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**TESTS FOR THE PRESENCE OF PRICE CONVERGENCE  
ON RESIDENTIAL PROPERTY MARKET  
IN SEVERAL DISTRICTS OF SZCZECIN IN 2006–2009**

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**Abstract**

Neighbouring local property markets are not separate realities. They influence one another and create an interrelated system of supply and demand. Some of these interrelations are convergent, while others result in contradictory trends on the markets. Convergence is a term denoting a process of some phenomena approaching its normative level. Tests for the presence of convergence help to assess if the objects under observation show resemblance in the context of the observed phenomenon, and to find out how long it takes for this resemblance to be complete. In this paper, I propose the application of methods normally used in tests for convergence for the purpose of the analysis of trends of the average residential property prices in some districts in Szczecin over the time range of 2006–2009, that is during the housing bubble on the residential property market. The study will provide information if such a market phase encourages price convergence.

**Keywords:** price convergence, residential property market

**JEL classification:** C38, R30

## **Introduction**

Local property markets are not separate realities where market processes run in isolation from the neighboring markets. The phenomena that determine supply and demand on one local property market leave impact on the market processes in its neighbourhood. The influence of one local market on the others can be either convergent or divergent. In the property market analysis, it is important to adequately assess the attractiveness of a given location in terms of a potential rate of return on investment. The local markets where the property prices are low are likely to experience a rise in prices, thus making investments more profitable. The observation of price trends on diverse property markets can be quite helpful in the analysis process. Prices in chosen locations may rise at a faster pace (converge) than on the expensive markets. In such a case, we talk about price convergence. When used in economics, the term originates from the studies on “levelling off of the economic development as a result of many years of growth rates in individual economies” (Lis, 2013). The forerunners in the research into the convergence of world economies are Barro and Sala-i-Martin (i.e. Barro, Sala-i-Martin, 1992; Sala-i-Martin, 1996). An interesting contribution in this field has been made by Bernard and Jones, who insist that it is necessary to take into consideration a wide range of aspects influencing the equalisation of national growth levels (Bernard, Jones, 1996). In the Polish literature, income convergence has been discussed by Batóg and Lis (Batóg, Batóg, 2006a, 2006b; Lis 2008). In classical deterministic convergence the following types are distinguished:

- type  $\beta$  (absolute and conditional),
- type  $\gamma$ ,
- type  $\sigma$ ,
- type  $\alpha$ .

The tests for the type  $\beta$  convergence are based on the regression analysis. In the analysis of the type  $\gamma$ , Kendall’s rank concordance coefficient is used. In the case of the type  $\sigma$ , the dispersion analysis is applied, while the type  $\alpha$  is examined by means of the relations among the directional trend indices determined for the boundary observations in every interval (Lis, 2013).

The paper proposes testing for price convergence on the residential property market by means of the methodology used originally for detecting income convergence. Special emphasis is put on the price convergence observed during the 2006–2009 housing bubble (data have been aggregated on a quarterly basis), that was followed by a slowdown in the world economy or, in some countries, by the economic crisis. The study has made it possible to determine if in the times of a housing bubble the local property markets saw the price convergence or,

quite the contrary, the price divergence. Geographically, the study embraced the area of the city of Szczecin. What was taken into consideration were the city districts where the transaction prices were the highest, i.e. Warszewo, Pogodno, Gumieńce, and the lowest (Drzetowo, Turzyn, Śródmieście Zachód). In fact, the latter group of districts did not observe the lowest transaction prices, but they were selected for the study because in the districts where the recorded prices were actually the lowest, the number of the recorded transactions did not allow for building proper time series. In this particular instance, price convergence means that the average prices in the specified parts of Szczecin tended to the same level.

### 1. Convergence of type $\beta$ , $\sigma$ , and $\alpha$

The concepts of convergence that are the most common in scientific research are  $\beta$ -convergence and  $\sigma$ -convergence. The former type is subdivided into absolute convergence and conditional convergence. The absolute convergence means a situation which arises when the less developed economies tend to grow at faster rates than the richer economies. Such a type of convergence is measured by means of the  $\beta$  coefficient in the regression equation (1):

$$\gamma_{i,t_0,t_0+T} = \alpha - \beta \ln(Y_{i,t_0}) + \xi_{i,t} \quad (1)$$

where:

$$\gamma_{i,t_0,t_0+T} = \frac{\ln\left(\frac{Y_{i,t_0+T}}{Y_{i,t_0}}\right)}{T},$$

$Y_{i,t_0}$  – the level of the analyzed phenomenon (average residential property price) in the  $i$ -th object (city) in the time range  $t_0$  (the initial quarter),

$Y_{i,t_0+T}$  – the level of the analysed phenomenon in the time range  $t_0 + T$  (the initial quarter),

$T$  – the length of the interval of convergence empirical verification,

$\alpha, \beta$  – the model parameters,

$\xi_{i,t}$  – the random component.

