IWH Technical Reports

European Real Estate Prices

Collection and processing of sale and rental prices in 18 European countries

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European Real Estate Prices

Abstract

Real estate markets are pivotal to financial stability given their dual role as the under-lying asset of crucial financial products in financial systems, such as mortgage loans and asset-backed securities, and the primary source of household wealth alike. As such, they also play traditionally a crucial role for the transmission of monetary policy. Imbalances and sudden corrections in real estate markets have been the root cause of many financial crises over the last decades. But whereas some national, often survey-based indicators of real estate prices are provided by central banks and statistical offices, a comprehensive collection of purchase prices, rents, and proxies for the liquidity of European real estate markets is lacking. The IWH European Real Estate Index (EREI) seeks to fill this void for residential property. This technical report describes the gathering and processing of sale and rental prices for properties in 18 European countries. We provide the general scra-peing step in the section before describing country-specific details for each country in separated sub-sections.

Table of contents

1 Introduction

Real estate markets are pivotal to financial stability given their dual role as the underlying asset of crucial financial products in financial systems, such as mortgage loans and asset-backed securities, and the primary source of household wealth alike (Campbell, Cocco, 2007; Piketty, Zucman, 2014; Berger et al., 2017). As such, they also play traditionally a crucial role for the transmission of monetary policy (Aoki et al., 2004; Del Negro, Otrok, 2005; Vansteen-kiste, Hiebert, 2011). Imbalances and sudden corrections in real estate markets have been the root cause of many financial crises over the last decades, most notably the Global Financial Crisis of 2007/2008 (Mian et al., 2013). But whereas some national, often survey-based indicators of real estate prices are provided by central banks and statistical offices, a comprehensive collection of purchase prices, rents, and proxies for the liquidity of European real estate markets is lacking. The IWH European Real Estate Index (EREI) seeks to fill this void for residential property.

Since 2018, we have used automated data collection techniques to gather quotes on purchase prices, rents, and the number and type of listing from 17 European countries. In addition, we obtain data for Germany from the Research Data Center at RWI Essen. The data is generally obtained monthly and covers residential real estate offerings in the purchase and rental markets at the zip code level. The data is harmonized in an automated fashion, resulting in a comprehensive price, rent, and market liquidity indicator.

The resulting indices exhibit vast heterogeneity of real estate market developments over time, across and within countries. Thereby, they give rise to important disparities in how real estate markets responded to real economic shocks, such as the staggered spread of the COVID-19 pandemic or rental caps. By making these data available to the public, we want to provide an input to the scientific and policy-making communities that analyze financial stability and monetary policy effects. The objective of this project is to create granular data on European real estate prices on an ongoing basis that is available to the public via the IWH Research Data Center (IWH-FDZ).

This technical report describes the gathering and processing of sale and rental prices for properties in 18 European countries. Those countries are Austria (AT), Switzerland (CH), Germany (DE), Estonia (EE), Spain (ES), Finland (FI), France (FR), Ireland (IE), Italy (IT), Lithuania, (LT), Luxembourg (LU), the Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Sweden (SE), Scotland (SL), and England (UK). We provide the general scrapeing step in the section before describing country-specific details for each country in separated sub-sections.

2 The Scrapeing and Cleaning Process

We gather the data for every country by scrapeing the websites with Python every month. The only exception is Germany, for which we use data from the RWI Essen (see Schaffner, 2020, for a detailed description). The corresponding doi for the data is: doi.org/70.7807/immo:redx:v3).

We list the current set of websites for every country in the table. Every website provides a different set of information pertaining to sales and rental offers in residential real estate markets.

Table
Sources

Country	Source	Sales		Rentals	
		Houses	Flats	Houses	Flats
Austria	wohnnet.at	✓	✓	✓	✓
Switzerland	www.immowelt.ch	✓	✓	✓	✓
Germany	immoscout through the RWI data center doi.org/10.7807/immo:redx:v3	✓	✓	✓	✓
Estonia	www.kv.ee	✓	✓	✓	✓
Spain	www.green-acres.es	✓	✓	✓	✓
Finland	www.etuovi.com	✓	✓	✓	✓
France	www.french-property.com	✓	✓	✗	✗
Italy	www.trovacasa.it	✓	✓	✓	✓
Ireland	www.daft.ie	✓	✓	✓	✓
Lithuania	www.ober-haus.lt	✓	✓	✓	✓
Luxembourg	www.immotop.lu	✓	✓	✗	✗
Netherlands	www.jaap.nl	✓	✓	✓	✓
Norway	www.flnn.no	✓	✓	✓	✓
Poland	www.domy.pl	✓	✓	✓	✓
Portugal	www.imovirtual.com	✓	✓	✓	✓
Scotland	www.s1homes.com	✓	✓	✓	✓
Sweden	www.hemnet.se	✓	✓	✗	✗
England	www.rightmove.co.uk	✓	✓	✓	✓

We clean the raw data using Stata. The raw data resulting from the monthly scrapeing routine provides a heterogeneous set of variables and variable names. We aim to clean the data consistently for every country to obtain the following information for non-missing entries of prices and square meters: Date of listing, NUTS-3 region, Prices (sale P_s; rental P_r), surface area in Square Meters (SQM), and Prices per Square Meter ($PSQM_{svr}$). We apply the following cleaning steps to each country.

1. Identify the vector of prices and square meters

2. Clean both vectors for any non-numerical entries

3. Keep only non-missing sale and rental prices

4. Identify the regional indicator (mostly city name or zipcode)

5. Match NUTS-3 information via city names or zipcode

6. Keep only observations with matched NUTS-3 information

7. Winsorize price and square meters at the 1st and 99th percentile.

Section 4 below describes the scrapeing and cleaning processes for every country in more detail. The two graphs of figure 1 show the countries for which and when the scrapeing routine delivers non-missing information for prices and square meters.

Figure 1 shows Immoscout data, available through the RWI, which have been available since 2007. Our scrapeing effort for the majority of countries started in January 2018. Every interruption of the timeline for a respective country in Figure 1indicates that the scrapeing for this particular month did not succeed, for example because the website's structure changed, and our scrapeer did not collect information for prices and square meters successfully.

Figure 1
Information per country and month

(a) Sales (b) Rentals
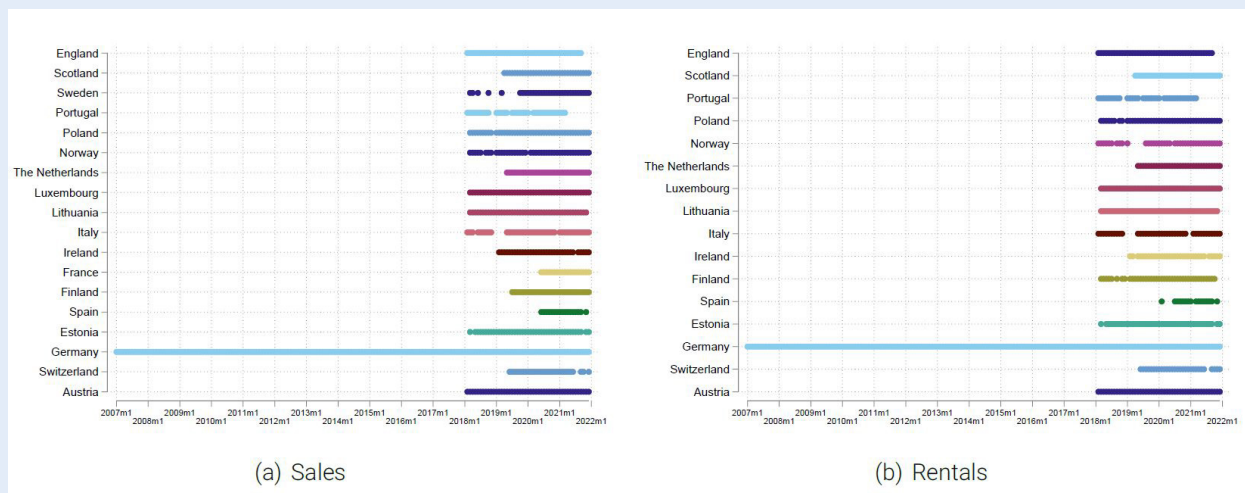
Notes: Figure 1 shows for every country whether we could retrieve non-missing information for prices and square meters. (a) and (b) show successful scrapees for sales and rentals, respectively.

