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Competitiveness and interest rates. The case of investing in new housing in Poland in 2002–2010

Abstract: The purpose of the paper is to examine the existence of a long-term relationship between interest rates on housing loans (mortgage rates) and investment in different forms of new housing in the years 2002–2010, along with competitiveness of those different forms of investing. This paper contains an empirical study using co-integration and impulse response analyses. A definition of competitiveness is introduced and discussed. The main trends in the number of newly completed housing units (broken down by type of investor) and interest rates in Poland are presented. Only competitive forms of investments have a long-term relationship with the interest rate in the Polish zlotys.
Keywords: competitiveness, interest rates, new housing, investor categories, co-integration analysis, investment, Poland.
JEL codes: B31, C22, D12, D23, E12, E13, E43, R31.

Introduction

The real estate sector is of great importance as a factor affecting stability of the economy. Between 2002–2010 the structure and volume of newly completed housing in Poland changed. In this paper particular attention is paid to the structure of the newly completed housing units broken down by the type of investor. During the study time the mortgage rate changed. The research investigates the existence of a relationship between the mortgage rate and the competitiveness of various forms of investment in housing.[1]

[1] The relationship between investment and such determinants as financial pressure, manufacturing output and lagged investment spending for data regarding Poland was researched e.g.in Kowalski, Wallusch and Zenka [2010].

1. Definitions and trends

This section discusses the definition of competitiveness. Further on it examines the number of housing units completed in the years of 2002–2010 in the following categories: co-operative, individual investors, developers (for sale or for rent) and others. Finally, it presents the average mortgage rates.

1.1. Competitiveness of different forms of investing in new housing

Competitiveness is defined in the literature in different ways and many criteria are used to classify the term. From the perspective of this paper it is important to divide competitiveness into micro, mezzo and macro levels [Dołęgowski 2002, p. 12]. According to Dołęgowski, competitiveness of a sector or industry is the size of opportunities offered for a return on investments and the ability to design, manufacture and sell products better than the competition. At the microeconomic level competitiveness is a long-term ability to challenge competition from other entities, to maintain and expand market share and achieve adequate profits [Dołęgowski 2002, p. 12]. The paper considers competitiveness of different forms of investment in the new housing as a component of GDP. Thus it was concluded that the best perspective for discussion will be to analyze competition at the mezzo level.

Attention should also be paid to distinction between competitive ability and competitive position. Competitive position, otherwise known as resulting competitiveness, refers to the participation of a given country in international trade [Bieńkowski 1995, p. 32]. Competitive position changes when the conditions of the country's participation in international trade are modified [Bieńkowski 1995, p. 33]. This is a macroeconomic perspective. Jankowska transferred this concept to the mezzoeconomic level [Jankowska 2005, p. 44]. According to her, an assessment of the industry position competitiveness can be made by measuring its impact in the creation of gross domestic product. This definition of competitiveness has been adopted in this paper.

A change in the structure of the newly completed housing units by the type of investor (in accordance with the accepted definition of competitiveness) has been considered as a symptom of change in the competitive position of individual investment forms in the newly completed housing. Competition between different forms of investment will be measured by the number of housing units delivered by a particular type of investor.

As can be seen in Figure 1, the number of new housing units completed in Poland in the period 2002–2010 was consistently rising. The years 2003, when the number of new housing units completed each month reached 16 000 (seasonally adjusted), and 2009, when the rising trend stopped as a result of the financial crisis, are both noteworthy.

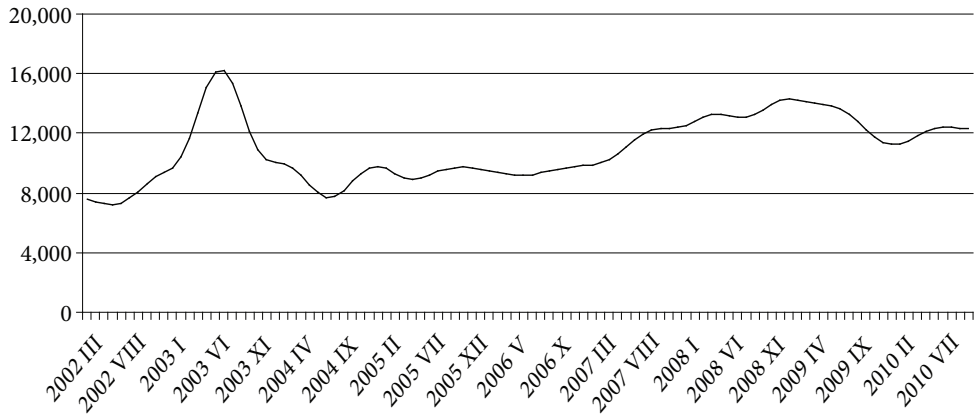

Figure 1. New housing in 2002–2010, monthly (seasonally adjusted data)
Source: Own calculations based on GUS (Central Statistical Office of Poland) data http://www.stat.gov.pl/gus/5840_3031_PLK_HTML.htm(Data regarding the number of new housing units was obtained from the Central Statistical Office (GUS)