The interpretation of the model parameters focuses on the  $\beta$  parameter. If it is found to be positive and statistically significant, we say that the objects show absolute  $\beta$ -convergence.

The second type is  $\sigma$ -convergence. We say that a group of objects is  $\sigma$ -convergent if the dispersion of the analysed phenomenon (the average residential property prices) is reduced. The simplest method to confirm the prevalence of  $\sigma$ -convergence is to find out if the inequality

$$\sigma_{\ln Y_{t_0}} - \sigma_{\ln Y_{t_0+T}} > \tag{2}$$

holds true,

where:

- $\sigma_{\ln Y_{t_0}}$  – the standard deviation of the analysed phenomenon in the study group of objects in the time range  $t_0$ ,
- $\sigma_{\ln Y_{t_0+T}}$  – the standard deviation of the analysed phenomenon in the study group of objects in the time range  $t_0 + T$ .

The last method used in this study to assess the level of convergence is the  $\alpha$ -convergence measurement. In order to test for the convergence presence, the directional trend indices ( $\alpha_1$ ) for the logarithms of the analysed phenomenon values are compared. The trends are estimated for maximum and minimum values in each time range  $t$ . The observations of the individual periods of time do not have to be the values for the same object. Such trends are called boundary trends:

$$\ln \left( \max_i Y_{it} \right) = \alpha_{1\max} t + \alpha_{0\max} + \xi_{\max t} \tag{3}$$

$$\ln \left( \min_i Y_{it} \right) = \alpha_{1\min} t + \alpha_{0\min} + \xi_{\min t} \tag{4}$$

where:

- $\max_i Y_{it}$  – maximum values of the analysed phenomenon reached by the objects in individual time periods of observation,
- $\min_i Y_{it}$  – minimum values of the analysed phenomenon reached by the objects in individual periods of observation,
- $\alpha_{1\max}, \alpha_{0\max}$  – the parameters of a linear trend for maximum values,
- $\alpha_{1\min}, \alpha_{0\min}$  – the parameters of a linear trend for minimum values,
- $\xi_{\max t}, \xi_{\min t}$  – the random trend components.

When the assessments of directional parameters are statistically significant and

$$\hat{\alpha}_{1\max} < \hat{\alpha}_{1\min} \tag{5}$$

then we have the  $\alpha$ -convergence.

## 2. Testing for Price Convergence in the Districts of Szczecin

The collected data concerned the average transaction prices of the flats located in the aforementioned administrative districts of the city of Szczecin. As stated in the introduction, the analysis covered the time of the housing bubble on the residential property market, i.e. the time range of 2006–2009. The data were presented on the quarterly basis. The total number of the transactions used in the study was almost 2,200. Figure 1 shows the trends of the average prices of the flats sold in the districts. In all the analysed districts, the unit price trends were similar. Over two years of 2006–2007, the local market saw a dynamic rise in the prices, followed by another two years of relative stability. In 2010 a market price adjustment took place, accompanied by an even more dramatic plunge in the number of transactions when strict credit policies were introduced by banks, thus slowing down the residential property market.

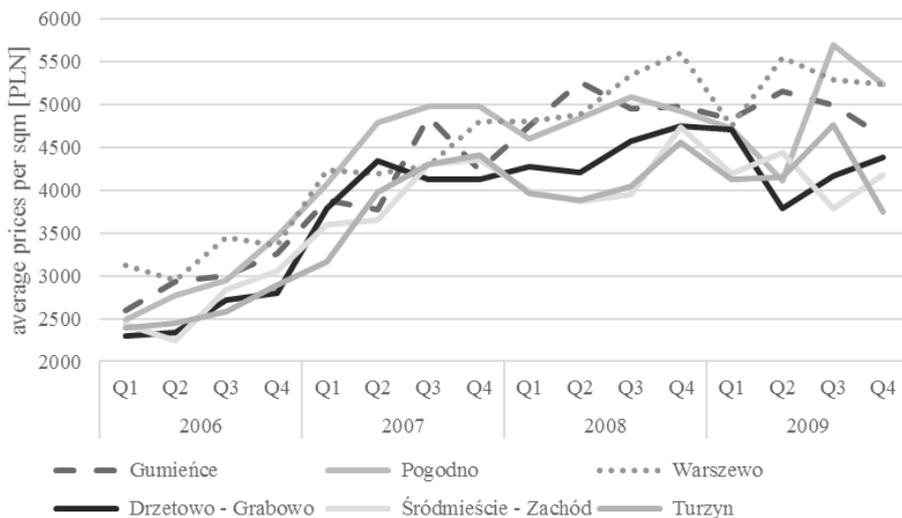


Figure 1. Average transaction prices of the flats in the observed districts of Szczecin in 2006–2009

Source: own study.