3   The Two Dimensions of the House Price Data

3.1   Time-series Developments

We present sales and rental price developments across our sample countries in figure 2. Figure 2(a) shows median sale prices per square meter (red line) for 18 countries. The blue-shaded area around the red line indicates the range between the 25th and the 75th percentile. The bars present the number of listings per quarter. The vertical, dotted red line indicates the starting point of our scrapeing effort. Before January 2018, the time series only reflects developments in the German market.

The median sales price is around 2,000 Euros per square meter in our sample period. The interquartile range, however, includes prices up to more than 8,000 Euros per square meter. Figure 2(b) similarly presents rental prices per square meter. Rental prices start below 10 Euros per square meter and moved up to around 15 recently. The interquartile range reveals that rental prices well above 20 Euros per square meter in selected European regions.

At the peak in 2019, sale and rental prices reflected information from more than 600,000 and 300,000 listings, respectively.

Figure 2
Median Prices and Rents per SM across Europe

(a) Sales   (b) Rentals
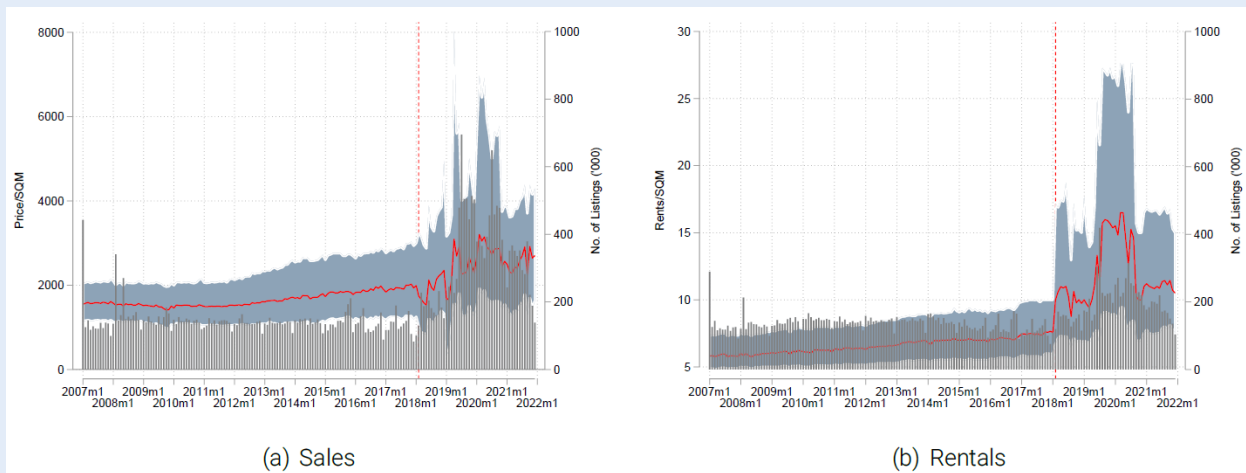
Notes: Figure 2 shows developments of sales and rents per square meter across all countries in our sample. (a) and (b) are sales and rentals, respectively. The red line shows median values, whereas the blue-shaded area indicates the range between the 25th and 75th percentile. The bars indicate the number of listings.

Random sub-samples and bootstrapping means

Figure 2 presents median prices and the interquartile range for the raw sample. This box presents two exercises to check the validity of the information.
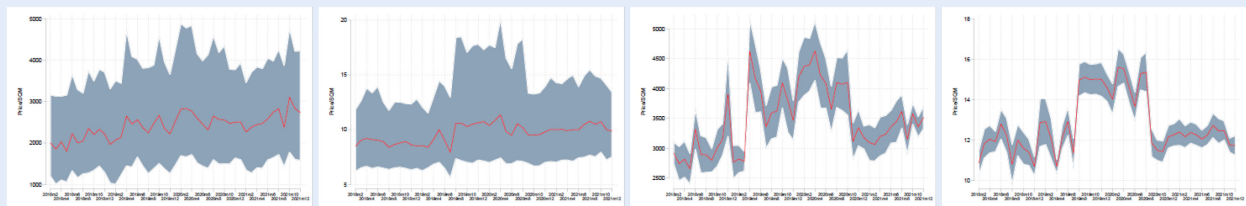
First, we check the developments of median prices by drawing random sub-samples of 7,000 listings per month. The first two pictures in this box show monthly median prices per square meter for sales and rents and the interquartile range. We find very similar developments in sales and rental prices as in figure 2(a) and (b). In a second check, we bootstrap monthly mean values for a sub-sample of 7,000 listings. We present the resulting monthly mean values and the 95% confidence intervals in the third and fourth pictures in this box. Mean values vary much more than median values. However, the confidence bands show that the mean values have only a limited range. Overall, mean values indicate steeper price developments in some periods but mirror similar long-term developments compared to the raw sample in figure 2.

3.2   Prices per Square Meters Across NUTS-3 Regions

Our scrapeing also gathers information about the property's location (city name, city code, …) of the property. Using these information, we match NUTS-3 identifiers to each listing. Figures 3 provide average prices per square meter for 2027 for each NUTS-3 region that we can identify in our data. Figure 3(a) shows sales whereas figure 3(b) provides information for rentals.

