The effects of spatially targeted housing policy: Evidence from land transaction permit system in South Korea

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Abstract

Since 2017, the surge in housing prices in South Korea has raised concerns about housing affordability and price bubbles. To dampen the escalating housing prices by regulating speculative demand, the land transaction permit (LTP) area is designated in the Gangnam area in Seoul. This policy represents one of the most stringent regulations because it imposes a mandatory two-year residency obligation, and transactions for those years are prohibited. This study examines the effects of LTP on sales and rental prices in Seoul, South Korea. Using the difference-in-differences method, I find that the LTP triggers up to a 7.7% decrease in sales prices, which is aligned with the policy's aim. However, the LTP also raises rental prices as well as both sales and rental prices in the surrounding area, which are undesirable and unintended outcomes of the policy from a broader real estate market perspective.

Spatially targeted policy. Housing policy. Housing market. The land transaction permit system.

1. Introduction

During recent years of sharp increases in housing prices, the Korean government has introduced various policies aimed at curbing the trend and slowing down the pace. The reason the government implemented numerous policies was that housing prices, which surged by over 50% from 2017 to 2022 (KB Kookmin Bank, 2023) seemed not to be supported by underlying economic fundamentals. In addition, such an overheated market placed an even greater burden on the middle class aspiring to own homes and accumulate assets.

The land transaction permit areas and the permit system (hereafter LTP) analyzed in this study strongly regulate demand. One of the key aspects of this policy is that in designated areas, obtaining a permit from the local district office is required when entering into a contract for the acquisition of a certain area or more. Particularly for residential land, a mandatory two-year residency obligation is imposed, and transactions (selling and renting) are prohibited for those years.

This policy, first introduced in 1978, has been consistently used across the country. As of February 2023, approximately 538 km² in the capital region alone were designated as a regulated area, and in the research area of this paper, Seoul, approximately 10% of the area (58 km²) was designated, playing a crucial role as a cornerstone in housing market demand regulation policies.[1]

However, previous research has primarily focused on reviewing the legality and legal improvement methods of LTP (Lee & Lee, 2017; Lee, 2013; Song, 2005; Suh, 2006), whereas relatively few studies have examined the effectiveness of policies and their impacts on the housing market in designated areas and their surrounding regions. For instance, Jung & Kim (2005) and Kim (2005), assess the effectiveness of LTP areas during the early 2000s, thereby establishing a foundational framework. More recently, Kim (2022) examines policy effects using the latest real estate transaction price data and integrating real estate institutional modifications.

However, these studies have yielded contradictory results. While Jung & Kim (2005) and Kim (2005) suggest that the LTP has no effect on land value changes or might have even produced counterproductive effects by increasing land values, Kim (2022) finds that the LTP decreases sales prices in the designated area. This conflicting evidence has made it challenging to derive clear policy implications.

The present study aims to complement and extend the research measuring the effects of LTP in two aspects. First, I conduct an analysis encompassing the effects of LTP on not only housing prices but also rental prices. Prior relevant studies have been limited in scope, focusing primarily on the effects of LTP on housing or land sales prices (Jung and Kim, 2005; Kim, 2022). This study seeks to broaden the scope by analyzing the unintended or unforeseen effects of LTP on rental prices, in addition to sales prices, to measure the overall effects of the policy more comprehensively.
Second, this study estimates the effects of LTP more rigorously. When assessing the policy effects of a place-based policy or program, such as LTP, which is implemented with geographic constraints, researchers often select neighboring areas as a comparison group and evaluate the policy's effects through comparisons with a treatment group (Busso et al., 2013; Ham et al., 2011; Kim, 2023a, 2023b; Kim & Yoon, 2023; Neumark & Kolko, 2010). However, in the case of LTP studies, it remains unclear whether the policy

[1] Data pertinent to Seoul are grounded in January 2023 (Seoul, 2023), Incheon's data rely on February 2023 (Incheon, 2023), and Gyeonggi Province's data pertain to the conclusion of December 2022 (Gyeonggi, 2023)

affects neighboring areas and the geographical limit of these effects. Furthermore, despite the necessity of identifying a more appropriate control group based on such analysis results on the geographical limit to estimate the policy's effects, to the best of my knowledge, no LTP studies have yet been conducted to address this issue.

This study addresses this research gap by examining the extent to which areas are influenced by spillover effects to construct a more suitable control group unaffected by such effects. Specifically, the methodology involves an initial comparison between the area nearest to the LTP area (i.e., within 500 meters of the LTP area) and the second adjacent area (i.e., spanning from 501 meters to 1,000 meters from the LTP area). Should the most adjacent area be statistically different from the second adjacent area, indicating the presence of spillover effects, a subsequent comparison is made between the second and third areas. If the second area is not statistically different from the third area, the spillover effects are considered significant only up to the most adjacent area (further clarification is provided in section 6). Drawing on this identified geographical limit of the spillover effects, a more appropriate control group is constructed, and treatment effects are subsequently measured.

The specific research questions addressed in this study are as follows: 1) does the designation of LTP affect the sales and rental prices of nearby apartments? If it does, to what geographical extent is it affected by the LTP? 2) do the sales and rental prices of apartments in the designated areas increase or decrease compared with those in the control group, which is selected based on the above first analysis results?

2. The Korean context and LTP in the Gangnam area

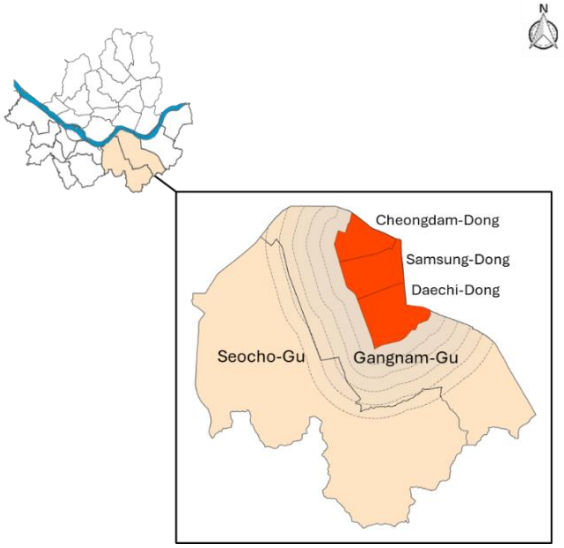
In South Korea, approximately 73% of individuals' assets are concentrated in real estate (Lee, 2023). Hence, the substantial influence of real estate on people's lives has prompted consistent scrutiny by Korean policymakers over the property and housing markets, resulting in frequent interventions, especially during periods of swift market volatility. This trend was evident during the sharp price increases between 2017 and 2020, urging the government to introduce policies of varying intensities aimed at stabilizing housing prices.

