Współczesna Gospodarka

FRACTIONAL COINTEGRATION RELATIONSHIPS BETWEEN THE POLISH, THE AUSTRIAN AND THE USA DIRECT PROPERTY MARKETS, SECURITIZED PROPERTY MARKETS AND STOCK MARKETS PRICE INDICES

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Summary

The main objective of this article is to present the results of the own research, which aim was to fulfill the literature gap in the scope of the existence of the domestic and the international fractional cointegration relationships between the domestic direct property markets, the securitized property markets and the stock markets price indices in the case of the economies of Poland, of Austria and of the USA, as well as in the case of the global relationships between these markets. The main findings of the scientific research, performed using the Engle-Granger two step approach combined with the fractional integration tests, have supported the thesis that the indicated indices have not been long term mutually nonlinearly cointegrated in the period between 2005 and 2014. Simultaneously, the lack of the long run mean reversion tendency have been confirmed in the selected cases, which is inconsistent with the previously obtained, by the author, confirmations of the linear long run equlibrium reversion relationships existence between all of the considered time series, using the Johansen tests approach.

Keywords: direct real estate markets, securitized real estate markets, Polish real estate indices, international fractional cointegration between the real estate and the capital markets

Introduction

The main objective of this article is to introduce the results of the own research on the existence of the fractional cointegration between price indices of the direct and the indirect real estate and the stock markets price indices in the CEE Region economies [Austria and Poland], as well as their fractional cointegration with the relevant US markets, which according to Roca [Roca, 2014] are linearly cointegrated with the global property and the stock markets price indices estimated by the MSCI. The research has been performed using multivariable cointegrating equations estimated according to the Engle-Granger approach and the Geweke Porter-Hudak tests on the existence of the fractional integration.

The currently presented results will be discussed, taking into the consideration, previously obtained by the author, results on the linear cointegration relationships between the considered indices [Kołtuniak, 2016], revealing the selected discrepancies between them.

1. Research problem

Are the fractional nonlinear cointegration relationships between the direct property, the indirect property and the overall stock markets price indices possible to scientifically prove in the case of the Polish, the Austrian and the USA economies ?

2. Literature review

2.1. Domestic cointegration relationships

Results of the previous research on the relationships between the aforementioned indices, which have been systematically conducted since 1990, have referred almost solely to some foreign developed economies. The aforesaid researches especially have had on purpose to confirm or to falsify the existence of the long term relationships between the above mentioned indices.

The majority of these researches have referred to the definitions of cointegration between the indicated markets, which were introduced by Liu et al. in 1990. The phenomenon of cointegration between asset markets occurs when the systematic risk is the only market risk factor that impacts pricing of investment assets in terms of the Capital Asset Pricing Model.

Review of the literature on cointegration between the aforementioned domestic markets has shown that, in quantitative terms, cointegration or segmentation have been confirmed in a comparable number of cases.

Cointegration between aforesaid domestic markets was confirmed by : Myer F. et al., 1993, MacKinnon G. et al., 2001, Liow K.H., 2006, Morawski J et al., 2008, Lin T.C. et al., 2011 [in the case of the selected economies], Hoesli M., 2012, Serrano C., Hoesli M., 2012, Kołtuniak M., 2016.

Segmentation between the aforementioned markets was confirmed by : Liu C.H. et al., 1990, Gyourko J., 1992, Wilson P.J. et al., 1995, Ling D.C. et al., 1999, Lin T. et al., 2011 [in the case of the selected economies].

2.2. International cointegration relationships

Wilson et al. [1996] have found the segmentation between the UK, the US and the Australian indirect securitized real estate markets, controlling for the foreign exchange rates volatility. Myer et al. [1997] have confirmed, using the linear Johansen tests, cointegration between the UK, the US and the Canadian indirect property markets price indices.

Liow [2009] has simultaneously confirmed the existence of cointegrating equations between local, regional and global securitized property markets price indices. Schindler and Voronkova [2010] have confirmed the existence of the regional cointegration relationships between securitized property markets price indices, considering several structural break dates.

