



Potential crime risk and housing market responses

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ABSTRACT

We study how information on local (dis)amenities is transmitted and manifested in housing markets. Using nationwide data on multifamily homes in South Korea, we analyze heterogeneity in the effect of a sex offender's presence on sale prices and rents of nearby homes. Our results demonstrate that the price effect of the offender's move-in varies significantly by spatial context. People react more strongly and persistently to the move-in of the offender in places wherein indicators of social connectedness are stronger, such as places with relatively low population density. We also find that, unlike housing prices, rents do not change in response to the move-in of a sex offender. These heterogeneous housing market responses may be attributed to better acquisition of and higher sensitivity to information on local (dis)amenities among (potential) members in highly connected communities, particularly among homeowners. We interpret our findings as suggestive evidence that social capital and social networks are important sources of information on local (dis)amenities.

Introduction

Economic theory suggests that if the public is informed about local conditions or (dis)amenities, these (dis)amenities will be transmitted to housing prices. However, little is known about the underlying mechanisms through which information on local (dis)amenities is acquired, perceived, and evaluated. In this study, we attempt to examine some of the effects of local (dis)amenities on housing market responses by analyzing heterogeneity in these responses across spatial attributes of local areas and household housing tenure.

We build on the literature that has demonstrated the capitalization of the presence of sex offenders into sale prices. The most notable example is [Linden and Rockoff \(2008\)](#). This literature has mainly focused on the sales data of single-family homes in single counties in the U.S., in the context of Megan's Law¹ ([Linden and Rockoff, 2008](#); [Pope, 2008](#); [Wentland et al., 2014](#); [Caudill et al., 2015](#)). Using the nationwide transaction database of multifamily homes in South Korea, we provide external validation to evidence from this literature and expand the analysis to heterogeneous housing market reactions. Specifically, we address the following two main research questions:

- 1 *Do housing market responses to the move-in of sex offenders evidenced in previous studies in the U.S. translate to South Korea?*
- 2 *What are the underlying mechanisms that drive heterogeneity in housing market responses?*

First, we find that the price effect of the move-in of sex offenders varies significantly by spatial context. The magnitude and localization of the price reduction we find are comparable to those from the previous studies related to the U.S., at approximately 5% within a 150-meter radius of the nearest sex offender. However, our finding that the average price effect disappears after 1 month is contrary to the evidence found in the U.S.-based studies that the effect persists for 1 or 2 years ([Linden and Rockoff, 2008](#); [Pope, 2008](#)). In trying to understand this difference, we find that while Megan's Law mandates real estate agents to disclose the presence of nearby sex offenders to potential homebuyers, such information disclosure is not required in South Korea. We also note that the population density and population turnover are significantly lower for the U.S. samples when compared to our Korean sample. Looking at areas in South Korea that are similar to the U.S. in these characteristics, our results are much more comparable. For instance, we find that multifamily homes located in areas with low population density and areas with low residential turnover experience a longer-term and larger reduction in sales prices after the offender's move-in. It is also evident that population density plays a dominant role in explaining spatial heterogeneity in population turnover. Our results suggest that people react more strongly and persistently to the move-in of a sex offender in places wherein indicators of social connectedness are stronger, but indicators of anonymity and transiency are lower such as locations with relatively low population density ([Glaeser and Gottlieb, 2006](#); [Brueckner and Largey, 2008](#)).

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¹ Since the 1994 Wetterling Crimes against Children and Sexually Violent Offender Registration Act and the 1996 Amendment to the Wetterling Act, commonly known as 'Megan's Law', U.S. state governments have been required to create a sex offender registry and to disseminate information on the location and description of sex offenders to the public.

Additionally, we find that while housing prices respond to the move-in of a sex offender, as in the previous literature, rents of nearby homes do not respond to the move-in. We assume that this heterogeneity can be explained by the differences between homeowners and renters in their pattern of information acquisition and evaluation. Presumably, potential or current homeowners have a higher probability of acquiring information on the offender's move-in than renters because they have an incentive to search for information on neighborhood (dis)amenities more intensely, and they are more likely to be engaged in social interactions than renters (Glaeser et al., 2002). As homeowners invest a lot more in housing than renters, and their investment risk associated with neighborhood disamenity is higher than that of renters (Hilber, 2005), potential or current homeowners are likely to evaluate the presence of a sex offender more sensitively.

We interpret our results as suggestive evidence that social capital and social networks are important sources of information on local (dis)amenities. The previous urban economics literature on social networks has offered evidence that spatial contexts of residence, such as population density and own housing tenure, are closely related with the level of social connectedness (Glaeser et al., 2002; Glaeser and Gottlieb, 2006; Brueckner and Largey, 2008). Our study adds insights on how such social connectedness can potentially influence the acquisition and evaluation of information on local (dis)amenities, which, in turn, can affect housing market outcomes. Two underlying mechanisms can explain our findings on heterogeneous price effects by population density and by housing tenure, although our empirical design does not aim to differentiate between the mechanisms. Households in low-density and, thus, highly-connected neighborhoods are more likely to acquire information on local (dis)amenities. Additionally, homeowners in less-anonymous and less-transient places may be more likely to react strongly.

Background

The impact of non-market amenities on nearby property values has long been a subject of study in urban economics. For example, studies have investigated the following: (1) the impact of a public release of the quality of public schools on nearby property values (Figlio and Lucas, 2004; Bayer et al., 2007; Fiva and Kirkeboen, 2011; Kuminoff and Pope, 2014; Imberman and Lovenheim, 2015); (2) the capitalization of environmental (dis)amenities in housing markets (Bui and Mayer, 2003; Chay and Greenstone, 2005; Kuminoff et al., 2010); and (3) an association between known crime rates and housing prices (e.g., Thaler, 1978; Schwartz et al., 2003; Ihlanfeldt and Mayock, 2010; Bishop and Murphy, 2011; Buonanno et al., 2013; Congdon-Hohman, 2013). Most closely related to our work, it has been found that the move-in of sex offenders, a particular disamenity, negatively affects nearby housing prices. Most empirical research took advantage of the public disclosure of sex offenders' location in the context of Megan's Law in the U.S. Using data from Mecklenburg County, North Carolina, Linden and Rock-off (2008) demonstrated that the move-in of a sex offender within 0.1 miles (169 m) reduced house prices by 4%. In Hillsborough County, Florida, Pope (2008) found a similar but smaller reduction in house prices within 0.1 miles of a sex offender. Recently, two studies attempted to make a methodological improvement by adding spatial elements (Caudill et al., 2015) and by accounting for selection and simultaneity bias (Wentland et al., 2014).

Although these previous studies have provided useful insights into the average effect of specific (dis)amenities transmitted in housing markets, most have not addressed the potential heterogeneity in this effect. One critical question for investigating such heterogeneity is how potential buyers and sellers acquire the information on (dis)amenities. The literature on social networks suggests the importance of learning and acquiring information via social interactions, especially through word-of-mouth communication. Empirical evidence has demonstrated that information sharing through social interactions plays an important role in investment decisions (Guiso et al., 2004; Hong et al., 2004).

Other researchers have focused on the spatial characteristics of residential communities wherein social interactions occur. For example, Glaeser and Gottlieb (2006) and Brueckner and Largey (2008) suggested that population density has a negative impact on social interactions. Glaeser et al. (2002) demonstrated that the level of social interactions is higher among homeowners and those who are less mobile. Rohe et al. (2002) and Dietz and Haurin (2003) similarly reported a positive relationship between homeownership rates and social interactions.

Another critical question underlying the analyses of heterogeneity in housing market responses to local (dis)amenities is how individual participants in housing markets evaluate the information on (dis)amenities and make their own housing decisions based on this evaluation. Some scholars have begun to recognize the drawbacks of existing hedonic models with a strong assumption that the marginal willingness to pay for amenities or to avoid disamenities is homogeneous across all households. For example, Bishop and Murphy (2011) suggested substantial heterogeneity in the household evaluation of crime by observed household characteristics, such as income and race.

In our setting, variation in both the acquisition and evaluation of information can play an important role. First, current residents of neighborhoods wherein sex offenders move-in can acquire the information on this move-in one of the following three ways: (1) an online search of the sex offender registry; (2) mail notification sent only once at the time the sex offender moves-in to households with children under 18 years of age; and (3) information sharing with neighbors. The first option is free, but the time cost may be large. To access sex offender information on a personal computer, a person must install five separate security programs and then go through the identity verification process.² While the second option does not involve any costs, it is provided only to residents with children under 18 years of age when the offender moves-in. Therefore, similar to investment decisions, how information is shared among residents may play an important role in the decisions of those who do not receive the information directly from the government. On the other hand, an online search would be the main channel for potential in-migrants to collect offender information. Unlike Megan's Law in the U.S., which mandates real estate agents to disclose the presence of nearby sex offenders to potential homebuyers (Caudill et al., 2015), such information disclosure is not required in South Korea. Therefore, those willing to bear fixed costs for the online search are more likely to learn about the presence of a sex offender when compared to others.

A further possible cause of heterogeneity in households' response to acquired information on the presence of a sex offender is variation in their evaluation of the information. Some households may evaluate this information more seriously if they are exposed to a higher financial risk associated with the presence of a sex offender. Some may perceive potential crime risks to be higher when compared to others due to their demographic characteristics or residential environments that are more vulnerable to such risks.

Data and methods

Data sources

We use the nationwide data in South Korea that link the information from sex offender registries with a transaction database of multi-family housing units.³ According to the 2010 Census, multifamily housing accounts for 71% of total housing in South Korea. Our data come from several sources. The first is a dataset on all multifamily housing transactions, including both sales and rentals over the period January

² In addition, access is not fully supported on some web browsers such as Chrome or Opera. See the website (<http://sexoffender.go.kr>) for more details.

³ Unfortunately, the South Korean government has not released transaction data for single-family housing units with individual addresses, and hence we cannot use them for our analyses.

