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Internet Offer Prices for Flats and Their Determinants

A Cross Section of Large European Cities

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Internet offer prices for flats and their determinants
A cross section of large European cities[¶]

Konstantin A. Kholodilin[*]

May 8, 2012

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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Contents

List of Tables

List of Figures

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 advertized 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 *FAI* (*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 sates (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[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

[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 45^0-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[4].

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.

[4]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.

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Appendix

Table 1: Home price determinants in the literature

Determinants	Number of uses of determinant			Share of uses of determinant, %		
	total	+	−	total	+	−
Income						
GDP per capita	2	2	0	2.2	2.2	0.0
income	3	2	1	3.3	2.2	1.1
income per capita	2	2	0	2.2	2.2	0.0
real GDP	4	3	1	4.4	3.3	1.1
GNP growth	0	1	0	0.0	1.1	0.0
economic activity	1	0	1	1.1	0.0	1.1
real wage	1	1	0	1.1	1.1	0.0
average monthly wage	1	1	0	1.1	1.1	0.0
Total Income	14	12	3	15.4	13.2	3.3
Interest rate						
real interest rate	7	0	7	7.7	0.0	7.7
mortgage rate	3	1	2	3.3	1.1	2.2
real mortgage rate	1	0	1	1.1	0.0	1.1
discount rate	1	0	1	1.1	0.0	1.1
Total Interest rate	12	1	11	13.2	1.1	12.1
Demography						
population	4	3	1	4.4	3.3	1.1
proportion of the population ≤ 15	1	1	0	1.1	1.1	0.0
net migration	1	1	0	1.1	1.1	0.0
marriage rate	1	1	0	1.1	1.1	0.0
divorces	1	1	0	1.1	1.1	0.0
number of households	1	0	1	1.1	0.0	1.1
proportion of non-elderly singles	1	1	0	1.1	1.1	0.0
number of black or hispanic	1	1	0	1.1	1.1	0.0
demographic demand	1	1	0	1.1	1.1	0.0
Total Demography	12	10	2	13.2	11.0	2.2
Credit						
domestic credit	2	2	0	2.2	2.2	0.0
housing credit	1	1	0	1.1	1.1	0.0
trend of mortgage/GDP ratio	1	0	1	1.1	0.0	1.1
loans	1	0	1	1.1	0.0	1.1
real non-food credit	1	0	1	1.1	0.0	1.1
Total Credit	6	3	3	6.6	3.3	3.3
Labor market						
unemployment	4	0	4	4.4	0.0	4.4
employment	1	1	0	1.1	1.1	0.0
vacancies/labour force	1	1	0	1.1	1.1	0.0
Total Labor market	6	2	4	6.6	2.2	4.4
Land supply						
land supply index	1	1	0	1.1	1.1	0.0
land supply	1	0	1	1.1	0.0	1.1
land prices	1	1	0	1.1	1.1	0.0
agricultural land prices	3	3	0	3.3	3.3	0.0
Total Land supply	6	5	1	6.6	5.5	1.1
Housing supply						
completed apartments	1	1	0	1.1	1.1	0.0
number of apartments per 1000 inhabitants	1	1	0	1.1	1.1	0.0
supply of dwellings	1	0	1	1.1	0.0	1.1
log of the number of dwellings per person	1	1	0	1.1	1.1	0.0
improvements in quality of new constructed or modified dwellings	1	1	0	1.1	1.1	0.0
number of home sales	1	0	1	1.1	0.0	1.1
Total Housing supply	6	4	2	6.6	4.4	2.2
Overall prices						
inflation	1	1	0	1.1	1.1	0.0
expected inflation	1	0	1	1.1	0.0	1.1
unexpected inflation	1	1	0	1.1	1.1	0.0
non-housing price	1	0	1	1.1	0.0	1.1
Total Overall prices	4	2	2	4.4	2.2	2.2
Institutions						
development of housing markets and housing financial institutions	1	1	0	1.1	1.1	0.0
institutional factor	1	1	0	1.1	1.1	0.0
municipalities / 100,000 households	2	0	2	2.2	0.0	2.2
Total Institutions	4	2	2	4.4	2.2	2.2
Miscellanea						
construction cost	6	6	0	6.6	6.6	0.0
real construction cost	2	2	0	2.2	2.2	0.0
real effective exchange rate	1	1	0	1.1	1.1	0.0
equity price	5	3	2	5.5	3.3	2.2
rent per month	1	1	0	1.1	1.1	0.0
composite index of taxes, wages, and utilities	1	1	0	1.1	1.1	0.0
turnover rate	1	0	1	1.1	0.0	1.1
risk premium	1	1	0	1.1	1.1	0.0
remittances	1	1	0	1.1	1.1	0.0
foreign inflows	1	1	0	1.1	1.1	0.0
FDI-to-GDP ratio	1	1	0	1.1	1.1	0.0
GRAND TOTAL	91	59	33	100.0	64.8	36.3