Ling et al. [2002] have confirmed the existence of the global securitized property marketsrisk diversification potential and the existence of the worldwide and country specific factors in the securitized property returns. Liow [2004], using the Arbitrage Pricing Model, has confirmed in terms of the UK and the US securitized real estate markets the presence of both the world real estate and the world stock markets risk premiums and the segmentation between the Asian and the European markets.

Roca [2014] has confirmed the existence of the global linear cointegration relations between the domestic real estate stock markets price indices in the selected developed economies,

including the USA economy, and the world property markets price indices estimated by the MSCI Inc., using the International Capital Asset Pricing Model.

Gilmore [2008] and Witkowska [2012] have examined relationships between the CEE Region capital market price indices, using the Johansen tests.

Kołtuniak [2016] has confirmed, using the Johansen test approach, the existence of the linear long term cointegrating equations between all of the considered in the currently presented research time series in the same time scope.

2.3. Fractional cointegration relationships

Phenomenon of the fractional integration among time series takes place when integration order of time series is different than 0 or 1. Consequently, residuals of cointegrating equations could be characterized by fractional integration order, which implies the existence of the fractional cointegration between considered series, expanding the concept of the linear cointegration. The examination on the fractional cointegration allows to check the existence of long run equilibrium, long memory and mean reversion tendencies among considered time series, especially fractional integration order >1 means that there is no long equilibrium and order between 0 and 1 indicates mean reversion tendency existence, characterized by the differentiated pace.

Wilson and Okunev [1995,1997, 1999] used the non-linear tests to examine integration between property and stock markets and found that these markets were fractionally cointegrated using nonlinear approach and segmented using tests on linear cointegration. In the international context they have not found any fractional cointegrating relationships. Liow et al. [2005, 2008, 2011] and Lin et al. [2011] have confirmed the existence and the importance of the fractional cointegration phenomenon in the understanding of the property and stock markets price indices relationships on the domestic and on the international scale.

Wójtowicz [2015] has examined the fractional cointegration between the Austrian, the German and the Polish stock markets and has found out that the ATX and WIG-20 indices have been fractionally cointegrated in the period between 2003 and 2014.

3. Research scope

The scope of the presented research encompasses price movements in the three national economies : the Polish, the Austrian and the USA on the three kinds of markets in each of these economies : the direct property, the indirect property and the stock markets in the period starting with the 31st of December 2004 and finishing with the 31st of December 2014. In terms of the Polish indirect property market the scope of the presented research encompasses enterprises, which stocks were included in the portfolio of the property enterprises stocks price index 'WIG-Developers', which is set by the WSE, as of the 31st of Dec. 2014.

4. Research aims

1. To verify the existence of the long term fractional nonlinear cointegrating relationships between the domestic direct and indirect property markets, as well as the domestic stock markets price indices in the case of the Polish, the Austrian and the USA economy.
2. To check the existence of the long term fractional nonlinear cointegrating relationships on the global scale between the separate groups of the direct property markets price indices, indirect property markets price indices, as well as the stock markets price indices among the Polish, the Austrian and the USA economy.
3. To collate the obtained results with the results previously obtained by the author [Kołtuniak, 2016] using the linear Johansen tests on the existence of the indicated economic relationships.

5. Research hypotheses

1. The Polish direct, the indirect property and the overall stock markets price indices are not altogether long term fractionally cointegrated.
2. The direct, the indirect property and the overall stock markets price indices are not altogether long term fractionally cointegrated on the domestic scale in the developed economies proxied by the USA and the Austrian markets price indices.
3. The Polish, the Austrian and the USA direct property market price indices are not fractionally cointegrated on the global scale [using the USA direct real estate market price index as proxy of the global direct property markets price indicators].
4. The Polish, the Austrian and the USA indirect property market price indices are not fractionally cointegrated on the global scale [using the USA indirect real estate market price index as proxy of the global indirect property market price indicators].
5. The Polish, the Austrian and the USA stock market price indices are not fractionally cointegrated on the global scale [using the USA stock markets price index as proxy of the global stock market price indicators].

