The Effect of Rezoning on Local Housing Supply and Demand: Evidence from New York City

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Abstract

As cities face housing affordability challenges, some local governments adopt land-use reforms to increase the residential development capacity in the city. This type of "upzoning" policy aims to increase housing supply and lower local housing costs, but it can also create positive amenity effects that attract high-income households to the neighborhood. This paper studies how the large-scale neighborhood upzoning in New York City between 2004 and 2013 affected local housing supply, prices, and residential mobility patterns using a difference-in-difference method. I construct a parcel-level dataset by combining zoning amendment maps with microdata tracking individual address histories. By comparing upzoned areas and the adjacent areas outside the upzoned boundaries, I find that housing supply increases after upzoning. Meanwhile, there is suggestive evidence of increased housing prices among existing properties on parcels with more increase in residential capacity. I also find that incumbent residents living in upzoned areas are more likely to move to a different neighborhood or leave the metropolitan area, but they are not more likely to move to lower-income areas. Finally, there is evidence that after the upzoning, in-migrants come from slightly higher-income neighborhoods. These results suggest that in this context, upzoning can both increase housing supply and change the composition of local residents in the neighborhood.

Keywords: Rezoning, Upzoning, Land-Use Regulations, Housing Supply, Residential Mobility

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1. Introduction

Housing affordability continues to be a great challenge for many large, economically successful cities in the United States. As cities attract high-skilled individuals with wage premiums and rich consumption amenities such as restaurants and nightlife, the cost of housing also rises rapidly. Literature points to the role that limited housing supply and stringent land-use regulations play in exacerbating the housing affordability crisis (Glaeser and Gyourko, 2002; Quigley and Raphael, 2004; Gyourko and Molloy, 2015; Hilber and Vermeulen, 2016). However, in cities like New York City where demand is high, concerns arise among local residents that relaxing land-use regulations may lead to new developments and amenities that primarily cater to the needs of the high-income population. They fear that this could contribute toor accelerate gentrification in their communities, resulting in higher rents, increased risk of eviction, and displacement for long-term residents (Been et al. 2019; Hankinson, 2018; Monkkonen, 2016). Economically vulnerable incumbent residents, particularly low-income renters, may be forced to relocate to higher-poverty or lower-opportunity neighborhoods, thereby exacerbating spatial inequality and adversely affecting the well-being ofthese families and their children. As regional and local governments increasingly consider zoning reforms and policies that relax land-use regulations to address housing supply constraints, it is crucial to gather better evidence and understanding of the potential effects of rezoning to inform housing policy decisions.

This paper examines how relaxing zoning regulations affect local housing supply and prices, neighborhood change, and residential mobility patterns of incumbent households over time. While existing literature extensively explores the impact of land-use regulations on housing supply and prices (Glaeser and Gyourko, 2002; Glaeser and Ward, 2009; Kok et al, 2014; Kulka et al. 2022) and residential sorting (Kulka, 2019; Song, 2022), few studies document the effect of housing regulations on migration patterns into and out of neighborhoods. To fill this gap, the focus of this study is on the rezoning efforts that took place in New York City between 2004 and 2013. During this period, the Bloomberg administration rezoned almost 40 percent of the city's land, resulting in significant changes across different neighborhoods. Although there are various forms of rezoning, this paper examines the effect of "upzoning," which generally refers to increasing the residential capacity of land that can be developed in an area. The city government typically adopts upzoning to promote housing construction and the redevelopment of under-utilized land. Using neighborhood-scale upzoning in New York City between 2004 and 2013, I aim to answer the following questions:

1. Does upzoning change local housing supply and housing prices?

2. Are incumbent residents more likely to move out of the neighborhood after upzoning? If so, which groups of incumbent residents are more likely to move, and do they move to lower-income areas?

3. Are in-migrants more likely to move in from high-income areas after upzoning?

While the policy objective of upzoning or relaxing zoning regulations aims to increase housing supply and decrease housing costs, the effect on local housing prices is theoretically ambiguous and remains an open empirical question. The increase in housing stock will have a supply effect, leading to a decrease in local housing prices and rents. However, expanding the buildable area on a lot will raise the option value of redevelopment, thereby increasing the housing prices of existing buildings that were constructed below the new cap on allowed residential capacity. Furthermore, upzoning can have positive or negative amenity effects on the neighborhood, depending on the existing neighborhood characteristics and household preferences. Through these different mechanisms, upzoning will not only affect local housing prices and rents but may also change the socio-demographic composition of local residents. If the increased option values of redevelopment and positive amenity effects outweigh the supply effect, housing costs will rise, making it more challenging for lower-income incumbent renters to remain in the neighborhood. They may choose to relocate to lower-cost neighborhoods instead. Conversely, if the supply effect dominates, the increased housing supply can lead to lower local housing prices and rents. This, in turn, may reduce the risk of displacement for renters and make it easier for them to continue residing in the neighborhood.

To study the impact of upzoning on the local housing market, I compile a uniquely rich set of granular, building- and parcel-level data on zoning maps, building characteristics, housing permits, and housing prices over time. I focus on city-led, large-scale neighborhood upzoning in New York City between 2004 and 2013. Moreover, I utilize address-level microdata on individual residential histories to examine the mobility patterns of incumbent residents and in-migrants in the upzoned areas. With this comprehensive dataset, I can track the origins of individuals' moves, as well as whether and where they choose to relocate after upzoning.

My empirical strategy exploits the granularity of parcel-level data and uses a difference-in-difference design that compares the upzoned area to the adjacent area located within 1000 feet outside the upzoned boundary while controlling for census tract fixed effects.[1] The identification assumption is that, prior to rezoning, both the upzoned area and the adjacent area exhibit similar patterns of real estate development and demographic changes. By focusing on the differences between these two areas following upzoning, the study aims to isolate the effect attributable to the change in zoning regulations. Additionally, considering that the change in residential capacity may vary across individual parcels within the upzoned area, I exploit this variation within the treatment area to examine how the effect of neighborhood upzoning differs for parcels receiving different treatment intensity.

I find that the total number of residential units increases after upzoning, and the growth is primarily driven by parcels that experience a greater percent increase in allowed residential capacity. Overall, the number of residential units increase by more than 4 percent seven years after upzoning. The parcels that are more intensively treated and receive a stronger boost in allowed residential capacity experience an 8 percent increase in housing supply. These findings suggest that developers seize the opportunity to construct more new housing as land-use restrictions are relaxed. There is also suggestive evidence of increased housing prices among existing properties on parcels that experience greater boosts in allowed residential capacity, particularly those located in the central city where demand may be higher demand. In contrast, properties on parcels that are not effectively upzoned do not exhibit the same price increase. I provide suggestive evidence that the price increase among the existing properties compared to those located in the control area can be attributed to increased option values to redevelop the buildings.

Regarding residential mobility patterns, I find that incumbent residents living in the upzoned area prior to upzoning are more likely to move to a different neighborhood or leave the metropolitan area after upzoning. The increase in overall mobility is primarily driven by renters, who may be more vulnerable to changes in housing cost than homeowners. However, incumbent residents moving after upzoning on average do not move to lower-income neighborhoods compared to out-migrants from the control area, regardless of their race or homeownership status.

[1] The average length of a north-south block in Manhattan of New York City is about 264 feet, though the actual distance varies. On average, 1000 feet covers about four north-south Manhattan blocks.

That being said, out-migration could still imply welfare loss if incumbent residents have strong preferences for their origin neighborhoods or if moving costs are high. To examine potential mechanisms for out-migration, I divide the parcels in the upzoned areas into two groups based on whether they receive any demolition, new building, or alteration permits after upzoning. The out-migration effect is driven by incumbent residents living in buildings that undergo such changes, indicating that they could move out due redevelopment or alteration of existing property. Finally, I find changes in the socioeconomic composition of in-migrants: six to seven years after upzoning, in-migrants come from census tracts with a median income that is around 5 percent higher compared to the control area. Overall, the findings suggest that upzoning can lead to changes in the composition of local residents in the upzoned neighborhood.

There are a few caveats to the study. First of all, the upzoned areas examined in this paper experience substantial increases in allowed residential capacity, and some of them involve city agencies committing to investing in local infrastructure such as public transit and waterfront parks. Additionally, some of these areas experience a complete transformation from once-industrial or manufacturing sites into residential neighborhoods. In that case, these upzonings can also be seen as comprehensive place-based policies aimed at promoting local economic development, thereby having stronger positive amenity effect than simply changing zoning codes. Second, the empirical approach adopted in this study compares the upzoned area to its surrounding area. Therefore, the effects observed on housing supply, housing prices, and migration patterns reflect hyper-local effects on the local housing market. It should not be interpreted as the general equilibrium effect on the broader housing market in New York City. It is plausible that relaxing zoning regulations in one part of the city may change housing prices and rents in other parts of the city or the greater region, but that effect is not captured within the scope of this paper. Moreover, I cannot rule out the possibility that supply and amenity effects caused by upzoning would spill over the rezoned boundary. Depending on whether the spillover effect is positive or negative, the main results of comparing the upzoned area and the 1000-feet ring could serve as either lower or higher bounds of the local effect of upzoning.[2] Nevertheless, the paper provides evidence that large-scale neighborhood upzoning leads to an increase in housing supply while also attracting in-migrants

[2] I examine the extent of spillover effect in Section 6.

from higher-income areas and increasing out-migration among incumbent residents in the neighborhood.

This paper ties into the strands of literature studying the effects of land-use regulations on housing markets and residential sorting. A large body of research points to the positive relationship between stringent land-use regulations and limited land development and housing supply (Wu and Cho, 2007; Jackson 2016) and high housing prices (Glaeser and Gyourko, 2002; Glaeser and Ward, 2009; Kok et al, 2014; Glaeser and Gyourko, 2018; Glaeser et al. 2005; Song 2022). Kulka et al. (2022) estimate the effect of various zoning regulations on housing markets in the Greater Boston Area using a boundary discontinuity design, and find that relaxing density restrictions (alone or jointly with relaxing other regulations) is most effective at increasing housing supply and reducing rents and housing prices. In terms of residential sorting, Kulka (2019) and Song (2022) both use a boundary discontinuity design and find strictly zoned neighborhoods (on minimum lot size) attract high income households. Existing literature on zoning has primarily studied the effects of land-use regulations by exploiting variation across metropolitan areas or over municipal boundaries, but few studies have examined how large-scale changes in zoning regulations over time, such as rezoning, affect the local housing market given the rarity of such events and challenges in acquiring data. This paper joins the emerging body of papers studying the effect of changes in land-use regulations over time, or zoning reforms, (Anagol et al. 2021; Freemark, 2020; Büchler and Lutz, 2021; Peng, 2023; Krimmel and Wang, 2023) on housing supply and prices. It further contributes to the literature by studying how upzoning affects migration patterns of incumbent residents and in-migrants to the neighborhood, which has not been studied in prior work to the author's knowledge.

Second, this paper is related to the literature examining the local effect of new construction on housing costs and migration. Oftentimes, new housing construction requires zoning changes beforehand unless it is built on a vacant land. Li (2021), Asquith et al. (2021), and Pennington (2021) find that the supply effect generally dominates the amenity effect when increasing new market-rate housing in the neighborhood, leading to lower rents or housing prices in the surrounding area. Pennington (2021) also finds evidence of lower displacement risk of incumbent residents but increased gentrification in the surrounding area of new construction. Baldomero-Quintana and Singh (2023), on the other hand, use an instrumental variable approach and find that new residential buildings generate positive consumption amenities by attracting high-income residents, lead to rent increases, and spur gentrification in the neighborhood. Rather than studying the effect of new construction, this paper steps back to the stage of regulation changes and examines the local effect of large-scale changes in zoning laws.

Finally, this paper is related to the literature studying the effect of place-based housing policies on local housing market and neighborhood residents. Previous work in this area has primarily focused on public housing demolitions (Tach and Emory 2017; Blanco, 2023; Almagro et al. 2023) or regenerations (Blanco and Neri, 2023), subsidized housing investment (Schwartz et al., 2006), and affordable housing programs such as the Low-Income Housing Tax Credit (Diamond and McQuade, 2019). As mentioned earlier, the New York City government used large-scale rezoning that spans across multiple blocks or neighborhoods as a comprehensive planning tool to reshape the neighborhood. This paper provides a new perspective to view and study upzoning as a type of place-based housing policy. The remainder of the paper is structured as follows. Section 2 describes the institutional background and theoretical framework, and Section 3 describes the data sources and provides summary statistics. Section 4 discusses the empirical approach, and Section 5 presents the results. Section 6 provides robustness check. Section 7 concludes and discusses policy implications.

2. Institutional Background and Theoretical Framework

2.1 Zoning Reform in New York City

New York City adopted the nation's first comprehensive municipal zoning ordinance in 1916, which regulated the use and density allowed on parcels. After the city enacted a new zoning resolution in 1961, it was largely unchanged until the 2000s. By that time, the 1961 zoning resolution was widely considered outdated, given the change in the city's industrial composition, residential environment, and population growth in the past decades. The 1961 zoning resolution highly restricted residential development in manufacturing districts to preserve the city's port, rail, and other industrial sites (Goldberg, 2015). However, the dominant economic activities of the city have shifted from manufacturing to finance, professional, and retail services over time. When the Bloomberg administration took office in 2002, the land in central city locations was largely built out while the city government projected continued population growth and a lack of project sites for new development. Therefore, the government started developing comprehensive plans and initiating neighborhood-scale rezoning to accommodate and promote economic and population growth in the city.

Between 2004 and 2013, the New York City Department of City Planning (DCP) implemented a series of neighborhood-scale rezoning that covered 40 percent of the land in the city. DCP tailored each rezoning initiative based on the local context, citing distinct planning goals and rationales for different rezoning. Some neighborhoods underwent zoning changes aimed at facilitating more intensive residential use ("upzoning"). During this period, the city focused on upzoning underutilized industrial sites, waterfronts, and transit-rich neighborhoods with development potential. The city also decreased the overall residential capacity in some neighborhoods to preserve the existing character of the neighborhood and prevent out-of-scale development ("downzoning"). There were also some rezoned neighborhoods where the city aimed to achieve a balance between increasing development capacity and neighborhood preservation, usually by increasing zoned densities on wide and commercial corridors and restricting densities in existing residential mid-blocks ("hybrid rezoning" or "contextual rezoning").

This paper specifically examines the impact of large-scale neighborhood upzoning as a means of relaxing land-use regulations. Previous research has rarely explored such changes in zoning regulations over time affect the local housing market due to the rarity of such events and data acquisition challenges. The ambitious, comprehensive rezoning plans in New York City offer an excellent opportunity to study these questions. It is also worth noting that while this study focuses exclusively on upzoning, other forms of rezoning are important and should be examined in future studies.

2.2 Theoretical Framework: How Would Upzoning Affect the Local Housing Market?

This paper aims to study the local effect of upzoning on housing supply, housing prices, and migration patterns of incumbent residents and in-migrants. This section lays out the theoretical framework and mechanisms for how upzoning would affect these outcomes.

On housing supply, the government adopts zoning changes and allows more residential buildable area on a parcel or in a neighborhood to induce developers to build more housing and increase housing supply. While this seems straightforward, there is no guarantee that developers will respond to the policy change if there are other frictions in the market or if the extent of removal of regulatory constraints is not enough to induce changes in the developers' behavior. This is the first-stage effect that I will examine in the paper.

There are three major channels through which upzoning would affect local *housing prices of existing residential properties*, including 1) the supply effect; 2) the amenity or demand effect; and 3) the option value of redevelopment. In a simple supply and demand framework, the *supply effect* of increased housing stock (if detected in the first stage after upzoning) will shift the housing supply curve outward and decrease local housing prices and rents.