LTP is one of the demand-suppression policies introduced in this context. This policy particularly addresses the so-called "gap investment," which is regarded as a factor contributing to rapid increases in housing prices. Gap investment refers to a way of financing typically approximately 50%–80% of the purchase price of a house in the form of the Jeons deposit (i.e., Jeonse price). Taking advantage of the Jeonse renting system, which offers private financial leverage to landlords through the lump-sum deposit for typically two years[2], investors can finance 50%–80% of the purchase price in the form of deposits without incurring interest charges. Gap investment is not aimed at immediately consuming housing; rather, it is an investment strategy focused on capital gains from future price increases. The proliferation of gap investment allows the purchase of a house with less personal equity using the tenant's Jeonse deposit,

[2] During the lease term, tenants do not pay monthly rent. And the Jeonse deposit is returned to the tenant without interest, less any itemized deductions for damages, when the lease term ends. In Seoul, Jeonse and monthly rental arrangements constitute approximately 55% of the lease contract. Refer to Table A1 in Appendix A for the breakdown of tenure type and housing type in Seoul.

thereby amplifying fluctuations beyond real demand and entailing higher risk. For these reasons, the Korean government often distinguishes this as "speculative" demand[3] and has curbed the influx of gap investment when prices soar. Against this background, the government introduced LTP (i.e., Daechi, Cheongdam, and Samsung-Dong) in the Gangnam area of Seoul in June 2020 (See Figure 1).[4]

Figure 1. Map of the city of Seoul, the LTP area, and buffer zones.



Notes: The dark red area indicates the land transaction permit zone. The area highlighted in yellow is the control group area. The Han River is highlighted in blue. Buffer zones (i.e., 0-500m, 500-1000m, 1000-1500m, 1500-2000m, and 2000-2500m from the LTP area) employed in the analysis are indicated with dotted lines.

The restrictions imposed by LTP are as follows. First, speculative investments in existing homes are prohibited, and the use of Jeonse deposits as private leverage is not permitted in real estate transactions. Second, upon purchasing a house in the designated area, the homeowner is obligated to reside in the property for a mandatory period of two years, after which the property can be sold or leased. [5]

[3] Sometimes it is challenging to differentiate purchase motivations, but generally, speculative demand refers to a case where a buyer already owns one or more houses and purchases a new property with the intention of potentially leasing it or leaving it vacant (Zhang et al., 2015). The primary purpose of owning additional properties in such cases is to wait for an opportunity to profit from resale. In this context, gap investment is classified as speculative demand, while rental demand is referred to as non-speculative or real demand in this study.

[4] Jamsil-Dong in Songpa-Gu, which is contiguous to Gangnam-Gu, was also designated as the LTP area in June 2020. I opted to restrict the analysis to Gangnam and Seocho-Gu, and exclude Jamsil-Dong. This is because, including Jamsil-Dong and surrounding areas of Jamsil-Dong, which are often considered to be in a different housing submarket due to varying price trends compared to Gangnam-Gu, as well as the composition of apartment complexes (with Jamsil-Dong predominantly consisting of large-scale complexes), and disparate symbolic meanings(Na, 2022; Oh, 2022), could raise an issue in comparability.

[5] For newly constructed housing, there is no residency obligation for the first two years, and immediate leasing is allowed.

The designation of this particular area as LTP is due to the anticipated large-scale development projects following the construction of a metropolitan integrated transfer center and the designation and approval of suitability assessments for the international exchange complex zone.

Also, the designation of LTP in the Gangnam area can be interpreted as a reflection of consideration of the entire real estate market in Korea. The Gangnam area serves as a barometer that prominently showcases changes in the Korean real estate market. Widely regarded as the most coveted residential locale, it is often depicted in various media outlets as synonymous with wealth and prestige, thereby fostering aspirations among individuals to reside within its confines (Choo, 2021; Yang, 2018). Therefore, the designation of this area as LTP on June 23, 2020, can also be considered a primary effort aimed at suppressing speculative demand across the entire real estate market in Korea. During a similar period, various people-based housing policies were implemented in Korea. These policies primarily focused on taxation or financial regulations, such as tax rate adjustments, and were designed to target individuals meeting specific criteria. The analysis results on the effects people-based housing policies have yielded conflicting conclusions, with some studies indicating stabilization effects on price escalation (Bae & Chung, 2021; Bae & Lee, 2022) and others revealing no significant impacts (Bae & Lee, 2023; Jung & Chung, 2023). Nevertheless, it is necessary to consider the potential effects of these people-based policies, especially if there were those policies that varied in application by location when estimating the effects of LTP to reduce the biases from simultaneous policies. However, during the study period in the Gangnam area, there were no such people-based policies varying by location, thus it is not expected for the effects of LTP designation to be influenced by those policies.

3. Possible effects of LTP designation

1) Effects of LTP on housing prices in the designated area

Restricting gap investment is expected to considerably alter the housing market of the designated three Dongs, nearby areas, and potentially the entire Seoul area. The most direct impact is the decrease in demand for for-sale apartments in the designated area because buyers cannot use gap investment and leverage the Jeonse price. Hence, the size of the demand would be smaller than before, and only those willing to live for more than two years with the full amount for purchasing a house would be able to be buyers. The shock to demand leads to a drop in housing prices, although the effect of this negative demand shock is probably offset to some extent by other factors discussed later.

On the supply side, the LTP does not directly stimulate the supply of additional housing. However, it could induce behavioral changes in existing homeowners. For example, existing homeowners may be discouraged due to diminished demand and a smaller number of possible buyers. If they think the LTP may not last long, then they postpone participating in the for-sale market and instead turn to the Jeonse rental market while waiting for the LTP to be dissolved and the market to rebound. Alternatively, if existing homeowners believe that the LTP and other regulations are likely to stabilize housing prices and the expectation of price appreciation is reduced, they may attempt to sell their apartment units. Consequently, it is anticipated that the magnitude of the indirect supply-side effects may not be larger than that of the demand decrease. Furthermore, these behavioral changes among homeowners are likely to have limited impacts, particularly due to potential offsets among homeowners.

The LTP is likely to demonstrate a discernible influence on the rental market as well. Rental housing demand is constituted by non-speculative elements, diverging considerably from the demand targeted by the LTP. Therefore, the policies' effects on the rental market can be regarded as unintended or indirectly influential. However, notwithstanding this distinction, a comprehensive examination of the rental market is imperative because over half of Seoul's population (Seo et al., 2023) currently engages in house leasing. Transitions in the demand and supply dynamics within the for-sale market prompt immediate shifts in the rental market.

In the Jeonse rental market, the LTP more directly influences the supply side. The provision of Jeonse ensues when purchasers acquire a property and choose to lease it, or when current homeowners decide to vacate their residence and subsequently opt for leasing out their property. In the designated areas, a restriction has been imposed requiring homeowners who acquire new homes and become homeowners to reside for a minimum of two years, rendering it impossible for new homeowners to rent out their properties for two years. As for the amounts of Jeonse supply through existing homeowners, on the other hand, are uncertain and depend on their judgment of the market. If they expect the market to stabilize because of the LTP in the area, they may choose to sell their house before prices drop further, which will result in a drop in the supply of Jeonse. In contrast, some may persevere and decide to wait for a seller-dominant market, consequently increasing Jeonse's supply instead of for-sale apartments.

On the demand side of Jeonse, the effect of LTP is probably marginal. If renters anticipate a continuous increase in housing prices, they may opt for the sales market instead of renewing their rental contract and seek to make a purchase before prices escalate further. Alternatively, renters who originally intended to purchase a house in the designated area could change their minds to wait for another two years in anticipation of a price drop due to the LTP.