    The above mentioned hypotheses will be checked in the entire period taken into the scope of the research [2004 Q4 – 2014 Q4] and in the two separate subperiods [2004Q4 – 2009Q2 and 2009Q3–2014Q4], indicated by the potential recovery date after the Global Financial Crisis, preceded by the local property markets crises occurrences.

6. Methodology

    In order to perform the scientific research in the above mentioned area there is a necessity to check if all of the time series listed in the 'Data used' section of the market price indices are nonstationary and the first differences of their natural logarithms [logarithmic rates of return] are stationary, i.e. that time series of the price indices are integrated in order 1., using the Augmented Dickey-Fuller Tests /ADF tests/. The above indicated confirmation is the first step of the Engle-Granger two steep approach procedure used in order to obtain the cointegrating equations between indicated indices, using the ordinary least squares method [OLS]. Consequently, after estimation of the OLS cointegrating equations, the time series of their residuals are estimated and the order of their integration is checked using the Local Whittle Estimator and the Geweke Porter-Hudak tests [Geweke, 1983], which enables to check the existence of the pairwise or the multivariable fractional cointegration between the considered time series.

7. Data used

    In order to conduct the research the nine time series of the market price indicesfrom the period 2004Q4-2014Q4 will be taken into consideration :
1. Price index of the property enterprises stocks taken into the scope of the research [the Polish securitized real estate market price index],
2. Investment property fair value index [the Polish direct real estate market price index, introduced and discussed in Kołtuniak [2016],
3. WIG index [the Polish stock market price index], according to the WSE data,
4. IATX index [the Austrian securitized real estate market price index], according to the Vienna Stock Exchange data,
5. Index of the housing prices in Vienna [the Austrian real estate market price index], according to the National Bank of Austria data,
6. ATX index [the Austrian stock market price index], according to the VSE data,

7. NAREIT index [the US securitized real estate market price index], according to the National Association of Real Estate Investment Trusts data,
8. NCREIF Index [the US direct real estate market price index], according to the National Council of Real Estate Investment Fiduciaries data,
9. S&P500 index [the US stock market price index], according to the S&P data.

The foreign indices will be controlled for the foreign exchange rates fluctuations, according to the National Bank of Poland data on the EUR/PLN and USD/PLN exchange rates.

Due to the lack of data connected with the real estate markets of higher frequency, quarterly data will be used.

8. Results and discussion

8.1. Results of the Augmented Dickey-Fuller tests on stationarity of the time series

Presented in the first table results of the Augmented Dickey-Fuller tests indicate that in the case of the majority of the considered time series of price indices their nonstationarity in the sample 4Q 2004 to 4Q 2014 have been confirmed at the 5% level of confidence, using the three alternative forms of the test equations, i.e. with a constant, with a constant and a linear trend, and with a constant and a linear and quadratic trends.

The same table presents also results of the analogical tests results on the first differences of natural logarithms of the aforesaid time series, i.e. logarithmic rates of return, which in all of the considered cases have been confirmed to be stationary in the entire sample. It could be concluded that all the considered time series are integrated in the first order. Consequently, the research on the cointegration relationships between these time series in levels using the Engle-Granger two step approach is fully legitimatized.

8.2. Results of the Geweke Porter-Hudak tests on the degree of integration of the residuals from the long term Engle-Granger cointegrating equations

In order to confirm or to falsify the research hypotheses several cointegrating equations have been estimated in line with the Engle-Granger two step approach, using the ordinary least squares method [OLS method], in the case of the entire sample period [2004Q4-2014Q4], as well as in the two subperiods [2004Q4-2009Q2, 2009Q3-2014Q4], chosen in line with the results of the attempt to indicate the most probable structural changes dates on the considered markets. However, it should be emphasized that in the case of the selected subperiods some separate variables turned out to be statistically insignificant at the 5% level of confidence [using t-statistics].

Consequently, the Local Whittle Estimator and the Geweke Porter-Hudak tests on the degree of integration of the residuals from the above indicated long term Engle-Granger cointegrating equations have been performed in order to check the existence of the long term nonlinear cointegrating relations between the taken into consideration time series. Geweke Porter-Hudak tests results were assumed as a conclusive.