### 2.1. Testing for absolute $\beta$ -convergence

We shall be able to speak of the absolute  $\beta$ -convergence of the average transaction prices on the residential property markets in the specified districts of the West Pomeranian capital when the assessment of the  $\beta$  parameter is statistically significant and positive.

Figure 2 shows the relationship between the average price increase rate in 2006–2009 and the 2006 average price logarithm. According to the collected data, the higher level of the average prices was accompanied by the slower decline of those prices. We obtain the estimated regression equation (1)

$$\hat{\gamma}_{i,t_0,t_0+T} = 0,0217 - 0,00220 \ln(Y_{i,t_0}).$$

The estimation error of the directional parameter is  $D(\hat{\beta}) = 0.0035$ . It gives the t-student statistics of 0.63, probability of  $p = 0.56$ , which means that with the adopted materiality level at 0.05, the assessment of the directional  $\hat{\beta}$  parameter is statistically insignificant. Thus, we can say that the prices on the local residential property markets in the analysed districts of Szczecin recorded at the time of a housing bubble were not subject to the absolute  $\beta$ -convergence. Also, when looking at Figure 2, we can see that there was no visible regularity. The only exception were the Warszewo data (far right in the diagram), that ‘artificially’ bent downward the regression line.

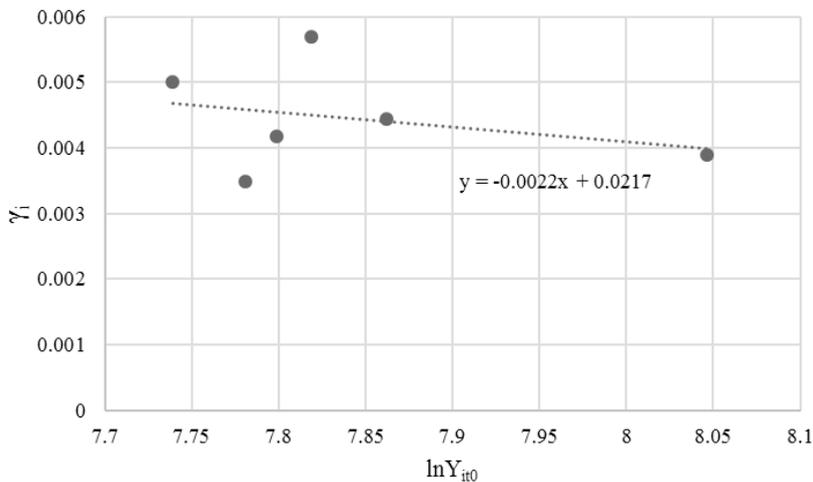


Figure 2. The relationship between the average price increase rate in 2006–2009 and the 2006 average price logarithm

Source: own study.

## 2.2. Testing for $\sigma$ -convergence

For each of the analysed quarters, the standard deviations of average transaction price logarithms were determined. Their changes are shown in Figure 3. There was an upward trend in the price dispersion in the six districts under study. Moreover, that trend was to some extent of a seasonal nature.

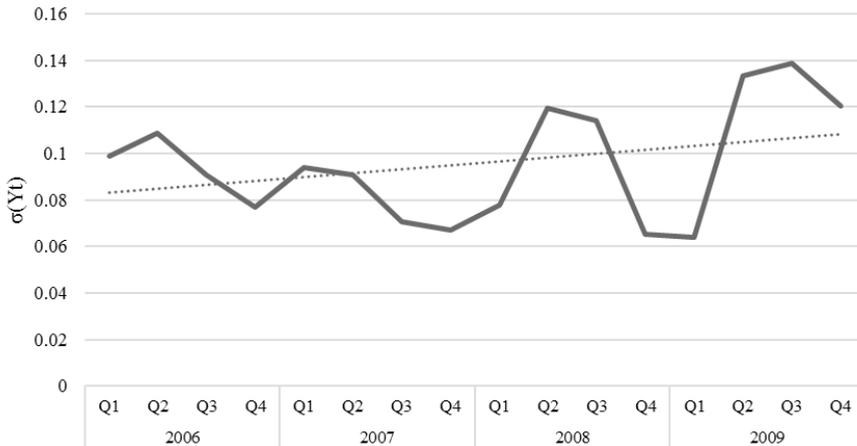


Figure 3. The standard deviations of the logarithms of the average transaction prices recorded on the residential property markets in the analysed districts of Szczecin

Source: own study.

