Internet Offer Prices for Flats and Their Determinants
A Cross Section of Large European Cities
Konstantin A. Kholodilin
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Konstantin A. Kholodilin*

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Abstract
In this paper, we construct a data set of Internet offer prices for flats in 48 large European cities from 24 countries. The data are collected in January – April 2012 from 33 websites, where the advertisements of flats for sale are placed. Using these data we investigate the determinants of the flat prices. Four factors are found to be relevant for the flats’ price level: income per capita, population density, unemployment rate, and Gini index. The results are robust both to excluding variables and to applying two alternative estimation techniques: OLS and quantile regression. Based on our estimation results we are able to identify the cities, where the prices are overvalued, and those, where the prices are undervalued. This is a useful information that allows analyzing and comparing the housing markets in large European cities.

Keywords: Internet ads; flats’ prices; large European cities; fundamental prices.

JEL classification: C21; R31.

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Wir sind zwar arm, aber trotzdem sexy.

Klaus Wowereit,
Mayor of Berlin

1 Introduction

The housing market is one of the most important markets, since it affects the life of virtually every person. One would expect in this connection that statistical data on flat prices abound. In fact, it is not the case. In particular, what is lacking is the information on the price level that would allow international or intercity comparisons. The official bodies (e.g., Bank for International Settlements) typically publish only the price indices expressed in percentages and not the price levels.

As a result, there are few if any studies on the determinants of the home price levels. By contrast, there are many papers dealing with the determinants of the price dynamics: Abraham and Hendershott (1996), Blackley and Follain (1991), Borowiecki (2009), Clapp and Giaccotto (1994), Ebru and Eban (2011), Egert and Mihaljek (2007), Follain and Velz (1995), Glindro et al. (2011), Hlaváček and Komárek (2009), Hort (1998), Hua and Craig (2011), Iacoviello (2002), Lee (2009), Mahalik and Mallick (2011), Ozanne and Thibodeau (1983), Özsoy and Şahin (2009), Poterba (1991), Stepanyan et al. (2010), and Sutton (2002) to name just a few. This is, of course, an important question. However, from a practical point of few, it is probably even more interesting to compare the price levels across countries or cities and to examine what makes them differ from each other.

In order to fill this gap I construct a data set of offer prices for flats in 48 large European cities. The data stem from the various Internet sites, where the flats are offered for sale. Using these data as proxy for the flats’ prices and some macroeconomic and demographical variables as regressors I investigate the determinants of the flats’ prices. In this way, I figure out the expected prices in all cities and can determine whether the actual price is above or below the expected one. When the actual price exceeds the expected price, it can be interpreted as a sign of the overvaluation in the market of flats for sale in the respective city.

The paper is structured as follows: Section 2 describes the data used in the study. In
section 3, the methodology of computing the flat rent/price indices is explained and results are discussed. Finally, section 5 concludes.

2 Flats’ price data

In order to construct the estimates of prices for flats in 48 large European cities, the advertisements offering flats for sale on different Internet sites were downloaded. The list of the corresponding sites can be found in Table 2. The choice of Internet sites, from which to download the data, was dictated by three criteria: 1) the size of the site — ideally, the site should contain the largest number of ads compared to its competitors; 2) the availability of data on both price and area (most British sites do not report information on area); 3) the possibility to download data — the websites have different designs, for some of which the downloading of data is problematic.

The codes for data downloading are written in the free software environment for statistical computing and graphics R\(^1\). The data were downloaded at monthly frequency in the period stretching from January until April 2012.

The original data contained in the Internet ads are quite noisy. Sometimes the ads of not yet constructed housing units are placed among the ads of the secondary market. This problem is particularly acute in case of real estate for sale, especially houses for sale. The detailed examination of the information contained in the ads, including the textual analysis as in Kholodilin and Mense (2011), could permit alleviating the problem. It is, however, a very time-consuming exercise and is not carried out here.