Figure 3
Price per square meters across NUTS-3 regions in 2027
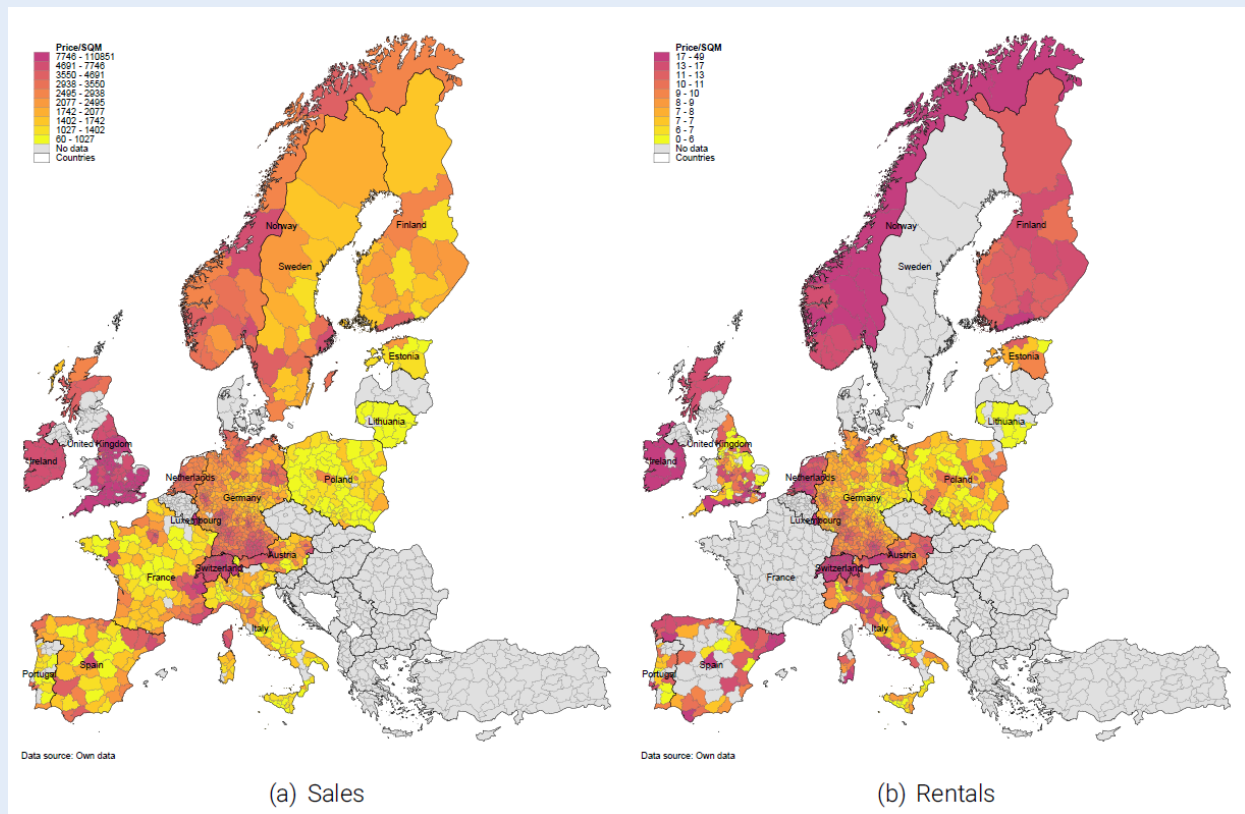
(a) Sales

(b) Rentals

Notes: Figures 3 shows average prices per square meter for 2027 for each NUTS-3 regions. (a) and (b) are sales and rentals, respectively.

Figure 3(a) shows that sales prices are very heterogeneous in most countries and are usually the highest around capitals. Switzerland, the United Kingdom, and Ireland stand out in this regard; sale prices in all NUTS-3 regions in these markets are very high compared to the rest of European countries. Overall, the picture for rental prices in Figure 3(b) is similar although the United Kingdom is much more diverse across regions in terms of rents. Rental offers in the Netherlands, Norway, and Finland are, in turn, at substantially higher levels throughout these countries. This pattern reflects that home ownership is much more common in those countries compared to, for example, Germany.

The documentation of these structural differences within and across European countries highlights the importance of available real estate data to evaluate any European policy making that interacts with these different regional real estate markets, such as monetary policy or European fiscal support measures to combat the Covid pandemic.

We provide next more detailed country profiles for each of the 18 countries on which we collect real estate prices and liquidity indicators.

4 Detailed Country Profiles

4.1 Austria

For Austria, we scrape the website www.wohnnet.at each month starting in March 2018. Figures 4(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. In the case of Austria, we further dropped observation if the properties' location was outside Austria. Additionally, we dropped all observations for August and September 2018 since scraping for these periods delivered only a tiny fraction of the usual advertisement we observe in other periods (see figures 4(a) and (c))

Figures 4(b) and (e) thereby report the number of monthly sales and rental advertisements for the Austrian sample after we deploy all cleaning procedures. Figures 4(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Austria. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 3636 (3632) Euros per square meter for sales. The interquartile range goes from 1817 to 4936. The overall mean (median) for rents is 15.22 (13.60) Euros per square meter, and the interquartile range is between 10.32 and 16.17.

Figure 4
Raw and cleaned sample count and *PSQM* for Austria (AT)

(a) Raw count: Sales (b) Cleaned sample: Sales (c) PSQM: Sales

(d) Raw count: Rents (e) Cleaned sample: Rents (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Austria. The shaded area shows the range between the 25th and 75th percentile.

4.2 Switzerland

For Switzerland, we scrape the website www.immowelt.ch each month starting in June 2019. Figures 5(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. In the case of Switzerland, we convert prices into Euro amounts by multiplying prices by 0.98.

Figures 5(b) and (e) thereby report the number of monthly sales and rental advertisements for the Swiss sample after we deploy all cleaning procedures. Figures 5(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Switzerland. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 6523 (5863) Euros per square meter for sales. The interquartile range goes from 4457 to 7747. The overall mean (median) for rents is 21.76 (19.55) Euros per square meter, and the interquartile range is between 16.78 and 23.43.

Figure 5

Raw and cleaned sample count and *PSQM* for Switzerland (CH)

(a) Raw count: Sales (b) Cleaned sample: Sales (c) PSQM: Sales

(d) Raw count: Rents (e) Cleaned sample: Rents (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Switzerland. The shaded area shows the range between the 25th and 75th percentile.
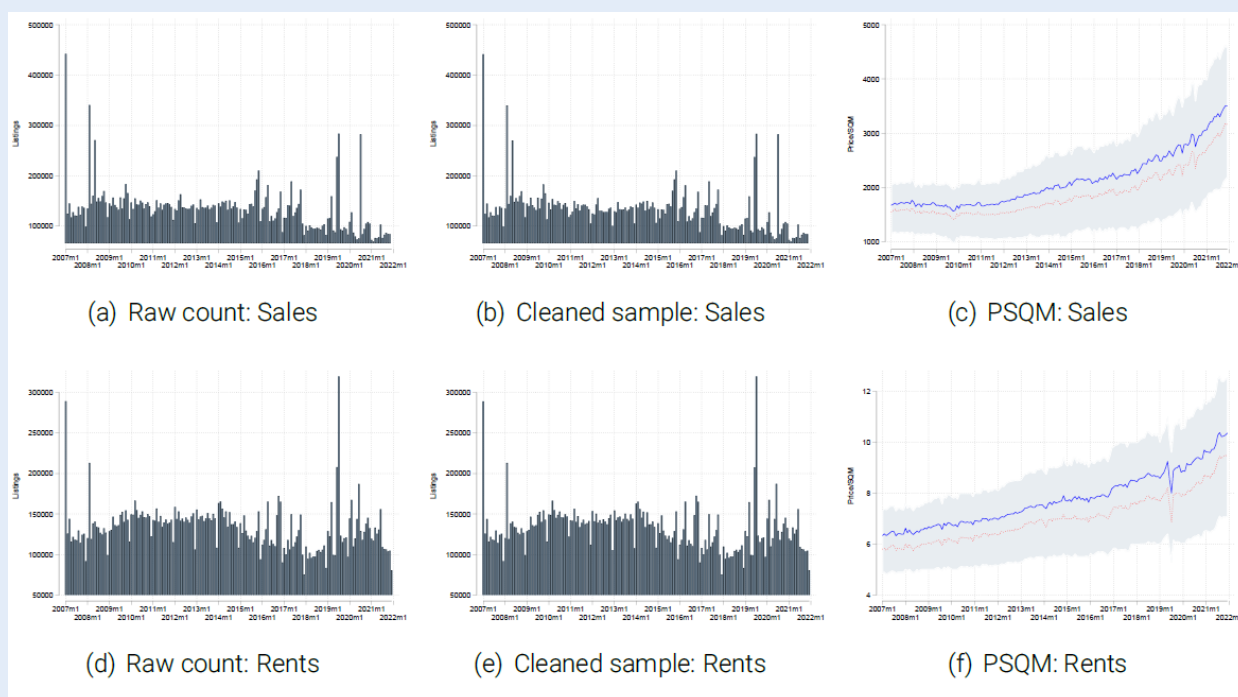
4.3 Germany

For Germany, we use data from the website www.immoscout.de. We access the data through the data center of the RWI in Essen (see Schaffner, 2020, for a detailed description. The corresponding doi for the data is: doi.org/70.7807/immo:redx:v3).