However, it should be emphasized that in 2010, the number of new housing units completed each month began to rise once more. The next figure shows the number of new housing units according to the type of investor. GUS data identifies the following categories: co-operatives, individual investors, developers and other investors: i.e. company apartments, communal and rented co-operative. During the

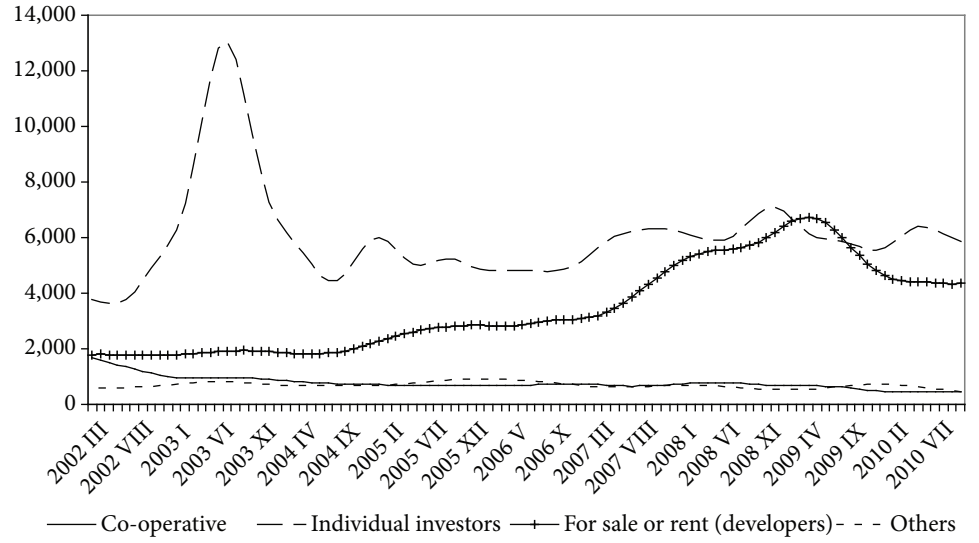

Figure 2. The number of new housing units completed monthly by investor type in 2002–2010 (seasonally adjusted data)
Source: Own calculations based on GUS data

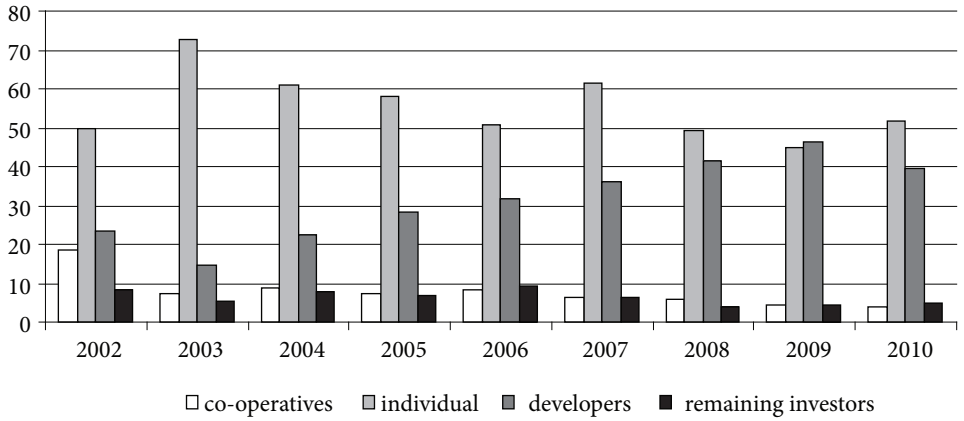

Figure 3. Market share of newly completed housing by type of investor in 2002–2010
Source: Own calculations based on GUS Data http://www.stat.gov.pl/gus/5840_3031_PLK_HTML.htm

period under examination, a clearly dominant role of individual investors in the property is observed. Furthermore, from being small players in 2002, developers became systematically more important to become the dominant category, although only once, in 2009 as shown in Figure 3. In contrast, the small role of co-operatives and other investors diminished further during this period.

The highest number of new housing units completed per month was in 2003 and 2009. Since building a house takes anything from a few to dozens of months, the data on the newly completed housing seem to have reacted to the eruption of the crisis with a delay.

Figure 3 presents changes in the structure of newly completed housing. In 2002 as much as 50% of individual investors comprised the market. Co-operatives and developers had almost equal shares of 20%, whilst the remaining investors had only a 10% share of the market.

A year later, individual investors played an increasingly dominant role, whilst that of co-operatives diminished. In 2006, when housing prices rose significantly, which is presented in Figure 4, there was a noticeable increase in the role of developers as well marginalization of investors in the "other" and co-operative categories. Developers dominated the market for new housing for a short time in 2009. It should be borne in mind that this was also the period during which there was a break in the upward trend of the number of newly completed housing units, compare Figure 1.