Table 1. Augmented Dickey-Fuller tests results on stationarity of the time series in the sample period 2004Q4-2014Q4 and in first differences of their natural logarithms in the sample period 2005Q1-2014Q4

Test statistic (1), P-value (2), Lags number (3), * indicates that the 5% significance level of confirmation of the null hypothesis on nonstationarity of the analyzed times series was exceed		Time series in levels							First differences of natural logarithms of the time series						
		Test with a constant		Test with a constant and a linear trend		Test with a constant and a linear and quadratic trends		(3)	Test with a constant		Test with a constant and a linear trend		Test with a constant and a linear and quadratic trends		(3)
		(1)	(2)	(1)	(2)	(1)	(2)		(1)	(2)	(1)	(2)	(1)	(2)	
1	Property enterprises stocks index, according to the own estimations	-1.08	0.72 *	-2.02	0.57 *	-1.66	0.90 *	7	-4.50	0.00	-3.43	0.05	-4.08	0.04	8
2	Investment property fair value index, according to the own estimations	-2.46	0.13 *	-1.87	0.67 *	-2.99	0.30 *	1	-5.27	0.00	-5.89	0.00	-5.31	0.00	0
3	WIG index, according to the WSE data	-1.97	0.30 *	-1.88	0.65 *	-1.89	0.84 *	0	-3.95	0.00	-3.93	0.02	-3.97	0.04	0
4	IATX index, according to the Vienna Stock Exchange data	-1.45	0.55 *	-1.28	0.88 *	-2.28	0.66 *	0	-5.39	0.00	-7.76	0.00	-10.9	0.00	0
5	Index of residential property prices on the direct market in Vienna, according to the National Bank of Austria data	-0.03	0.95 *	-2.64	0.26 *	-3.23	0.20 *	0	-5.95	0.00	-5.94	0.00	-5.92	0.00	0
6	ATX index, according to the VSE data	-1.76	0.40 *	-2.79	0.20 *	-3.10	0.25 *	1	-4.54	0.00	-4.51	0.00	-4.66	0.01	0
7	NAREIT equity index, according to the National Association of Real Estate Investment Trusts	-0.35	0.91 *	-0.65	0.97 *	-2.34	0.63 *	0	-5.31	0.00	-5.43	0.00	-5.74	0.00	0
8	NCREIF Property Index, according to the National Council of Real Estate Investment Fiduciaries data	1.35	0.99 *	-0.11	0.99 *	-3.14	0.23 *	4	-4.68	0.00	-5.05	0.00	-5.48	0.00	3
9	S&P500 index, according to the S&P Dow Jones Indices	1.36	0.99 *	0.83	0.99 *	-3.00	0.30 *	1	-3.75	0.01	-4.58	0.00	-5.09	0.00	0

Source : own estimations [Kołtuniak, 2016].

8.3. The existence of the domestic fractional cointegration within the considered economies

The second table indicates according to the Local Whittle Estimator and the GPH tests results that the direct, the indirect property and the overall stock markets price indices in Poland have not been altogether long term nonlinearly fractionally cointegrated in the entire sample period, which leads to the confirmation of the first research hypothesis. The results indicate that the process would permanently drift away from the equilibrium level as a result of any market disturbance and that there has not been any long term mean reversion tendency

among these indices [statistically significant degree of integration > 1.0]. According to the GPH tests results these indices have not been fractionally cointegrated in the considered sub-periods, which may have been caused by the statistical insignificance of the selected indices in the OLS cointegrating equations.

According to the contradictory results, previously obtained by the author, using the Johansen tests, the linear cointegrating equations existence between the aforementioned indices have been confirmed in the entire sample period, as well as in the selected subperiods.