Moreover, the quality of advertised flats can vary substantially both across cities and across time. Usually, it is correlated with the welfare level, culture, and availability of the free space in each city. For example, flats in Eastern and Central Europe (CEE) are usually smaller (50-60 $m^2$ and 2 rooms), whereas in Western Europe they are much larger (70-90 $m^2$ and 3 rooms), see Table 2 and Figure 7, where the CEE cities are denoted by red color. One notable exception is Paris, where a typical flat is about 60 $m^2$ large and has 2 rooms. One can even find the ads of flats as small as 9 $m^2$, which are offered for exorbitant prices in Paris. It is difficult to imagine something like this in Berlin. The flats in cities of non-continental

\(^1\)http://www.r-project.org/, see also R Development Core Team (2009).
and Nordic countries are also relatively small. The largest flats (about 110 $m^2$ and more than 3 rooms) can be found in Lisbon and Istanbul.

I do not dispose of the most detailed information published in the ads. I record only several most important characteristics of flats, whose list differs from one Internet site to another. This has to do both with our downloading techniques and with the amount of information published online. In some countries, for example, Germany or Russia, the Internet sites contain a very detailed information on flats, explicitly classified into separate fields. In other countries, like the United Kingdom, the information is very poorly structured and is presented in a much more implicit way: It is to be found not in separate fields, but is dispersed over the informal text of announcement. The British sites most often do not even report the area of the dwellings offered for sale. One is inclined to think that the British people do not care at all about the size of the flat but rather about the number of bedrooms. Counting of the rooms is another major difference in the way the flat’s characteristics are reported. While in most continental countries, the announcements contain the total number of rooms in the flat, the Belgian, British, Greek, and Turkish sites publish only the number of bedrooms. The French people, by contrast, sometimes report the number of all the premises of a flat, which possibly include the kitchen and bathroom.

Therefore, the data processing I undertake here is rather limited. It amounts basically to two types of corrections. Firstly, I consider the price per square meter and not the total value of flat. To some extent this permits adjusting the prices for the size of flats. It should be noted, however, that even the price for $m^2$ can vary depending on the size of the flat. Sometimes the larger the flat the lower the price per $m^2$, which can be explained by the diminishing marginal utility of the flat’s size. Secondly, the outliers for three key characteristics (price, area, and number of rooms) are removed. If an observation is higher (lower) than the median by 1.5 time interquartile range, then it is treated as an outlier and dropped out of sample. These corrections are, of course, far from being perfect, but can still deliver reasonable results.

Another problem is that in some countries the offer prices include the transactions costs. For example, in France the price is expressed as $F\text{AI}$ (*frais d’agence inclus*), that is, including the realtor’s fee. The fee can vary between 5% and 10% of the dwelling’s value. To make the things more complicated, it is subject to changes depending on the economic situation.
In the middle of a speculative bubble, the realtors have a stronger bargaining power and can charge even higher fees. When the housing market is in downturn, the fees decline. In the Netherlands, almost 90% of ads are *k.k.* (*kosten koper*), i.e., they contain the transaction costs, which can achieve 7.5% of the original dwelling’s value and include property tax, realtor’ fee, and land registry payment. The rest of flats — usually the new ones — are *v.o.n.* (*vrij op naam*), that is, include the loan-related costs, which represent 3% of the flat’s value\(^2\). In most other countries, the transaction costs are not mentioned at all in the ads. I corrected the French and Dutch prices by subtracting from them the corresponding fees: 7.5% from French prices and 7.5% from Dutch *k.k.* prices and 3% from Dutch *v.o.n.* prices.

Yet another complication arises due to heterogeneous typology of flats in different countries. As Table 3 shows, in some countries, like France, Germany, Italy, or Spain, the market participants differentiate between numerous types of dwellings. Whereas in other countries the market distinguishes normally only one type of flat. In the former Soviet Union countries, by contrast, more weight is put on the type of house — in what period and of what material (concrete, bricks, etc.) it was built and to what construction series it belongs —, in which the flat is located.