On the demand side, upzoning can have positive or negative *amenity effect* on the neighborhood, depending on the existing neighborhood characteristics and household preferences. Allowing more housing stock or increasing built density can decrease housing prices, particularly in low-density areas, if existing residents and potential homebuyers dislike density or potential congestion and traffic caused by new construction. However, the amenity effect can be positive for neighborhoods that have long been underinvested or for areas that transition from manufacturing sites to residential areas. In these areas, changes in housing regulations can also signal or create expectations that the upzoned neighborhoods have development potential or that the government will invest in the infrastructure in these neighborhoods. As new housing stock replaces vacant, abandoned land, or blight and attracts new businesses or higher-income residents to the area, neighborhood quality will improve, and this creates a positive amenity effect that puts upward pressure on local housing prices and rents. The theoretical framework for literature studying the effect of new construction generally involves the supply effect and positive amenity or demand effect pulling the housing prices in the opposite direction.

The third channel, the *option value of redevelopment*, is an important determinant of housing prices and a unique channel in the case of zoning change. The standard hedonic model posits that housing prices are comprised of the structure value of existing properties and the value of option to redevelop or reconfigure the existing structure (Clapp and Salavei, 2010; Clapp et al. 2012). For example, older, smaller houses may be redeveloped or renovated into larger or more modern buildings. In the case of upzoning, increasing the buildable area on a lot will increase the option value of redevelopment because developers can now build more intensively on a parcel, increasing the housing price of existing buildings. This effect can be stronger in high-demand areas or during the boom period in the housing market cycle (Clapp et al., 2013). Leather (2023) also provides evidence that manufacturing lots likely to be rezoned for residential use, which potentially embed high option values, sell at an average premium of 50 percent per square foot.

A few things set the option value channel apart from the supply and amenity effects. First, while the supply and amenity effects of upzoning may have spillover effects on surrounding parcels or areas, the option value channel primarily revolves around the direct increase in the buildable area of the upzoned parcel itself. Consequently, the option value of redevelopment is not expected to spill over to non-upzoned parcels. Second, the supply and amenity effects will change both housing prices and rents of existing properties, while the option value of redevelopment is captured in the implicit market value or sales prices but not in the short-term spot rents of existing properties.[3]

Through the different mechanisms mentioned above, upzoning will not only affect local housing prices and rents but may also change the migration patterns of incumbent residents and in-migrants, and eventually shift the socio-demographic composition of local residents. If increased option values of redevelopment and positive amenity effects outweigh the supply effect, housing costs will rise and lower-income incumbent renters may find it more difficult to stay and instead opt for lower-cost neighborhoods. During this process, developers may also choose to redevelop the buildings, directly displacing the tenants occupying those housing units. Homeowners may move out if they sell their homes to cash in on appreciating home values or have difficulty keeping up with increasing property taxes. By contrast, if the supply effect prevails, increased housing supply will lower local housing prices and rents (Asquith et al., 2021; Li, 2021). This would potentially lower displacement risks among renters and make it easier for them to stay in the neighborhood (Pennington, 2021). In terms of in-migration, positive amenities such as new buildings or businesses could attract higher-income households to the upzoned neighborhood.

3. Data and Summary Statistics

To study the impact of upzoning on the local housing market and migration patterns, this paper assembles publicly available and proprietary datasets from various sources to create a parcel-level

[3] In the hedonic model in Clapp et al. (2013), implicit market prices of residential properties measure the value of rents from existing property characteristics and option value to tear down and replace the existing property.

panel dataset tracking zoning changes, housing permits, housing prices, and migration patterns into and out of the neighborhood over time.

3.1 Zoning, Land-Use, and Housing Supply

I use the zoning amendment map from the New York City Department of City Planning (DCP) to identify the areas rezoned between 2004 and 2013.[4] The map contains the exact geographic boundary and adopted date for each rezoning district.[5] As the focus of this paper is to understand how large-scale, government-initiated upzoning affects local housing supply and demand, I merge the rezoning map with the New York City Zoning Application Portal data to identify rezonings initiated by DCP and exclude those proposed by developers. I then spatially merge the map with the 2002-2018 Primary Land Use Tax Lot Output (PLUTO) data, a publicly available dataset with parcel-level information such as lot area, zoning district, and maximum allowable floor area ratio (FAR). PLUTO also includes building characteristics such as building age, number of stories, and residential units. To measure the change in housing supply, I utilize the total number of residential units obtained from PLUTO.[6]

While this combined dataset incorporates comprehensive information on rezoning districts, including qualitative details on the goals of rezoning and existing neighborhood character, as well as changes in zoning code and maximum FAR, it does not provide a clear classification of rezoning districts into specific categories such as upzoning, contextual rezoning, or downzoning. Also, changes in zoning code can vary within a rezoning district, with different parts of the rezoning district experiencing different changes. For example, some parcels may transition from R5 to R5B, while others within the same rezoning district may change from R6 to R7D, resulting in different levels of changes in allowable buildable area. That being said, the city has a comprehensive planning goal for each rezoning district and upzoning typically aims to promote more intensive residential use in the designated area.[7] To identify the upzoning districts that experience notable

[4] The sample period is selected to allow observation of the pre-trend in the analysis since the land-use data, PLUTO, is only available since 2002.
[5] In this paper, rezoning districts or rezonings refer to zoning map amendments or selected city-initiated text amendments to the Zoning Resolution that have discrete geographical boundaries obtained from https://www1.nyc.gov/site/planning/data-maps/open-data/dwn-gis-zoning.page#metadata. They are also available in New York City's Zoning and Land Use Map (ZoLa) in https://www.nyc.gov/site/planning/data-maps/zola.page.
[6] The 2000-2018 building permit data on demolition, new building, or alteration permits is from the New York City Department of Buildings.
[7] Documents that provide overview and planning goal of each city-initiated rezoning can be found here: https://www.nyc.gov/site/planning/plans/borough.page

increases in allowed residential capacity overall, I use lot area and the lot's maximum residential floor area ratio (FAR) to calculate the allowable buildable residential area for each lot. FAR is the measurement of a building's gross floor area in relation to the size of the lot that the building is located on, and the maximum FAR regulates the total buildable area allowed.[8] While other restrictions may apply, the maximum FAR is the primary determinant development size (Armstrong et al., 2010).[9]

After calculating the buildable area allowed at the lot level, I aggregate the number to determine the total residential capacity allowed in each rezoning district. Since PLUTO provides data on a yearly basis, I can calculate the change in total residential capacity after the rezoned date. To focus on large-scale upzonings that involve notable changes in development capacity and have the potential to change neighborhood characteristics, I define a rezoning district as an upzoning if the aggregate residential capacity allowed in the entire district increases by 20 percent or more. I also conduct robustness analysis using different thresholds (e.g., 10 percent). As changes in zoning code can vary within the rezoning district, upzonings defined this way may have some groups of parcels with larger increases in FAR but may also have small pockets within the district experiencing no change or even slight decreases in FAR.[10] Setting a threshold for the overall increase in allowed residential capacity helps to focus on neighborhoods that experience larger-scale changes. However, one may still be concerned that it does not reflect the lot-level change in buildable areas across the entire rezoning district. To validate my definition of upzoning, I compare the lot-level residential capacity in the upzoned area and the surrounding area located up to 1000 feet away outside the upzoned boundary before and after upzoning. Figure 1 shows that the lots

[8] For example, a building on a 10,000 square foot lot that is in a zoning district with a maximum FAR of 1.5 would be allowed to have 15,000 square feet of buildable area (1.5 x 10,000). Depending on other restrictions such as height limit and type of property allowed, a developer can choose to build a one-story building with 15,000 square feet, or a three-story building with 5,000 square feet on each floor.

[9] This paper uses maximum allowable residential FAR and lot area to estimate the on-paper residential development capacity of a parcel, but the Zoning Resolution also use other regulations, such as height limits, front, side, and rear yard requirements, to regulate the shape and placement of buildings on the parcel. While other regulations exist, maximum FAR is the primary factor that limits the total size of a new building.

[10] On the other hand, there are some "hybrid" contextual rezoning districts where some lots located in the district are rezoned to have increased buildable area allowed, but they would not be classified as upzoning in my analysis if the aggregate residential capacity across the whole district does not increase above the threshold after rezoning.

within the upzoned boundary experience significant increases in allowed residential capacity compared to the immediate surrounding area outside the upzoned boundary.[11]

Table 1 and Figure 2 show the 22 upzoning districts (or upzoned areas)[12] across New York City rezoned between 2004 and 2013 in my sample. It includes upzonings in West Chelsea, Greenpoint-Williamsburg, and Long Island City, which have transformed underused industrial areas into neighborhoods full of high-rise buildings. It also includes other upzonings in the South Bronx as well as the Jamaica Plan in Queens.[13] Table 2 shows the building characteristics of parcels in upzoning districts prior to upzoning: they are more likely to be mixed-use buildings, warehouses, factories and industrial buildings, or garages. They are also more likely to fall under the "other" category, which includes commercial, office, and other facilities.

Panel A in Table 3 shows the summary statistics of the characteristics of parcels and buildings in the upzoned areas (column 2) and the 1000-feet ring areas outside the upzoned boundary (column 1) before upzoning. The parcels in upzoned areas have lower maximum FAR allowed and significantly lower residential capacity compared to the 1000-feet ring prior to upzoning. Because of the difference in maximum FAR allowed, the treatment area also has lower built FAR and residential area.[14] The gap between the buildable area allowed and the residential area in both the treatment and control groups indicates that neither is fully developed to reach its maximum residential capacity potentially due to other market frictions. The buildings in the 1000-feet rings are also slightly older and taller and have more residential units than those in the upzoned areas.

3.2 Housing Prices

I use the 2000-2019 housing sales data for residential properties from the NYC Department of Finance (DOF) and Automated City Register Information System (ACRIS). The Real Property Assessment Dataset (RPAD) from the DOF provides additional building characteristics such as building class, year built, and number of residential units. These variables are merged to the sales

[11] Appendix Figure B.1 shows the histogram of lot-level change in allowed residential capacity in upzoning districts after upzoning.
[12] "Upzoning districts", "upzonings", and "upzoned areas" are used interchangeably in this paper.
[13] Appendix Figure B.2 shows another map created by the New York City government in the strategic city planning report that lays out the rezonings from 2002 to 2011.
[14] Built FAR is the measurement of an existing building's gross floor area relative to the size of the lot that the building is located on, and maximum FAR is the zoning regulation on the largest FAR allowed on a lot.

data to control for building characteristics when estimating the effect of upzoning on housing prices.

3.3 In- and Out-Migration

To study the effect of upzoning on residential mobility patterns into and out of the neighborhood, I use a unique dataset that contains individual-level residential address history of adults living in the United States. Infutor Data Solutions compiles data from various sources, such as credit bureau data, cell phone plans, property deeds, and voter files. Asquith et al. (2021), Diamond et al. (2019), Pennington (2021), and Qian and Tan (2021) use the data in different contexts to study the migration patterns of individuals in response to changes in housing policy, new building construction, or firm entry. Phillips (2020) also shows that the dataset can be used to track mobility patterns of vulnerable populations with unstable housing situations, such as movements following public housing demolitions and evictions from private rental housing. By spatially merging the address data from Infutor and the zoning amendment maps, I can identify the in-migrants and incumbent residents in the upzoned areas and the surrounding areas.

The Infutor data closely matches the adult population aged over 25 years old at the tract level in the census, and the coverage is similar across census tract characteristics (Phillips, 2020; Diamond et al., 2019). In the analysis, I include all individuals aged 25 to 65 years old. Though the annual migration rate in the Infutor data is overall lower than the Census estimates, the rate appears to be uncorrelated with county characteristics (Asquith et al., 2021).[15] To test for pre-treatment balance, Panel B in Table 3 shows the demographic characteristics and the migration rate of the incumbent residents living in the treatment and control areas five years before upzoning. The annual mobility rate is 3.8 percent for those living in the treatment area and 4.1 percent for those in the control area. About 1.4 and 1.6 percent of the incumbent residents living in these areas leave New York City every year before upzoning.

To impute homeownership status, I assign individuals living in single-family homes, condos, and co-ops as homeowners. This could potentially undercount renters because owners of these properties could rent them out to other tenants. I assign those living in rental buildings with five units or more as renters. For those living in properties with 2-4 residential units, I randomly assign

[15] Asquith et al. (2021) find that the annual migration rate is 5.4 percent, which is lower than the 9.8 percent in the 2018 Current Population Survey.

them as renters or owners as it is more difficult to determine their homeownership status. Appendix Figure A.1 shows the validation results by comparing the homeownership rate at the census tract level with the homeownership rate from the 2015-2019 American Community Survey.

In addition to the address history, the Infutor data also has demographic information such as gender, birth year, and individual names. I apply the Bayesian Improved First Name Surname Geocoding (BIFSG) method and use the individual names and the census tracts of the individual's address history to extrapolate their race/ethnicity (Voicu, 2018). Using this method, I impute the race/ethnicity of 71 percent of the individuals in my analysis sample. Appendix A.2 provides full details of the imputation method and data validation. I then examine whether and how the mobility patterns of different imputed racial groups and homeownership status are affected in the upzoned areas. I use median household income of the census tract from the 2000 Census and 2005-2018 American Community Survey data to proxy the neighborhood quality that individuals move from and to. By doing this, I can examine whether incumbent residents are more likely to be displaced to lower-income or lower-quality neighborhoods. Since I cannot directly observe individual-level household income or wage, I use median household income of the original census tracts where in-migrant move from as a proxy for individual-level household income to study whether upzoning changes the socioeconomic composition of in-migrants.

4. Research Design

Since the upzoned locations can be endogenously selected, comparing upzoned areas and non-upzoned areas in the city can lead to biased estimates of the effect. Rezonings initiated by the New York City government usually have a strong land-use rationale. For instance, the rezonings during the Bloomberg administration focused on upzoning transit-friendly areas and underused manufacturing sites and waterfronts to increase residential capacity and prepare for potential growth for the city. By exploiting the granularity of the data at the parcel and building level, I use a “ring” difference-in-difference method to compare the treatment area that are upzoned and the immediate surrounding area up to 1000 feet outside the upzoned boundary before and after the city government rezones the area.[16] While there are baseline differences in average building and parcel characteristics, the upzoned area and the control area within a close proximity to the boundary should exhibit similar expected trends in housing market conditions and mobility patterns. The key identification assumption is that the outcomes of interest in these areas would have trended in parallel in the absence of upzoning. Figure 3 illustrates an example of the treatment and control areas.

To study the effect of upzoning on local housing supply and prices, I estimate the following equation:

$$Y_{it} = \alpha_{c(i)} + \theta_{p(i)} + \delta_{s(i)t} + \sum_{k=-3}^{7} [\beta_k * \mathbb{1}_{it} (t - t^* = k, r = 1)] + \gamma X'_{it} + \epsilon_{it} \tag{1}$$

I use an event-study specification to examine the parallel pre-trend assumption and to study how the outcomes of interest change over time in the upzoned area relative to the control area after upzoning. The outcome *Y* is the number of residential units on a parcel *i* or the sales price per unit for existing residential property *i* at year *t*. The indicator variable in the summatory interacts event year dummies *k* with the dummy variable indicating the treatment status *r* of the parcel. *t** is the year when upzoning is effective in the area where the parcel is located. The key coefficients of interest β_k denotes the effect of upzoning in the treatment area with respect to the control area over time.