Table 2. Results of the Local Whittle Estimator and the GPH tests on the degree of integration of the residuals from the long term cointegration equations between the domestic indirect, the direct property and the stock markets price indices in Poland

	Local Whittle Estimator			GPH test for fractional integration		
	Estimated degree of integration	Test statistic	P-value	Estimated degree of integration	Test statistic	P-value
2004Q4-2014Q4						
m = 7	1.08	5.69	0*	1.09	6.84	0.001*
m = 8	1.08	6.11	0*	1.1	8.29	0.0002*
m = 9	1.03	6.15	0*	1.04	8.53	0.0001*
2004Q4-2009Q2 [cointegrating equation without the direct property market price index]						
m = 4	1.19	4.76	0*	1.34	1.46	0.2794
2009Q3-2014Q4 [cointegrating equation without the stock market price index]						
m = 5	1.02	4.57	0*	1.16	2.23	0.1117

* indicates rejection of the null hypothesis that the degree of integration equals zero at the 0.05 confidence level.

Source : own estimations.

The third and the fourth tables according to the GPH tests results indicate that on the domestic scale the direct, the indirect property and the overall stock markets price indices in developed economies, proxied by the Austrian and the USA markets, have not been altogether long term nonlinearly fractionally cointegrated in the entire sample period, as well as in the selected subperiods, which leads to the confirmation of the second research hypothesis. However, according to the Local Whittle Estimator tests results these indices have been fractionally cointegrated in the entire sample period.

According to the previously obtained by the author results, using the Johansen tests, the linear cointegrating equations existence between the aforementioned indices have been confirmed in the entire sample period, as well as in the selected subperiods.

Table 3. Results of the Local Whittle Estimator and the GPH tests on the degree of integration of the residuals from the long term cointegration equations between the domestic indirect, the direct property and the stock markets price indices in Austria

	Local Whittle Estimator			GPH test for fractional integration		
	Estimated degree of integration	Test statistic	P-value	Estimated degree of integration	Test statistic	P-value
2004Q4-2014Q4						
m = 7	0.47	2.50	0.0122*	0.99	1.44	0.2094
m = 8	0.63	3.58	0.0003*	0.96	1.69	0.1411
m = 9	0.76	4.57	0*	0.95	1.95	0.091

	2004Q4-2009Q2 [cointegrating equation without the direct property market price index]					
m = 4	0.96	3.85	0.0001*	1.03	2.49	0.1299
	2009Q3-2014Q4					
m = 5	0.47	2.10	0.035*	0.63	1.02	0.3791

* indicates rejection of the null hypothesis that the degree of integration equals zero at the 0.05 confidence level.

Source : own estimations.

Table 4. Results of the Local Whittle Estimator and the GPH tests on the degree of integration of the residuals from the long term cointegration equations between the domestic indirect, the direct property and the stock markets price indices in the USA

	Local Whittle Estimator			GPH test for fractional integration		
	Estimated degree of integration	Test statistic	P-value	Estimated degree of integra-tion	Test statistic	P-value
	2004Q4-2014Q4					
m = 7	0.69	3.68	0.0002*	0.34	0.62	0.5574
m = 8	0.82	4.64	0*	0.47	1.02	0.3465
m = 9	0.96	5.76	0*	0.69	1.57	0.1603
	2004Q4-2009Q2 [cointegrating equation without the direct property market price index]					
m = 4	0.0014	0.25	0.9955	0.13	0.42	0.7858
	2009Q3-2014Q4 [cointegrating equation without the stock market price index]					
m = 5	-0.0024	-0.011	0.9914	0.14	0.35	0.7471

* indicates rejection of the null hypothesis that the degree of integration equals zero at the 0.05 confidence level.

Source : own estimations.

8.4. The existence of the global fractional cointegration among the direct property indices

The fifth table according to the GPH tests results indicates that on the global scale the direct property price indices in developed economies, proxied by the Polish, the Austrian and the USA markets, have not been altogether long term nonlinearly fractionally cointegrated in the entire sample period, as well as in the selected subperiods, which leads to the confirmation of the third research hypothesis. However, according to the Local Whittle Estimator tests results these indices have been fractionally cointegrated in the entire sample period. According to the previously obtained by the author results, using the Johansen tests, the linear cointegrating equations existence between the aforementioned indices have been confirmed in the entire sample period, as well as in the selected subperiods.

