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 exploiting the plausibly exogenous boundaries of upzoned areas, I compare upzoned areas and the adjacent areas outside the upzoned boundaries. I find that housing supply increases after upzoning, but 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.

Keywords: Rezoning, Upzoning, Housing Supply, Residential Mobility

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1. Introduction

Housing affordability has continued to be a great challenge that many large, economically successful cities face in the United States. As cities attract high-skilled individuals with wage premiums and rich consumption amenities such as restaurants and nightlife, housing costs also rise quickly. Literature points to the role that limited housing supply and stringent land-use regulations play in exacerbating the housing affordability crisis (Quigley and Raphael, 2004; Gyourko and Molloy, 2015; Hilber and Vermeulen, 2016). However, in high-demand cities such as New York City, some local residents are concerned that relaxing land-use regulations will lead to new construction and amenities that gravitate toward the needs of the high-income population. They fear that this will induce or accelerate gentrification in the local community, and that incumbent residents will face higher rents and increased risk of eviction and displacement. The economically vulnerable incumbent residents, especially low-income renters, may be forced to move to higher-poverty or lower-opportunity neighborhoods, increasing spatial inequality and creating welfare loss for these families and their children. As regional and local governments increasingly turn their attention to land-use regulations and housing supply constraints, we need better evidence and understanding of the potential effect of rezoning to inform housing policy.

While extensive literature studies the effect of land-use regulations on housing supply and prices, few studies document the effect of housing regulations on migration patterns into and out of the neighborhoods. This paper addresses this gap in the literature and studies how changes in zoning regulations affect local housing supply and prices, neighborhood change, and residential mobility patterns of incumbent households over time. The Bloomberg administration in New York City (NYC) rezoned almost 40 percent of the land in the city from 2004 to 2013, bringing tremendous changes to neighborhoods such as Williamsburg and Long Island City, among many others. Although there are other forms of rezoning, this paper focuses on the effect of "upzoning", which generally refers to increasing the residential capacity of land that can be developed in an area. The city government usually adopts upzoning to encourage housing construction and the redevelopment of under-utilized land. I use a quasi-experimental difference-in-difference design to study neighborhood-scale upzoning in New York City between 2004 and 2013 and 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 rezoning? If so, which groups of incumbent residents are more likely to move, and where do they go?

3. Does upzoning change the socioeconomic characteristics of in-migrants?

Local housing stock and prices could be affected through different channels when the government upzones an area. On the one hand, increasing the buildable area on a lot will increase the option value of redevelopment, hence increasing the housing price of existing buildings built below the new cap on residential capacity. This effect could be especially strong in high-demand areas. On the other hand, the supply effect of increasing the housing stock will decrease local housing prices and rents. Upzoning can also have positive or negative amenity effects 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 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 or abandoned land and attracts new businesses or higher-income residents to the area, neighborhood quality will improve and create a positive amenity effect that can increase local housing prices and rents. From this perspective, rezoning can also be seen as a place-based policy for its potential to change a neighborhood substantially. In fact, the New York City Department of City Planning frequently cites economic development as the rationale for upzoning an area (Armstrong et al., 2010).

Through the different mechanisms mentioned above, upzoning will not only affect local housing prices and rents but may also change the socio-demographic composition of local residents. If increased option values of redeployment 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. Homeowners may also 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. This would potentially lower displacement risks among renters and make it easier for them to stay in the neighborhood. A new strand of literature studying the local impact of new housing construction generally finds reductions in surrounding rents and housing prices (Asquith et al., 2021; Li, 2021; Pennington, 2021). This emerging body of literature also finds that new housing construction changes the characteristics of the in-migrants to the neighborhood and lowers displacement risk among incumbent residents.

To study the impact of upzoning in New York City on the local housing market, I assemble a 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 history to examine the mobility patterns of the incumbent residents and in-migrants living in the upzoned areas. This creates a unique dataset that allows me to track where people move in from, and whether and where they move after upzoning.

My empirical strategy exploits the plausibly exogenous boundary of upzoned areas and uses a difference-in-difference design that compares the upzoned area to the adjacent area (1000 feet) outside the upzoned boundary. The idea is that while city-led rezoning in New York City usually starts with a strong land-use rationale, the upzoned boundary can be driven by political or other idiosyncratic reasons that are uncorrelated with the existing trend in real estate development and demographic change. Because the empirical approach compares the upzoned (treatment) area to its surrounding area (control), any effect on housing supply, housing prices, and migration patterns represents a hyper-local effect on the local housing market. It should not be interpreted as the general equilibrium effect on the broader New York City market. Moreover, we cannot rule out the possibility that supply and amenity effect caused by upzoning would spill over the rezoned boundaries. If that is the case, the main results of comparing the upzoned and the 1000-feet ring could represent the lower bound of the local effect of upzoning. Since the parcel-level change of residential capacity may not be homogeneous across all the parcels within the upzoned area, I also exploit variation within the treatment area to examine how the effect of neighborhood upzoning differs for parcels that receive different treatment intensity.

I find that the number of newly completed and total residential units increases after upzoning, and the growth in housing units is mainly driven by parcels that experience a greater percent increase in residential capacity. Overall, the number of newly completed units increases up to 1 percent every year after upzoning, and total residential units increase by more than 4 percent seven years after upzoning. The findings suggest that developers take up the opportunity to build more new housing as the limits of land-use restrictions are relaxed. There is also suggestive evidence of increased property sales prices on parcels that receive boosts in residential capacity, particularly on parcels in the central area with high demand. The potential rise of prices among these properties compared to those located in the control area may be due to increased option values to redevelop the buildings or to demand effects from improved localized amenities in the long term.