2010–December 2014 in South Korea.⁴ While our main sample pools all multifamily housing units, we consider heterogeneous attributes of apartments and other multiplexes by including the dummy variable of apartments (typically called “APT” in South Korea) in our regression. The data, provided by the Ministry of Land, Infrastructure, and Transport, contain sales prices/rents, property characteristics, such as the floor area and story of the unit, and addresses. Since each multifamily housing complex is built on one parcel of land and only one address is assigned to a complex, we identify the centroid of this parcel to link spatially to the residential location of nearby sex offenders. We describe the technical details later in this section. Using these addresses, we create neighborhood fixed effects as well as neighborhood-specific quadratic time trends to control for housing market characteristics and temporal trends in our statistical analyses.⁵

The second dataset is the publicly available information on sex offenders. In January 2010, the Ministry of Gender Equality and Family (MGEF) launched a public website to provide personal information of sex offenders and expanded the details of the offender information in June 2013, such as the inclusion of the offender's photo.^{6,7} When sex offenders move to a new location, they are required to report a change in their residential location within 20 days. Their new address is updated on the public website, and the new offender information is mailed to families with children who reside in the same neighborhood within one month of the report. The registry data contain a wide range of information on sex offenders, such as current address, age, sex, portrait photo, a description of the sex crime they committed, sentence date, the duration of the sentence, and the age of the victim. We manually collected this information from the website run by the MGEF as of January 2014, and

this dataset was used for the main analyses in our study.⁸ There were 3,963 sex offenders, and our final sample consisted of 3,852 offenders after dropping individuals with missing geographic information. As shown in Panel A of Fig. 1, sex offenders are distributed quite evenly across the country with somewhat higher concentrations in large cities, such as Seoul (shown in Panel B), which also have a larger number of housing units.

Although our sex offender data are cross-sectional data of the registry record at a specific time (January 2014), we were able to construct retrospective panel data using the time and location variation in the dataset. We calculated the sex offender's date of release from prison, based on the duration of sentence for each sex offender, and used this date as the proximate move-in date to the location in our data. For those who were convicted, but whose jail time was suspended, we assume that the offender moved into the neighborhood of their residence immediately.⁹

We acknowledge that there are potential measurement error issues in our offender registry data, which could lead to treating a certain area as having a sex offender when it does not have any offender or vice versa. We omit some sex offenders entirely if they were dropped from the official registry before our data collection point¹⁰ or if they were released and moved-in to the new location after our data collection point.¹¹ We also have some sex offenders that appear in the sample but with incorrect move-in dates, if they have moved to the location observed in our data after their release date or to a new location after our data collection point.¹² As both these issues are about the incorrect measurement of the move-in treatment, they will bias the impact of a sex offender's move-in on housing prices toward zero, and our estimate can be interpreted as a lower bound of the true negative impact in terms of the magnitude.

Finally, we collect a wide range of information on surrounding areas, defined as a 100-meter radius from the center of a complex. The geographic information system (GIS) database, generated based on the publicly available cadastral map, provides useful data, including the number of passengers at subway station(s); number of bus routes; number of convenience stores; number of kindergartens; share of built-up areas; share of undeveloped land; and number of students enrolled in elemen-

⁴ There are three forms of rental transactions in South Korea: (1) monthly rental (a typical rental contract type in the U.S. and other developed countries), (2) *jeonse*, and (3) a mixture of these two. *Jeonse* is a unique real estate contract type in South Korea in which a renter makes a lump-sum deposit on a rental space of anywhere from 50% to 80% of the market value of the unit in lieu of paying monthly rent (i.e., zero monthly rent). In addition to our main analysis, which focuses on sales transactions, we examine rental market responses to sex crime risk (see Table 5). To do so, we use the full sample of rental units in which the deposit is converted into monthly rents based on the official conversion rate provided by the Korea Appraisal Board. Further details on *jeonse* can be found at <http://english.seoul.go.kr/life-information/residence/housing/1-wolse-jeonse/>.

⁵ Neighborhood units in South Korea are called *Dong* in urban areas and *Eup* or *Myun* in rural areas. These are the smallest geographic levels defined administratively in South Korea, and their median population size is approximately 5,000, similar to that of census tracts in the U.S. In this study, we define *Dong*, *Eup*, and *Myun* as neighborhoods and use the neighborhood fixed effects for all analyses. Larger geographic areas than these neighborhoods are referred to as *Gu* in big cities, *Shi* in small cities, and *Goon* in rural areas. In this study, we refer to these as districts and collect some key explanatory variables introduced later, such as population density and migration rates, at the district level. As neighborhood boundaries do not overlap district boundaries and each neighborhood is only in one district, our neighborhood fixed effects soak up baseline variation in district variables.

⁶ The website and details on the registration and notification policy can be found at <http://www.sexoffender.go.kr>. The categories of sex crimes punished by criminal law in South Korea include various types of sexual assaults and abuse, such as rape, groping, harassment, consensual relationships with a minor aged under 13 years, and attempted rape. By court ruling, the personal information of any offender who commits any of these crimes is subject to public disclosure. In most states in the U.S., including North Carolina, such offenses as rape, sexual acts, other than rape in which force or violence is involved, child molestation, and attempted sex offense or rape are subject to public disclosure (the federal Sex Offender Registration and Notification Act), and the listed offenses in the U.S. are very similar to those in South Korea.

⁷ Our sample shows that most sex offenders committed violent crimes: 33.25% committed rape, and 56.35% used forced physical touch (groping).

⁸ As we were unable to retrieve archived data, our analyses focus on move-in effects rather than move-out effects.

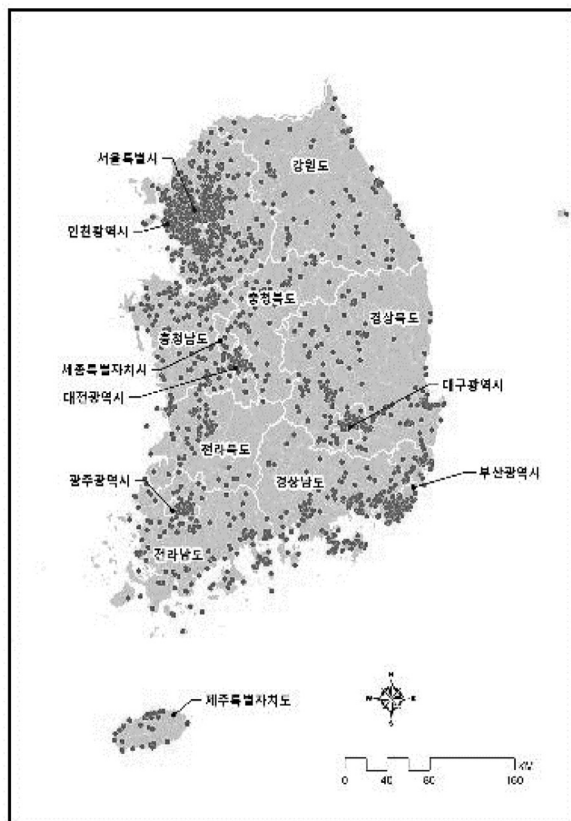
⁹ The offender would have resided in this location at the time of the court sentence following which the information on this location would have been publicly released.

¹⁰ The information on sex offenders is publicly disclosed for a maximum of 10 years and the most frequent disclosure period is 4 or 5 years in our data. As the public disclosure of information on sex offenders began in January 2010, offenders who were released before this date were not subject to the disclosure. Hence, only a small number of offenders released in 2010 or 2011 with the required disclosure period of less than 3 or 4 years would have been dropped from the data before we collected the data on January 1, 2014.

¹¹ Since offenders are in general included in the registry data soon after they are sentenced, we would miss only a few observations. These might include offenders who were sentenced after January 1, 2014 and released before December 31, 2014 with a jail term of less than 1 year; however, the average jail term in our data is approximately 2.5 years.

¹² Seventy percent of all offenders were released within 2 years from our data collection point. Additionally, the extent of residential mobility of sex offenders is not high, in our sample. We traced the registry data for 5 months until May 2014 and found that 77 offenders (less than 2% of the sample) were dropped from the sample and approximately 270 offenders (less than 7% of the sample) moved during these 5 months. Additionally, we collected the registry data for the city of Seoul in July 2015 and found that 300 out of 748 sex offenders had lived in the exact same location since January 2014. After accounting for 333 offenders who were newly added after January 2014, we found that only 117 offenders (15.6% of all offenders in Seoul) had moved within or to Seoul over the 19 months between January 2014 and July 2015. Among them, 84 offenders moved within the city of Seoul and the rest moved-in from other cities.

Panel A. South Korea



Panel B. Seoul

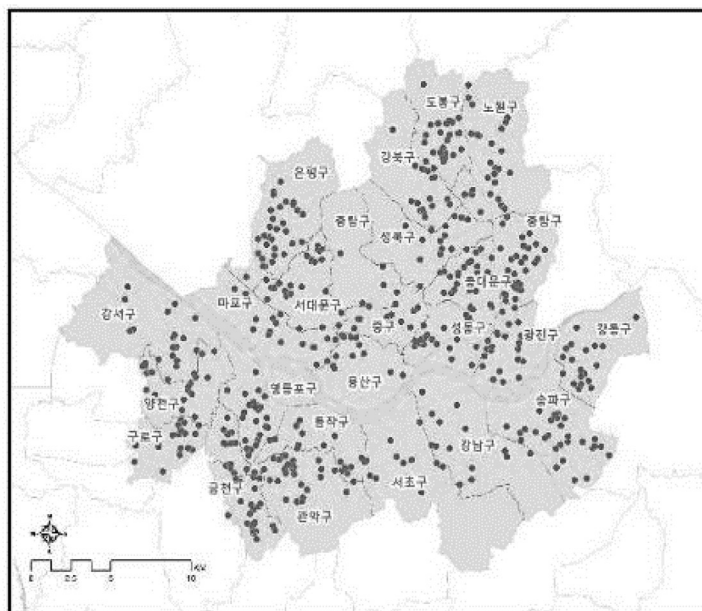


Fig. 1. Distribution of Sex Offender's Location (as of January 2014). Panel A. South Korea. Panel B. Seoul.

tary, middle, and high schools.¹³ As in previous literature, these amenities and the level of urbanity and urbanization are important determinants of housing prices and rents. Since all these area characteristics are measured at a very fine geographic level (100-meter radius),¹⁴ we expect them to be good controls in our main regression analyses. Additionally, from the Korean Statistical Information Service, we gather several district-level attributes, including population density and migration rates, as well as neighborhood-level demographic characteristics, such as population size, number of females, and population under 18 years old, for the analyses on spatial heterogeneity.

