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RESEARCH ARTICLE OPEN ACCESS

Immigration and Housing Rents: Short-Run Effects of the 2015 Refugee Crisis in Germany

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ABSTRACT

We study the impact of the 2015 mass arrival of refugees in Germany on housing rents. Using data on county-level refugee populations and offers of flats for rent from Germany's leading online property broker *ImmobilienScout24*, we find strong and robust evidence in DiD and IV regressions that refugee immigration adversely affected rental price growth. Additional explorations into native (German) mobility responses, related housing market metrics, and regional effect heterogeneity by prevalence of anti-refugee crimes, crimes against natives involving refugee suspects, neighborhood (1 km grid) characteristics, and local exposure to different types of refugee housing suggest that perceptions of refugee immigration as a (source of) disamenity are major drivers of our findings.

JEL Classification: R21, R23, R31

1 | Introduction

In the course of the 2015 European refugee crisis, which was fueled by the conflict in the Syrian Arab Republic (Middelhoff 2015), nearly one million refugees flowed into Germany, making it the biggest recipient country in absolute terms in the EU (Daldrup 2016).¹ Housing individuals from this largest refugee inflow to Germany since the early 1990s (BAMF 2016a) posed great challenges for state and local authorities, particularly in the heyday of the refugee crisis, in late 2015 and early 2016 (FOCUS 2015a). The sudden and large-scale immigration also raised concerns in the public that natives would face fiercer competition for rental units and potentially higher rental costs (Heising 2015; Psotta 2015), that socially deprived areas might develop (van Suntum 2015), leading to ghettoization (Kather 2015), and that refugee group quarters might adversely affect the value of rental units and privately

owned property located in their vicinity (FOCUS 2015b; Laufer 2015; Stoldt 2014). Little is known, however, on whether such fears had, and have, any justification. Empirical research remains scarce and evidence on rental price effects is lacking for both Germany and other Eurozone countries.²

Furthermore, the broader literature on immigration and housing markets provides little guidance, given its mixed findings and dominant focus on economic rather than forced migration. Addressing this gap in the literature, we provide a first comprehensive analysis of the impact that the 2015 mass arrival of refugees to Germany had on residential housing rents. For methodological reasons, we limit the focus of our analysis to the shorter-run impacts of refugee immigration in late 2015 and early 2016. This restriction in focus aids identification, as it limits the scope for potential endogenous responses in real estate construction activity (supply side responses) and for

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sizeable out-migration of natives as well as potential endogenous regional relocations of refugees (behavioral responses) that could confound the two primary relationships we investigate in this study between regional rental price growth, the scale of regional refugee immigration, and the regional prevalence of different types of refugee accommodation.

Immigration may impact host economies in multiple ways and in different domains, one of which is real estate. As housing rents account for a large share of private spending and personal wealth, they are of vital interest to both policy makers and the public at large. This is particularly true for Germany, where the majority (56%) of privately-occupied property is rented (Destatis 2015), not owner-occupied as in the USA or Great Britain. Despite its importance, however, real estate has only recently caught the interest of economists inquiring into the consequences of immigration, a field of study traditionally biased in focus toward the labor market. Furthermore, the link (if any), and its sign, is all but clear theoretically and unlikely to be just one dimensional in nature. In particular, two prime effects of opposing sign may be at work. Provided the supply of property is relatively inelastic, immigration-driven increases in the demand for rental accommodation are likely to cause upward pressure on prices (rents). However, and working in the opposite direction, prices of property may also decline if natives perceive local settlements of immigrants as a disamenity, an adverse effect that may be stronger for refugee settlements than for economic migrants. Which of the two effects dominates is a priori unclear. To answer this question, empirical evidence is required. In this paper, we will provide such evidence for Germany.

Using unique data on end of year (EoY) county-level refugee populations and data on monthly offers of flats for rent from Germany's leading online property broker *ImmobilienScout24* in difference-in-differences regressions, we find strong evidence for an adverse effect of refugee immigration on rental price growth. A one percentage point increase in the county-level EoY refugee stock (normalized by the 2014 county population) is associated with 0.34 percentage points lower average rental price growth in the last quarter of 2015, and 0.68 percentage points lower average rental price growth in the first quarter of 2016. Notably, overall year-on-year rental price growth in most regions remained positive though, considering base-level growth in housing rents worth 3.1% and 4.5% in the last quarter of 2015 and first quarter of 2016, respectively. However, this growth was attenuated by larger refugee inflows (the mean county-level refugee inflow equaled 1.2% of the 2014 county-level population, ranging between 0.02% and 9.08%). Various robustness checks corroborate this finding, including IV regressions that exploit for identification information on the pre-crisis location of refugee reception centers and public refugee group quarters.

Our first finding of an attenuating effect of large-scale refugee inflows on rental price growth stands in contrast to the positive relationship between mass migration and housing rents found in many related works (Saiz 2003; Tumen 2016; Kürschner 2016). Natives' perception (justified or unjustified) that local refugee settlements, particularly if concentrated in public refugee group

quarter accommodations, are more of a disamenity that lowers rental prices of property than non-refugee migrant settlements may sign responsible for this difference. Our second finding on heterogeneous treatment effects of refugee immigration by local exposure at municipality level to refugee populations and to different types of refugee accommodation supports this interpretation.³ Additional explorations into effect heterogeneity by pre-crisis neighborhood characteristics (at 1 km grid level), pre- and (post-)crisis exposure to anti-refugee crimes (at municipality level), and pre- and (post-)crisis exposure to crimes against natives involving refugee suspects (at county level) also suggest that our findings are attributable, at least in part, to a (perceived) disamenity effect.⁴

Our study relates and contributes to the literature on immigration and real estate in several ways. First, our study is the first to explore for a Eurozone country the link between regional refugee immigration and regional rental prices of property during the 2015 refugee crisis. Second, using novel and detailed data on county-level refugee populations and their composition, our study is also the first to analyze how different types of refugee accommodation (by prevalence of public refugee group quarters at municipality level) affect residential housing rents, a question of direct relevance for public policy. Third, our study is one of but few studies to consider a sudden, unexpected and sizeable inflow of migrants, a setting that aids identification. From a methodological perspective, our focus on forced migrants carries still further advantages. Economically motivated return migration should be a minor phenomenon at best, selection into migration less selective from origin populations, and selection into destination regions less subject to choice and hence confounding influences, being governed, at least in part, by strict between-state distribution and within-state allocation rules in Germany.⁵ Finally, in our hedonic price regressions, we make use of detailed information on property characteristics that goes beyond standard items, such as lot size and age, used in related studies, and control for regional fixed effects in real estate values at a very small administrative level (municipality).

The paper proceeds as follows. Section 2 provides background information on the mass inflow of refugees to Germany in 2015. It also reviews the existing literature on migration (economic or forced) and housing markets. Section 3 outlines our empirical strategy and describes the different data sources we use in the analysis. Section 4 presents and discusses our main findings, probes their robustness in several ways, and considers some additional explorations. Finally, Section 5 summarizes our main findings, discusses potential policy implications, and identifies areas that warrant further research.

2 | Background

2.1 | Previous Research

Studies on immigration and real estate markets are of fairly recent vintage and still comparatively few in number, although research in this area is proliferating rapidly. In fact, immigration-caused demand shocks to real estate markets have begun to attract growing interest in the migration literature

only in the last 20 years. To investigate their effects, studies in this area of research consider spatial variation in migrant inflows or changes in local shares of immigrant populations and changes in rental prices, house prices, or price indices at various levels of regional aggregation. Most, but not all, analyses in this body of literature control for potential endogeneity in regional migrant settlement patterns that may confound the relationship of interest between such inflows and outcomes on real estate markets. For this purpose, different instrumental variables are used, which exploit for identification historical settlement patterns of migrants, also known as the shift-share approach (Card 2001), combinations of exogenous origin-specific push factors of migration and the shift-share approach (Saiz 2007), or geographic proximity between origin and destination regions (Kürschner 2016).

Empirical studies on immigration and real estate markets have produced mixed findings. Most find a positive relationship between immigration (its scale) and housing rents or prices, some a negative relationship, and some no systematic link of any kind. The former group includes studies for the U.S. (Saiz 2003, 2007; Ottaviano and Peri 2007; Mussa et al. 2017), Canada (Akbari and Aydede 2012; Latif 2015), Spain (Gonzalez and Ortega 2013), Switzerland (Degen and Fischer 2017; Adams and Blickle 2018), Italy (Accetturo et al. 2014), Germany (Kürschner 2016; Unal et al. 2024), Poland (Gluszak and Trojanek 2024), and Turkey (Tumen 2016; Balkan et al. 2018).

Of these studies, a handful is closely related to the present study and exploits (in the majority) a natural experiment setting, considering, like us, a sudden, unexpected and sizeable inflow of migrants. The first of these studies, by Kürschner (2016), explores the effects that the mass exodus of East Germans to West Germany following German reunification in 1990 had on rents in West German metropolitan areas. Her results suggest that this migrant inflow to West Germany led to a sizeable surge in rents.⁶

Gluszak and Trojanek (2024), in turn, study the Ukrainian refugee crisis's impact on the housing market in Poland's five largest cities following the Russian invasion in February 2022. They find evidence for significant rent increases in regions with high refugee densities.

Two other closely-related studies, by Tumen (2016) and Balkan et al. (2018), analyze the consequences of the 2015 refugee crisis for Turkey. These studies also find evidence for a rent increase, albeit of different magnitude across rental market segments, which may be driven by an increased demand for residential segregation with respect to ethnicity.

Similarly, exploring the consequences of the Syrian refugee crisis in Jordan, Alhawarin et al. (2021) find evidence that a rising population share of Syrians in the country exerted a negative influence on natives' perceptions of the quality of housing and adversely affected their expectations concerning the future development of rents, particularly among poor households. The results of this study also indicate that regions closer to the Syrian border have been less sensitive to changes in the Syrian population share, which may be partly attributable to the presence of several international donors in the region that

enabled municipalities to cope better with the absorption of refugee inflows.

Finally, in an analysis for the city of Gothenburg in Sweden, van Vuuren et al. (2019) find that solely the announcement of a temporary building site for refugee housing in the wake of the European refugee crisis sufficed to depress prices of residential property within walking distance to such a site.

Complementing these studies, Daams et al. (2019) find that prices in the Netherlands of single-family houses in nonurban locations within one kilometer of asylum seeker reception centers fell by 5.2% to 9.3% over the years 2009 to 2017. Similarly, employing transaction data on houses sold over the years 1990 to 2015 in the Netherlands, Dröes and Koster (2023) find that property within two kilometers of refugee centers suffered price penalties of 3% to 6%. In addition, Lastrapes and Lebesmuehlbacher (2020) find evidence for a negative impact of refugee immigration to the UK on low priced dwellings in the years 2004 to 2015, a finding that may be driven by regions that voted to leave the EU in the Brexit referendum. The results of Lastrapes and Lebesmuehlbacher (2020) are consistent with those of related work for the UK which suggests that immigration (in general) and property prices can be negatively correlated, or not related at all, depending on the price segment one considers (Sá 2014; Braakmann 2019). According to these studies, negative impacts can materialize because of interactions between rental and property markets that are driven by mobility responses of natives and neighborhoods that are changed by immigration. Evidence for such mobility responses of natives to refugee immigration has been found by Andersson et al. (2021) in a study for Sweden.

Most of the studies on immigration and real estate markets reviewed above focus on economic rather than forced migration (the few notable exceptions are Saiz (2003), Tumen (2016), Balkan et al. (2018), Alhawarin et al. (2021), van Vuuren et al. (2019), Daams et al. (2019), Andersson et al. (2021), Dröes and Koster (2023), Gluszak and Trojanek (2024) and Lastrapes and Lebesmuehlbacher (2020)), and few study historical settings that exhibit features encountered and valued in natural experimental environments that aid identification, such as a sudden, unexpected and sizeable inflow of migrants, policy-restrictions on their regional mobility and settlement post arrival, limited return migration, and restricted endogenous selection into migration. Furthermore, regional units of analysis considered in this literature are often quite large, comprising whole metropolitan areas or entire counties. Recent evidence, however, suggests that such levels of aggregation may be too high for unearthing certain kinds of impact that immigration may have on housing markets.

Assessing immediate neighborhood effects within urban areas, Saiz and Wachter (2011) and Accetturo et al. (2014) find that house price growth tends to be relatively slower in residential areas in which migrants predominantly settle than in surrounding neighborhoods that are characterized by lower migrant densities. Likewise, Balkan et al. (2018) provide evidence for potential price premia paid by natives for rental units located in native-dominated residential areas following the mass arrival of Syrian refugees to Turkey, arguing that natives'

demand for residential segregation may have led to positive price effects for upper quality rental units, while lower quality dwellings seem to have been unaffected. Hence, adverse externality shocks of concentrated migrant settlement patterns may well harm rental prices and property values in immediately surrounding areas. In this context, ethnicity, differences in socioeconomic status, and the degree of cultural similarity or distance to natives may be of great importance for natives' perceptions, and changes therein, of the quality of local amenities, and thus for the local demand for residential segregation (Harris 1999; Saiz and Wachter 2011; Accetturo et al. 2014; Tumen 2016; Balkan et al. 2018).

2.2 | Germany and the 2015 European Refugee Crisis

Headlines on fatal boat incidents in the Mediterranean, leaving thousands of shipwrecked migrants dead, began to appear in the news already from the late-2000s (BBC 2007, 2009, 2011). However, it was not until these headlines recurred more frequently (BBC 2015a, b, c), triggered by an exodus of migrants from the Middle East, which was fueled by political instabilities, armed conflicts and state repressions (Keijzer and Schraven 2015), that these shipwrecking events were recognized as the sign of a major crisis which gathered momentum, a crisis that soon would be referred to as “the world’s largest humanitarian crisis since World War II” (ECHO 2015). The outbreak of civil war in the Syrian Arab Republic in 2011 and ISIS’s proclamation of the caliphate in the region in 2014, which resulted in a brutal war of faith (Middelhoff 2015), induced enormous numbers of civilians to abandon their home countries, most of them destined for Europe both seaborne and overland (Faigle et al. 2016), an exodus that sparked and fueled the 2015 European Refugee Crisis. This exodus gained momentum following a press conference on 31st August 2015 in which German chancellor Angela Merkel, faced with large numbers of displaced people persevering at the gates of Europe, declared in a famous statement that “[w]e will make it!” (*Wir schaffen das!*) (Federal Government 2015b). Opening the German border to numerous refugees stranded in Hungary on September 4th (Blume et al. 2016), Merkel announced that there were “no limits on the number of asylum seekers” (The Irish Times 2015) the country would admit.⁷

Germany suddenly found itself in an exceptional situation. More than 17,500 refugee arrivals to Munich central station alone were recorded in the following 2 days, and similar numbers, it appeared, had to be expected for weeks to come (Blume et al. 2016). As depicted in appendix Figure A1, monthly total arrivals of asylum seekers soared in the last 4 months of 2015. These mass arrivals only came to a halt when the *Balkan Route* was closed in March 2016 (European Council 2016; BMI 2016a, b, 2017; bpb 2018). Many Germans got active, helping those who arrived through private donations (monetary, and in kind) and voluntary work of various type (Hoesch 2018). Many also welcomed refugees upon their arrival at train stations throughout Germany (Dewast and Chaturvedi 2015)—gestures and signs of caring that led to the coinage of the term “culture of welcoming”

(*Willkommenskultur*) to characterize the reigning spirit at the time and the positive reception of refugees by large parts of the German population, a phenomenon that received global press coverage and attention (Sueddeutsche Zeitung 2015).

It did not take much time, however, until critics and skeptics began to raise their voice, both within Germany and abroad, and antiforeign sentiments began to spread (Hoesch 2018). Aided by events like the Cologne New Year’s Eve incidents, public opinion started to change and to question ever more forcefully, whether the German open-door policy and culture of welcoming had been short-sighted and wrong (Hewitt 2016; Scheer 2017). (Social) Media platforms were leveraged for antiforeigner campaigns and authorities blamed for their failure to master the administrative and logistical challenges created by the mass arrival of refugees to the country, resulting in heated debates, the stigmatization of refugee migrants, and a polarization of the general public (Erhardt 2015; Haller 2017).

The unexpectedness and scale of the vast migrant influx to Germany led to chaotic circumstances in late 2015 in the registration of refugees and their lodging, and also in the processing of asylum applications. This severely complicated, and in parts made impossible, the statistical recording of actual refugee inflows to different German regions at the time and the collection of high quality stock data on the end-of-year (EoY) spatial distribution of refugees in public registries, such as the *Central Register of Foreigners (Ausländerzentralregister, or AZR)*, as documented in Appendix A. In our analysis, we use high-quality register data on recipients of asylum benefits in accordance with the *Act on Benefits for Asylum Seekers (AsylBLG)* and the *Asylum Act (AsylG)* (Bundestag 2015b). Some of these data are unique special data extracts provided to us by the 16 statistical offices of the German federal states, drawn from the *Statistic on Asylum Seekers’ Benefits*, an EoY compulsory count with full coverage of all individuals receiving any such kind of benefit in Germany.