Table 2: Sources of flats' price data

City original language	City English	City short	Country	Website	Number of ads	Price, euros per m^2		Total area, m^2		Number of rooms	
						median	average	median	average	median	average
Amsterdam	Amsterdam	AMS	Netherlands	funda.nl	7308	3395.3	3405.1	72.0	75.9	3.0	2.8
Athina	Athens	ATH	Greece	spiti24.gr	9865	2075.3	2106.1	76.0	77.1	3.0	2.9
Barcelona	Barcelona	BCN	Spain	pisos.com	4448	3231.5	3356.6	77.0	80.8	3.0	2.8
Berlin	Berlin	BER	Germany	immobilienscout24.de	11202	2142.2	2295.9	75.0	82.5	2.5	2.6
Bruxelles	Brussels	BRU	Belgium	immoweb.be	4505	2343.8	2413.8	88.0	90.9	3.0	2.7
Bucuresti	Bucharest	BUH	Romania	imopedia.ro	11272	1019.2	1049.8	60.0	61.8	2.0	2.4
Budapest	Budapest	BUD	Hungary	maganingatlan.hu	1236	896.7	936.9	54.0	56.3	2.0	2.2
Dnepropetrovsk	Dnepropetrovsk	DNK	Ukraine	est.ua/dp	2113	725.3	784.9	56.0	58.2	2.0	2.3
Dublin	Dublin	DUB	Ireland	myhome.ie	499	3026.7	3134.3	65.0	64.3	3.0	2.7
Düsseldorf	Dusseldorf	DUS	Germany	immobilienscout24.de	1337	1956.8	2168.6	74.0	79.4	3.0	2.6
Ekaterinburg	Yekaterinburg	EKA	Russia	upn.ru	7473	1611.5	1629.5	49.0	53.8	2.0	2.2
Frankfurt am Main	Frankfurt	FRF	Germany	immobilienscout24.de	1652	2910.9	2953.3	84.0	91.0	3.0	3.0
Hamburg	Hamburg	HAM	Germany	immobilienscout24.de	1876	3072.6	3199.5	84.4	89.4	3.0	3.0
Istanbul	Istanbul	IST	Turkey	emlak.net	37866	486.6	517.2	100.0	110.0	3.0	3.4
Kazan	Kazan	KZN	Russia	kazan.mlsn.ru	5194	1268.1	1276.9	53.4	57.4	2.0	1.9
Kharkov	Kharkov	HRK	Ukraine	gorod.kharkov.com	6071	641.0	646.8	52.0	55.0	2.0	2.1
Kiev	Kiev	KIV	Ukraine	address.ua	53136	1331.7	1453.3	61.0	65.9	2.0	2.2
København	Copenhagen	CPH	Denmark	dba.dk	3541	2874.0	3039.0	74.0	78.0	3.0	2.6
Köln	Cologne	CGN	Germany	immobilienscout24.de	2130	1905.3	2081.8	75.0	75.6	3.0	2.7
Lisboa	Lisbon	LIS	Portugal	casa.trovit.pt	11261	2292.7	2392.3	100.0	109.6	3.0	3.4
London	London	LDN	UK	foxtons.co.uk	3944	6677.6	7362.7	63.0	64.8	3.0	2.8
Lyon	Lyon	LYN	France	seloger.fr	4267	3106.3	3185.2	74.0	77.2	2.0	2.2
Madrid	Madrid	MAD	Spain	pisos.com	13363	2787.5	2987.4	75.0	82.6	3.0	2.5
Marseille	Marseille	MRS	France	seloger.fr	8244	2507.4	2575.4	65.0	66.6	2.0	2.1
Milano	Milan	MLN	Italy	casa.it	17043	3518.5	3829.4	80.0	83.8	2.0	2.5
Moskva	Moscow	MSK	Russia	egsnk.ru	16161	3966.8	4145.1	55.0	60.4	2.0	2.1
München	Munich	MUC	Germany	immobilienscout24.de	3497	4067.5	4213.9	80.0	82.3	3.0	2.7
Napoli	Naples	NAP	Italy	casa.it	3117	3550.0	3721.2	90.0	90.7	3.0	3.2
Nij. Novgorod	Nizhniy Novgorod	NNG	Russia	gipernn.ru	5871	1262.8	1283.6	48.0	51.5	2.0	2.1
Odessa	Odessa	ODS	Ukraine	alians.com.ua	6761	922.7	972.6	64.0	68.1	2.0	2.2
Oslo	Oslo	OSL	Norway	finn.no/eiendom	805	5187.6	5186.8	64.0	64.0	3.0	2.7
Paris	Paris	PAR	France	seloger.fr	16989	8586.8	8864.1	55.0	61.6	2.0	1.9
Praha	Prague	PRG	Czech Republic	bytyvpraze.cz	7763	1953.4	2026.3	66.0	67.3	2.0	2.4
Riga	Riga	RIG	Latvia	ss.lv	11871	700.0	839.8	56.0	59.6	2.0	2.3
Roma	Rome	ROM	Italy	casa.it	20593	4375.0	4556.9	90.0	91.7	3.0	3.2
Rostov/Don	Rostov-on-Don	RND	Russia	rostov.life-realty.ru	67835	1312.0	1325.2	50.0	52.0	2.0	1.9
S.-Peterburg	St. Petersburg	SPB	Russia	restate.ru	12336	2165.0	2170.1	50.0	57.3	2.0	2.0
Samara	Samara	SAM	Russia	dom63.ru	9690	1233.8	1245.1	50.0	52.6	2.0	2.0
Sevilla	Seville	SEV	Spain	pisos.com	1383	1942.9	2123.8	85.0	87.9	3.0	2.7
Sofia	Sofia	SOF	Bulgaria	imoti.net	8822	750.0	773.0	80.0	83.9	2.0	2.4
Stockholm	Stockholm	STO	Sweden	bovision.se	4305	5245.9	5122.4	63.0	64.9	2.0	2.5
Stuttgart	Stuttgart	STU	Germany	immobilienscout24.de	1655	2187.5	2333.2	74.0	80.0	3.0	3.0
Tallinn	Tallinn	TAL	Estonia	ekspresskinnisvara.ee	5649	1065.2	1067.7	54.0	54.9	2.0	2.3
Torino	Turin	TUR	Italy	casa.it	6075	2225.0	2318.0	75.0	81.3	3.0	3.1
Valencia	Valencia	VAL	Spain	pisos.com	12127	1773.3	1883.1	93.0	96.5	3.0	2.8
Vilnius	Vilnius	VIL	Lithuania	reals.lt	2597	1262.0	1311.6	59.0	59.7	2.0	2.3
Warszawa	Warsaw	WAW	Poland	oferty.net	114189	1938.8	1982.7	54.0	56.7	2.0	2.4
Wien	Vienna	VIE	Austria	immobilien.net	7871	3636.4	3715.5	90.0	95.6	3.0	3.0

Table 3: Definitions of flat in different countries and websites

Country	Site	Type	Currency
Austria	immobilien.net	Eigentumswohnung	euro
Belgium	immoweb.be	appartement, duplex, flat/studio, loft/entrepôt, penthouse, rez-de-chaussée, triplex	euro
Bulgaria	imoti.net	апартамент/apartament	euro (> 99% of ads), lev, and US dollar
Czech Republic	bytyvpraze.cz	byt	Czech crown
Denmark	dba.dk	ejerbolig	Danish crown
Estonia	ekspresskinnisvara.ee	korter	euro
France	seloger.fr	appartement, duplex, loft, studette, studio, triplex	euro
Germany	immobilienscout24.de	Dachgeschoss, Loft, Maisonette, Penthouse, Terrassenwohnung, Souterrain, Erdgeschoß, Etagenwohnung, Hochparterre, Sonstige	euro
Greece	spiti24.gr	$\delta\iota\alpha\mu\epsilon\rho\iota\sigma\mu\alpha$/diamerisma	euro
Hungary	maganingatlan.hu	lakás	forint
Ireland	myhome.ie	apartment, dormer, duplex, penthouse, studio	euro
Italy	casa.it	appartamento, attico, loft, mansarda, monolocale	euro
Latvia	ss.lv	квартира/kvartira or dzivoklis	euro (> 52% of ads) and lat
Lithuania	reals.lt	butas	Lithuanian litas
Netherlands	funda.nl	appartement	euro
Norway	finn.no/eiendom	bolig	Norwegian crown
Poland	oferty.net	mieszkanie	zloty
Romania	imopedia.ro	apartament, garsoniera	euro
Russia	upn.ru	квартира/kvartira	Russian ruble
Russia	kazan.mlsn.ru	квартира/kvartira	Russian ruble
Russia	egsnk.ru	квартира/kvartira	Russian ruble
Russia	gipernn.ru	квартира/kvartira	Russian ruble
Russia	rostov.life-realty.ru	гостинка/gostinka, квартира/kvartira	Russian ruble
Russia	restate.ru	квартира/kvartira	Russian ruble
Russia	dom63.ru	квартира/kvartira	Russian ruble
Spain	pisos.com	ático, apartamento, dúplex, estudio, loft, piso	euro
Sweden	bovision.se	bostadsraetter	Swedish crown
UK	foxtons.co.uk	apartment, flat, maisonette	British pound
Ukraine	est.ua/dp	квартира/kvartira	US dollar
Ukraine	gorod.kharkov.com	квартира/kvartira	US dollar (denoted as conditional units)
Ukraine	address.ua	квартира/kvartira	US dollar
Ukraine	alians.com.ua	квартира/kvartira	US dollar
Turkey	emlak.net	daire	Turkish lira (> 99% of ads), US dollar, and euro

Table 4: Prices for flats — official data: sources and definitions

Country	Administrative level	Year	Source	Database / Publication	Definition
Austria	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Belgium	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Bulgaria	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Czech Rep.	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Denmark	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Estonia	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
France	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Germany	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Greece	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Hungary	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Ireland	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Italy	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Latvia	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Lithuania	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Netherlands	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Norway	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Poland	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Romania	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Russia	Moscow, St. Petersburg, oblasts, and autonomous republic Tatarstan	2003-2009	Rosstat	Russian regions database	Average price for a dwelling per m^2 in secondary market
Spain	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Sweden	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Turkey	—	—	—	—	—
UK	city	2003-2009	Eurostat	CSUA	Average price for an apartment per m^2
Ukraine	—	—	—	—	—