Overall, the implications of demand-side effects of LTP on the for-sale market unambiguously point to a decrease in demand and a price drop, whereas the effects of LTP on the supply of for-sale units are less clear and the magnitude of the effects appears to be relatively weak. On the other hand, the Jeonse rental market is expected to see a reduction in supply due to new transactions and upward pressure on prices.

2) Effects of LTP on housing prices in nearby areas

The effects of spatially-targeted housing policy are not constrained to the designated area and frequently influence property prices in adjacent areas. For example, housing developments subsidized through Low Income Housing Tax Credit (LIHTC) have been observed to generate spillover effects on the properties in the surrounding area (Deng, 2011; Dillman et al., 2017; Ellen et al, 2008) although the estimated effects are not uniform[6] and are contingent on whether the development project occurs in low-income areas or high-income areas (Diamond & McQuade, 2019).

Other housing policies that seek to mitigate housing speculation similar to LPT, are also found to have spillover effects on the property market near the designated area. The home purchase restriction adopted

[6] Some research find that LIHTC increases property prices of neighboring areas (Ellen et al., (2007); Deng, 2011) whereas others report insignificant (Funderburg & MacDonald, 2010) or even negative spillover effects (Woo et al., 2016).

in China is one of the well-studied anti-speculation housing policies. Early in 2010, as home prices hit all-time highs and surged at a level where that is considered a housing bubble, the Chinese government put a constraint on the eligibility in purchasing homes. Per the policy, people who own more than two homes and those who are not locally registered residents are simply prohibited from purchasing homes anymore. The policy seems effective in cooling down the real estate market (Sun et al., 2017), but the housing demand relocated from the regulated area to the nearby unregulated area leads to an increase in land prices (Zheng et al., 2021). As with other housing policies that seek to mitigate housing speculation similar to LTP, the LTP is also likely to affect nearby housing markets. The speculative demand using gap investment prohibited in the regulated area could flow to the neighboring area because investors can alternatively invest in for-sale units in the neighboring areas. From the perspective of Seoul as a whole, this housing price appreciation in the adjacent area caused by the spillovers could be regarded as unintended and negative effects.

On the other hand, the spillover effects of LTP on the supply side are probably more limited. This limitation arises because of the uncertain direction of behavioral changes induced by LTP. Some homeowners may perceive this timing as an opportunity to capitalize on potential capital gains, motivating them to list their properties for sale in anticipation of an increased demand relocated from the designated area, whereas other landlords may anticipate market stabilization owing to the LTP.

The Jeonse rental market in neighboring areas is also likely to be affected by LTP. On the demand side, a decrease in lease supply in LTP-designated areas may result in unmet demand. This could prompt a shift toward seeking rental housing in the adjacent area. The supply of lease offerings is contingent on expectations regarding changes in housing prices. If homeowners anticipate an increase in the prices of for-sale units due to a relocation of demand from the designated area, they may choose to list their homes in the for-sale market instead of renting them out. In contrast, if they perceive a cooling down of the real estate market, they may opt for another round of leasing.

However, in not only existing research on LTP but also in many previous studies on location-specific policies, geographical limits of spillover effects have not been rigorously addressed. In previous studies, the frequently adopted approach to measure the spillover effects of a policy has been comparing areas, for instance, those within 0–500 m of the treated area versus those beyond 500 m of the treated area. This estimation method has two potential limitations. First, the probability of divergent pre-treatment trends between the treated and control groups escalates with increasing distance from the treated area. Areas located, for instance, 600 and 2000m away from the treated zone may exhibit dissimilar pre-treatment trends.

Second, if spillover effects extend beyond 500 m of the treated area, influencing areas up to, for example, 1000 m, the inclusion of the area spanning from 500 m to 1000 m from the treated area into the control group can introduce bias to the estimates. To accurately determine the geographical limit of spillover effects and use a more appropriate control group, I explore the extent to which areas are influenced by the treated area.

4. Data and variables

The analytical dataset is derived from transaction records sourced from the Ministry of Land, Infrastructure, and Transport. This dataset encompasses comprehensive details on all transactions, including transaction price, contract date, apartment size, deposit amounts, monthly rent, construction year, apartment complex name, and address. [7] The analyzed data spans from the first quarter of 2019 to the fourth quarter of 2021, the period where Seoul, Gangnam-Gu, and the LTP area saw consistent price increases except for the immediate period after the designation of LTP (see Figure A3 in Appendix A). The behaviors of stakeholders in the real estate market are critically influenced by changes in the real estate market cycle. To highlight the impacts of such cyclical changes, housing market research often confines the analysis period to a consistent real estate cycle (Seo et al., 2023; Sunega & Lux, 2016). Drawing on this approach, this study delineates the analysis period coinciding with a phase of real estate expansion. Furthermore, the period from 2019 to 2021 encompasses both the time before and after the designation of land transaction permit zones. This inclusive timeframe allows not only testing the parallel trend before treatment but also analyzing the short- and medium-term effects after treatment.

Table 1. Summary Statistics

Variables	LTP area		1500m-2500m area	
	Median	SD	Median	SD
Panel A. Descriptive statistics for housing sales price models				
number of units	990.00	1,124.78	1,144.00	1,509.78
ln price	12.21	0.43	12.35	0.29
ln size	4.44	0.44	4.44	0.33
ln age	2.49	0.98	3.00	0.94
Panel B. Descriptive statistics for Jeonse price models				
number of units	910.00	231.17	1,144.00	1,568.44
ln jeonse price	10.67	0.44	11.44	0.48
ln_size	4.09	0.40	4.44	0.31
ln age	3.33	0.51	3.53	1.43

Table 1 presents summary statistics of the variables for both the for-sale housing price and Jeonse price models. To reduce the skewness typically observed in the sample of price and size variables, transaction prices, Jeonse prices, and the size of apartment variables are log-transformed.[8] The average housing sales prices (*ln price*) in the LTP area and the control area are similar (12.21 vs. 12.35). In contrast, Jeonse prices (*ln jeonse price*) are higher in the control area. This can be attributed to the larger median size of the control area's apartment units (*number of units*) (4.09 vs. 4.44). In the main analysis, the differences are taken into account, and I conduct regression analysis with apartment complexes that have 500 or more units to ensure sufficient observations for each complex. In the robustness analysis, the inclusion of apartments with fewer units (400 units) is also considered to validate the results.

[7] A more detailed description the transaction data is provided in Appendix A2.

[8] For apartments paying monthly rent payments, rental prices were converted to lump-sum Jeonse using the monthly conversion rate provided by the National Statistical Portal for Gangnam-Gu.

5. Empirical method

In this study, I estimate the effects of LTP on treated and surrounding areas through an extension of the difference-in-differences methodology known as the panel event-study design. The panel event-study design not only allows for the examination of the parallel trends assumption but also offers the advantage of assessing whether treatment effects strengthen, diminish over time, or represent temporary phenomena.

