nakieński, Toruński, Włocławski, Włocławek	-	Aleksandrowski, Bydgoski, Chełmiński, Mogileński, Świecki, T, Żniński, Grudziądz
Kujawsko – Pomorskie (Toruń)	Bydgoski, Inowrocławski	Brodnicki, Golubsko-Dobrzyński, Włocławski, Świecki, Toruński, Grudziądz, Włocławek	-	Aleksandrowski, Chełmiński, Mogileński, Nakieński, Tucholski, Żniński
Lubelskie (Lublin)	Opolski, Tomaszowski	Lubartowski, Parczewski, Puławski, Radzyński, Włodawski, Biała Podlaska, Chełm	-	Bialski, Biłgorajski, Hrubieszowski, Lubelski, Łęczyński, Kraśnicki, Łukowski, Świdnicki, Zamość
Lubuskie (Gorzów Wlkp.)	Ślubiński	Krośniewski, Międzyrzeczki, Żagański	Sulęciński	Gorzowski, Nowosolski, Strzelecko-Drezdenecki, Świebodziński, Zielonogórski, Żarski
Lubuskie (Zielona Góra)	Strzelecko-Drezdenecki, Sulęciński	Krośniewski, Międzyrzeczki, Ślubiński, Świebodziński, Zielonogórski, Żagański	-	Gorzowski, Nowosolski, Żarski
Łódzkie (Łódź)	Pabianicki, Rawski, Brzeziński, Piotrków Trybunalski, Skierniewice	Bełchatowski, Kutnowski, Łaski, Pajęczański, Radomszczanski, Tomaszowski, Wieruszowski	-	Łęczycki, Łowicki, Poddębicki, Sieradzki, Wieluński, Zgierski
Małopolskie (Kraków)	Brzeski, Myślenicki	Bocheński, Miechowski, Tarnów	Nowotarski, Tatrzański	Chrzanowski, Krakowski, Limanowski, Nowosądecki, Olkusi, Oświęcimski, Tarnowski, Wadowicki, Nowy Sącz
Mazowieckie (Warszawa)	Wyszowski	Garwoliński, Gostyniński, Grodzki, Grójecki, Kozienicki, Legionowski, Łosicki, Miński, Mławski, Nowodworski, Otwocki, Piaseczyński, Płocki, Płoński, Pruszkowski, Przasnyski, Pułtowski, Schaczeński, Sierpecki, Warszawski Zachodni, Wołomiński, Ostrołęka, Radom	-	Ciechanowski, Ostrowski, Radomski, Siedlecki, Sokołowski, Węgrowski, Żuromiński, Żyrardowski, Płock, Siedlce
Opolskie (Opole)	-	Brzeski, Kluczborski, Krapkowicki, Nyski, Strzelecki	-	Kędzierzyński-Kozielski, Namysłowski, Opolski
Podkarpackie (Rzeszów)	Jasielski, Krosno	Bieszczadzki, Przemyński, Strzyżowski, Leski, Przemyśl	-	Dębicki, Jarosławski, Łańcucki, Mielecki, Ropczycko-Sędziszowski, Rzeszowski, Sanocki, Tarnobrzeg
Podlaskie (Białystok)	-	Augustowski, Grajewski, Kolneński, Sokółski, Łomża, Suwałki	-	Białostocki, Zambrowski
Pomorskie (Gdańsk)	Chojnicki, Gdański, Kartuski, Kościerski,	Słupski, Starogardzki, Tczewski, Słupsk	Pucki, Gdynia, Sopot	Bytowski, Człuchowski, Kwidzyński, Lęborski, Malborski, Nowodworski,

