

Stojanova, Biljana Davidovska; Jovanovic, Branimir; Vojnovic, Maja Kadievskaja;
Ramadani, Gani; Petrovska, Magdalena

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National Bank of the Republic of Macedonia



Research Department

REAL ESTATE PRICES IN THE REPUBLIC OF MACEDONIA*

Real Sector Developments Division

Biljana Davidovska Stojanova, MSc

Branimir Jovanovic, MSc

MBA Maja Kadievaska Vojnovic

Gani Ramadani

Magdalena Petrovska

Skopje, August 2008

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Introduction

Increased attention is paid in the last several years to monitoring the real estate market developments, due to their significant impact on the economic developments in general. In view of that, the importance of regular monitoring of apartment prices is especially emphasized. Namely, housing real estate makes a significant part of the total assets of the population, and expenditures pertaining to these assets (housing loan or rent payments) make a great portion of the total population's expenditures. Fluctuations in apartment prices, rents, and housing loan interest rates, therefore, greatly impact the change of real estate value, as well as the population's income and expenditures, and consequently the changes in aggregate demand and inflation. Home prices are sensitive to interest rate changes, i.e. to the expansion or restriction rate of the monetary policy, with which they can significantly participate in functioning of the transmission mechanism of the monetary policy. Rent prices also are a part of the Personal Consumption Expenditure (PCE), which is a basis for calculation of the Consumer Price Index (CPI), thus influencing the inflation movements. In more developed economies, more prominent fluctuations in home prices can also impact the financial and economic cycle and the financial stability of the country.

The truly functional real estate market includes a great number of institutions interconnected via numerous and complex interactions, that involve many participants from numerous important sectors, such as construction sector, banking sector, legislature, insurance and public sector. The development and normal functioning of this market segment entail establishing norms, standards, and adequate regulations, or in other words, existence of a cadastre, real estate agents, real estate appraisers, a banking system capable of offering long-term loans, and legislation that ensures protection of ownership rights. On the other hand, existence of construction companies is also necessary to engage in renovation of the existing and building of new housing. Establishing a functional real estate market in transition economies is a relatively long and slow process, and the real estate market thus remains a market segment that still falls behind in the development compared to the western economies. Besides that, there are big differences amongst the transition economies themselves in establishing the above mentioned institutional structure, as well as issues resulting from the faster development of the market structure than the legislative framework regulating this segment. Nevertheless, it is critically important for all transition economies, for the purpose of actuating the real estate market, to establish: housing loan industry, legislation for ownership rights protection and financial innovations in these countries' banking systems, which have enabled a significant growth of this segment, especially in the last several years.

Essential prerequisite for adequate monitoring and analysis of movements on the real estate market is the availability of quality data about this market segment. The calculation of the real estate prices index is not a simple operation, which is due to the real estate market characteristics. Namely, homes are extremely diverse category. They differ by quality and location features, due to which establishing a so-called "clean" price is very difficult. The advertised price is also not always equal to the final selling price of a real estate, and the fact that real estates are not subject to frequent sale and purchase is an additional problem.

The real estate market, and particularly the apartments market, as a distinct market segment in the Republic of Macedonia, has been an area not researched enough up till now. Unfortunately, the Republic of Macedonia does not have a developed statistics on real estate prices, which is one of the main reasons for this segment to be insufficiently researched in the country. This paper, based on world trends, is the first serious attempt in this field, and, as a pioneer project, it greatly contributes to filling in the void in the local literature by dealing with the issue of apartment prices in the country.

The significance of this paper is primarily seen in the construction of *real estate index by using hedonic methods*, which make it possible to establish the so-called “clean” change of price of homes, i.e. to isolate the effect of price variations resulting from variations in quality and location features of the real estate in different periods of time. Besides the index construction, an *econometric analysis of the determinants of movement of real estate prices in the Republic of Macedonia* has also been made, with the purpose of estimating whether real estate prices are harmonized with fundamentals in terms of offer and demand, and of the factors determining their dynamics, which is also a significant element of labor. This has been done by constructing a model of apartments market.

The Paper is structured as follows: the first chapter is about the construction of apartment prices index in the Republic of Macedonia; the second chapter is about the most commonly applied methods of assessing the over or underestimation of apartments value, and about comparison of prices of apartments in Macedonia with those in other countries; the third chapter is about analysis of determinants of apartment prices; the conclusion sums up the most important aspects of the analysis.

1. Construction of Hedonic Index for Apartment Prices in Macedonia

This chapter of the paper is about construction of hedonic index of apartment prices in Macedonia. In the first part, we present a short elaboration of the hedonic price models, from which hedonic price indexes result, and we present the two most common methods for calculation of these indexes. In the latter part, the process of construction of the hedonic index of apartment prices in Macedonia is presented. In the end, we comment on the results.

1.1 Hedonic Price Index^b

Hedonic price indexes are based on hedonic price models that, following the analogy of *hedonistic* perception, view the product from the aspect of the consumer's utility and luck (Court, 1939, p.107). The first hedonic index was calculated by Andrew Court (1939), while the modern views on the index result from the work of Zvi Griliches (1961); they both calculated hedonic indices for car prices. Nowadays they are included in the statistical systems of many OECD countries, mainly for high-tech products that change rapidly, as well as for real estates.

Hedonic price index is each price index calculated by hedonic function. Hedonic function is a relation between prices of different types of one product, and characteristics of distinct types. For instance, the price of a car can simply be expressed as a function derived from its characteristics – engine power, brand and equipment.

$$\text{price}_i = a_0 + a_1 * \text{engine power}_i + a_2 * \text{brand} + a_3 * \text{equipment}_i + \varepsilon_i \quad (1)$$

These hedonic functions are evaluated with regression. The coefficients **a₁**, **a₂** and **a₃** measure the effect of the engine, brand and equipment on the price, respectively. In other words, they give the *implicit prices* or *prices of distinct characteristics*. Namely, the hedonic models treat a product as a sum of characteristics, where product price is a sum of the individual prices of characteristics. The ε_i gives the error (residual), **a₁** is a constant, while **i** is a term referring to different cars.

The advantage of hedonic price indexes, in comparison with the conventional methods for monitoring a certain product over time (matched model methods), is that hedonic methods recognize the possibility for the product to have undergone some changes, and explicitly take that possibility into account. Therefore, with hedonic indexes one can isolate the variation of price resulting from quality improvement, for which reason they are also called “constant quality indexes”. That is precisely why they are most frequently applied for products that constantly improve.

There are several methods for computing hedonic price indexes, out of which the most significant are the “*time dummy variable method*” and the “*characteristics price method*”.

The “*time dummy variable method*” is the method that was first developed and is most commonly used for calculating the hedonic price index. According to this method, one regression equation is computed for all periods for which the index is calculated, where a time dummy variable for each distinct period is included. Thus the index is produced directly from the time dummy variables' coefficients.

Therefore, if an index for automobile price is constructed for three periods, for example for years 2000, 2001 and 2002, the regression equation according to this method looks as follows:

[†] The discussion in this part is mostly based on Berndt (1991) and Triplett (2004).

$$\text{price}_{it} = a_0 + a_1 * \text{engine}_i + a_2 * \text{brand}_i + a_3 * \text{equipment}_i + b_1 * (D_{2001}) + b_2 * (D_{2002}) + \varepsilon_{it} \quad (2)$$

The coefficients of characteristics (a_1, a_2, a_3) include the changes in the engine, brand and equipment, which means the quality of the cars in all three years is constant. The coefficients of *dummy variables* b_1 and b_2 measure the change in car prices in 2001 and 2002 compared to the base period – year 2000. Thus, if coefficients b_1 and b_2 equal 0.1 and 0.15 respectively, index is 1 in year 2000[‡], 1.1 in 2001, and 1.15 in 2002.

The “characteristics price method” uses traditional index formulas – of Paasche, Laspeyres or Fisher – for price index construction, where prices are presented as regression coefficients of a hedonic function. The logic behind the characteristics price method comes from the interpretation of coefficients of the hedonic function – they present the price of one unit of characteristics, for example of one horsepower of the engine.

For construction of hedonic index by using the characteristics price method, the hedonic function *for each* period needs to be estimated (in the example given those would be: $t, t+1, t+2$). This means that several (in this particular case, three) regressions are estimated, which is why another name for this method is *regression method*. Then, the price index for one product is derived as per the formula below:

$$\text{index} = \frac{\sum_{i=1}^n c_{i,t+1} * q_{i,t}}{\sum_{i=1}^n c_{i,t} * q_{i,t}} \quad (3)$$

In this Laspeyres’ formula, as a price of the characteristics i in the period t ($c_{i,t}$), its coefficient from the hedonic regression for period t is taken. For the weight of the characteristics i (q_i), the quantity in the base period is taken, i.e. the assumption is that product characteristics during the whole period are equal to those in the base period.

The characteristics price method is considered to have several advantages compared to the dummy variable method (see Triplett, 2004). The most important weakness of the dummy variables methods is the assumption that characteristics prices are equal in all time periods. Namely, even if this can be justified for a short period of time, from an economic point of view it is very difficult to imagine a stagnant price for a longer period of time. The characteristics price method, on the other hand, clearly recognizes the possibility for the implicit prices to vary. Nevertheless, despite the theoretical advantages of the characteristics price method, most of the empirical studies comparing the two methods suggest that although the assumption for equality of regression coefficients through time is not complied with, the difference between the two indexes is not significant (see Triplett, 2004 and studies listed there).

[‡] The number of time variables is by one less than the number of periods, for the reason that the average price in the base period is, actually, a constant. If the price is in linear form, as in equation (2), the coefficients give the percentage variation of the price between periods. If the price is in logarithmic form, the percentage variation is derived when an antilogarithm (exponent) is subtracted from the coefficients.

1.2. Construction of the house price index

1.2.1. Data and variables

The sample used for this index construction comprised 4,368 apartments advertised for sale in a Macedonian advertising paper, as the only available source of data about real estates in the Republic of Macedonia in the period from year 2000 to 2007. Data refer to advertisements published by real estate agencies and are with quarterly dynamics. Data refer only to real estate on the territory of Skopje, which means we are dealing with a metropolitan price index.

The data base contains data of: the advertised price, the apartment area in square meters, the floor it is located on, information on whether it has central heating or not, whether it is new or old, and on the location (residential area) it is located at. The “price” variable presents the *advertised* apartment prices, not the actually paid ones. This is not a serious problem and does not affect the price index results as long as the difference between the advertised and actual transaction price is approximately constant, which we consider to be the case in reality with the advertisements of real estate agencies. Hence, the model used in the analysis can be presented as follows:

$$\text{Price} = f(\text{area, floor, central heating, new, location}) \quad (4)$$

The number of variables explaining the price, compared to other hedonic studies, is rather limited (for example, see Fletcher et al., 2000). This refers in particular to unavailability of data on the age of the apartment is, and about the number of rooms. Despite the fact that this problem is of an utterly objective nature – these data are not presented in the advertisements for most of the apartments – there are several arguments that it is not a very serious problem. Firstly, it is very possible that the effect of these two characteristics is captured by one of the included variables. For example, the number of rooms may be captured by the area (larger apartments have more rooms), and the age of the apartment may be captured by the location variable (the apartments in the area of Karpos are, on the average, older than those in the area of Novo Lisice). If the primary objective of our analysis is to examine the determinants of apartment prices from a hedonic aspect, the inability to make a difference between the effect of the number of rooms and the area would be problematic. However, our primary objective is construction of price index, so the uncertainty about the effects of distinct characteristics is not that important. It is also disputable how much these two characteristics impact the apartment prices in Macedonia, considering the fact that they are most frequently omitted in the advertisements. To support this argument, we would mention the “fit” (the coefficient of determination) of our regressions (which will be explained in more detail later in the paper), which is around 0.92, and which means that the factors included explain 92% of the apartment price variations. This is a relatively high explanatory power compared to what is usually seen in the hedonic models, which is why we consider that characteristics that determine the price are well covered (the coefficient of determination usually found in literature is at a rate of about 0.85; see Fletcher et al. 2000, Bowen et al. 2001, Bover and Vellila, 2001).

The descriptive statistics of the whole sample is presented in Table 1[§]. The numbers referring to qualitative variables – central heating, new/old, floor and location – mark the number of apartments owning the stated characteristic. The modalities of characteristics “floor” and “residential area” were grouped for better clarity, and on the grounds of similar effects. Thus, in the basic regression, one variable was included for each floor and each residential area, and then they were grouped^{**} based on the similarity of coefficients before these variables.

[§] The descriptive statistics for each quarter separately is not presented for better clarity, but is given in Appendix 1, Table 1.

^{**} The results from this regression are presented in Appendix 1, Table 2.

Table 1: Descriptive statistics of sample

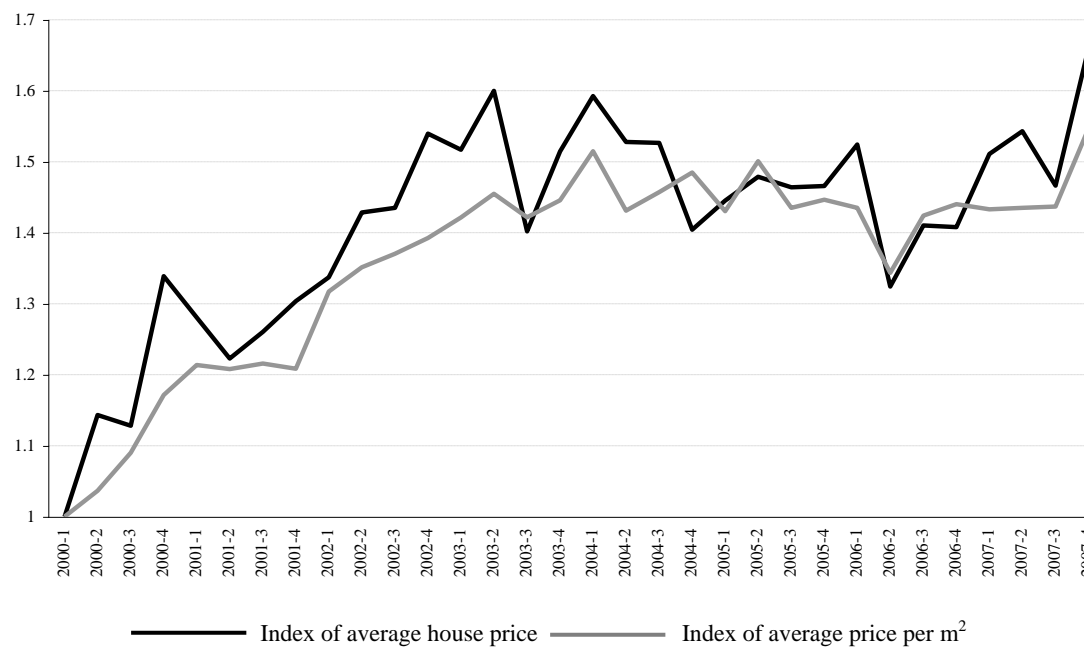
Number of apartments	4368
Average apartment price (Euros)	47676.84
Maximum apartment price (Euros)	246000
Minimum apartment price (Euros)	8000
Average apartment area (m ²)	65.55
Maximum apartment area (m ²)	246
Minimum apartment area (m ²)	15
Number of apartments:	
With central heating	3711
Newly built	162
On floors no. 0, 4, 5, 6, 7	2054
On floors no. 1, 2, 3	1894
On floors no. 8, 9	251
On floors no. 10+	169
In residential area no. 1	1387
In residential area no. 2	820
In residential area no. 3	1400
In residential area no. 4	304
In residential area no. 5	457
<i>Residential area 1: Centar, Debar Maalo, Crnice, Vodno and Kapistec</i>	
<i>Residential area 2: Kozle, Karpos 1, 2 and 3, Ostrovo and Taftalidze</i>	
<i>Residential area 3: Aerodrom, Karpos 4, Vlae, Kisela Voda & Novo Lisice</i>	
<i>Residential area 4: Avtokomanda, Gorce Petrov, Hrom and Zelezara</i>	
<i>Residential area 5: Cair, Cento, Hipodrom, Madzari, Novoselski Pat, Radisani, Skopje Sever and Topansko Pole</i>	

The movement of the average price of an apartment in the analyzed period, as well as the price per square meter, is presented in Table 2 and Graph 1. As observed, the apartment prices note a significant increase. The difference between the two presented indexes is also evident. According to the apartment price index, the price in end 2007 was higher than the one in early 2000 for about 66%. According to the square meter price index, the price growth in the same period was 55%. The explanation of this difference is that, in the fourth quarter of 2007 the apartments were of a bigger average area than in the first quarter of 2000 (see Appendix 1, Table 1), i.e. the quality of the apartments in these two time periods is not constant. Considering that with hedonic price indexes the effect of the apartment quality change on their price is completely isolated, it will be interesting to see to what extent the factual apartment price increase results from the better quality of apartments.

Table 1: Average price, in Euros

	Average price per apartment	Average price per m ²
2000-1	33745.53	536.373
2000-2	38579.17	555.9406
2000-3	38069.71	584.5678
2000-4	45174.17	628.2583
2001-1	43219.49	650.9838
2001-2	41261.48	647.8082
2001-3	42532.95	652.1
2001-4	43988.76	648.0799
2002-1	45128.18	706.5001
2002-2	48202.07	724.8726
2002-3	48426.93	734.962
2002-4	51951.2	746.9353
2003-1	51192.73	762.4163
2003-2	53984.34	780.2946
2003-3	47309.7	762.5867
2003-4	51113.2	775.4344
2004-1	53740.4	812.5711
2004-2	51556.39	767.5684
2004-3	51510.81	781.5481
2004-4	47386.9	796.4854
2005-1	48770.2	767.1834
2005-2	49904.35	805.0229
2005-3	49401.43	769.6463
2005-4	49461.21	775.8524
2006-1	51431.29	769.6565
2006-2	44685.8	720.5852
2006-3	47593.72	763.8178
2006-4	47506.91	772.4481
2007-1	50982.99	768.6534
2007-2	52072.15	769.6976
2007-3	49478.15	770.7092
2007-4	56009.18	829.7875

Graph 1: Average price movement



1.2.2. Econometric Analysis

In the following section we present a technical review of certain questions related to the index construction, which researchers are regularly faced with when making econometric analysis. For that reason, we consider this section useful mostly for readers of that orientation.

The first question we should answer in relation to the regression analysis is the model specification. An appropriate specification is necessary for a simple reason that in case the model is misspecified, the results might be biased. During the specification, decisions are made about two important things – which variables will be included in the model, and what will be the functional form of the relationship amongst the variables. In our case, with limited number of variables, choice of the model specification comes down to a choice of a functional form of the price and the area. More precisely, the question is whether the price will be taken in a linear, or logarithmic form, and whether the area will be taken in linear, logarithmic or square form (when we say that one variable enters with square form, it actually enters with both linear and square form). The six abovementioned alternatives are presented in Table 3, where the asterisk (*) shows what is the combination made. The criterion for choice of specification are the standard diagnostic tests – Jarque-Bera test for normality and White test for homoscedasticity of the residuals, Ramsey RESET test, which is of a general character and indicates omitted variable or a wrong functional form, as well as the coefficient of determination (R^2), which shows what percentage of variations in the price are explained with the included variables⁶.

Table 2: Criteria for choice of the most adequate specification

	price	price	price	log(price)	log(price)	log(price)
Area	*		*	*		*
log(area)		*			*	
Area2			*			*
R^2	0.821	0.764	0.831	0.840	0.847	0.849
Jarque-Bera	0.000	0.000	0.000	0.000	0.000	0.000
White	0.000	0.000	0.000	0.000	0.000	0.000
Ramsey's RESET	0.000	0.000	0.000	0.000	0.000	0.768

One can easily see that, in all models, the null hypothesis for normality and homoscedasticity of the residuals can be rejected with a minimum error possibility. The hypothesis for correct functional form can not be rejected only in the last specification, which has the highest explanatory power, too⁷. Thus, in the further analysis, we will use precisely this specification.

The fact that the dependent variable is in a logarithmic form means that coefficients of quantitative variables (i.e. area) give the semi-elasticities of the price in relation to them, i.e. when interpreting the coefficients, the change of the dependent variable will be in percents, and not in units (specifically in Euros). The value of the constant also now presents the median (and not average) apartment price, while coefficients of qualitative (dummy) variables give the deviation from the median price (see Gujarati, 2004, p. 320). However, if the average and median values of the price are close, practically one can loosely interpret the coefficients in relation to the average price (for the price of all apartments the median and

⁶ The test for serial correlation between the residual is not taken into consideration as it is significant only in the analysis of time series, where the observations have a natural order.

⁷ It should be emphasized that the coefficient of determination in models with different dependent variable, e.g. price and log(price) can not be directly compared.

average prices are 10,70322 and 10,70324 respectively). The square form for the area is also plausible – it implies diminishing marginal effect of area on price, which would mean that for small apartments the area influences the price stronger than for big apartments.

Rejection of the hypotheses for normality and homoscedasticity of residuals, although initially seems worrying, is not very problematic. It will be seen later in the paper that at individual regressions the hypotheses are almost always preserved. The reason for their rejection in the complete sample was found in the big number of observations and adequately low critical values for rejection of hypotheses. The histogram of the residuals (see App. 1, Graph 1), although a little asymmetric on the left, has the bell-shaped look of the normal distributions. The kurtosis is 3.7, i.e. not much different than the theoretical 3, and the skewness is -0.33, also not much different than the theoretical 0. As for the heteroscedasticity of the residuals, it is expected when working with large samples, and it does not affect the value of coefficients. Hence, we consider our model to be correctly specified.

The results of the regression model, *evaluated for the complete sample*, are presented below. It should be emphasized that when constructing the index by the characteristics price method (regressions method) this model is estimated for each quarter (in that case we estimate a total of 32 regressions, presented in Appendix 1, Table 3⁸). When the index is constructed by the method of time dummies, in the model presented here 31 time dummy variables were added, one for each quarter (these results are presented in Appendix 1, Table 4).

$$\begin{aligned} \log(\text{price}) = & \quad 9.680466 & + 0.045133*\text{floor123} & - 0.05115*\text{floor89} & - 0.11618*\text{floor10 plus} \\ & (554.13)** & (9.79)** & (5.26)** & (10.00)** \\ & - 0.0876*\text{zone2} & - 0.19669*\text{zone3} & - 0.33702*\text{zone4} & - 0.50362*\text{zone5} \\ & (12.56)** & (33.90)** & (33.87)** & (53.39)** \\ & + 0.086149*\text{central} & + 0.102417*\text{new} & + 0.020324*\text{area} & - 0.000048*\text{area2} \\ & \text{heating} & & & \\ & (11.60)** & (8.80)** & (46.97)** & (16.58)** \\ & R^2=0.85 \end{aligned}$$

Absolute value of the t-statistics in brackets. ** means significance at a level of 1%.

The constant, which gives the median (average) price of an *old* apartment in zone 1 on ground floor (or floors 4, 5, 6 or 7), without central heating, with an area of zero square meters, obviously has no economic interpretation. Apartments on the first, second or third floor are more expensive than the respective ones on the ground floor (or on floors 4, 5, 6 and 7), on average by 4.6%, those on floors 8 and 9 are cheaper by 5%, and those on floor 10 or up are cheaper by 11%. An apartment with central heating is more expensive than an identical one without central heating on average by 9%, and the new apartments are more expensive by 10.8%. Apartments in zone 2 are cheaper than those in zone 1 by 8.4%, in zone 3 by 17.9%, in zone 4 by 28.6%, and in zone 5 by 39.6%⁹. As for the area, the positive sign in front of the linear term, and the negative one in front of the square term, mean that the relation between the area and price is parabolic, and not linear, i.e. that the marginal effect of the area on the price decreases with a constant rate¹⁰. All coefficients are significant, with the expected signs and with the expected size.

⁸ Coefficients of these regressions are graphically presented in Appendix 1, Graph 3, for the purpose of showing their stability.

⁹ When interpreting the model coefficients, it should be taken into account that the effect of the *time dummy variables* in models where the *dependent variable is in logarithm* is derived by taking an exponential (antilogarithm with a base *e*) from the coefficient, and subtracting 1 from this (see Gujarati, 2004, p. 321).