Specifically, the treatment effect is estimated using the following model.

$$Y_{i,d,t} = \sum_{\substack{j=-5, \\ j\neq -1}}^{6} \beta_j \, Treatment_{i,d,t}^{j} + \gamma X_{i,d,t} + \lambda_t + \lambda_d + \epsilon_{i,d,t} \qquad \text{Equation (1)}$$

$Y_{i,d,t}$ represents the log-transformed sales prices or log-transformed Jeonse prices of an individual apartment i belonging to the d apartment complex at time t (on an annual-quarterly basis). j denotes the relative time compared with the quarter in which the LTP area is designated. The $j = -1$ quarter is excluded as the baseline period for analysis. $Treatment_{i,d,t}^{j}$ is a treatment variable, equal to 1 if an individual apartment is within the LTP area at time t and 0 otherwise. $X_{i,d,t}$ denotes apartment characteristics, including floor area and age. λ_t controls for time-fixed effects, capturing the impact that varies with the trend changing on an annual–quarterly basis. λ_d represents apartment complex fixed effects. Apartment complex fixed effects control for time-invariant characteristics at the complex level (such as proximity to schools or specific facilities) and, thus, reduce omitted variable bias. $\epsilon_{i,d,t}$ is the error term. The analysis begins by examining the geographical limits of spillover effects to identify the most appropriate control group. Specifically, it first compares the areas closest to the LTP area and the second closest area. If the area closest to the LTP area is statistically different from the second closest area, which indicates spillover effects, a comparison is made between the second and third areas. This process is extended to areas where spillover effects are not observed. Alternatively, the first and second areas may not be statistically distinct. In this case, the result may indicate that both areas are influenced by spillovers or that neither area is affected. Further comparisons with subsequent areas can confirm the extent of spillover effects. This statistical method is an adaptation of the approach of Ham et al. (2011).

The control group is restricted to the relatively homogeneous housing markets of Gangnam-Gu and Seocho-Gu (see Figure 1). When establishing the control group using a buffer zone, other districts, which do not belong to the Gangnam area, may be included. However, given the nature of this study, which aims to examine the impact on speculative demand, it is deemed beneficial to limit the scope of the control group to Gangnam-Gu and Seocho-Gu to enhance comparability.[9]

[9] Although the adjacent northern part of the LTP area falls within the 2500m buffer distance, it is not included due to being separated by the Han River and belonging to a different housing submarket. In addition, the sample from Apgujeong-Dong in Gangnam-Gu is not suitable as a control group for estimating post-April 2021 effects, as this area was designated as an additional LTP area on April 27, 2021. Therefore, the sample from Apgujeong-Dong is excluded when estimating the effects.

6. Analysis Results

Table 2. Spillover effects of LTP on housing sales prices

Time period relative to LTP	0-500m vs. 500-1000m	500-1000m vs. 1000-1500m	1000-1500m vs. 1500-2000m	1500-2000m vs. 2000-2500m
-5	-0.0577	0.0244	-0.0378	0.0108
	(0.0431)	(0.0501)	(0.0354)	(0.0280)
-4	-0.0046	-0.0199	0.0091	-0.0171
	(0.0333)	(0.0387)	(0.0281)	(0.0172)
-3	-0.0401	0.0177	0.035	-0.0535*
	(0.0298)	(0.0300)	(0.0221)	(0.0208)
-2	-0.0021	-0.004	0.0171	-0.0358
	(0.0309)	(0.0316)	(0.0190)	(0.0174)
-1	-	-	-	-
	-	-	-	-
0	0.0100	-0.0213	0.01	-0.022
	(0.0182)	(0.0221)	(0.0205)	(0.0132)
1	0.0015	-0.0022	0.0289	-0.0382
	(0.0217)	(0.0238)	(0.0213)	(0.0211)
2	0.0277	-0.0219	0.0284	-0.0401
	(0.0244)	(0.0319)	(0.0303)	(0.0195)
3	-0.0020	-0.0118	0.0688*	-0.0511
	(0.0403)	(0.0395)	(0.0252)	(0.0290)
4	-0.0258	0.055	0.048	-0.0558
	(0.0434)	(0.0463)	(0.0321)	(0.0272)
5	-0.0165	0.0312	0.0352*	-0.0594
	(0.0475)	(0.0483)	(0.0159)	(0.0365)
6	-0.0276	-0.007	0.0653*	-0.0447
	(0.0467)	(0.0447)	(0.0300)	(0.0345)
ln_size	0.7419***	0.7801***	0.6739***	0.5584***
	(0.0317)	(0.0482)	(0.0175)	(0.0175)
ln_age	-0.0072	-0.0072	0.1181	-0.0199**
	(0.0037)	(0.0039)	(0.0617)	(0.0059)
Fixed-Effects:				
Apartment Complex		Yes		
Quarter		Yes		
Observations	2,268	1,295	1,201	1,352
R^2	0.9701	0.9827	0.9789	0.9838
Within R^2	0.8586	0.7990	0.8252	0.9051

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

First, I explore spillover effects on housing sale prices to confirm the geographical limit of the LTP designation effects (see Table 2). Spillover effects are initially examined by selecting areas within 500 m from the LTP as the treatment area. Subsequently, I compare this treated area with an adjacent area (i.e.,

within 500 m to 1,000m from the LTP), which is considered to possess characteristics most similar to those of the treated area. The results are presented in column 2 of Table 2.

During the pre-treatment period, the treated and control groups exhibited similar trends, supporting a causal interpretation. In the post-treatment period, the areas within 0–500 m and 500–1000 m are found to be statistically indistinguishable. The statistical indistinction between these two areas may arise from two possible scenarios. First, both areas may be statistically indistinguishable due to being influenced by the spillover effects of the LTP. Alternatively, the results may indicate that neither of the areas is affected by LTP. To determine which scenario is plausible, I compare the next set of areas, namely the 500–1000 m area and the 1000–1500 m area. If the 500–1000 m area differs from the 1000–1500 m area, it can be inferred that the influence of the LTP extends only up to 500–1000 m. However, the analysis results reveal no statistical distinction between the 500–1000 m and 1000–1500 m areas. Thus, I extend the distance from the LTP area once more and compared the 1000–1500 m area with the 1500–2000 m area. The results show that the prices in the 1000–1500 m area are approximately 3.5% to 6.9% higher in the post-quarters 3, 5, and 6. In other words, the spatially diffused effects of the LTP appear to have led to a relatively higher sale price in the 1000–1500 m area than in the 1500–2000m area.

A plausible explanation for the price increase in the adjacent areas can be attributed to speculative demand and, to some extent, non-speculative demand relocating from the designated area to its adjacent areas. Concurrently, existing landowners in the surrounding areas might have expanded their supply in response to the increase in demand, intending to maximize their capital gains. However, the results imply that the transition in demand surpassed these efforts.

Finally, to reaffirm the geographical limit of spillover effects up to the 0–1500 m area, a comparison was made between the 1500–2000 m and 2000–2500 m regions. The results in column 5 of Table 2 indicate no statistical distinction between the 1500–2000 m and 2000–2500 m areas, implying that both regions were equally unaffected by the spillover effects. The confirmed geographical limit of LTP spillover effects aligns consistently with the subsequent Jeonse price model to be examined, further reassuring the selection of the 1500–2500 m area as the control group.