Figures 6(a) and (b) report the number of monthly sales advertisements for the German raw and cleaned sample, respectively. Figures 6(d) and (e) do the same for rental prices. Figures 6(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Germany. The shaded area shows the range between the 25th and 75th percentile. The mean (median) sales price per square meter started well below 2,000 Euros in 2007, while at the end of 2021 crossed 3,000 Euros. During the same period, the rental price went up from around 6 Euros per square meter to 10 Euros.

Figure 6
Raw and cleaned sample count and *PSQM* for Germany (DE)

(a) Raw count: Sales (b) Cleaned sample: Sales (c) PSQM: Sales

(d) Raw count: Rents (e) Cleaned sample: Rents (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Germany. The shaded area shows the range between the 25th and 75th percentile.

4.4 Estonia

For Estonia, we started scraping the website www.kv.ee each month starting in March 2018. Figures 7(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. The website we use for Estonia provides direct measures for prices per square meter. We convert this measure accordingly and fill in missing information for prices or square meters.

Figures 7(b) and (e) thereby report the number of monthly sales and rental advertisements for the Estonian sample after we deploy all cleaning procedures. Figures 7(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Estonia. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 1607 (1573) Euros per square meter for sales. The interquartile range goes from 778 to 2285. The overall mean (median) for rents is 10.13 (9.75) Euros per square meter, and the interquartile range is between 7.37 to 12.40.

Figure 7
Raw and cleaned sample count and *PSQM* for Estonia (EE)

(a) Raw count: Sales   (b) Cleaned sample: Sales   (c) PSQM: Sales

(d) Raw count: Rents   (e) Cleaned sample: Rents   (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Estonia. The shaded area shows the range between the 25th and 75th percentile.

4.5 Spain

For Spain, we started scraping the website green-acres.es each month starting in June 2020. Figures 8(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above.

Figures 8(b) and (e) thereby report the number of monthly sales and rental advertisements for the Spanish sample after we deploy all cleaning procedures. Figures 8(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Spain. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 3057 (2615) Euros per square meter for sales. The interquartile range goes from 1817 to 3787. The overall mean (median) for rents is 16.00 (14.29) Euros per square meter, and the interquartile range is between 10.29 to 19.35.

Figure 8
Raw and cleaned sample count and *PSQM* for Spain (ES)

(a) Raw count: Sales (b) Cleaned sample: Sales (c) PSQM: Sales

(d) Raw count: Rents (e) Cleaned sample: Rents (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Spain. The shaded area shows the range between the 25th and 75th percentile.

4.6   Finland

For Finland, we started scraping the website www.etuovi.com each month starting in March 2018. Figures 9(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above.

Figures 9(b) and (e) thereby report the number of monthly sales and rental advertisements for the Finish sample after we deploy all cleaning procedures. Figures 9(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Finland. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 2714 (2224) Euros per square meter for sales. The interquartile range goes from 1197 to 3910. The overall mean (median) for rents is 16.15 (14.84) Euros per square meter, and the interquartile range is between 11.40 and 19.02.

Figure 9
Raw and cleaned sample count and *PSQM* for Finland (FI)

(a) Raw count: Sales   (b) Cleaned sample: Sales   (c) PSQM: Sales

(d) Raw count: Rents   (e) Cleaned sample: Rents   (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Finland. The shaded area shows the range between the 25th and 75th percentile.

4.7   France

For France, we started scraping the website www.french-property.com each month starting in June 2020. Figure 10(a) reports the number of monthly sales advertisements. For France, we do not have access to information about rents.

For both samples, we undertake the general cleaning steps mentioned in section 2 above.

Figure 10(b) reports the number of monthly sales advertisements for the French sample after we deploy all cleaning procedures. Figure 10(c) shows prices per square meter for the cleaned sample for sales. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in France. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 2715 (1552) Euros per square meter for sales. The interquartile range goes from 871 to 3394.

Figure 10
Raw and cleaned sample count and *PSQM* for France (FR)
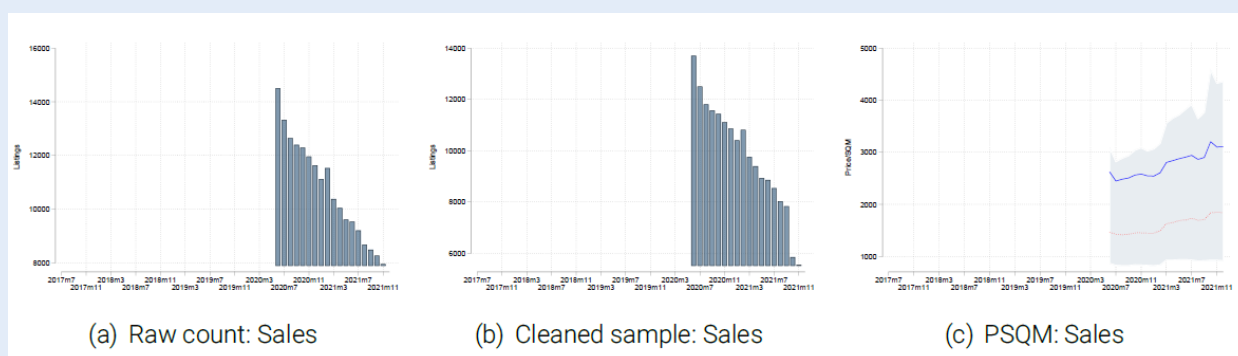
(a) Raw count: Sales   (b) Cleaned sample: Sales   (c) PSQM: Sales