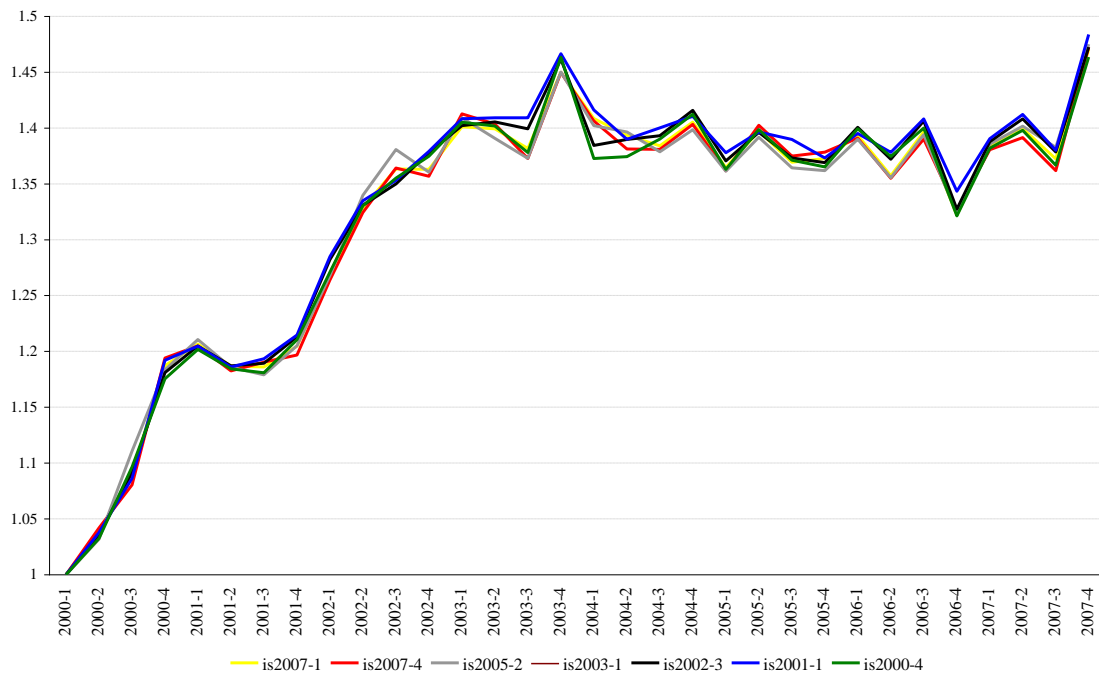
¹⁰ The marginal effect here is not constant, it depends on the area, and is derived by the formula: $b_1 + 2*b_2*area$, where b_1 is the coefficient before the linear term, and b_2 before the square one (see Wooldridge 2002, p. 68). The marginal effect of the area is presented in Appendix 1, Graph 2. It can be seen that, after certain value, the effect becomes negative. This means that, for ex., an apartment of 220m² is on the average cheaper than an identical apartment of 219 m².

1.2.3. Calculation of the index

Obtaining the index of apartments by the *regression method*, after deriving the coefficients of the quarterly regression, is a simple calculation. Values of variables for one chosen basic period are multiplied with the previously derived coefficients for each quarter. Then, as the dependent variable is in logarithms, an antilogarithm is computed from values derived in this way. The values derived after computing the antilogarithm present the prices of apartments given by the model (fitted values), in Euros. These prices are then added up, and their total sum gives the value of housing units in that period of time. The apartment price index is derived after these values are based.

The choice of the base period may greatly impact the derived index in case when the structure of apartments is not constant in all periods. One should remember that apartments from the base period present the total housing units number, which is assumed not to change over time. Consequently, for a base period one should choose a period of a similar structure as that of the total housing units number. To check the index consistency, we selected several different base periods for index calculation. Some of the periods had a structure similar to that of the total sample, and some of them a bit different one. The alternative indexes are presented in Graph 2 (the index name contains the base period taken for the calculation).

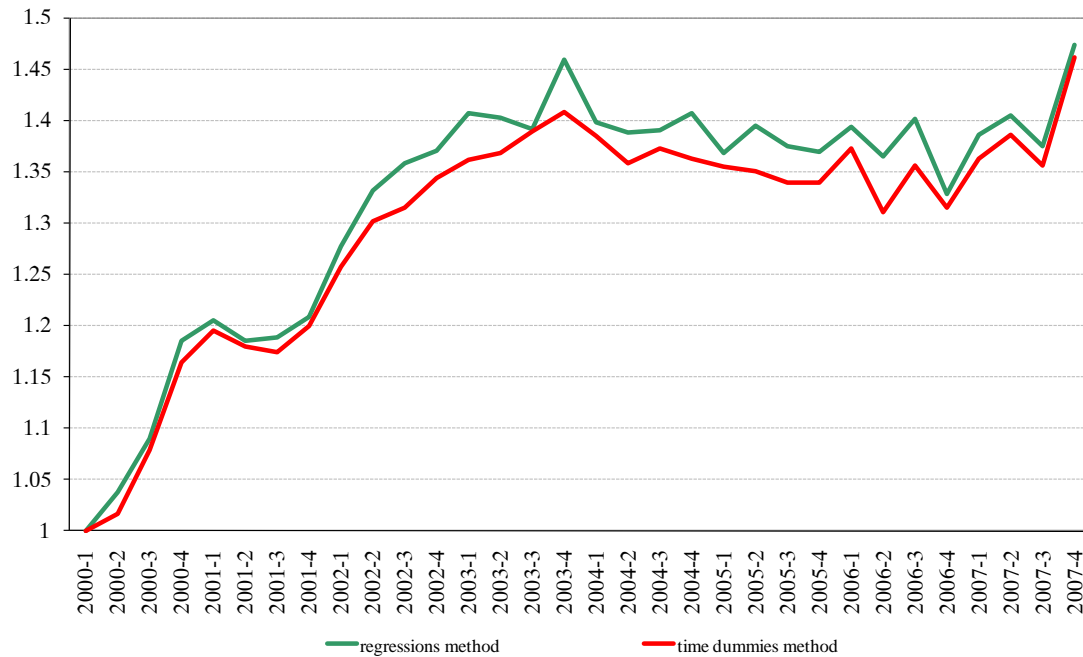
Graph 2: Alternative indexes derived by regression method



Different indexes, show almost identical movements of apartment prices: from 2000 to end 2003, the apartment prices were growing constantly, except in 2001, when the prices stagnated. Then, from 2004 to end 2006 the prices were slightly declining, but in 2007 they started growing again.

The index by time dummy variable method is derived by a simple calculation – antilogarithm is taken from the coefficient of the time dummy variable (because the price is in logarithmic form). The index derived by this method, together with the average value of the alternative indexes derived by the previous method, is presented in Graph 3.

Graph 3: Apartment prices by the time dummy variables method and average by regression method



Despite the obvious differences between the two indexes, it is important to note that trends of both indexes are identical, i.e. the story is the same. As expected, the oscillations of the index derived by time dummy variables are lesser, which is due to the considerable variation rate of the coefficients from one to another regression (Appendix 1, Graph 3).

1.3. Construction of rent index

The method for construction of rent index is identical to the one for apartment price index, therefore in this section we will focus only on the most important issues¹¹. The database of apartments for rent initially includes 2,199 apartments. The data was collected in the same way as the data on apartments for sale. The variables that impact the rent include the apartment area, central heating, residential area and apartment equipment, i.e. whether it is unfurnished, furnished or luxuriously furnished. The rent index model can be expressed as follows:

$$\text{Rent} = f(\text{area, furnished, central heating, residential area}) \quad (5)$$

¹¹ Details about rents are reserved for the Appendix. The descriptive statistics for all periods is given in Table 5, the movement of rents and of rents per square meter are presented in Table 6 and Graph 4, the criteria for selection of model specification are in Table 7, the results of the basic regression in Table 8, the results of specific regressions are in Table 9, and of the regression by time dummy variables in Table 10. The distribution of the residuals from the basic regression is presented in Graph 5.

Table 3: Descriptive statistics of the sample

Number of apartments	2199
Average rent per apartment (Euros)	270.92
Maximum rent per apartment	1600
Minimum rent per apartment (Euros)	75
Average apartment area (m ²)	66.13
Maximum apartment area (m ²)	250
Minimum apartment area (m ²)	24
Number of apartments:	
With central heating	2046
Unfurnished	467
Furnished	1394
Luxuriously furnished	338
In zone 1	863
In zone 2	794
In zone 3	445
In zone 4	97

Zone 1: Centar, Crnice, Vodno, Debar Maalo, Kozle and Kapistec

Zone 2: Aerodrom, Karpos 1, 2 i 3, Ostrovo, Prolet and Taftalidze

Zone 3: Kisela Voda, Karpos 4, Vlae and Novo Lisice

Zone 4: Avtokomanda, Cento, Cair, Gorce Petrov, Skopje Sever, Zelezara, Madzari, Topansko Pole and Hrom.

Results from the basic regression for the whole sample are:

$$\begin{aligned} \log(\text{rent}) = & \quad 4.696 & - 0.139*\text{zone2} & - 0.269*\text{zone3} & - 0.37*\text{zone 4} \\ & (214.01)** & (14.19)** & (22.78)** & (16.72)** \\ & + 0.158*\text{central} & + 0.484*\text{luxurious} & - 0.146*\text{unfurnished} & + 0.011*\text{area} \\ & \text{heating} & & & \\ & (9.16)** & (38.01)** & (13.94)** & (53.74)** \end{aligned}$$

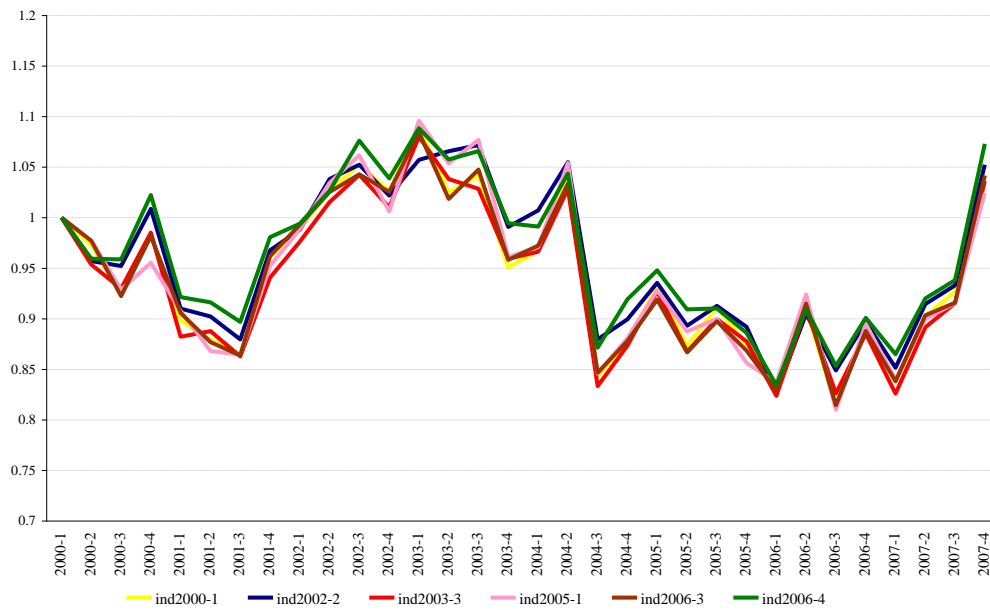
$$R^2=0.82$$

Absolute value of the t-statistics in brackets. ** means significance at a level of 1%.

All variables are highly significant and with signs and magnitudes as expected. The interpretation is identical to the previous one, the only difference being that in this case the area has a linear impact on the rent. This means that area increase for 1m² causes a price growth of 1.1%.

Rate indexes derived by regression method with different basic periods are presented in Graph 4.

Graph 4: Alternative rent indexes, regressions method



Alternative rent indexes that are derived by regressions method manifest very similar movements. It is also obvious that variation (oscillation) rate from one period to another is higher in rents than in apartment prices. As for the trends in the index, by the third quarter of 2001, the rents were constantly declining, after which they started increasing until mid 2004. In the third quarter of 2004, rents marked a significant fall for unclear reasons, after which they stagnated until early 2007. Afterwards, they started an intensive growth.

The rent index derived by time dummy variables method, together with the average of indexes derived by regressions method, is presented in Graph 5.

Graph 5: Rate indexes derived by both methods (regressions and time dummy variables)



The significant difference between the two indexes is easily noted, which points to a certain uncertainty in the movements of rents. The trends of the two indexes are generally similar, except in the first two years, when the time dummy variables method shows no decline of rents. What is especially important is that in the index derived by time dummy variables method, the previously mentioned unusual decline in the third quarter of 2004 is not present. The index derived by the time dummy variables method is also less volatile. The differences between the two rent indexes are explained with the lower quality of data for the apartments for rent.

1.4. Results from the apartment price index and rent index

For an *apartment price index* on which further analysis will be based, we selected the index derived from an average of the alternative indexes derived by the *regressions method*. Since there were no significant differences between this index and the index derived by the time dummy variables method, we based this decision on the advantage given in the literature to the regressions method. We will, however, use the index derived by the time dummy variables method to assess the sensitivity of the results.

Based on the results from the derived apartment price index, several trends in the movement of apartment prices can be isolated in Macedonia in the period from 2000-2007. The period from 2000 to end 2003 is characterized with an intensive price growth, at an average of about 10% annually, which made the apartments in end 2003 by about 46% more expensive than in early 2000. The year of 2001 is an exception from that general trend, because the prices stagnated. The apartment prices also generally stagnated in the period from 2004 till end 2006, with a minor downward trend, so that the prices in end 2006 were by about 9% cheaper than in end 2003. In 2007, the apartment prices mark an intensive growth, and in end 2007 they are by about 11% more expensive than in end 2006. Thus, the apartment price in the Republic of Macedonia in end 2007 is by 47% higher than the one in the beginning of 2000. A reminder that the average price growth by a square meter in the same period of time was 55%, which indicates that 8 percentage points of that price increase was due to the improved quality of apartments.

In regard to the *rent index*, the decision on which of the indexes would be used in the further analysis could not be based on the methodological advantages of the regressions method. On the contrary, due to its greater variability, as well as due to the unclear decline in 2004, we decided for the index derived by the time dummy variables method. Nevertheless, the index derived by regressions method will also be consulted to assess the sensitivity of results.

The dynamics of the rent index could be summed up in the following way. From 2000 till the first quarter of 2003, the rents mark a trend of a mild growth, and their cumulative growth is about 7%. The year of 2001 is, once again, an exception, as rents marked a minor decline then. In the period that followed, the rents were declining, and in the first quarter of 2006, compared to the second quarter of 2003, the rent was lower by about 20%. In the last two years, the rents were again increasing, and in end 2007 they were by about 21% higher than in early 2006, or by about 6% higher than in early 2000. At the same time, the average rent per square meter in the fourth quarter of 2007 is higher by about 10% than the one in the first quarter of 2000 (Table 6, Appendix 1), which indicates that the 4 percentage points of the factual price increase in end 2007 was due to the quality improvements.

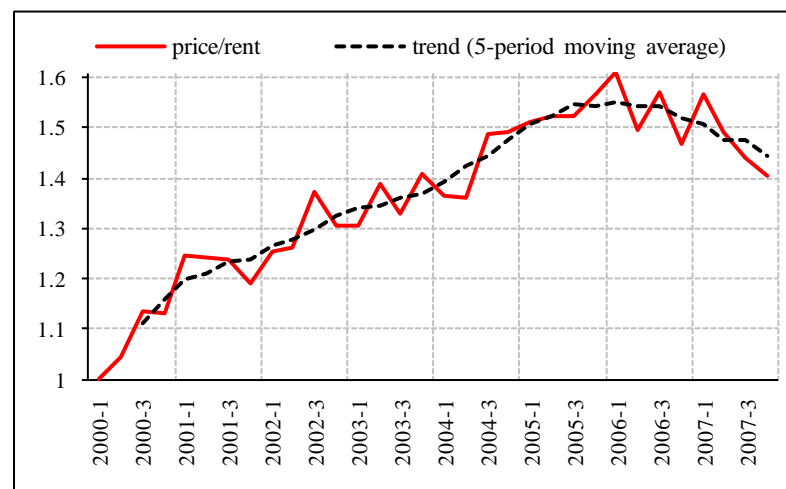
2. Different methods for determining over- or under-valuation of house prices

We begin the analysis of house prices in Macedonia by presenting the different methods found in the literature about the question on whether house prices are overvalued or not. House price bubble is considered to be a price growth unsupported by changes in the fundamentals (Stiglitz, 1990). In this chapter we mainly focus on the following methods for determining overvaluation/undervaluation: indicators “price/rent” and “price/income”, and approaches of “perpetuity” and “imputed rent”. The regression analysis approach, considered as the most appropriate for establishing the apartments’ over/undervaluation, is described in more details in the next chapter of this Paper. To support the alternative methods for determining the apartments’ over/undervaluation, we also make comparison between Macedonia and the other countries on the basis of several indicators.

2.1. Price/rent

The first and simplest method for determining whether the apartments are overvalued is by the indicator “price/rent”. This indicator is based on the premise that buying and renting are substitutes, and gives the relative price of owning versus renting an apartment. Therefore, if the apartment price is too high, the economic agents will turn towards renting rather than buying, which will result in price drop. The ratio price/rent should be approximately constant, and its growth during a longer time period indicates that the price is not driven by the fundamental factors, but by the expectations for its future growth.

Graph 6: Indicator price/rent for Macedonia



As can be seen, the “price/rent” indicator for Macedonia was continuously growing from the beginning of 2000, in 2005 and 2006 the level reached a maximum level, and in 2007 it marked a minor decline. The intensive growth until 2005, which coincided with the growth of the market price of apartments, indicates that the apartment prices were growing unjustifiably in that period of time.

Several arguments diminish the validity of the “price/rent” indicator. Firstly, it must not be forgotten that renting and buying an apartment are just imperfect substitutes – owning an apartment satisfies the need for housing in a superior way to renting, and, besides that, it also satisfies some other higher needs. In our opinion, this is especially valid in the case of

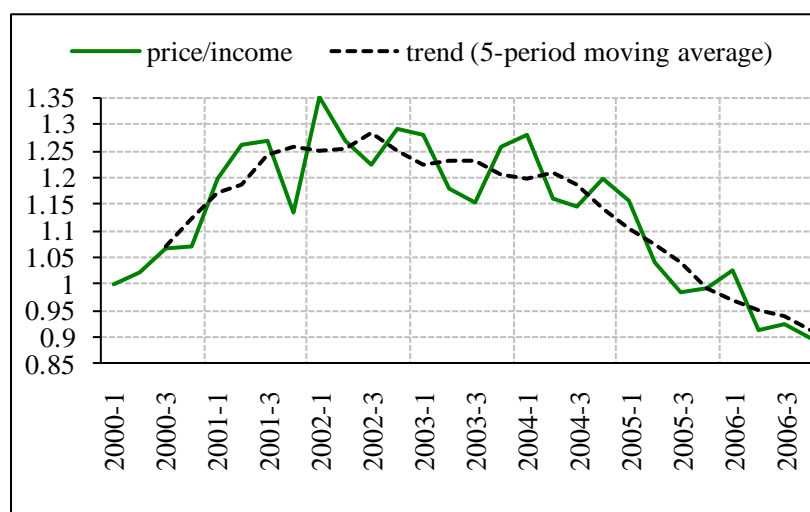
Macedonia, where population prefers living in their own homes¹². This means that there are factors that impact the apartment price, but that have no or little impact on the rent (e.g. – the interest rate). On the other hand, the growth of price/rent ratio might indicate that the apartment price is becoming too high, or that the rent was too high in the beginning of the period of time covered. This also sounds reasonable in our case – there might have been intensive growth of rents just before the beginning of the covered period, in 1999, as a consequence of the refugee crisis that resulted in a large presence of refugees and foreign diplomats (unfortunately, we do not have data for 1999 to be able to support this statement with facts). Unlike the rents, the apartment prices grew intensively in 2000, after the refugee crisis. One of the explanations about these movements of rents and prices in that period is that rents react much faster to changes in fundamentals than the apartment prices do.

Therefore, despite the fact that the “price/rent” indicator shows that the apartment prices in Macedonia in the period 2000-2005 were too high, we would take that with a reserve.

2.2. Price/income

The second indicator “price/income” is much like the previous one, and measures the ratio between the apartment price and the personal income, i.e. it shows affordability of apartments for families. The logic here is also very simple – if the prices grow much more than the income for a longer period of time, i.e. if the price/income indicator increases, it means the apartments are becoming too expensive¹³.

Graph 7: Price/income indicator for Macedonia



By 2002, when the indicator price/income increased significantly, the apartment price grew more intensely than the income, thus indicating the possible overvaluation of apartments in that period of time. In the remaining period, due to the impact of the stronger income growth, the price/income indicator drops continuously – moderately in 2002-2004 and more intensely in 2005-2006, which speaks in favor of the realistic valuation of apartments in Macedonia.

¹² According to the latest census of the population, households and homes, conducted by the State Statistical Office in 2002, 99% of the apartments in the Republic of Macedonia are in private ownership, 86% of the households live in their own homes, while only 2.6% are renters of homes. As a comparison, in the central and eastern Europe countries, 80-95% of the apartments are in private ownership, while the percentage of households living in their own homes exceeds 90% (source: Egert and Mihaljek, 2007).

¹³ The series of income that we use in the analysis is the real per capita disposable income in Macedonia calculated by the National Bank of the Republic of Macedonia. Besides the real per capita disposable income, one can use the average salary, the GDP etc. as data on income.

The price/income indicator can be criticized on the same grounds as the previous indicator, i.e. although the income is an undoubtedly important factor that determines the price movement, the price is affected by many other factors that may or may not influence the income. Therefore, the observations pointed at by the dynamics of the price/income indicator should be taken only as indicative.

If we compare the movements of the indicators price/rent and price/income, we notice that both indicators grow steadily until 2002, which speaks about apartments being overestimated in this period. In the period 2005-2007, however, both indicators declined which indicates that in this period the apartments were not overestimated.

2.3. Approach of “perpetuity”

The third approach to evaluating apartment prices is the approach of “perpetuity”, according to which the market house prices are compared with the price index constructed by the method of “perpetuity”. Perpetuity is defined as annuity without a definite ending, i.e. an everlasting annuity. A good example for illustrating the perpetuity concept are the UK Government’s treasury bills named Consols, which have no maturity date, i.e. there is no repayment of the principal, but only payment of the continuous interest by the treasury bill owner. Thus, based on the time value of money, the treasury bill price is actually the fixed interest payment discounted by a certain interest rate, which presents the speed with which money loses its value during time.

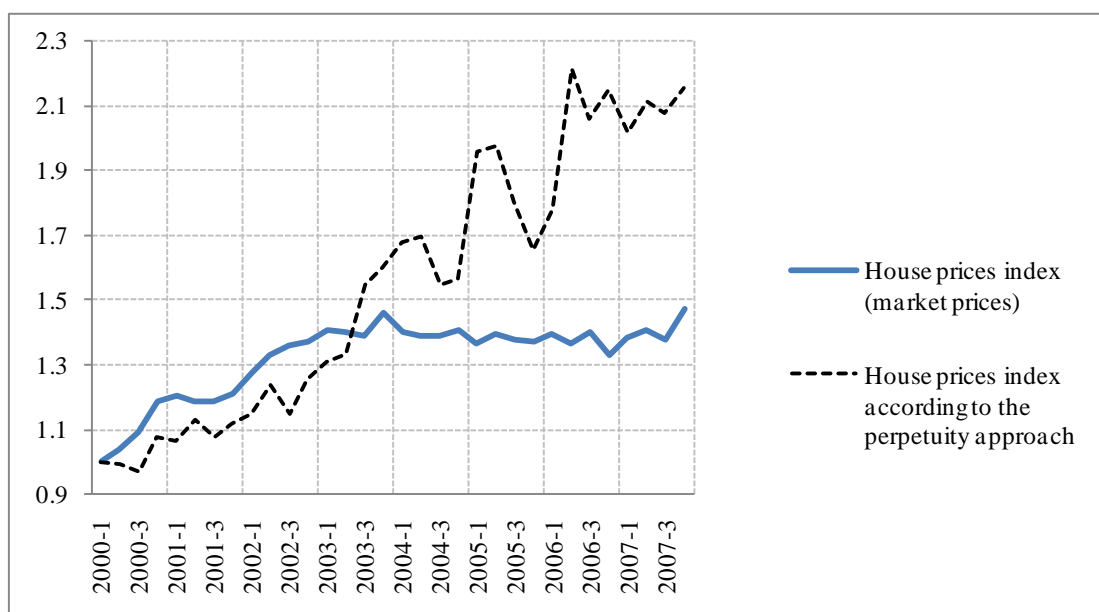
According to that, this approach assumes a very specific premise – renting a real estate forever. More precisely, the hypothetical value of the apartment, according to the “perpetuity” approach, is equal to the income incurred from its future leasing, i.e. to the current value of future rents.

$$Ph = \sum_{k=1}^{\infty} \frac{R}{(1+i)^{k-1}} = \frac{R(1+i)}{i} \quad (6)$$

Here the Ph is the apartment value according to the “perpetuity” method, R is the market rent, and i is the interest rate. Our model assumes that the interest rate of the deposits¹⁴ presents the minimum required interest rate. Although the capitalization rate is usually calculated as a difference between the interest rate and a certain rent increase rate, our model does not assume future rent fluctuations, i.e. it assumes that future rents will be equal to the current ones. The apartment price depends in direct proportion to the rent, and in inverse proportion to the interest rates. The apartment prices index by the “perpetuity” method, compared to the factual market index, is presented in Graph 8.