The finding that 0-1500 m from the LTP area marks the geographical boundary of spillover effects indicates that these areas may be classified as the same housing submarket due to their relatively homogeneous and outstanding residential environments including educational resources and reputation, urban infrastructure, and amenities. The size and area of the submarket to which the LTP and surrounding area belong are further supported by the analysis results of Kim et al., (2019)[10]

[10] The areas identified as belonging to the same housing submarket as the LTP area in Kim et al. (2019) seem to be within approximately 1000-2000 meters.

Table 3. The effects of LTP on housing sales prices

Time period relative to LTP	LTP vs. 1500m-2500m
-5	-0.0527***
	(0.0154)
-4	-0.0083
	(0.0171)
-3	-0.0100
	(0.0184)
-2	-0.0041
	(0.0155)
0	-0.021
	(0.0132)
1	-0.0111
	(0.0152)
2	-0.0370*
	(0.0159)
3	-0.0359*
	(0.0148)
4	-0.0366
	(0.0237)
5	-0.0768**
	(0.0240)
6	-0.0762**
	(0.0269)
ln_size	0.5990***
	(0.0271)
ln_age	-0.0163***
	(0.0055)
Fixed-Effects:	
Apartment Complex	Yes
Quarter	Yes
Observations	2,643
R^2	0.9756
Within R^2	0.8848

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Now, I turn to the direct effects of LTP on the sales prices within the designated area. The 1500–2500 m area from the LTP area is used as a control group based on the identified spillover effects. The analysis results in Table 3 show that sales prices in the designated area decrease by approximately 3.6% to 7.7% starting from the second quarter after designation. This finding aligns with the policy intent to curb speculative demand inflow in the designated area and mitigate potential rapid price increases in the future.

And the results are also consistent with the findings of Kim (2022), who reported a decline of approximately 7.2%.

Table 4. Spillover effects of LTP on Jeonse prices

Time period relative to LTP	0-500m vs. 500-1000m	500-1000m vs. 1000-1500m	1000-1500m vs. 1500-2000m	1500-2000m vs. 2000-2500m
-5	0.0527	-0.0853	-0.0132	-0.0044
	(0.0678)	(0.0634)	(0.0260)	(0.0182)
-4	0.0269	-0.0667	-0.0316	0.0246
	(0.0706)	(0.0716)	(0.0268)	(0.0212)
-3	-0.0277	-0.0255	-0.0237	-0.0029
	(0.0395)	(0.0481)	(0.0252)	(0.0130)
-2	0.0073	-0.0154	0.0032	-0.0272***
	(0.0163)	(0.0176)	(0.0130)	(0.0065)
-1	-	-	-	-
	-	-	-	-
0	-0.0389	0.0041	0.0267	0.0032
	(0.0226)	(0.0238)	(0.0158)	(0.0082)
1	-0.0158	0.0069	0.0300*	0.0267*
	(0.0315)	(0.0308)	(0.0138)	(0.0081)
2	0.0362	-0.0357	0.0542*	0.0133
	(0.0580)	(0.0556)	(0.0234)	(0.0099)
3	0.0233	-0.0333	0.0600*	-0.0568
	(0.0481)	(0.0478)	(0.0273)	(0.0295)
4	0.0622	-0.0811	0.0374	-0.0081
	(0.1133)	(0.1084)	(0.0223)	(0.0079)
5	-0.0327	0.0029	0.0664**	-0.0245
	(0.0415)	(0.0415)	(0.0226)	(0.0112)
6	-0.0118	-0.0286	0.0293	0.0010
	(0.0382)	(0.0375)	(0.0282)	(0.0246)
ln_size	0.9523***	1.133***	0.9092***	0.7968***
	(0.0565)	(0.0624)	(0.0722)	(0.0210)
ln_age	0.0017	0.0035	0.2838*	0.3509***
	(0.0032)	(0.0036)	(0.1101)	(0.0833)
Fixed-Effects:				
Apartment Complex		Yes		
Quarter		Yes		
Observations	12,924	7,832	5,502	2,552
R^2	0.86706	0.83562	0.90587	0.92076
Within R^2	0.52934	0.47959	0.54293	0.6706

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05

Table 4 presents the spillover effects of the LTP on the rental market. The analysis results show, first, that no statistical difference is observed between the LTP area and the control area during the pre-treatment period. Furthermore, when comparing the 1000–1500 m area to the 1500–2000m area, the Jeonse prices in the 1000–1500 m area are higher. This is in line with the findings of the for-sale market analysis and indicates that the spillover effects extend up to 1500 m from the LTP area.

The increase in Jeonse prices in the surrounding area represents the unintended consequences of the LTP, where demand originating from the designated area disperses spatially into adjacent regions, as observed in the sales price models. More precisely, as the supply of Jeonse decreases in the designated area, demand for it shifts to the surrounding areas, resulting in an increase in Jeonse prices. Moreover, as sales prices increase, existing property owners might have shown a preference for sales over rental arrangements. This inclination could have contributed to a decline in the availability of Jeonse properties, exerting upward pressure on Jeonse prices again.

Table 5. The effects of LTP on Jeonse prices

Time period relative to LTP	ln_Jeonse price
-5	-0.0334
	(0.0267)
-4	-0.0575*
	(0.0237)
-3	-0.0600***
	(0.0142)
-2	-0.0089
	(0.0109)
-1	-
	-
0	-0.002
	(0.0094)
1	0.0370*
	(0.0172)
2	0.0670**
	(0.0221)
3	0.0321
	(0.0309)
4	0.0633**
	(0.0204)
5	0.0934*
	(0.0388)
6	0.0008
	(0.0326)
ln_size	0.8440***
	(0.0420)
ln_age	-0.1539
	(0.1217)
Fixed-Effects:	
Apartment Complex	Yes
Quarter	Yes
Observations	11,304
R^2	0.8771
Within R^2	0.51011
Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05	

How are Jeonse prices within the designated area affected? Jeonse prices appear to have increased by approximately 3.8% to 9.8%. The primary reason for the rise is a decrease in the supply of Jeonse properties, particularly those provided through gap investment. The increase in Jeonse price in the designated area is also an unintended consequence of the policy, similar to the spillover effects observed in the rise of both sales and Jeonse prices in the surrounding areas, because Jeonse demand, which consists of non-speculative demand, is not the type of demand the LTP aims to restrict.

One notable observation in Table 5 is, similar to that shown in Table 4, where the influence on Jeonse prices becomes statistically insignificant in quarter 6. Upon reflection on potential explanations from the demand perspective, it can be inferred that there may be no reason for Jeonse demand to vary in the designated area compared with the control area. On the supply side, the supply of Jeonse through gap investment is regulated by the LTP. However, remember that there is an exception to the LTP, which applies when becoming the owner of a newly built apartment. In such cases, there is no obligation to reside for two years, allowing for immediate rental. Therefore, considering the apartments newly built in Daechi-dong and Samsung-dong by the end of September 2021, it was possible to rent them out, contributing to an increase in Jeonse supply in the designated area. [11][12] Jeonse prices do not frequently undergo considerable changes in demand; thus, the increase in Jeonse supply due to new apartments in the designated area might have exerted downward pressure on Jeonse prices.