	Wejherowski			Wejherowski	
Śląskie (Katowice)	Bielski, Lubliniecki, Mikołowski, Bieruńsko- Lędziński, Zawierciański, Żywiecki, Bytom, Ruda Śląska, Rybnik, Siemianowice Śląskie, Zabrze, Żory	Dąbrowa Górnicza, Jastrzębie- Zdrój, Jaworzno	Będziński, Cieszyński, Kłobucki, Pszczynski, Tarnogórski, Chorzów, Częstochowa, Gliwice, Mysłowice, Sosnowiec, Tychy	Gliwicki, Raciborski, Rybnicki, Wodzisławski, Bielsko-Biała, Piekary Śląskie, Świętochłowice	
Świętokrzyskie	-	Ostrowiecki, Sandomierski, Jędrzejowski	-	Skarżyski	
Warmińsko - Mazurskie (Olsztyn)	Olsztyński, Ostródzki, Elbląg	Bartoszycki, Elbląski, Elcki, Giżycki, Piski, Szczycieński, Gołdapski, Węgorzewski	-	Braniewski, Działdowski, Iławski, Kętrzyński, Lidzbarski, Mrągowski, Nidzicki, Olecki, Nowomiejski	
Wielkopolskie (Poznań)	Wolsztyński	Chodzieński, Gnieźnieński, Leszczyński, Nowotomyski, Poznański, Słupski, Szamotulski, Turecki, Wągrowiecki, Kalisz, Leszno	-	Czarnkowsko-Trzcianecki, Gostyński, Grodzki, Jarociński, Kępniński, Kościański, Krotoszyński, Międzychodzki, Obornicki, Ostrowski, Ostreszowski, Pilecki, Pleszewski, Rawicki, Średzki, Śremski, Konin, Wrzesiński, Złotowski	
Zachodnio- pomorskie (Szczecin)	Gryfiński, Policki, Świdwiński, Koszalin	Choszczeński, Goleniowski, Myśliborski	Sławieński	Białogardzki, Gryficki, Kamieński, Kołobrzeczki, Koszaliński, Stargardzki, Szczecinecki, Wałecki, Łobeski, Świnoujście	

Source: own elaboration.

Table 6

Comparison of the income affordability of flats in voivodship cities and counties - test results (SM)

Voivodship and its capital	Counties - no grounds to reject the hypothesis H0	Counties - H1 accepted	Counties - H2 accepted	Counties - the test was not carried out (different variances or lack of normality of the distribution)
Dolnośląskie (Wrocław)	-	Bolesławiecki, Dzierżoniowski, Głogowski, Górowski, Jaworski, Jeleniogórski, Kamiennogórski, Kłodzki, Lubański, Lubięński, Lwówecki, Milicki, Oleśnicki, Oławski, Polkowicki, Strzeliński, Średzki, Świdnicki, Trzebnicki, Wałbrzyski, Wrocławski, Ząbkowicki, Zgorzelecki, Jelenia Góra, Legnica, Wałbrzych	-	Legnicki, Wołowski, Złotoryjski
Kujawsko - Pomorskie (Bydgoszcz)	-	Aleksandrowski, Brodnicki, Lipnowski, Wąbrzeski, Włocławek	-	Bydgoski, Chełmiński, Golubsko- Dobrzyński, Grudziądzki, Inowrocławski, Mogileński, Nakielski, R, Rypieński, Sępoleński, Świecki, Toruński, Tucholski, Włocławski, Żniński, Grudziądz
Kujawsko - Pomorskie (Toruń)	-	Aleksandrowski, Brodnicki, Bydgoski, Chełmiński, Golubsko- Dobrzyński, Inowrocławski, Lipnowski, Mogileński, Nakielski,	-	Grudziądzki, Radziejowski, Rypieński, Sępoleński

		Świecki, Toruński, Tucholski, Wąbrzeski, Włocławski, Żniński, Grudziądz, Włocławek		
Lubelskie (Lublin)	-	Bialski, Krasnostawski, Lubartowski, Łukowski, Opolski, Puławski, Rycki, Świdnicki, Tomaszowski, Biała Podlaska, Chełm, Zamość	-	Biłgorajski, Chełmski, Hrubieszowski, Janowski, Kraśnicki, Lubelski, Łęczyński, Parczewski, Radzyński, Włodawski, Zamojski
Lubuskie (Gorzów Wlkp.)	Ślubicki	Gorzowski, Krośnieński, Międzyrzeski, Nowosolski, Strzelecko-Drezdenecki, Świebodziński, Zielonogórski, Żagański, Żarski, Wschowski	-	Sulęciński
Lubuskie (Zielona Góra)	-	Gorzowski, Krośnieński, Międzyrzeski, Nowosolski, Ślubicki, Strzelecko- Drezdenecki, Sulęciński, Świebodziński, Zielonogórski, Żagański, Żarski, Wschowski	-	-
Łódzkie (Łódź)	Kutnowski, Łaski, Łowicki, Łódzki Wschodni, Opoczyński, Pabianicki, Pajęczański, Radomszczański, Skierniewicki, Tomaszowski, Wieluński, Wieruszowski, Zduńskowolski, Zgierski, Piotrków Trybunalski	Bełchatowski, Łęczycki, Poddębicki, S	Rawski, Skierniewice	Brzeziński, Piotrkowski
Małopolskie (Kraków)		Bocheński, Brzeski, Krakowski, Limanowski, Myślenicki, Nowosądecki, Olkuski, Oświęcimski, Wielicki, Nowy Sącz, Tarnów	Tatrzański	Chrzanowski, Dąbrowski, Gorlicki, Miechowski, Nowotarski, Proszowicki, Suski, Tarnowski, Wadowicki
Mazowieckie (Warszawa)	Wołomiński	Ciechanowski, Grodziski, Kozienicki, Otwocki, Radom, Siedlce	-	Białobrzegi, Garwoliński, Gostyniński, Grójecki, Legionowski, Lipski, Łosicki, Makowski, Miński, Mławski, Nowodworski, Ostrołęcki, Ostrowski, Piaseczyński, Płocki, Płoński, Pruszkowski, Przasnyski, Przysuski, Pułtusk, Radomski, Siedlce, Sierpecki, Sochaczewski, Sokołowski, Szydłowiecki, Warszawski Zachodni, Węgrowski, Wyszowski, Zwoleński, Żuromiński, Żyrardowski, Ostrołęka, Płock
Opolskie (Opole)	-	Brzeski, Kluczborski, Namysłowski, Nyski, Oleski, Opolski, Strzelecki	-	Głubczycki, Kędzierzyński- Kozielecki, Krapkowicki, Prudnicki
Podkarpackie (Rzeszów)	Łańcucki, Rzeszowski	Bieszczadzki, Dębicki, Jarosławski, Leżajski, Mielecki, Niżański, Przeworski, Stalowowolski, Krosno	-	Brzozowski, Jasielski, Krośnieński, Lubaczowski, Przemyski, Ropczycko- Sędziszowski, Sanocki, Strzyżowski, Tarnobrzegi, Leski, Przemyśl, Tarnobrzeg
Podlaskie (Białystok)	-	Augustowski, Białostocki, Bielski, Grajewski, Łomżyński, Sokółski, Łomża, Suwałki	-	Hajnowski, Kolneński, Moniecki, Sejneński, Siemiatycki, Suwalski, Wysokomazowiecki, Zambrowski