In all the models, I use time fixed effects δ_{st} at the sub-borough area (SBA) by year level to adjust for local time-varying shocks.[17] In the analysis on housing prices, I also control for time-varying building characteristics X'_{it} such as building age, building size in terms of gross square feet, building class, lot area, and whether the lot is a corner lot to account for changes in the composition of sales over time. Finally, I include census tract fixed effects α_c and upzoning district fixed effect $\theta_p$to control for baseline differences in housing supply and prices across census tracts

[16] To ensure that the parcels in control group are clean controls, I remove parcels from the control group if they are located in any other rezonings during the sample period, regardless of whether the rezonings are initiated by the city or the private developers, or whether they are upzoning, downzoning, or contextual-rezoning.
[17] The United States Census Bureau divides New York City into 55 sub-borough areas (SBA).

and upzoning districts. Standard errors are clustered at the upzoning district level to account for spatial correlation within the upzoned area.[18]

To estimate the effect on out-migration among incumbent residents, I restrict the sample to individuals who lived in the treatment or control areas five years before upzoning. I estimate Equation (1) but switch to person-level data and use the following outcome variables: 1) whether the individual moves away from the original address; 2) whether the person moves to a different neighborhood (proxied by census tract); and 3) whether the person moves to a different metropolitan area as defined by Core-Based Statistical Area (CBSA) up to seven years after upzoning. In the analysis of out-migration, I control for building characteristics such as building size and building age and individual characteristics such as imputed race and homeownership status. I also include census tract, upzoning district, and sub-borough area by year fixed effects.[19] To examine whether the movers are more likely to end up in lower-income neighborhoods after upzoning, I further restrict the sample to incumbent residents who move and use the log median household income of the destination census tract as the outcome variable.

Finally, I estimate how the characteristics of in-migrants change and whether they are more likely to come from higher-income areas after upzoning. This is to examine whether the neighborhoods have become more attractive to higher-income individuals. Since I do not directly observe individual income in the Infutor data, I use the median tract income of the in-migrants' previous residential location to proxy for their income level. The sample is restricted to people who move into the treatment or control areas during the sample period. All of the census tract, upzoning district, and sub-borough area by year fixed effects are also included.

The main specification uses the immediate surrounding area up to 1000 feet outside the upzoned boundary as the control group and compares it to the upzoned (treatment) area. To further isolate and identify the effect through option values in the analysis on housing prices, I take a boundary discontinuity approach and restrict the sample of analysis to existing buildings in a smaller band (500 feet) right inside and outside the upzoned boundary. The underlying assumption is that within an even narrower band on the opposite side of the boundary, there should be no

[18] I also cluster standard errors at the tract level and the results are very similar to clustering at the upzoning district level.

[19] After the first period that the individual moves away from the original address in the treatment or control areas, I remove them from the analysis sample. Therefore, the coefficient in each period is interpreted as the average change in move-out rate in that period compared to the year before upzoning rather than the cumulative change over time.

difference in localized supply and amenity effects after upzoning, and the primary factor contributing to disparities in housing prices would be the increased option values of redevelopment.

Considering the possibility of supply and amenity effects spilling over the upzoned boundary into the control area, I also construct multiple rings at different distances from the boundary to study the extent of spillover effects (see Section 6). The robustness analysis shows small degrees of spillover effects in the control area but they are not statistically significant in most cases. Therefore, the main results of comparing the upzoned area and the 1000-feet ring could represent the lower or higher bound of the local effect of upzoning.

5. Results

5.1 Effect of Upzoning on Local Housing Supply

To examine how housing supply changes after upzoning, I estimate Equation (1) using the log of the number of residential units on each lot as the outcome. The results in Figure 4and Table 4 (column 1) show a significant increase in housing units by 4 percent in the upzoned area compared to the control area seven years after upzoning. There is no pre-trend prior to upzoning, and the effect only becomes positive and statistically significant two to three years after upzoning. The delay in the positive effect reflects that it can take several years to start the building permitting process and finish construction. The gradual and continuous increase in housing supply also potentially suggests different paces for developers to respond to the zoning change, different construction times, or a persistent effect on local housing development.

The above analysis estimates the overall treatment effect of neighborhood-level upzoning on parcel-level housing supply. However, changes in zoning code and residential capacity allowed on the parcel may vary within the upzoning district. Therefore, I separate the treated parcels located in the upzoned or treatment area into three groups to proxy treatment intensity at the parcel level: 1) parcels that have no increase in residential capacity; 2) parcels that experience increase in residential capacity up to 50 percent; and 3) parcels that experience residential capacity increase of greater than 50 percent. As shown in column 2 in Table 4, the increase in housing supply in the upzoned area, as measured by the total number of residential units from the tax lot data PLUTO, is driven by parcels that experience greater increases in residential capacity. Four to seven years after upzoning, total residential units increase by 2.6 percent on parcels with moderate treatment intensity and 7.9 percent on parcels with the strongest treatment intensity. On the other hand, residential units do not increase on parcels in the treatment area with no increase in residential capacity, potentially because the buildings on these parcels have already reached the maximum allowable FAR, or if existing frictions on redeveloping the property persist.[20]

5.2 Effect of Upzoning on Local Housing Prices

I estimate the local effect of upzoning on sales prices per unit for different types of residential properties using Equation (1) and control for a series of property and parcel characteristics, including building size in square feet, building age, building age squared, number of stories, building class, lot area, and whether the lot is a corner lot. I include only properties built before 2004, the earliest year of upzoning in my sample. This is because newly built properties may have different characteristics from the older buildings that are not controlled in the hedonic regression. If I include newly built buildings, the change in housing prices can be driven by the difference in the composition of the properties.[21] I include up to four years of pre-periods since the analysis sample focuses on upzoned areas rezoned between 2004 and 2013 but the sales data is only available starting 2000. Finally, I pool every two years in the analysis due to the smaller sample size of housing sales in the sample.[22]

Figure 5A shows a null effect of upzoning on local housing prices in the upzoned area. There are several channels through which upzoning can affect housing prices in the short and long term, as it can remove the disamenity of abandoned land or manufacturing sites as well as create positive amenities as more businesses and higher-income individuals are attracted to the neighborhood. Increasing the allowable density on a parcel can also increase the option values of redevelopment and thus the land value. On the other hand, I find in the previous analysis that there is an increase in housing supply after upzoning, which would decrease housing prices through the supply effect.

[20] Within three years after upzoning, the mean of difference in maximum allowable and built FAR (potentially indicating how much more residential capacity can be added if redeveloping the existing property on the parcel) on these parcels is 0.21 while that number is 1.0 for parcels with moderate increase in capacity and 1.9 for parcels with substantial increase in capacity.

[21] The robustness check analysis incorporating all new and older buildings shows similar results (Appendix Figure C.1).

[22] The total observation number for the full sample analysis is 28,314. The full table for Figure 5 can be found in Appendix Table D.1.

Construction of new buildings can also create a disamenity effect on the immediate surrounding properties during the construction period. Even more, high-rise buildings may be a disamenity for the properties in lower-density neighborhoods dominated by smaller properties. The results shown in Figure 5A may be the result of several different channels.

To explore heterogeneity within the treatment area, I divide the parcels in the treatment area into two groups based on whether the parcel effectively experiences an increase in residential development capacity after upzoning.[23] According to Figure 5B, the housing price per unit for existing buildings on treatment parcels with de facto increase in allowed capacity shows an increase by about 7.6 percent compared to comparable properties in the control area after upzoning. However, for existing buildings in the treatment area with no increase in residential capacity, the sales price per unit did not exhibit such a price increase. Assuming that both types of parcels in the treatment area are subject to similar supply and amenity effects, the primary distinction between these parcels after upzoning lies in whether they are effectively upzoned and experience a change in the option value of redevelopment. On the other hand, the null (or slightly negative) effect observed in the other parcels without an increase in buildable areas could be attributed to countervailing forces of the positive amenity effect and the supply effect.

To further isolate and identify the effect through option value, I restrict the sample of analysis to existing buildings in a smaller band (500 feet) right inside and outside the upzoned boundary. Consistent with the earlier finding, Figure 6 illustrates a positive effect, with an 8 percent increase in housing prices for existing properties on parcels that are effectively upzoned, in comparison to the control parcels following upzoning. This rise in prices is primarily driven by the increased option values, as parcels in close proximity to the upzoned boundary should experience similar supply and amenity effects. This finding is also consistent with Freemark (2020), who finds an increase in property transaction prices on parcels that received a boost in allowed building size after upzoning in Chicago. Clapp et al. (2013) also show that for homes with high development potential, 40 percent of the price increases during the boom years after the fall of the Berlin Wall were related to increased option value.

[23] In this part of the analysis, I group treated parcels with moderate (<=50%) and substantial (>50%) increase in residential capacity into one group because of the limited sample size in the housing transactions data.

Figure 5C uses the original sample in the main analysis and further shows that the positive effect on sales prices from Figure 5B is driven by properties located in the central city, as defined by the distance to the Empire State Building.[24] This could be attributed to the higher demand for properties in central locations, where the increased buildable areas after upzoning generates greater potential for redevelopment value. Been et al. (2016) also find that the designation of historic districts, which enhances the aesthetic value of the neighborhood but prohibits demolitions and redevelopment of existing properties in the designated area, has differential impacts on property values in central and non-central locations in New York City due to option values. Leather (2023) also uses rezoning in New York City as the context and estimates that the average option values of redevelopment account for 20 percent of the total estimated property values in Manhattan (more centrally located) and 8.5 percent in Brooklyn.

Overall, the above results provide suggestive evidence that following upzoning, property values increase among parcels that receive a boost in allowed building size due to increased option values of redevelopment. However, the overall price effect is null if including all types of parcels in the upzoned area. It is also worth pointing out that the price effect is relative to the price changes in the control area, which is the 1000-feet (or 500-feet) surrounding area outside the upzoned boundary. Therefore, any observed effect is the effect on the hyper-local housing market.[25] In Section 6, I explore the extent of spillover effects on prices in the broader neighborhood by exploiting different distances to the upzoned boundary.[26]

Finally, I do not directly estimate the effect on rents because of data limitations, and the effect on rents may differ from the effect on local housing prices. The housing price captures the discounted value of the long-term future rent, while rent represents the short-term spot market. There may also be market segmentation between the rental and owner-occupied housing market that leads to different effects on rents versus housing prices.

[24] I define a parcel as centrally located if it is located in a census tract whose distance to the Empire State Building is within 11.58 miles (the median distance to the Empire State Building of census tracts in New York City).
[25] Section 6 provides analysis examining the spillover effect by constructing multiple rings at different distances from the boundary.
[26] The spillover price effect can only come from the supply effect or the amenity effect, since option values of redevelopment will only change for the parcels that de facto experience increase in buildable area or residential capacity.

5.3 Effect of Upzoning on Out-Migration of Incumbent Residents

5.3.1 Overall Out-Migration Effect

To answer the question of whether incumbent residents living in the upzoned area are more likely to move or leave New York City after upzoning, I switch to person-level data with address histories from the Infutor data. I restrict the sample to people who already lived in the upzoned area five years before upzoning to capture the effect on incumbent residents. Figure 7 shows the coefficients plots of the estimated results from Equation (1). In Panel A of Figure 7, we see no pre-trends in the probability of moving leading up to the treatment year. After upzoning, incumbent residents in the treatment area are significantly more likely to move than those in the control area. The effect on out-migration remains persistent for up to seven years after upzoning. To interpret the coefficients, I pool the estimated results into the short-run effect of 0-3 years and long-run effect of 4-7 years after upzoning. Panel A in Table 5 shows that in both the short and long term, individuals living in the upzoned areas before upzoning are 0.3 percentage points more likely to move. Relative to the baseline mean of 3.8 percent, this reflects a 7.9 percent increase in the probability of moving. On average, there are 113,062 incumbent residents living in upzoned areas prior to upzoning. This suggests that around 339 (113,062*0.038*0.079) more incumbent residents move out of their buildings in all upzoning districts in New York City every year after upzoning.

I also explore the type of moves by examining how far people have moved from their initial residence (Figure 7 Panel B). If individuals leave the original neighborhood, they could lose access to hyper-local social capital, networks, and amenities. I proxy neighborhoods using census tracts and find that individuals are 0.3 percentage points (8.2 percent increase relative to pre-treatment mobility rate of 3.62 percent) more likely to move out of the original neighborhood after upzoning. This suggests that upzoning can lead to changes in the composition of local residents in the upzoned neighborhood (Table 5 column 2). Finally, I find that upzoning increases the probability of moving to a different metropolitan area by 0.1 percentage point (12.6 percent increase relative to the pre-treatment mobility rate) among incumbent residents (Table 5 column 4). Such long-distance moves could be more likely to lead to loss of local ties, and they involve higher moving costs and a change in the labor and housing market that could require more time and resources to adjust to.

Out-migration could particularly harm incumbent welfare if movers end up in lower-quality neighborhoods with poor access to employment or worse economic and educational opportunities for children in the household. Even though the above analysis finds that individuals are more likely to move, we do not know whether they end up in worse neighborhoods. I use the median household income of the census tract as a proxy for neighborhood quality and estimate whether incumbent residents in the upzoned area move to lower-income tracts after upzoning. In this part of the analysis, I restrict the sample to those who move. Figure 8 shows that movers from the upzoned area do not end up in lower-income tracts compared to those from the control area. The coefficients are positive with small magnitudes and are not statistically significant (Table 5 column 5). Though incumbent movers are not more likely to end up in lower-income neighborhoods, out-migration could still lead to welfare loss if incumbent residents have strong idiosyncratic preferences for their origin neighborhoods or if moving costs are high (Brummet and Reed, 2021).

5.3.2 Heterogeneity by Individual Demographics and Housing Tenures

I conduct the same analysis to examine heterogeneity using the imputed homeownership status. Panel B and C in Table 5 show the short-term and long-term effects of out-migration and neighborhood quality of movers by housing tenure of their initial address. Within the first three years after upzoning, incumbent renters living in the upzoned area are 0.3 percentage points more likely to move away from the initial address or leave the original neighborhood than renters in the control area. In the long term, the probability of moving to a different address or leaving the neighborhood increases by 0.5 percentage points, and the probability of leaving New York City increases by 0.2 percentage points among the incumbent renters. However, they are not more likely to move to a different metropolitan area (or CBSA). Renters may move out of the neighborhood because upzoning changes the local amenities and improves neighborhood quality, hence increasing rents. As upzoning increases the redevelopment values of existing properties built below the new cap on residential capacity under the newly adopted zoning regulations, property owners could be more likely to demolish and redevelop the buildings. This would also force incumbent residents in these buildings to move. I explore potential mechanisms later in this section.

Among homeowners, the coefficient of the probability of moving to a different address or a different neighborhood is not statistically significant. However, there seem to be some spatial substitutions in the moving patterns as the probability of moving within New York City decreases while the probability of moving out of New York City increases by 0.2 percentage points among incumbent homeowners. In the long term, the probability of moving to a different metropolitan area increases slightly by 0.1 percentage points. It is less clear how to interpret the increase in mobility among homeowners. If property values increase after upzoning due to improvement in local amenities or increase option values, homeowners may opt to sell and cash in, or they may have trouble keeping up with the increasing property taxes. They may also dislike increases in density in the neighborhood after upzoning. Brummet and Reed (2021) also find an increase in out-migration among homeowners in gentrifying neighborhoods. Finally, neither incumbent homeowners nor renters are more likely to move to higher- or lower-income tracts.

I also examine heterogeneity by imputed race to study whether out-migration outcomes vary for different racial groups. Figure 9 shows that non-Hispanic white incumbent residents in the upzoned area are 0.3 percentage points more likely to move to a different census tract than the equivalent white movers in the control area in the short term (0-3 years) after upzoning. Non-Hispanic Black incumbent residents in the upzoned area are 0.2 percentage points more likely to move to a different tract than Black residents in the control area in the long term (4-7 years) after upzoning. Hispanic incumbent residents are also more likely to move to a different neighborhood while Asian Americans and Pacific Islanders (AAPI) are less likely to move after upzoning in the long term, but the coefficients are not statistically significant. In terms of the destination neighborhood characteristics among movers, non-Hispanic white movers from the upzoned area are more likely to relocate to slightly higher income tracts (3 to 5 percent higher) compared to the equivalent group who move from the control group in the long term.