As indicated in Zenka-Podlaszewska [2010, p. 68] there are differences in the way companies access external capital, with banks preferring very large companies to the small ones, which in turn is likely to have an adverse effect on the competitiveness of smaller players. This phenomenon may be the reason behind the increasing role of developers at the expense of individual investors.

This section contains an analysis of trends in completion of the new housing units in the period 2002–2010. There is a noticeable upward trend, which ceased in 2009. Individual investors played a dominant role, and it should be noted that there was an increasing role of developers, as well as a reduced role of co-operatives, workers' housing, communal homes and social housing.

Assuming that competitiveness refers to the best result in GDP creation, the most competitive forms of investment should be regarded as being individual investors, a group which maintained its dominant position, and developers, who doubled their market share from 20% to 40% in the period 2002–2010. During the whole period individual investors dominated the Polish market, with a share of approx. 50%, with the exception of 2009, which resulted from the boom in real estate. According to the definition of competitiveness, individual investors and developers remained the most competitive. Following the brief domination of developers in 2009, the financial crisis returned individual investors to their primary position in terms of competition.

Summarizing this section, it should be emphasized that the competitiveness of particular forms of real estate investments in Poland is measured by the number of housing units completed. Thus, the most competitive forms of investment are individual investors and developers. The following subsection of this paper presents the state of the mortgage rate market in the context of housing.

1.2. Average mortgage rates

In the period reviewed there was a significant rise in house prices in Poland, compare Figure 4. One of the reasons for the increase in property prices was the excess liquidity of international financial markets [Gorynia & Kowalski 2009, p. 224; NBP 2010, p. 11]. Consequently, decreasing interest rates were reported in the years of 2002–2006, which is presented in Figure 5. According to Łaszek [2011, p. 7] decreasing interest rates were the result of a high competition in the banking sector in Poland. Another reason for the increase of property prices in Poland was a growth in demand due to demographic factors, with a rigid short-term supply of housing [NBP 2010, p. 11]. The increase in property prices in 2000–2008 was, according to Gorynia and Kowalski [2009, p. 224], a universal phenomenon in the world, with the general index of house prices in the U.S. reaching its maximum level in 2007. A significant increase in house prices took place in Poland in 2006/2007, an example of this phenomenon is shown for prices in Poznań, compare Figure 4. Commercial banks began to raise interest rates even faster than the central bank. Commercial bank interest rate levels were on average almost twice as high as the re-discount rate. According to the NBP [2010, p. 38], rapid lending from banks resulted in the housing market inflation in Poland, and in increasing liquidity problems for banks, which consequently began to raise interest rates.

At the beginning of 2008, the relationship between loan interest rates and central bank rates improved before worsening once more towards the end of 2008, which was certainly linked to the development of the financial crisis on global markets and banks tightening credit conditions.

In the period January 2007–May 2010, the average interest rate charged on home loans was much higher on the Polish zloty [PLN] denominated loans than on those in Swiss francs [CHF]. The difference was significant and varied between 2 percentage points in February 2007 and 4.8 percentage points in January 2009, i.e. during the financial crisis. From September 2009, these interest rates dropped significantly for both PLN and CHF mortgages, whilst the difference in the interest rates themselves stabilized at a level of approx. 3.5 percentage points. Majority of mortgages on the Polish market in recent years were in foreign currencies [compare NBP, 2010, p. 38] and, consequently, this leaves households and the housing market in general open to both the exchange rate risk and the negative impact of international financial market volatility. Also Łaszek [2011, p. 7] underlines that in the period of 2002–2008 loans denominated in foreign currencies were refinanced on the European capital market. The housing market's response to increasing mortgage rates towards the end of 2008 and the beginning of 2009 was a drop in the volume of housing completed, compare Figure 1.

In Table 1 the structure of growth in new mortgages is shown. In 2002 80% of new mortgages were in foreign currencies, in 2008 even 91%, and in 2009 only 26% of new mortgages were in foreign currencies.

It should be stressed that in May 2010, interest rates on both CHF and PLN denominated mortgages fell to pre-financial crisis levels. There was also an upturn in

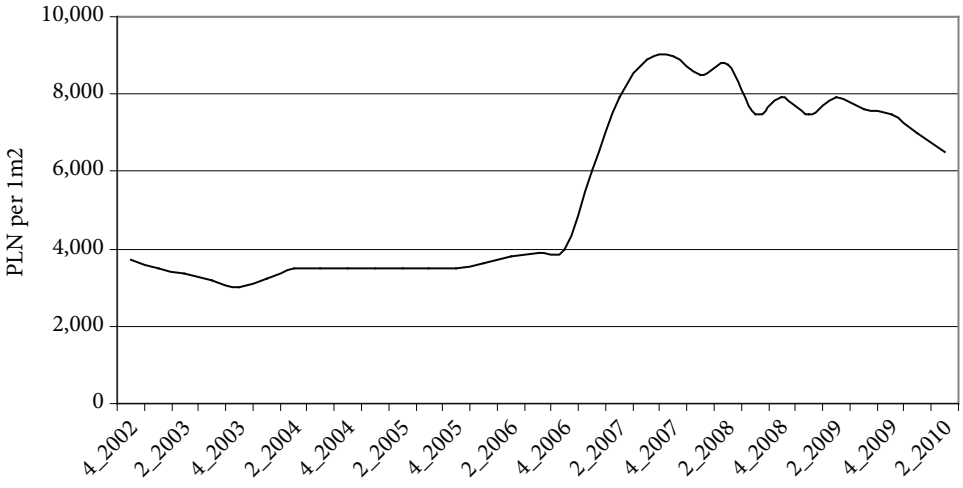

Figure 4. Offer prices of flats on the primary market in Poznań in 2002–2010
Source: [NBP 2011, p. 4]