Table 5. Results of the Local Whittle Estimator and the GPH tests on the degree of integration of the residuals from the long term cointegration equations between the direct property markets price indices in Poland, in Austria and in the USA

	Local Whittle Estimator			GPH test for fractional integration		
	Estimated degree of integration	Test sta-tistic	P-value	Estimated degree of integra-tion	Test statistic	P-value
	2004Q4-2014Q4					
m = 7	0.71	3.80	0.0001*	1.24	1.89	0.1163
m = 8	0.78	4.43	0*	1.22	2.25	0.0647
m = 9	0.74	4.46	0*	1.01	2.02	0.0826

2004Q4-2009Q2 [cointegrating equation without the USA direct property market price index]					
m = 4	1.23	4.92	0*	1.39	2.98	0.0963

2009Q3-2014Q4 [cointegrating equation without the Polish direct property market price index]					
m = 5	0.32	1.44	0.1475	0.34	0.777272	0.4937

* indicates rejection of the null hypothesis that the degree of integration equals zero at the 0.05 confidence level.

Source : own estimations.

8.5. The existence of the global fractional cointegration among the indirect property indices

The sixth table according to the Local Whittle Estimator and GPH tests results indicates that on the global scale the indirect property price indices in developed economies, proxied by the Polish, the Austrian and the USA markets [the last one is linearly cointegrated with the global real estate market price index estimated by the MSCI [Roca, 2014]], have not been altogether long term nonlinearly fractionally cointegrated in the entire sample period, as well as in the first subperiod [2004Q4-2009Q2], which leads to the confirmation of the fourth research hypothesis. The presented results indicate that the process would not display the mean reversion tendency [according to the GPH tests results the estimated degree of integration is higher than 1.0]. According to the contradictory results, previously obtained by the author, using the Johansen tests, the linear cointegrating equations existence between the aforementioned indices have been confirmed in the entire sample period, as well as in the selected subperiods.

Table 6. Results of the Local Whittle Estimator and the GPH tests on the degree of integration of the residuals from the long term cointegration equations between the indirect property markets price indices in Poland, in Austria and in the USA

	Local Whittle Estimator			GPH test for fractional integration		
	Estimated degree of integration	Test statistic	P-value	Estimated degree of integration	Test statistic	P-value
2004Q4-2014Q4						
m = 7	0.70	3.74	0.0002*	0.83	2.24	0.0746
m = 8	0.81	4.62	0*	1.21	2.68	0.0361*
m = 9	0.75	4.51	0*	1.03	2.47	0.0424*
2004Q4-2009Q2 [cointegrating equation without the Austrian indirect property market price index]						
m = 4	1.32	5.28	0*	1.39	6.99	0.0198*
2009Q3-2014Q4						
m = 5	0.41	1.86	0.062	0.13	0.32	0.7684

* indicates rejection of the null hypothesis that the degree of integration equals zero at the 0.05 confidence level.

Source : own estimations.

8.6. The existence of the global fractional cointegration among the stock markets indices

The seventh table according to the Local Whittle Estimator and GPH tests results indicates that on the global scale the overall stock market price indices in developed economies, proxied by the Polish, the Austrian and the USA markets, have not been altogether long term nonlinearly fractionally cointegrated in the entire sample period, which leads to the confirmation of the last research hypothesis. Results indicate that the process would permanently drift away from the equilibrium level as a result of any market disturbance and that there has not been any long term mean reversion tendency among these indices [statistically significant degree of integra-

tion > 1.0]. According to the Local Whittle Estimator and to the GPH tests results these indices have not been fractionally cointegrated in the both of the considered subperiods.

According to the contradictory results, previously obtained by the author, using the Johansen tests, the linear cointegrating equations existence between the aforementioned indices have been confirmed in the entire sample period, as well as in the selected subperiods.as well as in the selected subperiods.