We use a GIS tool to measure the proximity of each transacted housing unit to sex offenders. Based on the calculation of straight-line distances between the centroid of multifamily housing complexes and residential location of sex offenders, we generate two binary variables that capture the presence of sex offenders and associated sex crime risk, including the following: (1) whether the nearest sex offender is located within a 150-meter radius and (2) whether the nearest sex offender is located within a radius of 150–300 m. Our distance criteria are determined following the previous research: the 0.1-mile and 1/3-mile radii used by [Linden and Rockoff \(2008\)](#) and 0.1-mile and 0.1–0.2-mile radii used by [Pope \(2008\)](#). Panel A, [Fig. 2](#), presents the price gradient of distance from the nearest offender; this suggests that the move-in effects are mainly concentrated on housing units within a 150-m radius of the

nearest offender, and the price decline gradually disappears as the distance approaches 300 m.¹⁵

Sample of sales transactions

Table 1 provides summary statistics for our sample of sales transactions of multifamily housing units in South Korea. This sample is created by dropping all housing units that had more than one offender location within a 300-meter radius between 2010 and 2014. In other words, the sample is composed of multifamily homes that were never near a sex offender's location (control group, column 3) and those that were near only one offender's location (treatment group, column 1 and column 2). Following Pope (2008), this restriction aims to ensure that movements of multiple sex offenders do not obscure the treatment effect. The subsample of the treatment group I is composed of multifamily homes within a 150-meter radius of only one offender location during 2010–2014 (column 1), while the subsample of treatment group II includes homes within a 150- and 300-meter radius from one offender's location (column 2). There are approximately 150,000 and 330,000 units in treatment groups I and II, respectively, and our control sample contains approximately 2.46 million units. Table 1 shows that the treatment groups and control group differ in terms of several observable characteristics, and hence it is likely that also they differ in terms of unobservable characteristics. Therefore, we propose an empirical strategy that utilizes a time dimension to allow us to generate cleaner identification than is possible to achieve using a cross-section.

¹³ In South Korea, most public schools serve students in their residential zones. The residential zone for elementary schools is smaller than residential zones for middle and high schools.

¹⁴ Our area characteristics are measured at a very fine geographic level (within a 100-m radius from each complex), while our fixed effects are at a larger geographic scale, namely, a neighborhood *Dong*. Thus, these area characteristics might not be absorbed by the neighborhood fixed effects.

¹⁵ Price gradients are calculated using a locally weighted non-parametric regression method often called LOWESS (with the default bandwidth of 0.8).

Table 1
Summary Statistics.

	(1) Subsample of transactions within 150 m from offender 153,458		(2) Subsample of transactions between 150 and 300 m from offender 330,819		(3) Control sample of sales transactions 2,455,604	
Number of observations	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<i>Unit characteristics</i>						
Real price (in 1,000 Korean won)	142,276	107,325	171,769	131,819	190,169	163,004
Unit area (square meter)	62.70	23.74	67.38	26.60	73.07	28.07
Age (years)	14.48	7.60	14.33	7.88	12.46	7.79
Age squared	267.50	246.10	267.60	250.10	216.06	235.44
Floor level	6.66	5.41	6.86	5.83	7.57	5.83
Apartment (Yes = 1; No = 0)	0.72	0.45	0.73	0.45	0.83	0.38
<i>Area (within 100 m radius) characteristics</i>						
No of bus routes	3.08	9.31	2.56	7.71	2.34	7.81
No of passengers at the subway station(s)	34.97	866.3	77.23	1394.0	53.71	1480.9
No of students enrolled in elementary school	18.24	115.4	15.55	114.2	19.10	132.2
No of students enrolled in middle school	3.86	55.3	12.38	107.3	7.19	80.7
No of students enrolled in high school	3.88	61.9	4.87	75.4	5.22	78.1
No of kindergartens	0.12	0.34	0.13	0.35	0.12	0.34
Share of built-up area (percent)	72.97	36.0	74.54	36.4	61.80	41.0
Share of bare ground (percent)	1.76	10.5	1.68	9.97	3.30	14.4
No of convenience stores	0.26	0.56	0.29	0.57	0.21	0.49
<i>District characteristics</i>						
Number of Population	335,078	138,032	347,280	136,994	334,211	140,935
Population density (persons/km ²)	6,865	6,967	7,958	7,204	6,090	6,628

Note 1: All monetary values are in CPI-adjusted real terms (August 2010).

Note 2: KRW 1,180 = US\$1 as of May 2016.

Empirical methodology

As indicated by previous researchers (Linden and Rockoff, 2008; Pope, 2008), it is possible that the presence of a nearby sex offender is correlated with unobserved property and location characteristics and with a temporal market trend. Cross-sectional regressions cannot avoid being subject to the problem of unobserved spatial heterogeneity and omitted variable bias. For example, if unobserved negative attributes already exist at or near the location that a sex offender chooses, those factors would reduce the prices of homes within a 150- or 300-meter radius from this location immediately before the sex offender moves-in. In fact, Panel A of Fig. 2 suggests that the price gradients prior to the sex offender's move-in are upward sloping for areas between 0 and 200 m from the offender's location, and sex offenders tend to move into areas with lower house prices. As the main goal of our analysis is to estimate the isolated effect of the move-in of a nearby sex offender on house prices, we use a difference-in-difference (DID) approach using variations in the distance from and the pre- and post-move-in date of the nearest sex offender as our main empirical strategy.¹⁶ We employ the DID model as follows:

$$\begin{aligned} \text{Log}(P_{ijt}) = & \beta D_{ijt}^{150} + \delta D_{ijt}^{300} + \theta D_{ijt}^{150} \times \text{Post}_{it} + \lambda D_{ijt}^{300} \times \text{Post}_{it} + X'_{it}\gamma + \varphi_t \\ & + \alpha_j + \rho_j t + \tau_j t^2 + \varepsilon_{ijt} \end{aligned} \quad (1)$$

where P_{ijt} is the sales price of housing unit i in neighborhood j transacted in month t , D_{ijt}^{150} is a binary indicator of whether a sex offender moved-in during the sample period within a 150-meter radius of housing unit i , D_{ijt}^{300} is a binary indicator of whether a sex offender moved-in during the sample period within a 150–300-meter radius of housing unit i , and Post_{it} is a binary indicator that the sale of housing unit i in month t occurred after the move-in of the nearest sex offender. θ and λ pick up the post-arrival impacts of a sex offender's move-in within a 150-meter radius and a 150–300-meter radius on sales prices, respectively. For the temporal variation of Post , we limit our analysis to transactions that occurred within 1 year before and after sex offenders' arrivals, and we try

different time windows, such as one month, two months, three months, six months, and one year. By doing so, we attempt to estimate the short- and long-term effects of the responsiveness to the sex offender's move-in.¹⁷ X is a control vector of property- and area-specific characteristics. We include the year-month and neighborhood fixed effects as well as neighborhood-specific linear and quadratic time trends to control for unobserved heterogeneity.¹⁸ ε_{ijt} is an error term. To account for the potential serial correlation of residuals within a neighborhood, we cluster standard errors at neighborhood level j , following the recommendation of Bertrand et al. (2004) and Cameron and Miller (2015).¹⁹

The underlying assumption imposed by our DID model is that the treatment and control areas have parallel price trends. To validate this assumption, Panel B of Fig. 2 presents the price gradients by the distance from offenders and by the time periods prior to and after the offender's arrival (i.e., +/- 6 months, +/- 3 months, and +/- 1 month). The result demonstrates that price gradients do not evolve much prior to the nearest offender's move-in. One month after the move-in, there is a sharp drop in prices only for the treatment areas, and, at this time, we find a significant, negative treatment effect in our empirical results. After this short-term treatment effect, the prices in the treatment areas return to the initial level, and treatment and control areas continue to have parallel price trends. Hence, Fig. 2 shows that treat-

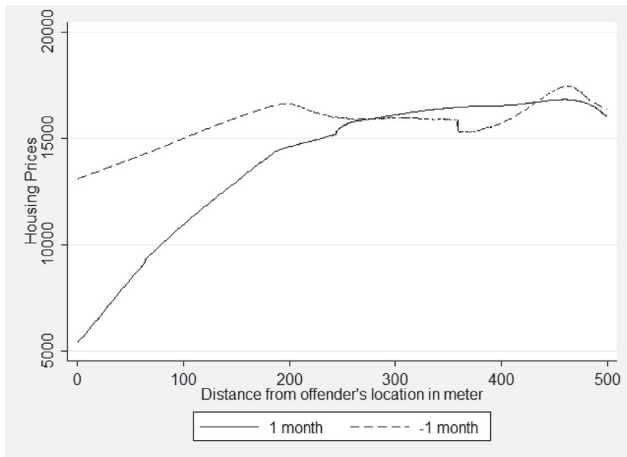
¹⁷ Previous research reported only 1- or 2-year time windows and did not report the shorter-term effect of the information on potential sex crime risk. The analysis of the short-term move-in effect is feasible in our research as opposed to previous research because our sample size is 15 times larger than that of Linden and Rockoff (2008) or Pope (2008).

¹⁸ Both Linden and Rockoff (2008) and Pope (2008) use only the year-specific fixed effects. Thus, their specifications raise a potential concern with regard to omitting the short-term changes in housing markets.

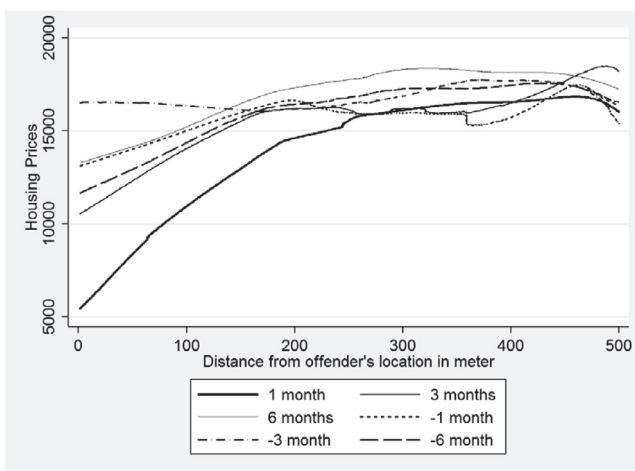
¹⁹ Alternatively, standard errors can be clustered at the neighborhood-month level. However, this cannot account for serial correlation within the neighborhood, and thus potentially inflate the statistical significance of the coefficient estimates. We do not report the results using the neighborhood- and month-specific clustered standard errors, but we find that the coefficient estimates indeed become more statistically significant. This suggests that our results are statistically more conservative.

¹⁶ We also conduct cross-sectional regressions using our sample. The results are shown in Appendix 1.

Panel A. 1 month before and after the nearest offender's move in



Panel B. 1–6 months before and after the nearest offender's move in



Note: Results from locally weighted non-parametric estimation of transaction prices on the distance from offenders.

Fig. 2. Price Gradient by the Distance from Offenders and by the Time Periods. Panel A. 1 month before and after the nearest offender's move in. Panel B. 1–6 months before and after the nearest offender's move in. Note: Results from locally weighted non-parametric estimation of transaction prices on the distance from offenders.

ment areas did not experience a higher price reduction or lower price increase before the move-in of a sex offender when compared to control areas, and suggests that DID is a valid empirical approach for our analysis.

We estimate the DID model using our primary sample of sales transactions of multifamily homes in South Korea. Subsequently, we compare these results with those of the previous studies that use samples of single-family homes in the U.S. counties with almost identical specifications. To explore spatial heterogeneity in housing market responses, we add the interaction terms of the treatment effect and spatial characteristics, such as population density and migration rates, in the districts wherein the housing units are located. Additionally, we estimate the same DID model for the sample of rental transactions for the same period of 2010–2014 in South Korea and compare these results with our main results using the sample of sales transactions.