7. Robustness checks

In the main analysis, the 1500–2500 m area from the LTP area is used as a control group because of the positive spillover effects observed in the 0–1500 m area. As a robustness check, I reassess the (spillover) effects of LTP using alternative buffer sizes and different control groups: 1) 1000–2500 m, 2) 500–2500 m, and 3) 0–2500 m.

First, I employ a buffer interval of 600 m instead of 500 m to confirm the geographical limit of the spillover effects. The results are presented in Tables B1 and B3 in Appendix B. The coefficients attain significance solely when comparing the 1200-1800 m area with the 1800-2400m area, indicating the spatial extent of spillover effects is confined within the range of 1200-1800 m from the LTP area. In the main results using a 500 m buffer, the 1000-1500 m area served as the geographical limit. Thus, I further test whether the spillover effects are present within the 1500-1800 m area, which has not undergone double-checking due to the difference in size between the two buffer intervals used. Tables B2 and B4 in Appendix B show that the spillover effects are not found within the 1500-1800 m area in both sales and Jeonse price models,

[11] From June 2020, after the designation of the LTP, until the time before the construction of these two apartments, no new apartments were built in the LTP area.

[12] Considering that the proportion of new apartments leased to the rental market is estimated to be between 20% and 40% (Oh, 2022), it can be inferred that the increase in Jeonse supply would be close to 3-400 units. Although this numerical value may not appear substantial in absolute terms, it gains significance when contextualized with the fact that the total rental supply for the LTP area stood at only 2,910 units in July 2021 (Asil, 2023). In contrast, in the control group area, only 232 units of new apartments were additionally supplied in Gaepo-Dong, Gangnam-Gu, from September to December 2021.

with the exception of the coefficient for the 6th quarter following the LTP designation in the Jeonse price model. Hence, the results of the robustness check endorse the utilization of the 1500-2500m area as a control group unaffected by spillover effects. [13]

Next, the results of the robustness check using varying control groups are presented in Table B5 in Appendix B. If the 0–1500 m area is subject to positive spillover effects, it is anticipated that the estimates will exhibit higher negative values (i.e., smaller estimates) than those derived from the main results in Table 3. In addition, the estimates are expected to further diminish as they encompass a broader range of areas affected by spillover effects. These expectations are validated by the analysis results. That is, with the sequential addition of the 1000–1500 m area, followed by the 500–1000 m area, and lastly, the 0–500 m area to the control group, the downward bias becomes more pronounced. This supports the appropriateness of using the 1500–2500m area as a control group.

In the Jeonse price models, I employ a consistent method of varying the control group. As a result, the upward impact on Jeonse prices vanishes in all models when 1000–2500 m, 500–2500 m, and 0–2500 m are used as control groups (see Tables B6 in Appendix B). The reason behind this is the incorporation of areas affected by the positive spillover effects of LTP into the control group causes the estimates to be downward biased.

As a third robustness check, I expand the sample by reducing the threshold from apartment complexes with more than 500 units to those with 400 units (see Tables B7 and B8 in Appendix B). Including smaller apartment complexes could result in greater compositional changes in observations over time; however, it allows us to increase the overall number of observations, enhancing statistical power. The results in both the sales and Jeonse price models are unaffected and consistent.

8. Conclusion

Since 2017, the rapid increase in housing prices in South Korea has raised concerns about housing affordability and price bubbles driven by speculative demand. In response, the government has adopted various policies to curb the rise in housing prices. Among these, one of the stricter and more stringent policies is the LTP. This study analyzes the policy and examines not only the intended consequences for sales prices but also the unintended consequences on the rental market. In addition, a control group area as a counterfactual is meticulously selected to reduce possible biases stemming from spillovers. The findings and methods adopted in this study have implications not only for the evaluation of other demand restriction housing policies in Korea but also for countries such as China, where home purchase restrictions

[13] This argument does not suggest that the limit exactly extends to 1500 m because, not all buffer distances (such as those between 1400 m and 1500 m, or between 1500 m and 1680 m), have been tested for their potential spillover effects. Testing all buffer distances with the dataset used is not feasible due to the challenge of ensuring an adequate number of observations per quarter and the associated risk of escalating standard errors, which could lead to imprecise estimates as the number of observations decreases. Consequently, it would be more accurate to state that the spillover effects diminish as the distance from the LTP area increases within the range of approximately 1500 m-1800 m.

are extensively implemented, and for Singapore, which has introduced diverse demand control housing policies.

The analysis yields the following results, and several policy implications emerge from these findings. First, as expected, the LTP area designation decreases sales prices. This is attributed to the reduction in speculative demand as gap investment is restricted, validating the adoption of the LTP to cool down the designated area's housing market. Second, the effects of LTP are observed to diffuse into the surrounding areas, increasing sales prices as seen in the cases of LIHTC in the U.S. and the home purchase restrictions in China. The results imply that a detailed examination of the geographical limit of influence and the selection of areas unaffected by spillover effects as counterfactuals are crucial when evaluating location-based policies such as LTP.

Next, the LTP policy appears to increase rental prices in both designated and surrounding areas. The increase in rental prices, which is distant from speculative demand, is an undesirable and unintended outcome of the policy. Given that renters constitute a relatively vulnerable population in the real estate market, it is necessary to take into account the possibility that housing policies aimed at stabilizing housing prices may inadvertently lead to rent hikes, and further exacerbate affordability concerns.

The analysis results of this study demonstrate that robustly restricting speculative demand can stabilize prices. However, importantly, we cannot be entirely certain that price stability is solely attributed to the reduction in speculative demand. This uncertainty arises because the strong expression of government policy may have prompted a decrease in future expected investment returns, potentially leading to a contraction in not only speculative but also non-speculative demand. Furthermore, this study limited its scope to periods of price increases or stability to control for other market factors. Future research may need to examine how the policy has influenced the period of price decline, particularly in the latter half of 2022 and throughout 2023. Lastly, the housing transaction data used in the analysis focus solely on the actual transactions that have taken place, which may differ in nature from other housing properties where transactions have not occurred. Also, the transaction frequency varies over time and locations, and it could affect the composition of observations and estimation results. Thus, the findings need to be cautiously applied to the entire housing market.