Table 1. New mortgages in Poland (structure of growth, in %)

Currencies	2002	2003	2004	2005	2006	2007	2008	2009
In Polish zloty	20	27	74	19	36	62	9	74
In foreign currencies	80	73	26	81	64	38	91	26

Source: [NBP 2010, p. 39].

the volume of new housing in 2010, which is shown in Figure 1. Figure 5 presents the trend in the average interest rate on new home loans in the whole examined period (i.e. 2002–2010).

Loan interest rates are analyzed in this subsection. There was a reduction in interest rates on mortgages in the period 2002–2007, compare Figure 5. This phenomenon is part of a worldwide trend of reduction in market interest rates on the mortgage market, which Gorynia and Kowalski [2009, p. 225] classified as one of the secondary reasons for the current crisis. According to these authors, its most important sources are: 1) inclusion of the Chinese economy into the global circulation while maintaining the undervalued renminbi, 2) excessive monetary expansion in the U.S. and world-wide, and 3) expansionary U.S. fiscal policy [Gorynia & Kowalski 2009, p. 225]. A growth in loan interest rates during the housing market boom was also noted. It is important to stress that a large proportion of mortgages sold in Poland were in CHF.

Section 1 discusses the number of newly completed housing units. In 2004–2008 there was a systematic increase in this number, although in 2009 this trend was re-

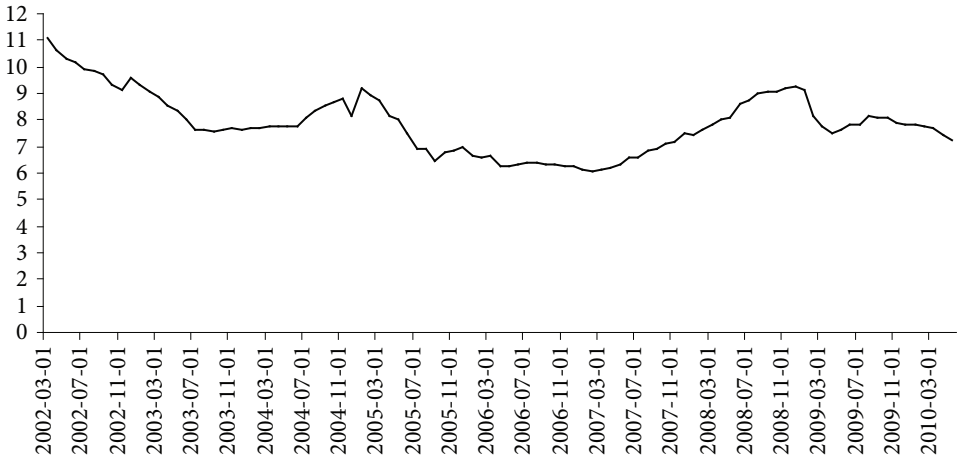

Figure 5. The average interest rate on new household loans [denominated in PLN] in the period 2002–2010

Source: Own calculations based on NBP data

versed. During the studied period the dominant role was played by individual investors and the importance of developers increased significantly. Following the huge increase in housing prices in late 2006/2007, the banks raised their interest rates on loans in 2007–2008 from about 6% to about 9%. However, before 2007 they had caused house price inflation through a continuous reduction in their interest rates from 2002. The crisis slowed down the growth trend of housing prices and to some extent lower prices were recorded before returning to their pre-2006 level. The competitiveness of various forms of real estate investment in Poland is measured in this paper by the volume of housing. Thus the most competitive forms of investment are individual investors and developers.

The volume of housing seems to be linked with the level of mortgage interest rates, as the number fell during the periods of increasing rates and rose when the rates were falling (e.g. in 2010). However, the answer to this question is dealt with in Section 3; before we go to this, some predictions for the relationship: interest rate – investment will be introduced in Section 2.

2. Predictions of economic theory

2.1. Keynes's theory

For Keynes, the relation between the interest rate and investment is very strong indeed. Current investment depends on the relation between the marginal capital efficiency curve and the interest rate. He believed that manipulating the interest rate could have a direct influence on the quantity of investment, of course with the relevant assumptions about the capital efficiency curve, which cannot fall more quickly than the interest rate in order to achieve the expected effect. Keynes [1997] wrote: "Ceteris paribus, a fall in the interest will cause investment to increase in investment, although this will not occur if the marginal capital efficiency curve moves downwards more rapidly than the interest rate falls." Determinants of the level of investment are: a) propensity to invest (three elements come into play here: marginal capital efficiency, long-term forecasts, interest rates) and b) interrelation between marginal efficiency of capital and rate of interest. From this it is clear that Keynes makes investment strongly and negatively dependent on the level of interest rates.