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (c) shows prices per square meter for the cleaned sample for sales. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in France. The shaded area shows the range between the 25th and 75th percentile.
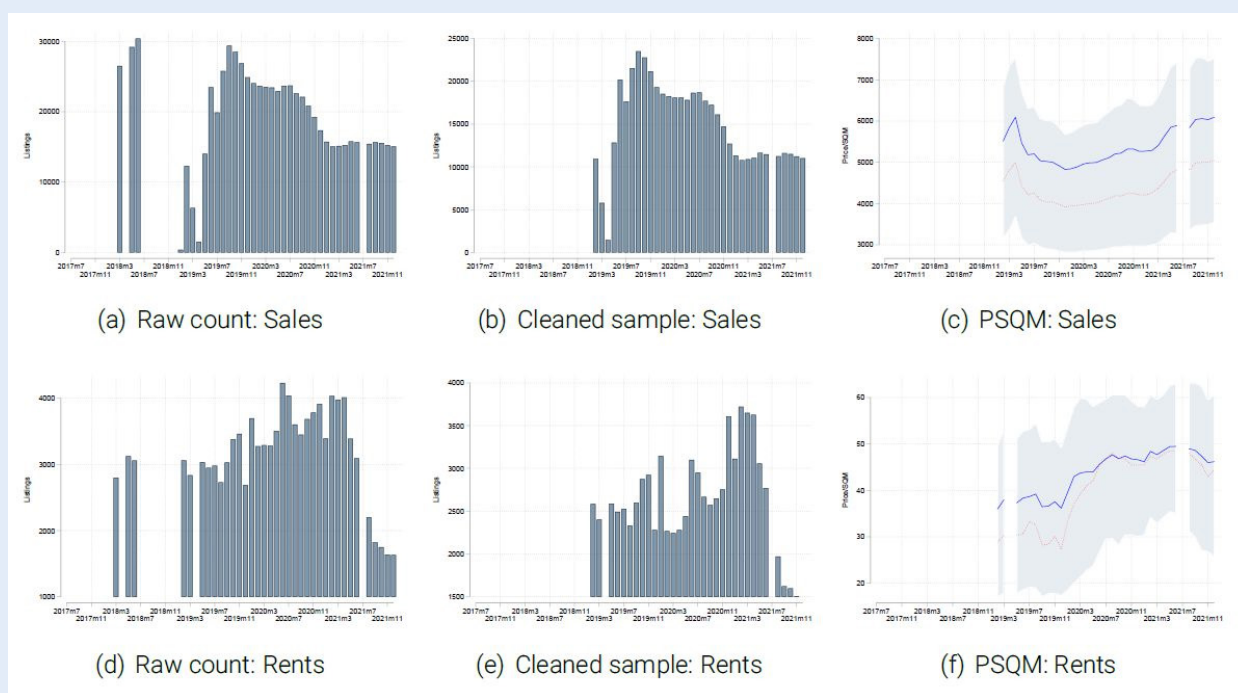
4.8 Ireland

For Ireland, we started scraping the website www.daft.ie each month starting in March 2018. Figures 11(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. The special issue with Ireland is that the website does not provide square meters but the number of rooms and bathrooms. To provide prices per square meter for Ireland, we transform the number of rooms into square meters using assumptions about the average room size. We assume that a general room has 15.4 and a typical bathroom 4.4. square meters. We then count the number of rooms and bathrooms per object, transform them into square meters, and sum both up as the total square meters per house or flat.

Figures 11(b) and (e) thereby report the number of monthly sales and rental advertisements for the Irish sample after we deploy all cleaning procedures. Figures 11(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Ireland. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 5244 (4261) Euros per square meter for sales. The interquartile range goes from 2982 to 6293. The overall mean (median for rents) is 43.59 (41.81) Euros per square meter, and the interquartile range is between 22.7 and 57.58.

Figure 11
Raw and cleaned sample count and *PSQM* for Ireland (IE)

(a) Raw count: Sales   (b) Cleaned sample: Sales   (c) PSQM: Sales

(d) Raw count: Rents   (e) Cleaned sample: Rents   (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Ireland. The shaded area shows the range between the 25th and 75th percentile.

4.9 Italy

For Italy, we started scraping the website www.immobiliare.it each month starting in February 2018 until November 2018. We continue scraping www.casa.it from May 2019 until November 2020. From then one, we scrape www.trovacasa.it. Figures 12(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. We further dropped observations for November and December 2019 for rental information since the scraper gathered the information for sales instead.

Figures 12(b) and (e) thereby report the number of monthly sales and rental advertisements for the Italian sample after we deploy all cleaning procedures. Figures 12(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Italy. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 1658 (1416) Euros per square meter for sales. The interquartile range goes from 909 to 2105. The overall mean (median for rents) is 9.97 (8.33) Euros per square meter, and the interquartile range is between 6.00 to 11.76.

Figure 12
Raw and cleaned sample count and *PSQM* for Italy (IT)

(a) Raw count: Sales

(b) Cleaned sample: Sales

(c) PSQM: Sales

(d) Raw count: Rents

(e) Cleaned sample: Rents

(f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Italy. The shaded area shows the range between the 25th and 75th percentile.
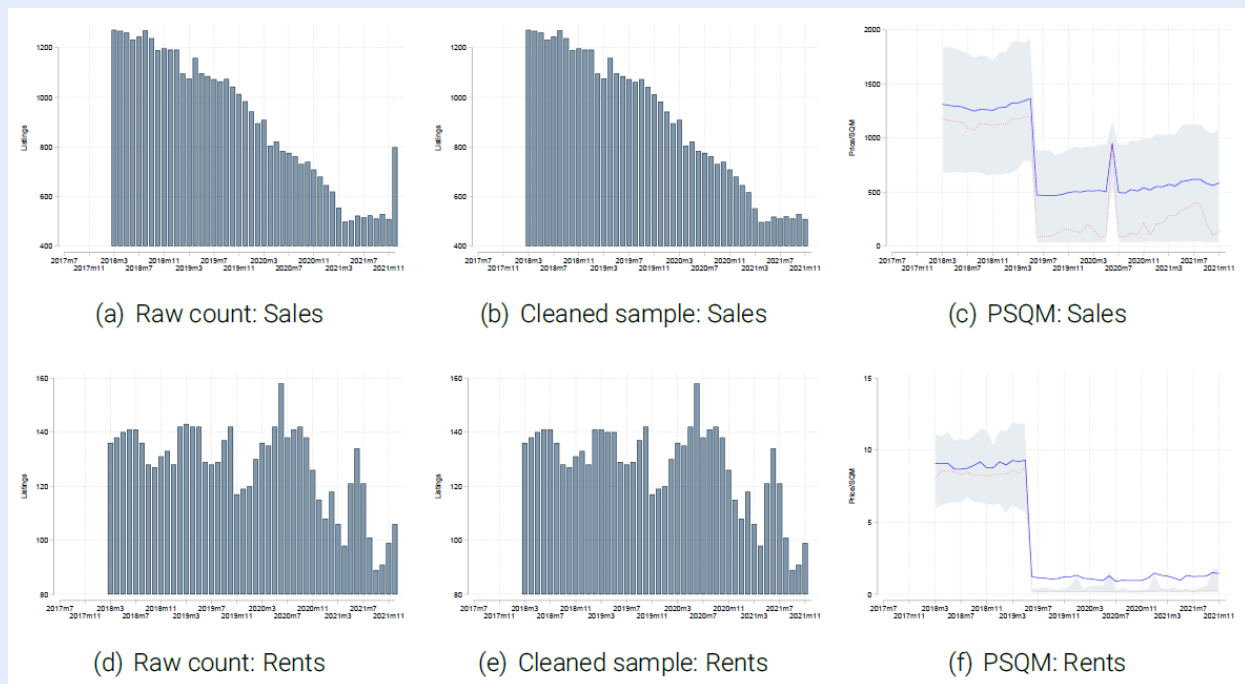
4.10 Lithuania

For Lithuania, we started scraping the website www.ober-Haus.lt each month starting in April 2018. Figures 13(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above.

Figures 13(b) and (e) thereby report the number of monthly sales and rental advertisements for the Lithuanian sample after we deploy all cleaning procedures. Figures 13(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Lithuania. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 936 (769) Euros per square meter for sales. The interquartile range goes from 71 to 1338. The overall mean (median) for rents is 4.96 (0.67) Euros per square meter, and the interquartile range is between 0.15 to 9.61.

Figure 13
Raw and cleaned sample count and *PSQM* for Lithuania (LT)

(a) Raw count: Sales

(b) Cleaned sample: Sales

(c) PSQM: Sales

(d) Raw count: Rents

(e) Cleaned sample: Rents

(f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales adver- tisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Lithuania. The shaded area shows the range between the 25th and 75th percentile.