Pomorskie (Gdańsk)	Gdański, Kartuski	Lęborski, Tczewski, Słupsk	Wejherowski, Gdynia, Sopot	Bytowski, Chojnicki, Człuchowski, Kościerski, Kwidzyński, Malborski, Nowodworski, Pucki, Słupski, Starogardzki, Sztumski
Świętokrzyskie (Kielce)	-	Buski, Jędrzejowski, Kazimierski, Kielecki, Konecki, Opatowski, Ostrowiecki, Pińczowski, Skarżyski, Starachowicki, Staszowski	-	Sandomierski, Włoszczowski
Warmińsko – Mazurskie (Olsztyn)	Węgorzewski	Elcki, Giżycki, Kętrzyński, Lidzbarski, Mrągowski, Nowomiejski, Olsztyński, Ostródzki, Piski, Szczycieński, Gołdapski, Elbląg	-	Bartoszycki, Braniewski, Działdowski, Elbląski, Iławski, Lidzbarski, Mrągowski, Nidzicki, Nowomiejski, Olecki
Wielkopolskie (Poznań)	Poznański	Gostyński, Jarociński, Kolski, Krotoszyński, Ostrowski, Pilski, Poznański, Śremski, Turecki, Wrzesiński, Konin, Leszno	-	Chodziecki, Czarnkowsko- Trzcianecki, Gnieźnieński, Grodziski, Kaliski, Kępiński, Koniński, Kościański, Leszczyński, Międzybórz, Nowotomyski, Obornicki, Ostrzeszowski, Pilski, Pleszewski, Rawicki, Słupski, Szamotuński, Średzki, Wągrowiecki, Wolsztyński, Złotowski, Kalisz
Zachodnio- pomorskie (Szczecin)	Gryficki, Policki, Stargardzki, Koszalin	Choszczeński, Drawski, Goleniowski, Gryfiński, Myśliborski, Pyrzycki, Sławieński, Szczecinecki, Walecki, Łobeski	Kamieński, Kołobrzeczki, Świnoujście	Białogardzki, Koszaliński, Świdwiński

Source: own elaboration.

In the Podkarpackie Voivodeship, it was found that, in 5 counties, the affordability of flats on the PM was statistically significantly higher than in Rzeszów; for 2 counties, there were no grounds for rejecting the H_0 hypothesis. In the case of the SM, for 9 counties, a statistically significant higher availability of flats was found than in Rzeszów; for 2 counties, there were no grounds for rejecting the H_0 hypothesis.

In the Podlaskie Voivodeship, it was found that, in 6 counties, the affordability of flats on the PM was statistically significantly higher than in Białystok. In the case of the SM, a statistically significant higher affordability of flats than in Białystok was found in 8 counties.