Since  $\sigma_{\ln Y_0} = 0.10$  and  $\sigma_{\ln Y_{0+T}} = 0.12$ , according to formula (2) we can say that  $\sigma$ -convergence did not occur. Generally, in 2006–2009 the dispersion of prices was increasing.

## 2.3. Testing for $\alpha$ -convergence

The maximum and minimum values of the average transaction price logarithms were determined for each of the analysed quarters. On the basis of those values, the ‘boundary’ trends (3) and (4) were estimated, that served as a test for the  $\alpha$ -convergence presence. Figure 4 shows the logarithms of the transaction prices in the districts under observation, and the ‘boundary’ trends for the minimum and maximum prices recorded in each quarter.

The assessments of the directional parameters are statistically significant, but they do not satisfy the inequality (5). It means that the presence of the  $\alpha$ -convergence was not confirmed. In the analysed range of time, the maximum residential property prices were rising slowly, but at a faster rate than the minimum prices. In this manner, the third method confirmed that during the

housing bubble, the observed residential property markets did not show a trend towards aligning prices. It means that over the time range of 2006–2009, no price convergence was observed on those markets.

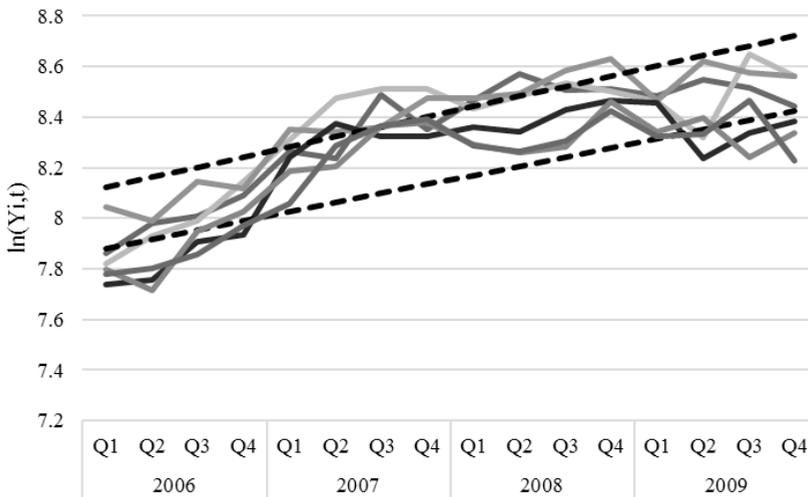


Figure 4. The natural logarithms of the average transaction prices on the residential property markets in the analysed districts of Szczecin in 2006–2009, and their boundary trends

Source: own study.

Table 1 contains the estimates of the directional boundary trend parameters.

Table 1. The estimates of the directional boundary trend parameters

	Upper trend	Bottom trend
Parameter estimate ( $\hat{\alpha}_1$ )	0.040	0.036
Estimation error $D(\hat{\alpha}_1)$	0.006	0.008
t stat	6.73	4.60
p-value	$9.7 \times 10^{-6}$	$4.2 \times 10^{-4}$

Source: own study.

One of the elements of testing for the presence of convergence (particularly when it is focused on the income aspect, i.e. when its purpose is to find out if the poorer economies’ per capita incomes are catching up with the higher income economies) is the estimation of how long it will take for the poorer economies to attain the same economic level as the richer ones. In the case of the testing for price convergence on the local residential property markets in

Szczecin, that particular estimation was abandoned due to the fact that in the time range of the study the local markets price divergence was observed. Given the continuation of that trend, the convergence of the prices could not occur. Moreover, we know now that after 2009 the slump on the real property markets resulted in the changes in the existing statistical patterns. Further studies on the price convergence in Szczecin area after the crisis have already been launched (see Gnat, 2014).

## **Conclusions**

The paper discusses the new application of the instruments used originally to test the income convergence of states and regions in the new field of the real property market. What is proposed is the use of the measurement of  $\beta$ ,  $\sigma$ , and  $\alpha$  convergence for detecting the alignment trends of the residential property prices in the specified administrative units of the city of Szczecin in the time range of 2006–2009. The application of several research methods to test a single phenomenon helps avoid a situation where a number of methods lead to confusing results, which can considerably obstruct logical reasoning. However, in the case of the local property markets in Warszewo, Pogodno, Gumieńce, Drzetowo, Turzyn and Śródmieście Zachód, the obtained results were similar. The study revealed that during the housing bubble there was no price convergence on those markets. The same conclusion was drawn disregarding which instrument was used in the testing process. It means that in the time range of the study, the local property markets in Szczecin did not tend towards the equal level of the transaction prices. From the practical point of view, we can extrapolate that not every district where the prices of the flats were low was the location where investors could expect the above-average rates of return. When seeking a residential property for investment purposes, the prospective buyers need to support their decision with a thorough analysis of the market environment.

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