¹⁴ The calculation includes the interest rate on all deposits, i.e. a sum, all maturity periods, all sectors and all currencies.

Graph 8: Market price of apartments and price by the “perpetuity” method



The “perpetuity” index, , given the fairly stable rents, shows high sensitivity with respect to the deposits interest rate. Namely, the rapid decline of the interest rates in the analyzed period implies a rapid growth of the “perpetuity” index. Therefore, beginning from mid-2003, the price by the “perpetuity” method constantly exceeds the market price, and in 2007 it is higher by one half. Nevertheless, similarly to the previous two indicators, by mid 2003, the market price exceeds the “perpetuity” price, suggesting that the apartments in that period were overvalued.

The criticism addressed to the previous two methods is equally valid for the “perpetuity” method, because, although taking into consideration two factors in calculation of the real apartment value (the rent and the interest rate), it still neglects many other potential influences.

2.4. Imputed rent

The “imputed” rent approach is a little more complex than the three previously presented approaches, and there are many published papers that elaborate only this method in greater detail (e.g., Smith and Smith, 2006). It is based on the *cost of living in user’s own apartment* (*user cost of living, u*), which is calculated by the following formula (Poterba, 1984, Himmelberg et al. 2005, Smith and Smith, 2006):

$$u = \text{interest rate} + \text{property tax} + \text{depreciation} - \text{capital gain} + \text{risk premium} \quad (7)$$

The *interest rate* represents the opportunity cost of the home owner for investing the money in the apartment, instead of investing it in something else, and is usually taken as a risk-free interest rate. The *property tax* refers to the annual cost the owner is obliged to pay for the property tax, and it is equal to the tax rate for the property tax. The *depreciation* reflects the expenses for home maintenance (wear and tear) and it is taken as some common rate that is usually found in the literature. The *capital gain* is the expected capital gain in the coming year, in case the real estate is sold (if a positive price change is expected, the capital gain should be entered in the formula with a negative sign, as in that case it presents a gain, not an expense for the owner). The last component in the formula is the *risk premium*, which

presents the higher risk in owning than in renting an apartment. Like the depreciation, it is also taken as some common rate usually found in literature.

The annual cost of owning an apartment equals the user cost of living (u) times the apartment price (P). Assuming that rents are always in balance with the fundamentals, i.e. that there is no rent overvaluation, when the real estate market is in equilibrium, the annual cost of owning an apartment should equal the annual rent (R):

$$R = P * u \quad (8)$$

$$P/R = 1/u \quad (9)$$

Consequently, whether the apartments are overpriced or not can not be established by comparing the ratio *apartment price/annual rent* with inverse value of the user cost.

To illustrate this, we made calculation for 2007. As risk-free interest rate we took the interest rate of the three-month treasury bill (the average interest rate in 2007 was 5.6%); the property tax was 0.1%; we assumed the period of a total depreciation of the apartment to be 40 years, i.e. a depreciation rate of 2.5% (Himmelberg et al. 2005); as an expected capital gain, we used a long-term annual average of the apartment price growth rate, which in the period 2000-2007 was 4.97%; and we put the risk premium rate at 2% (Himmelberg et al. 2005, according to Flavin and Yamashita, 2002). The calculation was as follows:

$$u = 5.6\% + 0.1\% + 2.5\% - 4.97\% + 2\% = 5.23\% \quad (10)$$

According to our calculation, the user cost of living in 2007 was 5.23% (for comparison, Himmelberg et al. 2004, come up with a cost of 5%). The price/rent ratio in 2007 was 15.4 (average annual rent of 51 Euros per square meter, and average price of 785 Euros by square meter). As per the equation (9), the lower price/rent ratio (15.4) than the inverse value of the user cost of living (19.1), indicates that apartments in 2007 were not overvalued, but rather undervalued.

Similarly as with all previously elaborated approaches, the findings of the “imputed rent” approach should also be accepted with a caution. The first criticism of this approach goes to the arbitrary character of the assumptions for some of the cost. In our case, however, the results did not prove to be very sensitive to these assumptions. For instance, the conclusion that the apartments were not overvalued was also maintained when we assumed the total depreciation of an apartment to be 30 years instead of 40, as well as when we assumed a higher risk in owning an apartment (see Table 5).

Table 4: Analysis of sensitivity of calculations of the user cost of living

	Basic version	Higher depreciation	Higher risk
Interest rate	5.6	5.6	5.6
Property tax	0.1	0.1	0.1
Depreciation	2.5	3.3	2.5
Capital gain	4.97	4.97	4.97
Risk	2	2	3
User cost of living (u)	5.23	6.03	6.23
Inverse value (1/u)	19.1	16.6	16.1
Average price in 2007 (P), Euros by m ²	785	785	785
Average annual rent in 2007 (R), Euros by m ²	51	51	51
P/R	15.4	15.4	15.4

The second important criticism refers to the connection between the rent and the price, i.e. to the assumption that the user cost of living should equal the rent. As previously stated, apartment owning and renting are not perfect substitutes, and people will often be ready to pay more to live in their own apartment than in a rented one. The final criticism goes to the premise on which this approach is based, i.e. that the apartment price represents a function of the cost of living. Namely, this is not fully in accord with the understanding that the price of the apartments, as well as the price of most of the products, is determined by demand and supply. For instance, this method does not include many of the factors that undoubtedly contribute to the growth of the equilibrium price of the apartments, such as the income or demography. Consequently, since the focus is not on the fundamentals that move the price, the “imputed rent” approach is not able to explain dynamics of apartment prices over time.

2.5. Regression analysis

The approach that is used most often for analyzing over- or under-valuation of house prices in the literature is the regression analysis approach. In addition, in our opinion, it is the most adequate for our case, since it simultaneously helps answering two questions: whether houses are realistically valued and what are the factors that drive house price. This approach pins down to estimating an equation for the house prices, including the fundamentals, i.e. all factors that are considered to affect the price, independent variables. The equation is most frequently estimated by cointegration methods. Given that cointegration as a concept means that there is a long-run equilibrium relationship amongst the variables, the existence of cointegration between the price and fundamentals is interpreted as a confirmation that the price is realistic, i.e. that the apartments are not overvalued. More detailed elaboration of this approach for the case of the Republic of Macedonia is presented in the third chapter of this paper.

2.6. Comparative analysis

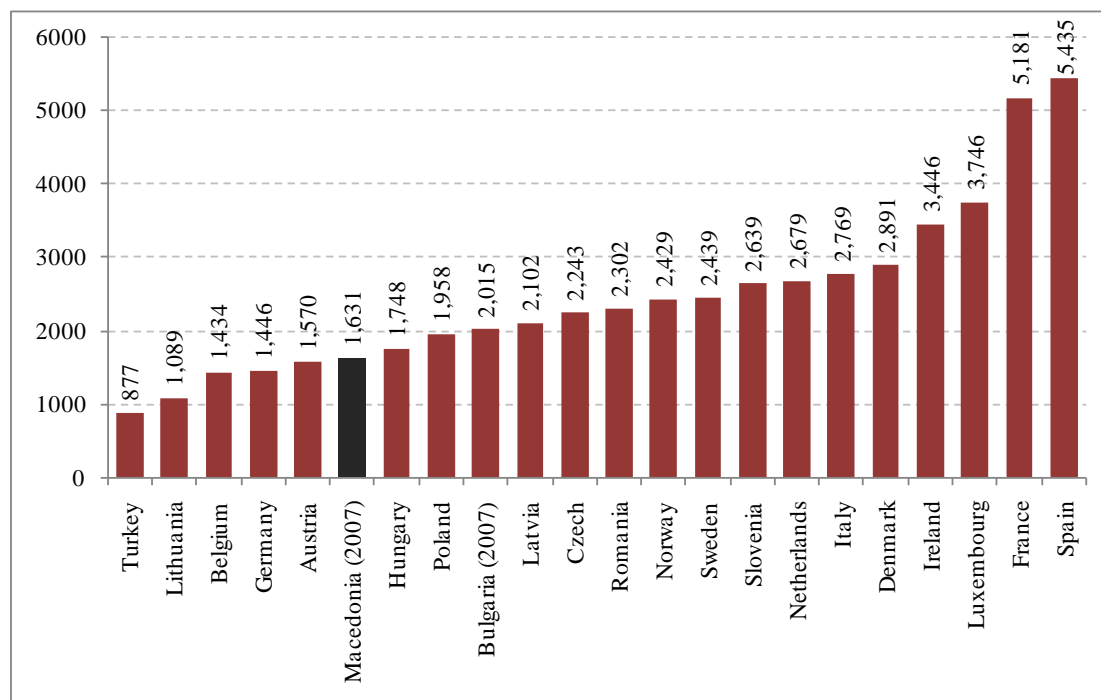
The simple indicators we elaborated so far indicated that the apartments in Macedonia were not overvalued in the period 2004-2007. To support this argument, we compare the situation in Macedonia with the situation in several other countries. Although the developed industrial countries dominate the sample, we find the inclusion of former transition countries from Central and Eastern Europe to be representative enough. Bulgaria and Croatia are the only countries from Southeastern Europe included, though not for all indicators; unavailability of data made it impossible to include these countries more thoroughly¹⁵. We find it especially important to emphasize that the comparative analysis presented does not show whether the apartments are overvalued or not. The analysis only arguments whether the apartments in Macedonia are more expensive than in the other countries, which is, still, something else.

The comparison is made on the grounds of six indicators that can be grouped in three sets: the first set compares the apartment prices and their dynamics; the second takes into account the relative ratio between the price and the rents or the income; and the third incorporates the interest rate in the comparison of the price and the rent (or income). In the comparison, unless stated otherwise, the data about Macedonia are for the year 2007, while the data about the other countries are for the year 2005; the reason for choosing 2005 was that most of the data available were for that year. Also, unless stated otherwise, the data about the apartment prices refer to the capital cities of the countries.

The first criterion by which we compare house prices amongst countries is *the price per square meter, adjusted for the differences in price levels between the countries*. This indicator actually measures the real apartment price, i.e. the price of apartments in ratio with the other prices in the respective countries.

¹⁵ For the transition countries in Central and Eastern Europe, and for the countries in Southeastern Europe, hereinafter, for the purpose of simplicity, the term “transition countries” shall be used.

Graph 9: Price per square meter in different countries, adjusted for the differences in price levels, year 2005 (Euros)



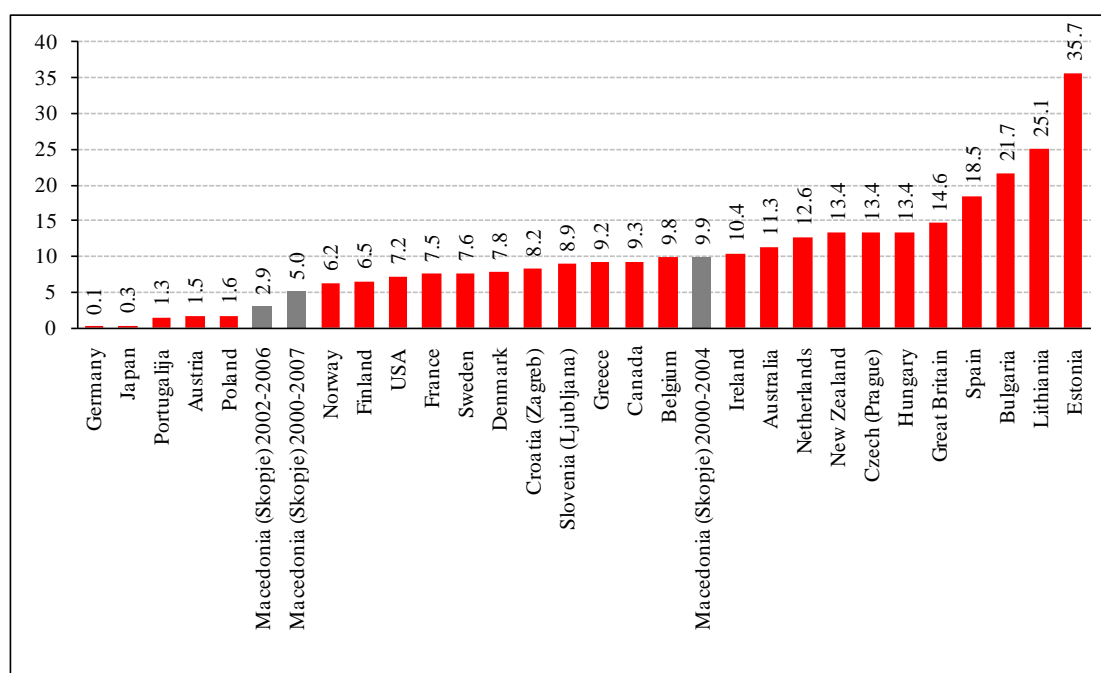
Sources: Apartment prices in Macedonia were obtained from the National Bank of the Republic of Macedonia (NBRM); for Bulgaria – from the National Statistics Institute of Bulgaria; for the other countries – from the European Council of Real Estate Professions).

The price levels were obtained from the Eurostat.

Out of the 22 countries analyzed, 16 had higher real prices of apartments than Macedonia, and only 5 had lower, whereas only Turkey and Lithuania had *significantly lower* prices. The apartment prices in all the transition countries included in this sample in 2005, excluding Lithuania, were higher than prices in Macedonia in 2007. Consequently, the comparison shows that apartments in Macedonia were cheaper than in the other countries.

The next indicator we analyze is the *growth rate of the house prices*. The average growth rate of prices in Macedonia for the period 2002-2007 was about 5% and was significantly lower than in the other countries. Namely, in the period 2002-2006 (a period for which there is data available), only 5 of the 28 countries had a lower growth rate of the house prices, the only transition country of those 5 being Poland. Even the 9.9% growth rate of apartment prices in Macedonia for the period 2000-2004, when there was an intensive and continuous price growth, was still much lower than in most of the transition countries, and was significantly higher only than the rate in Poland. Therefore, we conclude that the growth of the house prices in Macedonia was considerably lower than in the other countries.

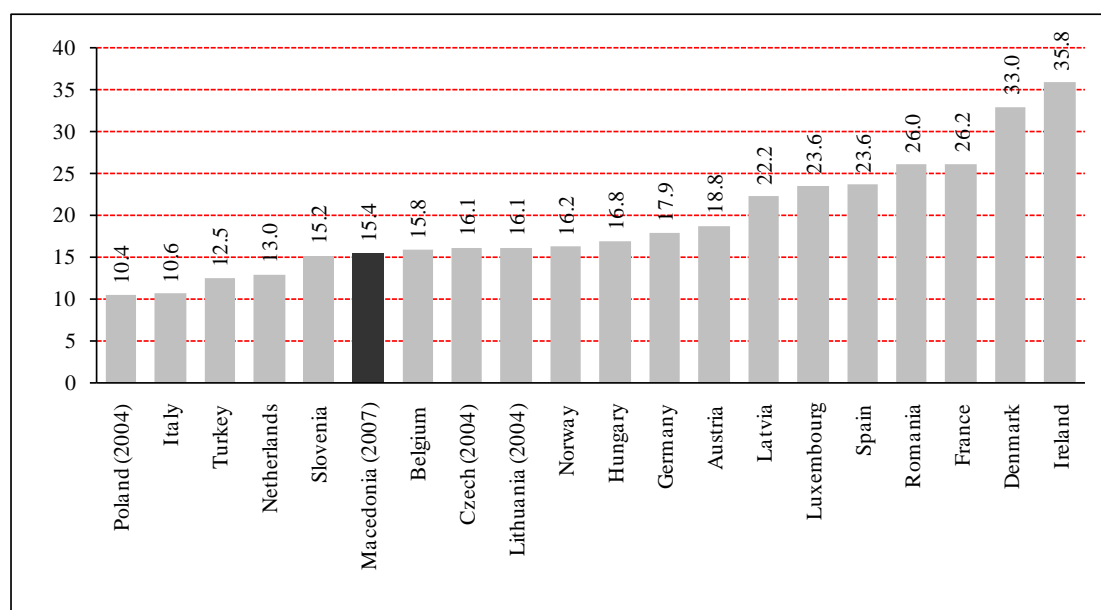
Graph 10: Average growth rate of apartment prices in the period 2002-2006 in various countries (%)



Sources: For Macedonia - NBRM, for other countries – Table 1 from Egert and Mihaljek (2007), p. 3. NB: these data **do not** refer to capital cities, unless stated otherwise.

The *price/rent indicator*, which was calculated as a ratio between the average price per m² and the average annual rent per m², gives the relative price of owning an apartment versus renting an apartment. Although this indicator was previously presented as a measurement of the overvaluation of the apartments, one must note that it is the *growth in this indicator* that indicates overvaluation, and not *the amount itself*. At an international level, this indicator in Macedonia is higher than the indicators of only five countries out of the twenty countries included in this sample, which implies that, abstracting from possible differences in rent levels amongst the countries, the apartments in Macedonia are cheaper than in the other analyzed countries.

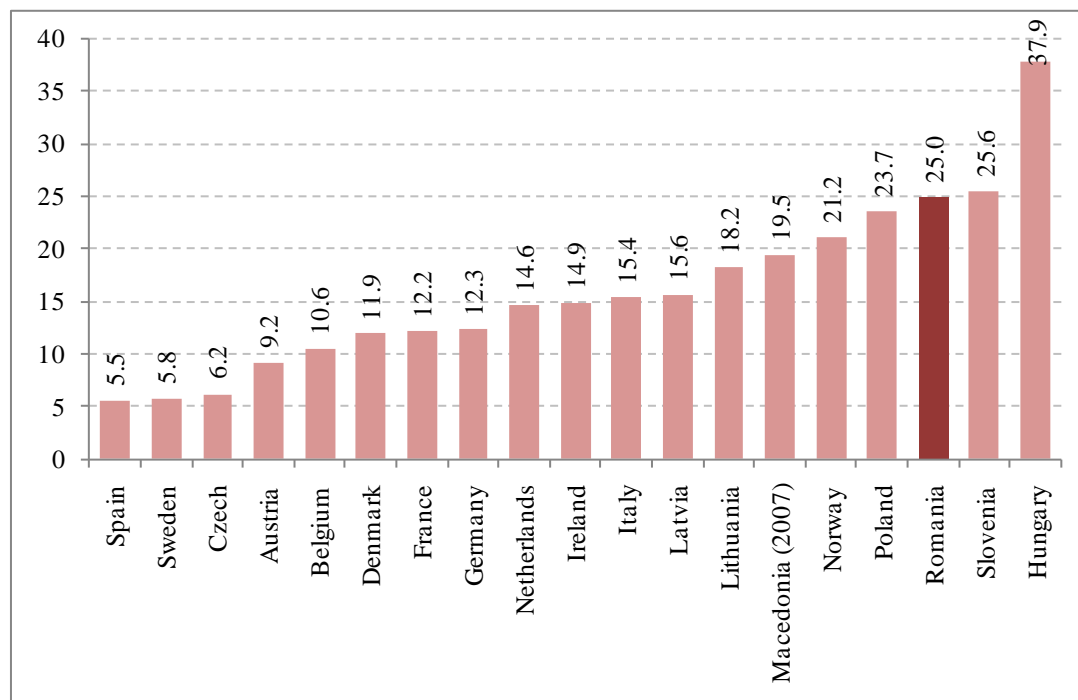
Graph 11: Price/rent indicator in various countries



Sources: NBRM and the European Council of Real Estate Professions

The cross-country comparison of the *price/income* indicator points to a slightly different conclusion. This indicator was calculated as a ratio between the average price of an apartment of 70m² and the annual households' disposable income *per capita*, and shows how much higher the price of one apartment is than the annual income of one person. Out of the 19 countries analyzed, only two have a higher price/income indicator than Macedonia, which clearly shows that houses in Macedonia are more expensive than in the other analyzed countries. The high value of this indicator in Macedonia stems from the significantly lower income than the income in the other countries. Because of that, it is expected that the indicators incorporating the income will show higher values for Macedonia (actually, these indicators generally show higher values in transition countries, because the income in all transition economies is much lower than in the developed industrial countries).

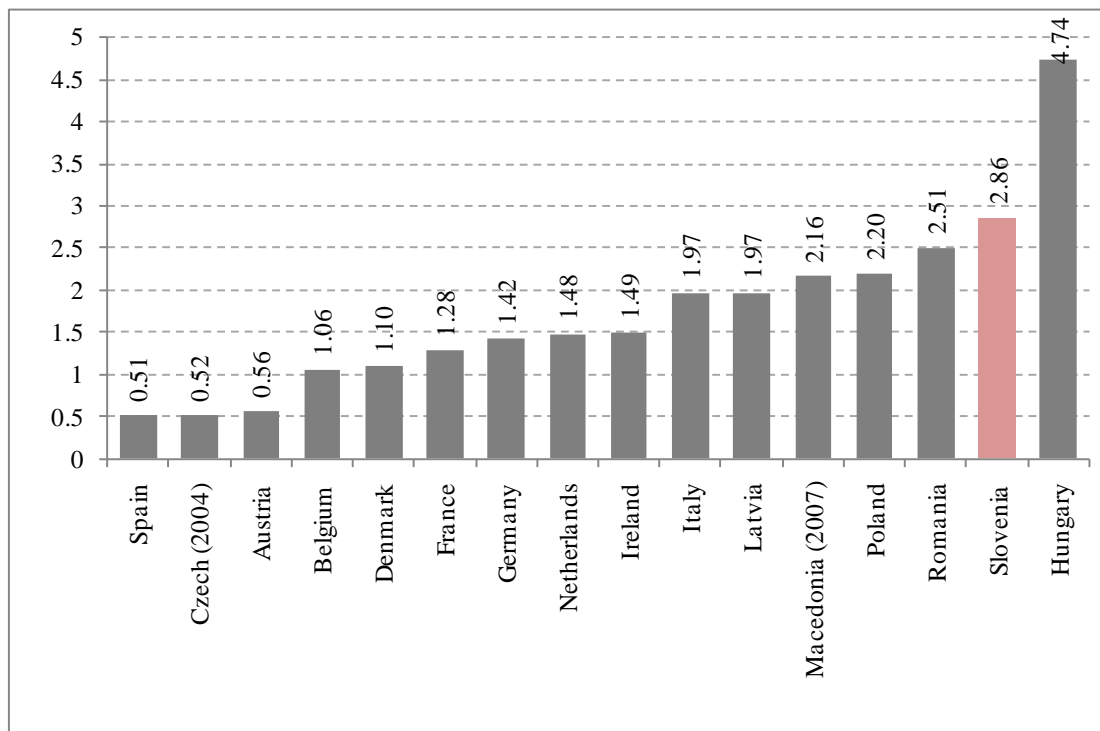
Graph 12: Price/income indicator for various countries



Sources: For apartment prices - NBRM and the European Council of Real Estate Professions. For income – NBRM and Eurostat.

The last set of indicators measures the affordability of buying an apartment. The *annuity/income* indicator compares the annual annuity to be paid for a 15 years mortgage on a 70 m² apartment, and the annual income per capita. The 2.9 value in Macedonia shows that the annuity to be paid for a housing loan in Macedonia in 2007 is almost three times higher than the income per capita. Out of the 16 sample countries, only Romania had a higher value of this indicator than Macedonia, whereas all the other countries had significantly lower values, which indicates that apartments in Macedonia are relatively more expensive. In addition, the arguments about the differences in income levels amongst the countries refer equally to this indicator, as well.