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Appendix A – Contexts of the Korean real estate market and real estate transaction data

Table A1. Housing and tenure types in Seoul, 2020

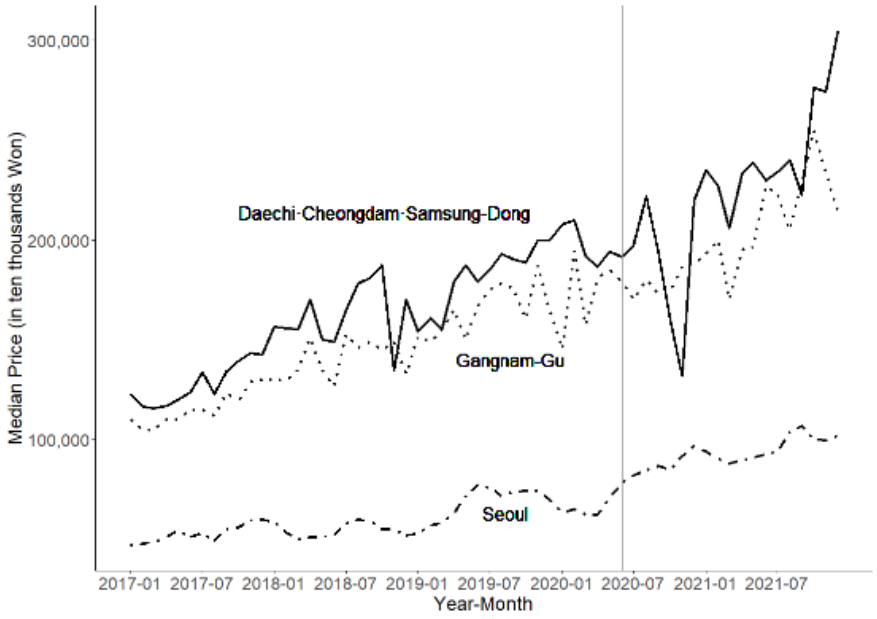
Housing type		Tenure type	
Non-apartment dwellings	39.60%	Owner-occupied	44.60%
Apartments	59.46%	Renter-occupied*	55.40%

Notes: The data are from 2020 Population and Housing Census (Statistics Korea, 2020)
*Renter-occupied includes both Jeonse and monthly rental arrangements.

A2. Description of real estate transaction records

The Ministry of Land, Infrastructure, and Transport provides real estate transaction records covering various types including housing, commercial, pre-sale or right to residency, land, and factory. As for the housing transaction records, the records are collected through a mandatory report system. Buyers and renters are required to report their transactions within 30 days from the transaction dates if the deposit exceeds 60,000,000 KRW or the monthly rent is higher than 300,000 KRW. These records contain information such as the address, name of the apartment complex, size, contract data, prices, built year, transaction type, buyer type, seller type, and the address of the realtor office, along with the registration date. The data is publicly available and downloadable through https://rt.molit.go.kr/.

Figure A3. Apartments sales prices trends, 2017 to 2022.



Note: The horizontal line indicates the timing of LTP designation. The calculation utilizes apartment units with an exclusive dwelling area larger than 60 square meters but smaller than 85 square meters, which represent the most common apartment sizes in Korea. The data are from https://rt.molit.go.kr/

Appendix B – Robustness analysis

Table B1. The effects of LTP on sales prices using a 600m buffer distance

Time period relative to LTP	0-600m vs. 600-1200m	600-1200m vs. 1200-1800m	1200-1800m vs. 1800-2400m	1800-2400m vs. 2400-3000m
-5	-0.0376	-0.0208	-0.0391	-0.0021
	(0.0426)	(0.0264)	(0.0346)	(0.0263)
-4	-0.0140	-0.0004	-0.0300	-0.0228
	(0.0310)	(0.0229)	(0.0199)	(0.0164)
-3	-0.0243	-0.0048	-0.0047	-0.0247
	(0.0278)	(0.0219)	(0.0148)	(0.0154)
-2	-0.0033	0.0079	-0.0052	-0.0192
	(0.0280)	(0.0182)	(0.0107)	(0.0148)
-1	-	-	-	-
	-	-	-	-
0	-0.0007	-0.0027	-0.0110	0.0203
	(0.0167)	(0.0206)	(0.0185)	(0.0167)
1	-0.0127	-0.0110	0.0140	0.0076
	(0.0211)	(0.0288)	(0.0194)	(0.0167)
2	0.0215	0.0211	-0.011	0.0094
	(0.0222)	(0.0282)	(0.0232)	(0.0186)
3	-0.0168	0.0367	0.0299*	-0.0172
	(0.0367)	(0.0352)	(0.0127)	(0.0275)
4	-0.0301	0.0569	0.0557**	-0.0450
	(0.0400)	(0.0372)	(0.0169)	(0.0316)
5	0.0007	0.0410	0.0319*	0.0477
	(0.0376)	(0.0259)	(0.0128)	(0.0544)
6	-0.0109	0.0481	-0.0129	-0.0094
	(0.0394)	(0.0357)	(0.0253)	(0.0319)
ln_size	0.7418***	0.7085***	0.7274***	0.6010***
	(0.0306)	(0.0359)	(0.0293)	(0.0339)
ln_age	-0.0088**	-0.0053*	0.0094***	-0.0097*
	(0.0030)	(0.0024)	(0.0015)	(0.0045)
Fixed-Effects:				
Apartment Complex			Yes	
Quarter			Yes	
Observations	2,474	2,452	3,226	2,939
R^2	0.9697	0.9705	0.9739	0.9469
Within R^2	0.8532	0.8588	0.8495	0.7185

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Table B2. The effects of LTP on sales prices (1500-1800m vs. 1800-2500m)

Time period relative to LTP	1500-1800m vs. 1800-2500m
-5	0.0936***
	(0.0157)
-4	0.0347*
	(0.0159)
-3	-0.0097
	(0.0278)
-2	0.0182
	(0.0200)
-1	-
	-
0	-0.0177
	(0.0295)
1	-0.0206
	(0.0250)
2	0.0179
	(0.0193)
3	-0.0082
	(0.0248)
4	-0.0028
	(0.0333)
5	-0.0344
	(0.0448)
6	0.0180
	(0.0407)
ln_size	0.6531***
	(0.0397)
ln_age	0.0075**
	(0.0030)
Fixed-Effects:	
Apartment Complex	Yes
Quarter	Yes
Observations	1,352
R^2	0.97474
Within R2	0.83635

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Table B3. The effects of LTP on Jeonse prices using a 600m buffer distance

Time period relative to LTP	0-600m vs. 600-1200m	600-1200m vs. 1200-1800m	1200-1800m vs. 1800-2400m	1800-2400m vs. 2400-3000m
-5	0.0510	-0.0731	-0.0168	-0.0097**
	(0.0646)	(0.061)	(0.0246)	(0.0194)
-4	0.0316	-0.0722	-0.0194	0.0180
	(0.0646)	(0.0662)	(0.0315)	(0.0414)
-3	-0.0193	-0.0369	-0.0240	0.1136
	(0.0344)	(0.0413)	(0.0234)	(0.1002)
-2	0.0071	-0.0156	-0.0047	-0.0818
	(0.0149)	(0.0163)	(0.0107)	(0.0433)
-1	-	-	-	-
	-	-	-	-
0	-0.0318	0.0043	0.0256	-0.0085
	(0.0221)	(0.0229)	(0.0138)	(0.0495)
1	0.0052	0.0075	0.0273*	0.0189
	(0.0262)	(0.0261)	(0.0113)	(0.0380)
2	0.0458	-0.0161	0.0383**	-0.0371
	(0.0523)	(0.0497)	(0.0123)	(0.0429)
3	0.0302	-0.0269	0.0550	0.0691
	(0.0428)	(0.0420)	(0.0305)	(0.0646)
4	0.0812	-0.0778	0.0202	0.0269
	(0.1026)	(0.0981)	(0.0160)	(0.0712)
5	-0.0329	0.0118	0.0594**	0.2699
	(0.0394)	(0.0384)	(0.0175)	(0.2001)
6	-0.0071	-0.0270	0.0575*	-0.1725
	(0.0349)	(0.0352)	(0.0234)	(0.2077)
ln_size	0.9571***	0.7085***	0.8779***	0.6830***
	(0.0553)	(0.0359)	(0.0708)	(0.1216)
ln_age	0.0027	-0.0053*	0.3493***	0.5268***
	(0.0029)	(0.0024)	(0.0838)	(0.1741)
Fixed-Effects:				
Apartment Complex			Yes	
Quarter			Yes	
Observations	13,879	8,006	4,965	2,719
R^2	0.8639	0.8371	0.9026	0.9113
Within R^2	0.5284	0.5054	0.5510	0.3753