2.2. Neo-classical theory

Although according to Chetty [2004] already Haavelmo [1960] pioneered the neoclassical theory of investment, it was Jorgenson who presented the theory of invest-

ment behavior [1963] based on the neoclassical theory of optimal accumulation of capital. Jorgenson [1963] derived equations to estimate the user cost of capital on investment and via doing this he challenged the accelerator theories of investment [Precious 1987].[2] He derived a demand function for investment goods based on purely neoclassical considerations. He described two bases for such a theory of investment [Jorgenson 1963, p.184]:

a) the demand for investment goods can be taken to depend on the cost of capital (such a theory of investment behavior can be, according to Jorgenson, derived from the neoclassical theory of optimal capital accumulation);
b) the assumption that business firms maximize utility (which is broader than profit) defined more broadly than in the characterization of objectives (profit) of the firm in the neoclassical theory of optimal capital accumulation.[3]

According to Jorgenson, the rate of interest and the price of investment goods enter the demand for investment goods only through the user cost of capital services. There is no effect of the price of investment goods except in combination with the rate of interest and *vice versa*. In the neoclassical theory of investment behavior the central role is played by the user cost of capital – implicit rental of one unit of capital service per period of time. Investment depends on the interest rate via the user cost of capital. Investment in Jorgenson theory is dependent on the supply side of the economy, on variable input and on desired and real capital stock. The capital stock is dependent on output and its price divided by the user cost of capital.

According to Jorgenson [1971, 1996], the determinants of investment are: output, internal funds, and the cost of external finance. They may be included as determinants of the desired level of capital. It must be underlined that in the face of the financial crisis voices are heard that the neoclassical theory lost its credibility due to systemic changes that happened within institutions, markets, and instruments over the last three decades [compare Szyszka 2011].

3. Empirical analysis

This paper attempts to verify empirically the existence of a long-term relationship between the volume of new housing, the type of investor, and mortgage rates. Interest rate data obtained from the NBP and GUS were seasonally adjusted us-

[2] But some authors think that the flexible accelerator and the neoclassical models are not competing models; the only difference between them according to those authors concerns the underlying production function: Leontief in the former, Cobb-Douglas in the latter – see e.g. Kohli U.R and Ryan C.J. [1985].

[3] Jorgenson takes the second assumption from Meyer and Kuh [1957, p. 9].

ing the Census II X–11 method and Henderson curve. All series used in this paper were monthly samples from the years 2002:3–2010:10 and therefore 104 observations were obtained. The following subsections will cover co-integration and impulse response analyses.

Where the analyzed time series are non-stationary (most economic time series are non-stationary: as is stressed by Łuczyński [2004, p. 38], economic processes are largely non-linear), the application of an ordinary least squares method, for example, can lead to the discovery of the so-called spurious regression [Granger & Newbold 1974]. Non-stationarity means that a process which lacks a fixed expected value, a fixed variance in random variables, or a covariance value for two observations will change depending upon the period of observation [Charemza & Deadman 1997, p.105]. In order to claim non-stationarity the single unit root test is used and in this paper the ADF as well as Philips-Perron tests are applied. There are three versions of the Augmented Dickey-Fuller test including zero hypothesis for the presence of a single unit root and stationarity. It is used to test the level of integration in time series and more information regarding the single unit root test can be found in Philips and Xiao [1998] or Bai and Ng [2004]. Over the last 20 years, co-integration has become a widely used concept in the analysis of relationships between non-stationary time series. There is a wide related literature regarding co-integration, see for example Charemza and Deadman [1997], Maddala [2006], Juselius [2006], Hendry and Juselius [2000a, b], Patterson [2000], Welfe [2003], Syczewska [1999], Gujarati [1995], Majsterek and Welfe [2000], Kotłowski [2006], Kusideł [2000], Stążka [2008].

Co-integration was introduced by Engle and Granger [1987]. They showed that each co-integrated series is reflected in the form of an error correction mechanism – the so-called representation theorem. It shows that VAR[p] for each variable k:

$$\mathbf{x}_t = \sum_{i=1}^{p} \mathbf{A}_i \mathbf{x}_{t-1} + \mathbf{u}_t,$$

where:

$\boldsymbol{x}_t = [y_t, x_t]'$,

$\boldsymbol{u}_t = [u_{1,t}, u_{2t}]'$

can be expressed as a error correction model:

$$\Delta \mathbf{x}_t = \mathbf{\Pi} \mathbf{x}_{t-1} + \sum_{i=1}^{m} \mathbf{B}_i \Delta \mathbf{x}_t + \boldsymbol{\varepsilon}_t.$$

Next the Π matrix is decomposed into two matrices [i.e. Charemza & Deadman 1997, p. 163]:

$$\Pi = \alpha\beta'.$$

One of these is a matrix of adjustment coefficients [α][4] as well as co-integration vector [β']. For co-integration, the column of the matrix must be less than the number of variables and greater than zero.