Graph 13: Annuity/income indicator for various countries



Source: Calculations of NBRM.

The last indicator that we compute, the *annuity/rent*, compares the annual annuity to be paid on a 15-year housing loan and the annual rent for an apartment of an equal area¹⁶. The value of 1.8 for this indicator in Macedonia shows that in 2007 the loan repayment for one's own apartment was about 80% more expensive than renting an apartment of an equal size¹⁷. Out of the 18 analyzed countries, Macedonia was somewhere in the middle, i.e. ten countries had a lower value of this indicator than Macedonia, and seven had a higher value. We consider that only Italy, Netherlands and Poland had a much lower value, and five countries had a much higher value. Consequently, this indicator shows a moderate apartment price in Macedonia.

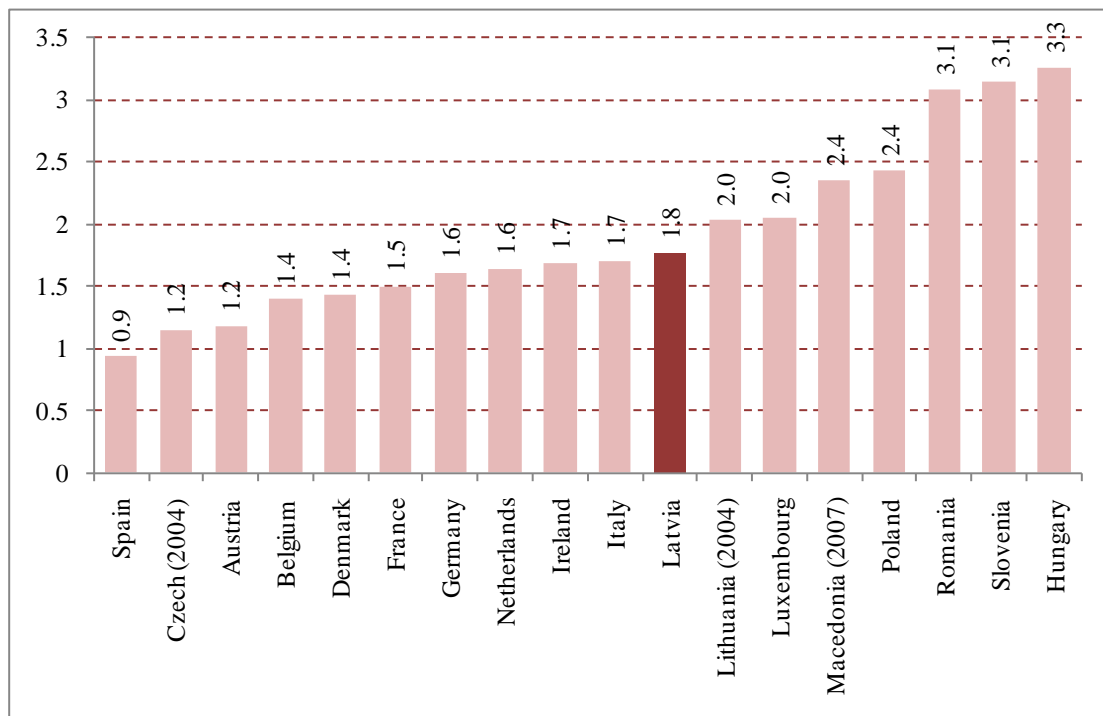
¹⁶ The annuity is calculated by the formula:

$$\text{Annuity} = \text{Price} * \frac{\left(1 + \frac{\text{interest}}{100}\right)^{15} * \left(\frac{\text{interest}}{100}\right)}{\left(1 + \frac{\text{interest}}{100}\right)^{15} - 1}$$

In the formula above, the repayment period is 15 years, and the *interest* refers to the interest rate. The assumption is that the loan amortisation is in equal annual annuities and in annual interest, that annuity repayment and interest calculation is in the end of the period, as well as that the amortisation and repayment period coincide. We believe that this kind of approximation is realistic. The interest rates refer to housing loans and are taken from Central banks of the respective countries. For Macedonia, since there are no data about the average interest rate on total housing loans, an "annual rate of total expenses" for a housing loan is taken, i.e. the effective interest rate of one of the biggest commercial banks on December 31, 2007, which is 7.66%.

¹⁷ It must not be forgotten that in the calculation, the presumed credit deposit is 0%.

Graph 14: Annuity/rent indicator for various countries



Source: Calculations of NBRM.

To summarize, out of the six indicators that were calculated in the comparative analysis, four indicated that the apartments in Macedonia were not more expensive than in the other countries, while two showed quite the opposite. Considering that the two indicators suggesting that apartments were relatively expensive are those that incorporate the income per capita, we find that these conclusions are due to the low income in Macedonia.

In regard to the appropriateness of the comparative analysis, one should take into account the possibly big differences amongst the values of the presented indicators, stemming from the differences in people's preferences, because of which the comparisons amongst countries should always be taken with a grain of salt. It should also be remembered that the real estate market in all other analyzed countries is fully liberalized, which is not the case in Macedonia, and which also points to differences at the price levels. All the above indicates that with the comparative analysis one can not directly argue whether the apartments are overestimated or not, but only whether they are more expensive or cheaper than in the other countries. The issue of the overvaluation of the apartments can only be evaluated by the regression analysis, which we now turn to.

3. Determinants of Apartment Prices

This chapter is dedicated to the econometric analysis of the house price index. In addition to the discussion in the previous chapter, we, once again, investigate whether house prices are too high, and, at the same time, we consider the factors that determine the movements of the house prices. First we explain the theoretical model of the equilibrium price, with which we investigate if the price corresponds to the movement of the fundamentals, i.e. the factors that affect the supply and demand of apartments. Then we elaborate the determinants of the supply and the demand in the case of the Republic of Macedonia. Next we explain the choice of the estimation method, and we present the results of the different empirical models of the apartment price in Macedonia. In the end we sum up the conclusions related to the equilibrium price and the factual price.

3.1. The model

The model of the equilibrium apartment price that we use in the analysis is a structural model of housing supply and demand. The main determinants of the demand are: the apartment price, the income, the interest rate on housing loans, the rent, the wealth and the population. The function of demand can also include factors referring to certain qualitative characteristics of the apartments (old/new, condition), as well as institutional factors that affect the accessibility to financial means (e.g. innovations on the housing loans market), which all enter in the vector of other factors (X). Hence, the function of the demand (D^H) for apartments can be presented as follows:

$$D^H = f(\text{price, income, interest rate, rent, wealth, population, } X) \quad (11)$$

In the function presented in this way, the demand for apartments increases in case of: lower price, increased income per capita, decline of the interest rate, and increase of the rent, the wealth, or the population.

The supply of apartments consists of existing and newly built apartments and is most frequently expressed as a positive function of the apartment price and a negative function of the real cost of construction (including the price of land, salaries of construction workers and cost of construction material), as well as other factors that affect the supply (Y).

$$S^H = f(\text{price, construction costs, } Y) \quad (12)$$

When the housing market is in equilibrium, the demand for apartments equals the supply, and the equilibrium apartment price is a function of determinants of the supply and demand.

$$D^H = S^H \quad (13)$$

$$\text{price, income, int. rate, rent, wealth, population, } X = \text{price, costs, } Y \quad (14)$$

$$\text{price} = f(\text{income, int. rate, rent, wealth, population, costs, } X, Y) \quad (15)$$

Consequently, if the apartment price is not driven by the fundamentals, the market is not in balance. Since the equilibrium of the housing market is a long term concept, the apartment price is in balance if there is a cointegration between the price and the fundamentals, although short term deviations of the price from the equilibrium level are possible. In other words, the existence of a cointegration implies that the market price fluctuates around the equilibrium price, which is given by equation (15).

The fundamentals found in literature are very diverse. For example, McCarthy and Peach (2002, 2004) use the income and the nominal interest rates of mortgage loans to explain the price on the real estate market. Shiller (2005) and Gallin (2006) use the income, construction costs, population, housing costs and interest rates as fundamentals, while Case and Shiller (2003) use real long term interest rates, income, population, employment rate, construction costs, and the number of newly built apartments. Mikhed and Zemcik (2007) in their panel estimations include: the rent, the interest rate on housing loans, inflation, population, income, construction costs, and the stock exchange index (as a measurement of the wealth). Egert and Mihaljek (2007) analyze house prices in the countries of Central and Eastern Europe using as explanatory variables the real income, the real interest rates, housing loans, the stock exchange indexes, demographic factors, and some specific transitional factors, such as: improvement of the housing quality (proxied by real wages) and the improvement of banking and non-banking institutions – participants in this market segment (by including the EBRD reform indicators).

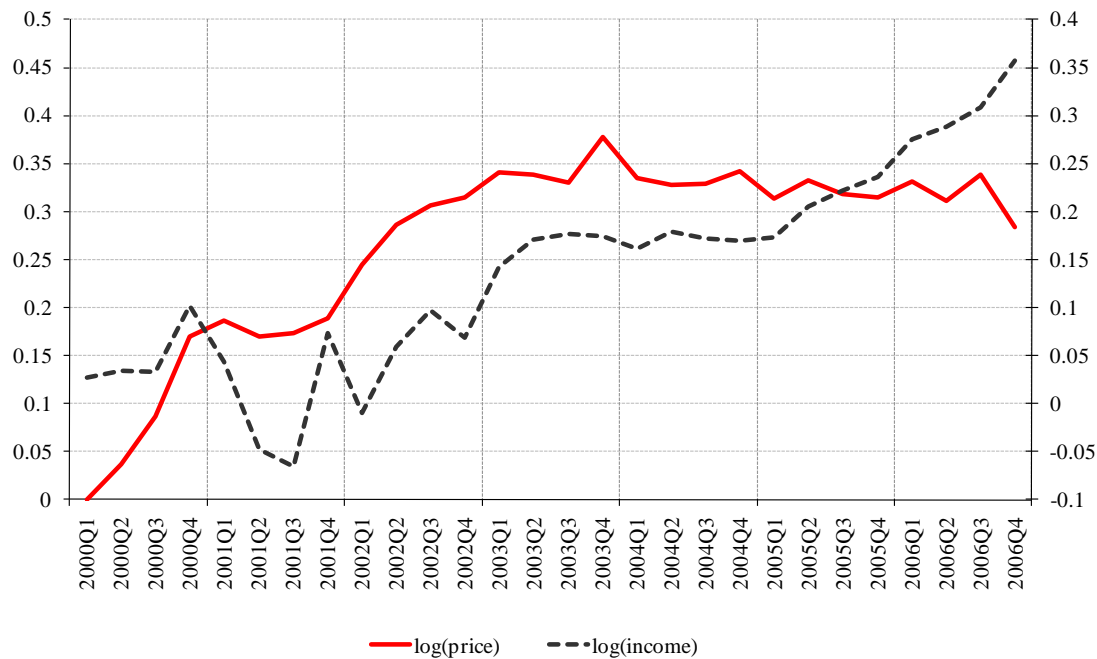
3.2. Apartment Price and Macroeconomic Fundamentals in the Republic of Macedonia

The correct choice of the supply and demand determinants is very important for the model specification. The choice of fundamentals in the empirical model for the Republic of Macedonia was based on the previously reviewed literature, with the following variables included: the real per-capita disposable income, the long term interest rate on total loans, the approved housing loans, the rent, the number of new settlers to Skopje, the value added in the construction industry, the number of newly built apartments, the construction costs, and the stock exchange index¹⁸. Besides the selection of variables, equally important for the analysis is the way of including the variables in the model, i.e. it is important to include the fundamentals simultaneously rather than separately. Namely, many of the studies investigating the overvaluation of apartments include only one fundamental, which might point to an absence of cointegration precisely due to the exclusion of the rest of the fundamentals (Egert and Mihaljek, 2007, Mikhed and Zemcik, 2007).

The variable “*income*” refers to the real per-capita disposable income in the Republic of Macedonia. This category has a direct and positive effect on the apartment price, as growth in income, holding all other factors unchanged (*ceteris paribus*), leads to a growth in demand, thus creating pressure for growth of the apartment price. By visual (graphic) analysis of the income and apartment prices series in the RM, it is difficult to identify the real connection between these variables, although there seem to be indications for a positive relationship. Namely, in the period from 2000-2004, both series have a growing trend, with a declining trend during the crisis in 2001, while in the period from 2004-2006 the relationship becomes less clear, because the price stagnates while the income grows continuously. The cumulative income growth and apartment price for the total period from 2000-2006 is almost identical, about 35%.

¹⁸ Detailed explanation of the data used and the construction of certain variables is given in Appendix 2. The sample on which the analysis was made includes the period from the first quarter of 2000 to the fourth quarter of 2006, due to the unavailability of some data for 2007.

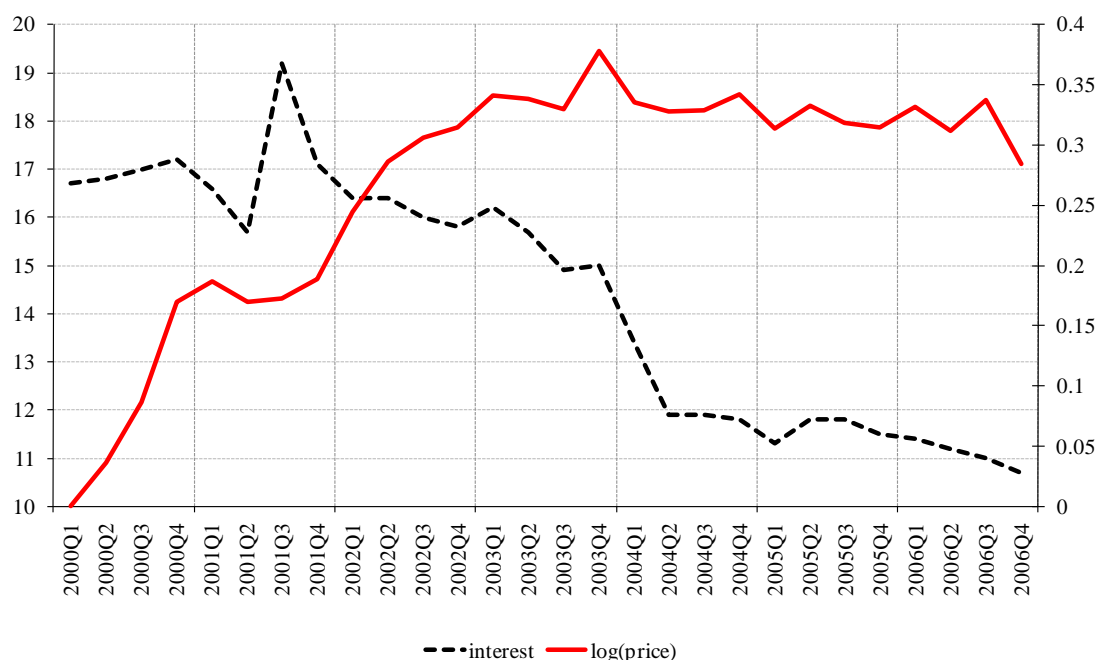
Graph 15: Movement of the apartment price and the real per-capita disposable income in the period 2000-2006



The second fundamental refers to the *interest rate* on housing loans. The interest rate decline increases the demand for apartments and, consequently, the price. According to Sutton (2002), Tsatsaronis and Zhu (2004), quoted by Egert and Mihaljek (2007), it is the *nominal* interest rate that affects the apartment price, and not the *real* interest rates. The reason for this is that banks base their decisions on the ratio between the annuity and the income per capita, which depends on the nominal interest rate, and not on the real. In the Republic of Macedonia, the long term interest rate on loans¹⁹ during the whole period of analysis was marked by a declining trend, with a more intensive drop until 2004, when the apartment price rapidly grew. In the period from 2004-2006, the trend of interest rate declining slowed down, and the apartment price stagnated. The cumulative drop of the interest rate throughout the monitored period was about 6 percentage points, while the apartment price growth was 40%.

¹⁹ In absence of data about the interest rate on the housing loans, in our case the average pondered long term interest on *total* loans is taken, for the reason that for the period before 2005 there is no data available about the interest rate on long term loans for the population.

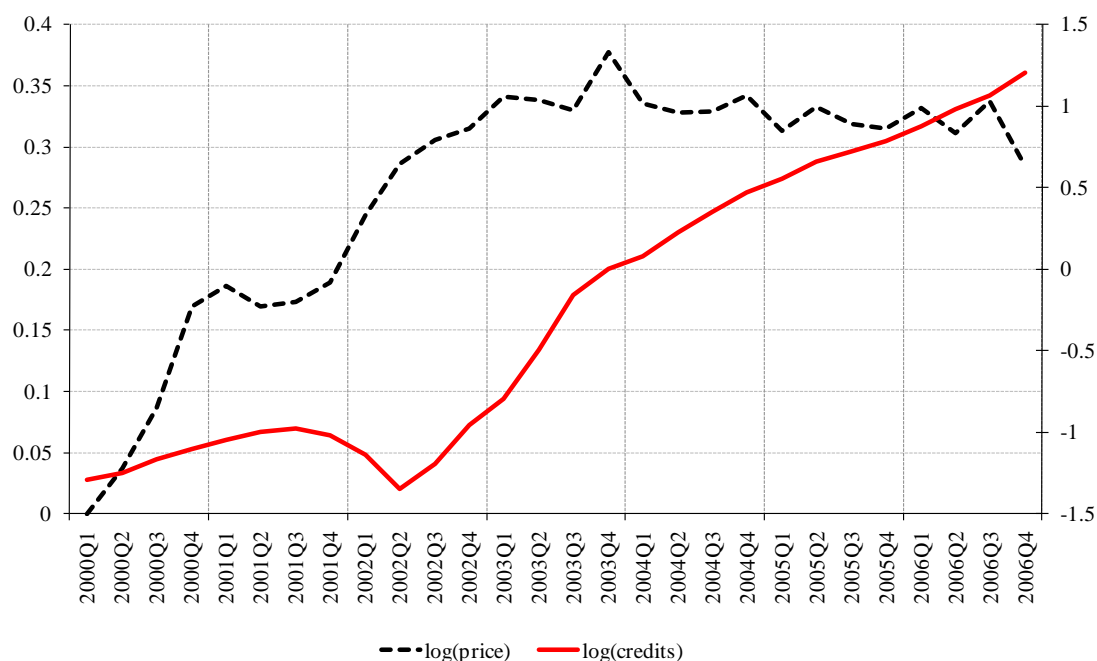
Graph 16: Movement of the apartment price and the interest rate in 2000-2006



An alternative variable to the interest rate in modeling the equilibrium apartment price are the *housing loans*. Increased housing loans have a positive effect on the demand for apartments, which, in circumstances of a stable supply, leads to a growth in the apartment prices. In the Republic of Macedonia, the intensive price growth by 2003 did not correspond to the mild growth of crediting in the same period, while the intensive credit growth from 2003-2006 was coupled with a stagnating apartment price. One must not forget the low initial level of the housing loans, however, as it contributes to an intensive growth of loans (by 12 times) in the analyzed period. at the same time, the price growth in this period was 40%, which indicates a small impact of this variable on the apartment price.

Since the growth of housing loans corresponds to growth of the total support of the banks of the households, the participation of the housing loans in the total loans approved is relatively stable, about one fifth. This, on the other hand, indicates a still small exposure of banks in Macedonia to the risk from variations in the real estate prices and from possible disturbances on the real estate market. As a comparison, in the EU countries, housing loans make two thirds of the total number of approved loans to the population (European Central Bank).

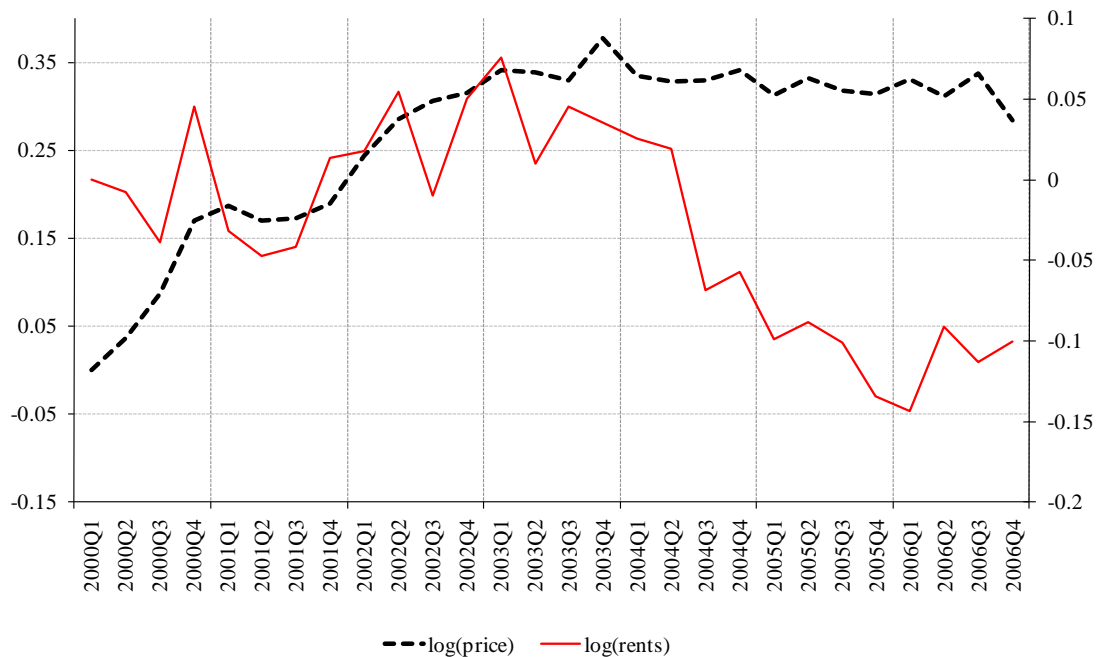
Graph 17: Dynamics of apartment prices and housing loans in 2000-2006



It should be noted that movements in the interest rate and in loans may reflect certain institutional changes, such as increased availability of loans, improved corporate governance of banks, or improved mortgage payment. In circumstances when it is impossible to explicitly model these changes this means that their effect on the apartment price is incorporated in the interest rate, i.e. the loans.

The expected relation between the apartment price and the *rents* is positive, though multidimensional. If renting an apartment is considered a substitute for buying, higher rents would induce families redirect their interest towards buying instead of renting, which would result in growth of the demand and of the price of apartments. On the other hand, if the rent is viewed as a return on owning an apartment, increasing rent may cause growth of demand for apartments to be leased, and consequently growth of their price. In case of the RM, rents marked a minor increase in 2000, while the apartment price grew more intensely. The minor rent increase in that period was probably due to the hindered dynamics of growth immediately after the Kosovo crisis, as mentioned before. The rents and the apartment prices in 2001 and 2002 movements were almost identical. During the internal conflict in RM, both rents and prices declined, after which they were increasing until end 2002. As of 2003, the movements are different, i.e. the rents decline, while the apartment price stagnates.