Finally, in some cases the webpages still contain ads that were placed several years ago. In the cases, when the date of publishing an ad is known, the advertisements placed prior to July 2011 are removed. Thus, to a certain extent I can guarantee that my data set delivers the recent price information. In any case, the proportion of older ads is usually comparatively small. So, they cannot have a decisive effect on the average or median price.

As seen in Table 3, in most cases, the currency, in which the prices for flats are expressed, is euro. To a large extent this has to do with the fact that most cities in our sample are located in the Euro area countries. Nevertheless, some non-Euro area states (Bulgaria, Latvia, Romania, and Serbia) also quote their prices in euros. Belarus and Ukraine instead of using their local currencies, quote their housing prices in US dollars, sometimes euphemistically calling them “conditional units”. Thus, the property prices are anchored to a more stable currency than the national one. All prices in foreign currencies are converted in euros.

The Internet offer prices for flats in 48 European cities are shown in Figure 1. For each city a boxplot of the offer prices for flats is displayed. The width of boxplot is proportional to

\(^2\)The transaction costs in that case are paid by the seller.
the number of ads. The notches represent an estimated confidence interval for each median estimate. The total number of downloaded and processed ads in all 35 webpages exceeds 593,000. The biggest number of ads is available for Warsaw (more than 114,000), whilst the fewest ads are available for Oslo (805).

To the best of my knowledge, this is a unique database of prices for flats in cities. The only comparable one is the database of the Eurostat “City statistics — Urban Audit”. It contains a wide range of data on 378 cities in the 27 member states of the European Union as well as in candidate and EFTA countries. Among other variables, the database includes “Average price for an apartment per $m^2$”. This variable is available for five periods (1989-1993, 1994-1998, 1999-2002, 2003-2006, and 2007-2009), but the panel is highly unbalanced. The number of observations varies from 32 for 1989-1993 and 47 for 1994-1998 to 153 for 1999-2002, 192 for 2003-2006, and 188 for 2007-2009. My data set is, of course, much smaller. However, its two big advantages are that 1) it includes also the cities in non-member countries and 2) it is very up-to-date. The last feature is especially important, given the speed and magnitude, at which the real-estate prices change.

I extended the Eurostat apartment prices database by including the average flat price levels in 7 Russian cities and Belgrade from Federal State Statistical Service of the Russian Federation (Rosstat) and Statistical Office of the Republic of Serbia. The price levels were converted from local currencies into euros using the average annual exchange rates. Then, the averages over 2003-2006 and 2007-2009 were computed.

Figure 3 compares the price levels reported by the official sources (Eurostat, Rosstat, and Statistical Office of the Republic of Serbia) for 2003-2006 (red) and 2007-2009 (blue) to the prices we constructed using the Internet ads. For the first period, there are 31 observations that belong to both databases, while for 2007-2009 there are 25 observations. The correlation in the former case is very high (0.86), while in the latter case it is somewhat smaller (0.62) but significant. The correlation with the more recent prices is lower possibly because 2007-2009 was a period of a speculative bubble on many European housing markets. Only towards the end of that period the prices started to decline. This can clearly be seen in Figure 3: the 2012 Internet prices are higher than most of the 2003-2006 prices, but lower than most of the 2007-2009 prices. In 2010-2012, the prices in countries, where the speculative bubbles burst —especially, in Ireland and Spain, have undergone a strong downward correction, returning
to the pre-bubble levels. All in all, I can conclude that my price estimates are relatively close to those produced by the official statistics.