Note: CSUA = City statistics — Urban Audit

Table 5: GDP per capita: sources of data

Country	Administrative level	Year	Source	Database / Publication	Currency
Austria	NUTS3	2008	Eurostat	Regional statistics	euros
Belgium	NUTS3	2010	BNB	BNB (2012)	euros
Bulgaria	NUTS3	2008	Eurostat	Regional statistics	euros
Czech Rep.	NUTS3	2008	Eurostat	Regional statistics	euros
Denmark	NUTS3	2008	Eurostat	Regional statistics	euros
Estonia	NUTS3	2008	Eurostat	Regional statistics	euros
France	NUTS3	2008	Eurostat	Regional statistics	euros
Germany	NUTS3	2009	Destatis	VGRdL	euros
Greece	NUTS3	2008	Eurostat	Regional statistics	euros
Hungary	NUTS3	2008	Eurostat	Regional statistics	euros
Ireland	NUTS3	2008	Eurostat	Regional statistics	euros
Italy	NUTS3	2008	Eurostat	Regional statistics	euros
Latvia	NUTS3	2008	Eurostat	Regional statistics	euros
Lithuania	NUTS3	2008	Eurostat	Regional statistics	euros
Netherlands	NUTS3	2008	Eurostat	Regional statistics	euros
Norway	NUTS3	2007	Statistics Norway		Norwegian crowns
Poland	NUTS3	2009	Statistical Office in Warsaw		zlotys
Romania	NUTS3	2008	Eurostat	Regional statistics	euros
Russia	Moscow, St. Petersburg, oblasts, and autonomous republic Tatarstan	2009	Rosstat	Russian regions database	Russian rubles
Spain	NUTS3	2008	Eurostat	Regional statistics	euros
Sweden	NUTS3	2008	Eurostat	Regional statistics	euros
Turkey	NUTS3	2008	Turkstat		Turkish liras
UK	NUTS3	2008	Eurostat	Regional statistics	euros
Ukraine	Kiev and oblasts	2009	Ukrstat	Ukrstat (2011a)	hryvnas

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

Table 6: Population: sources of data

Country	Administrative level	Year	Source	Database / Publication
Austria	city	2003-2006	Eurostat	CSUA
Belgium	city	2003-2006	Eurostat	CSUA
Bulgaria	city	2003-2006	Eurostat	CSUA
Czech Rep.	city	2003-2006	Eurostat	CSUA
Denmark	city	2003-2006	Eurostat	CSUA
Estonia	city	2003-2006	Eurostat	CSUA
France	city	2003-2006	Eurostat	CSUA
Germany	city	2003-2006	Eurostat	CSUA
Greece	city	2003-2006	Eurostat	CSUA
Hungary	city	2003-2006	Eurostat	CSUA
Italy	city	2003-2006	Eurostat	CSUA
Ireland	city	2003-2006	Eurostat	CSUA
Latvia	city	2003-2006	Eurostat	CSUA
Lithuania	city	2003-2006	Eurostat	CSUA
Netherlands	city	2003-2006	Eurostat	CSUA
Norway	city	2003-2006	Eurostat	CSUA
Poland	city	2003-2006	Eurostat	CSUA
Romania	city	2003-2006	Eurostat	CSUA
Russia	city	2009	Rosstat	Russian cities database
Spain	city	2003-2006	Eurostat	CSUA
Sweden	city	2003-2006	Eurostat	CSUA
Turkey	city	2007-2011	Turkstat	Turkey's Statistical Yearbook 2010
UK	city	2003-2006	Eurostat	CSUA
Ukraine	city	2010	Ukrstat	Ukrstat (2011b)

Notes: 1) CSUA = City statistics — Urban Audit. 2) Ukrstat = State Satistics Committee of Ukraine.

Table 7: Unemployment rate: sources of data

Country	Administrative level	Year	Source	Database / Publication
Austria	city	2003-2006	Eurostat	City statistics - Urban Audit
Belgium	city	2003-2006	Eurostat	CSUA
Bulgaria	city	2007-2009	Eurostat	CSUA
Czech Rep.	city	2003-2006	Eurostat	CSUA
Denmark	city	2003-2006	Eurostat	CSUA
Estonia	city	2007-2009	Eurostat	CSUA
France	city	2003-2006	Eurostat	CSUA
Germany	city	2007-2009	Eurostat	CSUA
Greece	city	2003-2006	Eurostat	CSUA
Hungary	city	2003-2006	Eurostat	CSUA
Ireland	city	2003-2006	Eurostat	CSUA
Italy	city	2003-2006	Eurostat	CSUA
Latvia	city	2003-2006	Eurostat	CSUA
Lithuania	city	2007-2009	Eurostat	CSUA
Netherlands	city	2007-2009	Eurostat	CSUA
Norway	city	2007-2009	Eurostat	CSUA
Poland	city	2010	Statistical Office in Warsaw	SOW (2011)
Romania	city	2003-2006	Eurostat	City statistics - Urban Audit
Russia	Moscow, St. Petersburg, oblasts, and autonomous republic Tatarstan	2010	Rosstat	Russian regions database
Spain	city	2007-2009	Eurostat	CSUA
Sweden	city	2007-2009	Eurostat	CSUA
Turkey	city	2010	Turkstat	Turkey's Statistical Yearbook 2010
UK	city	2007-2009	Eurostat	CSUA
Ukraine	city	2010	Main administration for statistics of the respective regions	

Notes: 1) CSUA = City statistics — Urban Audit. 2) IIS = Institute for Informatics and Statistics.

Table 8: Gini index: sources and definitions

Country	Administrative level	Year	Source	Database / Publication	Definition
Austria	whole country	2009	Eurostat	ILC	Total disposable household income
Belgium	Rgion de Bruxelles-Capitale	2008	Belgian Federal Government	Marché du travail et conditions de la vie	Fiscal data, income before taxation
Bulgaria	whole country	2009	Eurostat	ILC	Total disposable household income
Czech Rep.	whole country	2009	Eurostat	ILC	Total disposable household income
Denmark	whole country	2009	Eurostat	ILC	Total disposable household income
Estonia	whole country	2009	Eurostat	ILC	Total disposable household income
France	units urbaines	2009	INSEE	Revenus fiscaux localisés des ménages — Année 2009	
Germany	Bundeslaender	2009	Destatis		Net equivalence income of households
Greece	whole country	2009	Eurostat	ILC	Total disposable household income
Hungary	whole country	2009	Eurostat	ILC	Total disposable household income
Ireland	whole country	2009	Eurostat	ILC	Total disposable household income
Italy	regioni	2009	INS		Net family income excluding imputed rent
Latvia	whole country	2009	Eurostat	ILC	Total disposable household income
Lithuania	whole country	2009	Eurostat	ILC	Total disposable household income
Netherlands	whole country	2009	Eurostat	ILC	Total disposable household income
Norway	whole country	2009	Eurostat	ILC	Total disposable household income
Poland	Centralny region	2009	GUS	ILC	Equivalized disposable income before social transfers except old-age and survivors benefits (not clear)
Romania	whole country	2009	Eurostat	ILC	Total disposable household income
Russia	Moscow, St. Petersburg, oblasts, and autonomous republic Tatarstan	2009	Rosstat	Russian regions database	Per-capita monetary income (not clear)
Spain	comunidades autonomas	2006	INE	Encuesta de Estructura Salarial 2006	Annual salary
Sweden	whole country	2009	Eurostat	ILC	Total disposable household income
Turkey	city	2010	Turkstat		Equivalized household disposable income
UK	whole country	2009	Eurostat	ILC	Total disposable household income
Ukraine	whole country	2007	Ukrstat	Ukrstat (2010)	Money per-capita income in urban settlements

Notes: 1) ILC = Income and Living Conditions database. 2) Ukrstat = State Statistics Committee of Ukraine.