5.3.3 Heterogeneity by Neighborhood Characteristics

To understand whether upzoned areas with different characteristics experience different effects on out-migration, I break down the upzoned neighborhoods into four different types of neighborhoods depending on whether they are centrally located and whether they are high-income neighborhoods prior to upzoning.[27] As show in Table 6, the effect on out-migration of incumbent residents is mainly driven by centrally located neighborhoods (columns 1 and 2), while there is no statistically significant effect on neighborhoods that are located further away (columns 3 and 4). Among the centrally located upzoned areas, the average short-term effect (0-3 years after upzoning) is stronger for middle and lower-income neighborhoods, while the average long-term effect (4-7 years) is similar in both types of neighborhoods.

5.3.4 Heterogeneity by Type of Parcels

I try to examine the mechanisms for out-migration by breaking down the parcels in the treatment area into two types of parcels: ones that receive any demolition, new building, or alteration permits and ones that never receive these permits after upzoning during the sample period. Panel A in Table 7 shows that incumbent residents living in buildings on parcels that receive such permits are 0.4 percentage points more likely to move out of the building or leave the neighborhood after upzoning. Following the housing supply and property values analysis, I also examine the treatment effect of different treatment intensity based on the parcel-level change in residential development capacity. As shown in Panel B in Table 7, I find that incumbent residents living on parcels with substantially increased residential capacity (>50%) are more likely to move, potentially because these parcels are more likely to be redeveloped and altered later.[28] Those living on parcels with a moderate increase in capacity (<=50%) are also more likely to move and the magnitude of coefficient is only slightly smaller. On the other hand, incumbent residents living on parcels in the treatment area not experiencing increase in residential capacity or receiving any demolition, new building, or alteration permits are not more likely to move after upzoning. These findings suggest that incumbent residents could be moving out because of demolitions and redevelopment of existing buildings, and also because landlords renovate or alter the buildings to raise rents.

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[27] Furman Center (2016) categorizes the New York City neighborhoods into high-income, gentrifying, and non-gentrifying areas based on their 1990 median income and rents growth during 1990–2014. Tracts in the top 60th percentile of the 1990 neighborhood income distribution are defined as high-income. I combine the gentrifying and non-gentrifying neighborhoods into "middle and lower-income" neighborhoods due to smaller sample size of these two groups. As discussed earlier, a census tract is defined as centrally located if it is located within 11.58 miles to the Empire State Building (the median distance to the Empire State Building of census tracts in New York City).

[28] On average, 47 percent of parcels in the treatment area that receive substantial boost (>50%) in residential capacity receive any demolition, new building, or alteration permit after upzoning. That number is 32 percent for parcels that experience moderate increase in residential capacity, and 25 percent for parcels located in upzoning districts but do not experience increases in residential capacity.

Finally, I examine whether the upzoning effect on mobility rates differ for those living in rent-stabilized buildings and those in non-stabilized buildings in the treatment area. Panel C in Table 7 shows that following upzoning, incumbent residents living in rent-stabilized buildings in the treatment area are no less likely to move out the buildings or the census tract compared to those in non-stabilized buildings in the upzoned area.

5.4 Effect of Upzoning on In-Migration

I next examine whether in-migrants are more likely to come from higher-income neighborhoods after upzoning. Results from Figure 10 provide evidence that new migrants moving into the treatment area come from neighborhoods with slightly higher median household income. At years six and seven after upzoning, in-migrants come from 5 percent higher-income tracts. Table 8 collapses the effect in the short term (0-3 years) and the long term (4-7 years). While in-migrants come from 2.8 percent higher-income tracts on average in the long term, the effect is marginally statistically significant.[29] I also examine other characteristics of in-migrants and do not find strong evidence of upzoning attracting in-migrants from outside the city (column 2 of Table 8). Therefore, it is likely that higher-income in-migrants move into upzoned areas from elsewhere in New York City, which would open up other housing stocks and relieve rents and housing prices in other places in the city.

6. Robustness of Results

6.1 Spatial Spillover Effect

The empirical strategy for the main results compares the upzoned areas and the adjacent areas (within 1000 feet) outside the upzoned boundary. While there is no strong pre-trend leading up to the upzoning year, one may be concerned about potential spatial spillover effects over the boundary. For example, developers can also build more housing units in the parcels built under the existing constraint in the 1000-feet ring area even if the control area is not upzoned. They may do so because they expect the demand for the neighborhood to increase after upzoning. It is also possible that amenity and supply effects on prices spill over the upzoned boundary. To examine the extent of spatial spillovers outside the boundary, I construct multiple rings from the upzoned

[29] P-value is 0.112.

boundary (0-1000 feet, 1000-2000 feet, and 2000-3000 feet) and uses the outer ring furthest away from the upzoned area (2000-3000 feet) as the control group. This alternative approach assumes that proximity to the upzoned boundary determines treatment intensity, and the underlying assumption is that all rings share similar expected trends in housing market conditions. By switching the control group to the outer ring, I can examine the effects of upzoning in both the upzoned areas (treatment in the main results) and the potential spatial spillover effect in the inner ring (0-1000 feet) and the middle ring (1000-2000 feet). Similar to the original estimated equation, I also control for parcel and building characteristics, local varying time trend, and census tract fixed effect. I estimate the following equation:

$$Y_{it} = \alpha_{c(i)} + \theta_{p(i)} + \delta_{s(i)t} + \sum_{k=-3}^{7} \sum_{r \in R} \beta_{k,r} * \mathbb{1}_{it} \, (t - t^* = k, r = r) + \gamma X'_{it} + \epsilon_{it} \tag{2}$$

Appendix Figure C.2 shows the effect of upzoning in the upzoned area (original treatment area), the inner ring (0-1000 feet), and the middle ring (1000-2000 feet) compared to the outer ring (2000-3000 feet). The upzoned area experiences persistent increases in residential units in the long term as before. While residential units in the inner ring (0-1000 feet) increase slightly, the magnitude is relatively small compared to the effect in the treatment area, and is not statistically significant at the 95 percent level. This indicates that there is positive but limited spillover effect on housing supply in the surrounding area of the upzoned areas after upzoning, and using the inner ring as the control area in the main specification can be considered the lower bound of the upzoning effect.

In terms of the spillover effect on housing prices, I also break down the parcels in the upzoning district or treatment area into parcels that de facto experience an increase in residential capacity allowed and those that do not. Appendix Figure C.3 plots the coefficients of the effect on parcels in the treatment area that do not experience increase in residential capacity allowed compared to the outer ring of 2000-3000 feet. It also shows the effect of upzoning on parcels in the treatment area that experience increase in allowed residential capacity compared to the outer ring of 2000-3000 feet. The equation also estimates the effect in the inner (0-1000 feet) and middle ring (1000-2000 feet) compared to the outer ting. The results show that the inner ring experiences a slight decrease in housing prices compared to the outer ring after upzoning, potentially due to supply or competition effect, but the effect is mostly not statistically significant.

6.2 Alternative Threshold for Defining Upzoning

In the main analysis, a rezoning district is defined as an upzoning if the aggregate allowed residential capacity in the district increases by 20 percent or more. Appendix Figures C.4 and C.5 show results on housing supply and prices using an alternative threshold of 10 percent to define upzoning. The results look similar to the main analysis, but the magnitude on housing supply is weaker.

7. Discussion and Conclusion

This paper shows that housing supply increases in upzoned areas in New York City after upzoning takes effect. There is suggestive evidence of increased housing prices among the buildings located on parcels that experience a boost in allowed residential capacity, particularly in high-demand areas, likely due to increased option or redevelopment values. Meanwhile, residential properties on parcels located inside upzoning districts but which do not experience an increase in allowed residential capacity do not have such an increase in housing prices. In terms of migration patterns, I find that incumbent residents living in upzoned areas, especially renters, are more likely to move to a different neighborhood after upzoning. The increased out-migration is driven by those living in buildings that are demolished, redeveloped, or altered after upzoning. However, incumbent residents moving after upzoning do not move to lower-income neighborhoods compared to out-migrants from the control area. That being said, out-migration could still cause welfare loss if incumbent residents have strong preferences for their origin neighborhoods or if moving costs are high. Finally, I find that in-migrants come from slightly higher-income neighborhoods after upzoning.

Overall, it is likely that while large-scale upzoning increases housing supply, the potential amenity and demand effects still attract in-migrants from higher-income areas and increase out-migration of incumbent residents. There are a few caveats to the findings of this paper. First of all, the empirical design compares the upzoned area to its adjacent area, capturing the hyper-local effect on the housing market rather than the general equilibrium effect on the broader New York

City market. Housing costs may potentially decrease in other areas of the city when overall housing stock increases. Second, this study examines the effect of large-scale, neighborhood-level upzonings, which involved substantial increases in residential capacity (20 percent or more). Some of these upzonings included investments in local infrastructure and the transformation of industrial or manufacturing sites into residential neighborhoods. Thus, the findings may be specific to cities with strong housing markets and areas that experience large-scale upzoning, and the impact may differ for other cities or municipalities if amenity and demand effects depend on local contexts. Future research should also consider other forms of rezoning, such as hybrid rezoning or downzoning. Lastly, it is possible that the boundaries of the rezoned areas were strategically drawn to align with anticipated development patterns and local market demand, although no apparent pre-trends are evident. If this is the case, the effect of upzoning reported in this study may be somewhat overstated.

Nevertheless, this paper provides evidence that upzoning that substantially increases residential capacity in a neighborhood can potentially change the mobility patterns and composition of local residents. While incumbent residents do not relocate to worse neighborhoods, local governments should also consider additional affordable housing policy instruments, such as inclusionary zoning or enhanced tenant protections, alongside relaxing land-use regulations, if retaining incumbent residents and preserving long-term income diversity is also the policy goal.

8. Tables

Table 1: List of Upzoning Districts in New York City (2004-2013)

Name	Year Rezoned
Downtown Brooklyn Development	2004
Hunters Point Subdistrict Rezoning	2004
Ladies Mile Rezoning	2004
East Flushing Rezoning	2005
Greenpoint-Williamsburg	2005
Hudson Yards	2005
Kew Gardens-Richmond Hill	2005
Port Morris/Bruckner Blvd Rezoning	2005
West Chelsea/High Line	2005
New Stapleton Waterfront Development	2006
Pelham Parkway/Indian Village Rezoning	2006
The Jamaica Plan	2007
125th St Corridor	2008
161St Street Rezoning	2009
Coney Island Comprehensive Plan	2009
Dumbo Rezoning	2009
Lower Concourse	2009
Special Forest Hills District	2009
North Tribeca Rezoning	2010
Third Ave-Tremont Ave Corridors	2010
West Clinton Rezoning	2011
East Fordham Road	2013

Note: The table shows the list of city-initiated upzoning districts rezoned between 2004 and 2013. A rezoning district is defined as an upzoning if the aggregate allowed residential capacity in the entire district increases by 20 percent or more after rezoning.

Table 2: Building Class Characteristics of Parcels before Upzoning

Building Class	Upzoning Districts	New York City
Residential	66.7%	81.7%
Residential/Mixed-Use	8.3%	4.2%
Warehouse/Industrial/Garage	10.2%	3.4%
Vacant	4.5%	5.1%
Other	10.3%	5.6%
Number of Parcels (unique)	*21,242*	*848,338*

Note: The table reports the building class characteristics of parcels in upzoning districts and all parcels in New York City in 2002 using PLUTO data.

Table 3: Summary Statistics before Upzoning

	Control (1000-feet adjacent area)	Treatment (Upzoned area)	Difference
	(1)	(2)	(3)
Panel A: Parcel and Building Characteristics			
Maximum FAR Allowed	1.755	1.375	0.678***
	(1.677)	(1.223)	(0.0108)
Built FAR	1.459	1.133	0.288***
	(1.855)	(1.260)	(0.0116)
Buildable Area Allowed / Residential Capacity (square feet)	12404.5	6473.7	7571.6***
	(106343.5)	(21249.9)	(420.4)
Residential Area (square feet)	7038.8	3078.9	3677.8***
	(44766.4)	(11421.9)	(183.3)
Building Age (year)	73.72	72.91	0.895***
	(26.58)	(23.38)	(0.152)
Number of Residential Units in Building	7.021	3.205	3.615***
	(42.00)	(13.13)	(0.178)
Number of Floors	2.834	2.384	0.550***
	(2.232)	(1.297)	(0.0133)
Number of Parcels (unique)	19,105	21,242	
Panel B: Individual Characteristics of Incumbent Residents			
Age	43.46	43.18	0.286***
	(13.16)	(12.68)	(0.0314)
Share of Homeowners (Imputed)	0.273	0.251	0.021***
	(0.445)	(0.434)	(0.001)
Years in current address	5.739	5.535	0.205***
	(5.271)	(5.027)	(0.01)
Migration: Move to a different building	0.0411	0.0382	0.003***
	(0.198)	(0.192)	(0.0004)
Migration: Move to a different tract	0.0390	0.0362	0.003***
	(0.194)	(0.187)	(0.0004)
Migration: Move out of NYC	0.0162	0.0143	0.002***
	(0.126)	(0.119)	(0.0002)
Number of Persons	197,784	113,062	

Note: Panel A in this table reports the summary statistics of parcel and building characteristics using the New York City Primary Land Use Tax Lot Output (PLUTO) data 1-3 years before upzoning, and Panel B reports the individual characteristics of incumbent residents in the Infutor data 1-4 years before upzoning. Column1 reports the mean of various parcel and building characteristics among those located within 1000 feet outside the upzoned boundary (control area), and it also shows the mean of different individual characteristics among incumbent residents living in control areas five years before upzoning. Column 2 shows the same parcel and individual characteristics for those in the upzoned or treatment area. Column 3 reports the differences between the column 1 and column 2. Numbers in parenthesis report the standard errors. Significance: * p<0.1, ** p<0.5, *** p<0.01

Table 4: Effect on Housing Supply

	(1)	(2)
	Log(Residential Units)	Log(Residential Units)
0 to 3 years*Treatment	0.012*	
	(0.006)	
4 to 7 years*Treatment	0.041**	
	(0.015)	
0 to 3 years*Treatment: No Increase in Residential Capacity		0.011
		(0.008)
0 to 3 years*Treatment: Moderate Increase in Residential Capacity (<=50%)		0.004
		(0.010)
0 to 3 years*Treatment: Substantial Increase in Residential Capacity (>50%)		0.017
		(0.011)
4 to 7 years*Treatment: No Increase in Residential Capacity		0.011
		(0.012)
4 to 7 years*Treatment: Moderate Increase in Residential Capacity (<=50%)		0.026**
		(0.011)
4 to 7 years*Treatment: Substantial Increase in Residential Capacity (>50%)		0.079**
		(0.035)
Observations	365,378	365,223

Note: Column 1 in this table shows the coefficients of a pooled version of Equation (1) by pooling post-upzoning periods into 0-3 years and 4-7 years after upzoning and using log of number of residential units as the outcome variable. The coefficients reflect the cumulative difference in residential units between the upzoned area and the control area (1000-feet area outside the upzoned boundary). Column 2 breaks down the parcels in treatment area into three groups of parcels: 1) Parcels that experience no increase in residential capacity; 2) Parcels that experience moderate increase in residential capacity (0-50%); and 3) Parcels that experience substantial increase in residential capacity (>50%). The coefficients reflect the change in residential units in these parcels relative to parcels in the control area. The baseline is 1-3 years before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effects, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level and reported in parentheses. Significance: * p<0.1, ** p<0.5, *** p<0.01

Table 5: Effect on Out-Migration

	(1)	(2)	(3)	(4)	(5)
	Any Move	Move Tract	Leave NYC	Move Metro	Log Median Tract Income among Movers
Panel A: All individuals					
0-3 years after * Treatment	0.003*	0.003**	0.002**	0.001*	0.004
	(0.001)	(0.001)	(0.001)	(0.000)	(0.011)
4-7 years after * Treatment	0.003***	0.003***	0.002***	0.001***	0.012
	(0.001)	(0.001)	(0.001)	(0.000)	(0.014)
N	2677288	2676226	2677068	2677068	97214
Panel B: Renters					
0-3 years after * Treatment	0.003*	0.003**	0.002	0.000	0.013
	(0.001)	(0.001)	(0.001)	(0.001)	(0.013)
4-7 years after * Treatment	0.005***	0.005***	0.002**	0.001	0.016
	(0.001)	(0.001)	(0.001)	(0.001)	(0.016)
N	1689376	1665335	1689983	1689983	61227
Panel C: Owners					
0-3 years after * Treatment	0.002	0.001	0.002**	0.001**	-0.012
	(0.001)	(0.001)	(0.001)	(0.001)	(0.012)
4-7 years after * Treatment	-0.0003	-0.0001	0.002**	0.001**	0.008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.022)
N	963390	963114	963336	963336	34874