3 Determinants of housing prices

The literature suggests a wide range of the determinants of the flat prices. Table 1 contains a list of the determinants with corresponding signs in regressions (“+” or “–”), which are grouped in broad categories. This list is far from being exhaustive and is based on the results of 18 papers in this area, namely: Abraham and Hendershott (1996), Blackley and Follain (1991), Borowiecki (2009), Clapp and Giaccotto (1994), Egert and Mihaljek (2007), Follain and Velz (1995), Glindro et al. (2011), Hlaváček and Komárek (2009), Hort (1998), Hua and Craig (2011), Iacoviello (2002), Lee (2009), Mahalik and Mallick (2011), Ozanne and Thibodeau (1983), Özsoy and Şahin (2009), Poterba (1991), Stepanyan et al. (2010), and Sutton (2002). It shows both the total number of uses of a determinant (columns 2 through 4) and the proportion of the uses (columns 5 through 7). The most frequently used determinants are income variables (15.4%, exerting predominantly positive effect), demographic variables (13.2%, exerting predominantly positive effect), and interest rates (13.2%, exerting exclusively negative effect). Other groups of determinants ordered according to the frequency of their use include: 1) Credit (6.6%) and Housing supply (6.6%), 2) Labor market (6.6%), 3) Land supply (6.6%), 4) Overall prices (4.4%), and 5) Institutions (4.4%). In addition, equity prices and construction cost are frequently used in the home price regressions.

Guided by the literature and common sense I examine the following determinants of flat prices:

- Per-capita income is a measure of welfare of a particular city and thus a good indicator of the demand for housing. It is expected that the income has a positive effect upon the price level. As a proxy for the income we take GDP per capita in the city. In cases, where such information is not available for the city, per-capita GDP for region, to which the city belongs, is taken.

- The housing is a very expensive good. Therefore, in majority of the cases, its purchase by households implies borrowing money. Hence, the variables of the credit market are
of utmost importance to explain the variations in housing prices. Often, the interest rates are cited in the literature as such an indicator. Indeed, the long-term interest rate on housing loans represents the cost of borrowing, which is extremely relevant when acquiring a dwelling. Therefore, a negative impact of the interest rate upon property prices is expected. However, since I dispose of static price data only, it is hardly possible to observe the effect of the interest rate upon the prices for flats. In addition, the data on mortgage interest rates are too heterogeneous. They refer to different maturities and can be variable or fixed, which precludes their meaningful use in regression. Moreover, to a large extent the effect is determined by the institutional structure of the financial market and national preferences towards the risk taking. The restrictions on providing housing loans to the individuals as well as the willingness of the credit institutions to grant such loans are quite different in different countries. In addition, the risk aversion is very different across countries. In Germany, for example, the people are more risk-averse and therefore prefer to have housing loans with the interest rates fixed for a relatively long period of time, say, 10 to 20 years. Therefore, I opted for using, instead of the interest rate, an amount of mortgage loans per capita. The indicator refers to 2010 and stems from the European Mortgage Federation. This variable reflects both the demand for housing credit and the restrictions on the supply side of the credit market. It is expected to have a positive impact upon the flats’ price. A big disadvantage is that the variable is only available at the country level. However, the same problem is faced in case of the interest rate.

• Population is a measure of size of the city. It thus also should represent the demand pressure on the housing market.

• Population density is at the same time a measure of demand pressure and an indirect measure of supply shortage. When the population density is high, it may imply that the land endowment is very limited and thus the possibilities to increase the supply of housing are restrained. This should lead to higher real-estate prices.

• Unemployment rate measures a share of people who cannot afford buying dwellings and thus whose demand is excluded from the housing market. Moreover, it is an indicator of the stability of income. Higher unemployment rate signals that it is easier to loose
job but more difficult to find a new one. Therefore, a higher unemployment rate should imply lower housing prices.

- Income inequality can be an important determinant of the property prices. On the one hand, the high per-capita income alone does not guarantee that the majority of the population of a city is rich and can afford buying expensive dwellings. On the other hand, the existence of a handful of very rich people can imply that these people will be looking for investment opportunities and thus invest part of their excessive capital into the property. Hence, the sign of the income inequality measure is rather unclear. We use the Gini index as an income inequality measure.