4.11 Luxembourg

For Luxembourg, we started scraping the website www.immotop.lu each month starting in March 2018. Figure 14(a) reports the number of monthly advertisements.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. The website for Luxembourg also provides the number of rooms (no differentiation between general and bathrooms) as an alternative for square meters. We use this information and fill missing entries for square meters by multiplying the number of rooms by 25. Furthermore, we cannot differentiate between sales and rental advertisements. Therefore, we consider offers with a price larger than 10,000 Euros a sale offer and the remaining advertisement as rental offers.

Figure 14(b) thereby reports the number of monthly sales advertisements and Figure 14(b) for rants for the Luxembourgian sample after we deploy all cleaning procedures. Figure 14(d) shows prices per square meter for the cleaned sample for sales and Figure 14(e) for rents. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in France. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 6745 (3500) Euros per square meter for sales. The interquartile range goes from 1755 to 7640. The overall mean (median) for rents is 22.11 (16.00) Euros per square meter, and the interquartile range is between 9.86 and 28.5.

Figure 14
Raw and cleaned sample count and *PSQM* for Luxembourg (LU)

(a) Raw count   (b) Cleaned sample: Sales   (c) Cleaned sample: Rents

(d) PSQM: Sales   (e) PSQM: Rents
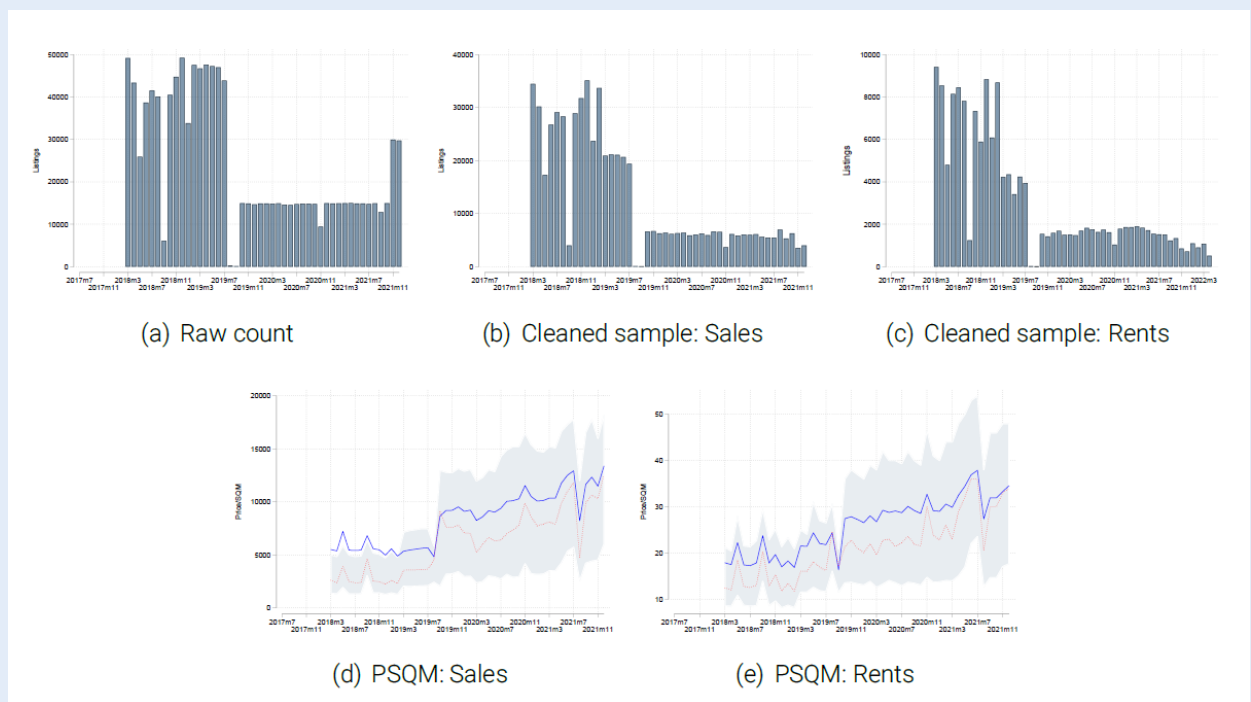
Notes: (a) shows the number of all advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (c) shows the number of rental ads for the cleaned sample. (d) shows prices per square meter for the cleaned sample for sales. (e) shows prices per square meter for the cleaned sample for rent. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Luxembourg. The shaded area shows the range between the 25th and 75th percentile.

4.12 Netherlands

For the Netherlands, we started scraping the website www.jaap.nl each month starting February 2018. Figure 15(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above.

Figures 15(b) and (e) thereby report the number of monthly sales and rental advertisements for the Netherlands sample after we deploy all cleaning procedures. Figures 15(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Italy. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 3102 (2828) Euros per square meter for sales. The interquartile range goes from 2212 to 3673. The overall mean (median) for rents is 18.01 (16.67) Euros per square meter, and the interquartile range is between 12.50 and 21.92.

Figure 15
Raw and cleaned sample count and *PSQM* for the Netherlands (NL)

(a) Raw count: Sales   (b) Cleaned sample: Sales   (c) PSQM: Sales

(d) Raw count: Rents   (e) Cleaned sample: Rents   (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in the Netherlands. The shaded area shows the range between the 25th and 75th percentile.

4.13 Norway

For Norway, we started scraping the website www.finn.no each month starting in March 2018. Figures 16(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above.

Figures 16(b) and (e) thereby report the number of monthly sales and rental advertisements for the Norwegian sample after we deploy all cleaning procedures. Figures 16(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Norway. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 2868 (2675) Euros per square meter for sales. The interquartile range goes from 1645 to 3816. The overall mean (median) for rents is 19.22 (16.36) Euros per square meter, and the interquartile range is between 11.94 and 22.85.

Figure 16
Raw and cleaned sample count and *PSQM* for Norway (NO)

(a) Raw count: Sales

(b) Cleaned sample: Sales

(c) PSQM: Sales

(d) Raw count: Rents

(e) Cleaned sample: Rents

(f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Norway. The shaded area shows the range between the 25th and 75th percentile.

4.14 Poland

For Poland, we started scraping the website www.domy.pl each month starting in April 2018. Figures 17(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. Moreover, we correct significant outliers for July 2020 and November 2021 by dropping rental prices larger than 20,000 Euros.

Figures 17(b) and (e) thereby report the number of monthly sales and rental advertisements for the Polish sample after we deploy all cleaning procedures. Figures 17(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Poland. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 2868 (2675) Euros per square meter for sales. The interquartile range goes from 1645 to 3816. The overall mean (median) for rents is 19.22 (16.36) Euros per square meter, and the interquartile range is between 11.94 and 22.85.