Table 9: Homeownership rate: sources and definitions

Country	Administrative level	Year	Source	Database / Publication	Definition
Austria	city	2007-2009	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Belgium	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Bulgaria	city	2007-2009	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Czech Rep.	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Denmark	city	2003-2006	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Estonia	city	2007-2009	Eurostat	CSUA	Proportion of households living in owned dwellings, %
France	city	2003-2006	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Germany	city	2007-2009	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Greece	city	2003-2006	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Hungary	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Ireland	city	2003-2006	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Italy	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Latvia	city	2007-2009	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Lithuania	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Netherlands	city	2007-2009	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Norway	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Poland	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Romania	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Russia	Moscow, St. Petersburg, oblasts, and autonomous republic Tatarstan	2009	Rosstat	Russian regions database	Proportion of area of dwellings owned by private persons, %
Spain	city	1999-2006	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Sweden	city	1999-2002	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Turkey	city	2005	Turkstat		Proportion of households living in owned dwellings, %
UK	city	2003-2006	Eurostat	CSUA	Proportion of households living in owned dwellings, %
Ukraine	city	2010	Ukrstat	based on Ukrstat (2011c)	Proportion of households living in owned dwellings, %

Note: CSUA = City statistics — Urban Audit

Table 10: Estimation results of OLS and quantile regressions

Regressor	OLS regressions						Quantile regressions					
	Coeff.	St. error	p-value	Coeff.	St. error	p-value	Coeff.	St. error	p-value	Coeff.	St. error	p-value
Intercept	1.656	1.698	0.337	1.875	0.958	0.057	3.380	4.032	0.408	2.883	1.558	0.072
LGDP_PC	0.359	0.131	0.010	0.278	0.075	0.001	0.325	0.317	0.313	0.159	0.114	0.170
LPopulation	-0.040	0.105	0.710				-0.189	0.354	0.598			
LDensity	0.221	0.157	0.170	0.224	0.080	0.008	0.259	0.403	0.525	0.225	0.118	0.064
URate	-0.041	0.016	0.014	-0.032	0.009	0.001	-0.053	0.045	0.253	-0.038	0.014	0.010
Gini	0.031	0.011	0.006	0.032	0.008	0.000	0.044	0.017	0.012	0.036	0.011	0.002
HOR	0.003	0.004	0.480				0.003	0.013	0.796			
Euro_area	-2.056	3.262	0.533				-1.949	6.238	0.757			
LGDP_EA	-0.057	0.249	0.820				-0.126	0.497	0.802			
LPop_EA	0.246	0.168	0.153	0.041	0.012	0.002	0.242	0.411	0.560	0.050	0.020	0.018
LDensity_EA	-0.006	0.196	0.976				0.001	0.445	0.998			
URate_EA	0.021	0.023	0.386				0.019	0.052	0.710			
Gini_EA	-0.010	0.024	0.679				0.012	0.038	0.756			
HOR_EA	-0.002	0.006	0.718				-0.005	0.015	0.755			
Mortgage_PC2010	0.023	0.009	0.018	0.027	0.007	0.000	0.021	0.061	0.726	0.033	0.025	0.198
Mortgage_EA	-0.019	0.015	0.195	-0.024	0.010	0.018	-0.011	0.061	0.857	-0.027	0.026	0.305
R^2_{adj}	0.741			0.777			0.766			0.697		
Breusch-Pagan test	13.260		0.582	10.834		0.146						

Table 11: Actual vs. fitted prices

City	Actual price P	OLS regression			Quantile regression, $\tau = 0.5$		
		Fitted $\widehat{P}_{OLS}$	Absolute difference $P - \widehat{P}_{OLS}$	Relative difference, % $100\frac{P-\widehat{P}_{OLS}}{P}$	Fitted $\widehat{P}_{QR}$	Absolute difference $P - \widehat{P}_{QR}$	Relative difference, % $100\frac{P-\widehat{P}_{QR}}{P}$
Amsterdam	3415	3341	74	2	3415	0	0
Athina	2109	2237	-128	-6	2272	-163	-8
Barcelona	3298	3704	-406	-12	3819	-522	-16
Berlin	2300	2293	7	0	2300	0	0
Bruxelles	2426	3527	-1102	-45	3278	-853	-35
Bucuresti	1048	1451	-403	-38	1353	-305	-29
Budapest	936	1070	-134	-14	936	0	0
Dnepropetrovsk	768	665	103	13	744	24	3
Dublin	3106	2407	699	23	2272	834	27
Düsseldorf	2186	3082	-896	-41	2799	-613	-28
Ekaterinburg	1643	1333	310	19	1464	179	11
Frankfurt am Main	2958	3305	-347	-12	2986	-28	-1
Hamburg	3148	3199	-51	-2	3148	0	0
Istanbul	524	1000	-476	-91	952	-427	-82
Kazan	1306	1375	-69	-5	1503	-196	-15
Kharkov	654	695	-41	-6	800	-146	-22
Kiev	1495	1487	8	1	1621	-126	-8
København	3105	5748	-2643	-85	5755	-2650	-85
Köln	2084	2574	-490	-23	2491	-407	-20
Lisboa	2410	1996	414	17	1937	473	20
London	7437	4076	3361	45	3565	3872	52
Lyon	3189	2954	235	7	2937	252	8
Madrid	2967	3666	-699	-24	3853	-886	-30
Marseille	2589	2311	278	11	2294	295	11
Milano	3834	3778	56	1	3794	40	1
Moskva	4187	4016	171	4	4187	0	0
München	4181	3517	663	16	3394	786	19
Napoli	3731	3293	439	12	3668	63	2
Nij. Novgorod	1308	1174	134	10	1308	0	0
Odessa	978	758	220	23	883	95	10
Oslo	5174	5186	-11	0	5174	0	0
Paris	8869	7172	1697	19	6637	2232	25
Praha	2030	1390	640	32	1229	801	39
Riga	834	923	-89	-11	834	0	0
Roma	4564	2586	1978	43	2586	1979	43
Rostov/Don	1340	1109	231	17	1282	58	4
S.-Peterburg	2193	1922	272	12	2109	84	4
Samara	1260	1453	-194	-15	1660	-400	-32
Sevilla	2110	1651	459	22	1638	472	22
Sofia	768	1410	-642	-84	1445	-677	-88
Stockholm	5163	3417	1746	34	3244	1919	37
Stuttgart	2338	3068	-730	-31	2925	-587	-25
Tallinn	1065	1539	-474	-44	1664	-599	-56
Torino	2332	2731	-399	-17	2704	-372	-16
Valencia	1871	2082	-211	-11	2116	-245	-13
Vilnius	1299	932	367	28	872	427	33
Warszawa	1978	2085	-107	-5	1935	43	2
Wien	3685	2782	904	25	2655	1030	28

Figure 1: Internet offer prices for flats in large European cities, January – April 2012