3 | Empirical Strategy and Data

3.1 | Data and Setting

For our empirical analysis, we make use of two main sources of data, individual property market data from *ImmobilienScout24*,⁸ Germany’s leading online property broker,⁹ and regional data (partly in the form of special data extracts) on EoY refugee populations and their type of accommodation from the *Statistic on Asylum Seekers’ Benefits*.¹⁰

The *ImmobilienScout24* data we use covers the universe of monthly geo-referenced individual offers of flats for rent that were posted on the broker’s website between January 2007 and September 2016. Comprising on average 235 thousand observations on rental apartments per calendar month, the data set covers a large part of the German housing supply and is suitable for the analysis of property prices even at small regional units (Bauer et al. 2013; Georgi and Barkow 2010).¹¹ We pool these offer postings into a pre- and (post-)crisis period, each of 6 months length, which we use in difference-in-differences

YoY Change in Quartely Rental Price Index (2014-15:Q4)

YoY Change in Quartely Rental Price Index (2015-16:Q1)



FIGURE 2 | Regional variation in rent growth, refugee inflows and refugee housing. *Note:* The two maps in the top panel show the year-on-year (YoY) change in rental price indices at county level between the fourth quarters of 2014 and 2015 (top left map), respectively the first quarters of 2015 and 2016 (top right map). The two maps in the lower panel show the EoY refugee stock in 2015 normalized by the 2014 population (bottom left map) and the 2015 EoY refugee share in private apartments (bottom right map). County values are grouped into quintiles and depicted by different shades of gray (darker colors indicate larger values). County-level rental price indices were calculated using the hedonic time-dummy method and the universe of rental price data from 2007 to 2016, following the methodological approach outlined in Bauer et al. (2013). The hedonic regressions were applied to stratified samples at county level, including municipality fixed effects as well as the full set of property-specific characteristics used in this paper. Data used for constructing these maps come from *ImmobilienScout24* (for property data) and special data extracts from the *Statistic on Asylum Seekers' Benefits* (for refugee data).

$$\log rent_{ict} = \mu_m + \tau_t + X'_{ict}\beta + \eta POST_t + \delta POST_t \times \frac{ref_{c2015}}{pop_{c2014}} + \epsilon_{ict}, \quad (1)$$

where $\log rent_{ict}$ is the log base rent (i.e. excluding utilities) in Euro per square meter of flat i in county c in month t . The main explanatory variable is the interaction term $POST_t \times \frac{ref_{c2015}}{pop_{c2014}}$, which measures the 2015 refugee inflow to county c (as approximated by the EoY refugee stock in 2015 and normalized by the 2014 population of county c). $POST_t$ is a dummy variable for the (post-)crisis period, taking value one in the period October 2015 to March 2016, and zero otherwise.¹⁸ The primary coefficient of interest, δ , hence captures the average effect on rental price growth at county level (in percentage points) of an increase in the EoY refugee stock in 2015 equal to one percent

of the initial local population.¹⁹ All regressions include spatial (municipality) and season (month of year) fixed effects, denoted by μ_m and τ_t , and control for various characteristics of flats and their location X_{ict} (a list of these characteristics is provided in Tables B1 and B2 in the appendix).

To control for potential confounding influences at the neighborhood level, we also include as regressors a set of lagged neighborhood characteristics (from 2013) at the one kilometer grid level, which we obtained from the RWI-GEO-GRID (Breidenbach and Eilers 2018; microm Consumer Marketing 2016). These include the unemployment rate (RWI and microm 2017c), the share of the foreign-born population (RWI and microm 2017b), and the share of buildings that are predominantly in commercial use before the crisis (RWI and microm 2017a). These covariates intend to control for location-specific migrant

self-selection and/or selectivity in refugee allocations by responsible authorities that are related to pre-crisis local economic conditions, neighborhoods' ethnic composition, and the structure of the local housing market. All three measures enter both in levels and as interactions with the dummy variable(s) for the (post-)crisis period to capture differential trends in neighborhood-level rental price growth which is related to these location-specific factors.²⁰

4 | Results

4.1 | Main Results

We start by estimating two versions of a simplified variant of the difference-in-differences model specified in Equation (1), in which we consider only the impact of the (size of the) county-level refugee inflow on rent price growth. In both models, we control for regional (municipality) and season (month of year) fixed effects, as well as various characteristics of flats and their location (for a list of these characteristics, see Tables B1 and B2 in the appendix). The first considers the entire 6 month period October 2015 to March 2016 as the (post-)crisis treatment period, the second splits that period into two sub periods of equal length, the last quarter in 2015 and the first quarter in 2016 (see column (1) in Table 1). As motivated in Section 3.2, this split permits us to explore and compare the immediate response and subsequent evolution of rents to the mass arrival of refugees in the heyday of the crisis in late 2015, of which we take stock on 31st December 2015. In additional explorations, we also study the evolution of treatment effects beyond this time period (i.e. up to and including the 3rd quarter of 2016).²¹

For better legibility, we report only estimated coefficients of treatment period indicators and estimated treatment effects for the scale of county-level refugee inflows, i.e. the coefficients on interactions of these period indicators with the 2015 refugee inflow to a county (as approximated by the EoY refugee stock in 2015 and normalized by the 2014 population of the county).²² As can be seen, refugee immigration in 2015 exerted a sizeable adverse effect on rental prices. A one percentage point increase in the 2015 EoY refugee stock (normalized by 2014 county population) is associated with 0.68 percentage points lower year-on-year average rental price growth in the period October 2015 to March 2016.²³ Furthermore, this effect is nearly twice as large in the latter half of this period (first quarter of 2016) than in the first (last quarter of 2015).

We next add controls for lagged neighborhood characteristics (from 2013) measured at 1km grid level. Column (2) reports estimated period and treatment effects of county-level refugee inflows on rent price growth. For all three treatment periods considered (October 2015 to March 2016, last quarter of 2015, and first quarter of 2016), refugee immigration continues to lower year-on-year rent price growth, albeit now somewhat less strongly. Furthermore, these effects are still largest in magnitude in the first quarter of 2016. The importance of local neighborhood characteristics for the size of the estimated treatment effects suggests that property location (at very small spatial level) is vital for the response of property prices to immigration.²⁴ Many studies on immigration and real estate

which we reviewed in Section 2.1, however, consider only quite large regional units of analysis, such as whole metropolitan areas or entire counties, and fail to control for both municipality and neighborhood heterogeneity and their effects on individual real estate prices. Such failure may give rise to bias.

Next, we use this fully-fledged model with lagged neighborhood characteristics (see column (2)) as our baseline model that we subject to various sensitivity tests. As a first robustness check, we change the level of spatial fixed effects that we consider from municipalities to the larger administrative regional unit of counties. As shown in column (3) of Table 1, estimated treatment effects for refugee immigration remain of the same sign and their magnitude decreases somewhat in size. Furthermore, the estimated effect in the first quarter of analysis (October–December 2015) remains no longer statistically significant when we account only for spatial heterogeneity at the broader (less granular) level of entire counties instead of municipalities.

Second, we add interactions of our treatment period indicators with various lagged socioeconomic county characteristics to control for potential differences in rental price trends across counties that may be correlated with the county-level scale of refugee immigration in late 2015. Lagged county characteristics we consider include county-level GDP per capita in 2013, the county-level crime rate in 2013, annual per capita guest arrivals (business and non-business-related) in a county in 2013, annual per capita building permits issued for flats in 2013, and the county-level vacancy rate in 2011. The lagged county-level crime rate and tourism statistic are catch-all variables for county (dis-)amenities pre treatment.²⁵ Lagged building permits and vacancy rates, in turn, capture regional differences in pre-treatment housing market conditions, housing market activity, and housing market prospects. As shown in column (4) of Table 1, our estimated treatment effects for refugee immigration in 2015 increase somewhat in magnitude, remaining negatively signed and statistically significant at the 5% level in the first quarter of 2016.

The results from a battery of further robustness tests are provided in Appendix C. These include sample restrictions to new inflows and outflows of property listings as well as additional controls for: total population growth or the share of refugees housed in private apartments (at county level), rental price regulations (at municipality level), and current time on the market (at individual offer level), provided in Appendix C.3. We also estimate instrumental variables (IV) regressions (see Appendices C.4 and C.5), exploiting for identification arguably exogenous variation (conditional on controls) in refugee inflows across regions, related to the pre-crisis locational infrastructure of publicly-run refugee group quarters and (pre-determined) allocation mechanisms of state and substate authorities governing the regional distribution of refugees.²⁶ Our baseline results are robust (qualitatively, and often also quantitatively) to all of these tests.

Summarizing the above, our first analyses point to adverse consequences of refugee inflows on rental price growth. There is a possibility that regional refugee settlements throughout the 2015 refugee crisis may have been endogenous to pre-trends in

TABLE 1 | Regression results for impact of refugee immigration on rent price growth.

	Dependent variable: $\text{Log}(\text{Rent}/\text{m}^2)$			
	(1)	(2)	(3)	(4)
Treatment periods				
$Oct_{2015} - Mar_{2016}$	0.0434*** (0.0043)	0.0378*** (0.0050)	0.0385*** (0.0050)	0.0243** (0.0050)
$Oct - Dec_{2015}$	0.0357*** (0.0042)	0.0310*** (0.0051)	0.0315*** (0.0050)	0.0201** (0.0099)
$Jan - Mar_{2016}$	0.0509*** (0.0045)	0.0445*** (0.0053)	0.0454*** (0.0053)	0.0287** (0.0123)
Treatment effects—refugee immigration				
$Oct_{2015} - Mar_{2016} \times ref_{c2015} / pop_{c2014}$	-0.6788*** (0.2094)	-0.5156** (0.2104)	-0.4959** (0.2095)	-0.5562* (0.2946)
$Oct - Dec_{2015} \times ref_{c2015} / pop_{c2014}$	-0.4732** (0.1972)	-0.3396* (0.1969)	-0.2992 (0.1997)	-0.3613 (0.2725)
$Jan - Mar_{2016} \times ref_{c2015} / pop_{c2014}$	-0.8737*** (0.2237)	-0.6800*** (0.2262)	-0.6791*** (0.2220)	-0.7379** (0.3175)
Regional fixed effects	Municipality	Municipality	County	Municipality
Seasonal effects	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes
Lagged neighborhood chr.s (1 km grid)	No	Yes	Yes	Yes
Lagged county characteristics	No	No	No	Yes
Observations	1,986,303	1,985,590	1,985,590	1,985,590

Note: The dependent variable is the log of the base rent per square meter posted. For a list of the flat-specific characteristics considered, see Table B1 in the appendix. Lagged neighborhood characteristics (from 2013) at 1 km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. Lagged county characteristics include county-level GDP per capita in 2013, the county-level crime rate in 2013, annual per capita guest arrivals (business and non-business-related) in a county in 2013, annual per capita building permits issued for flats in 2013, and the county-level vacancy rate in 2011. The number of regional fixed effects is 7,187 in specifications (1), (2) and (4), and 402 in specification (3). Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

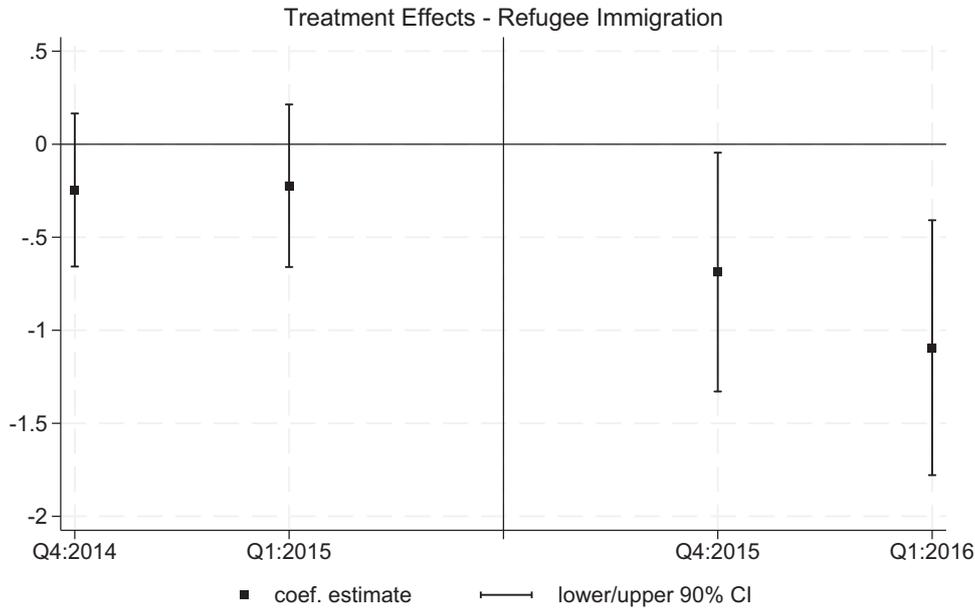


FIGURE 3 | Placebo test II—graphical illustration of pre- and (post-)crisis treatment effects in expanded sample (incl. Oct. 2013–Mar. 2014). Note: Point estimates for the treatment variable $\frac{ref_{c2015}}{pop_{c2014}}$ are marked by a square. Vertical bands indicate the 90% confidence interval for each estimate.

region-specific property price growth. To test for the pretreatment exogeneity of the outcome measure to (post-)treatment intensities in 2015 regional refugee inflows, we carried out placebo tests, in which we regressed rental price data of previous years (i.e. pre crisis) on the corresponding property characteristics and other covariates from our baseline regressions. More precisely, we conducted the exact same analysis as elaborated above, shifting, however, the pooled cross sections of the outcome measure 2 years back in time. The pre- and post-placebo samples of property market data we used for this purpose comprise offers posted on the platform between October 2012 and March 2013 (pre period) as well as between October 2013 and March 2014 (post period). We also considered additional specifications, which include as regressors (like in our baseline analyses) socioeconomic characteristics at 1km grid level (from 2013, to maintain all other aspects from the main analysis). Reassuringly, the results of these tests, reported in appendix Table C2 (Placebo Test I), indicate no systematic link between pre-crisis county-specific trends in rental price growth and 2015 refugee inflows across regions.²⁷

Finally, we formally tested for common pre-trends in the pre-crisis property sample employed in our baseline analysis (October 2014 to March 2015). For this purpose, we expanded our baseline estimation sample to include also the pre-crisis period October 2013 to March 2014 (i.e. common season extension) and augmented our regression model so as to check for treatment effects not only in the (post-)crisis period October 2015 to March 2016, but also in the pre-crisis baseline period October 2014 to March 2015. As in our baseline analysis, we regressed individual offer rents on the treatment variable and corresponding property characteristics, controlling also for regional and month-of-year (i.e. seasonal) fixed effects. Figure 3 plots the corresponding coefficient estimates for refugee immigration. The common pre-trend assumption appears satisfied: Coefficient estimates for the fourth quarter of 2014 and

the first quarter of 2015 are negatively signed, but small and statistically insignificant. The negative point estimates for the (post-)crisis period, in contrast, are much larger in magnitude and also statistically different from zero (albeit somewhat less precisely estimated than in our baseline estimation sample where the 6 months October 2014 to March 2015 constitute the base period). The findings from this Placebo Test II are also consistent with, and corroborated by, our findings from Placebo Test I (described above and summarized in appendix Table C2).

What can explain such adverse effects of refugee inflows on rental price growth? One explanation, and a prime potential causal pathway, is that property prices may decline if natives perceive local settlements of refugees as a disamenity (per se) or a signal and source of future disamenities to be witnessed locally, such as pro- and anti-refugee demonstrations, anti-refugee crimes and attacks on public refugee group quarters, and potential losses in social cohesion of natives and prospective tenants more generally (Albarosa and Elsner 2023). If indeed the case, rent prices of property located closer to refugees and refugee accommodation facilities within a county should be affected more. In the following, we explore such potential effect heterogeneity of county-level variations in refugee inflows by within-county location of property.