- Homeownership rate (HOR) and flat prices can be in a reciprocal relationship. On the one hand, a low homeownership rate means that smaller number of people are eager to buy a dwelling. This can happen even if the flat prices are low. A nice example of such a situation has been the Post-World War II Germany. The HOR can be to a large extent affected by institutional factors (see, e.g., Voigtländer (2006)) and thus reflect the lack of attractiveness of possessing an own dwelling that is explained by other factors than the price. This, of course, pushes the property prices down. An opposite example is found in the Central and East European countries but also in South European countries, where the homeownership is considered to be one of the important attributes that almost everybody must strive at attaining and a kind of symbol of success. Therefore, in these countries, even despite high and growing property prices people are dreaming of their own home. It should be noticed also that in many CEE countries the high homeownership rate is explained by a free privatization of the dwellings, which was carried out in favor of the tenants who used to live in them. On the other hand, even in the homeownership-friendly countries, the high property prices can deter people from buying a dwelling. Therefore, there is a certain endogeneity problem in case of the HOR. Hence, in order to avoid the problem we take the past HOR values.

- Finally, a dummy for the Euro area (EA) is included to account for the fact that the EA countries have a common monetary policy. In addition, for each explanatory
variable an interaction term with the EA dummy is created, which is denoted by the suffix “_EA”.

The sources of data and their definitions are reported in Tables 4 through 9. It should be admitted that the data are quite heterogeneous, since the reporting periods and definitions are different.

In many cases, the GDP and unemployment rate data refer to 2008 or even earlier periods. I extrapolated the GDP data and unemployment rates up to 2010. In some cases, the growth rates of these variables at the national level were used for extrapolation. In other cases, I utilized the growth rates of the variables at the higher regional level. For example, for Paris the growth rate of per-capita GDP in Île-de-France, whereas for Rome that in Lazio was used. For Russia and Spain the regional GDP data are available up to 2010, while for Germany and Ukraine they are available up to 2009. For Germany, Russia, and Ukraine the unemployment rate data are now available up to 2010.

The data heterogeneity is especially pronounced in the case of such constructed variables, as Gini index and homeownership rate. For instance, for Russia no HOR in its usual meaning—as proportion of people living in own dwellings—is available. It is approximated by the proportion of the area of the dwellings belonging to the private persons in the total area of housing, see Table 9. Given that the property owners are on average richer than the tenants, this indicator can overestimate the actual homeownership rate. Moreover, several dwellings can belong to a single owner. On the other hand, it would be reasonable to assume that the Belorussian and Russian HOR proxies are household based. I am inclined to think so because a dwelling is typically equivalent to a household, especially in the former Soviet Union republics with their housing shortage. By contrast, the Eurostat HOR measure is person- and not household-based one. Provided that the owners of dwellings typically have larger families, the share of persons living in own dwellings will be higher than the similar indicator for households. Hence, the Eurostat measure is higher than the household-based HOR. This at least in part compensates for the upward bias of the Belorussian and Russian HOR proxies.
4 Estimation results

The relationship between the flats’ prices and their potential determinants is estimated using a simple ordinary least squares (OLS) regression. In addition, for the sake of robustness check the model is estimated using the quantile regression for median quantile, $\tau = 0.5$, see Koenker and Hallock (2001). A big advantage of the quantile regression is that it is not sensitive to the outliers, unlike the ordinary least squares.

Two versions of each model are presented: a large and a small one. The large models include all the potential determinants mentioned above. The small model is specified using the automatic econometric model selection program PcGets\textsuperscript{3} and keeps only those explanatory variables that turned out to be significant at least at the 5% level.

The estimation results are reported in Table 10. It contains the coefficient estimates, standard errors, and $p$-values of four models: large and small OLS models and large and small quantile models. According to the OLS model, four variables are relevant for determining the price level: per-capita GDP, population density, unemployment rate, Gini index, and mortgage loans per capita. Moreover, the interaction of population as well as mortgage per capita with the Euro Area dummy are significant. As expected, the per-capita GDP and mortgage loans have a positive sign. Higher population density is associated with higher flats’ prices. Higher unemployment leads to the lower prices for flats. Income inequality appears to positively affect the flats’ prices. The goodness of fit is relatively high — in the small OLS model the adjusted $R^2$ is 0.777. According to the small quantile regression, in which the standard errors and $p$-values were bootstrapped, only four variables are statistically significant, namely: density of population, unemployment rate, Gini coefficient, and the interaction terms of EA dummy variable with population is kept in the parsimonious specification of the model. The signs and magnitudes of the regression coefficients in the OLS and quantile models are similar.