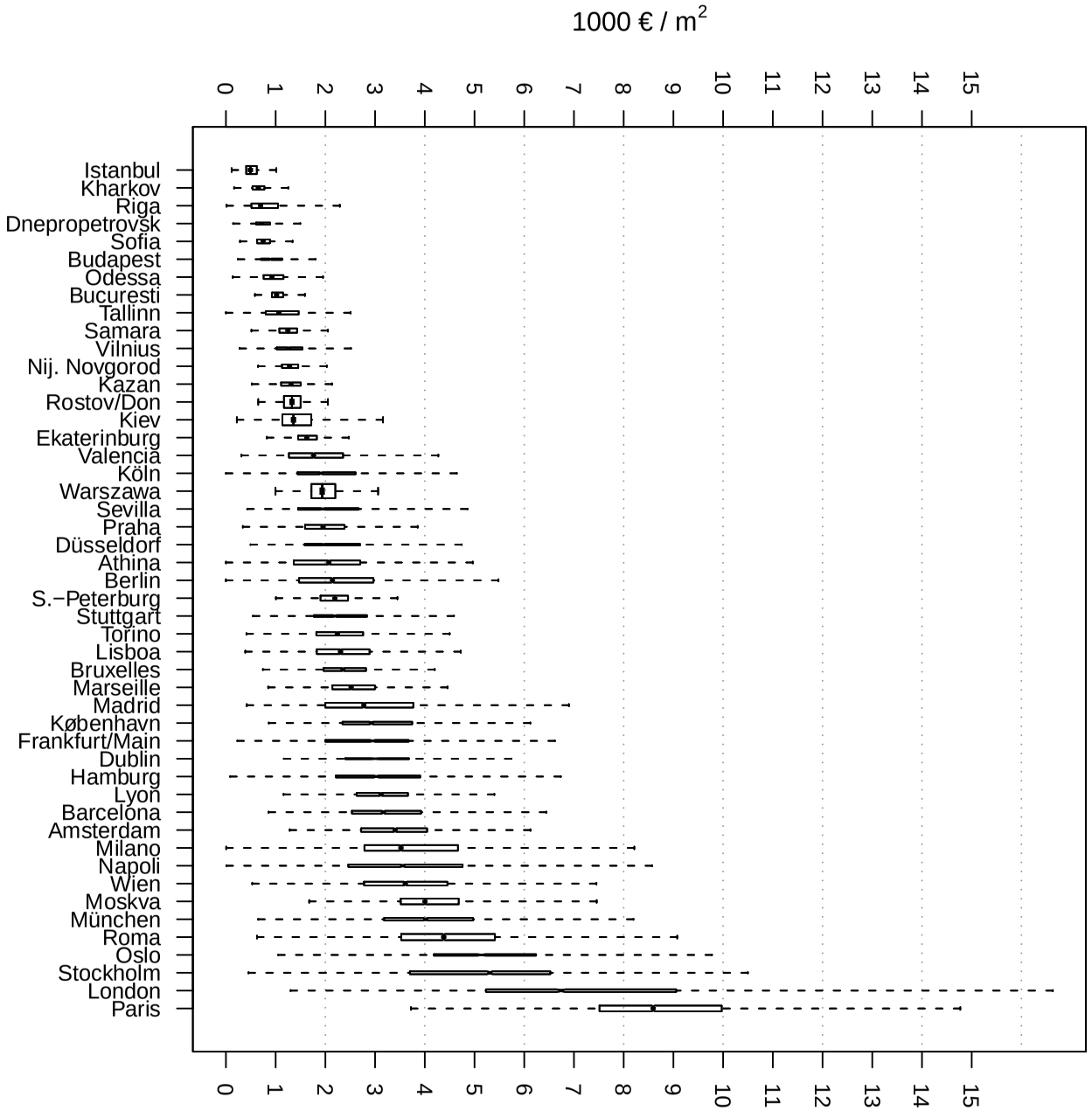
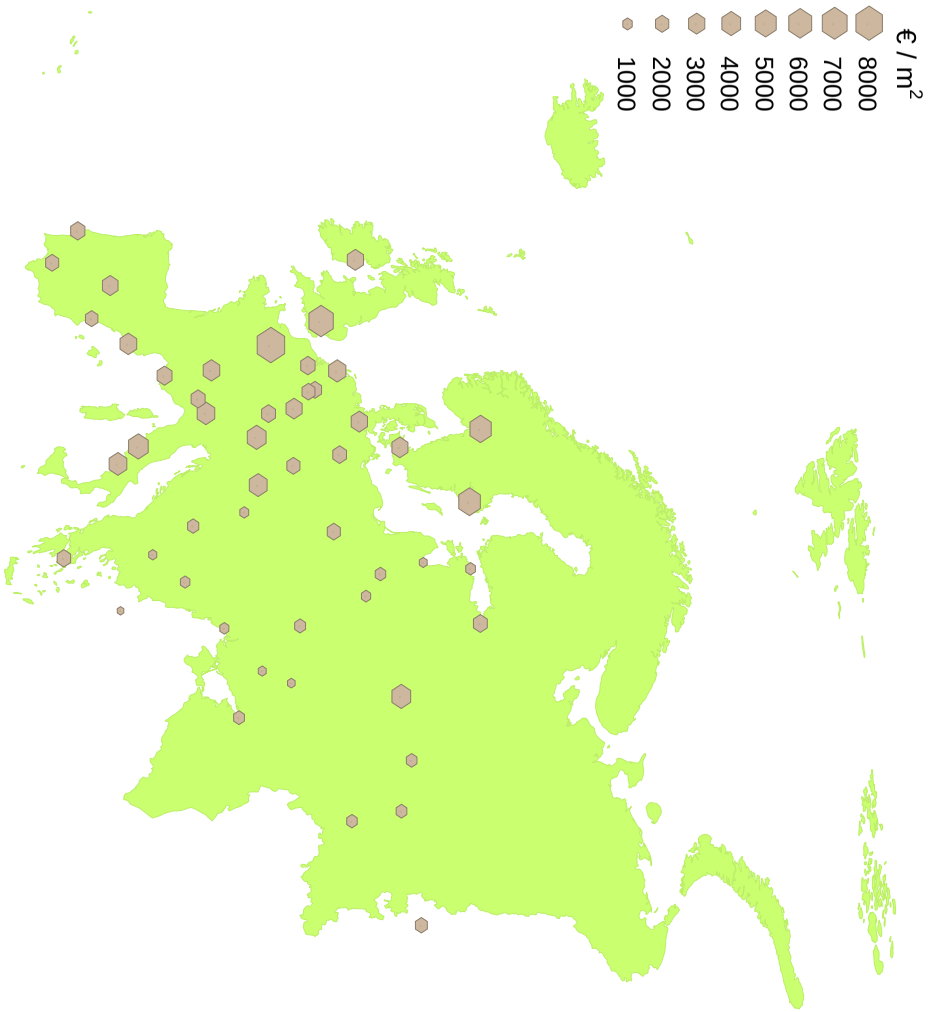


Figure 2: Geographical distribution of Internet offer prices for flats, January – April 2012



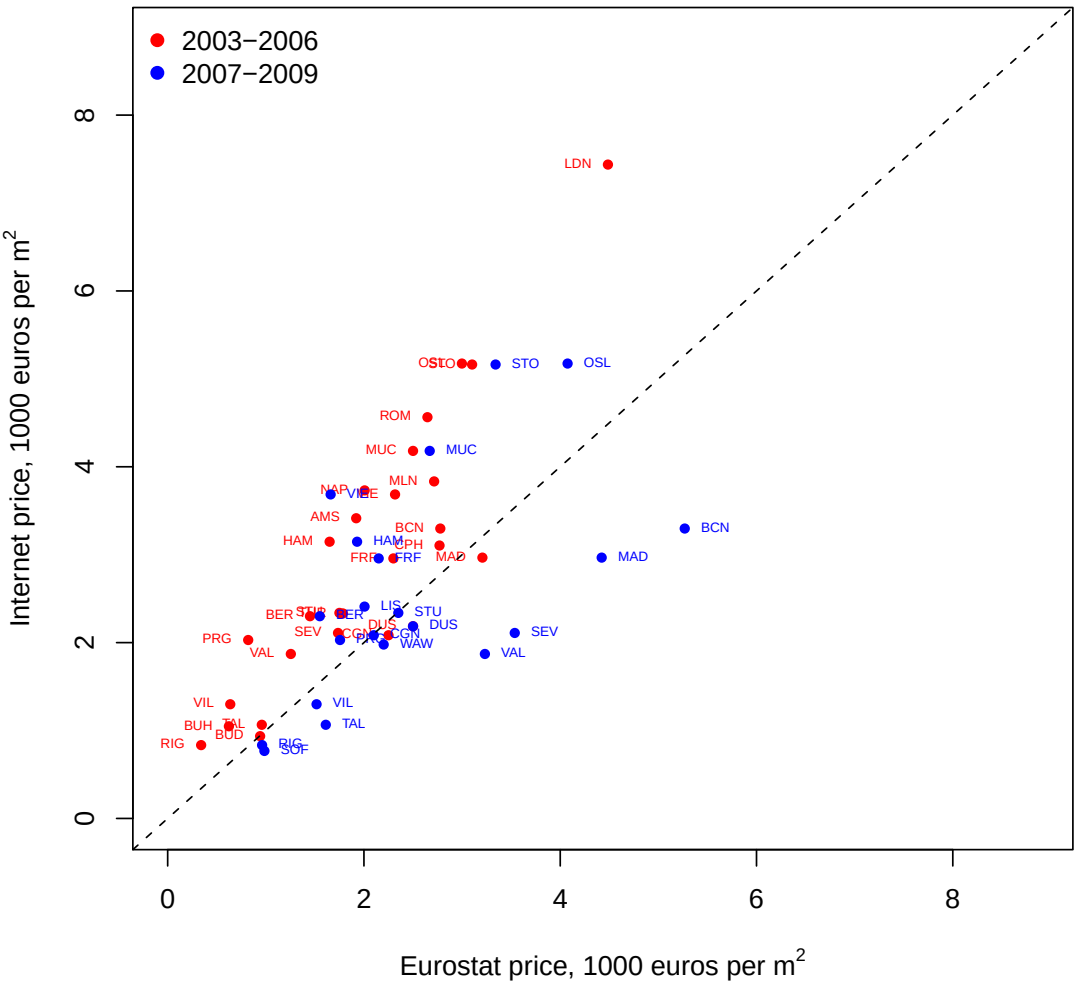


Figure 3: Eurostat prices vs. Internet-based prices measured in January – April 2012