Note: This table reports the coefficients estimating the difference in move-out rates between all incumbent residents (Panel A), renters (Panel B), and homeowners (Panel C) living in the upzoned area and the control area (1000-feet area outside the upzoned boundary). Column 1 shows the effect on moves out of the building. Column 2 shows the effect on moves out the census tract. Column 3 shows the effect on moves out of New York City. Column 4 shows the effect on moves out of the metropolitan area (CBSA). Column 5 reports the difference in median household income of destination census tracts between the incumbent residents who move from the upzoned area and the control area. The baseline period is 1-4 years before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other building and individual characteristics such as building age, imputed race, and years in the current address. Standard errors are clustered at the upzoning district level and reported in parentheses. Significance: * $p<0.1$, ** $p<0.5$, *** $p<0.01$

Table 6: Effect on Out-Migration, by Neighborhood Characteristics

	Dependent variable: Move Tract			
	(1)	(2)	(3)	(4)
Type of Neighborhood	Centrally Located + High-Income	Centrally Located + Not High-Income	Not Centrally Located + High-Income	Not Centrally Located + Not High-Income
0-3 years after* Treatment	0.003*	0.007***	0.002	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)
4-7 years after* Treatment	0.005*	0.005***	0.0016	0.003
	(0.002)	(0.001)	(0.0009)	(0.002)
N	551120	501373	1234800	388933

Note: This table shows the coefficients estimating the difference in the probability of moving to a different census tract between incumbent residents living in the upzoned area and those living in the control area (1000-feet area outside the upzoned boundary) after upzoning, broken down into four different types of neighborhoods based on whether they are centrally located in the city and whether they are high-income tracts prior to upzoning. Standard errors are clustered at the upzoning district level and reported in parentheses. Significance: * p<0.1, ** p<0.5, *** p<0.01

Table 7: Effect on Out-Migration, by Type of Parcel

	(1)	(2)
	Any Move	Move Tract
Panel A: By whether parcel receives new permit after upzoning		
Post Upzoning (0-7 years) * No new building, demolition, or alteration permit	0.001	0.001
	(0.001)	(0.001)
Post Upzoning (0-7 years) * New building, demolition, or alteration permit	0.004***	0.004***
	(0.001)	(0.001)
Panel B: By parcel-level change in residential capacity allowed		
Post Upzoning (0-7 years)* No Increase	0.001	0.001
	(0.001)	(0.001)
Post Upzoning (0-7 years)* Moderate Increase (<=50%)	0.003*	0.003**
	(0.001)	(0.001)
Post Upzoning (0-7 years)* Substantial Increase (>50%)	0.004***	0.004***
	(0.001)	(0.001)
Panel C: Buildings with rent-stabilized units		
Post Upzoning*Treatment*Buildings with rent-stabilized units	0.0009	0.0007
	(0.0015)	(0.0015)
N	2677288	2676226

Note: This table shows the coefficients estimating the difference in the probability of moving to a different building (column 1) and to a different census tract (column 2) between incumbent residents living in the upzoned area and those living in the control area (1000-feet area outside the upzoned boundary) after upzoning. Standard errors are clustered at the upzoning district level and reported in parentheses. Significance: * p<0.1, ** p<0.5, *** p<0.01

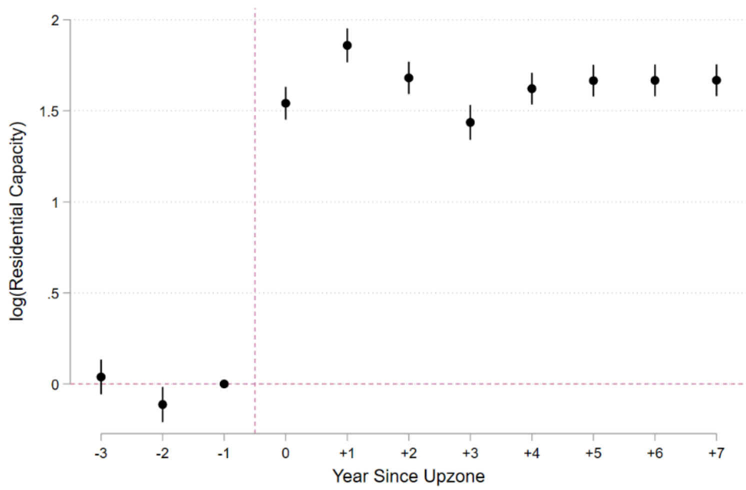
Table 8: Effect on In-Migration

	(1)	(2)
	Log (Origin Tract Income)	Not from NYC
0-3 years after*Treatment	0.020	-0.001
	(0.013)	(0.009)
4-8 years after*Treatment	0.028	-0.008
	(0.017)	(0.009)
N	156473	156473

Note: Table 8 reports the difference in the characteristics of in-migrants between those moving to the upzoned area and those moving to the control area (1000-feet area outside the upzoned boundary). Column 1 shows the difference in the median household income of origin census tract. Column 2 shows whether the in-migrant moves from outside New York City. Standard errors are clustered at the upzoning district level and reported in parentheses. Significance: * p<0.1, ** p<0.5, *** p<0.01

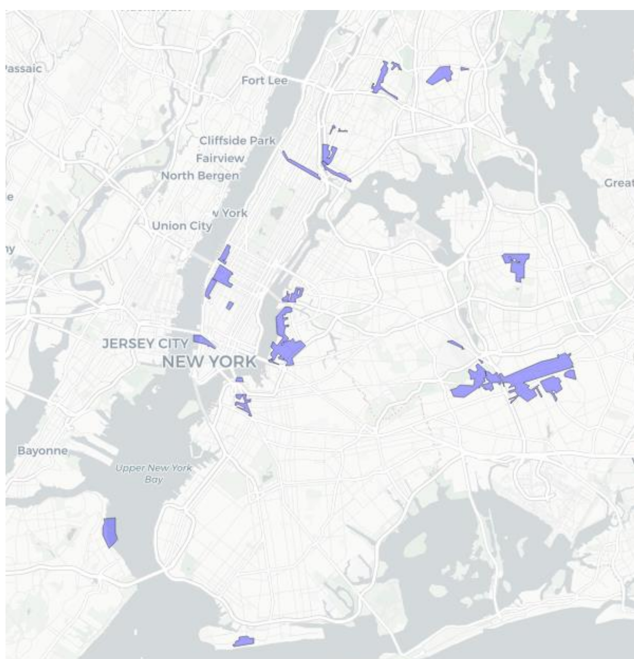
9. Figures

Figure 1: Lot-level change in residential capacity allowed



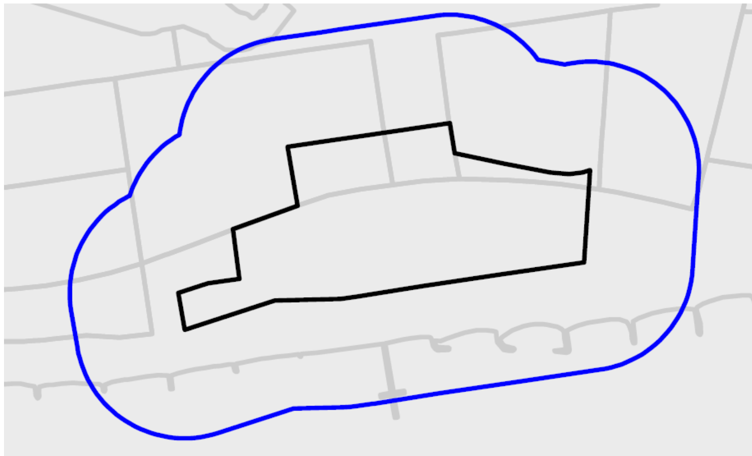
Note: This figure shows the lot-level (or parcel-level) difference in residential capacity allowed (calculated using lot area and maximum residential floor area ratio allowed) between lots located in the upzoning district and lots located within 1000 feet outside the upzoned boundary before and upzoning. The Y axis uses the log of residential capacity allowed.

Figure 2: Upzoning Districts in NYC (2004-2013)



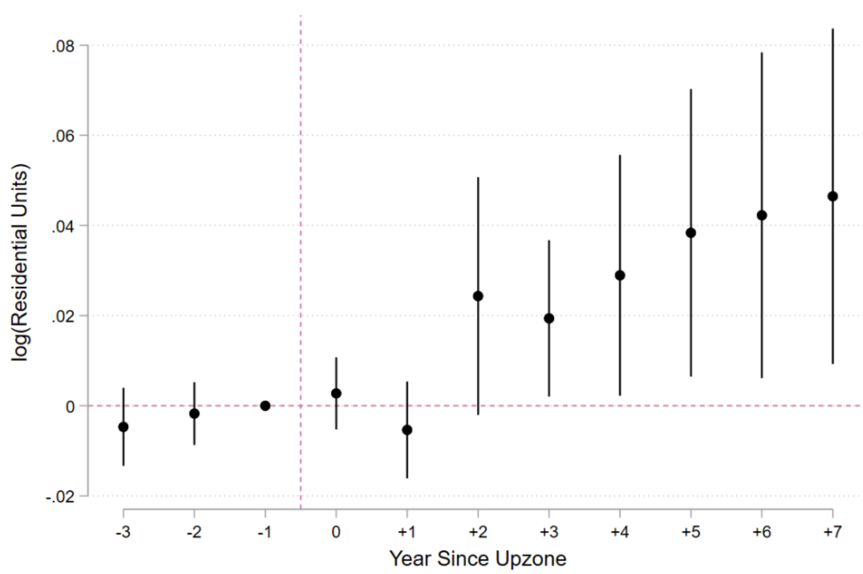
Note: The map shows city-initiated upzoning districts rezoned between 2004 and 2013 (the full list in Table 1). A rezoning district is defined as upzoning if the aggregate allowed residential capacity in the district increases by 20 percent or more after rezoning.

Figure 3: Demonstration Figure of Treatment and Control Area



Note: Figure 3 illustrates an example of the treatment and control areas in the analysis. The black line is the upzoned boundary, and the blue line draws a 1000 feet ring outside the upzoned boundary. Gray lines represent census tract boundaries.

Figure 4: Effect of Upzoning on Total Number of Residential Units



Note: Figure 4 shows the key coefficients β_k in Equation (1) using the log of number of residential units as the outcome variable. It plots the cumulative difference in residential units between the upzoned area and the control area (1000-feet area outside the upzoned boundary). The baseline year is one year before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level.