Results and discussion

Average housing market responses to the sex offender's move-in in South Korea

Our main quasi-experimental treatment examines the move-in of a sex offender within a 150-meter radius of multifamily homes. We estimate the treatment effect on transacted sales prices of these homes after the offender's move-in. We compare the significance and magnitude of this treatment effect with another treatment effect found in homes that are located within a 150–300-meter radius of a sex offender's location and transacted after the move-in of the offender.

Table 2 shows the estimation results of a series of DID specifications that use the primary sample of sales transaction data. The results in column 1 demonstrate that the move-in of a sex offender within a 150-meter radius causes a significant reduction in sales prices. Prior to the offender's move-in, these homes were sold for an approximately 2.5% less price than homes with similar unit-specific characteristics that did not receive any offenders and were sold in the same neighborhood and month. After the offender's move-in, however, homes located within a 150-meter radius of a sex offender's location sold for a price that was low by an additional 6.3%. For homes located within the 150–300-meter radius, the estimated price reduction after the offender's move-in was approximately 3.6%. As reported in columns 2 and 3, the magnitude of the reduction in prices after the move-in of a sex offender within a 150-meter radius became slightly smaller when controlling for a neighborhood-specific quadratic time trend and characteristics of the surrounding area.

The results presented in column 3 show that housing prices fall by 5.5% for multifamily homes within a 150-meter radius of the nearest sex offender 1 month after this offender moves-in, when compared to the prices of similar homes in this area before the move-in.²⁰ This additional 5.5% reduction in sales price is statistically significant at the 6.9% level. A back-of-the-envelope calculation based on this result suggests that multifamily homes within a 150-meter radius of an offender's location sold for approximately KRW7.8 million less (US \$6,632) after the offender's move-in when compared to the average transaction price of homes of KRW142 million (US \$120,800) prior to the move-in. For homes located within the 150–300-meter radius of an offender's location, the estimated price reduction after the offender's move-in was 3% when compared to before the move-in. This 3% additional reduction is smaller than the 5.5% further reduction for homes within a 150-meter radius. Hence, the treatment effect of the move-in of a sex offender appears to be strongest for homes that are very close to the location of a sex offender and dissipates gradually according to distance to the offender's location.

Columns 3–7 in Table 2 show the regression results using different time windows, such as 1 month, 2 months, 3 months, 6 months, and 1 year. We see that the effect of sex crime risk rapidly disappears 1 month after the offender's move-in. In other words, the sex offender's move-in in South Korea appears to have only a short-term effect on housing markets rather than an enduring effect over longer time horizons.

There is a potential concern that observed treatment effects may arise from price movements before the sex offender moves-in, as the time horizons are restrictive in our main specification. We conduct robustness checks by specifying a series of interactions of 12 time dummies (i.e., –6 to –5 months, –5 to –4 months . . . +4 to +5 months, +5 to +6 months) with 2 distance dummies (treatment areas). As reported in Appendix 2, we do not find any significant price movement before the

²⁰ As mentioned in the Data and Methods section, our sample has a potential issue of incorrect measurement of the move-in treatment. To address this issue, when limiting our sample to housing units transacted before February 28, 2014, which is just two months after our data collection point, results consistently show a significant and negative price effect. Results are available upon request.

Table 2

Difference-in-Differences Regression Results: Sex Offender Move-in Effects on Sales Prices by Different Specifications and Time Windows.

VARIABLES	(1) 1 month log (sales price)	(2) 1 month	(3) 1 month	(4) 2 months	(5) 3 months	(6) 6 months	(7) 12 months
Within 150 m from offender	−0.0245*** (0.0075)	−0.0269*** (0.0071)	−0.0251*** (0.0071)	−0.0252*** (0.0071)	−0.0255*** (0.0072)	−0.0262*** (0.0073)	−0.0276*** (0.0076)
Within 150 m from offender & Sold during _ month(s) after offender moved in	−0.0633* (0.0335)	−0.0521* (0.0299)	−0.0549* (0.0302)	−0.0336 (0.0273)	−0.0200 (0.0232)	−0.0058 (0.0147)	0.0035 (0.0098)
Between 150 and 300 m from offender	−0.0068 (0.0053)	−0.0085* (0.0049)	−0.0070 (0.0049)	−0.0070 (0.0050)	−0.0073 (0.0050)	−0.0076 (0.0049)	−0.0092* (0.0050)
Between 150 and 300 m from offender & Sold during _ month(s) after offender moved in	−0.0360** (0.0182)	−0.0294* (0.0163)	−0.0302* (0.0164)	−0.0178 (0.0141)	−0.0083 (0.0117)	−0.0026 (0.0081)	0.0065 (0.0057)
Observations	2,939,881	2,939,881	2,939,881	2,939,881	2,939,881	2,939,881	2,939,881
R-squared	0.896	0.909	0.909	0.909	0.909	0.909	0.909
Area (within 100 m radius) characteristics	No	No	Yes	Yes	Yes	Yes	Yes
Unit characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood-specific quadratic time trend	No	Yes	Yes	Yes	Yes	Yes	Yes

Note 1: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 2: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

offender moves-in, for the main treatment group within a 150-meter radius of the sex offender. Consistent with our empirical results, the price reduction is significant only for 0 to +1 months, and the effect dissipates subsequently for both treatment groups. In addition, we perform a falsification test using false arrival dates that are six months and one year before the offenders' actual arrival dates. As shown in Appendix 3, the regression results reveal no evidence that house prices in treatment areas wherein offenders move-in were experiencing a downward trend. In short, both appendices 2 and 3 support the validity of our results by showing no difference in price movements between the treatment and control areas before the treatment.²¹

Comparisons with U.S. results

To answer our first research question on the international translation of evidence regarding housing market responses to the sex offender's move-in, we attempt to compare our results with existing evidence in the context of Megan's Law. When we replicate the empirical strategy used for the U.S.-based studies conducted earlier, Table 2 demonstrates a significant reduction in sales prices of nearby homes after the move-in of a sex offender, and the magnitude of a 5.5% reduction is comparable to a 4% impact²² found in Linden and Rockoff (2008). Given this significant price effect, potential sex crime risk appears to be considered as a neighborhood disamenity in South Korea. Additionally, the results from our main DID model suggest a dissipating treatment effect according to the distance from the location of the nearest sex offender, and this finding is consistent with the previous studies undertaken in the U.S. context (Linden and Rockoff, 2008; Pope, 2008). Therefore, we confirm the external validity of the significantly negative and localized effect of the presence of sex offenders on transaction prices of nearby homes.

However, our result of the short-term price reduction contrasts with the U.S. evidence obtained earlier that the treatment effect of the move-in of a sex offender lasts for 1 year (Pope, 2008) or 2 years (Linden and Rockoff, 2008). Intuitively, if the new disamenity emerging from the presence of a sex offender within a proximate location affects the price reduction of nearby homes, then this effect would persist during the

offender's presence. On the other hand, many previous studies on the price effect of neighborhood (dis)amenities suggest the diminishing or temporary nature of this effect (Gamble and Downing, 1982; Kohlhasse, 1991; Figlio and Lucas, 2004; Fiva and Kirkeboen, 2011). One plausible reason for the rapid price rebound is the increasing cost of information acquisition over time. As mentioned in the Background section, in South Korea, the mail notification sent directly to existing residents with children could be the main channel for acquiring information about a sex offender at the time of the offender's move-in. Moreover, real estate agents are not required to disclose the presence of nearby sex offenders to potential buyers in South Korea. Therefore, to acquire sex offender information in the long-run, one would have to rely on an online search or acquire information from neighbors in South Korea.

A further problem complicating comparisons of the United States with South Korea involves spatial contexts that affect how information is acquired in the long-run and how the perception of potential crime risk is adjusted over time. Appendix 4 reports vast differences in spatial characteristics between our sample and those used for U.S.-based studies conducted earlier. For example, areas used for our sample (7,579 per square kilometer) in South Korea are almost 20 times denser than the two U.S. counties used in Linden and Rockoff (2008) (510 per square kilometer) and Pope (2008) (367 per square kilometer). Additionally, our sample areas in South Korea show higher in-migration rates than areas used for the U.S. samples. Fig. 3 illustrates the magnitude of the difference in housing density. While there are approximately 50 housing units within a 0.1-mile radius from the sex offender's location in the Mecklenburg County, North Carolina, there are approximately 580 housing units within a 150-meter radius in Seoul, South Korea. Based on this observation, we assume that such significant differences in population density and population turnover might be potentially associated with their differences in the persistence of treatment effects. We explore this assumption by addressing our second research question on the underlying mechanisms that drive the housing market responses by analyzing what factors drive heterogeneity in those responses.

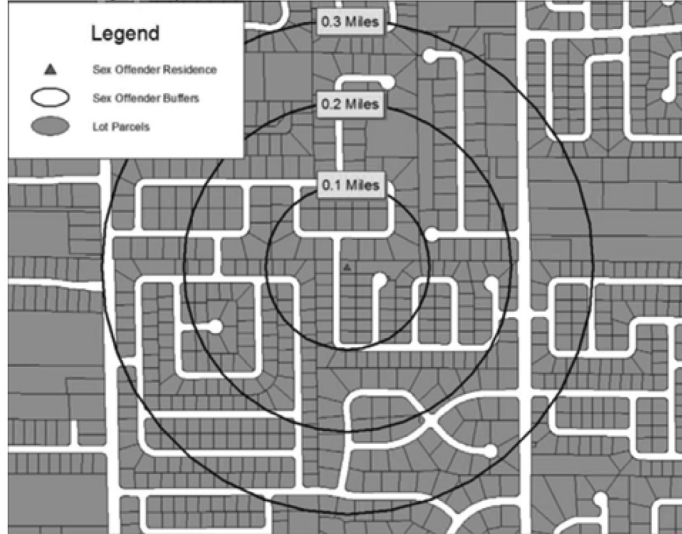
Heterogeneous housing market responses by spatial context

Based on the urban economics literature, we propose two potential underlying mechanisms through which spatial contexts influence housing market responses. First, if the level of social connectedness is higher in areas with lower density and lower population turnover (Glaeser et al., 2002; Glaeser and Gottlieb, 2006; Brueckner and Largey, 2008),

²¹ While both appendices essentially perform the same test, Appendix 2 is slightly more flexible.

²² It is the average effect over the period of 12 months. While Linden and Rockoff (2008) did not explicitly report the post-1-month move-in effect in their study, it is inferred to be approximately 10%, based on Figure 3A (p. 1113).

