THE COMPARATIVE ANALYSIS OF ASKING AND TRADED PRICE INDICES IN DIFFERENT FLOOR AREA SUBSEGMENTS OF THE RESIDENTIAL PROPERTY MARKET

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Abstract

There are several acknowledged methods for determining residential property price indices. However, all of them have their drawbacks and advantages and reflect the averaged real movements of prices with varying accuracy. The paper attempts to answer the question: How faithfully do indices based on asking prices reflect the movements of traded prices? As a result we will find out whether, in the situation when property price indices cannot be determined, asking price based indices can be used instead. The paper specifies theoretical and practical aspects of constructing residential property price indices on the basis of asking and traded prices. It also contains an empirical analysis of these two index types.

Key words: *real estate market, real estate price indices.*

JEL Classification: R20.

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1. Introduction

Price movements on the residential property market are difficult to observe. This is due particularly to the specific character of this market where price indices cannot be constructed by means of methodologies applied on other markets (WOOD 2005) because the very observation of prices is performed in a non-standard way (KOKOT 2015A). Individual transactions on the residential property market concern diversified objects. Every property is different, as it has its own market and specific attributes. Market attributes are the product features whose impact on its value can at least be approximated, thus determining the realistic market price of this product. In the case of the property market this can be, for instance, the location of the property and its environment, the technical condition and type of building it is located in, the floor surface area, the functional layout of an apartment, its location in the building (floor, southern or northern exposure) or its standard. Property specific attributes are such features whose effect on the property value is hard to determine, but which in some situations may influence the traded price as individual buyers perceive them as relevant. In the case of a residential property such features include: interior design, a shower or a bathtub, the

color of bathroom tiles, the fitting-out of the building (e.g. a lift, a refuse disposal chute), a location convenient for the buyer (close to work, their parents' apartment, a tram line, etc.). Due to the combination of all the property attributes and the buyers' obscure interests, the marketed properties and their traded prices are highly diversified. Therefore, the fact that marketed objects are not uniform in different periods of time is a key problem when constructing property price indices (GUO, et. al. 2014). At the same time many financial institutions and individual buyers are substantially interested in access to information on whether property prices are rising or dropping, and at what rate (FRANCKE 2010). Thus, naturally, the question of how to determine property price indices so that they reflect market price movements as accurately as possible arises. The methodology of research into the price dynamics on the property market is still a subject of scientific studies, while the precise estimation of the property price indices is an essential issue for researchers dealing with the property market (CLAPP, GIACOTTO 1992).

Traded prices are a principal source for calculating property price indices. There are three elementary methods of determining the indices on the basis of these prices. The first consists of calculating the mean or median of prices observed on the market over a certain period of time and then referring it to a corresponding value, period-to-period, disregarding aspects related to sample homogeneity. In the case of a slightly more advanced version of this method, we can determine indices for more homogeneous groups of properties. The essential advantage of this method is the simplicity of computations, while its disadvantage is the risk that, in different periods of time, the means will be determined for samples that vary in terms of qualitative structure. In the second method, the indices are calculated based on the re-sale price of the same property. Indices for individual properties are determined, and then a mean is drawn for the whole market. Here the problem lies in the changes made to the residential property attributes between transactions that affect the traded prices. The third is a hedonic method where a periodic appraisal is made by means of a specific model (e.g. a regression function) in which the value is a function of the property market attributes. What is regarded as a principal drawback of this method is the necessity to collect and regularly update plenty of data essential to the property appraisal (NICHOLAS, SCHERBINA 2013). The above-mentioned methods are applied in their many variations or, occasionally, in a hybrid way (TROJANEK 2008).

In this article we determine residential property price indices by means of the first of the above methods, based on actual traded prices and on asking prices coming from one of the popular real estate sales websites. The main purpose of this study is to find out how accurately the indices calculated on the basis of asking prices reflect the movements of traded prices. This is interesting in so far as calculating indices according to asking prices is much simpler than basing them on traded prices because, generally speaking, we can avoid collecting data on transactions happening on the housing market which often turn out non-representative anyway. Only a few related analyses have been published so far, yet their results are quite optimistic. For instance, the correlation coefficient between the indices of mean quarterly asking and traded prices in Poznań in 1996-2005 reached the level of 0.99 (TROJANEK 2008). Also in several other cities, in the period between 2006-2012, the coefficient value exceeded 0.9 (although in some cities it reached lower values) (DITTMANN 2013). There are more reasons why basing property price indices on traded prices is controversial (KOKOT 2015B):

1. small amount of data on concluded deals (few transactions on the market),
2. not enough information in notarial deeds about the traded residential properties, which sometimes prevents identification of the elementary attributes of the property, thus making it hard to decide if the unit price is adequate to the marketed property (e.g. the use of different property size measures such as cubature, footprint area, total floor area, usable floor area, etc.),
3. false information in notarial deeds concerning traded prices – for various reasons they are lower or higher than the price that was actually paid,
4. errors made when entering data to the price and value registers,
5. substantial delays in entering notarial deeds in the price and value registers.