Enders [1995] underlined several issues. Firstly that co-integration refers to the linear combinations of non-stationary variables. Current econometric practice is not able to test non-linear co-integration relationships. Secondly: all variables must be integrated to the same degree. Of course, this does not mean that all variables which are integrated to the same degree were co-integrated. The lack of co-integration means that variables can drift independently of each other. Co-integration does not require long-term equilibrium between variables to be generated by market forces. Thirdly, if x_t has n constituents, there can be a maximum of $n - l$ linearly independent integration vectors. The number of integrating vectors is called co-integration row. Fourthly, most literature on the subject of co-integration focuses on the case where each variable has a single unit root. This makes economic sense, as very few economic variables are integrated to a greater extent than 1. However, the situation where variables have more than one single unit root and are co-integrated with each other, is also possible. And fifthly, co-integration does not indicate the direction of causality.

Co-integration [Bierens 2007a, b] can be interpreted as a long-term relationship or, in economic terms, as long-term equilibrium [static equilibrium relations] between variables. For two processes, co-integration is often indicated through a more or less similarly shaped charts for given variables. As outlined by Kamiński [2002], co-integration is a characteristic of two or more time series which causes these series to form a certain long-term equilibrium in relation to each other. In other words, if random effects [which cause variables to skew away from equilibrium] were to be eliminated, it could be quite easy to calculate the value of one of these series at time t based upon the co-integration vector, the value of the other variable, the fixed variable. As the author continues, this equilibrium takes the form $y_t - \beta x_t = \alpha$. The co-integration vector is $[1, -\beta]$, whilst 1 is the parameter next to y_t, and $[-\beta]$ the parameter next to x_t. In reality there is a random component which impacts the value of series Y and which should be added to the right side of the equation. Kaminski stresses further that the random component causes the variables to oscillate around the path laid out by long-term relationships. The process of adaptation which prevents the successive increase in the effect of the random component in the long-term relationship is known as the error correction mechanism. The Johansen method [Johansen 1995] applied in this study is available in

[4] These elements measure the speed in which specific variables react as a result of disturbances to the equilibrium state [Charemza and Deadman 1997, p. 165].

most econometric software including the EViews package which was used here. It is worth pointing out that another method [the non-parametric approach] was also proposed by Bierens. Others, which are often referred to in the related literature, include the Engle-Granger or Phillips Spectral Regression models.

Another method applied in this study is the impulse response analysis. In vector auto-regression, it allows you to trace the effects of a single impulse. In other words, it is an analysis of the reaction of endogenous variables to impulses in the form of random components. The impulse response analysis allows you to test if the estimated VAR model is consistent with economic knowledge:

The following algorithm was applied in this study:

1. Co-integration analysis was started by carrying out single unit root tests in order to establish the level of integration in each series under examination;
2. Once all of the examined series were verified as being integrated to the same degree (in the case of economic data, most often the first degree and rarely the second) the appropriate co-integration analysis was started;
3. Based upon one of the information criteria, the form of the model was selected by describing the number of delays p as well as the deterministic variables which appeared in the co-integration vector and the short-term dynamics model; based on Aznar and Salwador [2002], the model selection criterion requires the minimization of the Schwarz information criterion) the decision was made regarding the level of delays, model form as well as deterministic variables;
4. Next, the Π matrix rank was tested;
5. If co-integration vectors were detected, an impulse response analysis was carried out.

3.1. The level of series integration

The first stage of analysis following on from seasonal adjustments is an analysis of the level of series integration. This is an important step because co-integration analysis can only be used for series which have an equal level of integration. As was mentioned above, tests were carried out using ADF and PP tests.

Based on the unit root tests presented in Table 2, it was concluded that both tests allowed for the null hypothesis regarding the unit root process to be rejected in the case of the interest rate series.Equality of both unit root tests in the case of the "other" series meant that this series was excluded from the analysis. The requirement of equal integration was not met (here: interest rates and others).

For the remaining analysis it has been concluded that the series General, Co-operative, Individual and Developers are characterized by first-level integration. The next step is to carry out a co-integration analysis for the next series pairs: Interest – General, Interest – Co-operative, Interest – Individual and Interest – Developers.