Mecklenburg County, NC (Source: Linden and Rockoff 2008)



Seoul, South Korea



Fig. 3. Comparison of Housing Density (Mecklenburg County, NC vs. Seoul, South Korea). Mecklenburg County, NC (Source: Linden and Rockoff 2008). Seoul, South Korea.

then there would be active and enduring information sharing regarding the presence of sex offenders, which would lead to a more significant, longer-term treatment effect in these areas. For example, the level of information sharing among neighbors after the initial mail notification may have been lower among multifamily homes located in denser and more mobile areas of South Korea when compared to that among single-family homes located in the U.S. counties sampled in the previous studies (Linden and Rockoff, 2008; Pope, 2008). As previously mentioned, in South Korea, such information sharing is likely to be a particularly important channel for the long-run acquisition of sex offender information because, unlike in the U.S., acquiring such information from real estate agents is not possible in South Korea.

Additionally, since residents in large, high-density cities tend to be more transient and anonymous than those residing in smaller, low-density cities (Glaeser and Sacerdote, 1999), they could be more indifferent to their neighbors. Thus, the majority of existing residents or potential in-movers in areas with higher population density and higher population turnover may not perceive the arrival of a single sex offender as a huge crime risk. This potential mechanism could help explain why no statistically significant average price effect is found past the first month after the move-in of a sex offender in our sample, which has much higher density and higher population turnover than the U.S. samples in the existing studies.

Both the density and transiency mechanisms may lead to spatial heterogeneity in the housing market responses. We attempt to analyze this heterogeneity by using variation in the spatial characteristics among multifamily homes in our nationwide sample. Specifically, we use the interaction of treatment variables used in the main DID specification in Table 2 with quartile measures of spatial attributes, such as population density and migration rates.²³ Table 3 presents heterogeneity in treatment effects between the bottom 25% and top 25% in terms of these

attributes.²⁴ First, the result suggests that depending on the time window after a sex offender moves-in the homes located in the districts in the bottom 25% of population density experience an approximately 3–8% reduction in sales prices after the offender's move-in within a 150-meter boundary (columns 1–5). The size of the treatment effect for these homes in the lower density quartile decreases over time but remains statistically significant at the 5% level for at least up to 9 months. Conversely, homes in high-density districts experience no significant price reduction after the offender's move-in (columns 1–5).²⁵

Table 3 continues to report results of heterogeneity in housing market responses by quartiles of migration rates at the district level. The table shows that multifamily housing units located in the districts in the bottom 25% of migration rates experience a 4–9% further drop in sales prices after a sex offender moves-in (columns 6–10). It is noteworthy that the move-in effect for these units, which are located in areas wherein population turnover is low, remains statistically significant at the 10% level over a period of at least 6 months. Conversely, districts in the top 25% of migration rates do not experience any significant price reduction after the offender's move-in and instead show insignificant positive coefficients for most time windows (columns 6–10).

To further investigate our finding that both population density and population turnover may influence heterogeneity in housing market responses to the sex offender's move-in, we run a horse race between these spatial dimensions by including two interactions in one regression. As shown in Table 3 (columns 11–15), we find that population density plays a more dominant role in spatial heterogeneity in hous-

²³ We try to address potential unobserved heterogeneity that may be associated with both these spatial attributes and housing decisions. For example, if residents who are more sensitive to information of potential sex crime risk (e.g., females under 18 years of age) are concentrated more in areas with lower population density than higher-density areas; these demographic differences might be another important source of spatial heterogeneity in housing market outcomes. Hence, we add the proportion of the female population under 18 years of age at the neighborhood level as well as the share of female population and the share of the population under 18 years of age in this regression.

²⁴ Full results are shown in Appendix 5. It suggests that results on price reduction in low density/migration areas hold true only for sales that occur after the offender's move-in.

²⁵ Our DID approach focuses on a causal treatment effect of the move-in of a single offender. One may argue that the addition of one offender nearby may mean different absolute changes in the potential crime risk in densely populated areas than in sparsely populated areas. To further validate our results on spatial heterogeneity in the price effect, we attempt to include all multifamily homes near multiple sex offenders and use the number of offenders per residence within 300 meters, for each property and for each month. Results report that this continuous offender measure has a significant negative correlation with the sales price. Additionally, such baseline outcome persists only in areas with a lower population density when we add interactions on offenders per residence and population density. Results are not shown but are available upon request.

Table 3
Heterogeneous Housing Market Responses by Spatial Context.

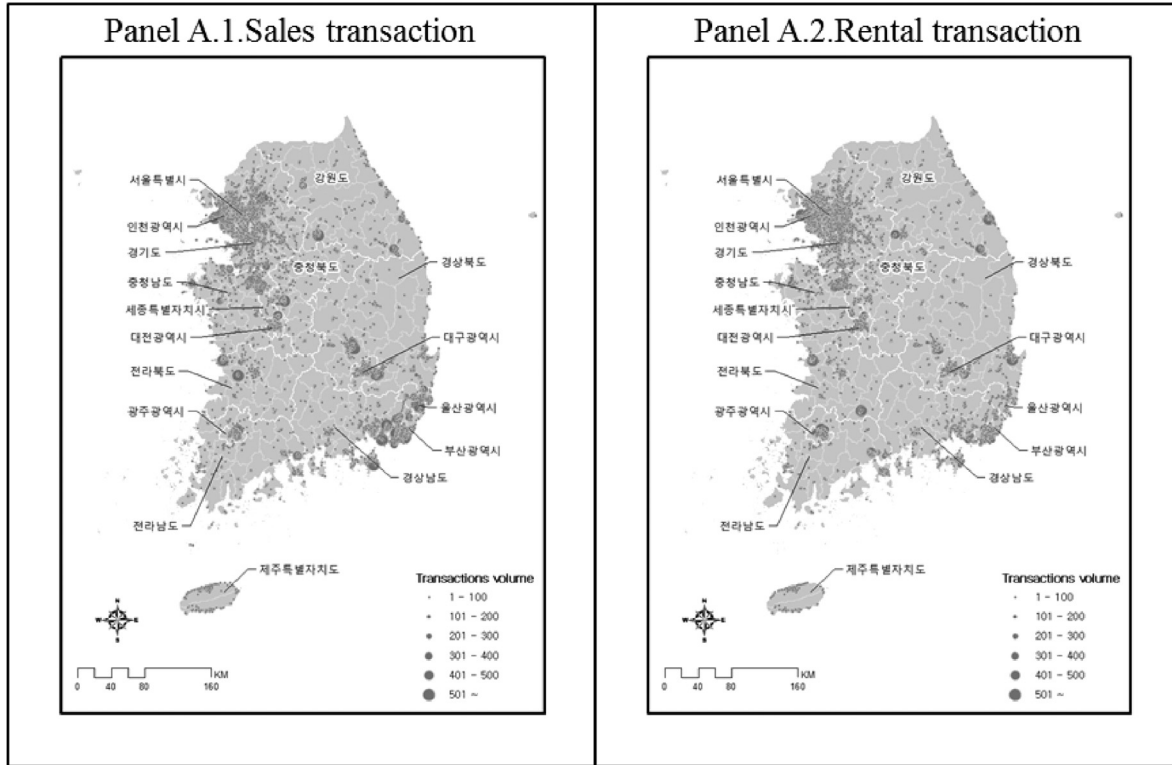
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Population Density					Net Migration Rate					Both (population density and migration rate)				
	1 month log (sales price)	3 months log (sales price)	6 months log (sales price)	9 months log (sales price)	12 months log (sales price)	1 month log (sales price)	3 months log (sales price)	6 months log (sales price)	9 months log (sales price)	12 months log (sales price)	1 month log (sales price)	3 months log (sales price)	6 months log (sales price)	9 months log (sales price)	12 months log (sales price)
Within 150 m from offender	−0.0215** (0.0100)	−0.0217** (0.00996)	−0.0224** (0.0101)	−0.0231** (0.0102)	−0.0235** (0.0103)	−0.0374*** (0.0102)	−0.0378*** (0.0102)	−0.0381*** (0.0102)	−0.0373*** (0.0101)	−0.0384*** (0.0102)	−0.0353*** (0.0126)	−0.0363*** (0.0125)	−0.0368*** (0.0126)	−0.0367*** (0.0128)	−0.0364*** (0.0130)
Within 150 m from offender	−0.0104 (0.0176)	0.000491 (0.0131)	0.00676 (0.00810)	0.00982 (0.00674)	0.00950 (0.00599)	−0.0172 (0.0190)	0.00198 (0.0130)	0.00347 (0.00897)	−0.00360 (0.0113)	0.00329 (0.00949)	0.00269 (0.0260)	0.0242 (0.0206)	0.0237 (0.0145)	0.0184 (0.0134)	0.0159 (0.0128)
Sold during ____ after offender moved in	−0.0817** (0.0322)	−0.0737** (0.0334)	−0.0491* (0.0266)	−0.0510** (0.0233)	−0.0267 (0.0223)						−0.0667*** (0.0258)	−0.0612*** (0.0237)	−0.0474** (0.0208)	−0.0500** (0.0214)	−0.0271 (0.0203)
Bottom 25% of population density	−0.0109 (0.0287)	−0.00705 (0.0203)	−0.00997 (0.0133)	−0.00798 (0.0110)	−0.00468 (0.00982)						−0.0216 (0.0261)	−0.0184 (0.0203)	−0.0215 (0.0146)	−0.0188 (0.0128)	−0.0129 (0.0118)
Bottom 25% of net migration rate						−0.0943*** (0.0287)	−0.0963** (0.0374)	−0.0725* (0.0379)	−0.0515 (0.0360)	−0.0388 (0.0341)	−0.0440* (0.0251)	−0.0679*** (0.0260)	−0.0533** (0.0260)	−0.0375 (0.0276)	−0.0291 (0.0275)
Top 25% of net migration rate						0.00720 (0.0294)	−0.00643 (0.0222)	0.00242 (0.0156)	0.0190 (0.0158)	0.0121 (0.0142)	−0.00122 (0.0277)	−0.0183 (0.0228)	−0.00605 (0.0177)	0.00791 (0.0166)	0.00662 (0.0160)
Between 150 and 300 m from offender	−0.0149** (0.00659)	−0.0152** (0.00663)	−0.0154** (0.00666)	−0.0158** (0.00677)	−0.0160** (0.00680)	−0.0154** (0.00755)	−0.0162** (0.00746)	−0.0167** (0.00744)	−0.0175** (0.00748)	−0.0185** (0.00749)	−0.0256*** (0.00877)	−0.0264*** (0.00883)	−0.0269*** (0.00879)	−0.0271*** (0.00893)	−0.0278*** (0.00897)
Between 150 and 300 m from offender	−0.00371 (0.0115)	0.00368 (0.00756)	0.00441 (0.00531)	0.00564 (0.00476)	0.00544 (0.00454)	0.00316 (0.0149)	0.0166 (0.0105)	0.0125 (0.00779)	0.0141* (0.00724)	0.0158** (0.00689)	0.0104 (0.0191)	0.0220* (0.0120)	0.0197* (0.0105)	0.0169* (0.00990)	0.0185* (0.0102)
Sold during ____ after offender moved in	−0.0620** (0.0268)	−0.0287 (0.0255)	−0.0402 (0.0265)	−0.0249 (0.0233)	−0.0233 (0.0257)						−0.0553* (0.0282)	−0.0280 (0.0241)	−0.0472* (0.0278)	−0.0318 (0.0242)	−0.0305 (0.0274)
Bottom 25% of population density	0.0383** (0.0150)	0.0139 (0.0103)	0.0117 (0.00735)	0.0126** (0.00642)	0.0122** (0.00624)						0.0252 (0.0166)	0.00779 (0.0126)	0.0167 (0.0105)	0.0170* (0.00880)	0.0160* (0.00900)
Bottom 25% of net migration rate						−0.0795*** (0.0238)	−0.0565** (0.0235)	−0.0330 (0.0242)	−0.0247 (0.0236)	−0.0260 (0.0233)	−0.0478* (0.0255)	−0.0424* (0.0222)	−0.0176 (0.0210)	−0.0126 (0.0210)	−0.0163 (0.0215)
Top 25% of net migration rate						0.0208 (0.0181)	−0.0115 (0.0144)	−0.0238 (0.0175)	−0.0181 (0.0131)	−0.0206 (0.0145)	0.00170 (0.0175)	−0.0208 (0.0148)	−0.0379* (0.0206)	−0.0288* (0.0155)	−0.0307* (0.0182)
Observations	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508
R-squared	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913
Unit characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area (within 100 m radius) characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District-level characteristics (e.g. %females under 18)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood-specific quadratic time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note 1: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 2: *** p < 0.01, ** p < 0.05, * p < 0.1