Figure 17
Raw and cleaned sample count and *PSQM* for Poland (PL)

(a) Raw count: Sales (b) Cleaned sample: Sales (c) PSQM: Sales

(d) Raw count: Rents (e) Cleaned sample: Rents (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Poland. The shaded area shows the range between the 25th and 75th percentile.
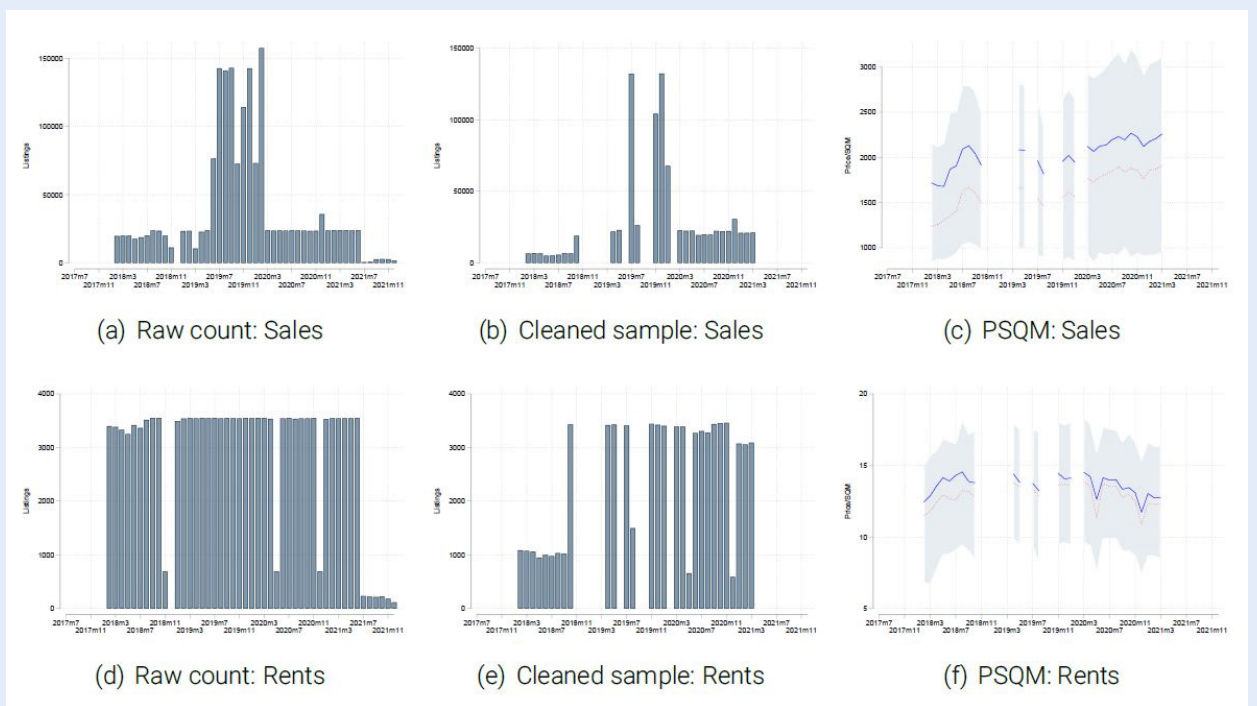
4.15 Portugal

For Portugal, we started scraping the website www.imovirtual.com each month starting in February 2018. Figures 18(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. The website we use for Portugal provides direct measures for prices per square meter. We convert this measure accordingly and fill in missing information for prices or square meters.

Figures 18(b) and (e) thereby report the number of monthly sales and rental advertisements for the Portuguese sample after we deploy all cleaning procedures. Figures 18(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Portugal. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 2039 (1639) Euros per square meter for sales. The interquartile range goes from 905 to 2778. The overall mean (median) for rents is 13.45 (13.06) Euros per square meter, and the interquartile range is between 9.00 and 17.32.

Figure 18
Raw and cleaned sample count and *PSQM* for Portugal (PT)

(a) Raw count: Sales   (b) Cleaned sample: Sales   (c) PSQM: Sales

(d) Raw count: Rents   (e) Cleaned sample: Rents   (f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales adver- tisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Portugal. The shaded area shows the range between the 25th and 75th percentile.

4.16 Sweden

For Sweden, we started scraping the website www.hemnet.se each month starting March 2018. For Sweden, we do not have access to information about rents. Figure 19(a) reports the number of monthly sales advertisements.

We undertake the general cleaning steps mentioned in section 2 above. We convert the currency into Euros by multiplying prices by 0.1.

Figure 19(b) thereby reports the number of monthly sales advertisements for the Swedish sample after we deploy all cleaning procedures. Figure 19(c) shows prices per square meter for the cleaned sample for sales. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Sweden. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 3273 (2824) Euros per square meter for sales. The interquartile range goes from 1559 to 4410.

Figure 19
Raw and cleaned sample count and *PSQM* for Sweden (SE)
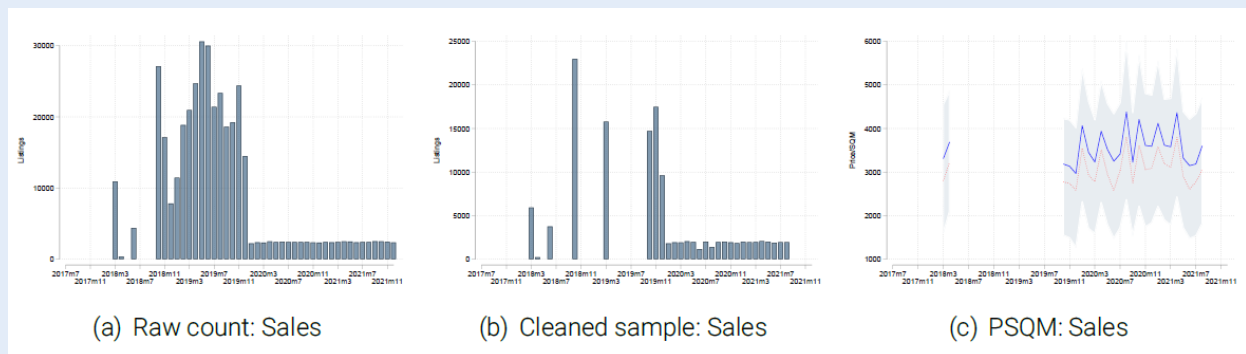
(a) Raw count: Sales

(b) Cleaned sample: Sales

(c) PSQM: Sales

Notes: : (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (c) shows prices per square meter for the cleaned sample for sales. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Sweden. The shaded area shows the range between the 25th and 75th percentile.
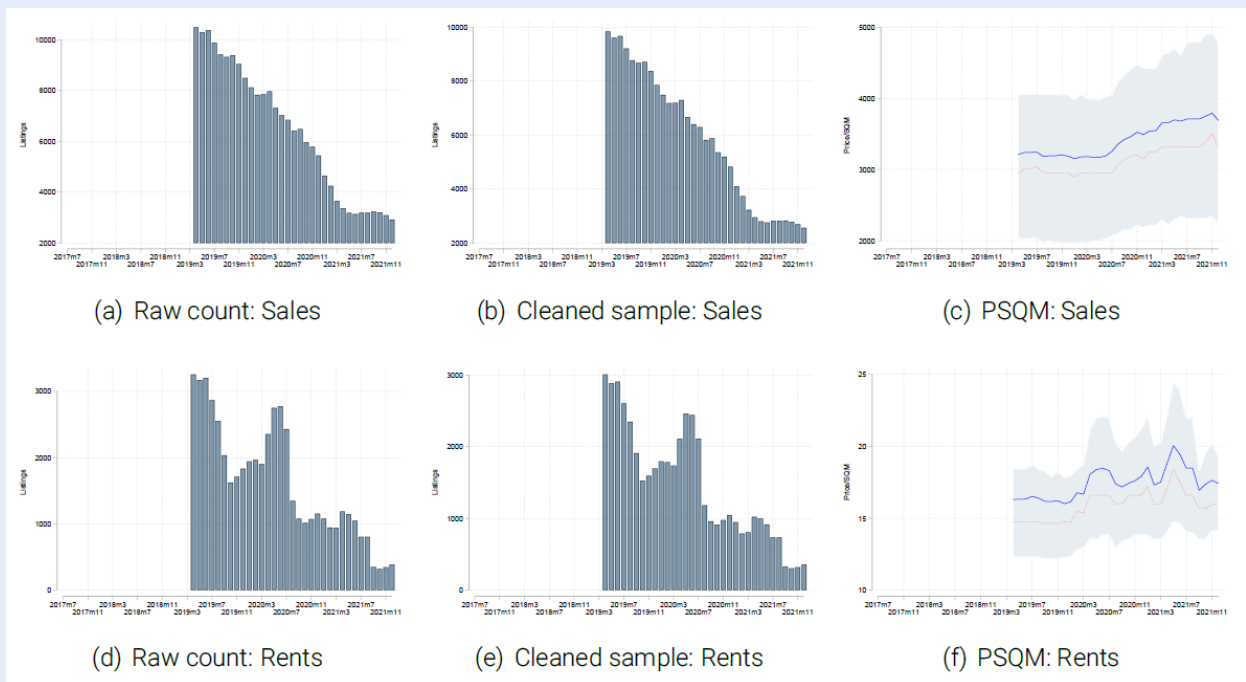
4.17 Scotland