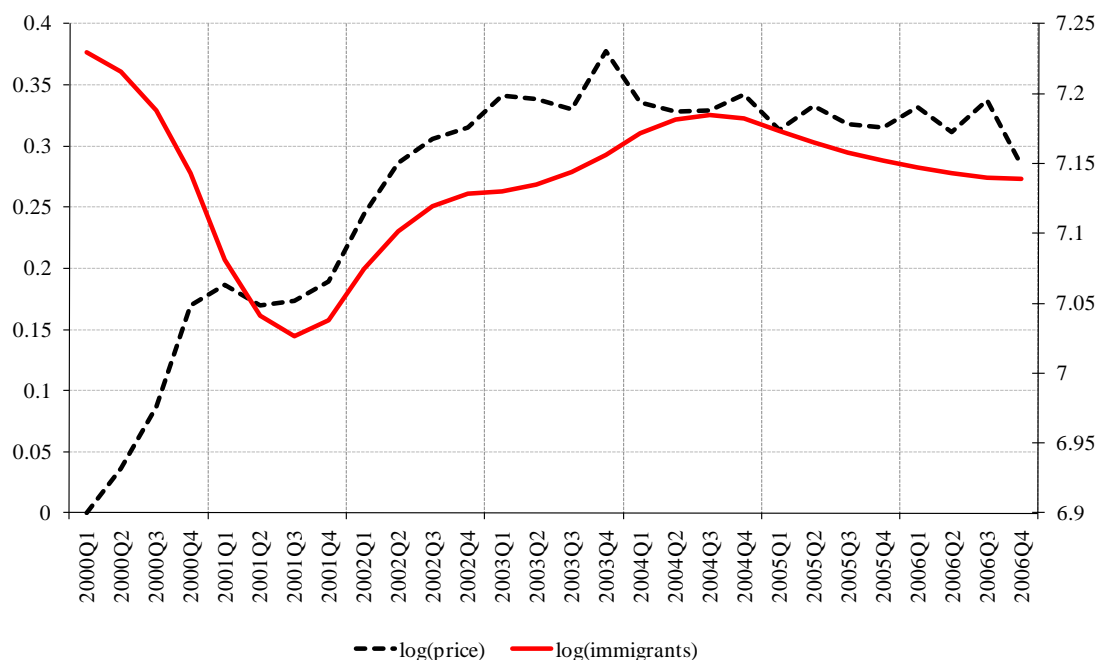
Graph 18: Dynamics of apartment prices and rents in 2000-2006



The last analyzed fundament that stimulates the demand for apartments and consequently positively impacts the apartment price is the *population growth*. Considering that the model refers to prices of apartments in Skopje, we are taking into account the movement of the new settlers to Skopje. If the movement of the apartment price and the number of the new settlers to Skopje are analyzed together, one might observe a high level of co-movement: after 2001, both series manifest very similar trends, whereas the movements differ only during 2000. In conclusion, a clear positive interrelation can be expected between the number of new settlers and the price, although the indicators about demographic factors should be taken with a reserve, due to the weak scope of the series²⁰.

²⁰ It is believed that a large number of newly settled people from the other parts of the country that have moved to Skopje are not registered as residents of Skopje.

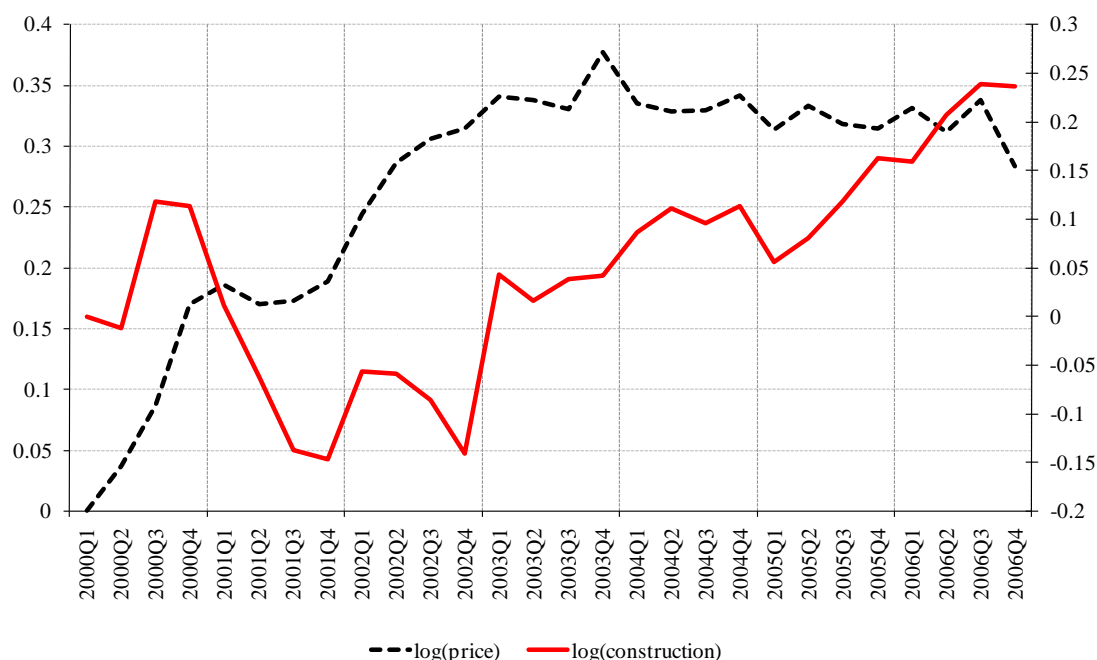
Graph 19: Dynamics of the apartment prices and the number of new settles in 2000-2006



Considering the supply, the following variables were examined when building the empirical model for the Republic of Macedonia: the added value in the construction industry, the number of finished apartments, and the costs of apartment construction.

The relationship between the *value added in the construction industry* (taken as an indicator of the newly built apartments) and the apartment price is expected to be negative – higher supply of new apartments on the market reduces the price. Thus, if the movement of these series in the Republic of Macedonia is analyzed, it can be observed that in 2001-2003, when the offer was reduced or stagnant, the apartment prices were increasing, while in 2004-2006, when the added value in the construction industry was growing, the apartment prices were stagnating. The year 2000 is again an exception, as both the activity in the construction industry and the apartment prices grew then.

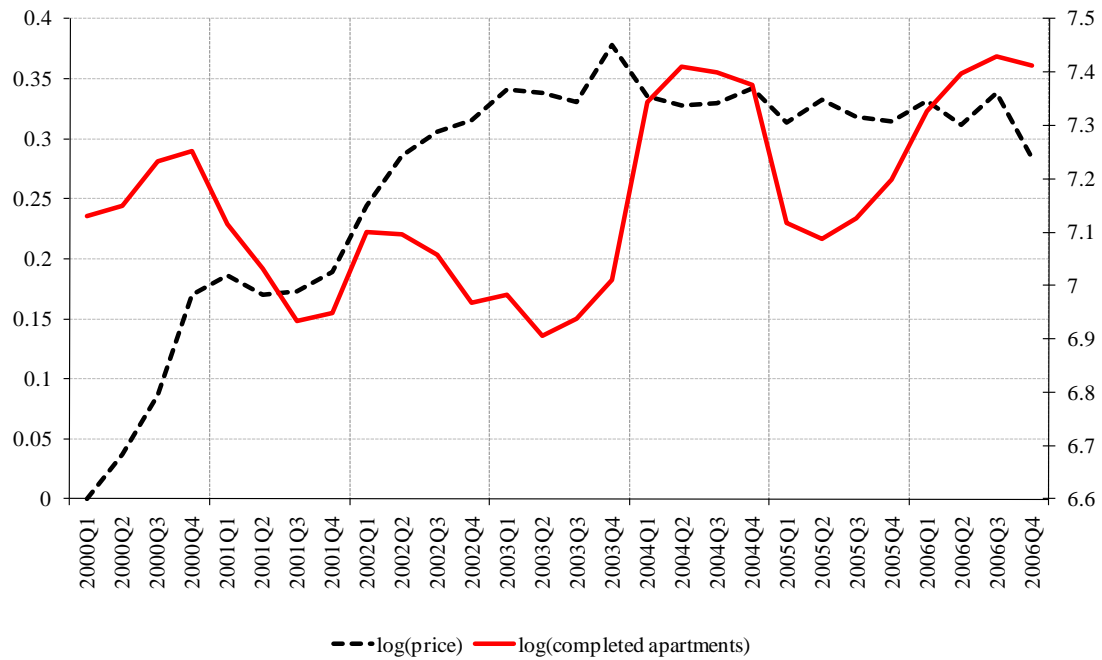
Graph 20: Dynamics of the apartment price and the construction industry in 2000-2006



The alternative series for the construction – *the finished apartments* – does not seem to exhibit a clear connection with the price due to its great volatility. The movement of the series of finished apartments, however, somewhat coincides with the movement of the series about the added value in the construction industry – it is evident that the supply was low in 2003 and significantly higher in 2004-2006, which indicates that the supply of apartments was lower in the first period, and higher in the second period²¹.

²¹ According to official data about the finished apartments in the Republic of Macedonia by years, in the period from 1995-2002, a total of 36,407 apartments were built. The difference between the total number of housing units registered with the Census of population, households and homes in 2002, and the situation registered with the census in 1994, indicates that during that time the number of newly built apartments had increased by 117,187 apartments, which is 3.2 times more than the registered number according to the records on newly finished apartments. Assuming that the census data reflects the real situation in the housing units, the differences point to incomplete evidence of newly built apartments in the records, which somewhat explains the dissatisfactory results in the modeling.

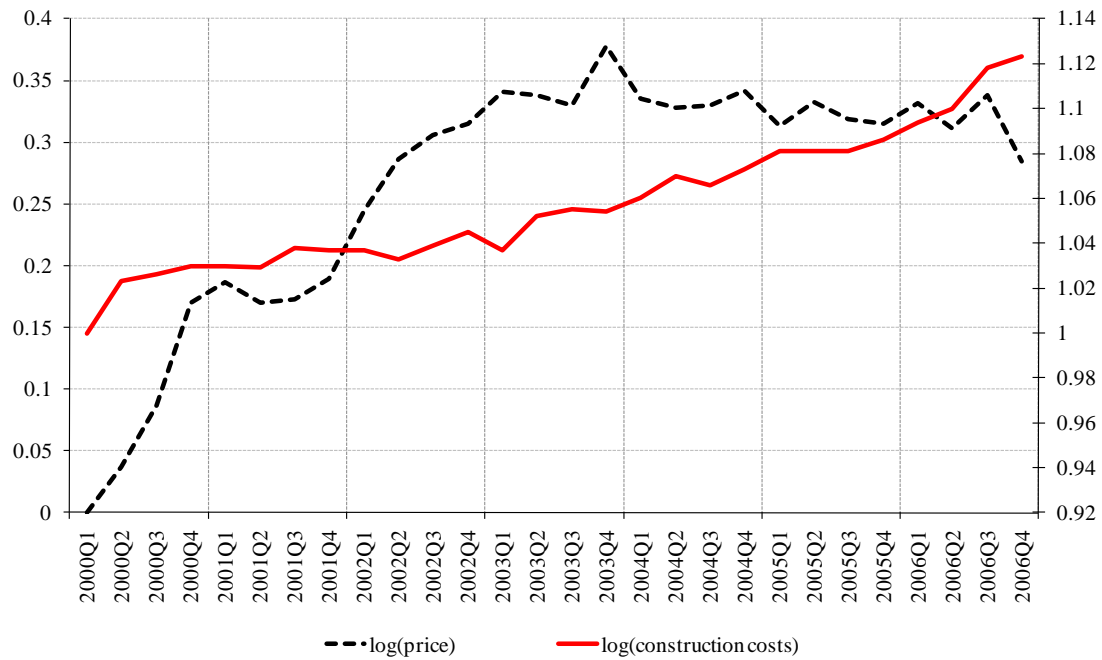
Graph 21: Dynamics of the apartment prices and of the finished apartments in 2000-2006



The relationship between the sales price of the apartments and the *costs of the apartment construction*²² is expected to be positive, i.e. the sales price should increase when the construction costs increase. The visual inspection of the series of these variables in the RM, however, does not indicate a clear relationship. Namely, the construction costs grew at an almost constant rate during the whole period, while the apartment price was increasing by 2003, and then it was stagnating, which indicates that the construction costs are not a significant determinant in the apartment price in the RM.

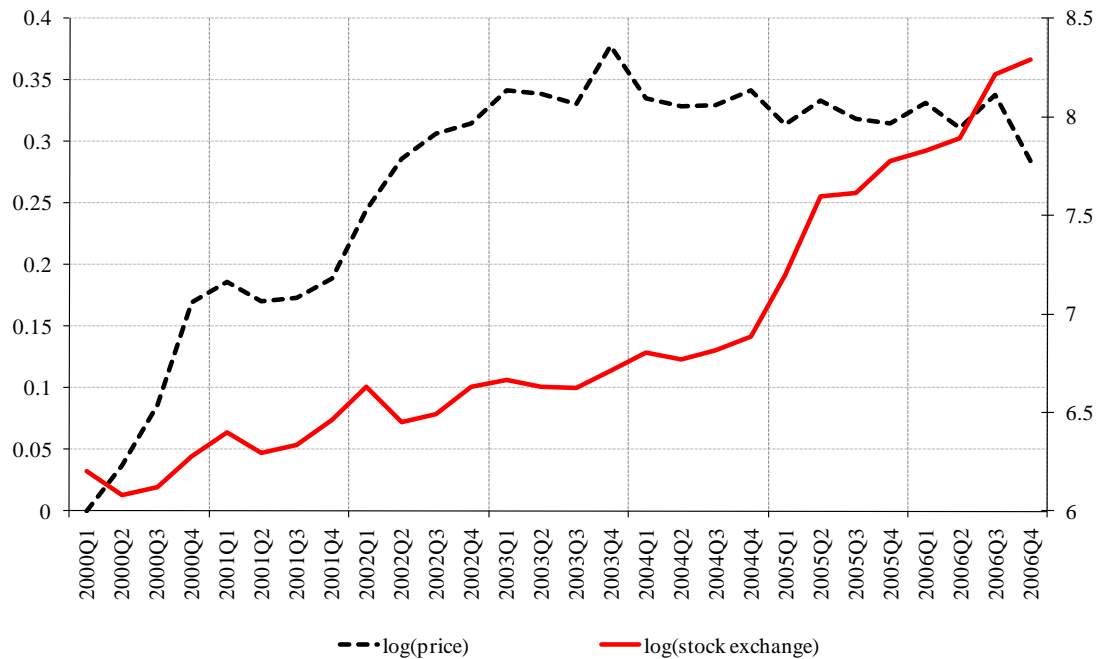
²² The costs of construction are calculated as a weighted average of salaries in the construction industry (25%) and the prices of the construction materials (75%). We believe this ratio is realistic.

Graph 22: Dynamics of the apartment price and the construction costs in 2000-2006



The last variable which we investigated was the *stock exchange index*. This variable is often found in the literature as an indicator of wealth, more precisely, the financial wealth, which means that the relation between the apartment price and the stock exchange index is expected to be positive, since wealth and income have a similar impact on the consumers' decisions, and income has a positive effect on the apartment price. In our case, however, it is interesting to investigate another hypothesis. Namely, when the financial market is shallow and underdeveloped, buying an apartment may be an alternative for an investment on the stock exchange, i.e. investments in real estate may substitute investments in stocks (such a possibility is recognized by Egert and Mihaljek, 2007, in other transition economies). This hypothesis is supported by the fact that in the period from 2000 to 2003, when the stock exchange index had low growth rates, the apartment prices were growing rapidly, while the intensive growth of the stock exchange index after 2003 was followed by a stagnation of the apartment prices.

Graph 23: Movement of the apartment prices and the stock exchange index in 2000-2006



Finally, we point out that some of the institutional factors, i.e. some specific transitional factors, as well as certain external influences (refugee crisis in 1999) could not be explicitly incorporated in the analysis. As mentioned before, however, we consider that their impact was incorporated, i.e. reflected in the movements of some of the fundamentals that were already integrated in the model.

3.3. Methodology

The preliminary graphic analysis of the variables points to certain moments related to the determinants of the apartment price. Nevertheless, the visual inspection of the series inevitably includes a dose of subjectivism and should, therefore, be treated as indicative only. It does not quantify the phenomena, i.e. can not establish whether the apartments price move in concordance with the fundamentals, that is whether they are overvalued or not. To answer that question, it is necessary to use more rigorous, quantitative methods.

The choice of the quantitative method for assessment of the relation between the apartment price and the determinants is of a crucial importance. Despite the huge possibilities of the econometric techniques, as every other powerful tool, they should be applied carefully. This especially refers to the ad hoc implementation of the cointegration technique when analyzing time series data, without considering the assumptions they are based on. The cointegration actually means that there exists a *long-run* equilibrium relationship between two or more series. At the same time, cointegration implies that each deviation from the long-run relationship (from the equilibrium state) is only temporary. Therefore, if a variable deviates from the equilibrium level in the short run, the so-called error correction mechanism (ECM) will push that variable towards the balance in the periods that follow. At the same time, the short-run movement of the variables can depend on the same factors as the long-run movement, but it can also be determined by completely different factors.

In our case, the specific research question that we wanted to investigate - whether house prices are overvalued or not - determined the method of estimation, at least to some

extent. Since we want to assess whether the market price is in concordance with the equilibrium price, the equilibrium price being defined as the price that is determined by the fundamentals, the cointegration technique is the most appropriate method for doing that. The existence of cointegrating relationship between the price and the fundamentals means that the price fluctuates around the equilibrium value, i.e. that apartments are not overvalued. Numerous analyses investigate this presented thesis in this way (McCarthy and Peach, 2002, Gallin, 2003, Egert and Mihaljek, 2007, Mikhed and Zemcik, 2007). Additional argument supporting the thesis that cointegration is the appropriate method for analyzing the apartment prices in the Republic of Macedonia is the fact that series are not stationary (which can be noted from the preliminary graphic analysis, as well as from the tests presented in Appendix 3, Table 1). Given this, the ordinary least square method would not seem to be the most appropriate one. The only issue that could undermine the appropriateness of the cointegration method, which refers to the equilibrium relation between series in a *long run*, is the fact that the time period of eight years, that we have, can hardly be considered as long enough.

Regarding the short sample, there are studies in the empirical literature that apply cointegration techniques for similar short periods, some of them being rather relevant (e.g. McCarthy and Peach, 2002; see Table 2, p. 147). Besides that, it should be taken into account that strict following of the rules practically disables a more serious analysis for the transition economies, since their series are too short for cointegration, yet non-stationary for the conventional techniques.

Although these arguments justify the use of cointegration for our purpose, still we apply additional methods (although somewhat less appropriate) to identify if they take us to similar conclusions. Consequently, we begin the quantitative analysis by investigating the existence of cointegration using the Johansen technique and by a thorough analysis of the derived results. Then we check the stability of the results applying an alternative cointegration technique – the ARDL method, as well as the ordinary least squares method. In the end, we sum up the results from the total quantitative analysis.

3.4. Empirical Results

3.4.1. Johansen Technique

One can freely say that what the ordinary least square method is for the cross-section analysis, the Johansen technique is for the time series analysis (Johansen, 1988, 1992). In our case we use the Johansen technique for structural analysis of the determinants of the apartment price in the RM, refraining from the methodological elaboration, which is not our main point of interest. Thus, we opted for the conventional approach in modelling – from general to specific by applying the Johansen estimation technique, which means that we begin from an initial model, to which we later add new variables and investigate various combinations, until reaching a satisfactory cointegrating relation. As a criterion for a satisfactory cointegrating relation we choose the economic rationality of the relationship – the sign and size of the coefficients. The road from the initial specification to the first satisfactory specification, i.e. the first five models, is presented in Appendix 3, Table 3.

The application of the Johansen technique usually consists of several steps. First, we determine the number of lagged values of variables included in VAR (Vector Autoregressive) model (i.e. we determine the order of the VAR model). Then we establish the presence of deterministic elements in the model – trend and a constant (i.e. we select one of the five options) and establish the number of vectors of cointegration (this is usually done simultaneously, according to the Pantula principle). Finally, the vector is estimated and

additionally analyzed (see Harris and Sollis, 2003). An expert will notice that our analysis will occasionally “stray” from the just-described textbook approach, but not radically. Thus, we limit the maximum order of the VAR model at two²³. The second step, the selection of deterministic components, is also slightly modified – we consider the only reasonable options to be option 2 – constant in the long-term relation and without a trend, option 3 – constant in the short-term relation and without a trend²⁴, and option 4 – constant in the short-term relation and a trend in a long-term relation. We then apply the Pantula principle for VAR with two lags, from option 2 to option 4, and in case we fail to find a cointegration at none of the options, we move to VAR with one lag. Later in the text we present only the final results, whereas the cointegration tests are presented in Appendix 3, Table 2. The complete results from certain models are not attached to conserve space, but are available on request.

The first satisfactory combination, Model 6, is presented in the first column of Table 7, and uses the following explaining variables for the price: income, rents, interest rate and value added in construction. All coefficients in this model are with signs and magnitudes that are common in the literature (see Egert and Mihaljek, 2007, and Girouard et al. 2005). The elasticity of the price in ratio with the income is reasonable – it implies unitary growth in price when income grows by 1%, i.e. a price growth of about 35% when the factual income growth was 35% in the observed period. The coefficient of the interest implies a 3% price growth when the interest rate declines by 1 percentage point, which in case of a decline in the interest rate by 6 percentage points – as in our case – indicates a price growth of 17%. The elasticity of -0.9 with respect to the newly built apartments is also sensible and means that the increased supply of apartments by 17% (average for 2006 in relation to the average for 2000) created pressure on the price to decline by 13%. The elasticity with respect to rents is 0.7, meaning that the 10% lower rents in end-2006 in comparison with early-2000 mark a 7% lower price²⁵.

In relation to the short term dynamics, the coefficient of the error correction mechanism in the short term equations for all the variables is with the expected sign (negative for variables that have a positive sign in the cointegration vector and positive for those that have a negative sign). At the same time, the error correction mechanism is the only significant term in the short term equation, which indicates that the price is not driven by the included variables in the short term.

Confirmation that the results from this combination are not spurious comes from the fact that coefficients differ very little when alternative series for the apartment prices and the rents are used (derived by the time dummy variables method and the regressions method, model 7, 8 and 9). The differences, although non-neglectable, are not essential.

²³ It is well known that in short series the final results are frequently too sensitive to the selected order of the VAR model. So, with one order, the result might show that there is cointegration, and with another order that there is no cointegration. To avoid this problem, criteria are recommended in the literature for making this decision. Nevertheless, in our case these criteria rarely gave the same answer, which is why we decided, because of the short time period, to limit the order of the VAR model to 2 at most. It must be noted that the arbitrary selection of the order of the VAR model is not that unusual. On the contrary, it is perfectly normal in cases similar to ours to limit the order of the VAR in order to avoid the inclusion of too many variables (over-parameterization).

²⁴ In other words, the constant is necessary primarily from economic aspects – there is no reason why the price would be zero if all factors are equal to zero, but also from statistical reasons – different measurement units (the interest rate in percentage, other in logarithms).

²⁵ The price change resulting from changes in some of the variables, due to the logarithmic form of the variables, is derived by the following formula: $d(\text{price}) = \exp(\text{coef} * d(x))$, where \exp stands for exponential (antilogarithm with a base e), d stands for the difference operator (change), coef is the coefficient before the variable, and x is the variable, in logarithm everywhere, except in the interest rate.

Table 5: Results from the models with the construction

	6	7	8	9
	Price regressions	Price regressions <i>Long term</i>	Price dummy	Price dummy
Income	0.998673 [-7.77947]	1.186466 [-7.75490]	0.892572 [-6.67461]	0.951631 [-6.30917]
Rents dummy	0.705792 [-5.96687]		0.559137 [-4.51058]	
Rents regressions		0.302836 [-3.64251]		0.293244 [-3.58776]
Interest rate	-0.02991 [5.86349]	-0.019396 [3.66992]	-0.021877 [3.92975]	-0.015969 [3.01668]
Construction	-0.902293 [10.1157]	-1.083603 [10.8747]	-0.793388 [8.49339]	-0.900114 [8.83854]
	<i>Short term</i>			
ECM	-0.375032 [-2.29925]	-0.291723 [-2.04688]	-0.432666 [-3.67972]	-0.343124 [-3.10985]

The dependent variable is in the first row. All variables are in logarithms, except for the interest rate. Only coefficients from the long-term relation and the error correction mechanism are presented. The constant is not given for better clarity. The value of the t-statistics is in brackets.

Motivated by the wish to have a more thorough analysis, we estimated several other models, in order to assess the arguments in favor of the theses that were already presented in the preliminary analysis of the variables. These models, in order to conserve space, were moved to Appendix 3, Table 4, whereas the main conclusion is that the other fundamentals do not improve the specification.

3.4.2. ARDL and OLS

Univariate cointegration techniques, such as the DOLS (dynamic OLS, Stock and Watson, 1997) and the ARDL (autoregressive distributed lag, Pesaran and Pesaran, 1997, Pesaran and Shin, 1997), are widely used as alternatives to the Johansen technique, especially for shorter time series, or in cases when it is difficult to determine the order of integration of the series. Our elaboration in this part will aim at investigating the results derived by the Johansen technique. We will only check whether the results derived for model 6 by ARDL and OLS methods differ than the ones derived by the previous method. Details are given in Appendix 4.