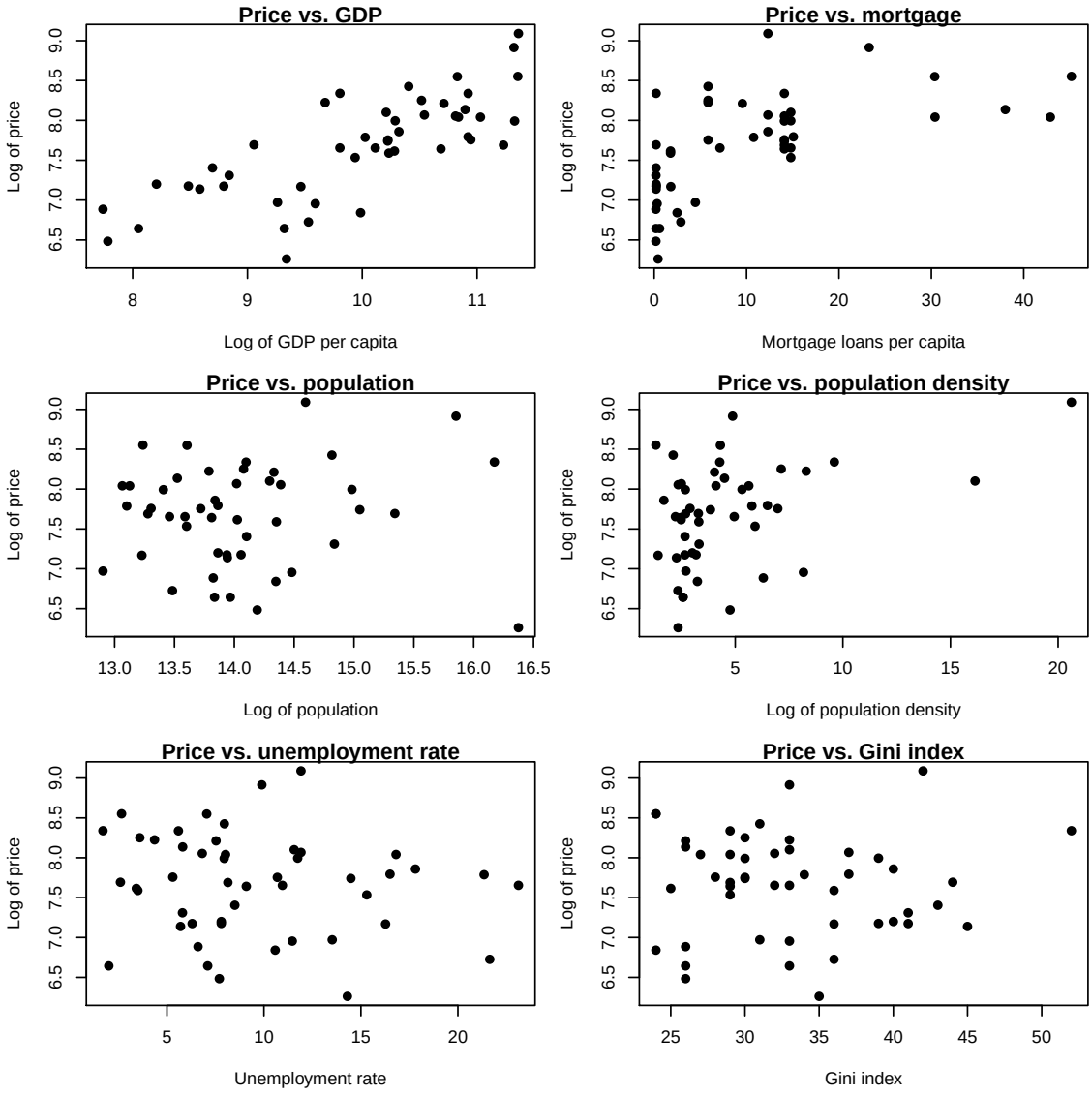


Figure 4: Potential determinants of the flats' prices

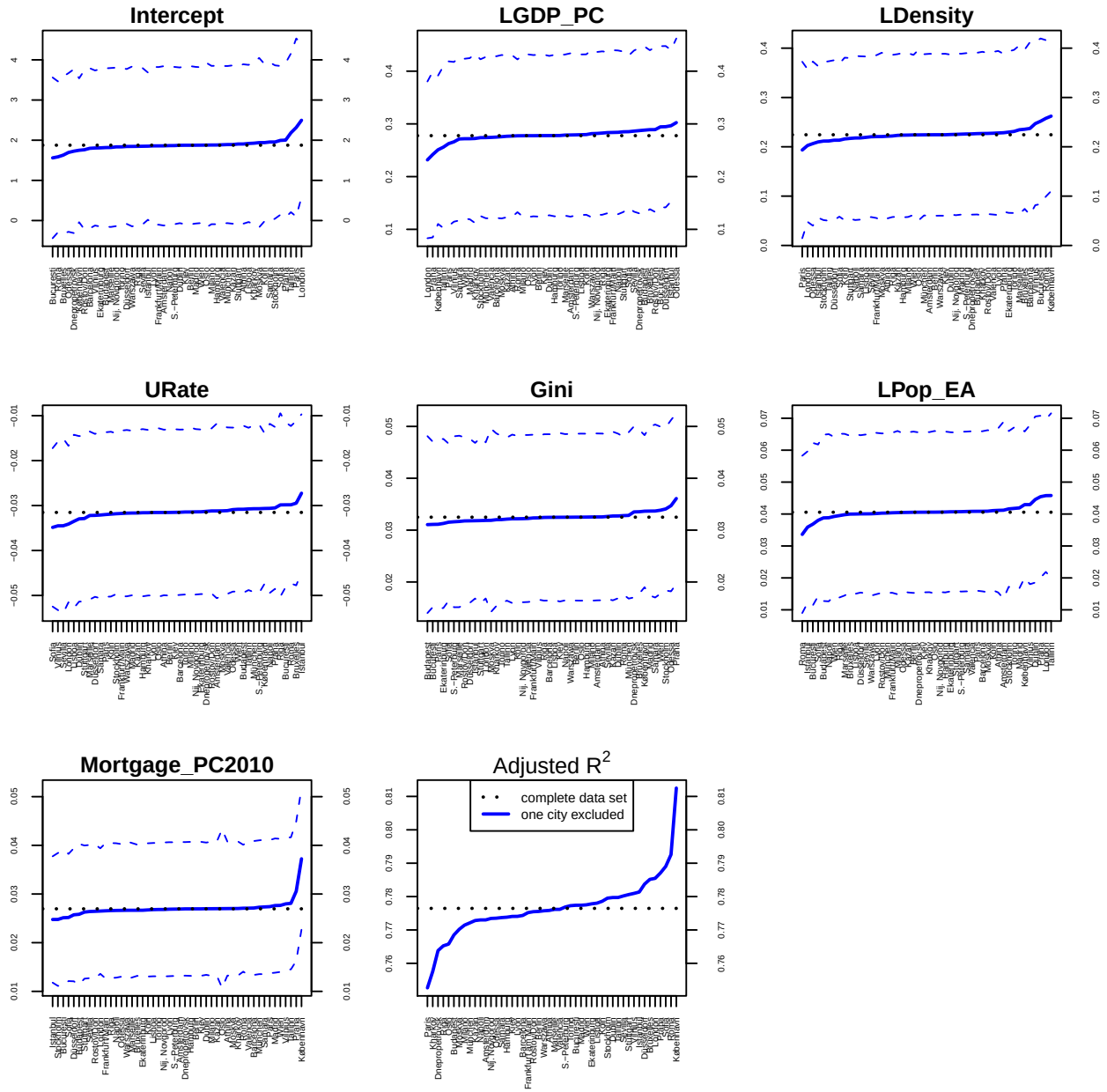