Points 2-5 can be regarded as problems of a technical and organizational nature. However, the first of the above listed problems is an effect of property market characteristics and may constitute an essential barrier when constructing residential property price indices (BOKHARI, GELTNER 2010). All the above-mentioned issues encourage the search for other methods and data sources that can be used

to calculate property price indices and which will accurately represent the actual movements of prices on the housing market.

2. Research Method

In this article the authors determined chain and fixed-base indices of residential property prices in Szczecin observed between January 2011 and October 2014, broken into the following groups of flats according to their floor area:

1. under 38 m²,
2. from 38 m² to 60 m²,
3. from 60 m² to 90 m².

The indices were calculated using the formulas:

1. chain indices:

$$i_t = \frac{X_t}{X_{t-1}} \quad (1)$$

2. fixed-base indices:

$$I_t = \frac{X_t}{X_T} \quad (2)$$

where:

X_t – the measure of the mean unit price in the period (month)

X_{t-1} – the measure of the mean unit price in the period (month) preceding the period for which the index is being determined,

X_T – the measure of the mean price unit in the base period (January 2011).

For each floor-area group the indices were determined on the basis of 3 types of data on prices:

1. traded prices – arithmetic means of traded prices identified in a given month were calculated:

$$\bar{X}_t = \bar{ct}_t \quad (3)$$

where:

$\bar{ct}_t$ – the arithmetic mean unit price in the period (month) for which the index is being determined.

2. smoothed traded prices – a 7-period moving average of the arithmetic mean of unit prices identified in individual months of observation:

$$X_t = \frac{\bar{ct}_{t-3} + \bar{ct}_{t-2} + \bar{ct}_{t-1} + \bar{ct}_t + \bar{ct}_{t+1} + \bar{ct}_{t+2} + \bar{ct}_{t+3}}{7} \quad (4)$$

3. asking prices – mean unit prices published on one of the popular websites.

The data sets included the purchase of both the flats as separate ownership units as well as cooperative member ownership rights to those flats. Mean traded prices were determined on the basis of a data set of 7,841 transactions. In all of the floor-area groups discussed here there were 2 to 123 transactions concluded per month. Mean asking prices were established based on a set of 397,150 offers, which gave 953-4,560 offers monthly in each of the floor-area categories.

The elementary measure of the traded price of a unit in a given month was the arithmetic mean, although it is known to be sensitive to outliers (particularly to extreme ones), which can distort its value as the measure of the average level of the observed phenomenon. A median is considered to be free of such defects, hence recommended in studies on the average level of phenomena featuring irregular (asymmetric) distributions (KOKOT 2015a). Despite this fact, the authors intentionally used the arithmetic mean due to the fact that the average asking prices are expressed by means of this measure. In this manner, they used the same methodology to express average prices coming from different sources (asking and traded prices).

Seven period moving averages were applied since shorter-period moving averages do not sufficiently eliminate the effect of random fluctuations, and 6-period moving averages, due to the even number of periods, require computing procedures, i.e. centering, so that their values can be ascribed to individual periods (KOKOT, BAS 2013). The drawback of this method, however, is "losing" observations from the initial and final periods (HOZER et al. 2002).

The essential flaw of taking the average unit asking prices directly from the website is the transience of information, as the website does not publish historical data (in the case of the website used as the data source in this study, the oldest information was three months old). Therefore, regular

observation of website publications is necessary. Other disadvantages include the lack of information about the method of calculating mean prices, the risk that the method can be changed overnight, or that the website can be taken down. What is more, the service may arbitrarily apply a system of breaking down observations into specific floor-area categories which, for the sake of result comparability, forces a corresponding system to be used in the remaining data sets. This could be remedied by conducting observations and collecting data on offers independently.