Several robustness checks are conducted. Figure 5 shows the changes in parameter estimates and coefficient of determination of the small OLS model after excluding one of the cities. The dotted line and the dashed lines show the coefficient estimate and the confidence bands of the model including all the cities. The bold blue line shows the parameter

\textsuperscript{3}See Hendry and Krolzig (2001).
estimates when one of the cities is excluded. The excluded city is indicated at the horizontal axis. It can be seen that the parameter estimates remain quite stable. The $R^2$ varies between 0.75 and 0.81. Inclusion in the regression of Copenhagen and Rome leads to the largest deterioration of its explanatory power.

Figure 6 displays parameter estimates for the sequence of quantile regressions with $\tau = 0.1, 0.2, \ldots, 0.9$. The bold blue line shows the point parameter estimates, while the cyan area represents the corresponding confidence intervals. The red solid and dashed lines depict the coefficient estimate and the confidence bands of the OLS regression. Again, the parameter estimates are relatively stable and significant for all variables, except population, HOR, and interaction terms with unemployment rate and HOR.

Figure 8 and 9 compare the actual Internet prices to the fitted prices obtained in the above regressions. The latter approximate the fundamental prices that one would expect, given the values of the price determinants. The cities where the offer prices are overvalued—the actual price is higher than the fitted one—are denoted by blue color. The cities with undervalued flats are denoted by red color. When an observation is lying on the dashed 45°-degree line, the fitted price is exactly equal to the actual price. In addition, the numeric values of the fitted prices as well as absolute and percentage deviations of the fitted values from actual prices for both estimation techniques are reported in Table 11. The results of the OLS and quantile regressions produce in most cases qualitatively similar picture. It should be noticed that the fitted price can vary depending on the specification of the regression model. Therefore, it gives just a rough approximation of the possible over- or undervaluation of flats’ prices in the cities examined in this paper. More attention should be probably paid to the sign of the relative difference between actual and fitted price. Moreover, small deviations between the actual and fitted price can be purely random. Thus, the fact that a relative difference between these prices is very small may mean that the actual and fitted price are, in fact, identical.

Figure 10 shows the distribution of the relative percentage differences between the actual and fitted prices obtained by excluding one city, or one variable variable, or one city and one variable from the small OLS and quantile regressions. The total number of cities-variables combinations for each city is $2N \times (K + 1) = 766$, where $N = 48$ is the number of cities and $K = 7$ is the number of regressors without intercept. To a certain extent, this distribution
allows determining the significance of price deviations from zero. Istanbul, Sofia, Bucharest, Tallinn, Brussels, Düsseldorf, Stuttgart, and Köln are the cities, where the fitted price is in at least 95% of cases smaller than the actual price. By contrast, London, Rome, Stockholm, Vienna, Paris, München, Ekaterinburg, and St. Petersburg are the cities, where in vast majority of cases the fitted price exceeds the actual price.

The most overvalued city is London, where the actual average price for flats per $m^2$ by 45-52% exceeds the fitted one. The most undervalued cities in relative terms are Istanbul, Copenhagen, and Sofia, where the actual prices are almost 82-91% lower than the expected ones.

The flats in Paris are overvalued by 19-25% and this overvaluation is significant.

The flats in the largest and most affluent Russian city Moscow appear to be correctly priced, while those in St. Petersburg are by 4-12% larger than the prices that could be expected, given its fundamental factors.