Figure 5: Coefficient estimates when one city is excluded from regression

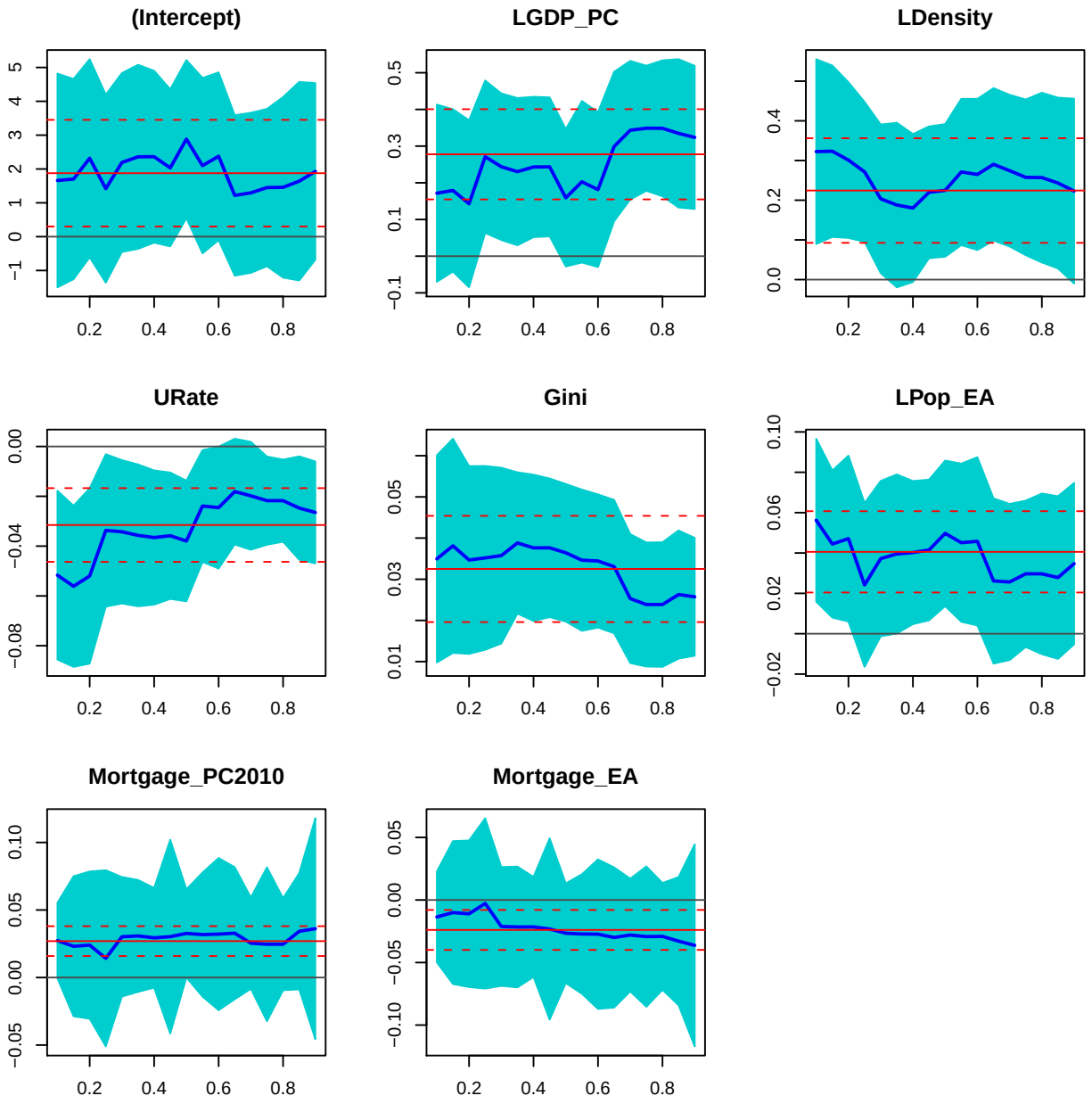
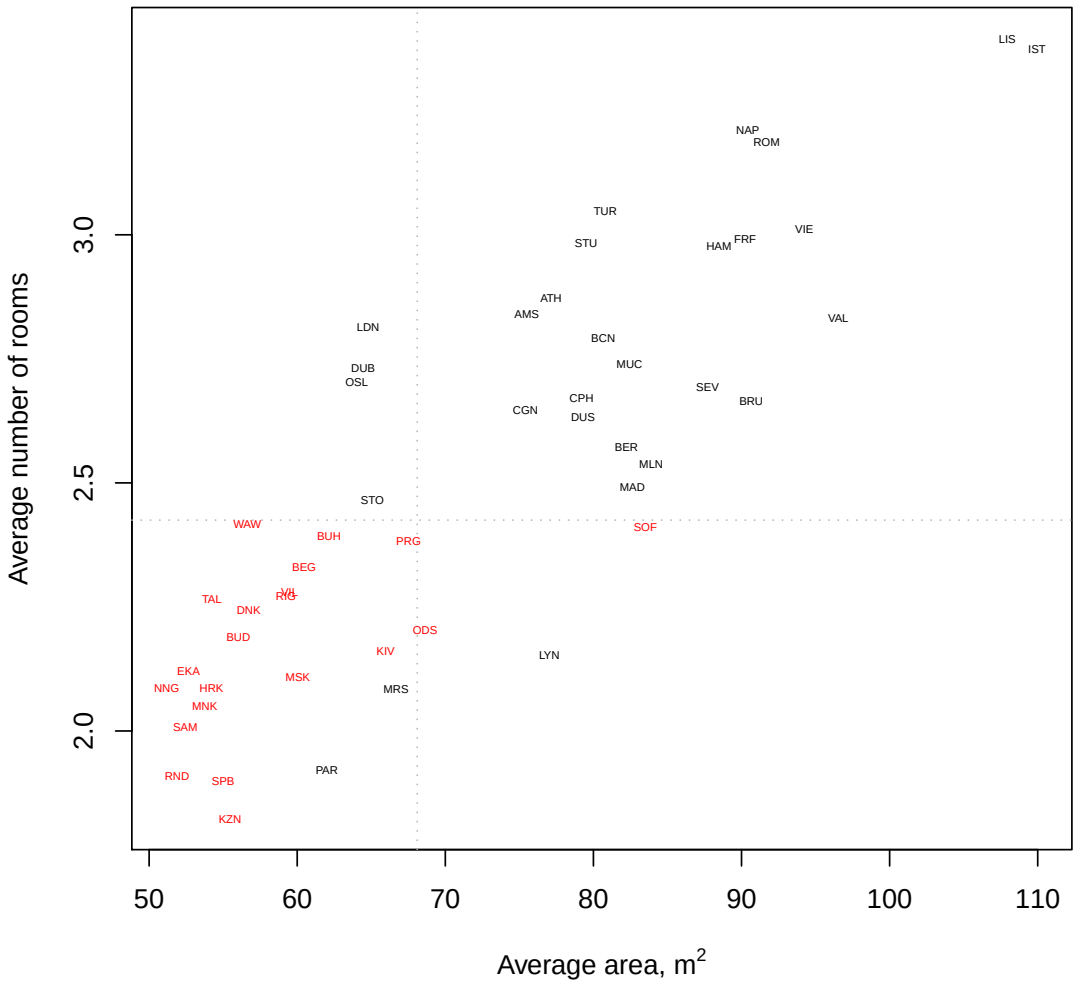