Figure 5A: Effect on Sales Prices of Residential Properties

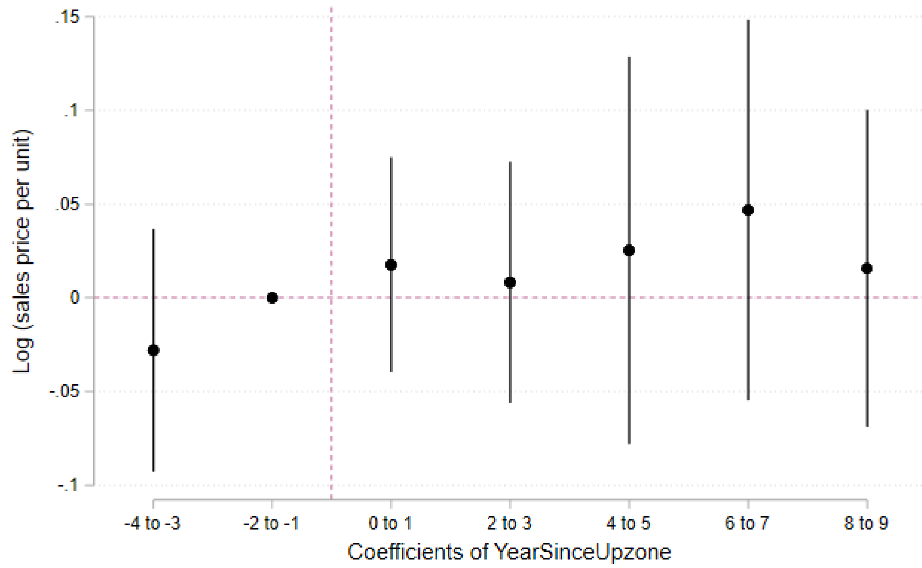


Figure 5B: Effect on Housing Prices, by Treatment Intensity

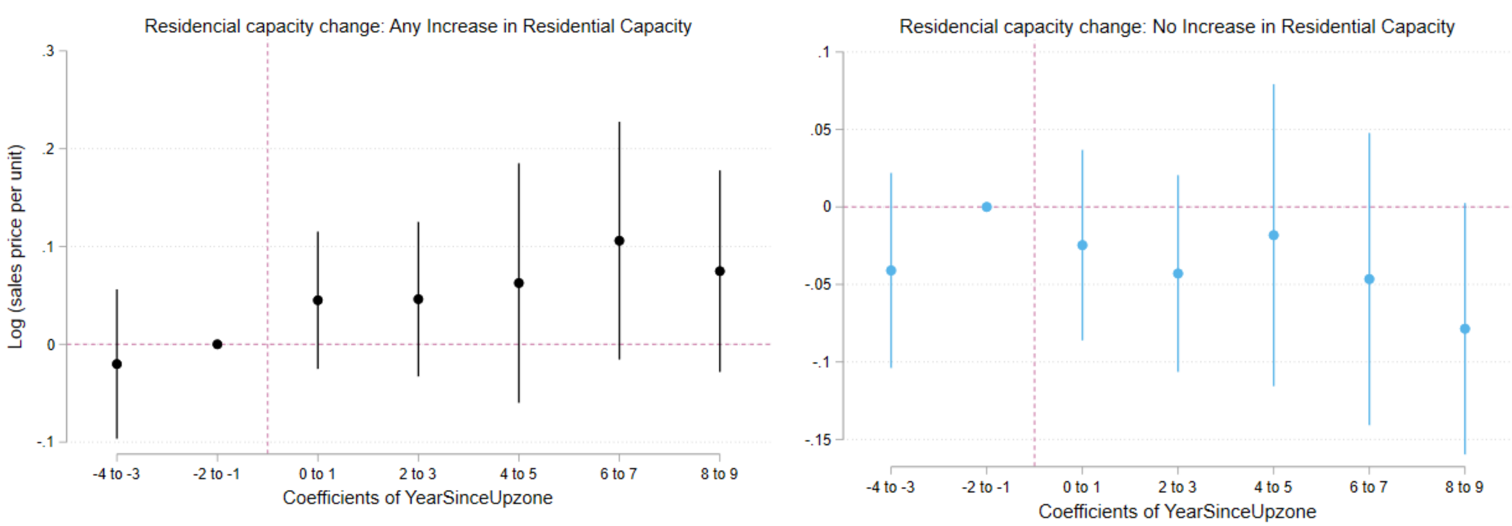
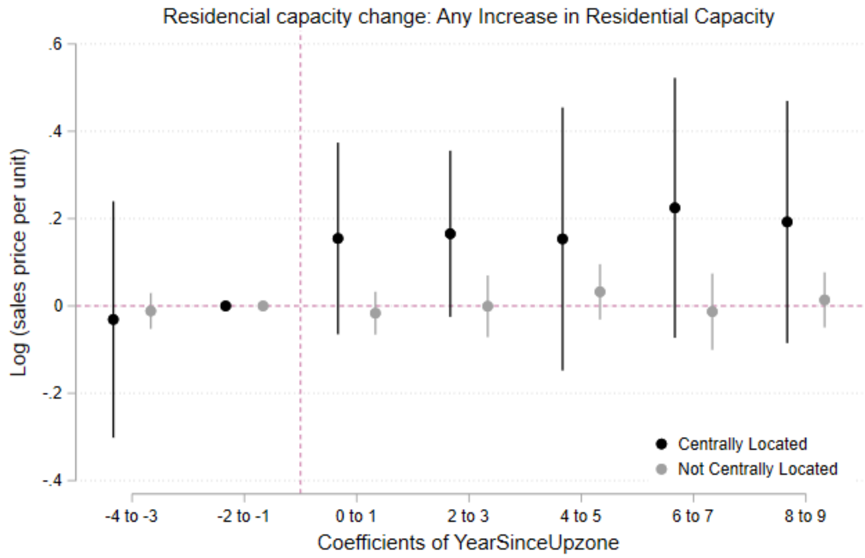
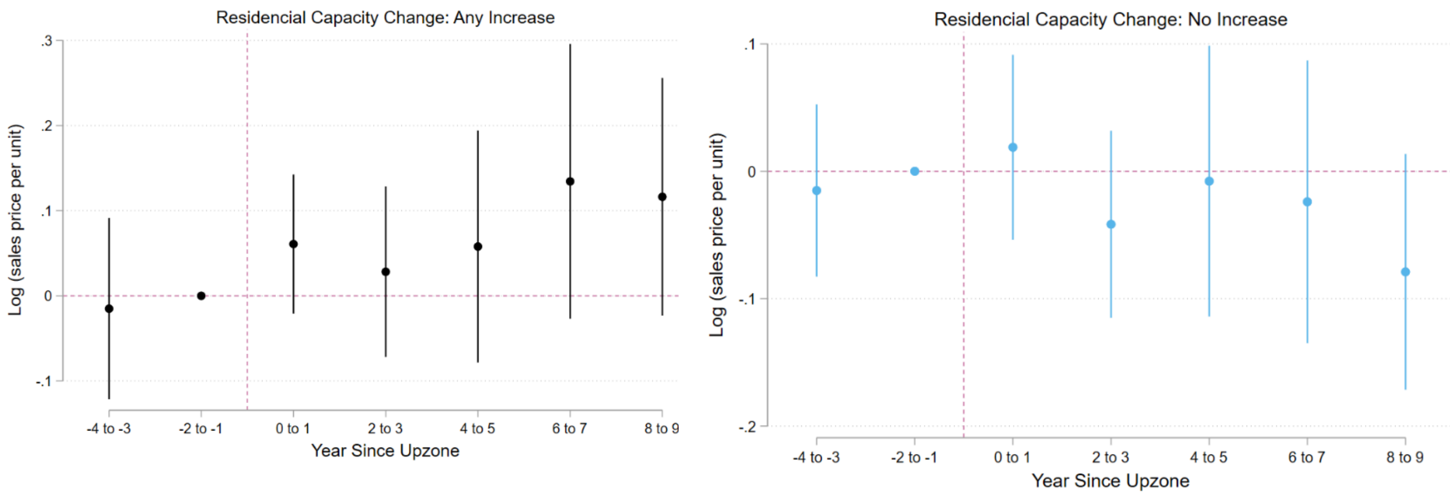


Figure 5C: Effect on Housing Prices, by Centrally Located vs Not Centrally Located



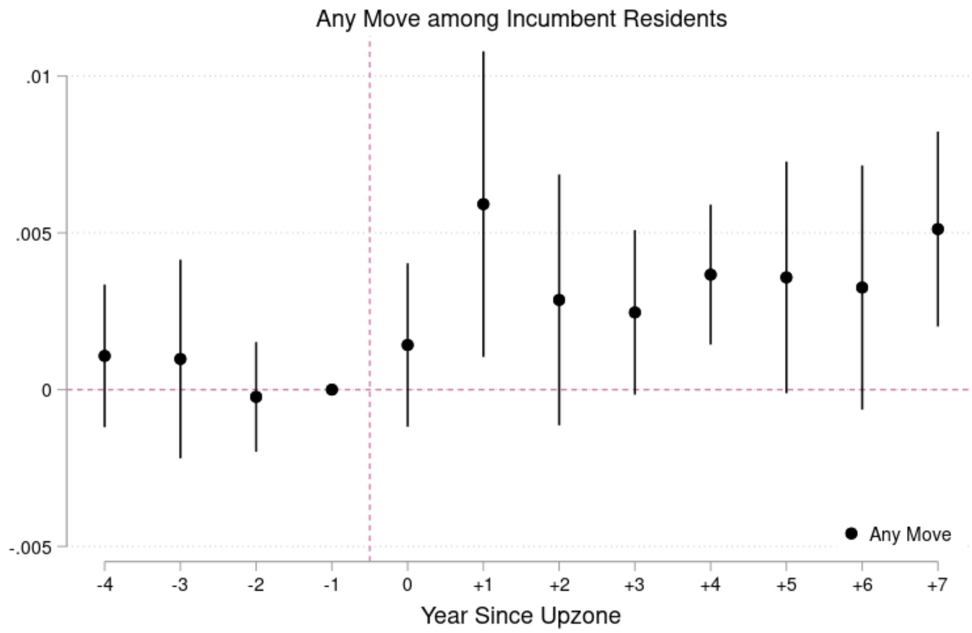
Note: Figure 5s show the key coefficients β_k in Equation (1) using the log of sales price per unit for existing residential properties as the outcome variable. They plot the difference in housing prices of existing residential properties (built before 2004) between those in the upzoned area and the control area (1000-feet area outside the upzoned boundary). Figure 5A includes all existing residential properties. Panel 1 in Figure 5B plots the effect among existing properties on treated parcels that are effectively upzoned, while Panel 2 in Figure 5B shows the effect among those on parcels in the treatment area that do not experience de facto increases in allowed residential capacity. Figure 5C further breaks down the effect in Figure 5B Panel 1 by whether the parcels are centrally located in the city. The baseline period is 1-2 years before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level.

Figure 6: Housing Price Analysis using Narrow Band (500 feet) inside and outside the Upzoned Boundary

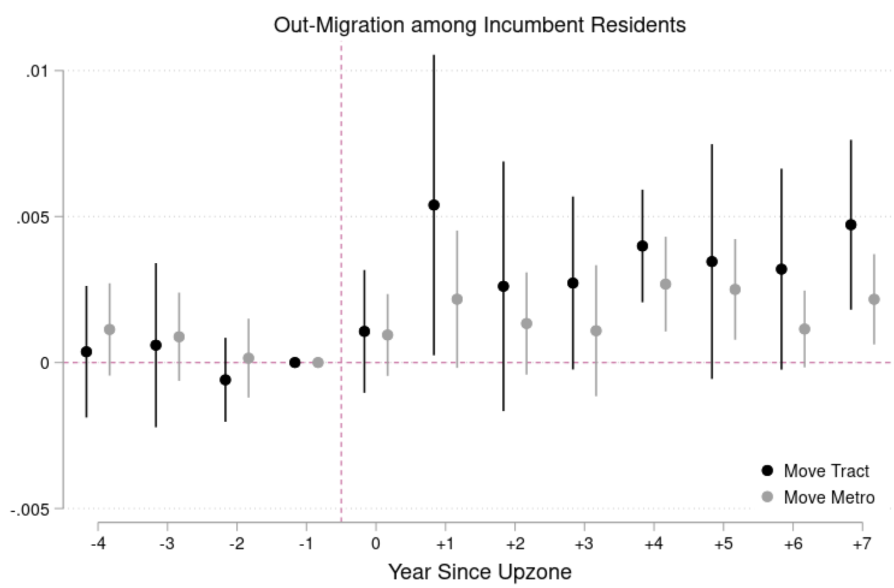


Note: Figure 6 shows the key coefficients β_k Equation (1) using log of sales price per unit for existing residential properties as the outcome variable. It plots the difference in housing prices of existing residential properties (built before 2004) between those located within 500 feet inside and outside the upzoned boundary. The baseline period is 1-2 years before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level.

Figure 7: Effect on Out-Migration



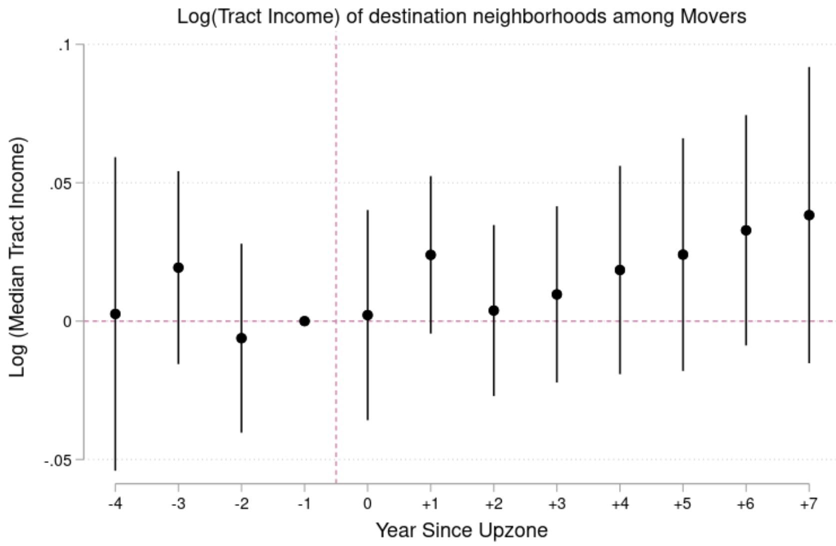
(A) Any Move



(B) Move Tract and Move Metropolitan Area

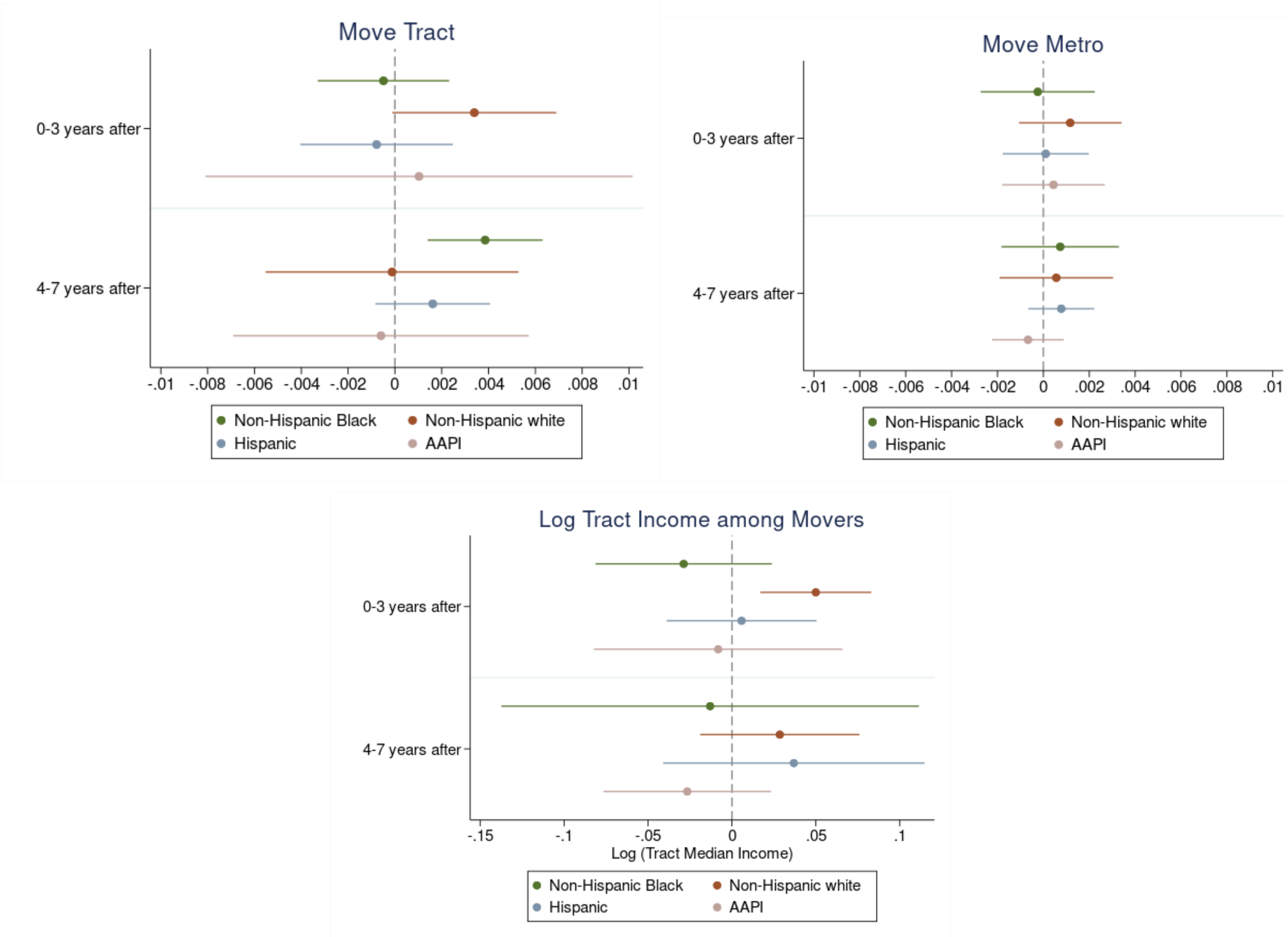
Note: Figure 7 plots the coefficients from estimating Equation (1) and shows the difference in move-out rates between the incumbent residents living in the upzoned area and the control area (1000-feet area outside the upzoned boundary). Panel A shows the effect on moves out of the building, and panel B shows the effect on moves out the census tract and moves out of the metropolitan area (CBSA). The baseline period is one year before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other building and individual characteristics such as building age, imputed homeownership status, imputed race, and years in the current address. Standard errors are clustered at the upzoning district level.

Figure 8: Effect on Destination Tract Income among Movers



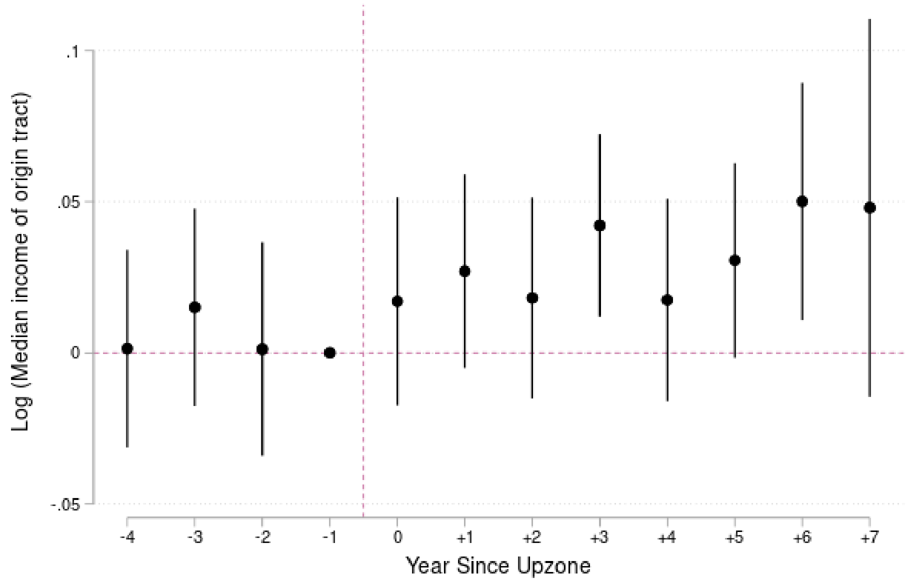
Note: Figure 8 shows the difference in log median household income of destination census tracts between the incumbent residents who move from the upzoned area and those moving from the control area (1000-feet area outside the upzoned boundary). The sample only includes incumbent residents who move. Tract-level median household income is obtained from 2000 and 2005-2018 American Community Survey (ACS) data. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other building and individual characteristics such as building age, imputed homeownership status, imputed race, and years in the current address. Standard errors are clustered at the upzoning district level.