In the case of the Pomorskie Voivodeship, it was found that, in 4 counties, the affordability of flats on the PM was statistically significantly higher than in Gdańsk; in 3 counties, the affordability of flats on the PM was statistically significantly lower than in Gdańsk, and for 5 counties, there were no grounds for rejecting the H_0 hypothesis. In the case of the SM, a statistically significant higher affordability of flats than in Gdańsk was found in 3 counties; in 3 counties the affordability of flats on the SM was statistically significantly lower than in Gdańsk, and for 2 counties, there were no grounds for rejecting the H_0 hypothesis.

In the Śląskie Voivodeship, it was determined that, in 11 counties, the affordability of housing on the PM was statistically significantly lower than in Katowice; in 3 counties the affordability of housing on the PM was statistically significantly higher than in Katowice; for 12 counties, no grounds for rejecting the H_0 hypothesis were determined. SM could not be tested due to the rejection of the hypothesis of a normal distribution for Katowice.

In the Świętokrzyskie Voivodeship, it was found that, in 3 counties, the affordability of flats on the PM was statistically significantly higher than in Kielce. In the case of the SM, a statistically significant higher affordability of flats than in Kielce was found for 11 counties.

In the Warmińsko - Mazurskie Voivodeship, it was found that, in 12 counties the affordability of flats on the PM was statistically significantly higher than in Olsztyn; for 3 counties, there were no grounds for rejecting the H_0 hypothesis. In the case of the SM, for 16 counties, a statistically significantly higher affordability of flats was found as compared to in Olsztyn; for 1 county, there were no grounds for rejecting the H_0 hypothesis.

In the Wielkopolskie Voivodeship, it was determined that, in 11 counties, the affordability of housing on the PM was statistically significantly higher than in Poznań; for 1 county there were no grounds for rejecting the H_0 hypothesis. In the case of the SM, a statistically significantly higher affordability of flats than in Poznań was found in 12 counties; for 1 county, there were no grounds for rejecting the H_0 hypothesis.

In the Zachodniopomorskie Voivodeship, it was determined that, in 3 counties, the affordability of housing on the PM was statistically significantly higher than in Szczecin; in 1 county, the affordability of flats on the PM was statistically significantly lower than in Szczecin, whilst for 4 counties, it was determined that there were no grounds for rejecting the H_0 hypothesis. In the case of the SM, a statistically significantly higher affordability of housing than in Szczecin was found for 10 counties; in 3 counties, the affordability of housing was found to be statistically significantly lower than in Szczecin, and in 4 counties, there were no grounds for rejecting the H_0 hypothesis.

5. Discussion and conclusions

The study which was conducted allows for the formulation of the following conclusions:

1. changes in the income affordability of flats in voivodeship cities in Poland were small over the course of the analyzed time period;
2. the average diversification of voivodeship cities in terms of the income affordability of flats was small (slightly higher on the secondary market as compared to the primary market). However, the differences in the income affordability of flats between the extreme cities were, in this respect, high. It was further found that the diversification of cities decreased, with respect to income affordability of flats, over the studied time period;
3. the average diversification of the income affordability of housing in individual voivodeships was, in some voivodeships - small, and in others - average. The maximum differences in income affordability of flats between counties of a given voivodeship were large;
4. the income affordability of flats (on the primary and secondary markets) in the voivodeship city for the majority of voivodeships was lower than in other counties of this voivodeship - however differences in the affordability were not always statistically significant. The exceptions were the following voivodeships: Pomorskie, Zachodniopomorskie, Śląskie, Łódzkie and Podkarpackie; in their case, the affordability of flats in the voivodeship capitals was not the lowest in the entire voivodeship.

In summary, it should be noted that an interpretation of income affordability of flats measured with the help of the given indicator should be made with great care. First of all, the average salaries in the counties may differ from the median salaries in the counties. Second, the acceptance of gross pay as the measure of pay (rather than disposable income) increases housing affordability. Third of all, this indicator assumes that the buyer is a single individual. In the case of a household (two wage-earners) such an estimated affordability will be underestimated. Fourthly, this indicator does not take into account the size of the flat to be purchased (usually, a lower price per m^2 characterizes flats of a larger total size). Fifthly, home prices on the primary market do not take into account the finishing costs. Nevertheless, although the construction of the indicator which was applied in this study introduces some limitations on its use, it should be concluded that it can be used to assess the diversity of income affordability of flats in Poland - which was the purpose of the article.

It is also worth noting that, in this study, counties and cities with county rights were accepted as local markets. These are, therefore, local housing markets which are designated administratively and not functionally. In practice, the geographic boundaries of local housing markets are determined by the need to travel to work. In the United Kingdom, functional markets are based on so called *Travel to Work Areas* (TTWA). Areas determined in this way can be treated as functional housing markets (14th Annual...2018).

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