The first step of the ARDL approach to cointegration, similar to the Johansen technique, is establishing the *maximum* number of lags of the variables in the ARDL model. Due to the small sample, we limit the maximum number of lags to two. The next step is testing for cointegration. The results of this test (presented in Appendix 4, Table 1) indicate uncertainty regarding the existence of a cointegrating relation amongst variables, but we proceed as if there was cointegration between the variables²⁶. Regarding the choice of the

²⁶ Explanation on how to test for cointegration in ARDL method can be seen in Pesaran and Pesaran (1997).

ARDL model, all criteria indicated the same model. Long term coefficients of these two ARDL models are presented together with those of the Johansen model.

Finally, we present the results of the same model, estimated by the ordinary least square method (OLS). Without investigating the diagnostics of the residuals, we find that the fact that they resemble the previously presented ones is a confirmation that the derived elasticities are robust.

Table 6: Results of the ARDL and OLS models

	Johansen (model 6)	ARDL (model 17)	OLS (model 18)
<i>Long term</i>			
Income	0.998673 [-7.77947]	0.3683 [1.4526]	0.680069 [4.032]
Rents	0.705792 [-5.96687]	0.60727 [2.0144]	0.600438 [2.554]
Interest rate	-0.02991 [5.86349]	-0.025963 [-2.116]	-0.028472 [2.198]
Construction	-0.902293 [10.1157]	-0.60382 [-2.5434]	-0.574222 [-2.545]
<i>Short term</i>			
ECM	-0.375032 [-2.29925]	-0.406 [-3.173]	

The dependent variable in all regressions is the price. All variables are in logarithms, except for the interest rate. The value of the t-statistics is in brackets. The constant is not given for better clarity.

Comparing the results of the three methods, one can notice that the income in the ARDL model is not significant, while the other variables are with lower coefficients. The error correction mechanism is with a similar magnitude and little higher. In the OLS model, all the parameters are significant, and comparing the size, they are somewhere in between the Johansen and the ARDL models. We consider that elasticities derived by the various methods do not differ significantly from each other, so *we conclude that there is no major difference in the general interpretation of the impact of the determinants on the apartment price.*

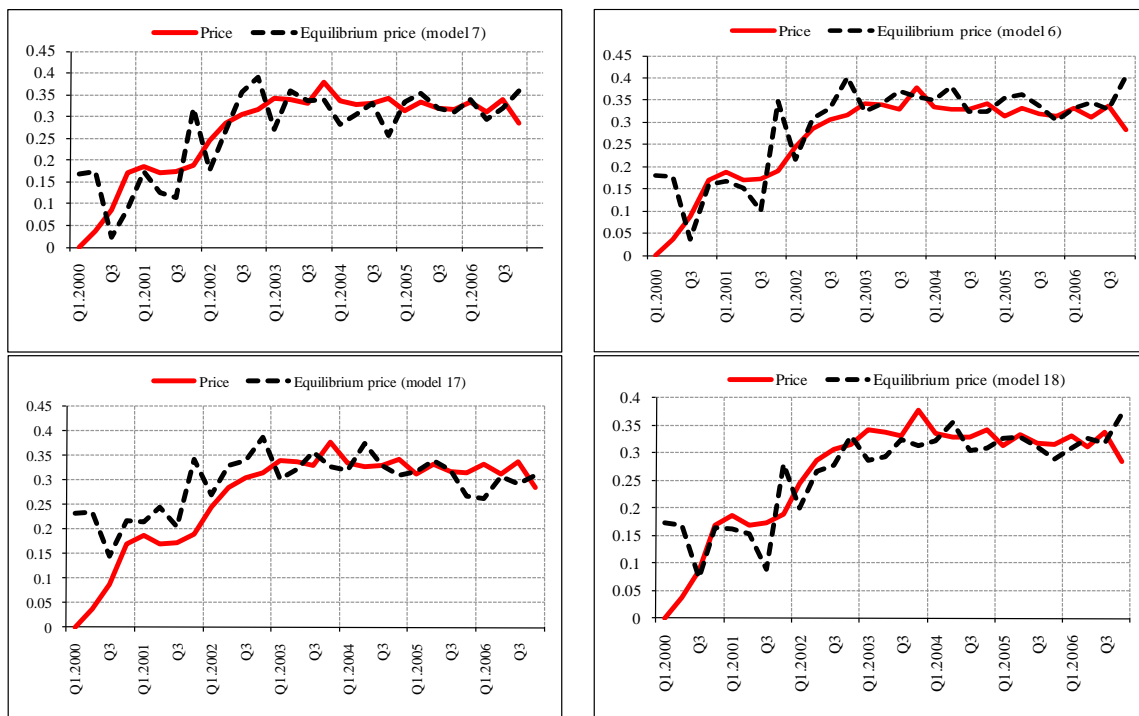
3.5. Presentation of the results and the equilibrium prices by the models

Considering the coefficients of the factors, as well as the dynamics of the series, it can be concluded that the movement of the apartment price in the Republic of Macedonia corresponds to the movement of the fundamentals, which implies that the price is not overvalued and that there is no house price bubble in the RM. Namely, the movements of income and interest rate imply higher demand for apartments during the whole period, which generates continuous pressure on the price growth. The rent was increasing in the period by 2003, while it was declining in the period thereafter, leading to similar movements in the apartment price; nevertheless, considering the small variations of rents, only a small part of the price movement is explained with the movement of rents. On the other hand, the small number of newly built apartments by 2003 means low supply and consequently a pressure on the price to increase in that period of time, while the increased supply after 2003 put pressures

on the price to decline. To sum up, it can be concluded that during the whole period the demand for apartments was constantly growing, while the supply was low by 2004, which lead to a price growth. After 2004, the supply of apartments began to increase rapidly, together with the demand, which caused a stagnation of the price.

The estimated equilibrium apartment prices, together with the factual ones, are presented in Graph 20. The equilibrium prices are actually the fitted values of the models (models 6 and 7, estimated by the Johansen technique and models 17 and 18, estimated by the ARDL and the OLS methods respectively), using only the coefficients of the long-term relation. Although this kind of presentation is not very common in the literature, it is still in accordance with the theory, and we believe that in our case, it can be useful.

Graph 24: Different equilibrium prices and the factual price



The presence of the cointegration relation, implying that apartment prices in the Republic of Macedonia are determined by the fundamentals and that prices fluctuate around the long-run equilibrium value, can be seen in Graph 20. If the prices are not in balance, the equilibrium and the factual values will differ during most of the time. Except for the equilibrium values derived by the ARDL method, which were constantly higher than the factual price in the first three years (the existence of the cointegration between the price and the fundamentals was uncertain in the ARDL method), the rest of the equilibrium prices were around the factual price during the whole period.

It is important to emphasize that in the first two quarters of 2000, the apartment price was below the balanced price according to all the methods. This would imply that the apartments in early 2000 were undervalued. The initial undershooting phenomenon is well known in the literature on house prices in transition economies (see Egert and Mihaljek, 2007), and is often stated as one of the reasons for the high price growth. We can not, however, investigate this phenomenon in this paper, as the data on apartment prices are available only from the year 2000.

Conclusion

Real estate prices and their importance for the macroeconomy were never neglected in the economic literature. Real estate constitutes a significant part households' wealth, and variations in its prices can have serious implications for the behavior of the economic agents, first and foremost for their consumption decisions, and consequently for the economy as a whole. Similarly to other transition countries in Central and Eastern Europe, this issue is becoming more and more important for the RM.

The analysis of the real estate prices (primarily of the apartment prices) in the case of the Republic of Macedonia is limited by the unavailability of relevant data. Considering that this area is not investigated enough, the contribution of this paper is twofold.

First, an index of apartment prices for the Republic of Macedonia is constructed for the very first time, applying the hedonic method, for the prices of the apartments in the capital city, for the period 2000-2007. With this, for the first time we are able to analyze the movement of the apartment price in the country. The results of the constructed index illustrate that apartments' prices grew by 47% in this period, those 47% reflecting the so-called "pure" price increase, excluding the impact of the quality improvement on the price increase. Most of the price growth happened in the period from 2000-2003, whereas price stagnated in the period from 2004-2006, to be followed by another rapid growth during 2007. The same calculation technique was also used for construction of a rent index, according to which rents in Macedonia, in the same period, increased by about 6%.

The second contribution of the paper is the effort to argument whether movements of the apartment price in this period of time was justified, i.e. whether apartments in Macedonia are overvalued or not. Besides the simple analysis based on a few intuitive indicators, as well as the corss-country comparative analysis, the assessment is also based on a rigorous and modern econometric analysis. The econometric analysis investigates whether the apartment price is in accordance with the fundamentals, i.e. with the factors that have an economically justified influence on the price, as well as in which way the fundamentals impact the price. The results of this analysis, based on the Johansen technique, the ARDL and the OLS method, verify that the movement of the apartment price in the Republic of Macedonia in the period from 2000-2006 was in accordance with the fundamentals – income, rents, interest rates and newly built apartments. In addition, the rapid price increase from 2000-2003 came as a consequence of the high demand for apartments when the supply was insufficient, whereas the price stagnation from 2003-2006 was in accordance with the increased supply of apartments in that period.

Although the analysis indicates that apartment prices in the period from 2000-2006 did not deviate from the economic rationality, we believe that it is necessary to carefully monitor the situation on the real estate market, especially considering the rapid growth of prices in 2007, which we were unable to include in our analysis, due to the limited data availability. In that direction, we hope that this pioneering papershall not remain the only one dealing with this subject matter.

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APPENDIX 1 - Construction of the hedonic price index

Table 1 - Sample used for construction of the apartments price index: descriptive statistics for the whole sample and for each quarter

	Whole sample	2000-1	2000-2	2000-3	2000-4	2001-1	2001-2	2001-3	2001-4	2002-1	2002-2	2002-3	2002-4
Number of apartments	4368	167	138	137	120	136	135	132	129	110	145	101	118
Average price	47676.84	33745.53	38579.17	38069.71	45174.17	43219.49	41261.48	42532.95	43988.76	45128.18	48202.07	48426.93	51951.20
Maximum price	246000	102000	93500	100000	95000	87500	95000	90000	92500	94000	147500	134700	135000
Minimum price	8000	12500	14000	17000	17500	20000	18500	15000	17500	16000	15500	13300	20000
Average size (m2)	65.55	63.20	69.28	66.24	71.67	66.68	66.68	65.73	68.10	64.80	66.32	65.56	68.94
Maximum size	246	150	120	113	141	110	120	122	123	120	145	120	140
Minimum size	15	17	28	26	30	30	30	20	27	20	23	25	29
Central heating	3711	128	115	104	101	109	116	112	109	90	121	92	100
New apartment	162	5	1	0	1	1	6	1	0	3	0	2	3
Floor 0,4,5,6,7	2054	95	62	72	60	57	73	66	68	51	77	51	53
Floor 1,2,3	1894	60	52	44	42	60	50	58	48	47	54	41	49
Floor 8,9	251	4	7	12	10	15	8	5	9	4	10	4	8
Floor 10+	169	8	17	9	8	4	4	3	4	8	4	5	8
Zone 1	1387	51	50	41	33	46	36	40	35	29	50	29	38
Zone 2	820	16	16	23	19	20	23	22	21	22	18	16	26
Zone 3	1400	57	44	44	46	44	48	42	47	41	52	38	32
Zone 4	304	12	13	9	6	8	15	9	9	9	9	7	8
Zone 5	457	31	15	20	16	18	13	19	17	9	16	11	14

	2003-1	2003-2	2003-3	2003-4	2004-1	2004-2	2004-3	2004-4	2005-1	2005-2	2005-3	2005-4
Number of apartments	110	122	134	122	125	133	111	129	203	138	140	116
Average price	51192.73	53984.34	47309.70	51113.20	53740.40	51556.39	51510.81	47386.90	48770.20	49904.35	49401.43	49461.21
Maximum price	144000	109000	90000	119600	110000	102000	130000	139000	114000	188600	121000	130000
Minimum price	19000	20000	16500	15000	8000	17000	18000	22940	17500	21000	15000	25000
Average size (m2)	66.97	69.14	62.56	65.07	66.19	67.57	66.16	59.74	63.88	61.84	64.09	63.96
Maximum size	144	140	110	120	123	125	152	140	154	164	153	145
Minimum size	27	28	29	30	15	21	28	30	24	24	22	28
Central heating	96	109	105	94	117	116	102	118	177	131	129	103
New apartment	2	4	3	0	1	5	0	11	6	7	4	6
Floor 0,4,5,6,7	51	55	70	48	50	61	50	61	77	61	62	53
Floor 1,2,3	42	44	55	65	60	58	53	60	115	68	69	55
Floor 8,9	12	11	5	8	10	6	5	7	8	4	8	8
Floor 10+	5	12	4	1	5	8	3	1	3	5	1	0
Zone 1	38	39	41	32	48	51	41	51	62	38	38	34
Zone 2	16	31	22	26	17	25	14	27	48	35	34	32
Zone 3	33	40	41	36	52	38	40	35	55	57	48	37
Zone 4	10	9	10	10	7	7	4	5	15	5	8	6
Zone 5	13	3	20	18	1	12	12	11	23	3	12	7

	2006-1	2006-2	2006-3	2006-4	2007-1	2007-2	2007-3	2007-4
Number of apartments	147	88	145	152	234	158	135	158
Average price	51431.29	44685.80	47593.72	47506.91	50982.99	52072.15	49478.15	56009.18
Maximum price	246000	90000	103500	126000	133000	114000	114000	120000
Minimum price	18000	13000	18300	10500	16500	18000	22500	25000
Average size (m2)	66.07	62.41	62.37	61.88	66.29	67.89	65.39	68.44
Maximum size	246	97	120	120	140	130	127	126
Minimum size	23	25	24	16	24	22	28	23
Central heating	125	73	116	131	202	137	110	123
New apartment	6	5	9	13	12	14	17	14
Floor 0,4,5,6,7	66	35	61	67	116	77	64	84
Floor 1,2,3	71	47	74	73	99	62	57	62
Floor 8,9	7	2	7	10	8	14	7	8
Floor 10+	3	4	3	2	11	5	7	4
Zone 1	45	26	49	66	68	37	42	57
Zone 2	31	16	21	23	52	46	31	31
Zone 3	42	23	44	47	80	44	36	43
Zone 4	11	6	11	8	15	12	15	16
Zone 5	18	17	20	8	19	19	11	11

Table 2 - Results of the main regression, including all floors and residential areas
Dependent variable - log(price)

	Coefficient	p value
CONSTANT	9.679978	0.000
NEW	0.104204	0.000
HEATING	0.084234	0.000
SIZE	0.020225	0.000
SIZE^2	-4.74E-05	0.000
F1	0.051421	0.000
F2	0.05142	0.000
F3	0.038501	0.000
F4	0.007346	0.376
F5	-0.009691	0.307
F6	0.020651	0.060
F7	-0.011518	0.335
F8	-0.037663	0.004
F9	-0.05682	0.000
F10	-0.123145	0.000
F11	-0.110458	0.000
F12	-0.107034	0.000
F13	-0.117789	0.043
F14	-0.111446	0.014
F15	-0.185036	0.004
F16	-0.106321	0.196
F17	-0.167218	0.238
AERO	-0.151374	0.000
AVTOK	-0.297536	0.000
CAIR	-0.492667	0.000
CENTO	-0.576526	0.000
CRNICE	-0.00883	0.798
DEBAR	0.059895	0.002
DJORCE	-0.364743	0.000
HIPODROM	-0.475112	0.000
HROM	-0.289391	0.000
KAPIS	0.000525	0.959
KAR123	-0.0835	0.000
KAR4	-0.179789	0.000
KOZLE	-0.061595	0.000
KVODA	-0.211868	0.000
MADZARI	-0.412904	0.000
NOVOLI	-0.243482	0.000
NPAT	-0.465206	0.000
OSTROVO	-0.084902	0.001
RADISANI	-0.499705	0.000
SEVER	-0.529409	0.000
TAFT	-0.092369	0.000
TPOLE	-0.529736	0.000
VLAE	-0.168194	0.000
VODNO	0.150811	0.002
ZELEZARA	-0.38959	0.000
Observations	4368	
R-squared	0.86	

Table 3 – Regression results for the whole sample and for each quarter. Dependent variable - log (price)

	Total sample	2000-1	2000-2	2000-3	2000-4	2001-1	2001-2	2001-3	2001-4	2002-1	2002-2	2002-3	2002-4
Constant	9.680 (554.13)**	9.461 (150.08)**	9.303 (87.36)**	9.713 (112.99)**	9.511 (90.10)**	9.709 (96.75)**	9.685 (116.14)**	9.397 (110.62)**	9.601 (101.99)**	9.508 (115.16)**	9.787 (121.34)**	9.915 (80.84)**	9.625 (89.65)**
floor123	0.045 (9.79)**	0.045 (2.46)*	0.049 (2.29)*	0.025 (1.37)	0.047 (2.39)*	0.029 (1.59)	0.025 (1.53)	0.022 (1.22)	0.024 (1.36)	0.022 (1.09)	0.046 (2.31)*	0.079 (3.24)**	0.022 (0.97)
floor89	-0.051 (5.26)**	-0.065 (1.13)	-0.052 (1.14)	0.005 (0.16)	-0.046 (1.42)	-0.033 (1.13)	-0.029 (0.85)	-0.074 (1.62)	-0.017 (0.51)	-0.092 (1.82)	-0.050 (1.31)	-0.090 (1.49)	-0.033 (0.74)
floor10+	-0.116 (10.00)**	-0.104 (2.49)*	-0.089 (2.78)**	-0.101 (2.91)**	-0.104 (2.97)**	-0.093 (1.84)	0.021 (0.45)	-0.131 (2.23)*	-0.024 (0.51)	-0.140 (3.72)**	-0.068 (1.18)	-0.087 (1.52)	-0.062 (1.36)
z2	-0.088 (12.56)**	-0.070 (1.97)	-0.091 (2.61)*	0.005 (0.16)	-0.074 (2.44)*	-0.079 (2.69)**	-0.082 (3.05)**	-0.113 (3.90)**	-0.050 (1.72)	-0.136 (4.36)**	-0.091 (2.69)**	-0.127 (3.10)**	-0.143 (4.08)**
z3	-0.197 (33.90)**	-0.169 (6.92)**	-0.195 (7.94)**	-0.160 (6.93)**	-0.181 (7.94)**	-0.148 (6.58)**	-0.146 (6.55)**	-0.199 (8.58)**	-0.181 (7.92)**	-0.205 (8.01)**	-0.216 (8.92)**	-0.195 (5.81)**	-0.183 (6.09)**
z4	-0.337 (33.87)**	-0.183 (4.75)**	-0.300 (8.23)**	-0.260 (6.77)**	-0.405 (8.88)**	-0.307 (7.74)**	-0.289 (9.28)**	-0.322 (7.82)**	-0.282 (7.49)**	-0.321 (7.45)**	-0.364 (8.35)**	-0.388 (6.71)**	-0.321 (6.56)**
z5	-0.504 (53.39)**	-0.384 (11.65)**	-0.385 (8.84)**	-0.383 (11.87)**	-0.570 (17.55)**	-0.432 (13.34)**	-0.408 (11.94)**	-0.435 (12.85)**	-0.418 (11.92)**	-0.480 (10.64)**	-0.554 (13.85)**	-0.556 (11.36)**	-0.501 (10.83)**
heating	0.086 (11.60)**	0.079 (2.87)**	0.114 (3.29)**	0.096 (4.01)**	0.010 (0.35)	0.065 (2.70)**	0.052 (1.91)	0.112 (3.87)**	0.081 (2.80)**	0.128 (4.28)**	0.058 (1.86)	0.018 (0.39)	0.105 (2.72)**
new	0.102 (8.80)**	0.105 (2.06)*	0.227 (2.01)*	0.000 (.)	0.150 (1.56)	0.156 (1.61)	0.133 (3.51)**	0.197 (1.98)*	0.000 (.)	0.058 (1)	0.000 (.)	0.105 (1.26)	-0.002 (0.02)
size	0.020 (46.97)**	0.018 (10.92)**	0.023 (7.60)**	0.012 (4.50)**	0.024 (8.94)**	0.017 (5.80)**	0.017 (7.14)**	0.027 (11.25)**	0.020 (8.04)**	0.026 (11.27)**	0.019 (9.19)**	0.015 (4.51)**	0.023 (8.21)**
size^2	0.000 (16.58)**	0.000 (2.96)**	0.000 (3.24)**	0.000 (0.63)	0.000 (4.18)**	0.000 (1.39)	0.000 (1.64)	0.000 (5.92)**	0.000 (2.86)**	0.000 (5.68)**	0.000 (2.66)**	0.000 (0.08)	0.000 (3.36)**
Observations	4368	167	138	137	120	136	135	132	129	110	145	101	118
R-squared	0.85	0.91	0.91	0.92	0.93	0.92	0.93	0.93	0.92	0.93	0.92	0.92	0.92
Jarque-Bera	0.000	0.138	0.101	0.710	0.830	0.065	0.014	0.854	0.296	0.001	0.000	0.940	0.000
White	0.000	0.306	0.060	0.020	0.026	0.269	0.880	0.200	0.284	0.079	0.169	0.616	0.616
Ramsey's RESET	0.768	0.676	0.006	0.683	0.798	0.354	0.001	0.021	0.380	0.043	0.546	0.070	0.784

Absolut values of t-statistics are given in brakets. ** significant at 1%, * significant at 5%.

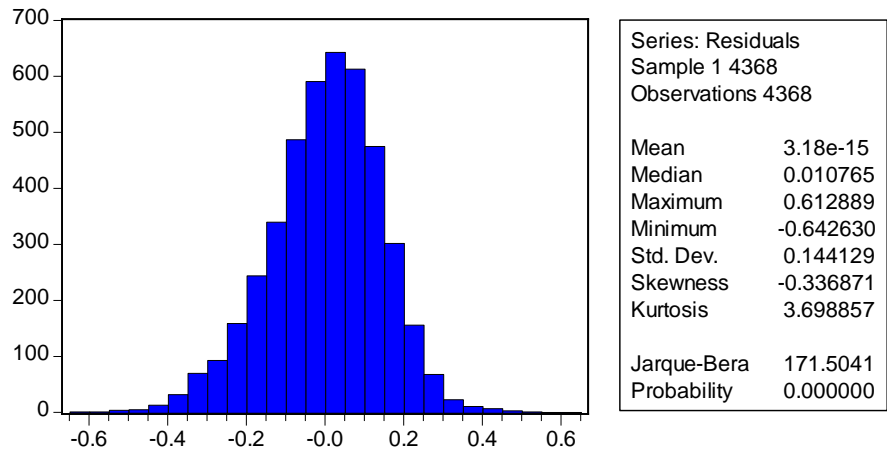
	2003-1	2003-2	2003-3	2003-4	2004-1	2004-2	2004-3	2004-4	2005-1	2005-2	2005-3	2005-4
Constant	9.828 (123.69)**	9.559 (109.95)**	9.411 (108.80)**	9.646 (99.20)**	9.621 (103.36)**	9.701 (86.25)**	9.654 (93.16)**	9.652 (95.97)**	9.562 (136.85)**	9.703 (114.05)**	9.599 (123.43)**	9.684 (89.30)**
floor123	0.022 (1	0.011 (0.51	0.018 (1.14	0.040 (2.08)*	0.017 (0.79	-0.028 (1.25	0.059 (2.50)*	0.050 (2.32)*	0.055 (3.02)**	0.012 (0.59	0.068 (3.92)**	0.025 (1.06
floor89	-0.095 (2.96)**	-0.055 (1.59	-0.126 (3.16)**	-0.031 (0.82	-0.108 (2.92)**	-0.182 (3.46)**	-0.065 (1.18	-0.053 (1.13	-0.048 (1.07	-0.047 (0.79	-0.059 (1.54	-0.064 (1.39
floor10+	-0.178 (3.79)**	-0.105 (3.19)**	-0.067 (1.53	-0.031 (0.32	-0.101 (1.95	-0.085 (1.7	-0.106 (1.46	0.106 (0.9	-0.138 (1.97	-0.064 (1.22	-0.129 (1.29	0.000 (.)
z2	-0.197 (6.25)**	-0.100 (3.64)**	-0.132 (5.17)**	-0.153 (5.51)**	-0.100 (3.04)**	-0.112 (3.20)**	-0.077 (2.02)*	-0.061 (2.04)*	-0.073 (2.79)**	-0.104 (3.64)**	-0.117 (4.51)**	-0.106 (3.27)**
z3	-0.275 (10.80)**	-0.224 (9.09)**	-0.192 (9.34)**	-0.258 (10.31)**	-0.168 (7.19)**	-0.175 (6.18)**	-0.186 (6.94)**	-0.189 (7.38)**	-0.176 (7.36)**	-0.187 (7.24)**	-0.212 (9.11)**	-0.189 (6.15)**
z4	-0.397 (10.33)**	-0.355 (8.55)**	-0.341 (10.15)**	-0.342 (8.88)**	-0.305 (5.71)**	-0.293 (5.40)**	-0.198 (2.99)**	-0.269 (4.52)**	-0.327 (8.43)**	-0.328 (5.02)**	-0.321 (7.43)**	-0.344 (6.03)**
z5	-0.629 (16.08)**	-0.466 (6.69)**	-0.554 (18.79)**	-0.588 (17.35)**	-0.987 (7.89)**	-0.503 (10.40)**	-0.405 (7.00)**	-0.457 (9.71)**	-0.447 (12.67)**	-0.491 (6.23)**	-0.585 (13.77)**	-0.468 (7.25)**
heating	0.075 (2.12)*	0.107 (3.06)**	0.076 (3.45)**	0.116 (4.50)**	0.064 (1.26	0.124 (3.21)**	0.081 (1.25	0.059 (1.32	0.091 (3.04)**	0.057 (0.96	0.028 (0.69	0.037 (0.79
new	0.093 (1.28	0.107 (2.00)*	-0.007 (0.14	0.000 (.)	0.021 (0.2	0.018 (0.33	0.000 (.)	0.043 (1.11	0.070 (1.39	0.109 (2.47)*	-0.002 (0.04	0.172 (3.41)**
size	0.020 (9.75)**	0.026 (11.63)**	0.034 (13.42)**	0.024 (8.64)**	0.025 (9.46)**	0.022 (7.12)**	0.022 (9.75)**	0.022 (8.40)**	0.024 (13.57)**	0.021 (13.42)**	0.025 (14.55)**	0.022 (8.35)**
size^2	0.000 (3.60)**	0.000 (5.57)**	0.000 (8.14)**	0.000 (3.49)**	0.000 (4.01)**	0.000 (2.91)**	0.000 (4.16)**	0.000 (2.96)**	0.000 (6.20)**	0.000 (4.22)**	0.000 (6.82)**	0.000 (3.36)**
Observations	110	122	134	122	125	133	111	129	203	138	140	116
R-squared	0.94	0.94	0.95	0.94	0.93	0.89	0.91	0.89	0.89	0.92	0.94	0.88
Jarque-Bera	0.018	0.935	0.074	0.028	0.936	0.000	0.424	0.899	0.000	0.676	0.483	0.000
White	0.833	0.012	0.614	0.077	0.545	0.902	0.699	0.726	0.838	0.410	0.535	0.092
Ramsey's RESET	0.198	0.809	0.809	0.220	0.454	0.836	0.884	0.561	0.243	0.412	0.153	0.027

Absolut values of t-statistics are given in brakets. ** significant at 1%, * significant at 5%.