Figure 6: Quantile regression's coefficient estimates at different quantiles

Figure 7: Size of flats in large European cities, January – April 2012



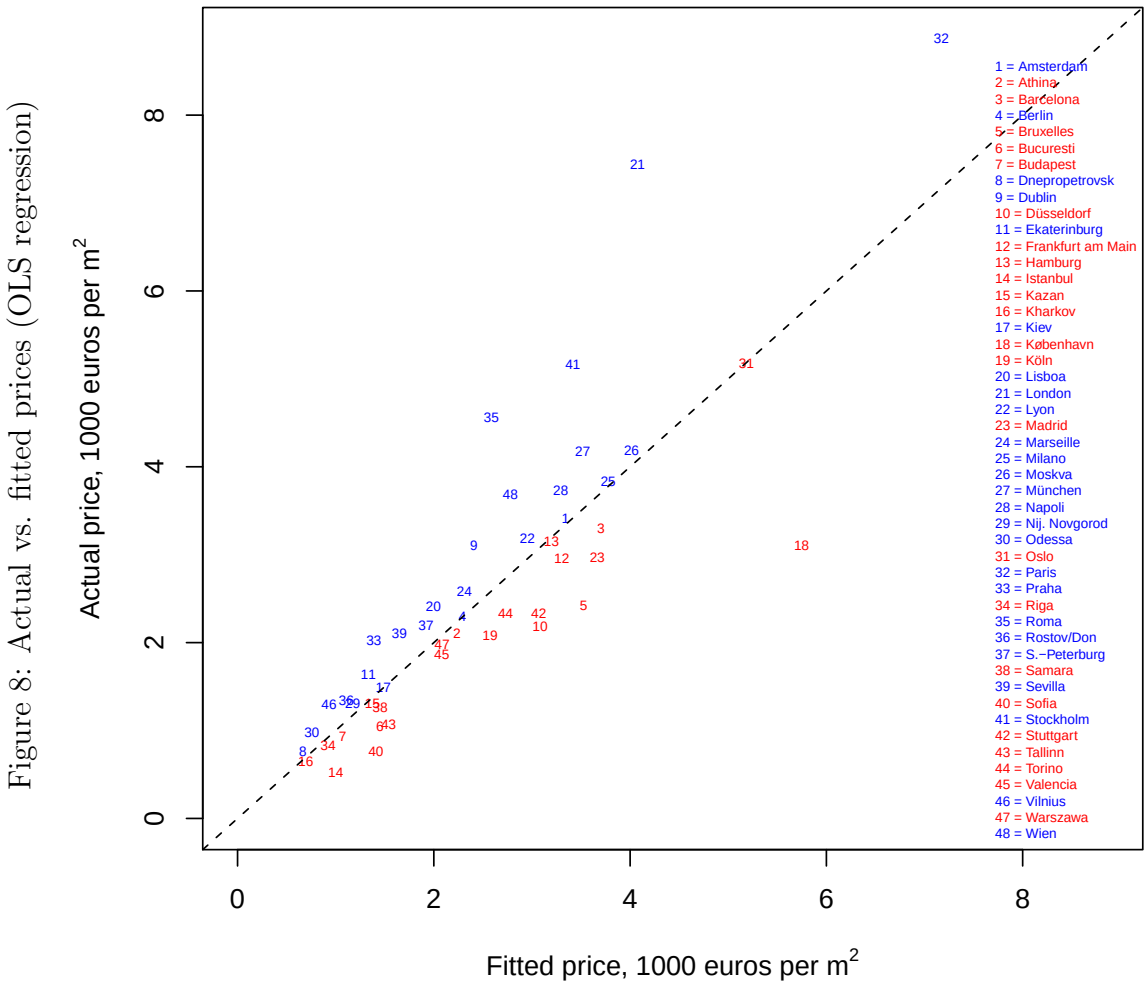


Figure 8: Actual vs. fitted prices (OLS regression)

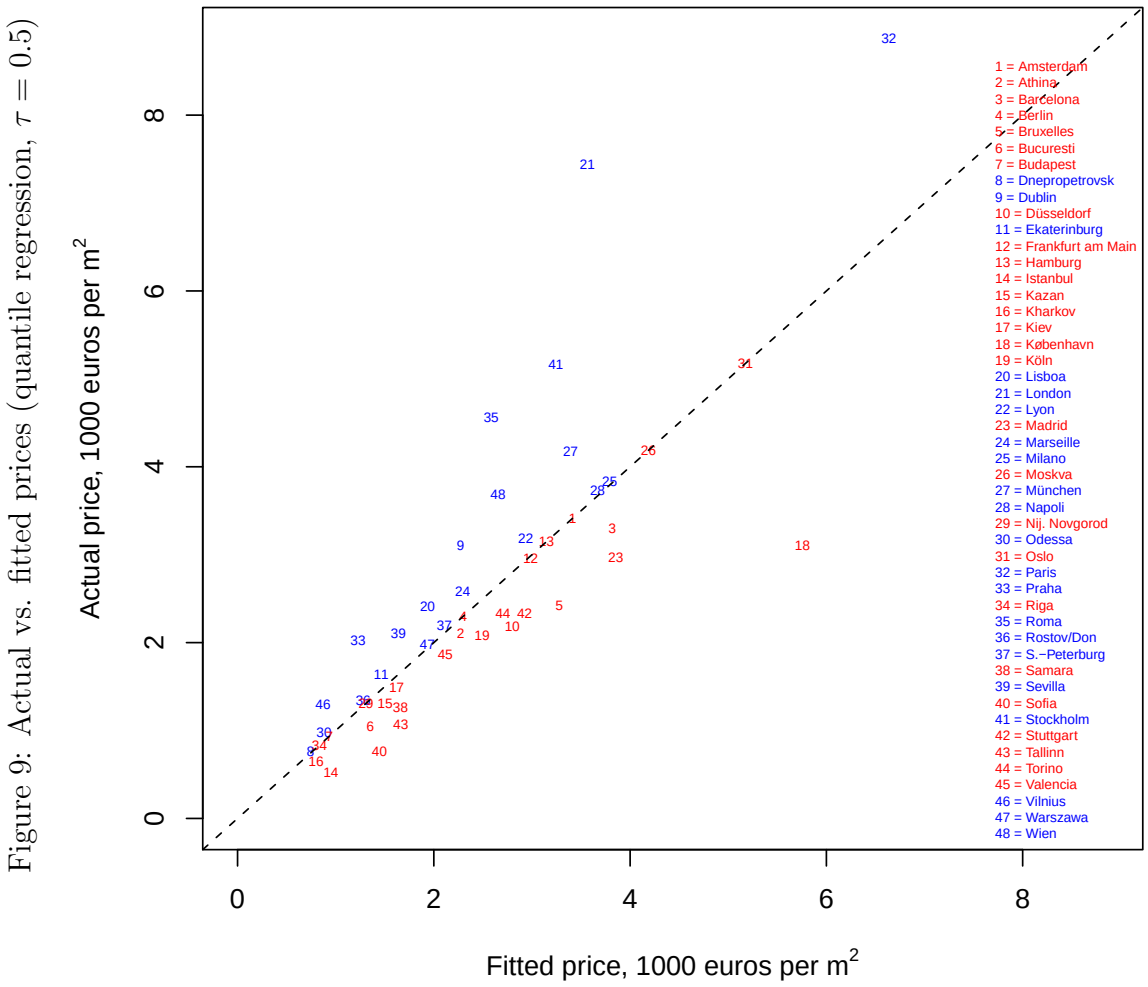


Figure 9: Actual vs. fitted prices (quantile regression, $\tau = 0.5$)

Figure 10: Distribution of relative difference between actual and fitted prices for flats, given different cities-variables combinations, January – April 2012