Figure 9: Out-Migration by Imputed Race/Ethnicity



Note: The first two subplots in Figure 9 report the coefficients estimating a pooled version of Equation 1 and show the difference in move-out rates between incumbent residents of specified racial/ethnic group living in the upzoned area and those in the control area (1000-feet area outside the upzoned boundary). The third subplot shows the difference in log median household income of destination census tracts between the incumbent residents of specified racial/ethnic group who move from the upzoned area and those from the control area. Tract-level median household income is obtained from 2000 and 2005-2018 American Community Survey (ACS) data. The baseline period is 1-4 years before the adoption of upzoning. Race is imputed using individual names and address histories the Infutor data (see Appendix A.2). Standard errors are clustered at the upzoning district level.

Figure 10: Effect on Household Income of Origin Tract among In-Migrants



Note: Figure 10 reports the difference in log median household income of origin census tracts between in-migrants moving to the upzoned area and those moving to the control area (1000-feet area outside the upzoned boundary). The baseline period is one year before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, and upzoning district fixed effect. Tract-level median household income is obtained from 2000 and 2005-2018 American Community Survey (ACS) data. Standard errors are clustered at the upzoning district level.

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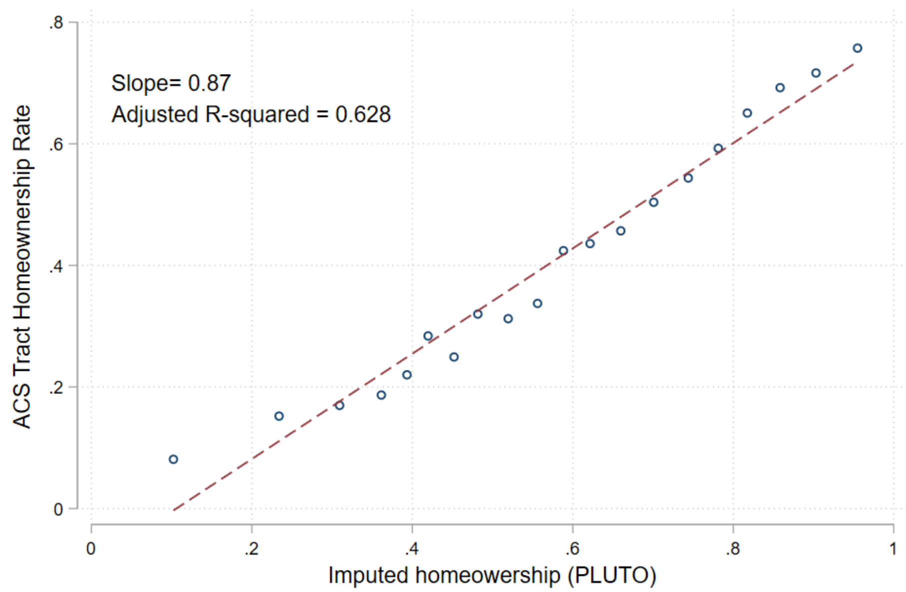
Appendix A: Data Construction and Descriptive Statistics

A.1 Homeownership Imputation

To impute homeownership, I use parcel-level data from New York City Primary Land Use Tax Lot Output (PLUTO), which contains building class and number of units in the building on the lot. By using this information, I break down the buildings into mutually exclusive groups of single-family homes, condos, co-ops, buildings with 2-4 units, or buildings with 5 or more units. I assign individuals living in single-family homes, condos, and co-ops as homeowners. I then assign those living in rental buildings with 5 units or more as renters. For those living in properties with 2-4 residential units, I randomly assign them as renters or owners as it is more difficult to determine their homeownership status. Figure A.1 shows the binscatter plot of 2015-2019 ACS homeownership rate and the imputed homeownership rate using 2017 PLUTO at the census tract level. I divide the sample into 20 bins and plot the average value for each bin. The regression returns a coefficient of 0.87, and the adjusted R-square is 0.628, which implies that the imputed homeownership explains 62.8 percent of the variation across census tracts.

Figure A.1: Validation for Homeownership Imputation



Note: This figure shows the binscatter plot that validates homeownership imputation at the census tract level. The y-axis is the tract-level homeownership rate from the 2015-2019 American Community Survey (ACS) and x-axis is the homeownership rate imputed using the Primary Land Use Tax Lot Output (PLUTO) data. I divide the sample into 20 bins and plot the average value for each bin. The regression coefficient and adjusted r-squared value are from the regression of ACS homeownership rate on imputed homeownership rate at the tract level.

A.2 Race Imputation

To impute the race/ethnicity of individuals in Infutor, I use a hybrid approach that mainly follows the methodology developed by Voicu (2018). This Bayesian Improved First Name Surname Geocoding (BIFSG) method combines first name, surname, and geography information to impute race/ethnicity. The BIFSG algorithm is built based on a naive Bayesian updating formula that updates the prior probability of membership in each racial/ethnic category as defined by the surname-based probabilities with the first-name-based and geography-based probabilities, respectively. According to Voicu (2018), the results outperform the Bayesian Improved Surname Geocoding (BISG) method, which does not use first names. More technical details can be found in their paper. That said, BISG is still commonly adopted by social scientists to impute race. When first names cannot be matched and the individual cannot be assigned racial probabilities, I apply the BISG method instead and only update the prior probability with geography-based probability.

I compile the data used for the imputation from the following sources:

Last name: I use the Census 2010 surname list that includes all surnames occurring 100 or more times in the Decennial Census 2010. Using this data to merge with Infutor, I can construct the baseline probabilities for the racial/ethnic groups by computing the percentage of people with a given surname that belong to the group. The six racial/ethnic categories include the following groups defined by the US Census Bureau: Hispanic; non-Hispanic white; non-Hispanic Black or African American; non-Hispanic Asian/Pacific Islander; non-Hispanic American Indian and Alaska Native; and non-Hispanic Multi-racial.

Geocode: I use the 2010 Decennial Census data to obtain the racial/ethnic characteristics of the census tract associated with the individual's past address history and estimate the posterior probabilities for the six racial/ethnic groups. I test how the imputed results look differently when using different addresses from the same individual's residential history. It turns out that the imputation results are not sensitive to the address I pick from the address history, especially since I also apply a probability threshold when assigning race.

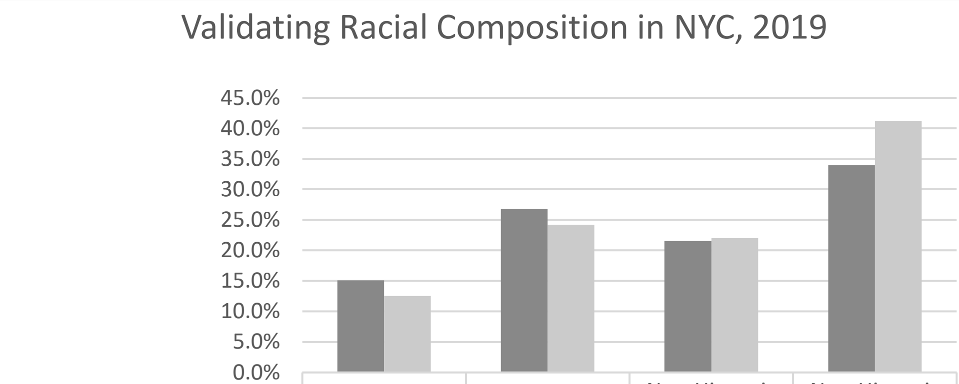
First name: Following Voicu (2018), I use the list of first names in Tzioumis (2017) that draws information on individual first names and their racial/ethnic group from proprietary mortgage datasets from anonymous lenders and merged HMDA/DataQuick data.

For an individual with surname *s* and first name *f* who resides in census tract *t*, I calculate the probability that they belong to each race/ethnicity *r*, where R denotes the set of six racial/ethnic categories:

$$\Pr(r|s,f,t) = \frac{\Pr(r|s)\Pr(t|r)\Pr(f|r)}{\sum_{r' \in R}\Pr(r'|s)\Pr(t|r')\Pr(f|r')}$$

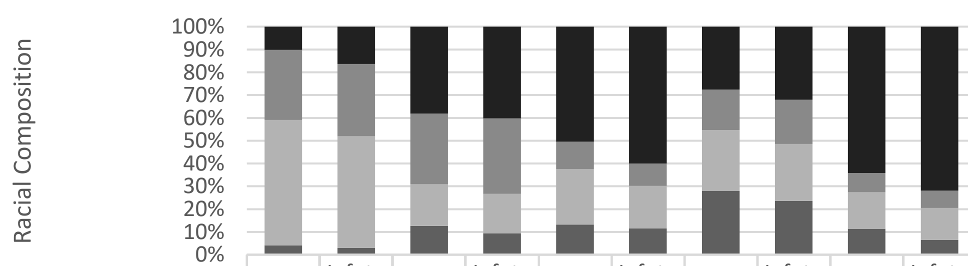
I follow Diamond, McQuade, and Qian (2019) and only assign imputed race to an individual if the probability of that race is above 80 percent. In my final sample, I impute the race/ethnicity of 71 percent of the incumbent residents living in the treatment or control areas. I validate the imputation results from the Infutor data using the 2019 American Community Survey (ACS). Figure A.2 and A.3 show the racial/ethnic composition of overall population in New York City and by five boroughs for the four main racial/ethnic categories in 2019. The imputed results from the Infutor data track the ACS data very well, though we seem to over count white individuals slightly, especially in Manhattan and Staten Island.

Figure A.2: Racial Composition in New York City, ACS v.s. Imputation from Infutor (2019)



	AAPI	Hispanic	Non-Hispanic Black	Non-Hispanic White
ACS for age 25+	15.1%	26.8%	21.5%	34.0%
Imputated from Infutor	12.5%	24.2%	22.0%	41.2%

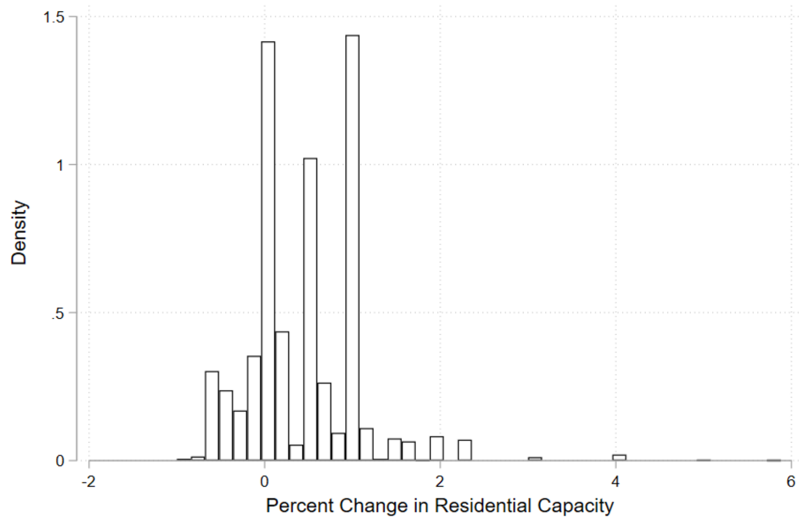
Figure A.3: Racial Composition by Borough/County in New York City, ACS v.s. Imputation from Infutor (2019)



	Bronx		Brooklyn		Manhattan		Queens		Staten Island	
	ACS	Infutor	ACS	Infutor	ACS	Infutor	ACS	Infutor	ACS	Infutor
Non-Hispanic White	10.0%	16.3%	37.1%	40.2%	49.3%	59.9%	26.6%	32.0%	63.3%	71.9%
Non-Hispanic Black	30.1%	31.7%	30.3%	33.1%	11.9%	9.9%	17.2%	19.4%	8.4%	7.6%
Hispanic	53.9%	49.0%	17.7%	17.2%	23.7%	18.6%	25.7%	25.0%	15.8%	14.0%
AAPI	4.0%	2.9%	12.3%	9.4%	12.9%	11.5%	27.0%	23.6%	11.2%	6.5%

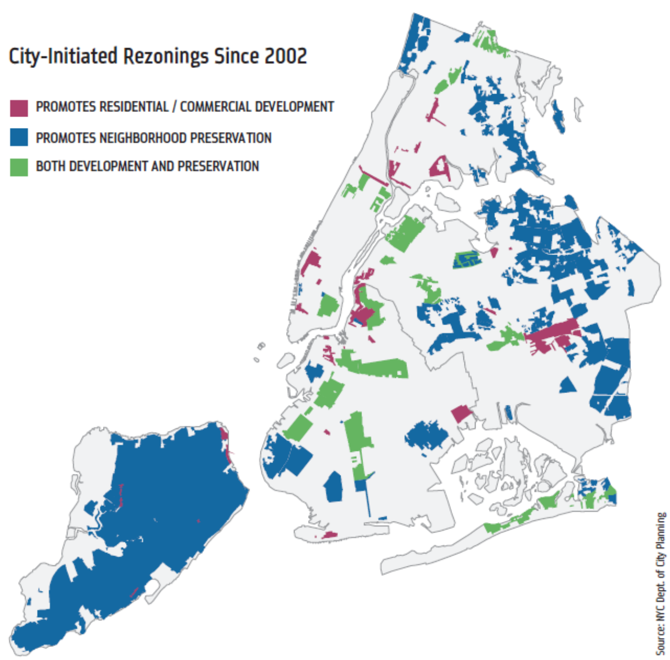
Appendix B: Additional Figures for Data and Summary Statistics

Figure B.1: Lot-level Percent Change in Allowed Residential Capacity in Upzoned Areas



Notes: This figure shows the distribution of lot-level percent change in allowed residential capacity in upzoned areas after upzoning. A rezoning district is defined as upzoning if the aggregate allowed residential capacity in the whole rezoning district increases by 20 percent or more.