Berlin housing seems to be correctly valued. The relative deviations between the actual and the fitted prices in both OLS and quantile regressions are close to zero. In addition, according to Figure 10, the 95% of distribution of the relative price deviations include both positive and negative values. Therefore, the recent property price increases in German capital—observed, for instance, in Kholodilin and Mense (2012)— can be considered as an overshoot that followed the adjustment from historically low values towards a fundamental price. Thus, rephrasing the famous slogan of Berlin’s mayor Wowereit, Berlin is not so poor and is sexy enough to support higher property prices.

The housing prices in Spanish cities (except Seville) are undervalued by 11-30%. The undervaluation is especially pronounced in Madrid. This definitely reflects the economic crisis through which Spain has been going in the last months.

In the Italian capital the actual prices are substantially higher than the fitted values. This overvaluation appears to be significant. In other large Italian cities included in the study, the situation is diverse. Thus, in Milano and Napoli, the prices are close to the equilibrium levels, whereas in Torino they are lower than the fitted ones.

Spanish websites contain even a special field showing the changes in the offer prices. Usually, these changes are negative, meaning that the persons who place ads reduce their prices being unable to find buyers. In January-April 2012, the price have been reduced on average by about 14 euros per $m^2$ in Madrid and 20 euros in Barcelona. This amounts to a price decline of 0.5% and 0.6%, respectively. Similar process can be observed in Lisbon, where the average price change is approximately -8 euros per $m^2$, or -0.3%.
The flats’ prices in Riga and especially in Tallinn are undervalued. As in case of Spain, it is a consequence of a deep recession that struck Baltic countries in 2008-2009. By contrast, in Vilnius they are overvalued, although this overvaluation cannot be considered significant, as Figure 10 testifies.

5 Conclusion

In this paper, I construct a data set of Internet offer prices for flats in 48 large European cities from 24 countries. For this purpose the prices as well as several most important characteristics of the flats, which are contained in the Internet ads, were downloaded from 33 webpages in January – April 2012. The data were cleant from outliers and to some minimum extent qualitatively adjusted.

Using the Internet data I investigated the determinants of the prices for flats. This was carried out using the ordinary least squares and quantile regression. The estimation results are quite similar in both cases. The income per capita, population density, and Gini index exert strong positive impact upon the flats’ prices, which is also robust. The coefficient of the unemployment rate is negative. It is significant only in the OLS regression.

Comparison of the actual prices to the fitted ones, which were obtained from the OLS and quantile regressions, allows examining the question, where the flats are overvalued and where they are undervalued. This permits to draw some interesting conclusions about the current situation in the housing market of largest European countries and make tentative conjectures about the possible future developments in these cities.

References


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Appendix
## Table 1: Home price determinants in the literature

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Number of uses of determinant</th>
<th>Share of uses of determinant, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
<td>+</td>
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<td><strong>Income</strong></td>
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<td></td>
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<td>average monthly wage</td>
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Table 4: Prices for flats — official data: sources and definitions

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Note: CSUA = City statistics — Urban Audit
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Notes: 1) CSUA = City statistics — Urban Audit. 2) VGRdL = Volkswirtschaftliche Gesamtrechnungen der Bundesländer (Regional accounts of Federal regions).

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Table 6: Population: sources of data

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Notes: 1) CSUA = City statistics — Urban Audit. 2) Ukrstat = State Statistics Committee of Ukraine.
Table 7: Unemployment rate: sources of data