For Scotland, we started scraping the website www.s1homes.com each month starting in April 2019. Figures 20(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. The special issue with Scotland is that the website does not provide square meters but the number of rooms. To provide prices per square meter for Ireland, we transform the number of rooms into square meters using assumptions about the average room size. We assume that a general room has 16 square meters. We then count the number of rooms per object and transform them into square meters. We further transform price in Euro by multiplying prices by 1.18.

Figures 20(b) and (e) thereby report the number of monthly sales and rental advertisements for the Scottish sample after we deploy all cleaning procedures. Figures 20(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Scotland. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 3324 (3042) Euros per square meter for sales. The interquartile range goes from 2065 to 4203. The overall mean (median) for rents is 17.17 (15.67) Euros per square meter, and the interquartile range is between 12.90 and 19.67.

Figure 20
Raw and cleaned sample count and *PSQM* for Scotland (SL)

(a) Raw count: Sales

(b) Cleaned sample: Sales

(c) PSQM: Sales

(d) Raw count: Rents

(e) Cleaned sample: Rents

(f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in Scotland. The shaded area shows the range between the 25th and 75th percentile.
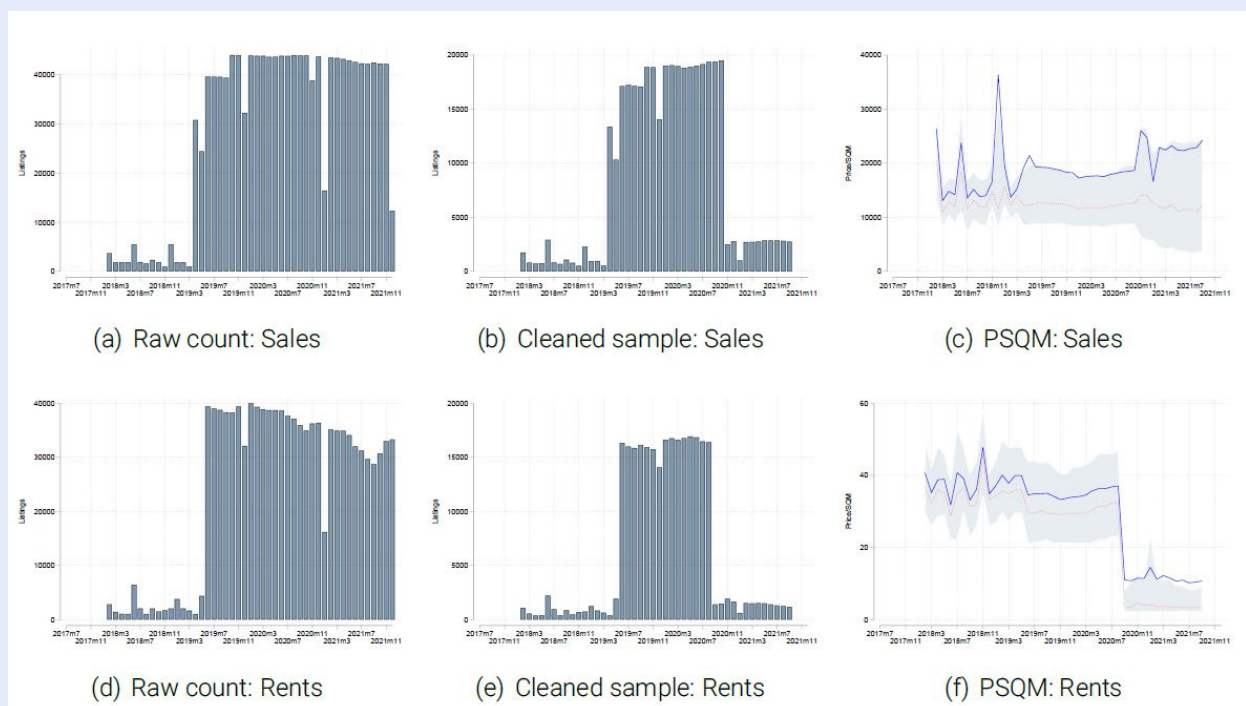
4.18 England

For England, we started scraping the website www.rightmove.co.uk each month starting in March 2018. Figures 21(a) and (d) report the number of monthly sales and rental advertisements, respectively.

For both samples, we undertake the general cleaning steps mentioned in section 2 above. The special issue with England is that the website does not provide square meters, but the number of rooms – bedrooms (average is 15.4 square meters), bathrooms (4.4 square meters on average) – instead. To provide prices per square meter for England, we transform the number of rooms in square meters using assumptions about the average size of a room. We assume that a general room has 76 square meters. We then count the number of rooms per object (if not available, we sum the number of bedrooms and bathrooms) and transform them into square meters. We further transform price in Euro by multiplying prices by 1.18.

Figures 21(b) and (e) thereby report the number of monthly sales and rental advertisements for the English sample after we deploy all cleaning procedures. Figures 21(c) and (f) show prices per square meter for the cleaned sample for sales and rents, respectively. The solid blue lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in England. The shaded area shows the range between the 25th and 75th percentile. The mean (median) across all periods is 3324 (3042) Euros per square meter for sales. The interquartile range goes from 2065 to 4203. The overall mean (median) for rents is 17.17 (15.67) Euros per square meter, and the interquartile range is between 12.90 and 19.67.

Figure 21
Raw and cleaned sample count and *PSQM* for England (GB)

(a) Raw count: Sales

(b) Cleaned sample: Sales

(c) PSQM: Sales

(d) Raw count: Rents

(e) Cleaned sample: Rents

(f) PSQM: Rents

Notes: (a) shows the number of sales advertisements for the raw sample. (b) shows the number of sales advertisements for the cleaned sample. (d) shows the number of rental advertisements for the raw sample. (e) shows the number of rental advertisements for the cleaned sample. (c) and (f) show the price per square meter for the cleaned sample for sales and rents, respectively. The blue solid lines (the orange dotted lines) indicate monthly mean (median) values across all NUTS-3 regions in England. The shaded area shows the range between the 25th and 75th percentile.

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