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. This suggests that upzoning can lead to changes in the composition of local residents in the upzoned neighborhood. The increase in overall mobility is primarily driven by renters, who may be more vulnerable to housing cost changes than homeowners. To examine potential mechanisms for out-migration, I break down the parcels in the upzoned areas into parcels that ever receive any demolition or new building after upzoning and parcels that do not. The out-migration effect is stronger for incumbent residents living in the former as existing buildings are being demolished and redeveloped. But the increased out-migration among those living in buildings that are not redeveloped later may suggest increased rents or changes of local amenities that are not aligned with the preferences of incumbent households. Consistent with this finding, I also find changes in the composition of in-migrants: eight years after upzoning, in-migrants come from census tracts with 4.4 percent higher median income. Finally, incumbent residents moving after upzoning do not move to significantly lower-income neighborhoods compared to out-migrants from the control area, regardless of their race or homeownership status. However, out-migration could still imply welfare loss if incumbent residents have strong preferences for their origin neighborhoods or if moving costs are high.

One caveat of the study is that the upzoning projects examined in this paper experience substantial increase in residential capacity, and some of them involve city agencies committing to investing in local infrastructure such as public transit and waterfront parks. Some completely transform once-industrial or manufacturing sites into residential neighborhoods. In that case, these projects can also be seen as comprehensive place-based policies to promote local economic development rather than simply changing the zoning code. Nevertheless, the paper provides evidence that while large-scale neighborhood upzoning increases housing supply, the potential amenity and demand effects induced by upzoning still attract in-migrants from higher-income areas and increase out-migration among incumbent residents.

This paper ties into the strands of literature studying the effects of land-use regulations on housing supply, housing prices, and residential sorting (Glaeser and Gyurko, 2018; Glaeser et al. 2005; Jackson 2016; Kulka, 2019; Kulka et al. 2022; Song 2021). Existing literature on zoning policy 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 contributes to the literature that studies the effect of rezoning on housing prices and option values (Freemark, 2020; Leather, 2022). Furthermore, the paper adds to this literature by studying how rezoning affects migration decisions and neighborhood composition. It is also related to the literature examining the local effects of new construction on local housing costs and migration (Asquith et al., 2021; Li, 2021; Pennington, 2021; Singh, 2020).

The remainder of the paper is structured as follows. Section 2 describes the institutional background, 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 concludes and discusses policy implications.

2. Institutional Background

New York City adopted its first zoning ordinance in 1916, which regulated the use and density allowed on parcels. It was also the first comprehensive municipal zoning ordinance in the United States. After the city enacted a new zoning resolution in 1961, it was largely unchanged until the 2000s. By that time, the 1961 zoning resolution had widely been 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 neighborhood-scale rezoning that covered 40 percent of the land in the city. DCP tailors each rezoning initiative based on the local context, citing different planning goals and rationale for different rezoning projects. In some neighborhoods, the zoning codes are changed with the overarching goal of allowing for more intensive residential use ("upzoning"). According to DCP, the city was dedicated to upzoning underutilized industrial sites and waterfronts as well as 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 are also some rezoned neighborhoods for which the city cites both goals of 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”). The focus of this paper is to study the effect of large-scale neighborhood upzoning, but the other types of rezoning are also important and should be examined in future work.

3. Data and Summary Statistics

This paper assembles publicly available and proprietary datasets from various sources to create a parcel-level 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 building characteristics

I use the zoning amendment map from the New York City (NYC) Department of City Planning (DCP) to identify the areas rezoned between 2004 and 2013.[1] The map contains the exact geographic boundary and adopted date for each rezoning project.[2] 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 NYC Zoning Application Portal data to identify rezoning projects 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), the publicly available data with parcel-level information such as lot area, zoning district, and maximum allowable floor area ratio (FAR). It also includes building characteristics such as building age and the number of stories and residential units.

While this combined dataset includes all rezoning projects and detailed qulitative information on the goal of rezoning, existing neighborhood character, and changes in zoning maps, it does not offer a clear-cut classification of whether a rezoning project is upzoning, contextual rezoning, or downzoning. Also, changes in zoning code are often not homogenous within the whole area of a rezoning project, as it is common that different parts of the area experience different changes in zoning code. For example, a part of the rezoning area may change from R5 to R5B and another part from R6 to R7D, and they have different implications for changes in allowable buildable area. That being said, the city usually has a comprehensive planning goal of what they hope to achieve with each rezoning project. To identify the upzoning projects that experience meaningful increases in residential development capacity overall, I

[1] The sample period is selected to allow observing the pre-trend in the analysis since the land-use data, PLUTO, is only available since 2002.
[2] The data can be downloaded here: https://www1.nyc.gov/site/planning/data-maps/open-data/dwn-gis-zoning.page#metadata

follow Armstrong et al. (2010) and using the lot area and the lot's maximum floor area ratio (FAR) to calculate the allowable buildable residential area for that 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.[3] While other restrictions may apply, a lot's maximum FAR is the primary determinant of the size of the development (Armstrong et al., 2010).[4]

After calculating the buildable area allowed at the lot level, I aggregate the number to the entire rezoned area to get the total residential capacity for each rezoning project. Because PLUTO provides data on a yearly basis, I can calculate the change in total residential capacity after the rezoned date for each project. To focus on upzoning projects with notable changes in development capacity that have the potential to change neighborhood characteristics, I define a rezoning project as upzoning if the total residential capacity in the area increases by at least 20 percent. I will also conduct robustness analysis by applying different thresholds (ex, 10 percent). As changes in zoning code are often not homogenous within the rezoning area, an upzoning project defined this way may have some parts in the area with larger increase in FAR but also with small pockets in the area having no change or even slightly decreased FAR.[5] Setting a threshold on the increase in residential development for the total area helps to focus on neighborhoods that experience larger-scale change across the area. However, one may still be concerned that it does not reflect the lot-level change in buildable area across the entire rezoned area. To validate my definition of upzoning, I compare the lot-level residential capacity in the upzoned areas and the surrounding areas up to 1000 feet away outside the upzoned boundary before and after upzoning. Figure 1 shows that compared to the immediate surrouding area

[3] 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.

[4] This paper uses maximum 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 exisit, maximum FAR is the primary factor that limits the total size of a new building,

[5] On the other hand, there are some “hybrid” contextual rezoning projects with some lots within the areas being rezoned to have increased FAR, but would not be included in my definition of upzoning if the total residential capacity across the whole area does not increase above the threshold.

outside the upzoned boundary, the lots within the upzoned boundary experience significant increase in residential capacity.