Note 3: Some variables such as district-level net migration rates and neighborhood-level % females under 18 are not available for all transactions in our sample. We exclude such transactions for this regression analysis to measure the treatment effects based on the consistent sample.

Panel A. Transactions in South Korea



Panel B. Transactions in Seoul

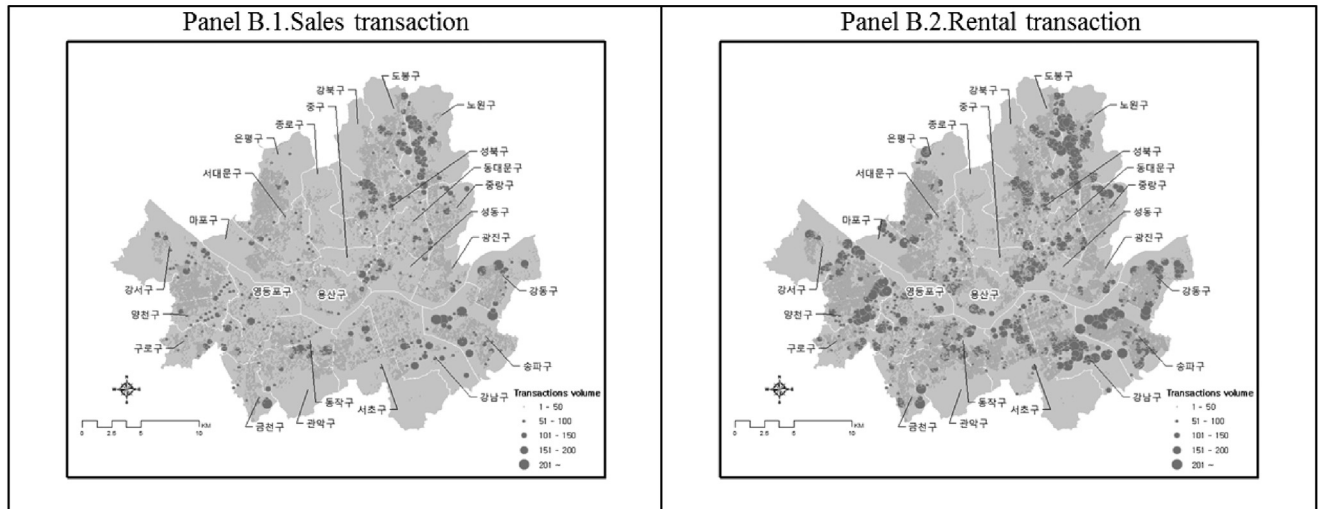


Fig. 4. Distribution of Sales vs. Rental Transactions in 2014. Panel A. Transactions in South Korea. Panel B. Transactions in Seoul.

ing market responses. This is because significant and longer-term treatment effects persist in lower density areas, while the magnitude and statistical significance of treatment effects become smaller in the areas with lower migration rates. Combined with the baseline effect of the move-in of a sex offender, a reduction in the housing price is approximately 2.4–6.4% and remains statistically significant at the 5% level for the first 9 months in the areas within a 150-meter boundary and in the bottom 25% of population density.²⁶ This suggests that popu-

lation density is a stronger driver of spatial heterogeneity in the price effect.

Our assessment of factors underlying spatial heterogeneity support our previous assumption that the enormous difference in population density between our sample and the U.S. samples in previous studies is related to the significant difference in the persistence of the average price effect. It is noteworthy that the magnitude of the long-run price reduction for housing units located in districts in the bottom 25% of population density is comparable to the 2% from Pope (2008) and

²⁶ We performed the F-test on the sum of the coefficient of the post-move-in baseline effect and the coefficient of the interaction with the bottom 25% density, for each column. The p-values remain below 0.05 until 9 months and become slightly higher than 0.1 in the case of the 12-month-effect. Hence, the

negative price effect in areas in the bottom 25% of population density appears to be significant during the first 9 months, but it slowly fades out after 9 months.

Table 4
Difference-in-Differences Regression Results: Sex Offender Move-in Effects on Rents by Time Windows.

VARIABLES	(1) 1 month log (monthly rent)	(2) 2 months	(3) 3 months	(4) 6 months	(5) 12 months
Within 150 m from offender	−0.0152** (0.0062)	−0.0154** (0.0062)	−0.0153** (0.0062)	−0.0147** (0.0062)	−0.0145** (0.0062)
Within 150 m from offender & Rented during __ month(s) after offender moved in	0.0078 (0.0066)	0.0066 (0.0048)	0.0038 (0.0049)	−0.0033 (0.0045)	−0.0026 (0.0033)
Between 150 and 300 m from offender	−0.0012 (0.0048)	−0.0014 (0.0048)	−0.0014 (0.0048)	−0.0014 (0.0048)	−0.0015 (0.0049)
Between 150 and 300 m from offender & Rented during __ month(s) after offender moved in	0.0000 (0.0043)	0.0038 (0.0031)	0.0035 (0.0033)	0.0016 (0.0025)	0.0011 (0.0023)
Observations	2,114,084	2,114,084	2,114,084	2,114,084	2,114,084
R-squared	0.884	0.884	0.884	0.884	0.884
Area (within 100 m radius) characteristics	Yes	Yes	Yes	Yes	Yes
Unit characteristics	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes
Neighborhood-specific quadratic time trend	Yes	Yes	Yes	Yes	Yes

Note 1: There are three forms of rental transactions in South Korea: (1) monthly rental (a typical rental contract type in the U.S. and other developed countries), (2) Jeonse, and (3) a mixture of these two. Jeonse is a unique real estate contract type in South Korea in which a renter makes a lump-sum deposit on a rental space at anywhere from 50% to 80% of the market value of the unit in lieu of paying monthly rent (i.e., zero monthly rent). In this regression using the full sample of rental transactions, we converted Jeonse deposit into monthly rents based on official conversion rate provided by the Korea Appraisal Board. We have performed the same regression for the subsamples of monthly rental transactions and Jeonse transactions and results are consistent.

Note 2: There are about 200,000 rental transactions from multifamily housing complexes that had no sales transactions over our sample period of 2010–2014. We exclude these transactions, which are less than 10% of total rental transactions, to address a potential difference in geographic distributions of sales and rental transactions and to assure that sales and rental transactions are not systematically different.

Note 3: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 4: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the 4% from Linden and Rockoff (2008).²⁷ As shown in Appendix 4, the average population density of our subsample in the bottom quartile of Korean population density distribution is comparable to the average county population density of samples used in the two U.S. studies. Overall, our results in this section suggest that housing market participants in lower density areas react to a change in local disamenities in a stronger and more persistent manner because they are more likely to collect the information on such disamenities and would be more sensitive to it.

Heterogeneous housing market responses by housing tenure

In the Background section, we hypothesize that housing tenure is another potential source of heterogeneity in housing market responses to the move-in of a sex offender. We run the DID model using the sample of rental transactions for the same period of 2010–2014 in South Korea and compare these results with our main results for sales transactions.²⁸

²⁷ In terms of statistical significance, our low-density areas show a slightly shorter-term price effect for two potential reasons. First, our sample in low-density areas consists of all multifamily housing units, and hence their actual population density at the smaller geographic level should be higher when compared to that among single-family housing units. Second, as mentioned in the previous section, the institutional feature that does not require real estate agents to reveal information about the sex offender may have led to a higher increase in the cost of information acquisition over time in South Korea (regardless of the spatial contexts) when compared to the U.S.

²⁸ One potential concern on this comparison is whether the spatial distribution of rental units is comparable to that of owner-occupied units. As shown in Figure 4, the locational distribution of housing units is not significantly different by the housing tenure status in South Korea. In fact, in Korean housing markets, the housing attributes (e.g., structure and size) are quite homogeneous across the housing tenure status, and the quality of rental units is not inferior to that of the owner-occupied units. To further address the potential difference in geographic distribution of sales and rental transactions as well as to ensure that these transactions are not systematically different, we exclude rental transactions from multifamily housing complexes that had no sales transactions over

The results shown in Table 4 demonstrates that the monthly rentals of homes within a 150-meter radius of the offender's location across different time windows (columns 1–5) does not change as a result of an offender's move-in, and especially for the post-1-month-period (column 1). These results are contrary to the significant post-1-month move-in effect found for sales prices (Table 2, column 3).²⁹

To explain such heterogeneous housing market responses by housing tenure, we propose potential underlying mechanisms based on the literature reviewed in the Background section. First, renters are more likely to be young and single. Thus, they are less likely to be informed of the offender move-in through mail notification, which is sent only to households with children under 18 years of age. Additionally, although a sex offenders' residential location is a publicly available information, it is time-consuming to access it online. Existing homeowners and potential homebuyers would be more willing to bear this cost and to search for information on sex crime risk more intensively when compared to renters because such neighborhood disamenities affect both future house price appreciation and their well-being for a longer time period. Furthermore, homeowners are more likely to acquire information on neighborhood disamenities through information sharing, as they are more likely to be engaged in social interactions than renters (Glaeser et al., 2002). Both these presumptions suggest that potential or current homeowners

our sample period of 2010–2014. These total to approximately 200,000 transactions and account for less than 10% of the total rental transactions.