For this purpose, we make use of triple interactions that capture differences in our estimated treatment effect for refugee immigration by type of municipality in which a property is located. We focus, for simplicity, exclusively on the (post-)crisis treatment period, which spans the entire 6 months from October 2015 to March 2016. We consider altogether $k = 5$ triple interactions of the form $Oct_{2015} - Mar_{2016} \times ref_{c2015} / pop_{c2014} \times municip_{2015}^k$ that differ only in the binaries $municip_{2015}^k$. These binaries capture whether the municipality in which a property is located houses at the end of 2015: (i) any refugees, (ii) any type of public group

quarter facility (i.e. refugee reception centers or other types of refugee group quarters), (iii) exclusively reception centers, (iv) exclusively other types of public group quarters, or (v) both types of group quarter facilities (reception centers and other types of group quarters).²⁸ Reception centers represent the initial stage of accommodation for refugees, characterized by facilities of considerable scale and density. These centers function as the primary entry point where refugees are provisionally housed during the preliminary processing phase. Initially, each refugee resides in a reception center pending the formal application for refugee status. However, during the 2015 crisis, substantial demand resulted in extended waiting periods of several weeks (see Appendix A for further details on the asylum procedure and recording of asylum seeker arrivals during the 2015 European refugee crisis in Germany). Once the process commenced, transitioning from informal application to formal application and registration, refugees are relocated to either private (self-contained) apartments or alternative public refugee group quarters. Alternative group quarters serve as subsequent stage accommodations, which also maintain significant scale and density. These facilities include repurposed military barracks, former hospitality venues, purpose-built container settlements, and converted educational institutions. Analogous to refugee reception centers, these facilities are designated exclusively for refugee habitation. To ease interpretation of these triple interactions, we center their continuous component $\frac{ref_{2015}}{pop_{2014}}$ at its mean. Positive (negative) values of this demeaned term hence indicate “above” (“below”) average county-level exposure to refugee immigration in 2015. We estimate three different specifications, whose results are shown in Table 2.

The first specification only considers the triple interaction for the presence of refugees in a municipality at the end of 2015 (see column (1)), the second adds the triple interaction for any kind of group quarter in a municipality (column (2)), and the third replaces the triple interaction for any kind of public group quarter with the three triple interactions for reception centers, other public group quarters, and the presence of both reception centers and other public group quarter facilities in a municipality (column (3)). Note that in each specification, we add to our set of regressors also the corresponding double interaction(s) $Oct_{2015} - Mar_{2016} \times municip_{2015}^k$. Estimated coefficients on our triple interactions hence capture the differential impact on the rental price of property in municipalities housing refugees (or different types of group quarter facilities) in 2015 that belong to counties which have been subject to “above” average county-level refugee immigration in 2015. For all specifications, the base category are flats offered for rent in the pre-crisis period which are located in municipalities that housed no refugees at the end of 2015 and which belong to counties with average refugee immigration in 2015. As can be seen from Table 2, rental price growth in this base group amounts to about 3.3%.

As shown in column (1), flats located in municipalities that housed no refugees at the end of 2015 but lie in counties with an ‘above’ average county-level exposure to refugee immigration do not differ in their average rental price growth from that exhibited by this base group, and neither does property in municipalities housing refugees in 2015 that lie in counties

experiencing only average county-level exposure to refugee immigration. Property in municipalities that do house refugees in 2015 and that are also exposed to above average county-level refugee immigration in 2015, however, exhibit sizeably lower and statistically significant growth in rental prices than does property in municipalities with refugees in 2015 that experienced only average county-level inflows of refugees in 2015. County-level refugee immigration one percentage point above average causes rental price growth in such municipalities to be 1.1611 percentage points²⁹ lower than the growth experienced by similar flats in municipalities that do not house any refugees in 2015 and that witness comparable levels of county-level exposure to refugee immigration.

Results reported in columns (2) and (3) of Table 2 show that such effect heterogeneity of county-level refugee immigration by exposure of municipalities to refugees is entirely driven by the presence of group quarters in municipalities (see column (2)), and among such municipalities entirely by those that house reception centers (column (3)). The latter, in fact, witness lower average rental price growth even when their county receives just average refugee inflows in 2015. Taken together, these findings are consistent with, and provide support for, our reading of the evidence reported in Table 1 that the sizeable adverse effects of county-level refugee immigration on rental price growth we found may be explained by natives perceiving the local presence of refugees (‘in the backyard’), particularly when concentrated, as a disamenity which is priced into housing rents.

4.2 | Additional Explorations and Effect Heterogeneity

In the following, we inquire further into the potential causal pathways that may explain our finding of a negative effect of refugee immigration on rental price growth. First, we consider the possibility that regional differences in (the scope for) quantitative supply and demand responses may have been systematically linked to the intensity of treatment at county level. For this purpose, we consider five additional outcome measures at county-month level: the total number of online offers for rent, the share of new offers, respectively last (observations of) offers, in total offers,³⁰ the turnover of offers, and the average dwell time of offers on the platform.³¹ The results are shown in Table 3. As is evident, there is some indication that supply (responses) indeed may have played a role, although the extent of that role remains unclear. The average supply of offers, although lower in the (post-)crisis period, turns out higher in counties which experienced comparably large refugee inflows. The shares of new and last offers in total offers, however, responded in similar fashion in the last quarter of 2015 in these counties. In the first quarter of 2016, in contrast, both shares (inflows and outflows of offers) as well as our third proxy for market liquidity, overall turnover, did increase systematically in counties that witnessed larger refugee immigration. As a consequence, average dwell time of offers on the platform, which declined in the second quarter of the (post-)crisis period, shows no systematic increase in these counties.³²

TABLE 2 | Regression results for impact of refugee immigration on rent price growth by exposure of municipalities to refugees and group quarters in 2015.

	Dependent variable: Log (Rent /m ²)		
	(1)	(2)	(3)
Treatment periods			
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆	0.0329*** (0.0060)	0.0327*** (0.0060)	0.0325*** (0.0060)
Treatment effects—refugee immigration (above mean)			
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	0.4472 (0.3641)	0.4473 (0.3641)	0.4496 (0.3627)
Rent price growth by type of municipality			
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>municipi</i> ₂₀₁₅ ^{refugees}	–0.0015 (0.0062)	0.0049 (0.0057)	0.0043 (0.0057)
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>municipi</i> ₂₀₁₅ ^{any group quarter}		–0.0069* (0.0040)	
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>municipi</i> ₂₀₁₅ ^{reception center}			–0.0173*** (0.0064)
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>municipi</i> ₂₀₁₅ ^{other group quarter}			–0.0006 (0.0052)
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>municipi</i> ₂₀₁₅ ^{reception center+other group quarter}			0.0083 (0.0059)
Treatment effects—refugee immigration (above mean) by type of municipality			
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> ₂₀₁₅ ^{refugees}	–1.0111** (0.4070)	0.9048** (0.8523)	0.9285 (0.8509)
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> ₂₀₁₅ ^{any group quarter}		–1.9426** (0.8885)	
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> ₂₀₁₅ ^{reception center}			–2.0146* (1.1833)
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> ₂₀₁₅ ^{other group quarter}			–1.5954 (1.0031)
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> ₂₀₁₅ ^{reception center+other group quarter}			1.8807 (1.3003)
Municipality fixed effects	Yes	Yes	Yes
Seasonal effects	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes
Lagged neighborhood characteristics (1 km grid)	Yes	Yes	Yes
Observations	1,985,590	1,985,590	1,985,590

Note: The dependent variable is the log of the base rent per square meter posted. For a list of the flat-specific characteristics considered, see Table B1 in the appendix. Lagged neighborhood characteristics (from 2013) at 1 km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. The continuous variable $\frac{ref_{c2015}}{pop_{c2014}}$ is centered at its mean. Municipality-level indicator variables are equal to one if a municipality housed refugees, respectively (particular types of) group quarters, in 2015. The base category in all three specifications are flats offered for rent in the pre-crisis period which are located in municipalities that housed no refugees at the end of 2015 and which belong to counties with average refugee immigration in 2015 ($\approx 1.2\%$), as approximated by the EoY refugee stock in 2015, which we normalize by the 2014 county population. The number of observations in municipalities that in 2015 house refugees is 1,949,402, that house any type of group quarter is 1,772,473, and that house reception centers is 1,093,619. Furthermore, there are 1,723,702 observations in municipalities that have other public refugee group quarters in 2015, and 1,044,848 observations in municipalities that have both reception centers and other group quarters. The number of municipality fixed effects is 7187. Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

TABLE 3 | Further outcomes—supply, offer composition, turnover and dwell time (county-month level).

Dependent variable	Log total offers (1)	Share new offers (2)	Share last offers (3)	Turnover (4)	Average dwell time (5)
Treatment periods					
<i>Oct – Dec</i> ₂₀₁₅	–0.3781*** (0.0325)	0.0062 (0.0092)	0.0256*** (0.0089)	–0.3755*** (0.0868)	–0.0969 (0.1199)
<i>Jan – Mar</i> ₂₀₁₆	–0.4837*** (0.0300)	–0.0201*** (0.0076)	0.0042 (0.0073)	–0.5439*** (0.0551)	–0.2466** (0.1208)
Treatment effects—refugee immigration					
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	7.3385*** (1.8070)	0.4802 (0.6158)	–0.0255 (0.5809)	12.1353 (8.1700)	–6.1109 (8.1112)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	8.8654*** (1.8369)	0.8291* (0.4564)	0.9410** (0.4586)	11.0974** (4.3391)	–5.2545 (6.5142)
County fixed effects	Yes	Yes	Yes	Yes	Yes
Seasonal effects	Yes	Yes	Yes	Yes	Yes
Observations	4824	4824	4824	4824	4824

Note: The table reports regression results for additional outcomes at county-month level: in column (1), supply as measured by the log total number of offers posted on *ImmobilienScout24*; in columns (2) and (3), the share of new inflows, respectively outflows in the total number of offers posted; in column (4), monthly turnover as measured by the average of new inflows and outflows per one thousand population; and in column (5), the average dwell time of offers spent on the platform. Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5% and 10% level.

Second, when the elasticity of housing supply is sufficiently low, current as well as anticipated changes in perceived (dis-) amenities will be directly capitalized into housing rents. Refugee immigration, if indeed seen as a disamenity, should hence lower rental price growth. Our findings of heterogenous treatment effects of county-level refugee immigration by municipality-level exposure to refugee settlements and type of refugee housing (see Section 4.1) suggest that such a mechanism indeed has been at work. To explore this channel further, we study potential effect heterogeneity of county-level refugee immigration at the sub-county level, i.e. by neighborhood composition in terms of pre-crisis socioeconomic features (in 2013). Specifically, we stratify our estimation sample along different dimensions, considering as cutoffs top quartiles of the 1km grid-level distributions of age-gender groups, respectively residential area types in terms of property composition.³³ As shown in appendix Table C5, which considers effect heterogeneity by neighborhood composition in terms of age-gender groups, some clear patterns emerge which suggest that refugee immigration indeed may have been perceived as a local disamenity. Negative treatment effects for the scale of refugee immigration are highly pronounced for neighborhoods in which comparably large shares of young children (aged 0–10 years) and adolescents (11–20 years) resided in 2013. The same effect is observable also in neighborhoods characterized by particularly large proportions of young female residents in 2013.

Such effect heterogeneity may reflect general safety concerns about elevated risks to fall victim to a crime, especially for young women, given the marked dominance of young men among 2015 regional refugee populations.³⁴ Native parents might also have been concerned that their children could face fiercer competition for educational resources. Consistent with a

‘threat’ version of the contact hypothesis initially formulated by Allport (1954), such concerns may materialize not only in immediate rental price growth penalties, but also induce residents to move out of localities where refugees reside and/or are expected to reside in the future, fueling demand for segregation. To explore whether such demand indeed increased, we examined spatial relocation responses by natives to refugee immigration, using county-level information on between-county and within-rural-county (i.e. between municipality) movements of German citizens from 2014 to 2016.

Table 4 summarizes, by gender, the results from regressions that consider as dependent variable the change (between 2014 and 2015, respectively 2014 and 2016) in the county-level immigrant share (columns (1) and (2)), the county-level emigrant share (columns (3) and (4)), and the county-level internal migrant share (columns (5) and (6)) of German citizens, measured respectively by their total cross-county-border relocations and cross-municipality-border relocations within rural counties, normalized by the recipient, respectively sending, county’s pre-crisis German population in 2014. Covariates used include the treatment variable and a set of lagged county-specific controls (GDP per capita, the foreign population share and the crime rate in 2013).³⁵ Strikingly, and consistent with our finding on spatial effect heterogeneity by age-gender composition, female but not male Germans responded vividly to refugee immigration by relocating spatially. Counties that received comparably large refugee inflows witnessed a systematic drop in female immigration. Associated regression coefficients are more precisely estimated for changes between 2014 and 2016. However, relocation responses are clearly visible already in the advent of the crisis (i.e. for changes between 2014 and 2015). Moreover, within-rural-county relocations of both males and females

TABLE 4 | Further outcomes—intra- and cross-county spatial relocation of Germans.

Dependent variable	$\Delta \frac{\text{Immigrants}_{c\text{German}}}{\text{POP}_{c2014,\text{German}}}$		$\Delta \frac{\text{Emigrants}_{c\text{German}}}{\text{POP}_{c2014,\text{German}}}$		$\Delta \frac{\text{Internal migrants}_{c\text{German}}}{\text{POP}_{c2014,\text{German}}}$	
	2014–15 (1)	2014–16 (2)	2014–15 (3)	2014–16 (4)	2014–15 (5)	2014–16 (6)
Treatment effects—refugee immigration	Females					
ref_{c2015}/pop_{c2014}	−0.0698* (0.0399)	−0.0790** (0.0319)	−0.0362 (0.0382)	−0.0777 (0.0592)	0.0275*** (0.0093)	−0.0003 (0.0134)
	Males					
ref_{c2015}/pop_{c2014}	−0.0095 (0.0320)	−0.0424 (0.0280)	−0.0380 (0.0449)	−0.0575 (0.0539)	0.0275** (0.0109)	0.0154 (0.0155)
	Females & Males					
ref_{c2015}/pop_{c2014}	−0.0206 (0.0176)	−0.0311** (0.0138)	−0.0184 (0.0205)	−0.0341 (0.0281)	0.0138*** (0.0044)	0.0037 (0.0069)
Lagged county characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Observations	402	402	402	402	295	295

Note: The table reports regression results for additional outcomes at county level: in columns (1) and (2), the dependent variable is the change between 2014 and 2015, respectively 2014 and 2016, in the county-level German immigrant share, measured by total cross-county-border relocations of German citizens into a county, normalized by the 2014 recipient county's German population; in columns (3) and (4), the dependent variable is the change between 2014 and 2015, respectively 2014 and 2016, in the county-level German emigrant share, measured by total cross-county-border relocations of German citizens out of a county, normalized by the 2014 sending county's German population; and in columns (5) and (6), the dependent variable is the change in within-rural-county, cross-municipality-border relocations of German citizens between 2014 and 2015, respectively 2014 and 2016. The data to construct these outcomes were obtained from the regional database of the German Federal Statistical Office. Standard errors are robust to heteroscedasticity. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

systematically increased (from 2014 to 2015) in the level of local refugee immigration.

Estimated effect heterogeneity by residential area type (in terms of property composition) provides further evidence that refugee immigration is systematically valued differently in different regions. As shown in Table 5, and consistent with our findings on neighborhood composition by age-gender groups, 1 km grids with large shares of detached and semi-detached (one to two family) houses, i.e. neighborhoods with presumably fewer refugees, have witnessed rental price growth that increases, albeit imprecisely estimated, in the scale of refugee immigration at county level. Neighborhoods characterized by multi family houses, particularly large scale apartment blocks with ten or more dwellings, on the other hand, experienced lower rental price growth if refugee immigration at county level was larger. Such neighborhoods (within counties) arguably saw larger inflows of refugees than the first type of neighborhoods considered. This effect heterogeneity by residential area type is consistent with related findings for the Syrian refugee crisis in Turkey (Tumen 2016; Balkan et al. 2018) and provides tentative support for a (demand for) residential segregation story.

Risks (perceived or real) of increased crime by refugees against resident populations as well as the spread and intensification of anti-refugee or antiforeign sentiments and corollaries thereof, such as demonstrations and violence against foreigners or refugee group quarters, could have been major triggers of disamenity perceptions, and hence, potential drivers of our results. To explore this possibility, we studied spatial treatment effect heterogeneity by exposure to both pre-crisis and crisis criminal activities of the kind described above using three additional data sources. The first consists of special data extracts from the *Police*

Crime Statistics of the Federal Criminal Police Office (Bundeskriminalamt), high-quality administrative data which comprise detailed information (at county-level) on crimes against natives with refugee suspects.³⁶ The second data source provides information on attacks against refugee group quarters by right-wing extremists, collated from reports by the *German Parliament* (see Bundestag (2015a, 2016a)). The third data source provides records on any type of anti-refugee crime, including individual assaults and attacks. Records stem from a chronicle of newspaper reports and statistics of state authorities, assembled and provided online by *Courage against right wing violence (Mut gegen rechte Gewalt)*, a platform run by two nongovernmental organizations, *PRO ASYL* and the *Amadeu Antonio Foundation* (see PRO ASYL and AAF (2018)).