Table 1 and Figure 2 show the 22 upzoning projects across NYC rezoned between 2004 and 2013 in my sample. It includes rezoning projects 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 rezoning projects in the South Bronx as well as the Jamaica Plan in Queens.

To test for balance across treatment and control properties, Panel A in Table 2 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.[6] 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. The buildings in the 1000-feet ring also have slightly older building age but more residential units in building and slightly higher floors than those in the upzoned areas.

3.2 Housing supply

I use the 2000-2018 NYC Building Permit dataset from the NYC Department of Buildings (DOB) to identify the timing and location of building permit approval. The dataset includes location, timing, and the characteristics of the approved new development. I also use the 2000-2018 NYC Certificate of Occupancy dataset to examine the number of completed residential units before and after changes in zoning regulations. Both datasets are linked to the PLUTO data and zoning amendments map using the BBL (Borough, Block, Lot) identifier. The Certificate of Occupancy data shows how many residential units in the building have been newly

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[6] 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.

completed. I also use the total number of residential units from the Primary Land Use Tax Lot Output (PLUTO) data to measure the effect on housing supply.

3.3 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 Assessment Dataset (RPAD) from the DOF includes building characteristics such as building class, year built, and the number of units. This information is merged to the sales data to control for building characteristics when estimating the effect of upzoning on housing prices.

3.4 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 the 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 of the upzoned areas and the buffer areas.

This dataset 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).[7] To test for pre-treatment balance, panel B in Table 2 shows the demographic characteristics and the migration

[7] 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.

rate of the incumbent residents living in the treatment and control areas in the years before upzoning. The annual mobility rate is 7 percent for those living in the treatment area and 6 percent for those in the control area. About 2 percent of the incumbent residents in both groups leave NYC 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 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 in Appendix 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 (Voicu, 2018). Using this method, I impute the race 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. I can also study whether in-migrants are more likely to move in from higher-income areas after upzoning.

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 of upzoning.

Neighborhood-scale rezonings in New York City usually have a strong land-use rationale. For instance, the rezoning initiatives 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. However, the precise boundaries of the upzoned areas can be driven by political or other idiosyncratic reasons that are uncorrelated with expected trends in market conditions. By exploiting the granularity of the data at the parcel and building level and the plausibly exogenous boundary of rezoned areas, I use a "ring" difference-in-difference method to compare the treated areas that are upzoned and the immediate surrounding areas up to 1000 feet outside the upzoned boundary before and after the city government rezones the area.[8] The identification assumption is that the treatment group and the control group within a small area over the rezoned boundary share similar pre-trends in terms of housing supply, prices, and mobility patterns, and the only plausible determinant that causes differential outcomes in the post-periods is the change in zoning regulations.

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

$$Y_{it} = \alpha_c + \theta_p + \delta_{st} + \sum_{k=-3}^{5}[\beta_k * \mathbb{1}_{it}\,(t - t^* = k, r = 1)] + \gamma X_{it}' + \epsilon_{it} \tag{1}$$

I use an event-study specification to examine the parallel pre-trend assumption and to study how the outcomes of interest change over time after a neighborhood is upzoned. The outcome *Y* is the number of new housing permits on a parcel *i* or the log sales price per unit for residential property *i* at year *t*. The indicator variable in the summatory interacts event year dummies *k* with 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 areas with respect to the control areas over time.

[8] 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 rezoning projects during the sample period, regardless of whether the projects are initiated by the city or the private developers, and whether they are in upzoning, downzoning, or contextual-rezoning projects.

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.[9] 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, and lot area to account for changes in the composition of sales over time. Finally, I include census tract fixed effects α_c and upzoning project fixed effect $\theta_p$to control for baseline differences in housing supply and prices across census tracts and upzoning projects. Standard errors are clustered at the upzoning project level to account for spatial correlation within the upzoned area.[10]

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 8 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 project, and sub-borough area by year fixed effects. Once the individual moves away from the original address in the treatment or the control areas, I remove them from the analysis sample. 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 cannot 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

[9] The United States Census Bureau divides New York City into 55 sub-borough areas (SBA).
[10] I also try clustereing standard errors at the tract level and the results are very similar to clustering at the upzoning project level.

people who move into the treatment or control areas during the sample period. All the census tract, upzoning project, and sub-borough area by year fixed effects are also included.

The main specification uses immediate surrounding areas up to 1000 feet outside the upzoned boundaries as the control group. As the supply and amenity effect could spill over the rezoned boundary, I will also apply different buffers to study the extent of spillover effects at different distances from the boundary. Because of the potential spillover effect, the main results of comparing the upzoned and the 1000-feet ring could represent the lower bound of the effect of upzoning.

5. Results

5.1 Effect of Upzoning on Local Housing Supply

By upzoning a neighborhood, the government relaxes the zoning regulations on residential development to encourage development activities. I estimate Equation (1) using the inverse hyperbolic sine of the number of newly completed residential units from the Certificate of Occupancy data to examine whether and how housing supply changes following upzoning.[11] The results in Figure 3A show a significant increase in newly completed housing units by 0.6 percent after upzoning in the treatment area compared to the control. The magnitude is small also because most parcels do not receive any certificate of occupancy from new construction during the sample period.[12] There is no pre-trend in the number of newly completed housing units, but we see an immediate increase after upzoning. Since it can take years to start the permitting process and finish construction, this may reflect developers who have pre-existing approved permits being more likely to follow through and finish construction. The coefficient increases slightly over time: the number of newly completed housing units increases more than 1 percent five years after upzoning is approved. I also use an alternative data source from the Department

[11] The inverse hyperbolic sine function is defined as $\operatorname{asinh}(x) = \ln(x + \sqrt{1 + x^2})$. This function preserves the interpretation of the logarithm while accounting for the cases in which the value of the variable is zero.
[12] On average, only 0.33 percent parcels in the treatment or control areas receive any certificate of occupancy from new construction between 2000 and 2018.

of Buildings (DOB) to examine how housing permits approved for new construction change after upzoning in Appendix B.1. The results show similar patterns.