²⁹ In addition to the DID regression of sales prices and rents, we run a linear probability model of sales and rental transaction volumes; this model uses a monthly panel of multifamily housing properties (Appendix 6). Results suggest an increase in sales after the move-in of an offender; in this case, the coefficient estimate is statistically insignificant. This finding is consistent with the DID results that current homeowners would acquire information on the offender's move-in and would subsequently want to move-out. On the other hand, the rental -transaction volumes go in the other direction; in this case, the coefficient estimate is insignificant.

would have a higher probability of acquiring information on potential sex crime risk when compared to the renters.

Additionally, potential or current homeowners would perceive and evaluate acquired information in a more serious manner when compared to renters because homeowners tend to be more sensitive to neighborhood disamenities, based on both user- and investment demand. Therefore, an increase in the neighborhood externality risk generated by the move-in of a sex offender may significantly reduce the demand for owner-occupied units but not the demand for rental units in the treated areas closer to the offender's location. Our proposition is closely related to Hilber (2005) who argues that neighborhood externality risk is a major component of housing investment risk among homeowners. He demonstrates that an increase in a neighborhood's externality risk, which is measured by residents' perceptions of the presence of litter, junk, noise, and crime in the neighborhood, more severely impacts owner-occupied units than rental units. In our study, we specifically focus on potential sex crime risk as a measure of neighborhoods' externality risk. Our empirical evidence on the difference in responses to this risk between owner-occupied and rental units is consistent with Hilber (2005). In summary, we suggest that housing decisions of potential or current homeowners and renters based on their evaluation of potential sex crime risk are partially translated into the difference in responses between owner-occupied and rental units.

Conclusion

We analyze households' reactions to a change in neighborhood environments, with a focus on heterogeneity in these reactions according to spatial contexts and housing tenure. Sex offender registry data that report the exact location of sex offenders provide an excellent opportunity to estimate such reactions. Using the nationwide administrative data in South Korea, we find that house prices fell by 5.5% for multifamily homes within a 150-meter radius of the nearest sex offender in 1 month after this offender moved-in. We also find that this effect decreases substantially with distance. Our results confirm the external validity of a significant localized price effect associated with the move-in of a sex offender beyond the U.S. context.

However, we also find that the price effect rapidly disappears after 1 month, and this finding is contrary to the previous U.S. evidence of persistent price reduction for 1 or 2 years. (Linden and Rockoff, 2008; Pope, 2008). This difference in the average price effect is partially explained by the institutional feature that offender information disclosure by real estate agents is not required in Korea, in contrast to the U.S. Thus, the cost of information acquisition becomes higher over time in South Korea. Based on the analyses that account for spatial variation within

our nationwide transaction sample, we demonstrate that the move-in of a sex offender leads to significantly heterogeneous housing market responses across different spatial contexts. Homes located in areas in the bottom 25% of population density experience a greater, longer-term price reduction after an offender's move-in when compared to those in areas in the top quartile. Our proposed underlying mechanism is better acquisition of and higher sensitivity to sex offender information among (potential) members in highly connected communities, such as places with relatively low population density. This mechanism also helps in explaining the difference in the persistence of the move-in effect between single-family homes in the U.S. and multifamily homes in much denser cities in South Korea.

Finally, we find that the responsiveness to the move-in of sex offenders varies by tenure status of housing units. While the move-in of a sex offender causes a reduction in sales prices, our results show no significant change in the rents of nearby homes. Similar to our explanation of spatial heterogeneity, our proposed underlying mechanism that aims to explain this difference is related to the patterns of information search and evaluation. Due to higher investment and risks involved with homeownership, potential or current homeowners are likely to be engaged in a more intensive search for information on neighborhood (dis)amenities when compared to the renters. For the same reason, homeowners are likely to evaluate potential sex crime risk in a more sensitive manner than renters, owing to housing investment risk associated with such neighborhood externality risk.

Our findings suggest that understanding how information on local (dis)amenities is acquired, transmitted, and evaluated is important to the evaluation of the effects of local (dis)amenities. In particular, such an understanding could be useful in explaining heterogeneities in housing market reactions to local (dis)amenities. Our findings also suggest that social capital and social networks may play an important role in how information on local (dis)amenities is transmitted. Future research will be able to expand the analyses to other types of information when compared to neighborhood (dis)amenities.

Declaration of conflicting interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendices

Appendix 1

Cross-Sectional Regression Results: Correlations with the Distance from Sex Offender.

VARIABLES	(1) log (sales price)	(2)	(3)
Within 150 m from offender	−0.0265*** (0.0078)	−0.0285*** (0.0074)	−0.0268*** (0.0074)
Between 150 and 300 m from offender	−0.0079 (0.0055)	−0.0094* (0.0051)	−0.0079 (0.0051)
Observations	2,939,881	2,939,881	2,939,881
R-squared	0.896	0.909	0.909
Area (within 100 m radius) characteristics	No	No	Yes
Unit characteristics	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes
Neighborhood-specific quadratic time trend	No	Yes	Yes

Note 1: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 2: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Appendix 2**

Difference-in-Differences Model Results: Price Trends Over Time.

VARIABLES	log (sales price)
Within 150 m from offender	−0.0262*** (0.00743)
Within 150 m from offender	Sold during _ month(s) before offender moved in
	0 to 1
	−0.0131 (0.0388)
	1 to 2
	0.0157 (0.00985)
	2 to 3
	0.0125 (0.0105)
	3 to 4
	−0.0183 (0.0323)
	4 to 5
	0.0126 (0.0114)
	5 to 6
	0.00960 (0.00950)
Within 150 m from offender	Sold during _ month(s) after offender moved in
	0 to 1
	−0.0533* (0.0308)
	1 to 2
	0.00132 (0.0150)
	2 to 3
	0.0176** (0.00883)
	3 to 4
	0.00647 (0.0114)
	4 to 5
	0.0161* (0.00887)
	5 to 6
	0.0131* (0.00748)
Observations	2,939,881
R-squared	0.909
Area (within 100 m radius) characteristics	Yes
Unit characteristics	Yes
Year-Month FE	Yes
Neighborhood FE	Yes
Neighborhood-specific quadratic time trend	Yes

Note 1: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 2: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note 3: The regression model includes the variables between 150 and 300 m, but their results are omitted for better illustration.

Appendix 3

Falsification Test.

VARIABLES	(1) 6-months prior arrival dates log (sales price)	(2) 1-year prior arrival dates
Within 150 m from offender	−0.0287*** (0.0075)	−0.0269*** (0.0075)
Within 150 m from offender & Sold during 1 month after offender arrival	0.0101 (0.0090)	0.0086 (0.0087)
Between 150 and 300 m from offender	−0.0093* (0.0051)	−0.0078 (0.0051)
Between 150 and 300 m from offender & Sold during 1 month after offender arrival	−0.0069 (0.0116)	−0.0046 (0.0119)
Observations	2,939,881	2,939,881
R-squared	0.909	0.909
Area (within 100 m radius) characteristics	Yes	Yes
Housing characteristics	Yes	Yes
Year-Month FE	Yes	Yes
Neighborhood FE	Yes	Yes
Neighborhood-specific quadratic time trend	Yes	Yes

Note 1: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 2: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix 4

Comparisons with Previous U.S. Results.

Research (sample)	DID design	Magnitude and endurance of the treatment effect on sales housing prices of nearby homes	Sample	Average Population density ³	Average In-migration rate ⁴
Out study (Multifamily housing, Nationwide, South Korea)	150 m & 150–300 m 1, 2, 3, 6, 12 months before & after	5% decrease for 150 m & 1 month No effect afterwards	The whole nation ¹ The subsample in bottom 25% The subsample in top 25%	7,579/km ² 444/km ² 18,881/km ²	15.16% 12.22% 18.41%
Linden and Rockoff, 2008 (Singles family housing, Mecklenburg County, NC)	0.1 mile & 1/3 mile 2 years before & after	4% decrease for 0.1 mile (about 10% for post-1 month, from the graph)	The county ²	510/km ²	9.15%
Pope, 2008 (Singles family housing, Hillsborough County, FL)	0.1 mile & 0.1–0.2 mile 1 year before & after	2.3% decrease for 0.1 mile	The county ²	367/km ²	13.41%

Source: U.S. data from U.S. Census Bureau and Korean data from Statistics Korea

Note 1: As our data consist of sales transactions of multifamily homes in South Korea, some rural neighborhoods and districts that do not have sales transactions of multifamily homes are excluded.

Note 2: If areas where single family homes are located have lower density, the actual population density may be lower in neighborhoods used for U.S. samples.

Note 3: For the U.S. data, this is the population density per square kilometer of land area data based on the 2000 Census. For the Korean data, the data are based on the average of annual data of 2011–2013 from Cadastral Statistics and Population Statistics.

Note 4: For the U.S. data, this is the share of population that lived in a different city, town, or county (including abroad) 1 year ago based on 2011–2013 American Community Survey 3-Year Estimates. For the Korean data, it is the share of population that lived in a different district or city 1 year ago based on the average of annual data of 2009–2014 from Internal Migration Statistics. As both of the data include all housing structures and mobility rates are usually higher for multifamily homes than single family homes, the actual migration rate for the neighborhoods/districts used is likely to be higher for the Korean sample and lower for the U.S. samples.

Appendix 5

Full Results of Heterogeneous Housing Market Responses by Spatial Context.