Table 2. Results of the unit root test

Variable	Adjusted Dickey-Fuller Test (ADF)					PP Test				
	Types	Test Results	Critical Value 5%	H0 Rejected?	Level of Integration According to ADF	Types	Test Results	Critical Value 5%	H0 Rejected?	Level of Integration According to PP
General	3	–3,560	–3,450	Y	Stationary	2	–2,370	–3,450	N	1
Δ general				–		1	–3,590	–1,940	Y	
Co-operative	3	–1,850	–3,450	N	1	2	–5,570	–3,450	Y	Stationary
Δ co-operative	1	–4,230	–1,940	Y		1	–3,530	–1,940	-	
Individual investors	2	–3,230	–2,890	Y	Stationary	1	–2,580	–2,880	N	1
Δ individual investors				–		1	–3,360	–1,940	Y	
Developers	3	–2,800	–3,450	N	2?	2	–1,030	–3,450	N	1
Δ developers	1	–1,480	–1,940	N		1	–2,400	–1,610	Y	
Other	3	–2,480	–3,450	N	2?	2	–1,890	–3,450	N	2?
Δ other	1	–3,280	–3,450	N		1	–2,470	–3,450	N	
Interest rate	3	–2,330	–3,450	N	1	2	–2,190	–3,450	N	1
Δ interest rate	1	–2,970	–1,940	Y		1	–2,390	–1,940	Y	

3.2. Co-integration analysis

A co-integration analysis between the PLN mortgage rate and new housing (generally) split by investor type: Co-operative, Individual and Developers will be carried out in this paper. The GUS also includes the "other" category, however, following on from the analysis carried out in sub-section 3.1, this series was excluded from further analyses.

The results are presented in Table 3. It shows that no co-integration vectors between the series mortgage interest rate and the General and Co-operative series were found.

In the case of the General variable in both versions of the model, the test statistics for a 0 number of hypothetical co-integration vectors transpired to be less than the critical value. The test statistic for the first version of the model amounted to 11.46787, whilst the critical value was 12.53. However, in the case of the second model, the test statistic amounted to 14.4199, whilst the critical value was 19.96. It can therefore be concluded that both tests indicate the lack of a co-integration vec-

Table 3. Co-Integration Analysis Results

Variable	Model Version	Hypothetical Number of Co-integration Vectors	Test Statistics	Critical Value	Conclusion
General	1	0	11.46787	12.53	0
		1	0.173049	3.84	
	2	0	14.4199	19.96	
		1	2.922554	9.24	
Co-operatives	1	0	7.730673	12.53	0
		1	2.402573	3.84	
	2	0	14.22672	19.96	
		1	2.543115	9.24	
Individual	1	0	28.22869	12.53	1
		1	1.136718	3.84	
Developers	1	0	10.60392	12.53	0
		1	0.000657	3.84	
	2	0	21.62454	19.96	2
		1	9.604185	9.24	

tor at the 95% confidence interval. The analysis indicates the lack of a co-integration vector at the 95% confidence interval between the new housing completed and the mortgage interest rates series. It can therefore be concluded that there is no long-term relationship between the series examined here. It transpires therefore that at the macroeconomic level (series: General) no co-integration vectors were found between the examined variables in either of the models (models 1 and 2). The analysis also indicates the lack of a co-integration vector at the 95% confidence interval for the Co-operatives series. This is testimony to the lack of a long-term relationship between the examined variables.

In the case of the "Individual" variable, the analysis revealed one co-integration vector. However, in the case of the "Developer" variable, the analysis revealed the existence of two co-integration vectors in the case of model 2 and no integration vectors in the case of model 1.

An impulse reaction analysis for variables which indicate the existence of a long-term relationship with the mortgage interest rate series will be carried out in the next sub-section.

3.3. Impulse response analysis

An impulse response analysis in the "Individual" and "Developers" series to mortgage interest rates will be carried out in this section, compare Figures 6 and 7. The direction, magnitude and length of the reaction are important in the analysis. In the case of individual investors, the impulse response to mortgage interest rates was positive, compare Figure 6, which is fundamentally inconsistent with the predictions of economic theory, e.g. Keynesian or Neo-Classical (see Section 2).

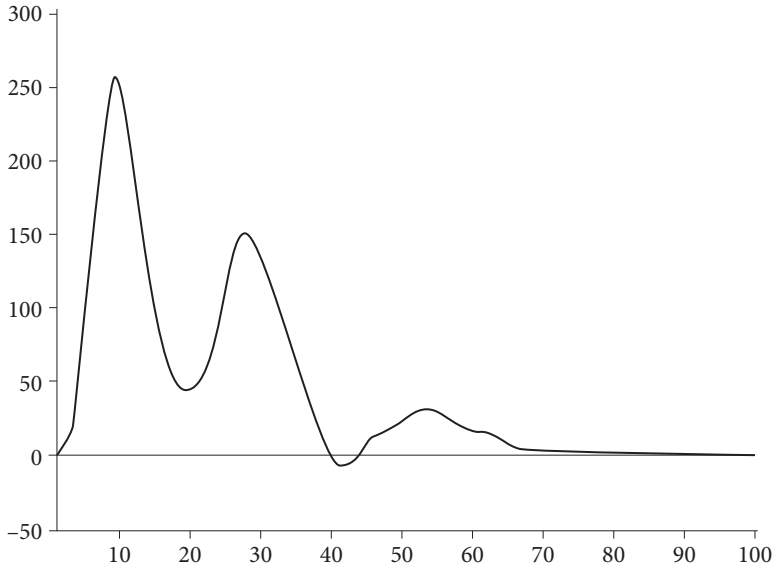

Figure 6. Impulse response to mortgage interest rates for the "Individual" series