There may be concerns that the increase in newly completed housing units in the treatment area relative to the control may come from developers shifting the new building location to the treatment area and decreasing the construction of new housing in the control area. If that is the case, the neighborhood's net housing supply would not increase. To address this concern, I examine the change of newly completed units in the treatment and control groups separately instead of using the difference-in-difference specification (Figure 3B). While there is a slight decrease in the number of newly completed housing units in the control area, especially in the year that upzoning is approved, the overall change is not significant. We also observe a strong increase in the number of certificates of occupancy issued in the treatment area after upzoning. This indicates that developers do not simply change where they build within the neighborhood but instead build more new housing in the upzoned area. An alternative way to measure how housing supply changes after upzoning is to estimate the change in the total number of residential units instead of newly completed units on the parcel. To examine this, I estimate Equation (1) using the log of the number of residential units from the tax lot data PLUTO and find that total residential units in the upzoned area increase by 4 percent relative to the control area seven years after upzoning (Figure 4 and Column 1 in Table 3).

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 on the parcel may not be homogeneous across the upzoned neighborhood. Within the same upzoned area, some parcels may experience larger increases in buildable areas while some parcels may only have moderate increases. 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 with greater than 50 percent. As shown in Column 2 in Table 3, 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. This finding suggests a strong direct effect of relaxing land use regulations on that parcel. 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 are already built to the maximum allowable floor area ratio (FAR), and no more new units will be produced from redeveloping the property.[13]

The findings are similar when using certificates of occupancy from new buildings as the outcome variable instead (Figure B.2). This suggests that within seven years after upzoning, the properties on parcels in the treatment area with no increase in residential capacity are not redeveloped or flipped into new residential buildings.

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, the number of stories, building class, lot area, and whether the lot is a corner lot. In the analysis, I include only properties built before 2004, the earliest year of the upzoning project 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. That being said, the robustness check analysis incorporating all new and older buildings shows similar results.[14] I also pool every two years into one group in this part of the analysis because of the smaller sample size of housing sales in my analysis sample.[15]

Figure 5A shows a null effect of upzoning on local housing prices in the upzoned area. There are several different channels through which upzoning can affect housing prices in the

[13] 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.
[14] See Figure B.3.
[15] The total observation number for the full-sample analysis is 28,314. The full table for Figure 5 can be found in Appendix Table C.1.

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. 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.

I further separate the parcels in the treatment area into two groups based on whether the parcel de facto receives increases in residential development capacity after upzoning.[16] Figure 5B shows that among the existing buildings on parcels in the treatment area with no increase in residential capacity, the sales price per unit decreases slightly over time after upzoning. The housing price per unit among existing buildings on the parcels in the treatment area with any increase in residential capacity, on the other hand, slowly increases by 7 to 10 percent compared to housing prices of comparable properties in the control area six to nine years after upzoning. The coefficients are only marginally significant at the 90 percent level. The differential effect between the two types of parcels potentially reflects a difference in the option values of redevelopment since parcels with increased buildable areas become more valuable after upzoning. This finding is consistent with Freemark (2020), who also finds an increase in property transaction prices on parcels that received a boost in allowed building size after upzoning in Chicago. On the other hand, the slight decrease in property prices on the other parcels with no increase in buildable areas may be due to dominating supply or competition effects.

Figure 5C further shows that the positive effect on sales prices is driven by properties in central locations of the city, as defined by the distance to the Empire State Building.[17] This could

[16] 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.
[17] 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).

be because the properties in central locations are in higher demand, and the increase in buildable areas creates more increased redevelopment value. Been et al. (2016) also finds that designation of historic districts, which increases the aesthetic values of the neighborhood but prohibits demolitions and redevelopment of existing properties in the designed area, has a differential effect on property values in central locations and non-central locations in New York City due to different demand and option values of redevelopment.

Overall, the above results provide suggestive evidence that upzoning increases property values on parcels that receive a boost in allowed building size due to increased option values of redevelopment, but the effect is marginally statistically significant. Furthermore, the overall price effect is null if including all 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 surrounding area outside the upzoned boundary. Therefore, any effect I find is the effect on the hyper-local housing market. 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.

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 also restrict the sample to people who already lived in the upzoned area five years before upzoning to capture the effect on incumbent residents. Figure 6 shows the coefficients plots of the estimated results from Equation (1). In Panel A of Figure 6, 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 7 years after upzoning. The increase in mobility one year after upzoning is approved may seem surprising since it can take time for people to adjust their residential location, especially when renters sign annual or longer leases with landlords. However, rezonings are typically widely debated and discussed before the city council approves them. Thus, residents and owners are likely to be aware of a potential upzoning in their neighborhood several years before the rezoning is adopted. To interpret the coefficients, I pool the estimated results into the short-run effect of 0-3 years and long-run effect of 4-8 years after upzoning. Panel A in Table 4 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 4.1 percent, this reflects a 7.3 percent increase in the probability of moving.

I also explore the type of moves by examining how far people have moved from their initial residence (Figure 6 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 (7.7 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 4 Column 2). Finally, I find that upzoning increases the probability of moving to a different metropolitan area by 0.1 percentage point (10.5 percent) among incumbent residents (Table 4 Column 4). Such long-distance moves could be more likely to lead to loss of local ties, and it involves 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 the 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 7 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 4 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 Characteristics

I conduct the same analysis to examine heterogeneity using the imputed homeownership status. Panel B and C in Table 4 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 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 are more likely to demolish and redevelop the buildings. (Leather, 2022). 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 NYC decreases while the probability of moving out of NYC increases by 0.2 percentage points among incumbent homeowners. In the long term, the probability of moving to a different CBSA 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 or renters are more likely to move to higher or lower-income tracts.