VARIABLES		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
		Population Density					Net Migration Rate					Both (population density and migration rate)				
		1 month log (sales price)	3 months	6 months	9 months	12 months	1 month log (sales price)	3 months	6 months	9 months	12 months	1 month log (sales price)	3 months	6 months	9 months	12 months
Within 150 m from offender		−0.0215** (0.0100)	−0.0217** (0.00996)	−0.0224** (0.0101)	−0.0231** (0.0102)	−0.0235** (0.0103)	−0.0374*** (0.0102)	−0.0378*** (0.0102)	−0.0381*** (0.0102)	−0.0373*** (0.0101)	−0.0384*** (0.0102)	−0.0353*** (0.0126)	−0.0363*** (0.0125)	−0.0368*** (0.0126)	−0.0367*** (0.0128)	−0.0364*** (0.0130)
Within 150 m from offender	Bottom 25% of population density	−0.0195 (0.0228)	−0.0192 (0.0231)	−0.0193 (0.0233)	−0.0173 (0.0234)	−0.0213 (0.0236)						−0.0212 (0.0222)	−0.0198 (0.0224)	−0.0201 (0.0226)	−0.0184 (0.0230)	−0.0221 (0.0232)
	Top 25% of population density	0.00637 (0.0139)	0.00659 (0.0139)	0.00722 (0.0140)	0.00742 (0.0141)	0.00716 (0.0143)						0.0168 (0.0150)	0.0173 (0.0150)	0.0181 (0.0151)	0.0185 (0.0153)	0.0178 (0.0154)
	Bottom 25% of net migration rate						0.0407*** (0.0151)	0.0424*** (0.0148)	0.0421*** (0.0149)	0.0415*** (0.0153)	0.0402*** (0.0154)	0.0447*** (0.0162)	0.0465*** (0.0159)	0.0466*** (0.0160)	0.0457*** (0.0162)	0.0440*** (0.0165)
	Top 25% of net migration rate						0.0118 (0.0131)	0.0122 (0.0132)	0.0118 (0.0134)	0.00950 (0.0134)	0.00997 (0.0137)	0.00225 (0.0136)	0.00300 (0.0137)	0.00240 (0.0140)	0.000554 (0.0143)	0.000129 (0.0146)
Within 150 m from offender	Sold during ____ after offender moved in	−0.0104 (0.0176)	0.000491 (0.0131)	0.00676 (0.00810)	0.00982 (0.00674)	0.00950 (0.00599)	−0.0172 (0.0190)	0.00198 (0.0130)	0.00347 (0.00897)	−0.00360 (0.0113)	0.00329 (0.00949)	0.00269 (0.0260)	0.0242 (0.0206)	0.0237 (0.0145)	0.0184 (0.0134)	0.0159 (0.0128)
	Sold during ____ after offender moved in	−0.0817** (0.0322)	−0.0737** (0.0334)	−0.0491* (0.0266)	−0.0510** (0.0233)	−0.0267 (0.0223)						−0.0667*** (0.0258)	−0.0612*** (0.0237)	−0.0474** (0.0208)	−0.0500** (0.0214)	−0.0271 (0.0203)
	Bottom 25% of population density	−0.0109 (0.0287)	−0.00705 (0.0203)	−0.00997 (0.0133)	−0.00798 (0.0110)	−0.00468 (0.00982)						−0.0216 (0.0261)	−0.0184 (0.0203)	−0.0215 (0.0146)	−0.0188 (0.0128)	−0.0129 (0.0118)
	Top 25% of population density						−0.0943*** (0.0287)	−0.0963** (0.0374)	−0.0725* (0.0379)	−0.0515 (0.0360)	−0.0388 (0.0341)	−0.0440* (0.0251)	−0.0679*** (0.0260)	−0.0533** (0.0260)	−0.0375 (0.0276)	−0.0291 (0.0275)
	Bottom 25% of net migration rate						0.00720 (0.0294)	−0.00643 (0.0222)	0.00242 (0.0156)	0.0190 (0.0158)	0.0121 (0.0142)	−0.00122 (0.0277)	−0.0183 (0.0228)	−0.00605 (0.0177)	0.00791 (0.0166)	0.00662 (0.0160)
	Top 25% of net migration rate						−0.0154** (0.00755)	−0.0162** (0.00746)	−0.0167** (0.00744)	−0.0175** (0.00748)	−0.0185** (0.00749)	−0.0256*** (0.00877)	−0.0264*** (0.00883)	−0.0269*** (0.00879)	−0.0271*** (0.00893)	−0.0278*** (0.00897)
Between 150 and 300 m from offender		−0.0149** (0.00659)	−0.0152** (0.00663)	−0.0154** (0.00666)	−0.0158** (0.00677)	−0.0160** (0.00680)						0.0218 (0.0214)	0.0210 (0.0218)	0.0225 (0.0211)	0.0213 (0.0212)	0.0212 (0.0213)
Between 150 and 300 m from offender	Bottom 25% of population density	0.00991 (0.00994)	0.00978 (0.00995)	0.00933 (0.01000)	0.00875 (0.0101)	0.00826 (0.0101)						0.0160 (0.0106)	0.0158 (0.0107)	0.0144 (0.0107)	0.0135 (0.0108)	0.0127 (0.0109)
	Top 25% of population density						0.0283** (0.0141)	0.0292** (0.0142)	0.0278* (0.0143)	0.0273* (0.0146)	0.0279* (0.0149)	0.0310** (0.0144)	0.0319** (0.0144)	0.0303** (0.0146)	0.0295** (0.0148)	0.0297** (0.0151)
	Bottom 25% of net migration rate						0.00506 (0.00892)	0.00590 (0.00890)	0.00758 (0.00851)	0.00795 (0.00856)	0.00927 (0.00842)	0.00608 (0.00915)	0.00697 (0.00926)	0.00951 (0.00832)	0.00978 (0.00844)	0.0113 (0.00811)
	Top 25% of net migration rate															

(continued on next page)

Appendix 5 (continued)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
		Population Density						Net Migration Rate				Both (population density and migration rate)				
VARIABLES		<u>1 month</u>	<u>3 months</u>	<u>6 months</u>	<u>9 months</u>	<u>12 months</u>	<u>1 month</u>	<u>3 months</u>	<u>6 months</u>	<u>9 months</u>	<u>12 months</u>	<u>1 month</u>	<u>3 months</u>	<u>6 months</u>	<u>9 months</u>	<u>12 months</u>
		log (sales price)						log (sales price)				log (sales price)				
Between 150 and 300 m from offender	Sold during ____ after offender moved in	–0.00371 (0.0115)	0.00368 (0.00756)	0.00441 (0.00531)	0.00564 (0.00476)	0.00544 (0.00454)	0.00316 (0.0149)	0.0166 (0.0105)	0.0125 (0.00779)	0.0141* (0.00724)	0.0158** (0.00689)	0.0104 (0.0191)	0.0220* (0.0120)	0.0197* (0.0105)	0.0169* (0.00990)	0.0185* (0.0102)
	Sold during ____ after offender moved in	–0.0620** (0.0268)	–0.0287 (0.0255)	–0.0402 (0.0265)	–0.0249 (0.0233)	–0.0233 (0.0257)						–0.0553* (0.0282)	–0.0280 (0.0241)	–0.0472* (0.0278)	–0.0318 (0.0242)	–0.0305 (0.0274)
	Bottom 25% of population density	0.0383** (0.0150)	0.0139 (0.0103)	0.0117 (0.00735)	0.0126** (0.00642)	0.0122** (0.00624)						0.0252 (0.0166)	0.00779 (0.0126)	0.0167 (0.0105)	0.0170* (0.00880)	0.0160* (0.00900)
	Top 25% of population density						–0.0795*** (0.0238)	–0.0565** (0.0235)	–0.0330 (0.0242)	–0.0247 (0.0236)	–0.0260 (0.0233)	–0.0478* (0.0255)	–0.0424* (0.0222)	–0.0176 (0.0210)	–0.0126 (0.0210)	–0.0163 (0.0215)
	Bottom 25% of net migration rate						0.0208 (0.0181)	–0.0115 (0.0144)	–0.0238 (0.0175)	–0.0181 (0.0131)	–0.0206 (0.0145)	0.00170 (0.0175)	–0.0208 (0.0148)	–0.0379* (0.0206)	–0.0288* (0.0155)	–0.0307* (0.0182)
	Top 25% of net migration rate											–0.00958 (0.00681)	–0.00964 (0.00689)	–0.00988 (0.00682)	–0.0101 (0.00672)	–0.0102 (0.00668)
Bottom 25% of population density		–2.306*** (0.0462)	–2.307*** (0.0463)	–2.307*** (0.0461)	–2.308*** (0.0461)	–2.309*** (0.0460)						–2.316*** (0.0464)	–2.317*** (0.0466)	–2.318*** (0.0464)	–2.319*** (0.0464)	–2.319*** (0.0463)
Top 25% of population density		–0.0872* (0.0459)	–0.0881* (0.0460)	–0.0895* (0.0459)	–0.0913** (0.0458)	–0.0919** (0.0458)						–0.106** (0.0475)	–0.106** (0.0478)	–0.107** (0.0476)	–0.110** (0.0476)	–0.110** (0.0475)
Bottom 25% of net migration rate							–0.00923 (0.00675)	–0.00932 (0.00680)	–0.00958 (0.00669)	–0.00978 (0.00657)	–0.00983 (0.00654)	–0.00958 (0.00681)	–0.00964 (0.00689)	–0.00988 (0.00682)	–0.0101 (0.00672)	–0.0102 (0.00668)
Top 25% of net migration rate							0.00589* (0.00329)	0.00589* (0.00329)	0.00589* (0.00329)	0.00582* (0.00329)	0.00583* (0.00330)	0.00638* (0.00330)	0.00641* (0.00330)	0.00645* (0.00330)	0.00646* (0.00330)	0.00651** (0.00331)
Observations		2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508	2,209,508
R-squared		0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913	0.913
Unit characteristics		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area (within 100 m radius) characteristics		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District-level characteristics (e.g. %females under 18)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood-specific quadratic time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note 1: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 2: *** p < 0.01, ** p < 0.05, * p < 0.1.

Note 3: Some variables such as district-level net migration rates and neighborhood-level % females under 18 are not available for all transactions in our sample. We exclude such transactions for this regression analysis to measure the treatment effects based on the consistent sample.

Note 4: Variation in sales prices between areas with different density quartiles mainly comes from the locational characteristics (rural vs urban).

Appendix 6

Linear Probability Model Results: Sex Offender Move-in Effects on the Probability of Transactions.

VARIABLES	(1) Probability of sales transactions	(2) Probability of rental transactions
Within 150 m from offender	−0.0059*** (0.0014)	−0.0056*** (0.0013)
Within 150 m from offender & Transacted during 1 month after offender moved in	0.0026 (0.0021)	−0.0021 (0.0024)
Between 150 and 300 m from offender	−0.0044*** (0.0011)	−0.0042*** (0.0010)
Between 150 and 300 m from offender & Transacted during 1 month after offender moved in	−0.0005 (0.0014)	0.0016 (0.0017)
Observations	12,039,054	12,039,054
R-squared	0.243	0.187
Area (within 100 m radius) characteristics	Yes	Yes
Unit characteristics	Yes	Yes
Year-Month FE	Yes	Yes
Neighborhood FE	Yes	Yes
Neighborhood-specific quadratic time trend	Yes	Yes

Note 1: The unit of analysis for columns 1 and 2 is multifamily housing complex-month. For unit characteristics, the largest unit area and the highest floor level among transacted units are considered for each complex.

Note 2: Standard errors clustered at the neighborhood level are reported in parentheses.

Note 3: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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