The following figures can be found below:

1. graphic representation of asking, traded and smoothed traded prices of flats in the above-mentioned floor area groups,
2. graphic and analytic representation of the trends of linear functions estimated by means of the least squares method for asking, traded and smoothed traded prices of flats in the above mentioned floor area groups,
3. graphic representation of chain indices of asking prices and smoothed traded prices of flats in the above-mentioned floor area groups,
4. graphic representation of fixed indices of asking prices and smoothed traded prices of flats in the above-mentioned floor area groups, ,
5. tables with the values of Pearson linear correlation coefficients for the series of:
 - smoothed traded prices and asking prices,
 - chain indices of smoothed traded prices and asking prices,
 - fixed-base indices of smoothed traded prices and asking prices,
 with and without shifting from -6 to +6 periods.

3. Research Results and Discussion

Figures 1-3 show the movements in the asking, traded and smoothed traded prices in the period under study in individual floor area groups along the trend lines. Below the diagrams, the functional equations of these trends are given.

Fig. 1. Asking, traded and smoothed traded prices of flats with a floor area under 38 m². Source: own study.

$$\hat{C}_t^{O(0-38)} = 5103,93 - 11,75 \times t$$

$$\hat{C}_t^{T(0-38)} = 4312,78 - 9,90 \times t$$

$$\hat{C}_t^{Tw(0-38)} = 4320,00 - 10,57 \times t$$

Fig. 2. Asking, traded and smoothed traded prices of flats with a floor area from 38 to 60 m². Source: own study.

$$\begin{aligned}\hat{C}_t^{O(38-60)} &= 4884,58 - 14,51 \times t \\ \hat{C}_t^{T(38-60)} &= 4192,88 - 13,79 \times t \\ \hat{C}_t^{Tw(38-60)} &= 4211,34 - 15,10 \times t\end{aligned}$$

Fig. 3. Asking, traded and smoothed traded prices of flats with a floor area from 60 to 90 m². Source: own study.

$$\begin{aligned}\hat{C}_t^{O(60-90)} &= 4658,67 - 13,49 \times t \\ \hat{C}_t^{T(60-90)} &= 3974,82 - 9,74 \times t \\ \hat{C}_t^{Tw(60-90)} &= 4006,51 - 11,69 \times t\end{aligned}$$

The analysis of Figures 1-3 leads to the following conclusions:

1. The line representing traded prices is jagged to such a significant extent that there is basically no doubt that their values do not correspond to a typical market price as, by nature, prices on the real property market do not change so abruptly and their level is susceptible to random factors, such as the qualitative structure of flats traded in the individual months. This effect cannot be eliminated by dividing the traded prices into groups according to the floor area of flats on offer. With such a volatility of monthly average prices it is hard to grasp the general trends in price movement.
2. The effect of the jagged course line representing traded prices is significantly alleviated by smoothing it with the 7-period moving averages. Nevertheless, also in this case, their fluctuations are substantial enough to raise doubts if they accurately represent the typical market price.
3. The average asking prices are considerably higher than the traded prices (on average by 20%), and their course is much more balanced, even than that of the smoothed traded prices.
4. The traded, smoothed traded and asking prices are subject to the same macro-fluctuations, which is reflected by the fact that, in the corresponding periods of time, their values are "over" or "under" the lines of analytical trends.

It should be noted that the gradients of the trend function that inform us about the average monthly movement of individual types of prices are similar, which means that, in the longer term (in this study, this is an almost 4-year-period), the price movements calculated on their basis will be similar too. For instance, the percentage relations of the gradients multiplied by 12 (to capture annual movements) to the absolute terms of trend functions determined for the 0-38 m² group are: for asking prices -2.76%, for traded prices -2.75%, and for smoothed traded prices -2.94%. These are the values of the average annual movements of individual types of prices in relation to the average price at the beginning of the study period, i.e. in January 2011. This gives reason to believe that, on the real property market, price changes are accurately reflected by the movements of asking prices.

Figures 4-6 show the movements in the chain indices [determined by means of formula (1)] of asking prices and smoothed traded prices in individual floor area groups.

Fig. 4. Values of chain indices of asking prices and smoothed traded prices in a group of flats with a floor area under 38 m². Source: own study.

According to the above diagrams, the conclusion can be drawn that both the asking prices and the smoothed traded prices are not reliable as values on the basis of which short-term (one-month, in the case of this study) price movements can be determined. The indices indicate the likelihood of considerable fluctuations, even higher than 2% from month-to-month, and, although the level of a price change may not be sound evidence that the above-applied method is reliable, frequent changes (subsequent downward and upward movements) of indices give reason to believe that indices

calculated in this way do not reflect actual price movements accurately. It should also be noted that indices determined on the basis of asking prices are much less volatile. What is also interesting is that the periods of high volatility of both types of indices do not occur simultaneously. To the contrary, there are moments when one of them is rising, while the other is falling.