	2006-1	2006-2	2006-3	2006-4	2007-1	2007-2	2007-3	2007-4
Constant	9.735	9.464	9.540	9.516	9.723	9.671	9.767	9.898
	(152.58)**	(53.12)**	(112.44)**	(109.24)**	(145.21)**	(101.94)**	(104.16)**	(130.33)**
floor123	-0.005	0.061	0.061	0.048	0.040	0.053	0.037	0.005
	(0.25)	(2.40)*	(3.18)**	(2.34)*	(2.59)*	(2.69)**	(1.65)	(0.31)
floor89	-0.073	0.112	-0.077	-0.013	-0.059	-0.049	-0.068	-0.061
	(1.51)	(1.34)	(1.76)	(0.32)	(1.43)	(1.46)	(1.46)	(1.6)
floor10+	-0.066	-0.176	-0.024	-0.273	-0.077	-0.059	-0.141	-0.130
	(0.93)	(2.91)**	(0.38)	(3.05)**	(2.14)*	(1.13)	(3.03)**	(2.49)*
z2	-0.085	-0.060	-0.119	-0.126	-0.112	-0.091	-0.078	-0.096
	(2.77)**	(1.51)	(3.89)**	(3.96)**	(4.79)**	(3.30)**	(2.43)*	(3.92)**
z3	-0.164	-0.174	-0.231	-0.181	-0.177	-0.170	-0.181	-0.208
	(5.87)**	(5.04)**	(9.90)**	(7.57)**	(8.78)**	(6.26)**	(6.36)**	(9.98)**
z4	-0.247	-0.538	-0.352	-0.460	-0.357	-0.280	-0.419	-0.421
	(5.56)**	(9.03)**	(8.56)**	(9.18)**	(10.23)**	(6.99)**	(10.79)**	(12.97)**
z5	-0.460	-0.531	-0.506	-0.592	-0.507	-0.515	-0.452	-0.566
	(10.36)**	(10.03)**	(14.77)**	(12.18)**	(15.17)**	(14.34)**	(9.09)**	(14.15)**
heating	0.071	0.055	0.124	0.072	0.071	0.090	0.099	0.021
	(1.95)	(1.08)	(4.50)**	(2.15)*	(2.91)**	(3.17)**	(3.01)**	(0.88)
new	0.023	-0.004	0.020	0.087	0.079	0.045	0.075	0.082
	(0.44)	(0.08)	(0.52)	(2.44)*	(2.33)*	(1.39)	(2.39)*	(2.83)**
size	0.020	0.026	0.025	0.026	0.021	0.023	0.020	0.022
	(18.88)**	(4.98)**	(10.55)**	(10.18)**	(12.04)**	(8.82)**	(8.31)**	(10.51)**
size^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(8.05)**	(1.83)	(4.52)**	(4.65)**	(4.59)**	(4.06)**	(3.36)**	(4.93)**
Observations	147	88	145	152	234	158	135	158
R-squared	0.92	0.9	0.93	0.9	0.91	0.9	0.9	0.92
Jarque-Bera	0.160	0.242	0.384	0.163	0.144	0.000	0.050	0.477
White	0.824	0.112	0.034	0.000	0.001	0.011	0.128	0.814
Ramsey's RESET	0.105	0.014	0.469	0.378	0.767	0.982	0.583	0.444

Absolut values of t-statistics are given in brakets. ** significant at 1%, * significant at 5%.

Chart 1: Histogram of residuals from the whole-sample regression



**Chart 2: Marginal effect of the apartment size on price
(x axis - size, y axis- effect)**

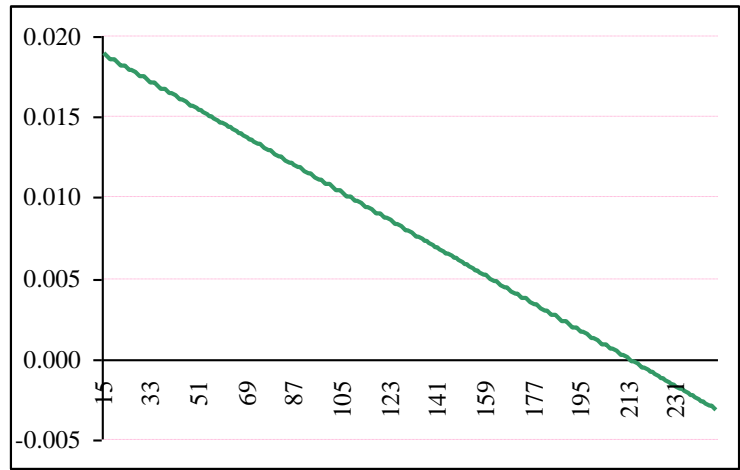


Chart 3: Stability of the coefficients by different periods

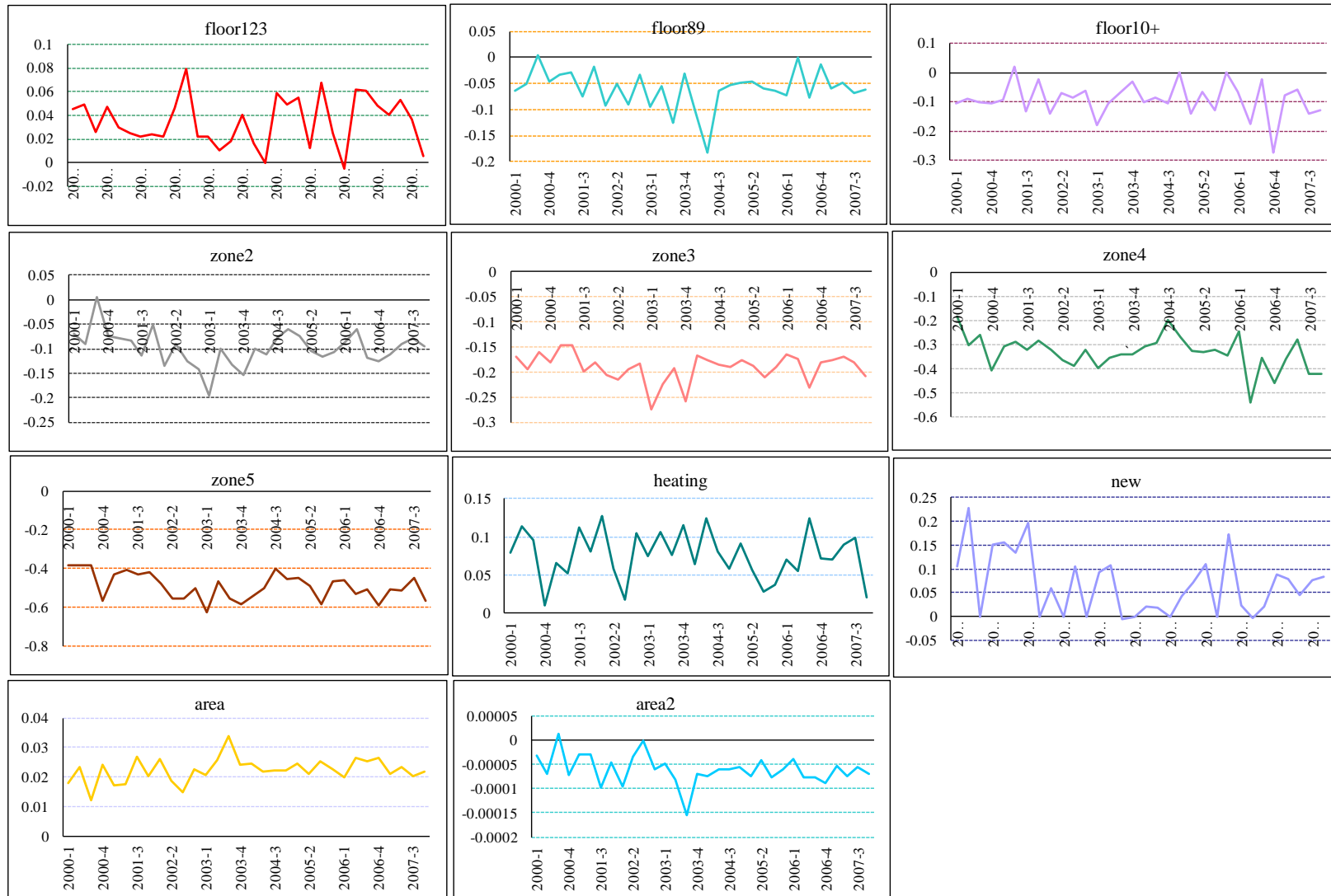


Table 4: Results from the regression with dummy variables

	Coefficient	p value
C	9.41102	0.000
FLOOR123	0.03428	0.000
FLOOR89	-0.05483	0.000
FLOOR10+	-0.09176	0.000
HEATING	0.07718	0.000
NEW	0.07140	0.000
SIZE	0.02089	0.000
SIZE^2	-0.00005	0.000
Z2	-0.09723	0.000
Z3	-0.19013	0.000
Z4	-0.33292	0.000
Z5	-0.48776	0.000
D2000-2	0.01637	0.197
D2000-3	0.07566	0.000
D2000-4	0.15129	0.000
D2001-1	0.17829	0.000
D2001-2	0.16564	0.000
D2001-3	0.16075	0.000
D2001-4	0.18193	0.000
D2002-1	0.22947	0.000
D2002-2	0.26416	0.000
D2002-3	0.27406	0.000
D2002-4	0.29514	0.000
D2003-1	0.30890	0.000
D2003-2	0.31429	0.000
D2003-3	0.32904	0.000
D2003-4	0.34186	0.000
D2004-1	0.32714	0.000
D2004-2	0.30665	0.000
D2004-3	0.31757	0.000
D2004-4	0.31083	0.000
D2005-1	0.30434	0.000
D2005-2	0.30188	0.000
D2005-3	0.29310	0.000
D2005-4	0.29321	0.000
D2006-1	0.31662	0.000
D2006-2	0.27018	0.000
D2006-3	0.30493	0.000
D2006-4	0.27509	0.000
D2007-1	0.31009	0.000
D2007-2	0.32640	0.000
D2007-3	0.30477	0.000
D2007-4	0.37938	0.000
R ²		0.913
Observations		4368

Table 5 - Sample used for construction of the rents index: descriptive statistics for the whole sample and for each quarter

	Total sample	2000-1	2000-2	2000-3	2000-4	2001-1	2001-2	2001-3	2001-4	2002-1	2002-2	2002-3	2002-4
Number of apartments	2199	99	70	101	74	71	91	86	78	66	61	79	61
Average rent	270.92	291.01	299.79	229.85	297.30	246.97	224.73	231.86	264.17	275.98	275.66	280.63	303.77
Maximum rent	1600	1250	1000	500	750	650	600	500	1000	1300	1250	1500	1600
Minimum rent	75	100	100	75	100	100	125	150	100	100	100	130	125
Average size (m2)	66.13	69.40	67.94	62.72	71.76	62.82	64.00	64.17	64.54	65.02	61.89	65.77	66.77
Maximum size	250	120	130	120	145	100	120	100	220	150	130	140	140
Minimum size	24	28	25	30	34	28	30	30	30	30	25	30	25
Central heating	2046	89	63	82	60	65	78	81	73	62	54	78	56
Unfurnished	467	18	11	16	16	8	24	14	12	18	11	14	11
Furnished	1394	67	45	73	49	52	62	69	58	41	41	53	39
Luxuriously furnished	338	14	14	12	9	11	5	3	8	7	9	12	11
Zone 1	863	35	25	11	18	18	16	33	22	18	6	29	17
Zone 2	794	37	20	25	29	28	34	23	29	26	30	30	23
Zone 3	445	14	10	22	9	17	20	22	17	16	17	16	15
Zone 4	97	3	8	24	4	2	8	3	5	2	1	3	1

	2003-1	2003-2	2003-3	2003-4	2004-1	2004-2	2004-3	2004-4	2005-1	2005-2	2005-3	2005-4
Number of apartments	57	62	62	78	56	56	69	59	46	44	42	46
Average rent	280.88	325.40	308.71	321.47	299.38	304.91	248.84	348.31	239.57	193.86	252.14	229.24
Maximum rent	1000	1500	1200	1000	1000	1000	600	1000	700	600	500	800
Minimum rent	150	130	150	120	150	150	130	120	130	130	100	100
Average size (m2)	63.86	65.45	67.39	71.59	68.54	64.52	66.17	76.08	67.93	54.00	62.17	65.07
Maximum size	100	140	115	130	120	110	160	220	130	90	150	175
Minimum size	30	30	30	32	35	27	30	30	25	33	31	32
Central heating	53	60	60	75	55	56	64	53	41	41	42	45
Unfurnished	13	14	18	20	17	10	7	8	16	16	10	9
Furnished	36	33	33	41	30	34	53	27	26	24	27	33
Luxuriously furnished	8	15	11	17	9	12	9	24	4	4	5	4
Zone 1	15	21	29	32	21	27	19	24	10	7	15	12
Zone 2	23	29	21	28	24	18	26	19	16	20	14	17
Zone 3	13	10	10	15	9	10	15	10	13	14	10	12
Zone 4	2	0	0	0	1	1	4	0	2	0	3	4

	2006-1	2006-2	2006-3	2006-4	2007-1	2007-2	2007-3	2007-4
Number of apartments	72	83	96	81	84	64	47	58
Average rent	223.06	242.11	238.75	231.98	295.36	287.03	292.98	327.93
Maximum rent	1000	700	800	600	1500	1500	800	1000
Minimum rent	100	100	100	100	100	110	120	100
Average size (m2)	62.17	63.72	66.45	63.07	70.42	66.64	70.81	71.52
Maximum size	130	120	160	100	250	150	136	130
Minimum size	30	24	28	25	24	30	30	31
Central heating	70	80	91	74	81	62	47	55
Unfurnished	23	22	20	20	12	14	9	16
Furnished	42	50	65	50	48	35	31	27
Luxuriously furnished	7	11	11	11	24	15	7	15
Zone 1	29	32	32	25	35	29	25	23
Zone 2	26	30	35	28	35	23	12	16
Zone 3	13	14	21	17	11	9	9	15
Zone 4	2	4	3	4	0	1	1	1

Table 6: Rents

	Average rent per apartment	Average rent per m2
2000-1	291.0101	4.122096
2000-2	299.7857	4.252306
2000-3	229.8515	3.716243
2000-4	297.2973	4.096354
2001-1	246.9718	4.019128
2001-2	224.7253	3.622944
2001-3	231.8605	3.672837
2001-4	264.1667	4.078617
2002-1	275.9848	4.068719
2002-2	275.6557	4.372308
2002-3	280.6329	4.143584
2002-4	303.7705	4.416963
2003-1	280.8772	4.374098
2003-2	325.4032	4.571114
2003-3	308.7097	4.460704
2003-4	321.4744	4.395127
2004-1	299.375	4.217358
2004-2	304.9107	4.542309
2004-3	248.8406	3.811769
2004-4	348.3051	4.678881
2005-1	239.5652	3.490236
2005-2	193.8636	3.607764
2005-3	252.1429	3.88271
2005-4	229.2391	3.480825
2006-1	223.0556	3.538054
2006-2	242.1084	3.787217
2006-3	238.75	3.668456
2006-4	231.9753	3.713602
2007-1	295.3571	4.123967
2007-2	287.0313	4.19852
2007-3	292.9787	4.08857
2007-4	327.931	4.540325

Chart 4: Rents**Table 7: Criteria for selection of most adequate specification**

	rent	rent	rent	log(rent)	log(rent)	log(rent)
size	*		*	*		*
log(size)		*			*	
size^2			*			*
R-squared	0.755	0.706	0.767	0.815	0.811	0.819
Jarque-Bera	0.000	0.000	0.000	0.000	0.000	0.000
White	0.000	0.000	0.000	0.000	0.000	0.000
Ramsey's RESET	0.000	0.000	0.000	0.199	0.000	0.000

Table 8 - Results from the main regression, including all residential areas
Dependent variable - log(rent)

	Coefficient	p value
C	4.846256	0.000
SIZE	0.011106	0.000
UNFURNISHED	-0.14036	0.000
LUXURY	0.479961	0.000
AERO	-0.17883	0.000
AVTOK	-0.33497	0.000
CAIR	-0.47021	0.000
CENTO	-0.53963	0.000
CRNICE	-0.0896	0.039
DEBAR	0.108549	0.001
DJORCE	-0.50608	0.000
HROM	-0.52122	0.000
KAPIS	-0.04171	0.007
F123	-0.13599	0.000
F4	-0.26368	0.000
KOZLE	-0.08556	0.000
KVODA	-0.29347	0.000
MADZARI	-0.68681	0.000
NOVOLI	-0.31177	0.000
OSTROVO	-0.19983	0.000
PROLET	-0.15337	0.273
SEVER	-0.50535	0.000
TAFT	-0.14947	0.000
TPOLE	-0.53331	0.000
VLAЕ	-0.27293	0.000
VODNO	0.026489	0.609
ZELEZARA	-0.45248	0.000
Observations	2199	
R-squared	0.81	

Table 9 - Regressions for the whole sample and for each quarter. Dependent variable - log (rent)

	Total sample	2000-1	2000-2	2000-3	2000-4	2001-1	2001-2	2001-3	2001-4	2002-1	2002-2	2002-3	2002-4
Constant	4.696 (214.01)**	4.449 (44.55)**	4.429 (30.34)**	4.858 (56.12)**	4.915 (44.95)**	4.479 (41.88)**	4.914 (63.24)**	4.921 (46.11)**	4.847 (51.64)**	4.534 (37.53)**	4.624 (30.67)**	5.078 (25.57)**	4.687 (38.62)**
zone 2	-0.139 (14.19)**	-0.107 (2.49)*	-0.197 (3.23)**	-0.123 (2.30)*	-0.12 (2.30)*	-0.073 (1.54)	-0.184 (4.82)**	-0.235 (5.34)**	-0.157 (3.49)**	-0.161 (2.96)**	-0.102 (1.29)	-0.245 (4.77)**	-0.163 (2.84)**
zone 3	-0.269 (22.78)**	-0.304 (5.22)**	-0.205 (2.62)*	-0.284 (5.36)**	-0.393 (5.20)**	-0.254 (4.42)**	-0.321 (7.17)**	-0.256 (5.69)**	-0.31 (5.99)**	-0.219 (3.53)**	-0.228 (2.51)*	-0.3 (4.91)**	-0.324 (5.01)**
zone 4	-0.37 (16.72)**	-0.474 (3.64)**	-0.403 (3.57)**	-0.409 (6.89)**	-0.339 (2.97)**	-0.007 (0.05)	-0.461 (7.22)**	-0.377 (3.67)**	-0.37 (4.45)**	-0.278 (2.09)*	-0.39 (1.52)	-0.314 (2.73)**	-0.22 (1.08)
size	0.011 (53.74)**	0.014 (13.28)**	0.015 (12.17)**	0.009 (9.17)**	0.007 (5.22)**	0.012 (10.38)**	0.007 (8.82)**	0.008 (6.49)**	0.01 (12.70)**	0.013 (11.36)**	0.014 (9.09)**	0.01 (9.91)**	0.011 (8.17)**
heating	0.158 (9.16)**	0.246 (3.32)**	0.209 (1.92)	0.111 (2.16)*	0.306 (4.60)**	0.266 (3.36)**	0.184 (3.78)**	0.11 (1.4)	0.168 (2.11)*	0.254 (2.69)**	0.078 (0.78)	-0.104 (0.55)	0.313 (3.23)**
luxury	0.484 (38.01)**	0.461 (8.22)**	0.39 (5.71)**	0.495 (7.72)**	0.471 (6.31)**	0.355 (6.11)**	0.518 (7.10)**	0.45 (4.45)**	0.303 (4.43)**	0.427 (5.36)**	0.479 (5.21)**	0.421 (6.18)**	0.397 (5.42)**
unfurnished	-0.146 (13.94)**	-0.126 (2.50)*	-0.241 (3.28)**	-0.062 (1.27)	-0.175 (2.96)**	-0.15 (2.29)*	-0.116 (3.24)**	-0.144 (2.95)**	-0.204 (3.86)**	-0.227 (4.39)**	-0.172 (2.06)*	-0.1 (1.77)	-0.254 (4.06)**
Observations	2199	99	70	101	74	71	91	86	78	66	61	79	61
R-squared	0.82	0.85	0.87	0.83	0.83	0.78	0.83	0.69	0.86	0.88	0.79	0.84	0.88
Jarque-Bera	0.00	0.37	0.01	0.43	0.02	0.58	0.04	0.52	0.00	0.36	0.41	0.46	0.55
White	0.00	0.12	0.82	0.49	0.99	0.05	0.80	0.24	0.85	0.25	0.44	0.13	0.03
Ramsey's RESET	0.20	0.14	0.47	0.16	0.92	0.37	0.35	0.40	0.32	0.07	0.86	0.10	0.13

Absolut values of t-statistics are given in brakets. ** significant at 1%, * significant at 5%.