I also examine heterogeneity by imputed race to examine whether out-migration outcomes vary for different racial groups. Figure 8 shows that non-Hispanic white incumbent residents in the upzoned area are 0.2 percentage points more likely to move 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 more 0.4 percentage points likely to move than Black residents in the control area in the long term (4-8 years) after upzoning. Hispanic movers are also more likely to move to a different neighborhood or CBSA after upzoning in the long term, but the coefficient is only marginally significant. Finally, Asian Americans and Pacific Islanders (AAPI) incumbent residents from the upzoned area seem less likely to move after upzoning, 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 (2 to 4 percent higher) compared to the equivalent group who move from the control group, but movers of other racial groups move to tracts of similar median income levels after upzoning.

5.3.3 Heterogeneity by Type of Parcels

I try to examine the mechanisms for out-migration by breaking down the parcels in the treatment area into ones that receive any demolition or new building permits after the upzoned year and ones that never receive these types of permits after upzoning during the sample period. Panel A in Table 5 shows that incumbent residents living on both types of parcels are more likely to move or leave the neighborhood after upzoning, but the magnitude of the coefficient is much bigger for those residing on parcels that are issued demolition or new building permits later (1 percentage points). This is not surprising as incumbent residents would have to move when the property owners demolish or redevelop existing properties. However, the coefficient is not precisely estimated due to large standard errors and the small sample size for this group of parcels.[18] On the other hand, those who live in buildings that are not demolished or redeveloped

[18] On average, only 2.5 percent of the parcels in the treatment area receive new building or demolition permits after upzoning in my sample.

later after upzoning are also more likely to move out of the neighborhood, but the coefficient is smaller (0.3 percentage points) and more precisely estimated. This could either be due to increases in housing costs induced by demand effects or changes in local amenities that no longer fit the preferences of local incumbents. I also use alternative data sources and break down the properties into ones that go through major alterations and ones that do not have major alterations after the upzoned year, and the results show very similar patterns: incumbent residents living in buildings with no major alterations completed after upzoning are also more likely to move compared to those in the control area.

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. I find that incumbent residents living on parcels that substantially increase residential capacity (> 50%) are the most likely to move, potentially because these parcels are more likely to be redeveloped and altered later.[19] Those living on parcels with a moderate increase in capacity (<=50 percent) are also more likely to move. However, incumbent residents living on parcels in the treatment area receiving no increase in residential capacity are not more likely to move after upzoning.

5.4 In-Migration

I then examine whether in-migrants are more likely to come from higher-income neighborhoods after upzoning. Results from Figure 9 show that new migrants moving into the treatment area come from neighborhoods with higher household income. The figure shows a slight increase in the median income of origin neighborhoods among in-migrants starting in the second year after upzoning, and then a growth in the income of origin neighborhoods starting five to six years after the rezoning. Table 5 collapses the results in the short term (0-3 years) and the long term (4-8 years). I also compare the treatment group to the inner ring of 500 feet (column 2) and the outer ring of 500 to 1000 feet (column 3). The effect is statistically significant using the full control group (0-1000 feet outside the upzoned boundary) 4-8 years

[19] On average, 4.5 percent of parcels that receive substantial boost (>50%) in residential capacity are demolished or reveloped after upzoning. However, only 1.8 percent of parcels that do not experience increases in residential capacity are demolished or reveloped afterwards. The shares are 12.0 percent and 5.5 percent respectively for alterations.

after upzoning, with an increase of 2 percent in the household income of the origin neighborhood. The findings provide potential evidence that upzoning attracts more high-income residents to the neighborhood.

6. Discussion and Conclusion

This paper shows that newly completed and total residential units increased in upzoned areas in New York City after they took effect. There is suggestive evidence of increased housing prices among the buildings located on parcels that experience a boost in residential capacity in high-demand areas, likely due to increased option or redevelopment values. In terms of migration patterns, I find that incumbent residents living in the upzoned area, especially renters, are more likely to move to a different neighborhood after upzoning. The increased out-migration among those living in buildings that are not redeveloped later potentially suggests increased rents or changes in local amenities that are not aligned with the preferences of incumbent residents. I also find that in-migrants are more likely to come from slightly higher-income neighborhoods after upzoning. Finally, incumbent residents moving after upzoning do not move to significantly lower-income neighborhoods compared to out-migrants from the control area. However, out-migration could still cause welfare loss if incumbent residents have strong preferences for their origin neighborhoods or if moving costs are high.

Overall, it is likely that while large-scale neighborhood upzonings increase housing supply, the potential amenity and demand effect still attracts 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, so the findings represent hyper-local effect on the local housing market and not the general equilibrium effect on the broader New York City market. For instance, it is plausible that housing costs may fall elsewhere in the city when overall housing stock increases. Second, this study examines the effect of the 22 large-scale, neighborhood-level upzonings during the Bloomberg administration in 2004-2013, and these areas experienced substantial increases in residential capacity (20 percent or more). Some of these upzoning projects involved city agencies committing to investing in local infrastructures such as public transit and waterfront parks, and some have completely transformed industrial or manufacturing sites into residential neighborhoods. Therefore, these projects can also be seen as comprehensive place-based policies to promote local economic development rather than simply changing the zoning code. In that case, the findings may be specific to cities with strong housing markets and areas that experience large-scale upzoning, and the effects can differ for other areas if amenity and demand effects depend on local contexts. Other forms of rezoning, such as hybrid rezoning or downzoning, are also important and should be examined in future work. Third, it is possible that the boundaries of the rezoning areas were drawn to match expected new development patterns and local market demand (even though there are no evident pre-trends). If so, then the effects here may be somewhat overstated.