Fig. 5. Values of chain indices of asking prices and smoothed traded prices in a group of flats with a floor area from 38 to 60 m². *Source:* own study.

Fig. 6. Values of chain indices of asking prices and smoothed traded prices in a group of flats with a floor area from 60 to 90 m². *Source:* own study.

On the other hand, frequent changes of direction can imply their self-adjustment, which means that, if in a given period the index value is overrated (too big), it will adjust itself by being underrated (too low) in the subsequent period (or periods). If such self-adjustment really worked, this would mean that the indices can be used to determine property price movements over long periods of time. In the light of such conclusions it seems that it is not advisable to use chain indices calculated in this way to represent short-term price movements. In order to find out if the proposed mean price measures can be applied to determine long-term changes in property prices, the authors calculated

fixed-base indices based on asking prices and smoothed traded prices using formula (2). The research results for individual floor area groups are shown in Figures 7-9.

Fig. 7. Values of fixed-base indices of asking and smoothed traded prices of flats with a floor area under 38 m². Source: own study.

Fig. 8. Values of fixed-base indices of asking and smoothed traded prices of flats with a floor area from 38 to 60 m². Source: own study.

The diagrams show that fixed-base indices established on the basis of smoothed traded prices and asking prices have similar courses. Even though they drift apart in some periods of time, with differences between them occasionally reaching 5pp, their lines periodically reach similar values, especially when the market is stable. The course of indices based on smoothed traded prices is more jagged with frequent sudden drops and gains. The line of indices based on asking prices is more even and seems to indicate market trends more explicitly, i.e. its drops and gains are less frequent. What is interesting is that in the 0-38 m² and 38-60 m² floor area groups, i.e. in those groups where the traded price index line is moderately jagged, the asking price indices are generally higher than the smoothed traded price ones. It can thus be assumed that the asking price indices respond more gently to signals from the market, at least during times of slow downtrends. This leads to the conclusion that the

movements of asking prices, particularly if observed over a long period of time, reflect changes in traded prices on the real property market well. It is difficult to decide which type of prices are a better measure of the actual changes on the market. Each of them has its advantages and disadvantages.

Fig. 9. Values of fixed-base indices of asking and smoothed traded prices of flats with a floor area from 60 to 90 m². *Source:* own study.

The traded prices are, by nature, closer to the market. However, their relative scarcity and the related, periodically diversified qualitative structure of flats on offer together with the factors mentioned above in the introduction to this paper give reason to believe that the measures of average prices based on them do not properly describe the objective market situation. On the other hand, asking prices are not the prices at which the properties are ultimately traded; therefore, the mean measures that are based on them do not reflect the mean market price. When we calculate indices based on them, we do not assume that they are subject to the same fluctuations as traded prices. Their advantage over traded prices lies, on the one hand, in easy access to databases, and on the other hand, in their large number, which helps reduce the impact of random factors (especially the diversified qualitative structure of properties on sale in different periods of time). Still, it is essential to use paid websites as the database source, or ones where properties on sale are available for a fixed period of time. Additionally, the service should be popular enough to provide a satisfying volume of data in order to provide access to a sufficient number of standing offers; hence the mean asking prices will not be blurred by out-of-date information.

During the last stage of this research for each of the floor area groups the authors determined Pearson coefficients of linear correlation between:

1. the series of smoothed traded prices and asking prices,
2. the series of chain indices of smoothed traded prices and asking prices,
3. the series of fixed-base indices of smoothed traded prices and asking prices.

The correlation coefficients were calculated for the series that were consistent in terms of the period to which certain values were assigned and which were shifted in time. It was the values in the series of prices, and chain and fixed-base indices of smoothed traded prices that were assigned to actual periods of time, while the series of prices, and chain and fixed-base indices of asking prices were shifted in time. The results are presented in Tables 1-3. The highest values of the correlation coefficients have been highlighted.

Table 1

Coefficients of correlation between series of smoothed traded prices and asking prices

	Floor area group		
Shift	0-38	38-60	60-90

-6	0.9478	0.9885	0.9383
-5	0.9504	0.9892	0.9276
-4	0.9490	0.9876	0.9231
-3	0.9443	0.9862	0.9181
-2	0.9389	0.9822	0.9149
-1	0.9309	0.9767	0.9108
0	0.9202	0.9663	0.9106
1	0.9034	0.9530	0.9055
2	0.8809	0.9366	0.8939
3	0.8488	0.9188	0.8758
4	0.8111	0.8992	0.8545
5	0.7654	0.8788	0.8326
6	0.7164	0.8551	0.8114

Source: own study.