	2003-1	2003-2	2003-3	2003-4	2004-1	2004-2	2004-3	2004-4	2005-1	2005-2	2005-3	2005-4
Constant	4.741 (33.86)**	4.746 (33.44)**	4.726 (30.36)**	4.583 (28.51)**	4.545 (22.95)**	4.693 (38.94)**	4.663 (55.25)**	4.855 (34.82)**	4.937 (27.59)**	4.902 (34.13)**	4.759 (51.44)**	4.545 (23.86)**
zone 2	-0.283 (4.84)**	-0.081 (1.66)	-0.114 (2.12)*	-0.062 (1.13)	-0.022 (0.4)	-0.083 (1.3)	-0.057 (1.43)	-0.167 (2.40)*	-0.222 (2.52)*	-0.157 (2.67)*	-0.18 (2.88)**	-0.111 (1.95)
zone 3	-0.306 (4.28)**	-0.167 (2.38)*	-0.086 (1.19)	-0.173 (2.55)*	-0.165 (2.32)*	-0.272 (3.65)**	-0.176 (3.85)**	-0.269 (3.15)**	-0.326 (3.43)**	-0.284 (4.42)**	-0.326 (4.57)**	-0.284 (4.43)**
zone 4	-0.376 (2.54)*	0 (.)	0 (.)	0 (.)	-0.217 (1.2)	-0.206 (1.02)	-0.216 (2.86)**	0 (.)	-0.346 (1.88)	0 (.)	-0.324 (2.93)**	-0.357 (3.58)**
size	0.013 (7.65)**	0.012 (10.05)**	0.013 (8.00)**	0.01 (7.38)**	0.012 (8.45)**	0.014 (7.95)**	0.01 (14.04)**	0.008 (10.57)**	0.01 (5.63)**	0.009 (4.56)**	0.012 (9.71)**	0.011 (11.22)**
heating	0.186 (1.78)	-0.058 (0.47)	0.029 (0.21)	0.296 (2.41)*	0.201 (1.1)	0 (.)	0.124 (1.92)	0.155 (1.46)	-0.092 (0.78)	-0.065 (0.69)	0 (.)	0.216 (1.21)
luxury	0.376 (4.30)**	0.711 (10.56)**	0.528 (6.66)**	0.585 (9.20)**	0.561 (7.52)**	0.512 (6.85)**	0.481 (9.37)**	0.492 (7.77)**	0.512 (3.61)**	0.511 (5.41)**	0.535 (6.40)**	0.602 (7.08)**
unfurnished	-0.127 (2.03)*	-0.041 (0.73)	-0.149 (2.54)*	-0.108 (1.9)	-0.18 (3.35)**	-0.141 (1.96)	-0.188 (3.31)**	-0.134 (1.36)	-0.146 (1.93)	-0.063 (1.18)	-0.252 (4.02)**	-0.237 (3.98)**
Observations	57	62	62	78	56	56	69	59	46	44	42	46
R-squared	0.81	0.92	0.84	0.83	0.87	0.86	0.89	0.85	0.78	0.79	0.91	0.9
Jarque-Bera	0.14	0.47	0.29	0.49	0.43	0.47	0.19	0.18	0.01	0.00	0.10	0.03
White	0.72	0.09	0.00	0.48	0.09	0.29	0.79	0.78	0.04	0.23	0.73	0.50
Ramsey's RESET	0.24	0.16	0.01	0.64	0.06	0.52	0.84	0.91	0.44	0.12	0.37	0.34

Absolut values of t-statistics are given in brakets. ** significant at 1%, * significant at 5%.

	2006-1	2006-2	2006-3	2006-4	2007-1	2007-2	2007-3	2007-4
Constant	4.496 (27.98)**	4.256 (34.26)**	4.622 (41.97)**	4.652 (51.08)**	4.654 (39.90)**	4.633 (37.11)**	4.953 (38.27)**	4.854 (30.24)**
zone 2	-0.194 (3.57)**	-0.142 (3.00)**	-0.069 (1.63)	-0.159 (3.24)**	-0.131 (3.04)**	-0.156 (3.71)**	-0.197 (2.32)*	-0.149 (2.15)*
zone 3	-0.273 (4.07)**	-0.231 (3.77)**	-0.3 (6.08)**	-0.278 (4.85)**	-0.28 (4.29)**	-0.212 (3.54)**	-0.334 (3.82)**	-0.351 (4.67)**
zone 4	-0.344 (2.41)*	-0.343 (3.39)**	-0.218 (1.77)	-0.429 (4.24)**	0 (.)	-0.181 (1.15)	-0.561 (2.39)*	-0.246 (1.15)
size	0.013 (10.24)**	0.015 (14.15)**	0.008 (10.52)**	0.012 (9.63)**	0.01 (14.57)**	0.011 (11.14)**	0.01 (5.70)**	0.009 (6.91)**
heating	0.119 (0.85)	0.27 (2.39)*	0.265 (2.79)**	0.09 (1.13)	0.172 (1.56)	0.196 (1.77)	0 (.)	0.294 (2.29)*
luxury	0.434 (5.14)**	0.458 (7.10)**	0.578 (9.83)**	0.443 (6.84)**	0.435 (8.77)**	0.472 (8.71)**	0.435 (3.80)**	0.416 (5.64)**
unfurnished	-0.166 (3.31)**	-0.111 (2.26)*	-0.075 (1.62)	-0.137 (2.67)**	-0.178 (2.98)**	-0.233 (4.74)**	-0.189 (2.18)*	-0.177 (2.56)*
Observations	72	83	96	81	84	64	47	58
R-squared	0.82	0.83	0.81	0.79	0.87	0.91	0.81	0.84
Jarque-Bera	0.95	0.03	0.68	0.63	0.60	0.31	0.95	0.38
White	0.93	0.00	0.00	0.02	0.00	0.17	0.08	0.21
Ramsey's RESET	0.08	0.44	0.07	0.00	0.00	0.87	0.84	0.16

Absolut values of t-statistics are given in brakets. ** significant at 1%, * significant at 5%.

Chart 5: Histogram of residuals from the regression on rents

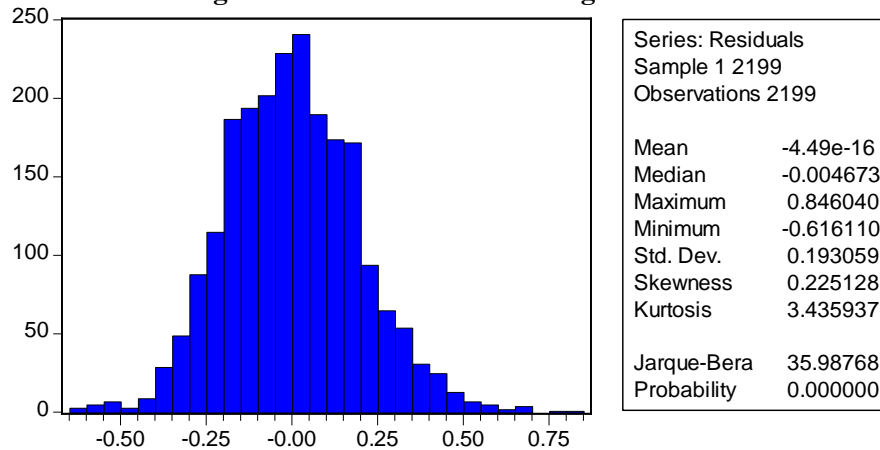


Table 10: Results from the regression with dummy variables

	Coefficient	p value
C	4.723401	0.000
Z2	-0.141069	0.000
Z3	-0.26995	0.000
Z4	-0.35957	0.000
SIZE	0.010737	0.000
UNFURNISHED	-0.145873	0.000
LUXURY	0.481027	0.000
HEATING	0.169642	0.000
2000-2	-0.007595	0.795
2000-3	-0.0386	0.151
2000-4	0.045339	0.116
2001-1	-0.031696	0.277
2001-2	-0.046954	0.085
2001-3	-0.041626	0.133
2001-4	0.01376	0.628
2002-1	0.017993	0.546
2002-2	0.054582	0.074
2002-3	-0.010002	0.724
2002-4	0.050366	0.099
2003-1	0.075989	0.015
2003-2	0.010064	0.741
2003-3	0.045779	0.132
2003-4	0.035454	0.212
2004-1	0.025631	0.414
2004-2	0.019185	0.541
2004-3	-0.068797	0.019
2004-4	-0.056856	0.066
2005-1	-0.098922	0.003
2005-2	-0.088008	0.010
2005-3	-0.101151	0.004
2005-4	-0.134211	0.000
2006-1	-0.143325	0.000
2006-2	-0.091062	0.001
2006-3	-0.112867	0.000
2006-4	-0.100354	0.000
2007-1	-0.122122	0.000
2007-2	-0.060251	0.045
2007-3	-0.04623	0.164
2007-4	0.04975	0.109
R ²		0.833
Observations		2199

APPENDIX 2 - Data and variables

House prices (for other countries) - Average sale prices per 1 m² for houses in the capital city, in EUR.

Source: European Council of Real Estate Professions.

Link: <http://www.cepi.eu/index.php?page=donnees-annuelles&hl=en>

Rental prices (for other countries) - Average monthly rental price per 1 m² for a two-bedroom apartment in the capital city, in EUR.

Source: European Council of Real Estate Professions.

Link: <http://www.cepi.eu/index.php?page=donnees-annuelles&hl=en>

Price levels (for all countries) - Final consumption of households, comparative price levels.

Source: Eurostat.

Link: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/prc/prc_ppp&language=en&product=EU_MASTER_R_prices&root=EU_MASTER_prices&scrollto=0

Income (for other countries) - Households' and NPISH (Non-Profit Institutions Serving Households) gross disposable income.

Source: Eurostat.

Link: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/na/nasq&language=en&product=EU_MASTER_national_accounts&root=EU_MASTER_national_accounts&scrollto=0

Total population (for all countries) – Population on 1 January of the corresponding year.

Source: Eurostat.

Link: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/populat/pop/demo/demo_pop&language=en&product=EU_MASTER_population&root=EU_MASTER_population&scrollto=0

Interest rates on housing loans (for other countries) - Interest rates on newly approved housing loans, in EUR, to households, with fixed interest rate for the first 1 to 5 years. Source: Central banks' Annual Reports.

Income (for Macedonia) - Households' disposable income data series. The series is constructed by the National Bank of the Republic of Macedonia. The series is seasonally adjusted using Census X-12 multiplicative method.

Interest rate (for Macedonia) - Long-term interest rate on total loans. Due to the lack of sectoral breakdown of the banks' lending interest rates prior to 2005, for this period the interest rate on total loans is used. For the period after 2005, the interest rate on total Denar loans with FX clause is used. Source: National Bank of the Republic of Macedonia.

Housing loans to households - Source: National Bank of the Republic of Macedonia

Immigrated citizens in Skopje-Total immigrant flows in Skopje within the calendar year, annual data. Source: Statistical Yearbook, State Statistical Office of the Republic of Macedonia. Interpolation of the annual data to quarterly was done by the Chow-Lin method without, interpolator series.

Value added in the construction industry - Source: State Statistical Office of the Republic of Macedonia, news release "Short-term Macroeconomic Indicators" and publication "Gross

Domestic Product of the Republic of Macedonia”. Seasonal adjustments were done using Census X-12, multiplicative method.

Accomplished residential dwellings - Accomplished residential dwellings within the calendar year, annual data. Source: Statistical Yearbook, State Statistical Office of the Republic of Macedonia. Interpolating annual data into quarterly was done by Chow-Lin interpolation method using the value added in the construction industry (seasonally adjusted series) as an interpolator.

Construction costs - Weighted average index that includes the average net wage in construction (with weight of 25%) and the construction materials prices (with weight of 75%). Data on net-wages is available from the news release on the average net-wage (source: SSO), and the data on the prices of the construction materials is available from the SSO's news release on Industrial Producer Prices, Other Non-Metallic Mineral Product Manufacturing .

Macedonian stock exchange index - For the period 2002-2004 the MBI index is used, whereas for the period from 2005 onwards, the MBI-10 is used (index that replaced the MBI). The two series were connected assuming that on the first day when a market value of the MBI-10 index is available there is a zero change in the index value. The daily data is converted into quarterly by averaging. For the period prior to 2002, due to the lack of any stock exchange indices, the development of the MBI index was extrapolated backwards using the linear trend and seasonal dummy variables method.

APPENDIX 3 - Unit Root Tests and details of the Johansen technique estimation

Table 1 - Unit Root Tests

Null hypothesis: Unit root

If the value of the computed test statistic is below the value of the critical value for a given significance level, in absolute terms, the null hypothesis cannot be rejected (i.e. the series can be considered to have a unit root, i.e. nonstationary).

Series	Test	Test statistics	1% critical value	5% critical value
Price (regressions)	ADF* (intercept)	-3.26	-3.66	-2.96
	ADF-GLS	-0.81	-2.64	-1.95
	Phillips-Perron	-3.54	-3.66	-2.96
Price (dummy variables)	ADF* (intercept)	-3.03	-3.66	-2.96
	ADF-GLS	-0.84	-2.64	-1.95
	Phillips-Perron	-3.37	-3.66	-2.96
Income	ADF* (trend and intercept)	-2.58	-4.28	-3.56
	ADF-GLS	-2.59	-3.77	-3.19
	Phillips-Perron	-2.49	-4.28	-3.56
Interest	ADF* (trend and intercept)	-2.63	-4.30	-3.57
	ADF-GLS	-2.28	-3.77	-3.19
	Phillips-Perron	-3.19	-4.28	-3.56
Loans	ADF* (trend, intercept and 1 lag)	-2.58	-4.30	-3.57
	ADF-GLS	-2.42	-3.77	-3.19
	Phillips-Perron	-1.95	-4.30	-3.57
Rents(regressions)	ADF* (intercept)	-2.61	-3.66	-2.94
	ADF-GLS	-2.51	-2.64	-1.95
	Phillips-Perron	-2.60	-3.66	-2.90
Rents (dummy variables)	ADF* (intercept)	-1.86	-3.66	-2.96
	ADF-GLS	-1.87	-2.64	-1.95
	Phillips-Perron	-1.78	-3.66	-2.96
Immigrants	ADF* (trend, intercept and 1 lag)	-6.61	-4.36	-3.60
	ADF-GLS	-5.01	-3.78	-3.19

	Phillips-Perron	-2.46	-4.34	-3.59
Construction	ADF* (trend and intercept)	-2.09	-4.28	-3.56
	ADF-GLS	-2.07	-3.77	-3.19
	Phillips-Perron	-1.57	-4.28	-3.56
Accomplished residential dwellings	ADF* (trend, intercept and 1 lag)	-3.18	-4.36	-3.60
	ADF-GLS	-3.27	-3.77	-3.19
	Phillips-Perron	-2.16	-4.34	-3.59
Construction costs	ADF* (intercept)	-0.04	-3.67	-2.96
	ADF-GLS	-1.02	-2.64	-1.95
	Phillips-Perron	-0.06	-3.67	-2.96
Stock exchange index	ADF* (constant and 2 lags)	-2.57	-3.68	-2.97
	ADF-GLS	-0.74	-2.65	-1.95
	Phillips-Perron	-2.97	-3.66	-2.96

*Since the ADF test can often produce contradictory results when different lag length and different deterministic components are included, we decided to follow the sequential procedure explained in Enders (1995, p.213). The procedure is briefly explained below:

1. The ADF test is done, including trend and intercept and as many lags as needed to clean up the residuals from serial correlation. If the null hypothesis can be rejected, one can say that there is evidence in support of the alternative hypothesis, i.e. that the series is stationary. Otherwise, proceed to Step 2.
2. The statistical significance of the trend is tested. If the trend is statistically significant, the series can be claimed to be nonstationary. If the trend is statistically insignificant, exclude it from the specification. If in this specification the test rejects the null hypothesis, the series is stationary. Otherwise, proceed to Step 3.
3. Test the statistical significance of the intercept. If the intercept is statistically significant, the series is nonstationary. If the intercept is statistically insignificant, exclude it from the specification. If in this specification the test rejects the null hypothesis, the series is stationary; otherwise, the series is nonstationary.

The table displays the outcomes of the finally chosen ADF test specifications (the specifications on which we make the final decision for the presence of a unit root in the series). The deterministic components (trend and intercept), as well as the number of lags, is given in the brackets. The same specification is employed in both the ADF-GLS and the Phillips-Perron test.

Table 2 Cointegration tests

The table displays the number of cointegration vectors for each of the models (1 to 9), for different options (2, 3 or 4) and for the both tests (λ_{trace} and λ_{max}).

The critical values are from MacKinnon-Haug-Michelis (1999) at 5% significance level.

Tests for models 11-16 are not shown in the table due to the fact that the existence of cointegrating relationship for these models was not examined.

	Test	Option 2	Option 3	Option 4
Model 1	λ_{trace}	1	1	1
	λ_{max}	1	1	1
Model 2	λ_{trace}	1	1	2
	λ_{max}	1	1	2
Model 3	λ_{trace}	1	0	1
	λ_{max}	0	0	0
Model 4	λ_{trace}	1	1	2
	λ_{max}	0	0	1
Model 5	λ_{trace}	2	1	1
	λ_{max}	2	1	2
Model 6	λ_{trace}	4	3	2
	λ_{max}	1	1	1
Model 7	λ_{trace}	4	1	2
	λ_{max}	1	1	2
Model 8	λ_{trace}	4	3	3
	λ_{max}	1	1	1
Model 9	λ_{trace}	4	1	2
	λ_{max}	1	1	2

Table 3 - The road to a satisfactory specification

	1	2	3	4	5
<i>Long run</i>					
Income	-0.165759 [1.03085]	-0.171023 [0.52885]	-0.537583 [1.66305]	-0.153401 [0.34929]	0.853398 [-2.86763]
Rents	0.293331 [-1.36741]	-0.07571 [0.19423]	2.21186 [-6.47171]	3.901193 [-7.90112]	0.150316 [-0.57032]
Interest		0.009216 [-0.51929]	-0.037261 [3.15664]	-0.144575 [6.82669]	-0.024166 [2.06703]
Stock exchange index			0.124142 [-2.19642]		
Immigrants				-2.862262 [5.79124]	
Construction costs					-4.367613 [3.15247]
<i>Short run</i>					
ECM	-0.245 [-3.51305]	-0.330 [-4.93683]	-0.154 [-2.41022]	0.059 [1.64507]	-0.256 [-3.54985]

Dependent variable in all regression - price. All variables, apart from the interest rate, are expressed in logarithmic terms. The table displays the coefficients from the long-run relationships, as well as the coefficients of the corresponding error correction mechanisms. The value of the t-statistics is in parentheses. The intercept is not shown in the table due to space limitations. The implausible coefficients are shown in **bold**.

The starting model, i.e. Model 1, explains the price as a function of *income* and *rents*. Although there is cointegration relationship (indicator that houses price is around the equilibrium one), the estimation results are not satisfactory, because according to this model, the income negatively affects the price. Thus, we abandon this model specification. In Model 2, we add the *interest*, but we abandon Model 2 as well, because the variables appear to have incorrect signs. Including the stock exchange index in Model 2 takes us to Model 3, but it again leads us to implausible results (coefficient in front of the *income* variable is still negative). Model 4 does not meet our expectations too (in this particular model instead of the *stock exchange index*, we include the *immigrants* in the capital city, but the coefficient in front of this variable, as well as the coefficient in front of the income variable is negative and counterintuitive). In addition, the coefficient in front of the ECM becomes positive. In Model 5 we introduce a supply side variable-*construction costs*. The costs appears to have a negative sign which is not in accordance with the theory, so we abandon this model specification, too.

Table 4 - Testing for some other hypotheses and attempts to improve the specification

	10	11	12	13	14	15	16
<i>Long run</i>							
Income	-0.544194 [1.59715]	0.541946 [-1.66491]	0.618446 [-2.12472]	1.791924 [-5.65113]	1.504055 [-6.76274]	1.344114 [-15.4263]	0.19503 [-1.18544]
Rents	2.144915 [-6.65426]	0.075745 [-0.27801]	1.416895 [-5.14577]	0.276056 [-0.86742]	-0.373864 [1.52457]	0.380966 [-5.62510]	0.98569 [-7.69531]
Interest	-0.093683 [5.41959]	0.005277 [-0.41448]	-0.034665 [3.91635]	-0.014819 [1.07432]	0.00971 [-0.93699]	-0.024977 [8.98052]	
Construction		-0.450282 [1.61027]	-0.582676 [3.49163]	-1.709508 [5.53775]	-1.280315 [8.27310]	-0.710509 [15.2361]	-1.171116 [13.2568]
Accomplished residential dwellings	-0.19227 [1.62217]						
Construction costs						-2.071496 [5.94364]	
Loans							0.262823 [-13.1799]
Stock exchange index			0.022401 [-0.50467]				
Immigrants				2.584511 [-8.52245]			
<i>Short run</i>							
ECM	-0.083093 [-1.01469]	-0.21988 [-4.14958]	-0.186314 [-2.24999]	-0.000249 [-0.00455]	-0.221194 [-2.55570]	-0.408834 [-2.48760]	0.085299 [0.73203]
Dummy 2001		-0.032486 [-1.69369]					
D(Immigrants)					0.232954 [2.56863]		

Price appears as dependent variable in all of the regression specifications. All variables apart from the interest rate are expressed in logarithmic terms. The intercept is not shown in the table, to conserve space. The value of the t-statistics is in parentheses. The implausible coefficients are shown in **bold**.

With Model 10 we want to examine whether introduction of the *accomplished residential dwellings* into the model, instead of the *added value in construction industry* could possibly improve the specification. The answer is no, because of the negative coefficient in front of the *income* variable. With Model 11 we check whether the *crisis from 2001* affected the house prices, but due to the insatisfactory model specification (positive sign in front of the *interest* variable), we reject the hypothesis. Model 12 examines the relationship between house prices and the stock exchange index, i.e. it examines whether buying a house and investing in the stock market are two alternative investments (negative relationship), or the stock market affects the houses price through the wealth (positive relationship). The statistical insignificance of the stock exchange index shows that the stock exchange index actually does not affect house prices. Model 13 aims at assessing the arguments that house prices are driven by the increased number of individuals inhabiting the capital city of Skopje. Again, due to the insatisfactory specification

(too high coefficients of *income*, *construction*, and *immigrants*, on the one hand, and too low coefficient of *rents*, on the other hand) we reject this thesis. Model 14 tests whether the flow of immigrants in the capital city affects the houses price in a short-run, but we again fail to find support in favour of this argument (i.e. wrong sign of the rent and the interest). Model 15 examines whether the construction costs affect house prices, but again the model specification fails to yield a reasonable relationship (negative sign). Last, with Model 16 we examine whether estimation results are significantly different if we replace the interest rate with the *housing credits*. Due to the lower coefficient in front of the income variable, and due to the positive ECM term in this particular specification, we consider the *interest rate* to be a better variable for this effect.

APPENDIX 4 – Details on ARDL and OLS estimation

ARDL

Table 1 – Cointegration Test

Ho: No cointegration relationship

Test statistics	5% Critical value	1% Critical value	Decision
3.966	3.94	4.84	At 1% significance level we fail to reject the hypothesis. At 5% we can reject the hypothesis.

Table 2 - ARDL Estimation

(selected according to all 3 information criteria)

Dependent variable: price

Variable	Coefficient	p value
Intercept	2.215	.063
Price (-1)	0.593	.000
Income	0.031	.722
Income (-1)	0.119	.217
Rents	0.247	.123
Interest	-0.000	1.00
Interest (-1)	-0.011	.097
Construction	-0.045	.707
Construction (-1)	0.019	.867
Construction (-2)	-0.220	.040
Number of observations		26
R ²		0.943
LM test for serial correlation		0.001
RESET test for functional form		0.041
Test for normality		0.975
Test for heteroschedasticity		0.301

Table 3 – Long-Run Relationship

Dependent variable: price

Variable	Long-run coefficients	p value
INCOME	0.368	.166
RENTS	0.607	.061
INTEREST	-0.026	.050
CONSTRUCTION	-0.604	.022
INTERCEPT	5.450	.012

Table 4 – Short-Run Relationship

Dependent variable: first difference of the price

Variable	Coefficient	p value
Δ INCOME	0.031	.721
Δ RENTS	0.247	.120
Δ INTEREST	-0.000	1.00
Δ CONSTRUCTION	-0.045	.706
Δ CONSTRUCTION (-1)	0.220	.038
INTERCEPT	2.215	.060
ECM (-1)	-0.406	.005
Number of observations		26
R ²		0.670

Table 5 – Results from the OLS estimation

Dependent variable: price

Variable	Coefficient	p value
Intercept	0.815	0.000
Income	0.680	0.018
Rents	0.600	0.038
Interest	-0.028	0.018
Construction	-0.574	0.010
Number of observations		28
R ²		67
Serial correlation test		0.600
Functional form test		0.883
Test for normality		0.000
Test for heteroschedasticity		0.751