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

7. Tables

Table 1: List of Upzoned Areas 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 Dist	2009
North Tribeca Rezoning	2010
Third Ave-Tremont Ave Corriodors	2010
West Clinton Rezoning	2011
East Fordham Road	2013

Table 2: 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			
Age	44.01	43.61	0.407***
	(12.96)	(12.64)	(0.0350)
Share of Homeowners (Imputed)	0.291	0.277	0.285
	(0.454)	(0.447)	(0.452)
Years in current address	6.542	6.579	0.0263*
	(5.855)	(5.824)	(0.0131)
Migration: Any Move	0.0703	0.0612	0.0063***
	(0.256)	(0.24)	(0.0005)
Migration: Move out of NYC	0.0245	0.0221	0.0018***
	(0.155)	(0.147)	(0.0003)
Number of Persons	171,145	102,208	

* p<0.1   ** p<0.5   *** p<0.01

Table 3: Effect on Housing Supply (PLUTO data)

	(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

Standard errors in parentheses

* p<0.1 ** p<0.5 *** p<0.01

Table 4: Effect on Out-Migration

	(1)	(2)	(3)	(4)	(5)
	Any Move	Move Tract	Leave NYC	Move CBSA	Log Median Tract Income amog 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)
4-8 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)
4-8 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)
4-8 years after # Treatment	-0.000	-0.000	0.002**	0.001**	0.008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.022)
N	963390	963114	963336	963336	34874

Standard errors in parentheses
* p<0.1 ** p<0.5 *** p<0.01

Table 5: 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 (0-8 years) # No new building or demolition permit	0.002***	0.003***
	(0.001)	(0.001)
Post Upzoning (0-8 years) # New building or demolition permit	0.011	0.012
	(0.009)	(0.008)
Panel B: By whether building on parcel is altered after upzoning		
Post Upzoning (0-8 years)# No alteration	0.002***	0.003***
	(0.001)	(0.001)
Post Upzoning (0-8 years) # Alteration	0.007	0.007
	(0.005)	(0.005)
Panel C: By parcel-level change in residential capacity		
Post Upzoning (0-8 years)# No Increase	0.001	0.001
	(0.001)	(0.001)
Post Upzoning (0-8 years) # Moderate Increase (<=50%)	0.003*	0.003**
	(0.001)	(0.001)
Post Upzoning (0-8 years) # Substantial Increase (>50%)	0.004***	0.004***
	(0.001)	(0.001)
N	2677288	2676226

* p<0.10 ** p<0.05 ***p<0.01

Table 6: Effect on In-Migration

	(1)	(2)	(3)
Log (Origin Tract Income)	Treatment v.s. full ring (0-1000 feet)	Treatment v.s. inner ring (0-500 feet)	Treatment v.s. outer ring (500-1000 feet)
0-3 years after=1 # treated=1	0.020*	0.017	0.018
	(0.012)	(0.013)	(0.018)
4-8 years after=1 # treated=1	0.022*	0.015	0.024
	(0.010)	(0.013)	(0.016)
N	144960	110183	89250

Standard errors in parentheses
* p<0.10 ** p<0.05 *** p<0.01

8. Figures

Figure 1: Lot-level change in residential capacity

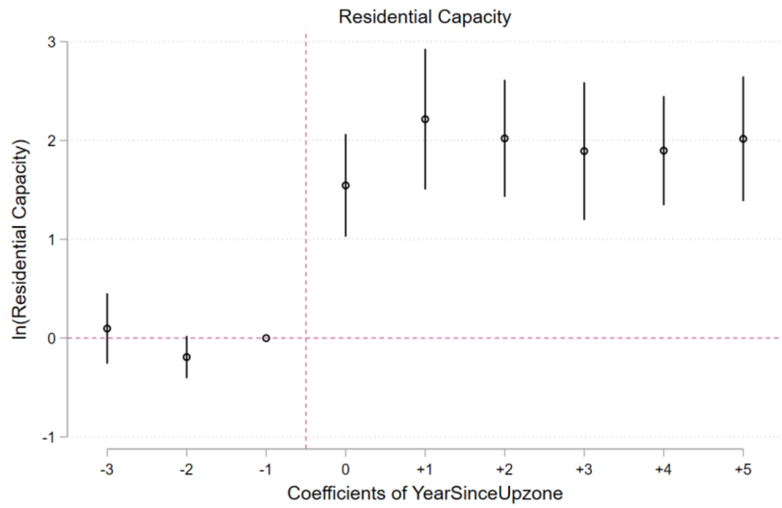


Figure 2: Upzoned areas in NYC from 2004-2013

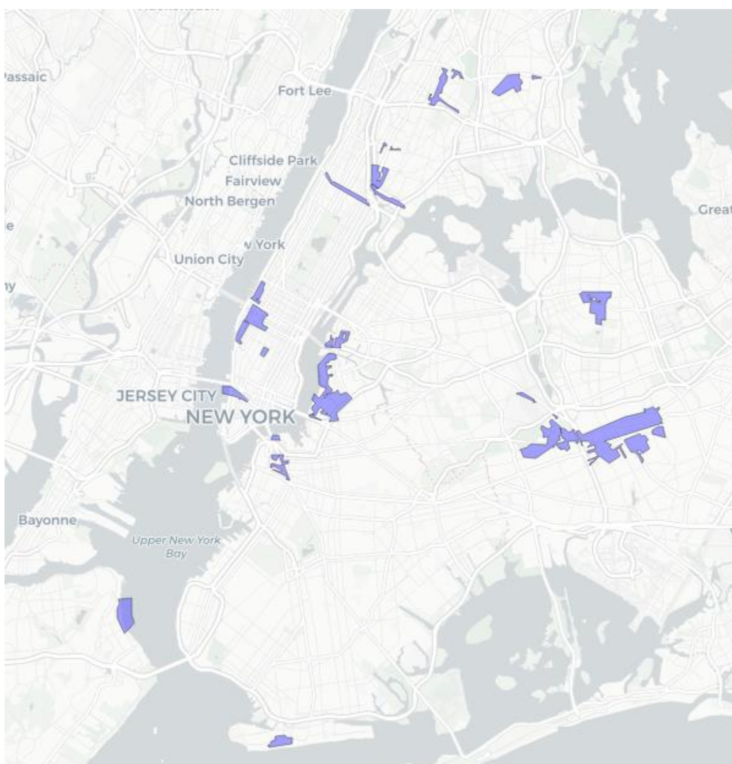


Figure 3—Effect of Upzoning on Housing Supply

Figure 3A: Effect of Upzoning on Certificate of Occupancy (difference-in-difference)