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Notes: 1) CSUA = City statistics — Urban Audit. 2) IIS = Institute for Informatics and Statistics.
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Notes: 1) ILC = Income and Living Conditions database. 2) Ukrsat = State Statistics Committee of Ukraine.
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\[ R^2_{adj} \]  
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<td>923</td>
<td>-89</td>
</tr>
<tr>
<td>Roma</td>
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<td>2586</td>
<td>1978</td>
</tr>
<tr>
<td>Rostov/Don</td>
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<td>1109</td>
<td>231</td>
</tr>
<tr>
<td>S.-Peterburg</td>
<td>2193</td>
<td>1922</td>
<td>272</td>
</tr>
<tr>
<td>Samara</td>
<td>1260</td>
<td>1453</td>
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</tr>
<tr>
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<td>2110</td>
<td>1651</td>
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<td>-642</td>
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<td>1746</td>
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<td>Stuttgart</td>
<td>2338</td>
<td>3068</td>
<td>-730</td>
</tr>
<tr>
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<td>1065</td>
<td>1539</td>
<td>-474</td>
</tr>
<tr>
<td>Torino</td>
<td>2332</td>
<td>2731</td>
<td>-399</td>
</tr>
<tr>
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<td>2082</td>
<td>-211</td>
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<tr>
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<td>1299</td>
<td>932</td>
<td>367</td>
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<td>1978</td>
<td>2085</td>
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<tr>
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<td>904</td>
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</table>
Figure 1: Internet offer prices for flats in large European cities, January – April 2012
Figure 2: Geographical distribution of Internet offer prices for flats, January – April 2012
Figure 3: Eurostat prices vs. Internet-based prices measured in January – April 2012.
Figure 4: Potential determinants of the flats’ prices
Figure 5: Coefficient estimates when one city is excluded from regression.
Figure 6: Quantile regression's coefficient estimates at different quantiles

- (Intercept)
- LGDP_PC
- LDensity
- URate
- Gini
- LPop_EA
- Mortgage_PC2010
- Mortgage_EA
Figure 7: Size of flats in large European cities, January – April 2012

Average area, m²

Average number of rooms

AMS
ATH
BRU
BUD
CPH
DUS
DOB
DUB
EOS
EKA
HRK
IST
KZN
LDN
LYN
MAD
MUC
NAP
NAP
OSL
PAR
RIG
ROM
RND
SAM
SEV
SOF
STO
STU
TUR
VAL
VIE
VIL
WAW

50 60 70 80 90 100 110
2.0 2.5 3.0
Figure 8: Actual vs. fitted prices (OLS regression)

- Amsterdam
- Athens
- Barcelona
- Berlin
- Bruxelles
- Bucuresti
- Dnepropetrovsk
- Dublin
- Dusseldorf
- Graz
- Hamburg
- Istanbul
- Kazan
- Kharkov
- Kiev
- Koblenz
- Köln
- Lisboa
- London
- Lyon
- Madrid
- Marseille
- Milano
- Moskva
- Münchhen
- Napoli
- Nij. Novgorod
- Odessa
- Oslo
- Paris
- Praha
- Riga
- Roma
- Rostov/Don
- S.-Petersburg
- Samara
- Sevilla
- Sofia
- Stockholm
- Stuttgart
- Tallinn
- Torino
- Valencia
- Vilnius
- Warszawa
- Wien
Figure 9: Actual vs. fitted prices (quantile regression, $\tau = 0.5$)

- Fitted price, 1000 euros per m$^2$
- Actual price, 1000 euros per m$^2$

Cities included in the graph:
1 = Amsterdam
2 = Athina
3 = Barcelona
4 = Berlin
5 = Bruxelles
6 = Bucuresti
7 = Budapest
8 = Dnepropetrovsk
9 = Dublin
10 = Düsseldorf
11 = Dubrovnik
12 = Frankfurt am Main
13 = Hamburg
14 = Istanbul
15 = Kazan
16 = Kharkov
17 = Kiev
18 = Kievan
19 = Köln
20 = Lisboa
21 = London
22 = Lyon
23 = Madrid
24 = Marseille
25 = Milano
26 = Moskva
27 = Münster
28 = Napoli
29 = Nij. N. Novgorod
30 = Odessa
31 = Oslo
32 = Paris
33 = Praha
34 = Riga
35 = Romi
36 = Rostov/Don
37 = St.-Petersburg
38 = Samara
39 = Sevilla
40 = Sofia
41 = Stockholm
42 = Stuttgart
43 = Tallinn
44 = Torino
45 = Valencia
46 = Vilnius
47 = Warszawa
48 = Wien
Figure 10: Distribution of relative difference between actual and fitted prices for flats, given different cities-variables combinations, January – April 2012.