Table 6 reports estimated impacts of refugee immigration on rent price growth by county-level exposure of natives (Germans) in crimes with refugee suspects. To capture such potential effect heterogeneity, specifications in columns (1) through (4) include triple interactions of quarterly (post-)crisis period dummies, refugee immigration (centered at the mean) and binaries that indicate if a property is located in a county that belongs to the top quintile of the county-level distribution in 2014 (columns (1) and (3)) or 2015 (columns (2) and (4)) of either the number of refugee suspects in crimes with German victims (columns (1) and (2)) or the number of German victims in crimes involving at least one refugee suspect (columns (3) and (4)), normalized respectively by pre-crisis (2014) county population size. The base category in all specifications consists of apartments offered for rent in the pre-crisis period which are located in counties with below top-quintile exposure to crimes against natives and average exposure to refugee immigration in 2015. As can be seen in Table 6, rental price growth is positive in these regions.

TABLE 5 | Heterogenous treatment effects—residential area by top quartile property type at 1 km grid level (2013).

	Dependent variable: Log(Rent/m ²)		
	(1)	(2)	(3)
Treatment periods			
<i>Oct – Dec</i> ₂₀₁₅	0.0254*** (0.085)	0.0296*** (0.0059)	0.0310*** (0.0082)
<i>Jan – Mar</i> ₂₀₁₆	0.0281*** (0.0099)	0.0409*** (0.0064)	0.0484*** (0.0078)
Treatment effects—refugee immigration			
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	0.2378 (0.4159)	−0.3398** (0.1700)	−0.3862* (0.2241)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	0.8693 (0.5532)	−0.6116*** (0.2075)	−0.7895*** (0.2513)
Strata—top 25% (at 1 km grid level)	1–2 Family house detached & semi- detached	Multi family house with 3–9 dwellings	Multi family house with ≥ 10 dwellings
Observations	70,876	930,195	1,410,345
Municipality fixed effects	5106	3016	2450
Seasonal effects	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes
Lagged neighborhood characteristics (1km grid)	Yes	Yes	Yes

Note: The dependent variable is the log of the base rent per square meter posted. Regression results for stratified samples according to top quartiles of residential building composition along the 1 km grid level distribution are reported. For a list of the flat-specific characteristics considered, see Table B1 in the appendix. Lagged neighborhood characteristics (from 2013) at 1 km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

Moreover, flats located in counties that are not subject to top-quintile crime exposure but exhibit “above” average refugee immigration do not differ in their average rental price growth from flats in the (respective) base group. Property that lie in crime prone counties with only average county-level exposure to refugee immigration, in contrast, tend to exhibit higher rental price growth than flats in base regions (predominantly in the second quarter of our analysis). Most important, however, there is a clear pattern that rental price growth was harmed more in counties that witnessed both “above” average refugee immigration in 2015 and a high degree of criminal activity by refugees against natives. Moreover, counties that witnessed high victimization rates of Germans in crimes with refugee suspects, in particular throughout the year 2014 (i.e. pre crisis), are characterized by comparably low rental price growth, which suggests that past adverse experiences with refugee crimes against natives have fueled, and in part signed responsible for, perceptions among native populations that large scale refugee immigration is a disamenity. In the aftermath of the Cologne New Year’s Eve incidents, concerns about refugee crimes resurged, which may explain the greater price growth penalties estimated for the first quarter of 2016.

As shown in Table 7, heterogenous treatment effects are visible also by municipality-level exposure to anti-refugee crimes, suggesting that local scaring effects from attacks against refugees and their shelters, as well as fears that such events might reoccur, may have materialized in rental price growth

penalties.³⁷ Analogous to our analysis of spatial effect heterogeneity by exposure to crimes against natives discussed before, we add to our baseline regression model triple interactions of quarterly dummies for the (post-)crisis period, refugee immigration (centered at the mean) and a set of binaries that indicate if a property is located in a municipality that witnessed at least one extremist-right attack against refugee group quarters (columns (1) to (3)), respectively any type of anti-refugee crime (columns (4) to (6)), in either 2014, 2015, or 2014 and 2015. Flats in the base category hence comprise apartments offered for rent in the pre-crisis period which are located in municipalities that have not witnessed an anti-refugee crime (as measured by the binaries described above) in either 2014, 2015, or 2014 and 2015 and that lie in counties with average refugee immigration in 2015. Again, rental price growth is positive in these regions.

Moreover, flats located in municipalities that did not witness associated types of anti-refugee crimes but belong to counties with ‘above’ average county-level refugee immigration do not differ in their average rental price growth from that of the respective base group. The same holds true for property in municipalities that were struck by such anti-refugee crime but that lie in counties, which experienced only average county-level exposure to refugee immigration. Property located in municipalities that witnessed both anti-refugee crimes in either 2014, 2015 or 2014 and 2015 and also “above” average county-level refugee immigration in 2015, however, exhibit sizeably

TABLE 6 | Heterogenous treatment effects—exposure to crimes against natives involving refugee suspects by top quintile of county-level crime distributions.

	Dependent variable: Log (Rent/m ²)			
	(1)	(2)	(3)	(4)
Treatment periods				
<i>Oct – Dec</i> ₂₀₁₅	0.0256*** (0.0033)	0.0256*** (0.0034)	0.0252*** (0.0035)	0.0256*** (0.0035)
<i>Jan – Mar</i> ₂₀₁₆	0.0346*** (0.0035)	0.0340*** (0.0035)	0.0341*** (0.0036)	0.0343*** (0.0036)
Treatment effects—refugee Immigration (above mean)				
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	0.0648 (0.4078)	0.2202 (0.3578)	0.1038 (0.3980)	−0.0154 (0.3773)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	0.0537 (0.4151)	0.0152 (0.3355)	−0.0421 (0.3807)	−0.2550 (0.3635)
Rent price growth by type of county				
<i>Oct – Dec</i> ₂₀₁₅ × <i>count y</i> ^{crime} _y	0.0071 (0.0048)	0.0076 (0.0047)	0.0095* (0.0050)	0.0064 (0.0048)
<i>Jan – Mar</i> ₂₀₁₆ × <i>count y</i> ^{crime} _y	0.0095* (0.0057)	0.0110* (0.0057)	0.0119* (0.0061)	0.0086 (0.0060)
Treatment effects—refugee immigration (above mean) by type of county				
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>count y</i> ^{crime} _y	−0.6831 (0.4606)	−0.9230** (0.4256)	−0.8123* (0.4680)	−0.5404 (0.4580)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>count y</i> ^{crime} _y	−1.1365** (0.4835)	−1.1536*** (0.4296)	−1.0893** (0.4799)	−0.6980* (0.4757)
Interaction term—top 20% (at county level)				
Year (y) committed	2014	2015	2014	2015
# Observations by top 20% type of county	776,803	873,717	817,348	844,961
Municipality fixed effects	Yes	Yes	Yes	Yes
Seasonal effects	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes
Lagged neighborhood characteristics (1 km grid)	Yes	Yes	Yes	Yes
Observations	1,985,590	1,985,590	1,985,590	1,985,590

Note: The dependent variable is the log of the base rent per square meter posted. For a list of the flat-specific characteristics considered, see Table B1 in the appendix. Lagged neighborhood characteristics (from 2013) at 1 km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. The continuous variable $\frac{ref_{c2015}}{pop_{c2014}}$ is centered at its mean. County-level indicator variables are equal to one if a county belongs to the top quintile of the county-level distribution of: (a) the number of refugee suspects in crimes with German victims in 2014 (column 1), respectively 2015 (column 2), normalized in both cases by the 2014 population of a county; and (b) the number of German victims in crimes with refugee suspects in 2014 (column 3), respectively 2015 (column 4), normalized again in both cases by the 2014 population of a county. Data used to construct these indicators have been obtained in the form of special data extracts from the *Police Crime Statistics of the Federal Criminal Police Office (Bundeskriminalamt)*. The base category are flats offered for rent in the pre-crisis period which are located in counties with below top-quintile exposure to crimes against natives that involved at least one refugee suspect in 2014 (2015) and average exposure to refugee immigration in 2015 ($\approx 1.2\%$), as approximated by the EoY refugee stock in 2015, which we normalize by the 2014 population of a county. The number of municipality fixed effects is 7187. Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

lower and statistically significant rental price growth in the first quarter of 2016. Furthermore, property located in municipalities that became subject to any type of crime against refugees in 2014 (pre crisis), or exposed to such crimes both in 2014 and again in 2015, are characterized by statistically significant lower rental price growth already in the heyday of the crisis (i.e. the last quarter of 2015). What is more, the negative rental price growth penalty is largest for property in municipalities that bore

anti-refugee crimes both in 2014 and 2015 and also experienced ‘above’ mean refugee immigration.³⁸

Summarizing the above, the evidence from our effect heterogeneity analyses and additional explorations strongly suggests that local residents perceived large scale refugee settlements in their region as a disamenity. In the shorter run, the capitalization of such disamenity perceptions is most clearly visible in

TABLE 7 | Heterogenous treatment effects—exposure to anti-refugee crimes at municipality level.

	Dependent variable: Log(Rent/m ²)					
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment periods						
<i>Oct – Dec</i> ₂₀₁₅	0.0263*** (0.0036)	0.0278*** (0.0034)	0.0263*** (0.0036)	0.0265*** (0.0036)	0.0286*** (0.0033)	0.0266*** (0.0036)
<i>Jan – Mar</i> ₂₀₁₆	0.0347*** (0.0037)	0.0357*** (0.0035)	0.0349*** (0.0037)	0.0349*** (0.0036)	0.0364*** (0.0034)	0.0351*** (0.0036)
Treatment effects—refugee immigration (above mean)						
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-0.1495 (0.2607)	0.0007 (0.2531)	-0.1107 (0.2548)	0.0059 (0.2519)	-0.0312 (0.2346)	0.0025 (0.2491)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-0.3230 (0.2861)	-0.1575 (0.2085)	-0.2800 (0.2820)	-0.2487 (0.2874)	-0.2807 (0.2087)	-0.2330 (0.2837)
Rent price growth by type of municipality						
<i>Oct – Dec</i> ₂₀₁₅ × <i>municipi</i> _y ^{anti-refugee crime}	0.0045 (0.0061)	-0.0019*** (0.0037)	0.0052** (0.0065)	0.0038 (0.0056)	-0.0044 (0.0036)	0.0037 (0.0059)
<i>Jan – Mar</i> ₂₀₁₆ × <i>municipi</i> _y ^{anti-refugee crime}	0.0099 (0.0070)	0.0021 (0.0044)	0.0109 (0.0074)	0.0087 (0.0065)	-0.0003 (0.0043)	0.0095 (0.0068)
Treatment effects—refugee immigration (above mean) by type of municipality						
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> _y ^{anti-refugee crime}	-0.4402 (0.3765)	-0.4987 (0.3416)	-0.5387*** (0.3860)	-0.7093** (0.3923)	-0.4489 (0.3281)	-0.7138* (0.4022)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014} × <i>municipi</i> _y ^{anti-refugee crime}	-0.8051* (0.4156)	-0.7723** (0.3487)	-0.9288** (0.4259)	-0.9305** (0.4372)	-0.5856* (0.3457)	-0.9882** (0.4444)
Type of anti-refugee crime (municipality level)						
Year (y) committed	2014	2015	2014 and '15	2014	2015	2014 and '15
# Municipalities by type of anti-refugee crime	103	534	39	163	635	79
# Observations by type of anti-refugee crime	605,496	1,221,882	567,704	682,595	1,284,478	645,764
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal effects	Yes	Yes	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes	Yes	Yes

(Continues)

TABLE 7 | (Continued)

	Dependent variable: Log (Rent/m ²)					
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged neighborhood characteristics (1 km grid)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,985,590	1,985,590	1,985,590	1,985,590	1,985,590	1,985,590

Note: The dependent variable is the log of the base rent per square meter posted. For a list of the flat-specific characteristics considered, see Table B1 in the appendix. Lagged neighborhood characteristics (from 2013) at 1km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. The continuous variable $\frac{rent_{2015}}{rent_{2014}}$ is centered at its mean. Municipality-level indicator variables are equal to one if a municipality witnessed in the year 2014 and/or 2015 at least one attack against a refugee group quarter committed by right extremists (columns (1) to (3)), respectively any type of anti-refugee crime recorded in the public chronicle of *Courage against right wing violence (Mut gegen rechte Gewalt)* (columns (4) to (6)). Data used to construct these indicators have been obtained from reports by the *German Parliament (Bundestag 2015a, 2016a)* (for data on right wing attacks against refugee group quarters) and from a collation by two nongovernmental organizations, i.e. *PRO ASYL* and the *Amadeu Antonio Foundation (PRO ASYL and AAF 2018)*, (for the public chronicle data). The base category are flats offered for rent in the pre-crisis period which are located in municipalities that did not witness such type of anti-refugee crime in year 2014 and/or 2015 and which belong to counties with average refugee immigration in 2015 ($\approx 1.2\%$), as approximated by the EoY refugee stock in 2015, which we normalize by the 2014 county population. The number of municipality fixed effects is 7,187. Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

vicinity of large scale refugee settlements that appeared in the heyday of the crisis, as our analysis of heterogenous treatment effects by municipality-level exposure to refugees, respectively, different types of group quarter housing for refugees, has shown. However, even in surrounding regions, property price growth appears to have stagnated. Fears of refugee crimes against natives and of growing antiforeign sentiments appear in part to sign responsible for these price changes, as our analyses of spatial effect heterogeneity at various levels of aggregation and associated explorations into natives' relocation responses suggest.

5 | Conclusion

In this study, we investigated the shorter-run impacts of the 2015 mass arrival of refugees to Germany on residential housing rents. Using unique data on end of year county-level refugee populations and data on monthly offers of flats for rent from Germany's leading online property broker *ImmobilienScout24*, we found strong evidence in difference-in-differences regressions for a negative effect of refugee immigration on rental price growth. Various sensitivity analyses corroborated this finding, including IV regressions that exploit for identification information on the pre-crisis location of refugee reception centers and other public group quarters.

Our first finding of an attenuating effect of refugee immigration on rental price growth does not agree with earlier findings in related studies which found a positive relationship between mass immigration and housing rents (Saiz 2003; Kürschner 2016). While the reasons for this may be multifaceted, a likely prime factor is that refugees are simply different from other (economic) immigrants, at least in the subjective perceptions of natives. Natives' perceptions (justified or unjustified) that local refugee settlements, particularly if concentrated, are more of a disamenity that lowers rental price growth of property than non-refugee migrant settlements may sign responsible for our findings. Our findings of spatial effect heterogeneity of refugee immigration by local exposures to different types of refugee accommodation as well as in samples stratified by the prevalence of certain neighborhood-level characteristics, respectively, by exposure to anti-refugee crimes and crimes against natives involving refugee suspects, are consistent with this view and suggest an important role of such '*not in my backyard*' (NIMBY) perceptions of natives for real estate market outcomes.

Importantly, and related, our findings show that the costs of refugee immigration for dwellers and landlords were, at least in part, determined by policy, i.e. the distributional policies and housing decisions of state authorities. While retrospective advice on what could have been done better is always difficult, and in the present context also likely misplaced, given the multiplicity of matters of concern to policy makers at the time and the great urgency to manage this unexpected and large inflow of refugees, our results do indicate clear costs of the decisions that were taken, costs that could be avoided, or at least lessened, in the future handling of refugee immigration and refugee housing. Disproportionate regional refugee immigration (allocation) distorts regional housing markets unequally

and lowers price growth more in regions that experience larger refugee inflows. A more equitable distribution of refugees across regions would hence lead to a more equitable distribution of such cost across regions. Similarly, a more expeditious transfer of new refugee arrivals from public refugee group quarters to private apartments would attenuate the size of rent penalties attached to the local housing of refugees. Adopted amendments to the existent legislation (Act on the Acceleration of Asylum Procedures (AsylVfBeschlG)) in the heyday of the crisis, which extended the requirement for asylum seekers to live in a designated reception center (or affiliated branch thereof) from at most 3 to at most 6 months, appear counter-productive in this respect and cast doubt on whether such benefits from a more equitable and dispersed allocation will be reaped in the future.

Further research is required to better understand the nature of potential ‘*not in my backyard*’ perceptions of natives and the importance of such perceptions for real estate market outcomes, both across time and for different types of neighborhoods and property. Single-family houses and flats for sale are of particular interest in this respect, as demand for such property should have received no direct stimulus from refugee immigration. Analyses of offer prices for such property would aid the identification, and detailed study, of local demands for segregation and *NIMBY* perceptions that make refugee settlements a disamenity lowering property price growth.