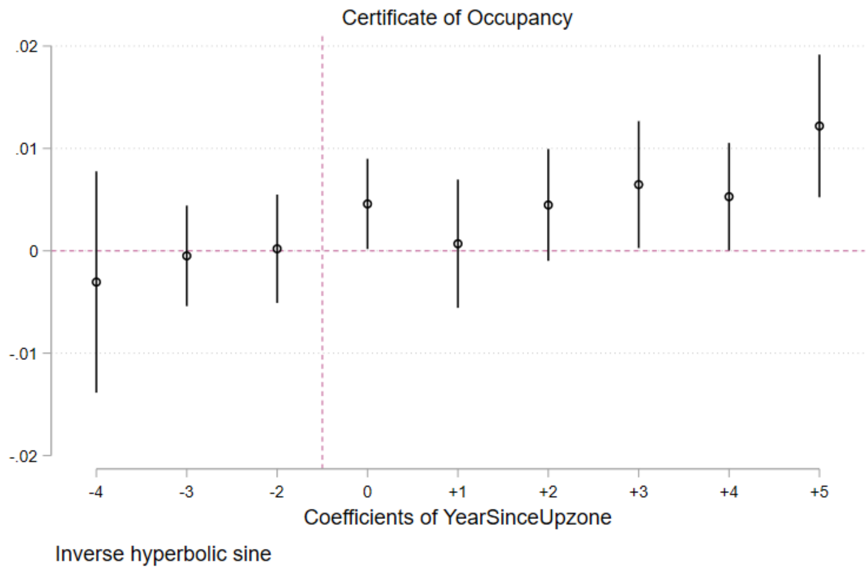


Figure 3B: Descriptive change of Certificate of Occupancy (treatment v.s. control)

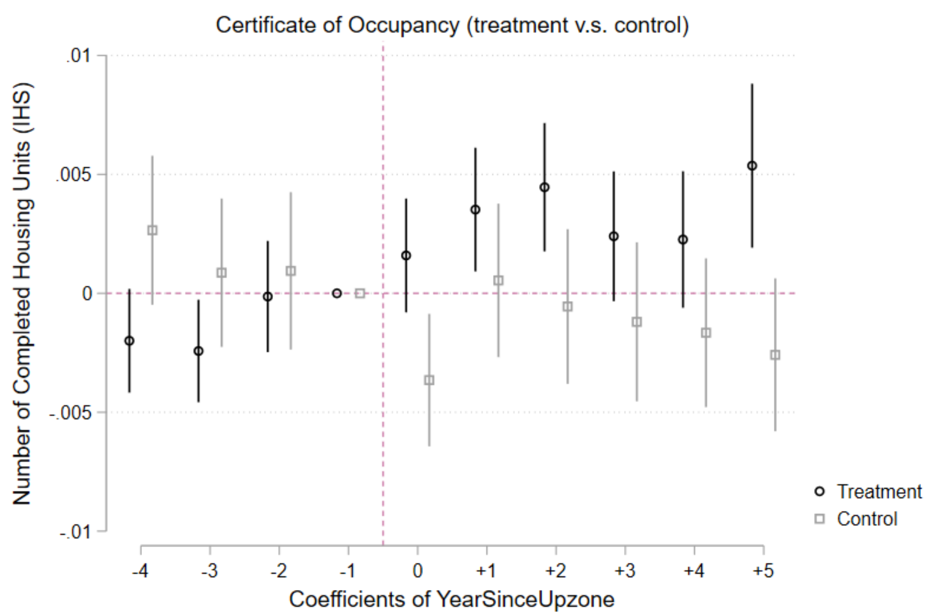


Figure 4: Effect of Upzoning on Total Number of Residential Units (PLUTO)