The problem of investment is to select the appropriate amount of capital to invest and the time period in order to maximize the present value of future rent minus construction costs, whilst these values are maximized for current expectations. Capozza and Li [2001], for example, suggest that the positive effects of increasing interest rates on levels of investment can be noticed on the property market when there is a lot of uncertainty and rapid growth. This was the case in Poland in 2002–2009. As it was stated in the NBP Report [2011a, p. 5] the last housing market cycle was unusually dynamic during the boom period which included the impact of international, fundamental and speculative factors. At this point, interest rates rise, expectations are rational and investors foresee future growth in interest rates. They bring forward planned investments in order that they not be realized during periods of an even faster growth in interest rates. Therefore, the positive impulse response to

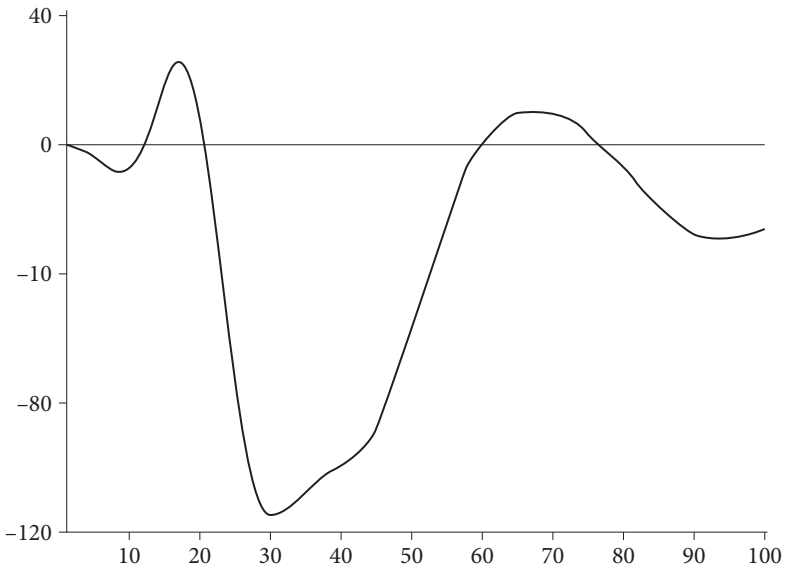

Figure 7. Impulse response to mortgage interest rates for the "Developer" series

the interest rate can be justified under certain assumptions regarding the prevailing market situations, as well as the manner in which entities form their expectations.

Moreover, the impulse response to mortgage rates was quite strong and long-lasting (it faded after approx. 70 periods). This could be an indication of a strong long-term relationship between the analyzed series.

In the case of the "Developer" series, Figure 7, the reaction was consistent with the traditional view of the relationship between investments and interest rates, i.e. the impulse response to interest rates generated a negative response. The response was weaker than in the case of the "Individual" series, although it did not fade.

Conclusions

Competitiveness is measured by participation of various forms of investment in GDP. In this paper it is translated into the number of housing units completed by the following categories of investor: "Co-operative", "Individual Investors", "Developers" and "Other" series. Most new homes are completed by Individual Investors. The real estate boom increased the importance of Developers, although this was clearly halted by the crisis, with the result being a return to the dominance of Individual Investors. It is therefore possible to conclude that in accordance with the earlier

definition, Individual Investors and Developers are the most competitive forms of investment in the new housing in Poland.

As the next stage a co-integration analysis was conducted. The long-term relationship between the PLN-denominated mortgage rates and the number of housing units constructed in the period 2002–2010 was analyzed. The number of new homes completed was analyzed at a general level ("General" series), and at the level disaggregated by type of investor ("Co-operative", "Individual Investors", "Developers" and "Other" series. In the case of the latter, this includes company apartments, communal and rented co-operative). A co-integration vector was identified at the level of "Individual Investor" series, as this is the dominant group of investors. It can therefore be assumed that individual investors link their decision regarding the construction of new homes with the level of mortgage rates. The impulse response analysis indicated some interesting dependencies. Impulse response to mortgage interest rate was positive. For Developers (which were identified as being the second most important category of investor) two co-integration vectors were identified. The impulse response analysis confirmed a standard level and response direction to the interest rate impulse. At the "General" series level, no co-integration vector was found and therefore it can be concluded that there is no long-term relationship between the PLN mortgage rates and the volume of new housing completed. The "Co-operative" series did not reveal a long-term co-integration with the interest rate series, whilst the "Other" was excluded from further analysis after conducting a single unit root test.

The presence of a co-integration vector in the case of the "Individual" series suggests that investment decisions for these entities are susceptible to fluctuations in PLN mortgage rates, despite the huge role of foreign currency mortgages on the Polish market for mortgages.

The analysis concludes that there is a long-term relationship between the volume of new housing and interest rates in zlotys in the case of competitive forms of investing, i.e. Individual Investors and Developers.

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