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Data Availability Statement

Please note that our paper uses proprietary data that we are not authorized to post. We therefore request an exemption from the data policy. We will provide programs that allow replication of all of the results in the paper, along with a file that describes how the data can be obtained or accessed, how the programs can be used to replicate the results, and any manipulation that was carried out to obtain the data in the data set. Replication can also at any time be carried out at RWI – Leibniz Institute for Economic Research in Essen, Germany, where the data are stored. We will fully cooperate with investigators seeking to conduct a replication.

Endnotes

¹We consider as ‘refugees’ all individuals who arrived in Germany in 2015 and registered informally as seeking protection with the intend

to lodge a formal asylum application, irrespective of their later residence status and the outcome of their asylum application. We hence, and henceforth, use the terms ‘refugee’ and ‘asylum seeker’ interchangeably. In practice, the classification of individuals into different categories/types of immigrants, in particular refugee migrants and other types of protection-seeking immigrants including asylum seekers, faces various difficulties (Hoesch 2018).

²Three recent studies have explored the consequences of the Syrian refugee crisis for property markets in Turkey (Tumen 2016; Balkan et al. 2018), respectively Jordan (Alhawarin et al. 2021). A further study (Lastrapes and Lebesmuehlbacher 2020) has analyzed the effects of refugee immigration for property markets in the UK, albeit over an extended period (2004 to 2015) that mostly predates the 2015 crisis. Similarly, Daams et al. (2019) and Dröes and Koster (2023) find negative price effects for houses sold in vicinity of refugee centers in the Netherlands over the years 2009 to 2017 and 1990 to 2015, respectively. Closely related are also the studies by Saiz (2003) and Kürschner (2016). The seminal study by Saiz (2003) explored the effects of the Mariel Boatlift to Miami, laying the foundation for a new branch of literature in economics on immigration and housing markets. Kürschner (2016), in turn, examined the consequences for regional property markets of the mass influx of East Germans to West Germany following the fall of the Berlin Wall.

³A repeated choice experiment by Liebe et al. (2018) provides evidence that is consistent with this reading of our results. Investigating the attitudes of Germans towards refugee accommodations in their neighborhoods, the study finds that the majority of Germans rather disapprove of refugee housing in vicinity of their neighborhoods and that this view has not changed over the twelve months since November 2015, i.e. the time which saw the internationally much-lauded “culture of welcoming” (*Willkommenskultur*) of the German public at its peak, a culture that received much coverage in the media and was actively promoted by politicians (Dewast and Chaturvedi 2015; *Sueddeutsche Zeitung* 2015). The study also found that about one fifth of the surveyed population which had formerly rather approved of the establishment of refugee accommodations in their vicinity no longer did so in 2016. According to Liebe et al. (2018), this change in attitude may, at least in part, be attributable to growth in ‘*not in my backyard*’ (*NIMBY*) perceptions (Dear 1992) among the surveyed population. Such change in perceptions were potentially fueled by the 2015 Cologne New Year’s Eve incidents (see Section 2.2).

⁴Our findings on the impact of refugee immigration on rental price growth during the refugee crisis and its immediate aftermath (the years 2015 and 2016) are likely to be indicative also of the longer-run rental price effects of this wave of immigration. The reason is that property prices reflect both the current value of local (dis)amenities and expectations about future changes in these (dis)amenities and their values. As residential (rental) property is a major tangible and immobile asset, any change of relevance for property values (present or future) tends to be immediately priced in by actors in the market for rental housing. The use of offer price data from *ImmobilienScout24* in our study is highly advantageous in this context. *ImmobilienScout24* allows modifications to existing offer postings (including rent prices) at any time. This facilitates the identification of (even instantaneous) pricing responses.

⁵Refugees entering Germany are distributed by authorities across the country’s 16 federal states according to the Koenigstein Key (*Königsteiner Schlüssel*), a pre-defined state-level refugee allocation quota based on demographic and economic characteristics of states. In constructing the key, state populations receive a weight of 1/3 and tax revenues a weight of 2/3. The allocation quota is calculated annually based on tax and population statistics that date 2 years back (GWK 2017; German Federal Social Insurance Authority 2016).

⁶Other recent studies for Germany focusing on non-refugee immigration are Unal et al. (2024) and Eilers et al. (2021). Unal et al. (2024) study the effects of labor-related migration on housing prices

across 382 German districts. Their findings indicate substantial heterogeneity in the impact of immigration on housing prices, with stronger effects in regions characterized by tighter housing markets and limited supply elasticity. Eilers et al. (2021), in turn, study rental price disparities between overall migrant and native populations in Germany in the years 2007–2012. They find that migrants often pay a premium for rentals compared to natives, even after controlling for observable characteristics.

⁷On 24th August, Germany invoked the ‘sovereignty clause’ in accordance with the *Dublin III Regulation (No. 604/2013)* for humanitarian reasons, thereby suspending the hitherto strictly enforced Dublin procedure, according to which asylum seekers had to file their asylum claims in the very country in which they first had entered the European Union. Syrian refugees who made it to Germany could therefore henceforth apply for asylum in Germany (ECRE 2015).

⁸See <https://www.immobilienscout24.de/>. A detailed description of the data is provided in Bauer et al. (2013).

⁹According to the *Unique Visitors* ranking of *comScore Media Matrix*, a market research institution, *ImmobilienScout24* had a market share of approximately 63% of the German online property market in March 2016 (*ImmobilienScout24* 2017). This figure, however, understates *ImmobilienScout24*’s true market coverage. Overlap between ads posted on *ImmobilienScout24* and competing online real estate brokers as well as alternative means to property marketing is large, as landlords and letting agents typically market available property via several available channels.

¹⁰See Destatis (2016) for a detailed description of this statistic.

¹¹Recent studies have used *ImmobilienScout24* data to analyze, amongst others, the consequences of location-specific exogenous shocks for regional house prices in Germany, such as nuclear power plant closures following the Fukushima Daiichi incident in 2011 (Bauer et al. 2017) or the establishment of wind turbines (Frondel et al. 2019).

¹²Additional explorations employ an extended sample to inquire into the evolution of treatment effects up to and including September 2016 (see Appendix C.1).

¹³We exclude flats with a listed rent per square meter below one Euro or above 100 Euro, flats with a living space below six and above 500 square meters, flats for which the number of rooms exceeds ten or is less than one, flats which are aged 200 years or more, and flats that are still under construction with an expected duration until completion that exceeds 2 years. We also exclude flats with more than five bathrooms, flats that are located above the 87th floor or below the lower ground floor, and flats that are dilapidated.

¹⁴The German Federal Statistical Office signs responsible for the design and organization of the count for the *Statistic on Asylum Seekers’ Benefits*, but the actual count is carried out by the statistical offices of the 16 federal states in Germany (Destatis 2016).

¹⁵Benefits are mainly in kind, such as housing, food, or medical services, but can also take the form of small financial allowances.

¹⁶As a consequence of legal data protection requirements, detailed information on refugees by type of accommodation is unavailable for two counties in the federal state of Baden-Wuerttemberg.

¹⁷These indices were calculated using data from *ImmobilienScout24* for the years 2007 to 2016.

¹⁸In some specifications, we split this 6 month treatment period into two subperiods of equal length, the last quarter in 2015 and the first quarter in 2016. This allows us to explore and compare the immediate response and the subsequent evolution of rents to the mass arrival of refugees in the heyday of the crisis in late 2015, of which we take stock on 31st December 2015.

¹⁹In additional explorations, we also used an alternative main explanatory variable (the percentage-point changes between 2014 and 2015 in the EoY refugee stock) to study the effects of *non-standard exposure* of counties during the 2015 refugee crisis on rental price growth. Results from these regressions produced qualitatively identical results.

²⁰Summary statistics for the lagged neighborhood characteristics at the one kilometer grid level are provided in Table B2 in the appendix.

²¹As shown in appendix Table C1, treatment effects prove persistent and even grow in size over this extended time horizon. However, these results should be interpreted with some caution. First, outcomes are now measured long after the heyday of the crisis and our stock taking of refugees on 31st December 2015. Identification, as a consequence, may be complicated by endogenous relocation responses of both refugee migrants and natives and suffer also from potentially confounding influences that materialize only slowly. Second, we extended only the (post-)crisis property sample, keeping the pre-crisis sample fixed (to alter but one aspect of the analysis). Seasonal effects for the last two quarters are hence not taken into account in this additional exercise.

²²Full tabulated regression output for all tables in this study can be obtained from the authors upon request.

²³The mean county-level 2015 EoY refugee stock (normalized by 2014 county population) is 1.2% (standard deviation 0.74%).

²⁴This reinforces the well-known real estate mantra “location, location, location” emphasizing the primary importance of the local environment in determining real estate values.

²⁵Related studies, such as Saiz (2007) and Gonzalez and Ortega (2013), also routinely consider time-invariant location-specific factors for the same purpose, albeit different ones, such as weather and other local amenities.

²⁶These existent structures were of importance for the routes refugees were to take along the stages of their asylum procedure in the later part of 2015 – a time during which authorities found themselves surprised and confronted with large-scale refugee arrivals for which they had to organize at short notice sufficient accommodation.

²⁷We conducted several additional placebo tests of this kind with alternative property samples for various time periods, dating back until October 2007 to March 2008 (pre period) and October 2008 to March 2009 (post period). The results of these tests also do not indicate a systematic pattern between pre-trends in regional rental price growth and treatment intensities. The corresponding results can be obtained from the authors upon request.

²⁸For constructing these municipality-level indicators for the within-county regional dispersion of refugees and public group quarter facilities of different type, we use information from special data extracts drawn from the *Statistic on Asylum Seekers’ Benefits*.

²⁹The growth differential of -1.1611 percentage points is given by the sum of the estimated coefficients on the respective double ($\times 100$) and triple interactions, i.e. -0.0015 and -1.0111 .

³⁰In Table 3, ‘new offers’ refers to first monthly observations of apartments posted for rent, capturing changes in the supply of rental units that stem from new postings. Analogously, ‘last offers’ refers to last observations of apartment listings before they were taken off the platform, capturing changes in the supply of rental units that stem from exits of offers from the market, in all likelihood because a flat has been contracted out.

³¹Summary statistics for these additional outcomes at county-month level are provided in appendix Table B3.

³²We also tested for changes in regional construction activity that may have coincided with, or responded to, refugee inflows during the crisis. Changes in local housing supply between 2014 and 2015 (2014 and 2016), as measured by the county-level annual number of newly

- issued building permits for residential apartments per capita, however, show no systematic link to treatment intensities in refugee immigration. Corresponding regression results can be obtained from the authors upon request.
- ³³Summary statistics for top quartile neighborhood characteristics at 1km grid level are provided in appendix Table B4.
- ³⁴The mean county-level male to female sex ratio in 2015 was 2.365 (std. dev. 1.648).
- ³⁵Summary statistics for these three outcomes and lagged county characteristics are provided in appendix Tables B3 and B2.
- ³⁶A detailed description of these data is provided in Huang and Kvasnicka (2019).
- ³⁷A distinct right-wing disposition that is present already pre-crisis in those regions provides an alternative explanation for these results.
- ³⁸Note that the base category in these specifications includes also property in municipalities that exclusively witnessed anti-refugee crimes in either 2014 or 2015.
- ³⁹The BüMA was the primitive predecessor of the *Proof of Arrival (Ankunftsnachweis)*, which was introduced in February 2016 to record biometric information at the initial registration (BMI 2015; BAMF 2016b; Destatis 2018). In the heyday of the refugee crisis, the BüMA was issued at times as a handwritten paper slip (Burger and Stoldt 2015), and it neither included security features nor was it standardized across states (BAMF 2016b).
- ⁴⁰The acronym EASY refers to *Erstverteilung der Asylbegehrenden*, i.e. the initial distribution of asylum seekers.
- ⁴¹In the advent of the crisis, in September 2015, the number of unprocessed asylum applications already amounted to approximately 300 thousand (Hoesch 2018).
- ⁴²Only 476,649 individuals have filed a formal asylum application in 2015 and are hence recorded in the EoY AZR count for 2015. This figure includes mostly first applications (441,899), but also some consecutive applications (34,750) (BAMF 2016a). A consecutive application may be filed if a previous application is withdrawn or has been rejected without right of appeal (§71AsylG).
- ⁴³Asylum seekers from save origin countries had to reside in their designated reception facility for the entire duration of their asylum procedure (§47 AsylG; AsylVfBeschlG).
- ⁴⁴Note that selective out-migration of natives from regions experiencing large refugee immigration, while a possibility, is unlikely to be of major practical importance in our setting, given the unexpectedness, and abruptness, of refugee immigration in late 2015 and the immediacy and limited length of the observation period in which we study the effects of this immigration on rental prices, i.e. the last quarter of 2015 and the first quarter of 2016.
- ⁴⁵Rental price caps on existing (not new) tenancy agreements have been imposed from May 2013 (i.e. before our observation period) in selected municipalities that are characterized by tight real estate markets (Haufe 2016).
- ⁴⁶Note that in previous regressions (and also in the following), we always control for potential changes in the type of property offered for rent by making use of an extensive set of hedonic apartment-specific characteristics that goes beyond standard items considered in the literature. The use of this set of covariates controls for price effects of potential changes in the composition of real estate supplied in the market in late 2015 and early 2016 that are caused by, or correlated with, refugee immigration in 2015.
- ⁴⁷Differences between offer rents and contracted rents may certainly prevail. However, rental prices offered are rarely subject to negotiation between landlord and prospective tenant, unlike prices for property that is for sale.
- ⁴⁸Note that landlords may modify at any time offer rents for dwellings already posted on the platform of the online property broker *ImmobilienScout24*.
- ⁴⁹The lower responsiveness of prices for new offers and higher responsiveness of prices for last offers may be explained by a combination of pricing and posting decisions of landlords. If there is a penalty attached to changing the asking price for a dwelling already posted online (e.g. customers may perceive such a change in price as a signal of bad quality of property), and future market prospects are hard to predict, then refraining from posting ‘underpriced’ offers until market uncertainty has resolved may well be optimal, as may be cuts in offer prices for existing posts if current demand is low and future prospects are both dim and uncertain.
- ⁵⁰The mean county-level 2015 EoY share of refugees in private apartments is 50% (standard deviation 35.17%).
- ⁵¹‘*Reception counties*’ and ‘*group quarter municipalities*’ denote administrative regions that house at least one reception center or group quarter in 2014, i.e. before the crisis. We calculate driving distances using the Stata module *osrmtime* (Huber and Rust 2016).

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Appendix A

Asylum Procedure and Recording of Asylum Seeker Arrivals During the 2015 European Refugee Crisis in Germany

Asylum seekers who arrived to Germany had to report to a state organization that they were seeking asylum, either upon arrival at the German border with border authorities or immediately after

their arrival with a state or public authority (e.g. the police, a branch office of the *Federal Office for Migration and Refugees (BAMF)*, or a reception facility) (BAMF 2016c). This initial *informal registration* of the request for asylum was registered via the EASY-system (Federal Government 2016) and asylum seekers were issued an *Asylum Seeker Registration Certificate (BüMA)*³⁹ (BAMF 2016b, c), which initiated the first step of the official asylum procedure (Burger and Stoldt 2015), entitled refugees to reside in Germany (*Aufenthaltsgestattung*) (§55(1) AsylG), and qualified them for receipt of asylum benefits in accordance with the *Act on Benefits for Asylum Seekers (AsylbLG)* and the *Asylum Act (AsylG)* (Bundestag 2015b). In our analysis, we use high-quality register data on these recipients (some of which are unique special data extracts provided to us by the sixteen statistical offices of the German federal states), drawn from the *Statistic on Asylum Seekers' Benefits*, an EoY compulsory count with full coverage of all individuals receiving any such kind of benefit in Germany.