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Table B4. The effects of LTP on Jeonse prices (1500-1800m vs. 1800-2500m)

Time period relative to LTP	1500-1800m vs. 1800-2500m
-5	0.0225
	(0.0311)
-4	0.0033
	(0.0329)
-3	-0.0215
	(0.0244)
-2	-0.0085
	(0.0093)
-1	-
	-
0	0.0141
	(0.0133)
1	0.0051
	(0.0172)
2	0.0201
	(0.0191)
3	0.0577
	(0.0290)
4	0.0016
	(0.0153)
5	0.0273
	(0.0166)
6	0.0803*
	(0.0259)
ln_size	0.7942***
	(0.0217)
ln_age	0.3869***
	(0.0597)
Fixed-Effects:	
Apartment Complex	Yes
Quarter	Yes
Observations	2,552
R2	0.9218
Within R2	0.6747

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Table B5. The effects of LTP on sales prices using varying control groups

Time period relative to LTP	1000m-2500m	500m-2500m	0-2500m
-5	-0.0453**	-0.0530**	-0.0319**
	(0.0160)	(0.0155)	(0.0130)
-4	-0.0118	-0.0103	-0.0050
	(0.0169)	(0.0165)	(0.0147)
-3	-0.0135	-0.0196	-0.0141
	(0.0161)	(0.0156)	(0.0145)
-2	-0.0044	-0.0053	-0.0037
	(0.0130)	(0.0130)	(0.0110)
-1	-	-	-
	-	-	-
0	-0.0247	-0.0227	-0.0234*
	(0.0131)	(0.0123)	(0.0107)
1	-0.0117	-0.0150	-0.0162
	(0.0137)	(0.0126)	(0.0114)
2	-0.0407*	-0.0416**	-0.0456**
	(0.0188)	(0.0172)	(0.0152)
3	-0.0480**	-0.0515**	-0.0592***
	(0.0154)	(0.0154)	(0.0123)
4	-0.0399*	-0.0501*	-0.0569***
	(0.0189)	(0.0188)	(0.0159)
5	-0.0793***	-0.0854***	-0.0913***
	(0.0202)	(0.0201)	(0.0179)
6	-0.0872***	-0.0873***	-0.0878***
	(0.0223)	(0.0215)	(0.0192)
ln_size	0.6148***	0.6288***	0.6640***
	(0.0306)	(0.0323)	(0.0333)
ln_age	-0.0188**	-0.0063**	-0.0084**
	(0.0059)	(0.0019)	(0.0020)
Fixed-Effects:			
Apartment Complex		Yes	
Quarter		Yes	
Observations	3,364	3,938	5,632
R^2	0.9775	0.9774	0.9726
Within R^2	0.8595	0.8490	0.8500

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '

Table B6. The effects of LTP on Jeonse prices using varying control groups

Time period relative to LTP	1000m-2500m	500m-2500m	0-2500m
-5	-0.0291	0.0089	0.0139
	(0.0195)	(0.0307)	(0.0219)
-4	-0.0462**	-0.0215	-0.0105
	(0.0160)	(0.0258)	(0.0161)
-3	-0.0543**	-0.0410*	-0.0131
	(0.0166)	0.0167	(0.0143)
-2	-0.0131	-0.0051	-0.0043
	(0.0126)	(0.0104)	(0.0094)
-1	-	-	-
	-	-	-
0	-0.0184	-0.0209	-0.0046
	(0.0110)	(0.0105)	(0.0091)
1	0.0187	0.006	0.0088
	(0.0174)	(0.0177)	(0.0164)
2	0.0340	0.0385	0.0302
	(0.0246)	(0.0282)	(0.0238)
3	0.0107	0.0116	0.0062
	(0.0240)	(0.0236)	(0.0197)
4	0.0467	0.077	0.0718
	(0.0242)	(0.0525)	(0.0364)
5	0.0609	0.0466	0.0554
	(0.0402)	(0.0405)	(0.0391)
6	-0.0095	-0.0058	0.0064
	(0.0311)	(0.0321)	(0.0306)
ln_size	0.8722***	0.9357***	0.9134***
	(0.0451)	(0.0583)	(0.0393)
ln_age	-0.1760	0.0057	0.0044*
	(0.0311)	(0.0032)	(0.0019)
Fixed-Effects:			
Apartment Complex	Yes		
Quarter	Yes		
Observations	14,675	19,136	27,599
R^2	0.88527	0.85805	0.87586
Within R^2	0.49671	0.48494	0.51208

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Table B7. The effects of LPT on sales prices using a 400 units threshold

Time period relative to LTP	LTP vs. 1500m-2500m
-5	-0.0536***
	(0.01146)
-4	-0.0050
	(0.0160)
-3	-0.0050
	(0.0170)
-2	-0.0060
	(0.0142)
-1	-
	-
0	-0.0194
	(0.0133)
1	-0.0101
	(0.0151)
2	-0.0425*
	(0.0191)
3	-0.0347*
	(0.0146)
4	-0.0356
	(0.0213)
5	-0.0719**
	(0.0212)
6	-0.0695**
	(0.0235)
ln_size	0.5988***
	(0.0257)
ln_age	-0.0184***
	(0.0039)
Fixed-Effects:	
Apartment Complex	Yes
Quarter	Yes
Observations	3,002
R^2	0.9750
Within R^2	0.8751

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05

Table B8. The effects of LPT on Jeonse prices using a 400 units threshold

Time period relative to LTP	ln_Jeonse price
-5	-0.0351
	(0.0217)
-4	-0.0529*
	(0.0152)
-3	-0.0558***
	(0.0152)
-2	-0.0090
	(0.0113)
-1	-
	-
0	-0.0004
	(0.0116)
1	0.0366*
	(0.0158)
2	0.0486*
	(0.0232)
3	0.0303
	(0.0282)
4	0.0527*
	(0.0211)
5	0.0737*
	(0.0305)
6	0.0025
	(0.0416)
ln_size	0.8487***
	(0.0416)
ln_age	-0.1443
	(0.1104)
Fixed-Effects:	
Apartment Complex	Yes
Quarter	Yes
Observations	12,344
R^2	0.87496
Within R^2	0.50155

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05