Table 2
Coefficients of correlation between series of chain indices of smoothed traded prices and asking prices

Shift	Floor area group		
	0-38	38-60	60-90
-6	0.1285	0.2124	0.1595
-5	0.3344	0.2673	0.0205
-4	0.5287	0.0745	-0.0121
-3	0.0457	0.1524	0.1212
-2	0.1091	0.0446	0.0363
-1	0.0945	0.2872	-0.0579
0	0.1868	-0.0791	-0.0292
1	0.0282	0.1380	0.0572
2	0.2551	0.0768	0.1103
3	0.0592	0.1349	0.0502
4	0.3383	-0.0161	0.0377
5	0.2500	0.1135	-0.1252
6	0.1505	0.0877	-0.2527

Source: own study.

Table 3
Coefficients of correlation between series of fixed-base indices of smoothed traded prices and asking prices

Shift	Floor area group		
	0-38	38-60	60-90
-6	0.9422	0.9889	0.9333
-5	0.9480	0.9896	0.9215
-4	0.9463	0.9868	0.9165
-3	0.9391	0.9849	0.9109
-2	0.9333	0.9807	0.9076
-1	0.9274	0.9753	0.9034

0	0.9179	0.9649	0.9029
1	0.9008	0.9516	0.8967
2	0.8743	0.9353	0.8852
3	0.8403	0.9184	0.8642
4	0.7998	0.8995	0.8404
5	0.7512	0.8772	0.8181
6	0.7005	0.8521	0.7945

Source: own study.

When analyzing the above results, we can conclude that the measures of mean traded prices are strongly correlated – in each of the floor area groups the correlation coefficient value is higher than 0.9, exceeding 0.96 in the group of flats with the largest floor area (38-60 m²). The correlation coefficient values are even higher when the price series are shifted backwards, reaching maximum values at the time shift of -5 months in the case of small and medium flats, and -6 in the case of large flats. Although the differences in the coefficient values with and without the time shift are minute, they imply that asking prices anticipate traded prices, which is an effect reverse to what had been expected. On the basis of the calculations in this paper it is rather difficult to consider it a general tendency as this study deals only with a local market and, as had already been mentioned, there are only slight differences between the coefficient values with and without the time shift. However, the observed effect gives reason to similar studies covering different research periods and other local markets. Another interesting observation is the weak correlation of the chain index series, which confirms that at least one of the methods of mean price measurement applied here to determine the indices (mean smoothed traded prices and mean asking prices) is not recommended for studying short-term price movements on the real property market, the "worst" being the method using smoothed traded prices, as the line of indices based on these prices fluctuates more dynamically and frequently. Obviously, this does not give reason to support the opinion that the method based on asking prices is fully reliable. Despite the weak correlation between the chain index series, the series of fixed-base indices are strongly correlated, which is demonstrated by the values of the correlation coefficient for the series without time shifts. This is similar to the price series over 0.9 that increase when shifted backwards to reach maximum values at -5 months in the case of small and medium flats and -6 months in the case of big flats. High values of the correlation coefficient give reason for drawing the conclusion that the aforementioned methods reflect long-term price movements on the real property market in a similar way. Hence, if two logically constructed methods give much the same results, they are highly likely to be reliable. Similarly to the study on the correlation within the series of chain indices, it is hard to decide which method is better, although a smoother, less jagged course of indices based on asking prices may imply that it is in fact the asking prices that should be regarded as a more accurate representation of price movements on the real property market.

4. Conclusions

The article presents the results of the study on improving the methods of calculating indices of residential property prices on the basis of different mean price measures (for asking and traded prices). The authors have demonstrated that, on the housing market in Szczecin, for the purpose of this study divided into three groups according to the floor area of flats on offer, indices based on asking prices and smoothed traded prices depict long-term price movements on the market in a similar way (which is manifested by strongly correlated series of fixed-base indices), while differing in describing short-term price movements. The lines of indices based on asking prices are more even and their course less jagged than is the case for indices determined based on smoothed traded prices. This gives reason to believe that asking prices represent real property price movements reliably enough, and perhaps even better than traded prices, especially in the long-term perspective. The above-presented research is to be continued in order to confirm if the same regularities occur on other local real property markets, and to improve the methods for smoothing the series of real property prices and indices.

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