The records in the EASY-system provided the basis for the initial distribution of asylum seekers onto the federal states according to the predetermined quota defined by the Koenigstein Key (Federal Government 2016; BAMF 2016c).⁴⁰ However, entries in EASY at the time did not contain any personal information, which led to an initial over-count (of the stock) of new asylum seekers in EASY because multiple recordings occurred when individuals registered (sequentially) in several federal states, or individuals relocated to another country, thus effectively (but unobserved) ending the asylum procedure (Federal Government 2016; Daldrup 2016). First EASY numbers released for 2015 recorded 1,091,894 new refugee arrivals for 2015 (BAMF 2016a). Accounting for double entries and exits, this figure was later revised to ~890,000 new asylum seekers (BMI 2016b). Furthermore, upon arrival at the assigned reception facility in a state, refugees in late 2015 often had to wait for weeks, because of the large numbers of arrivals and asylum applications (Burger and Stoldt 2015), before

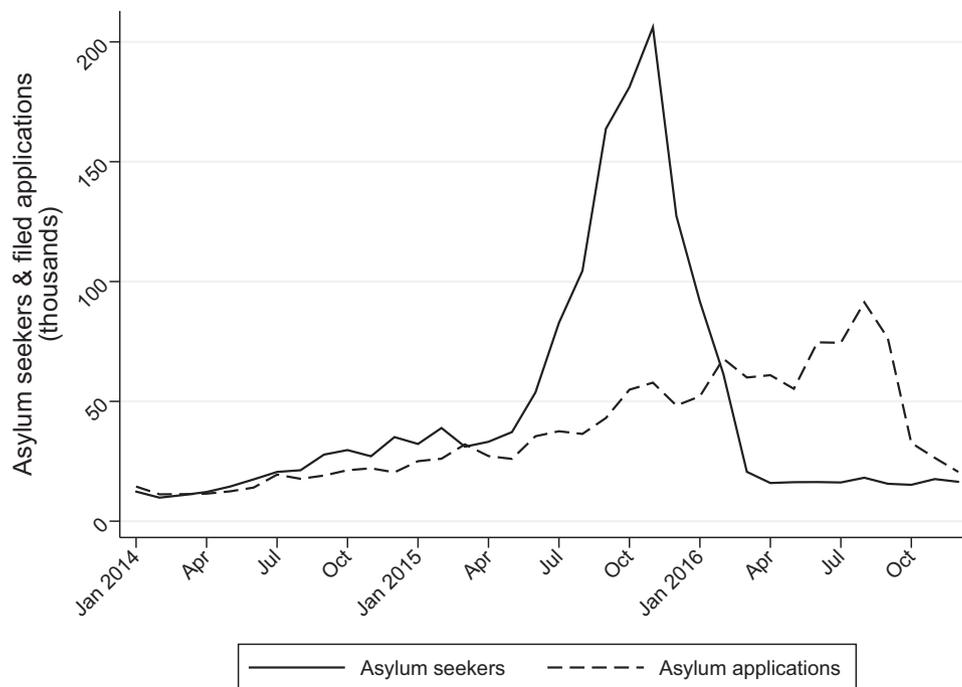


FIGURE A1 | Monthly arrivals of asylum seekers & asylum applications in Germany. *Note:* The solid line depicts the total number of monthly arrivals of asylum seekers to Germany in the period January 2014 to December 2016 as recorded by the EASY initial registry IT-system (BMI 2016a, b, 2017; bpb 2018), i.e. the number of informal registrations of individuals who intended to file an asylum application in Germany. The dashed line depicts the corresponding total number of actual asylum applications filed in Germany in this period, i.e. the total number of formal registrations of individuals seeking asylum in Germany (BAMF 2015, 2016a, 2017).

they could formally register as asylum seekers with the BAMF (*formal registration*, i.e. AZR—registration) (Bundestag 2016b; Federal Government 2016; Daldrup 2016).⁴¹ This unrecorded pent-up demand led to a substantial under-count of refugees in the EoY AZR figure for 2015 (Die Zeit 2015; Destatis 2018) of nearly half a million refugees (i.e. roughly every second arrival) compared to the total arrivals recorded in revised figures from the EASY-system.⁴² Figure A1 documents for 2014 to 2016 monthly refugee inflows to Germany recorded in the EASY system and monthly totals of formal asylum applications filed with the BAMF.

According to the *Statistic on Asylum Seekers' Benefits*, which we will use in our analysis, 974,551 individuals seeking protection received asylum seeker benefits on 31st December 2015 (Destatis 2016) in accordance with the AsylbLG and AsylG. This figure, unlike the EoY AZR count (which is but half in size), is close to the revised projected number from the EASY-system cited above (approx. 890,000 asylum seeker arrivals in 2015 (BMI 2016b)). This is due to the fact that the *Statistic on Asylum Seekers' Benefits* counts, and contains information on, all individuals in a pending asylum procedure, including also those who did not file yet a formal application with the BAMF (unlike the AZR) but only informally reported as asylum seekers upon arrival (§1(1) no. 1 AsylbLG; §§55(1) and 63 AsylG). What is more, the EoY 2015 state-level regional distribution of asylum seekers recorded in the *Statistic on Asylum Seekers' Benefits* resembles fairly closely actual state-level allocation quotas based on the Koenigstein Key. As shown in Table A1, this is not true for EoY AZR numbers. Because of various deficiencies in the registration and recording of formal asylum applications filed in late 2015 (Destatis 2018), the state-level distribution recorded in AZR matches that of the Koenigstein Key only very imprecisely

(differences in state quotas fluctuate between -6.13 and 2.49 percentage points, with a standard deviation of 1.96 percentage points). Relative differences in quotas (in percent) exceed 10% in 13 out of the 16 federal states and spread widely, ranging from -28.9% to 108.9% .

In 2015, refugees were obliged to reside (*Residenzpflicht*) for the first 3 months of the asylum procedure within a designated area (this could be a county, an administrative district or the entire federal state) depending on the allocated state (§56 AsylG; §61 AufenthG). Moreover, refugees were obliged to live for at most 3 months in the reception facility to which they had been allocated, an upper limit that was extended to 6 months with the passage of the *Act on the Acceleration of Asylum Procedures (AsylVfBeschIG)* on 24th Oct. 2015 (§47 AsylG).⁴³ The initial allocation of refugees by German authorities to different areas hence limited the geographical mobility of refugees for a considerable amount of time. If applicants were entitled to asylum (*Asylberechtigter*) (Art. 16a(1) GG), or granted refugee status (*Anerkannter Flüchtling*) (§3(1) AsylG), they received a residence permit for 3 years (§§25(1) or (2), 26 AufenthG), upon which they ceased to receive asylum seeker benefits but qualified for the receipt of social benefits in accordance with SGB II and SGB XII (§7(1) SGB II). If applicants received only subsidiary protection (§4(1) AsylG), were entitled to stay because of a ban preventing their deportation (§60(5) or (7) AufenthG), or their deportation was temporarily postponed (§60a AufenthG), they continued to be entitled to asylum seeker benefits if the residency title granted to them did not exceed 6 months (§1(2) AsylbLG). The latter restriction did not apply in cases where a temporary right to reside was issued (i.e. *Aufenthaltsgewährung*) on the basis of international law or on humanitarian grounds (§1(1) no. 3 AsylbLG; §§23(1), 24, 25(4) or (5) AufenthG).

TABLE A1 | 2015 EoY Asylum seekers and asylum applications in 2015.

Federal state	(1)	(2)		(3)		(4)	(5)	(6)	(7)
	Koenigstein key %	Total	%	Total	%	Total	%	(3)–(1) %-pt.s	(5)–(1) %-pt.s
Baden-Wuerttemberg	12.975	121,280	12.445	57,578	13.030	-0.530	0.055		
Bavaria	15.330	126,185	12.949	67,639	15.306	-2.382	-0.024		
Berlin	5.046	49,654	5.095	33,281	7.531	0.050	2.486		
Brandenburg	3.081	29,339	3.011	18,661	4.223	-0.070	1.142		
Bremen	0.941	11,159	1.145	4,689	1.061	0.204	0.120		
Hamburg	2.528	23,051	2.365	12,437	2.814	-0.162	0.287		
Hesse	7.316	68,122	6.990	27,239	6.164	-0.325	-1.151		
Mecklenburg Western Pomerania	2.042	20,332	2.086	18,851	4.266	0.045	2.224		
Lower Saxony	9.357	101,251	10.390	34,248	7.750	1.033	-1.607		
Northrhine-Westphalia	21.241	224,089	22.995	66,758	15.107	1.755	-6.133		
Rhineland Palatinate	4.835	49,475	5.077	17,625	3.988	0.242	-0.846		
Saarland	1.216	10,411	1.068	10,089	2.283	-0.147	1.067		
Saxony	5.101	45,749	4.695	27,180	6.151	-0.406	1.050		
Saxony-Anhalt	2.858	30,073	3.086	16,410	3.714	0.228	0.856		
Schleswig-Holstein	3.388	35,935	3.688	15,572	3.524	0.300	0.136		
Thuringia	2.748	28,401	2.914	13,455	3.045	0.166	0.296		
Unknown				187	0.042				
Total	100	974,506	100	441,899	100				

Note: The table shows for each federal state the total number of asylum seekers on 31st December 2015 recorded in the *Statistic on Asylum Seekers' Benefits*, the federal state quota of refugees to be allocated according to the Koenigstein Key, and the number of asylum applications filed in 2015.

Appendix B

Descriptive Statistics

TABLE B1 | Summary statistics I: Flat-specific characteristics.

	Pre-crisis		Post-crisis		Min.	Max.	t-test	
	Mean	Std. dev.	Mean	Std. dev.			Δ Mean	Std. err.
Rent/m ² [EUR]	7.526	3.095	7.697	3.476	1	100	0.171	0.0047
Log rent/m ²	1.950	0.357	1.964	0.376	0	4.605	0.013	0.0005
Living space [m ²]	74.746	31.002	72.559	29.992	6	500	-2.189	0.0437
Log living space	4.237	0.395	4.208	0.392	1.792	6.215	-0.028	0.0006
#rooms	2.665	0.979	2.619	0.956	1	10	-0.046	0.0014
Level: LG-1	0.448	0.497	0.427	0.495	0	1	-0.021	0.0007
Level: 2-5	0.528	0.499	0.544	0.498	0	1	0.016	0.0007
Level: 6-11	0.022	0.145	0.026	0.158	0	1	0.004	0.0002
Level: > 11	0.003	0.053	0.004	0.059	0	1	0.001	0.0001
Elevator: not stated (n.s.)	0.144	0.351	0.002	0.044	0	1	-0.142	0.0004
Elevator: Y	0.200	0.400	0.224	0.417	0	1	0.024	0.0006
Balcony: n.s.	0.069	0.253	0.001	0.035	0	1	-0.067	0.0003
Balcony: Y	0.641	0.480	0.641	0.480	0	1	-0.000	0.0007
Fitted kitchen: n.s.	0.154	0.361	0.003	0.052	0	1	-0.151	0.0004
Fitted kitchen: Y	0.365	0.481	0.332	0.471	0	1	-0.033	0.0007
Construction period: n.s.	0.234	0.424	0.161	0.367	0	1	-0.074	0.0006
Construction period: < 1915	0.106	0.308	0.119	0.324	0	1	0.013	0.0005
Construction period: 1915-1945	0.062	0.241	0.070	0.255	0	1	0.008	0.0004
Construction period: 1946-1969	0.188	0.391	0.204	0.403	0	1	0.016	0.0006
Construction period: 1970-1989	0.181	0.385	0.198	0.398	0	1	0.017	0.0006
Construction period: 1990-2005	0.147	0.354	0.146	0.353	0	1	-0.001	0.0005
Construction period: > 2005	0.081	0.273	0.103	0.304	0	1	0.021	0.0004
Object category (OC): n.s.	0.162	0.369	0.161	0.367	0	1	-0.002	0.0005
OC: other	0.014	0.118	0.015	0.121	0	1	0.001	0.0002
OC: attic	0.133	0.339	0.123	0.328	0	1	-0.010	0.0005
OC: loft	0.004	0.062	0.003	0.059	0	1	-0.000	0.0001
OC: maisonette	0.039	0.195	0.035	0.184	0	1	-0.004	0.0003
OC: penthouse	0.010	0.097	0.011	0.103	0	1	0.001	0.0001
OC: terrace	0.016	0.125	0.014	0.119	0	1	-0.002	0.0002
OC: ground floor	0.080	0.271	0.081	0.273	0	1	0.001	0.0004
OC: level flat	0.520	0.500	0.535	0.499	0	1	0.015	0.0007
OC: souterrain	0.005	0.072	0.005	0.069	0	1	-0.000	0.0001
OC: mezzanine	0.017	0.129	0.017	0.131	0	1	0.000	0.0002
Fittings: n.s.	0.430	0.495	0.419	0.493	0	1	-0.011	0.0007
Fittings: basic	0.009	0.095	0.008	0.089	0	1	-0.001	0.0001
Fittings: normal	0.299	0.458	0.307	0.461	0	1	0.008	0.0007
Fittings: upscale	0.233	0.423	0.236	0.424	0	1	0.002	0.0006
Fittings: luxury	0.029	0.166	0.031	0.172	0	1	0.002	0.0002

(Continues)

TABLE B1 | (Continued)

	Pre-crisis		Post-crisis		Min.	Max.	t-test	
	Mean	Std. dev.	Mean	Std. dev.			Δ Mean	Std. err.
Under constr.	0.003	0.050	0.003	0.056	0	1	0.001	0.0001
Same yr. constr.	0.024	0.154	0.030	0.170	0	1	0.006	0.0002
Existing housing stock	0.973	0.162	0.967	0.179	0	1	-0.006	0.0002
Distance to county pop. center [km]	8.552	7.215	8.547	7.502	0.001	103.87	-0.005	0.0105
Current dwell time [months]	4.995	9.806	4.558	8.736	1	111	-0.437	0.0134

Note: The total number of flat-month observations is 1,985,590, i.e. 1,115,436 and 870,154 observations pooled across the 6 month pre- and the 6 month (post-)crisis period, respectively.

TABLE B2 | Summary statistics II: Main explanatory variables, instruments, lagged county and neighborhood characteristics.

	Obs.	Mean	Std. dev.	Min.	Max.
<i>Main explanatory variable</i>					
Refugees '15/pop. '14	402	0.0120	0.0074	0.0002	0.0908
<i>Instrumental variables</i>					
Inverse log average travel distance	402	0.1949	0.1163	0.1506	1
County-level share of group quarter municipalities	402	0.4347	0.4208	0	1
<i>Total population growth</i>					
Population growth '14-'15	402	0.0109	0.0074	-0.0055	0.0594
<i>Lagged county characteristics</i>					
GDP p.c. '13 [EUR]	402	32,656.84	14,337.69	14,436	130,103
Foreigner share '13 [%]	402	7.0843	4.6056	0.9	31.3
Property market: vacancy rate '11	402	0.0482	0.0218	0.0140	0.1397
Property market: building permits (flats) '13/pop. '13	402	0.0028	0.0016	0.0004	0.0102
Amenities: annual guest arrivals (tourism) '13/pop. '13	402	1.8373	1.5049	0.2395	10.0353
(dis-)amenities: crimes '13/pop. '13	402	0.0629	0.0259	0.0232	0.1466
<i>Lagged neighborhood characteristics (1km grid level)</i>					
Unemployment rate '13 [%]	48,447	5.6531	4.0399	0	37.48
Foreigner share '13 [%]	48,447	6.1583	6.3833	0	95.92
Property composition: commercial buildings '13 [%]	48,447	3.2141	5.8050	0	100

TABLE B3 | Summary statistics III: Further outcomes.

	Obs.	Mean	Std. dev.	Min.	Max.
<i>Further outcomes (county-month level)</i>					
# total offers	4,824	411.61	934.65	3	14,844
Log total offers	4,824	5.1331	1.2660	1.0986	9.6054
Share new offers	4,824	0.3916	0.1211	0	0.9505
Share last offers	4,824	0.4002	0.1202	0	0.9088
Turnover	4,824	1.2913	1.4743	0	25.7989
Average dwell time	4,824	4.8922	2.0821	1.1918	25.60
<i>Further outcomes (county level)</i>					
<i>Females</i>					
$\Delta Immigrants_{c2014-15, German} / POP_{c2014, German}$	402	-0.00034	0.00384	-0.01335	0.04394
$\Delta Immigrants_{c2014-16, German} / POP_{c2014, German}$	402	0.00055	0.00459	-0.01854	0.04890

(Continues)

TABLE B3 | (Continued)

	Obs.	Mean	Std. dev.	Min.	Max.
$\Delta Emigrants_{c2014-15, German} / POP_{c2014, German}$	402	-0.00100	0.00265	-0.01522	0.00660
$\Delta Emigrants_{c2014-16, German} / POP_{c2014, German}$	402	0.00163	0.00405	-0.01824	0.04170
$\Delta Internal\ migrants_{c2014-15, German} / POP_{c2014, German}$	295	-0.00087	0.00185	-0.00645	0.00433
$\Delta Internal\ migrants_{c2014-16, German} / POP_{c2014, German}$	295	-0.00061	0.00208	-0.00798	0.00523
<i>Males</i>					
$\Delta Immigrants_{c2014-15, German} / POP_{c2014, German}$	402	-0.00035	0.00391	-0.01361	0.02927
$\Delta Immigrants_{c2014-16, German} / POP_{c2014, German}$	402	0.00095	0.00514	-0.01735	0.04641
$\Delta Emigrants_{c2014-15, German} / POP_{c2014, German}$	402	-0.00114	0.00306	-0.01873	0.00854
$\Delta Emigrants_{c2014-16, German} / POP_{c2014, German}$	402	0.00452	0.00530	-0.01172	0.04105
$\Delta Internal\ migrants_{c2014-15, German} / POP_{c2014, German}$	295	-0.00094	0.00197	-0.00927	0.00472
$\Delta Internal\ migrants_{c2014-16, German} / POP_{c2014, German}$	295	-0.00105	0.00226	-0.00936	0.00696
<i>Females & Males</i>					
$\Delta Immigrants_{c2014-15, German} / POP_{c2014, German}$	402	-0.00017	0.00179	-0.00614	0.01864
$\Delta Immigrants_{c2014-16, German} / POP_{c2014, German}$	402	0.00037	0.00229	-0.00898	0.02388
$\Delta Emigrants_{c2014-15, German} / POP_{c2014, German}$	402	-0.00053	0.00123	-0.00843	0.00278
$\Delta Emigrants_{c2014-16, German} / POP_{c2014, German}$	402	0.00151	0.00215	-0.00763	0.02071
$\Delta Internal\ migrants_{c2014-15, German} / POP_{c2014, German}$	295	-0.00045	0.00085	-0.00366	0.00179
$\Delta Internal\ migrants_{c2014-16, German} / POP_{c2014, German}$	295	-0.00041	0.00098	-0.00410	0.00270

Note: Turnover is the county-level monthly average of new inflows and outflows per one thousand population. Data on internal migration (i.e. within county, cross municipality-border relocations) are observed for nonurban (rural) counties only.