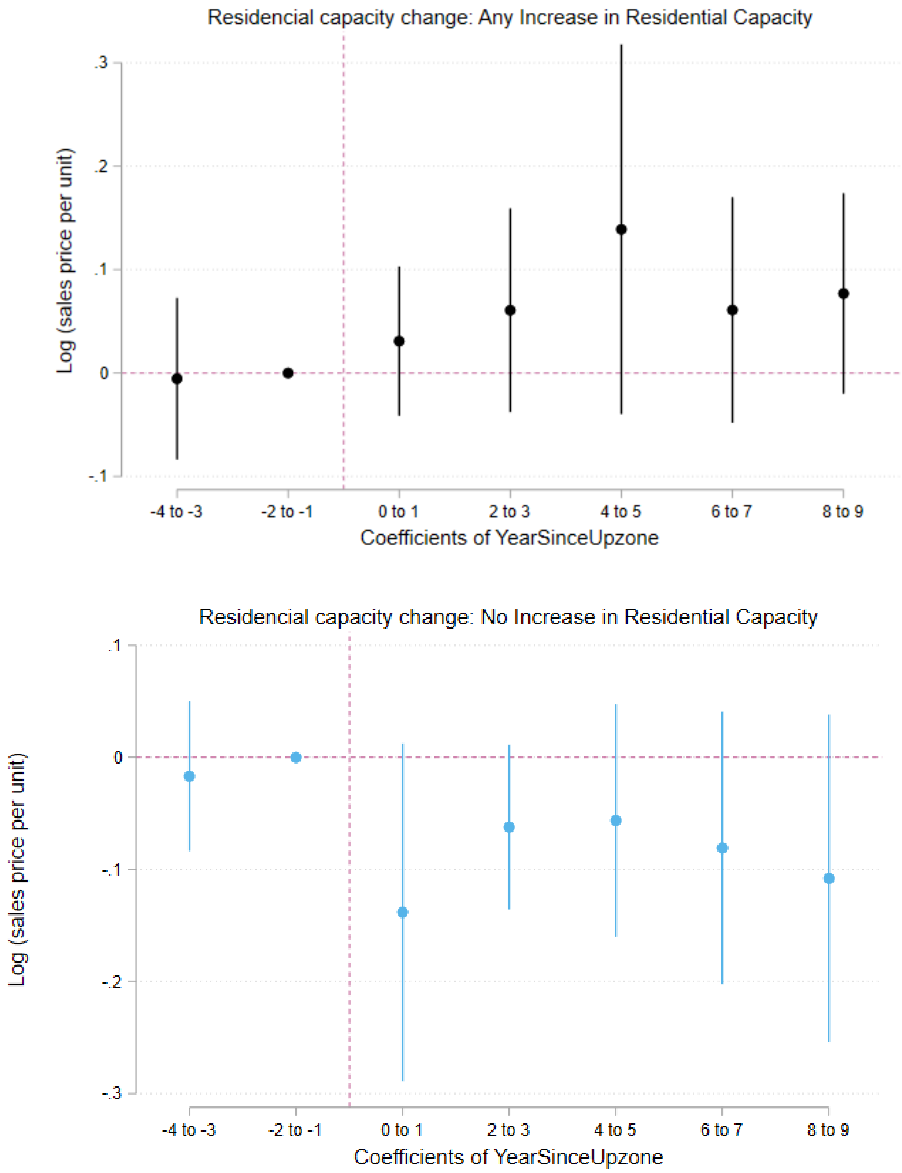
Figure B.2: City-Initiated Rezonings (2002-2011)



Notes: This map is obtained from the plaNYC report by the New York City government, and it plots the city-initiated rezonings between 2002 and 2011. The red shaded areas are reoznings that promote residential/commercial development, which are likely to be upzonings. The report can be downloaded here: https://www.nyc.gov/html/planyc/downloads/pdf/publications/planyc_2011_planyc_full_report.pdf

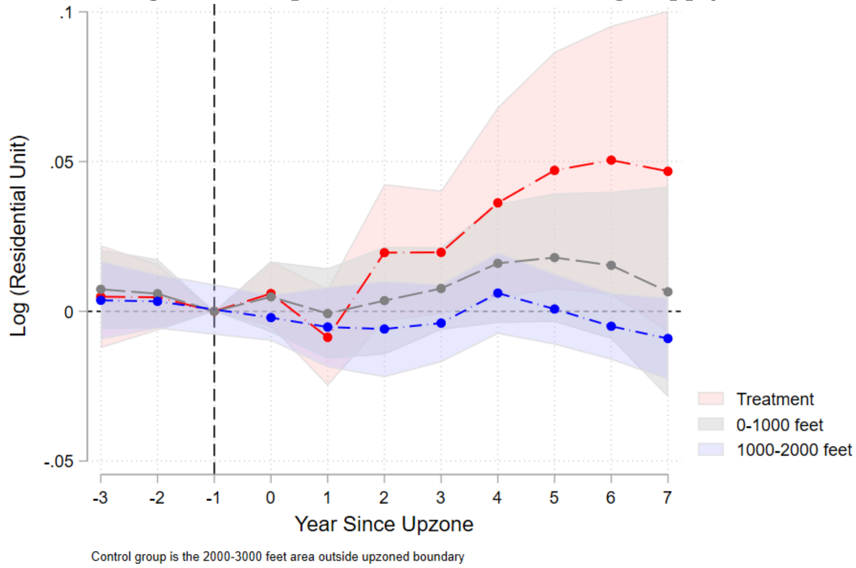
Appendix C: Additional Figures for Main Results and Robustness

Figure C.1: Robustness of Housing Price Analysis Including New Buildings



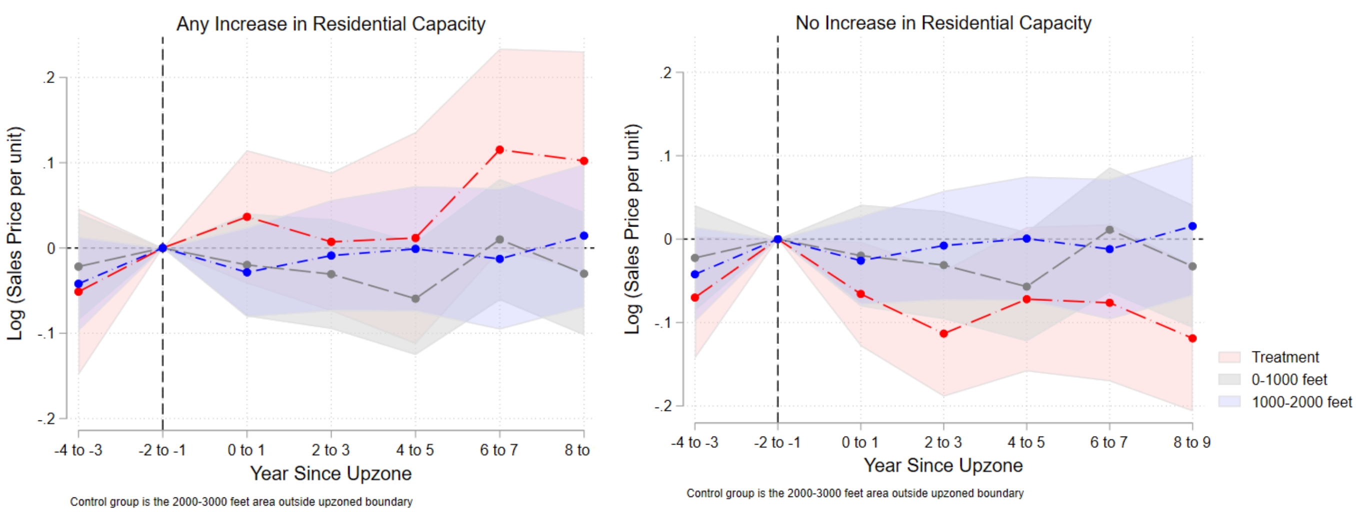
Note: Figure C.1 plots the key coefficients β_k in Equation (1) using log of sales price per unit for all residential properties as the outcome variable (including newly built buildings). It plots the difference in housing prices of all residential properties between those located in the upzoned area and the control area (1000-feet area outside the upzoned boundary). The first panel shows the effect on parcels located in the upzoned area but that do not experience increase in residential capacity after upzoning, and the second panel shows the effect on parcels in the upzoned area that are directly treated with increase in residential capacity. The baseline period is 1-2 years before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level.

Figure C.2: Spillover effect on Housing Supply



Note: Figure C.2 shows the key coefficients $\beta_{k,r}$ in Equation (2) using log of number of residential units as the outcome variable. It plots the cumulative effect of upzoning on residential units in the upzoned area (treatment area), the inner ring (0-1000 feet), and the middle ring (1000-2000 feet) compared to the outer ring (2000-3000 feet) separately. The baseline year is one year before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level.

Figure C.3: Spillover effect on Housing Prices



Note: Figure C.3 show the key coefficients $\beta_{k,r}$ in Equation (2) using log of sales price per unit as the outcome variable. It plots the effect of upzoning on housing prices of existing residential properties (built before 2004) in the upzoned area (treatment area), the inner ring (0-1000 feet), and the middle ring (1000-2000 feet) compared to the outer ring (2000-3000 feet) separately. Panel 1 plots the effect among existing properties on parcels that are effectively upzoned, while Panel 2 shows the effect on parcels that do not experience de facto increases in allowed residential capacity. The baseline period is 1-2 years before the adoption of upzoning. The equation also controls for census tract fixed effect, SBA by year fixed effect, upzoning district fixed effect, and other parcel and building characteristics such as building age and lot area. Standard errors are clustered at the upzoning district level.

Figure C.4: Alternative Threshold of Upzoning – Effect on Housing Supply

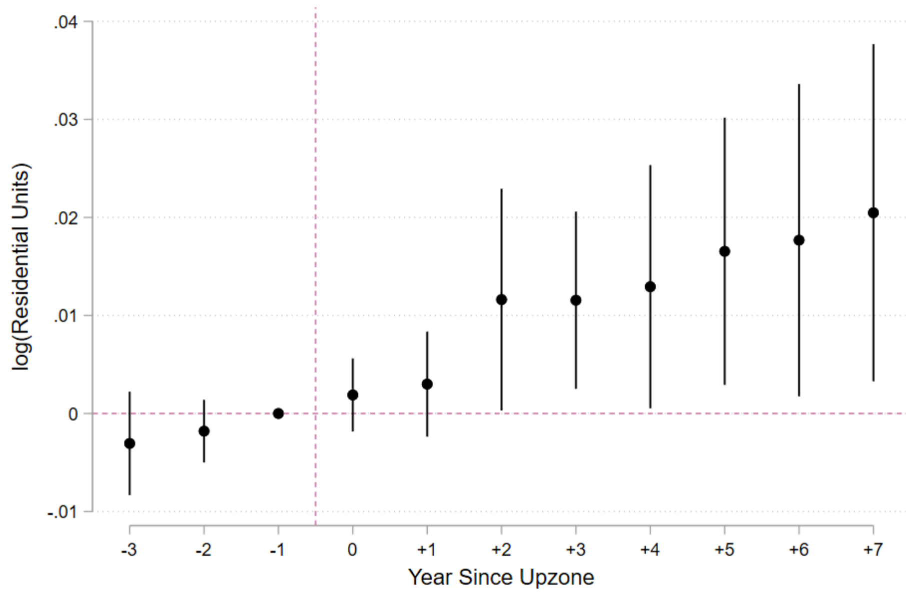
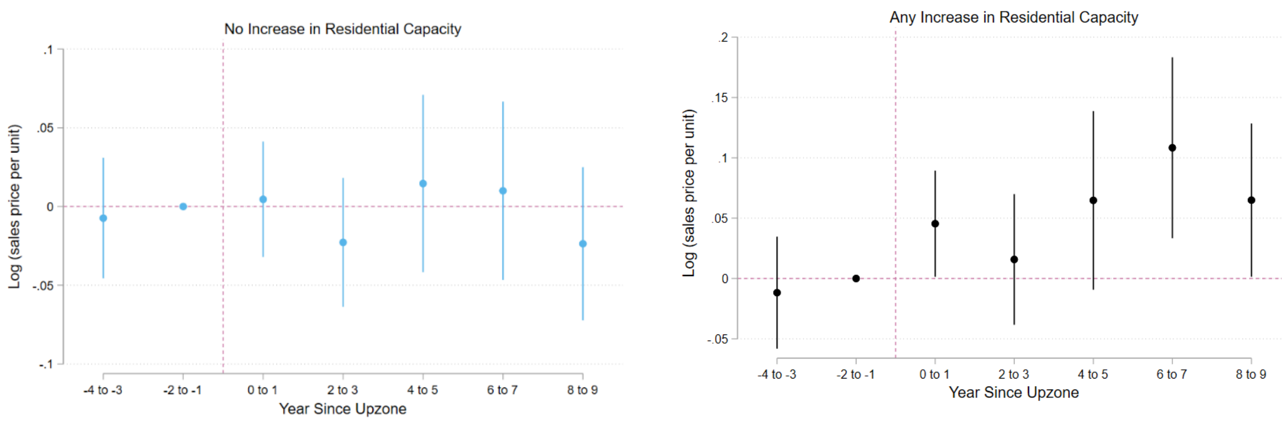


Figure C.5: Alternative Threshold of Upzoning – Effect on Housing Prices



Note: Figure C.4 is the equivalent of Figure 4 and Figure C.5 is the equivalent of Figure 5B, with a rezoning district defined as an upzoning if the aggregate residential capacity allowed in the district increases by more than 10 percent after upzoning.

Appendix D: Additional Tables for Main Results and Robustness

Table D.1: Effect on Housing Prices

	(1)	(2)	(3)	(4)
	Log(Sales Price per unit)	Log(Sales Price per unit)	Log(Sales Price per unit): Centrally Located	Log(Sales Price per unit): Not Centrally Located
-4 to -3 *Treatment	-0.028			
	(0.033)			
0 to 1 * Treatment	0.018			
	(0.029)			
2 to 3 * Treatment	0.008			
	(0.033)			
4 to 5 * Treatment	0.025			
	(0.052)			
6 to 7 * Treatment	0.047			
	(0.052)			
8 to 9 * Treatment	0.016			
	(0.043)			
-4 to -3 * Treatment: No Increase in Residential Capacity		-0.041	-0.165	-0.032
		(0.032)	(0.133)	(0.024)
-4 to -3 * Treatment: Any Increase in Residential Capacity		-0.021	-0.031	-0.012
		(0.039)	(0.136)	(0.021)
0 to 1 * Treatment: No Increase in Residential Capacity		-0.025	-0.074	-0.017
		(0.031)	(0.100)	(0.025)
0 to 1 * Treatment: Any Increase in Residential Capacity		0.044	0.155	-0.017
		(0.036)	(0.110)	(0.025)
2 to 3 * Treatment: No Increase in Residential Capacity		-0.043	-0.067	-0.036
		(0.032)	(0.068)	(0.036)
2 to 3 * Treatment: Any Increase in Residential Capacity		0.048	0.165*	-0.001
		(0.040)	(0.096)	(0.036)
4 to 5 * Treatment: No Increase in Residential Capacity		-0.018	0.073	-0.045
		(0.049)	(0.131)	(0.038)
4 to 5 * Treatment: Any Increase in Residential Capacity		0.062	0.153	0.032
		(0.062)	(0.152)	(0.032)
6 to 7 * Treatment: No Increase in Residential Capacity		-0.047	0.069	-0.125**

		(0.048)	(0.110)	(0.049)
6 to 7 * Treatment: Any Increase in Residential Capacity		0.105*	0.225	-0.013
		(0.062)	(0.150)	(0.044)
8 to 9 * Treatment: No Increase in Residential Capacity		-0.079*	0.003	-0.109***
		(0.041)	(0.109)	(0.035)
8 to 9 * Treatment: Any Increase in Residential Capacity		0.073	0.192	0.014
		(0.052)	(0.140)	(0.032)
Total building size	0.048***	0.049***	0.047***	0.049***
	(0.011)	(0.011)	(0.012)	(0.016)
Total number of units	-0.002	-0.002	-0.001	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
Number of Stories	0.004	0.004	0.005	0.021***
	(0.006)	(0.006)	(0.005)	(0.006)
Building Age	-0.003***	-0.003***	0.001	-0.005***
	(0.001)	(0.001)	(0.002)	(0.001)
Building Age Squared	0.000***	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Lot on corner	0.022	0.023	0.008	0.019
	(0.027)	(0.027)	(0.057)	(0.015)
Number of Buildings on Lot	-0.098**	-0.108**	-0.089*	-0.162***
	(0.047)	(0.046)	(0.049)	(0.062)
Lot Area (Ln)	0.176***	0.178***	0.116**	0.213***
	(0.026)	(0.026)	(0.050)	(0.023)
SBA by Year Fixed Effect	Yes	Yes	Yes	Yes
Tract Fixed Effect	Yes	Yes	Yes	Yes
Observations	28,349	28,314	15,266	13,048
Adjusted R-squared	0.777	0.778	0.708	0.674

Note: Table D.1 reports the full results of estimating Equation (1) using the log of sales price per unit for existing residential properties as the outcome variable. Column 1 reports the difference in housing prices of existing residential properties (built before 2004) between those in the upzoned area and the control area (1000-feet area outside the upzoned boundary). Column 2 breaks down the parcels in the upzoned area into parcels that are directly treated with increase in residential capacity, and parcels that are located in the upzoned area but do not experience increase in residential capacity after upzoning. Column 3 includes only existing properties that are centrally located, which is defined as being located in census tracts whose distance to the Empire State Building is within 11.58 miles (the median distance to the Empire State Building of census tracts in New York City). Column 4 includes only existing properties that are not centrally located. The baseline period is 1-2 years before the adoption of upzoning. Standard errors are clustered at the upzoning district level and reported in parentheses. Significance: * p<0.1, ** p<0.5, *** p<0.01