Table 7. Results of the Local Whittle Estimator and the GPH tests on the degree of integration of the residuals from the long term cointegration equations between the stock markets price indices in Poland, in Austria and in the USA

	Local Whittle Estimator			GPH test for fractional integration		
	Estimated degree of integration	Test statistic	P-value	Estimated degree of integration	Test statistic	P-value
2004Q4-2014Q4						
m = 7	1.29	6.83	0*	1.55	3.93	0.0111*
m = 8	1.26	7.16	0*	1.44	4.25	0.0053*
m = 9	1.23	7.42	0*	1.36	4.58	0.0025*
2004Q4-2009Q2						
m = 4	-0.30	-1.21	0.2251	-0.35	-0.85	0.4839
2009Q3-2014Q4						
m = 5	-0.04	0.2	0.8469	-0.10	0.35	0.7761

* indicates rejection of the null hypothesis that the degree of integration equals zero at the 0.05 confidence level.

Source : own estimations.

Summary

The lack of the existence of the nonlinear fractional cointegration relationships : 1. between the direct real estate market, the securitized real estate market and the stock market price indices altogether in Poland [domestic fractional cointegration] in the period among 2004 and 2014, 2. between the securitized real estate markets in Poland, in Austria and in the USA in the period among 2004 and 2014, as well as in the subperiod among 2004 and 2009 [global fractional cointegration, assuming that the US indirect property market price movements resemble the global price movements, due to their linear cointegration with the MSCI property markets price indices [Roca, 2014]] and 3. between the stock markets in Poland, in Austria and in the USA in the period among 2004 and 2014 has been confirmed using the Geweke Porter-Hudak tests combined with the Engle-Granger two step approach. The results indicate that there is no long run equilibrium among the aforementioned indices. Consequently, the first, the fourth and the fifth research hypotheses have been fully empirically confirmed. Indicated results are in contrast with the results of the Johansen tests, which have shown the existence of the linear cointegration in the aforementioned cases [Kołtuniak, 2016].

The lack of the existence of the nonlinear fractional cointegration relationships: 1. between the direct real estate market, the securitized real estate market and the stock market price indices altogether in Austria, as well as in the USA [domestic fractional cointegrations] and 2. between the direct real estate markets in Poland, in Austria and in the USA in the period among 2004 and 2014, as well as in all of the selected subperiods, has been confirmed using the above mentioned research methodology. Consequently, the second and the third research hypotheses have been fully empirically confirmed.

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KOINTEGRACJA UŁAMKOWA POMIĘDZY INDEKSAMI CENOWYMI RYNKÓW NIERUCHOMOŚCI, RYNKÓW INSTRUMENTÓW UDZIAŁOWYCH RYNKU NIERUCHOMOŚCI ORAZ RYNKÓW KAPITAŁOWYCH W POLSCE, W AUSTRII ORAZ W USA

Podsumowanie

Celem niniejszego artykułu jest zaprezentowanie wyników własnego badania naukowego, przeprowadzonego w celu wypełnienia luki badawczej w zakresie występowania krajowej oraz międzynarodowej kointegracji ułamkowej pomiędzy indeksami cenowymi rynków nieruchomości, rynków instrumentów udziałowych rynku nieruchomości oraz rynków kapitałowych w Polsce, w Austrii oraz w USA, jak również w zakresie występowania globalnej kointegracji ułamkowej pomiędzy wskazanymi grupami rynków inwestycyjnych. Rezultaty badania, przeprowadzonego z zastosowaniem testów kointegracji ułamkowej w ramach dwustopniowej procedury estymacji równań kointegrujących Engle'a-Granger'a, wsparły hipotezę, iż wskazane indeksy cenowe nie podlegały w okresie 2005-2014 wzajemnej nieliniowej kointegracji ułamkowej. Jednocześnie, w wybranych przypadkach został potwierdzony brak tendencji powrotu do długookresowego poziomu równowagi, co stoi w sprzeczności z wynikami uprzednio przeprowadzonego badania naukowego, z zastosowaniem metodyki testu Johansena,

potwierdzającymi istnienie liniowej długoterminowej kointegracji pomiędzy wszystkimi rozważanymi szeregami czasowymi zmiennych.

Słowa kluczowe: rynek nieruchomości, rynek instrumentów udziałowych rynku nieruchomości, indeksy cenowe rynku nieruchomości, międzynarodowa kointegracja ułamkowa pomiędzy rynkami nieruchomości a rynkami kapitałowymi

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