TABLE B4 | Summary statistics IV: Top quartile neighborhood characteristics (1 km grid level).

	Obs.	Mean	Std. dev.	Min.	Max.
<i>Strata - top 25% age groups</i>					
<i>Females</i>					
0-10 years	11,913	4.9532	0.3852	4.56	10.71
10-20 years	11,965	6.1258	0.4336	5.66	13.24
20-35 years	12,109	10.6707	2.0402	8.83	25.67
35-50 years	11,989	12.4109	0.6802	11.67	21.67
50-65 years	12,039	12.6261	0.8606	11.73	27.31
≥ 65 years	12,086	15.2127	1.7778	13.35	56.07
<i>Males</i>					
0-10 years	11,929	5.176	0.4094	4.78	12.85
10-20 years	12,009	6.485	0.4781	5.98	14.85
20-35 years	12,065	10.8929	1.7456	9.3	27.92
35-50 years	11,998	12.4279	0.7214	11.68	21.76
50-65 years	12,075	12.666	1.0394	11.66	35.14
≥ 65 years	12,105	11.1853	1.2033	10	39.6
<i>Females & Males</i>					
0-10 years	12,049	10.007	0.6956	9.28	19.24
10-20 years	12,094	12.4907	0.7884	11.6	26.52
20-35 years	12,108	21.4164	3.7165	18.03	47.5
35-50 years	12,076	24.6552	1.2924	23.26	42.75

(Continues)

TABLE B4 | (Continued)

	Obs.	Mean	Std. dev.	Min.	Max.
50–65 years	12,083	25.1441	1.7256	23.31	56.61
≥ 65 years	12,107	26.2498	2.8398	23.27	74.15
<i>Strata - top 25% property type</i>					
1–2 family house					
Detached & semi-detached	12,107	78.0369	7.4545	68.7	100
Multi family house					
3–9 dwellings	12,109	53.2443	8.8308	43.23	100
Multi family house					
≥ 10 dwellings	12,107	31.6328	16.6496	14.5	100

Note: Percentage values of neighborhood characteristics are depicted according to top quartiles along the 1 km grid level distribution.

Appendix C

Further Results

Extended Sample

TABLE C1 | Evolution of treatment effects (property data: Oct. 2014 - Mar. 2015 & Oct. 2015 - Sep. 2016).

	Dependent Variable: Log (Rent/m²)			
	(1)	(2)	(3)	(4)
<i>Treatment Periods</i>				
<i>Oct – Dec</i> ₂₀₁₅	0.0353*** (0.0042)	0.0303*** (0.0050)	0.0309*** (0.0050)	0.0198*** (0.0098)
<i>Jan – Mar</i> ₂₀₁₆	0.0504*** (0.0046)	0.0439*** (0.0053)	0.0449*** (0.0053)	0.0285** (0.0122)
<i>Apr – Jun</i> ₂₀₁₆	0.0722*** (0.0063)	0.0602*** (0.0069)	0.0601*** (0.0069)	0.0499*** (0.0139)
<i>Jul – Aug</i> ₂₀₁₆	0.0836*** (0.0068)	0.0686*** (0.0071)	0.0701*** (0.0072)	0.0592*** (0.0142)
<i>Treatment Effects - Refugee Immigration</i>				
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.4514** (0.2078)	–0.3150 (0.2016)	–0.2755 (0.2027)	–0.3433 (0.2718)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.8442*** (0.2366)	–0.6498*** (0.2336)	–0.6472*** (0.2287)	–0.7203** (0.3188)
<i>Apr – Jun</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.9853*** (0.3389)	–0.7581** (0.3052)	–0.6954** (0.3040)	–0.7845** (0.3819)
<i>Jul – Sep</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–1.1165*** (0.4226)	–0.8574** (0.3604)	–0.7739** (0.3707)	–0.8087** (0.3790)
Regional fixed effects	Municipality	Municipality	County	Municipality
Seasonal effects	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes
Lagged neighborhood characteristics (1km grid)	No	Yes	Yes	Yes

(Continues)

TABLE C1 | (Continued)

	Dependent Variable: Log(Rent/m ²)			
	(1)	(2)	(3)	(4)
Lagged county characteristics	No	No	No	Yes
Observations	2,707,898	2,707,898	2,707,898	2,707,898

Note: The dependent variable is the log of the base rent per square meter posted. For a list of the flat-specific characteristics considered, see appendix Table B1. Lagged neighborhood characteristics (from 2013) at 1km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. The number of municipality fixed effects is 7,487 in specifications (1), (2) and (4), and 402 in specification (3). Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5% and 10% level.

Placebo Test

Table C2

TABLE C2 | Placebo test I - exogeneity of pretreatment outcomes (property data: Oct. 2012 - Mar. 2013 & Oct. 2013 - Mar. 2014).

	Dependent Variable: Log(Rent/m ²)			
	(1)	(2)	(3)	(4)
<i>Treatment Periods</i>				
<i>Oct</i> ₂₀₁₃ – <i>Mar</i> ₂₀₁₄	0.0280*** (0.0031)	0.0202*** (0.0049)	0.0226*** (0.0048)	0.0120* (0.0064)
<i>Oct</i> – <i>Dec</i> ₂₀₁₃	0.0282*** (0.0032)	0.0206*** (0.0045)	0.0225*** (0.0045)	0.0128** (0.0062)
<i>Jan</i> – <i>Mar</i> ₂₀₁₄	0.0278*** (0.0032)	0.0198*** (0.0055)	0.0227*** (0.0053)	0.0113* (0.0069)
<i>Treatment Effects - Refugee Immigration</i>				
<i>Oct</i> ₂₀₁₃ – <i>Mar</i> ₂₀₁₄ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.1217 (0.2469)	–0.1539 (0.2425)	–0.2365 (0.2383)	–0.2213 (0.1975)
<i>Oct</i> – <i>Dec</i> ₂₀₁₃ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.0642 (0.2588)	–0.1339 (0.2385)	–0.2050 (0.2395)	–0.1862 (0.1886)
<i>Jan</i> – <i>Mar</i> ₂₀₁₄ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.1739 (0.2415)	–0.1732 (0.2500)	–0.2662 (0.2441)	–0.2538 (0.2099)
Regional fixed effects	Municipality	Municipality	County	Municipality
Seasonal effects	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes
Lagged neighborhood chr.s (1km grid)	No	Yes	Yes	Yes
Lagged county characteristics	No	No	No	Yes
Observations	2,270,371	2,270,371	2,270,371	2,270,371

Note: The dependent variable is the log of the base rent per square meter posted. Results from placebo tests, which employ pooled cross sectional data of flats on offer two years before the refugee crisis are reported. Precisely, flats on offer from October 2012 till March 2013 and October 2013 till March 2014 are assigned to a fictitious pre- and posttreatment period, respectively. All regressions include the full set of corresponding flat-specific characteristics as listed in appendix Table B1. Lagged neighborhood characteristics (from 2013) at 1 km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. Lagged county characteristics include county-level GDP per capita in 2013, the county-level crime rate in 2013, annual per capita guest arrivals (business and non-business-related) in a county in 2013, annual per capita building permits issued for flats in 2013, and the county-level vacancy rate in 2011. The number of regional fixed effects is 7,325 in specifications (1), (2) and (4), and 402 in specification (3). Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5% and 10% level.

Additional Robustness Tests

We will probe the robustness of our findings in a battery of additional sensitivity tests. The baseline model we consider in these tests is our preferred specification (see column (2) of Table 1) that considers the full set of observation-specific hedonics, seasonal and municipality fixed effects as well as lagged neighborhood characteristics at the 1km grid level. For the sake of brevity, we report only the results for the individual quarters October to December 2015 and January to March 2016. The results are summarized in Table C3. As a point of reference, the respective results corresponding to column (2) of Table 1 are replicated in column (1) of Table C3.

First, we allow year-on-year growth in first and fourth quarter rent prices to vary across counties by the rate of population growth they experienced in 2015 (see column (2)). This sensitivity test is inspired by the concern that county-level regional refugee inflows may be correlated, positively or negatively, with underlying county-level population growth that affects rental prices. Such correlation, which would lead to

bias in our estimates, may arise from systematic migrant self-selection, or selectivity in the allocation of refugees by authorities.⁴⁴ As it turns out, however, estimated treatment effects increase in absolute terms by about 0.08, respectively, 0.11 percentage points in the two quarters in which we measure outcomes.

Second, we add controls for local rental price caps on existing and new tenancy agreements. The latter have been imposed from June 2015 by state governments with tempo-spatial variation in selected areas that are characterized by excessively tight real estate markets (see column (3)) (Fabricius 2016).⁴⁵ Such rental price caps hence indicate two features of local real estate markets of potential relevance for our analysis, excessive market tightness and regulatory impediments to the ability of landlords to exploit such tightness in their pricing decisions. However, taking account of such caps in our analysis hardly affects our results. Estimated treatment effects decrease only slightly (in absolute value), albeit cease to be statistically significant in the first outcome quarter.

TABLE C3 | Further robustness tests: Results for quarterly outcome periods.

	Dependent Variable: $\log(\text{rent} / \text{m}^2)$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Treatment Periods</i>							
<i>Oct – Dec</i> ₂₀₁₅	0.0310*** (0.0051)	0.0245*** (0.0047)	0.0273*** (0.0053)	0.0308*** (0.0050)	0.0271*** (0.0056)	0.0207*** (0.0054)	0.0333*** (0.0060)
<i>Jan – Mar</i> ₂₀₁₆	0.0445*** (0.0053)	0.0357*** (0.0061)	0.0401*** (0.0058)	0.0440*** (0.0052)	0.0448*** (0.0055)	0.0431*** (0.0051)	0.0484*** (0.0068)
<i>Treatment Effects - Refugee Immigration</i>							
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.3396* (0.1969)	–0.4203* (0.2248)	–0.3088 (0.2028)	–0.3498* (0.2004)	–0.2046 (0.2313)	–0.0414 (0.2183)	–0.3827* (0.2123)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	–0.6800*** (0.2262)	–0.7854*** (0.2595)	–0.6311*** (0.2374)	–0.6872*** (0.2316)	–0.5850** (0.2465)	–0.6358** (0.2562)	–0.7527*** (0.2516)
<i>Oct – Dec</i> ₂₀₁₅ × <i>pop. growth</i> _{c2014–15}		0.5582 (0.4096)					
<i>Jan – Mar</i> ₂₀₁₆ × <i>pop. growth</i> _{c2014–15}		0.7349 (0.5127)					
<i>Current time on market</i> _{<i>t</i>}				–0.0015*** (0.0002)			
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref apart</i> _{c2015} / <i>ref</i> _{c2015}							–0.0047 (0.0048)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref apart</i> _{c2015} / <i>ref</i> _{c2015}							–0.0077 (0.0060)
Type of offers	All	All	All	All	New	Last	All
Rental price caps (municipality level)	No	No	Yes	No	No	No	No
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seasonal effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lagged neighborhood chr.s (1 km grid)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,985,590	1,985,590	1,985,590	1,985,590	1,002,414	1,002,414	1,982,767

Note: The dependent variable is the log of the base rent per square meter posted. For a list of the flat-specific characteristics considered, see appendix Table B1. Lagged neighborhood characteristics (from 2013) at 1km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. To ease comparison, column (1) reproduces the individual quarter effects corresponding to specification (2) of Table 1. The number of fixed effects is 7,187 in columns (1)–(6), and 7,171 in column (7). Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

Third, we check the robustness of our findings when controlling for the current dwell times of flats posted online for rent (i.e. time to market). As shown in column (4), however, our findings prove unchanged by inclusion of this control. Estimated treatment effects for county-level refugee immigration levels are still negative throughout, precisely estimated, and virtually identical in magnitude to those in our baseline analysis.

Fourth, we check whether the effects on rental price growth of refugee immigration and type of refugee housing are more pronounced for newly posted flats for rent and for flats immediately before their exit from the platform.⁴⁶ For this purpose, we trim our sample to include either new offers only (column (5)), or exclusively last offers (column (6)). New offers, i.e. first monthly observations that dwellings are posted for rent, capture changes in the supply of rental units that stem from new postings. Similarly, last offers or postings before an ad was taken off the platform capture changes in the supply of rental units that stem from exits of offers from the market, in all likelihood because a flat has been contracted out. Last offer rents observed just before property is taken off the platform therefore arguably match actual contract rents more closely than new offer rents or rents for flats in the entire stock of dwellings offered for rent in a given month.⁴⁷ Note also that our use of online offer price data is particularly advantageous for analyzing immediate price responses on real estate markets, as studied, at least in part, in the current analysis (i.e. 2015 fourth quarter rental price growth), for such data should reflect changes in local amenities more quickly than (administrative records or other recording of) transaction price data.⁴⁸ Our estimated treatment effects, reported in columns (5) and (6) of Table C3, reveal that YoY growth in rental prices of both new and last offers was slowed by county-level refugee immigration particularly in the first quarter of 2016, but somewhat less strongly so than for all posted offers considered in our baseline analysis. Taken together, new offers and last offers (i.e. changes in the supply of offers at the extensive margin) responded more strongly to refugee immigration in the first quarter of 2016.⁴⁹ Changes in public sentiment between the last quarter of 2015 and the first quarter of 2016, following the Cologne New Year's Eve incidents that shocked the country and fueled public concerns about refugee immigration (Hewitt 2016), may explain, at least in part, why price penalties attached to refugee immigration have grown in size.

Finally, we add a covariate to capture a characteristic of the regional refugee inflows that is of relevance to the housing market: $\frac{ref_apart_{c,2015}}{ref_{c,2015}}$ measures the 2015 end of year (EoY) share of refugees that are housed in private apartments in county c and is interacted again with the two (post-)crisis indicators for the last quarter in 2015 and the first quarter in 2016 (see column (7)). The coefficient estimates on the treatment effects for the scale of refugee immigration remain negatively signed and statistically significant (they even increase somewhat in absolute magnitude), both for the (post-)crisis period October to December 2015 and January to March 2016. Concerning the share of refugees accommodated outside of public group quarters, estimated treatment effects for both quarters are also negatively signed, but lack statistical significance.⁵⁰

In all sensitivity checks described above, we do find a consistent pattern of evidence for adverse effects of refugee immigration on rental price growth at county level, in particular, throughout the second quarter of analysis (January to March 2016). There also is some evidence, albeit more tentative, that higher rates of accommodation in private apartments tend to work in the same direction; this link lacks statistical significance, however, if one controls at fine spatial grid levels for lagged socioeconomic characteristics of neighborhoods.

IV Approach

Notwithstanding the favorableness of the contextual setting for identification, the use of fixed effects for small regional units, and the above-mentioned multitude of property and neighborhood characteristics

considered, there is still a risk that unobservables may confound the relationship of interest between regional inflows of refugees and regional rental price growth, causing bias in our estimate of δ in Equation (1). We therefore estimate also instrumental variables (IV) regressions, exploiting for identification arguably exogenous variation (conditional on our controls) in refugee inflows across regions, related to:

- a. Intra-state distances between counties that housed refugee reception centers in 2014 (i.e. before the crisis) and surrounding counties.
- b. The county-level share of municipalities, which housed public refugee group quarters in 2014 (i.e. again before the crisis).

These IVs exploit the pre-crisis locational structure of publicly-run refugee group quarters and related (pre-determined) allocation mechanisms of state and substate authorities governing the regional distribution of refugees, which are of importance for the routes refugees were to take along the stages of their asylum procedure in the later part of 2015 – a time where authorities found themselves surprised and confronted with large-scale refugee arrivals for which they had to organize at short notice sufficient accommodation.

As described in Appendix A, upon arrival to Germany, refugees were allocated first across the 16 federal states according to the Koenigstein Key, which is calculated annually based on tax and population figures from the previous 2 years (GWK 2017; German Federal Social Insurance Authority 2016), and thereafter to one of the designated state's reception centers from which they could, after a maximum residency of 3 months (6 months after the passage of the AsylVfBeschlG on 24th October 2015), be distributed by state and substate authorities onto other public refugee group quarters within the state or be housed in private apartments. As existing capacities of reception centers in late 2015 became in most instances rapidly exhausted, emergency shelters and affiliated reception facilities had to be opened at short notice and in large numbers (Federal Government 2015a). These additional facilities often opened in the vicinity of 'core' reception centers that had existed already in 2014, which permitted their incorporation into and utilization of the pre-crisis infrastructure for the allocation of refugees and the processing of their asylum applications in accordance with the set-out stages of the asylum procedure. For the same reasons, counties with a comparatively large share of municipalities housing refugee group quarters in 2014 have often resorted first and heavily to such facilities when large numbers of refugee arrivals required immediate and sufficient housing capacity. Figure C1 depicts an exemplary graphical illustration of the IV approach for the federal states of Saxony and Lower Saxony. For identification, our IV strategy requires that (conditional on controls) both the average intra-state distance between 'reception counties' and surrounding counties as well as the county-level concentration of 'group quarter municipalities' in 2014 affect rental prices in the (post-)crisis period (Q4:2015–Q1:2016) only via their influence on regional refugee inflows in late 2015. There must also be no unobserved factor that drives both our instruments and rental price growth. We construct our IVs, the average intra-state proximity between 'reception counties' and surrounding counties and the county-level concentration of 'group quarter municipalities' in 2014 using special data extracts from the *Statistic on Asylum Seekers' Benefits* (for both IVs) and driving distances (in kilometers) between 'reception counties' and surrounding counties using geo-referenced county-level population centers (for the first IV).⁵¹ Using these distance measures, for each county c , the inverse of the log average intra-state distance to all surrounding 'reception counties', denoted by $proximity_{c,reception\ county\ 2014}$, is defined as:

$$proximity_{c,reception\ county\ 2014} = \frac{1}{1 + \log(1 + average\ distance_{c,reception\ county\ 2014})}. \quad (C1)$$

The county-level share of municipalities housing at least one group quarter in 2014, $share_{c,group\ quarter\ 2014}$, in turn, is defined as:

Reception Centers (2014) & EoY Refugees (2015)/Pop. (2014)

Group Quarters (2014) & EoY Refugees Group (2015)/EoY Refugees (2015)

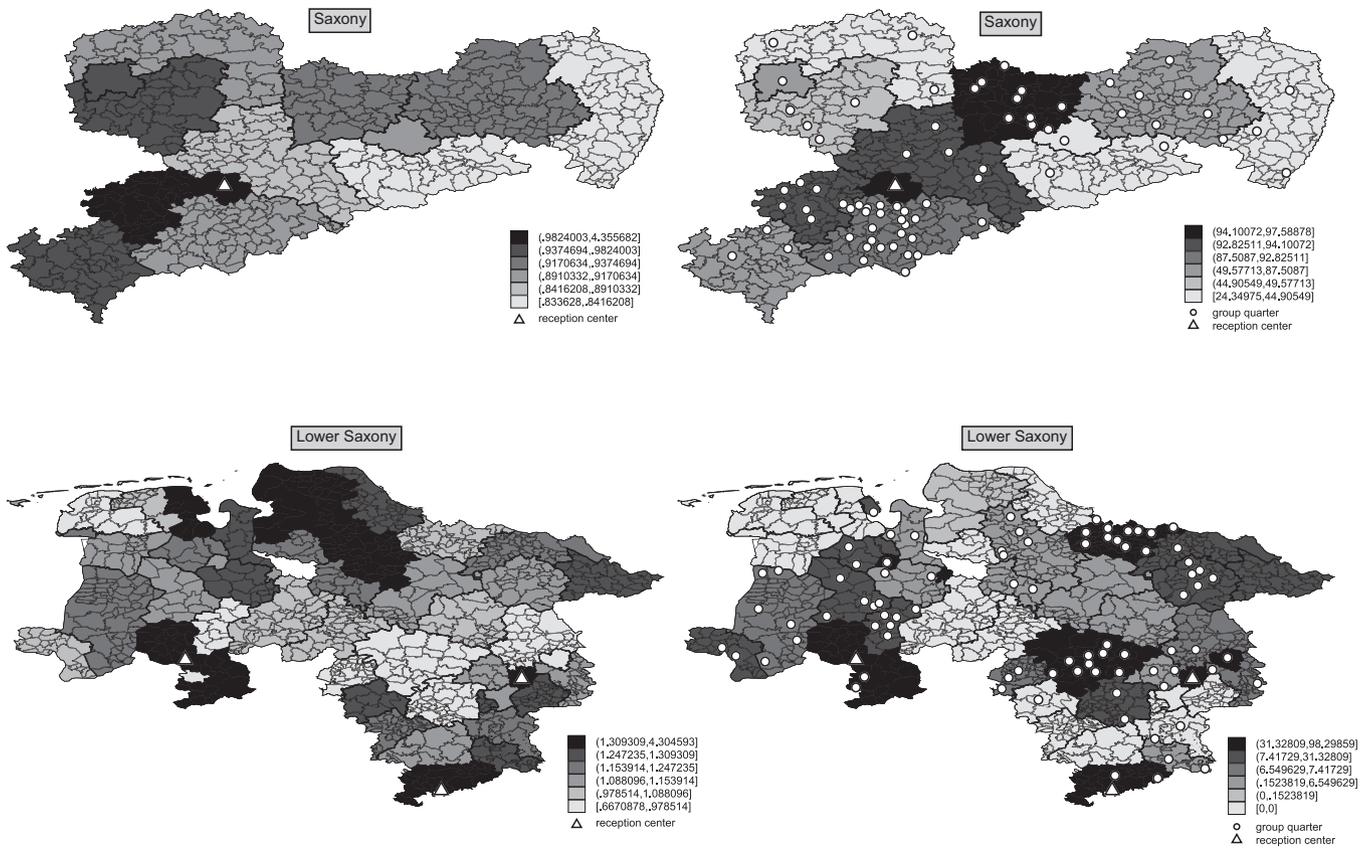


FIGURE C1 | IV approach - graphical illustration for the states of saxony and lower saxony. *Note:* The two maps in the top panel illustrate the IV approach for the state of Saxony (in former East Germany), the two maps in the bottom panel for the state of Lower Saxony (in former West Germany). County values of the (potentially endogenous) main explanatory variable, $\frac{refc_{2015}}{popc_{2014}}$, are grouped into quintiles and depicted by different shades of gray (LHS: darker colors indicate larger values of county-level refugee inflows, RHS: darker colors indicate larger shares of refugees in public group quarter accommodation). White triangles depict approximate (municipality-level) locations of refugee reception centers in 2014, and white dots illustrate the locations of municipalities that housed public group quarters other than reception facilities in 2014. Data used for constructing these maps come from special data extracts from the *Statistic on Asylum Seekers' Benefits*.

$$share_{c,group\ quarter\ 2014} = \frac{\#\ municipalities_{c,group\ quarter\ 2014}}{total\ \# \ municipalities_{c,2014}} \quad (C2)$$

Each instrument is statistically significantly correlated with the (potentially endogenous) regressor, i.e. the refugee inflow $\frac{refc_{2015}}{popc_{2014}}$. The relevant correlation coefficients are $corr\left(\frac{refc_{2015}}{popc_{2014}}, proximity_{c,reception\ county\ 2014}\right) = 0.39(p - value : 0.0000)$ and $corr\left(\frac{refc_{2015}}{popc_{2014}}, share_{c,group\ quarter\ 2014}\right) = 0.09(p - value : 0.0000)$.

IV Results

We estimated, for the entire 6 month (post-)crisis period October 2015 to March 2016, instrumental variables (IV) regressions, exploiting for identification arguably exogenous (conditional on our covariates) variation in refugee inflows across counties related to intra-state distances between counties that housed refugee reception centers in 2014 and surrounding counties that did not, as well as the 2014 spread of public refugee group quarters across municipalities within counties (see Section C.4 for a motivation and discussion of these instruments). The results are reported in Table C4.

Model specifications considered are analogous to those used in Table 1 for the (post-)crisis period October 2015 to March 2016. Column (1) of

Table C4 reports results for the baseline specification that does not use lagged neighborhood-level controls (as of 2013) at the 1km grid level, while columns (2) through (4) report results for specifications that do make use of such information as well as additional controls (columns (3) and (4)). First stage results are provided in the lower panel of Table C4. As can be seen, our two instruments prove strong. Consistent with expectations, they are highly correlated (in all specifications) with the (potentially endogenous) main explanatory variable, and associated *F*-test statistics for the excluded instruments are large. What is more, the signs of these correlations are as expected too. Both instruments, the inverse of the log average intra-state distance (i.e. proximity) between reception counties and surrounding counties as well as the 2014 county-level concentration of group quarter municipalities in 2014, are positively correlated with the scale of county-level refugee immigration in 2015. Second-stage results, reported in the upper panel of Table C4, largely confirm our baseline DiD regression results for these four specifications (see Table 1), with one notable exception: Qualitatively identical, i.e. of the same sign, and also statistically significant throughout, estimated treatment effects for the size of county-level refugee immigration in 2015 are now considerably larger. In the fully-fledged baseline model with lagged socioeconomic neighborhood characteristics (from 2013) at 1km grid level (see column (2) in Table C4), a one percentage point higher 2015 EoY refugee stock (normalized by 2014 county population) is associated with 0.94 percentage points lower year-on-year average rental price growth in the period October 2015 to March 2016 (an 80% increase in magnitude on our baseline estimate of 0.52 percentage points).

TABLE C4 | IV regression results for impact of refugee immigration on rent price growth.

Second stage	Dependent Variable: Log (Rent/m ²)			
	(1)	(2)	(3)	(4)
<i>Treatment Periods</i>				
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆	0.0504*** (0.0014)	0.0428*** (0.0015)	0.0461*** (0.0016)	0.0308*** (0.0016)
<i>Treatment Effects - Refugee Immigration</i>				
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-1.2506*** (0.1142)	-0.9368*** (0.1096)	-1.1322*** (0.1139)	-1.2366*** (0.0882)
<i>First Stage</i>				
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>proximity</i> _{c, reception county 2014}	0.0099*** [304.92]	0.0096*** [306.84]	0.0096*** [312.09]	0.0133*** [400.36]
<i>Oct</i> ₂₀₁₅ – <i>Mar</i> ₂₀₁₆ × <i>share</i> _{c, group quarter 2014}	0.0002*** [14.08]	0.0009*** [75.48]	0.0009*** [79.11]	0.0022*** [137.36]
<i>F</i> -excluded instruments	53,138.82	55,400.87	56,418.74	84,754.35
Regional fixed effects	Municipality	Municipality	County	Municipality
Seasonal effects	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes
Lagged neighborhood characteristics (1 km grid)	No	Yes	Yes	Yes
Lagged county characteristics	No	No	No	Yes
Observations	1,985,590	1,985,590	1,985,590	1,985,590

Note: The second-stage dependent variable is the log of the base rent per square meter posted. The first-stage dependent variable is the 2015 refugee inflow to county *c* (as approximated by the EoY refugee stock in 2015 and normalized by the 2014 population of county *c*). For a list of the flat-specific characteristics considered, see appendix Table B1. Lagged neighborhood characteristics (from 2013) at 1km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. The number of regional fixed effects is 7,187 in specifications (1), (2) and (4), and 402 in specification (3). First stage t-statistics are reported in square brackets. Second stage robust standard errors are reported in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.

Additional Explorations

Table C5

TABLE C5 | Heterogenous treatment effects - population composition by top quartile age-gender groups at 1km grid level (2013).

	Dependent Variable: Log (Rent/m ²)					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Females</i>						
<i>Treatment Periods</i>						
<i>Oct</i> – <i>Dec</i> ₂₀₁₅	0.0482*** (0.0081)	0.0395*** (0.0081)	0.0320*** (0.0096)	0.0305*** (0.0086)	0.0208*** (0.0070)	0.0270*** (0.0069)
<i>Jan</i> – <i>Mar</i> ₂₀₁₆	0.0533*** (0.0085)	0.0443*** (0.0085)	0.0518*** (0.0093)	0.0396*** (0.0088)	0.0257*** (0.0076)	0.0337*** (0.0053)
<i>Treatment Effects - Refugee Immigration</i>						
<i>Oct</i> – <i>Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-1.0753*** (0.4092)	-0.8683 (0.5646)	-0.4147 (0.2549)	-0.3482 (0.6035)	0.1550 (0.1705)	-0.1030 (0.1810)
<i>Jan</i> – <i>Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-1.2804** (0.5477)	-0.9896* (0.5936)	-0.8329*** (0.2701)	-0.3712 (0.6374)	-0.0827 (0.1958)	-0.4042** (0.2017)
Strata - top 25% (1 km grid level)	0–10 years	10–20 years	20–35 years	35–50 years	50–65 years	≥ 65 years
Observations	409,274	115,969	1,225,809	390,952	281,445	559,064

(Continues)

TABLE C5 | (Continued)

	Dependent Variable: Log(Rent/m ²)					
	(1)	(2)	(3)	(4)	(5)	(6)
Municipality fixed effects	3013	3265	1867	3304	3632	2403
<i>Males</i>						
<i>Treatment Periods</i>						
<i>Oct – Dec</i> ₂₀₁₅	0.0411*** (0.0090)	0.0376*** (0.0089)	0.0318*** (0.0098)	0.0321*** (0.0090)	0.0251*** (0.0058)	0.0260*** (0.0065)
<i>Jan – Mar</i> ₂₀₁₆	0.0437*** (0.0090)	0.0429*** (0.0093)	0.0523*** (0.0095)	0.0456*** (0.0093)	0.0292*** (0.0063)	0.0349*** (0.0052)
<i>Treatment Effects - Refugee Immigration</i>						
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-0.6848 (0.5354)	-0.5896 (0.4899)	-0.4801** (0.2426)	-0.1951 (0.5441)	0.1024 (0.1392)	-0.0359 (0.2375)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-0.5677 (0.5635)	-0.7957 (0.5179)	-0.8838*** (0.2557)	-0.5428 (0.6315)	-0.0780 (0.2078)	-0.3561 (0.2398)
Strata - top 25% (1 km grid level)	0–10 years	10–20 years	20–35 years	35–50 years	50–65 years	≥ 65 years
Observations	378,770	111,834	1,170,141	451,224	211,506	457,864
Municipality fixed effects	2939	3271	2167	3503	4239	2909
<i>Females & Males</i>						
<i>Treatment Periods</i>						
<i>Oct – Dec</i> ₂₀₁₅	0.0500*** (0.0091)	0.0379*** (0.0089)	0.0317*** (0.0097)	0.0356*** (0.0076)	0.0175** (0.0070)	0.0278*** (0.0069)
<i>Jan – Mar</i> ₂₀₁₆	0.0530*** (0.0102)	0.0521*** (0.0099)	0.0518*** (0.0094)	0.0471*** (0.0085)	0.0227*** (0.0078)	0.0366*** (0.0052)
<i>Treatment Effects - Refugee Immigration</i>						
<i>Oct – Dec</i> ₂₀₁₅ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-1.1910** (0.5605)	-0.7437 (0.5218)	-0.4288* (0.2509)	-0.4848 (0.4592)	0.2663 (0.1629)	-0.0839 (0.2039)
<i>Jan – Mar</i> ₂₀₁₆ × <i>ref</i> _{c2015} / <i>pop</i> _{c2014}	-1.3384* (0.7135)	-1.6036** (0.6342)	-0.8597*** (0.2638)	-0.7852 (0.5686)	0.0870 (0.2061)	-0.3527* (0.2051)
Strata - top 25% (1 km grid level)	0–10 years	10–20 years	20–35 years	35–50 years	50–65 years	≥ 65 years
Observations	396,402	112,745	1,211,204	419,696	248,318	517,936
Municipality fixed effects	2939	3293	1954	3416	3982	2586
Seasonal effects	Yes	Yes	Yes	Yes	Yes	Yes
Flat-specific characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Lagged neighborhood chr.s (1 km grid)	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the log of the base rent per square meter posted. Regression results for stratified samples according to top quartiles of age-gender group share (among the total population) along the 1km grid level distribution are reported. For a list of the flat-specific characteristics considered, see appendix Table B1. Lagged neighborhood characteristics (from 2013) at 1km grid level include the unemployment rate, the share of the foreign-born population, and the share of buildings that are predominantly in commercial use before the crisis. Standard errors are clustered at the county level. ***, **, * denote statistical significance at the 1%, 5%, and 10% level.