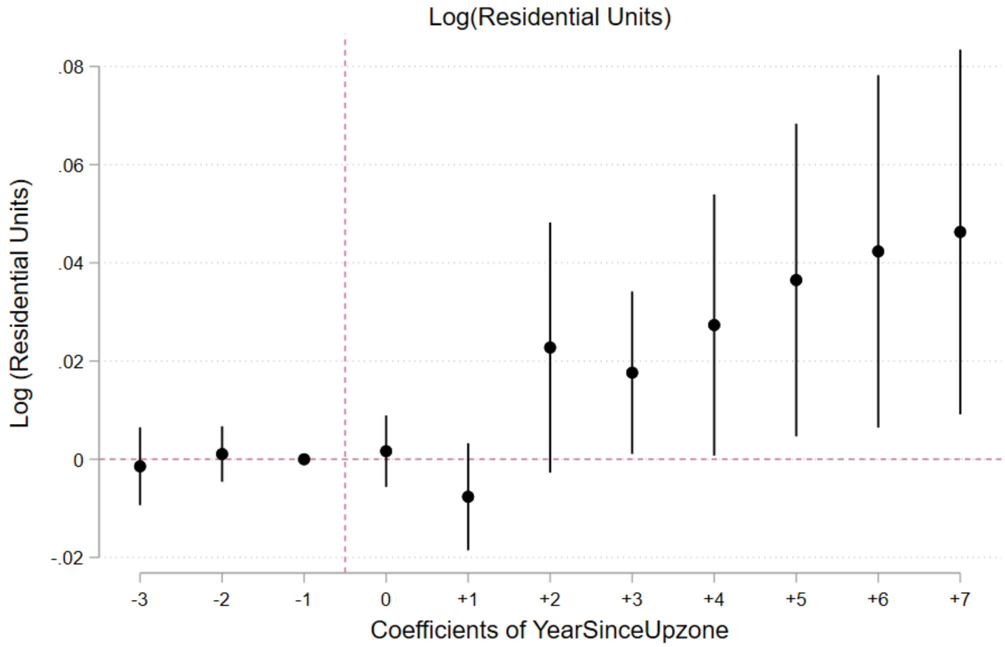


Figure 5A: Effect on Sales Prices of Residential Properties

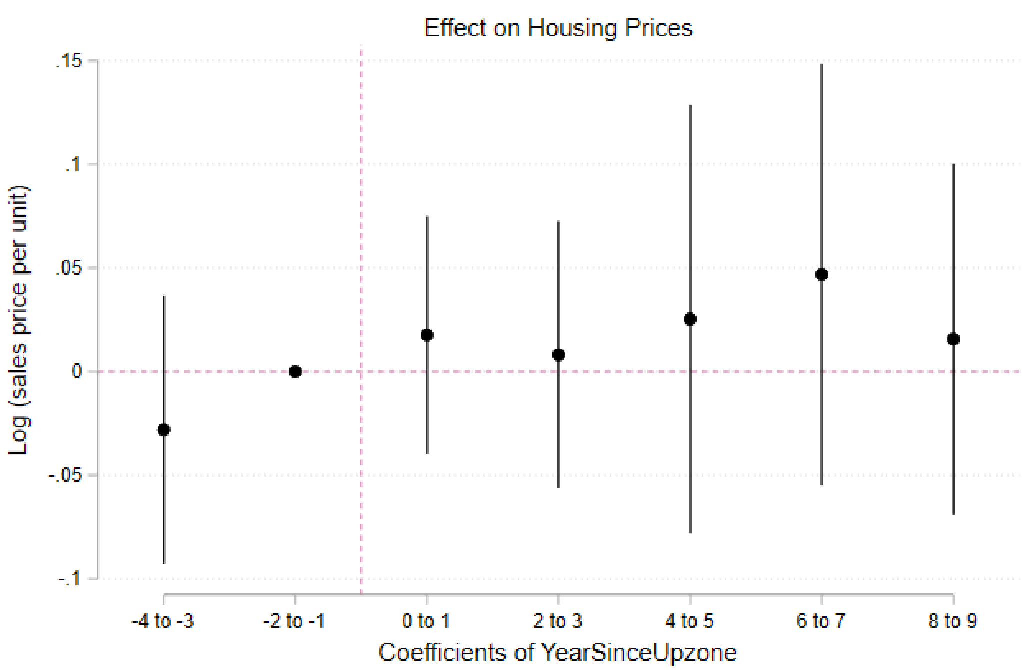


Figure 5B: Effect on Sales Prices of Residential Properties, by Treatment Intensity

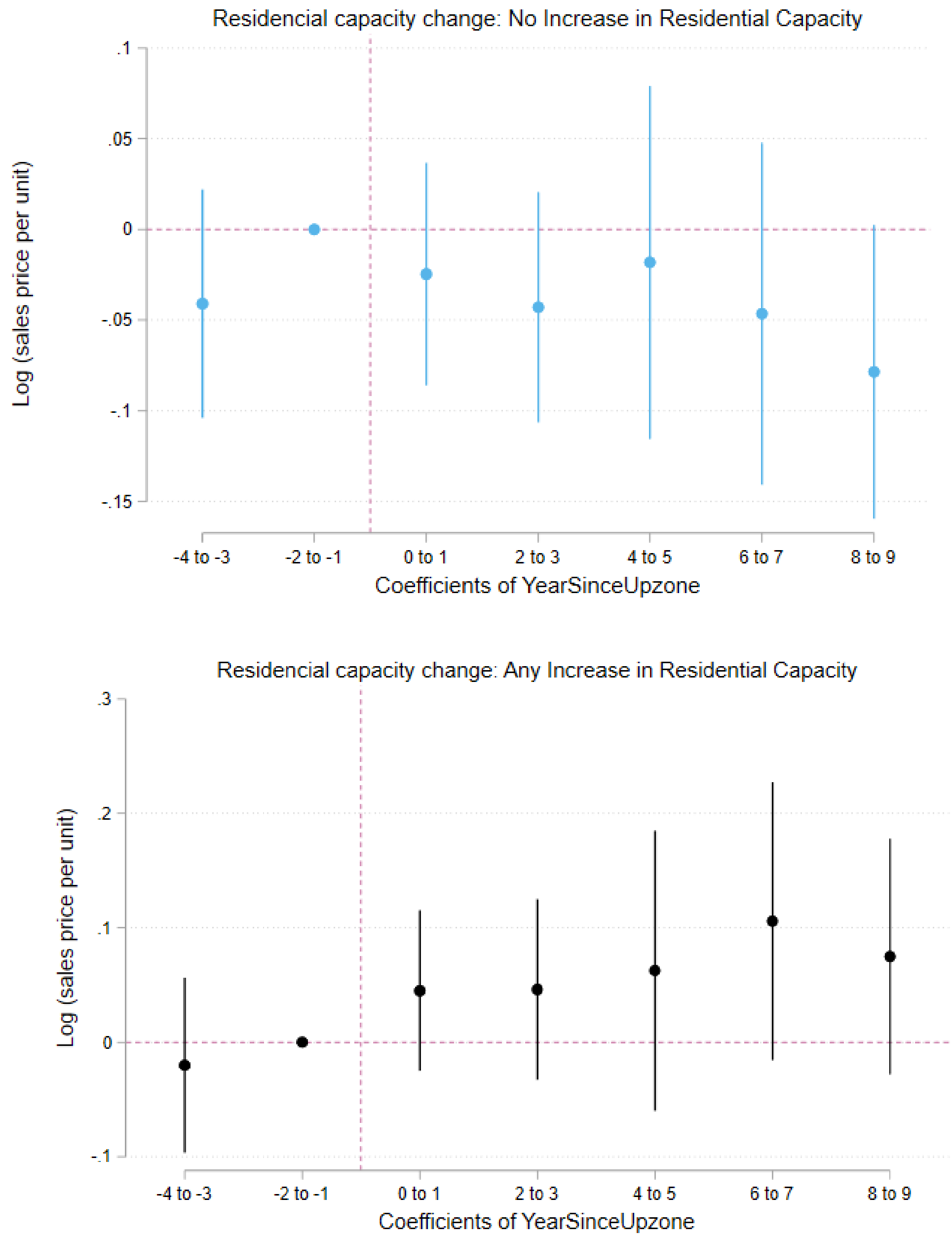


Figure 5C: Effect on Housing Prices of Residential Properties

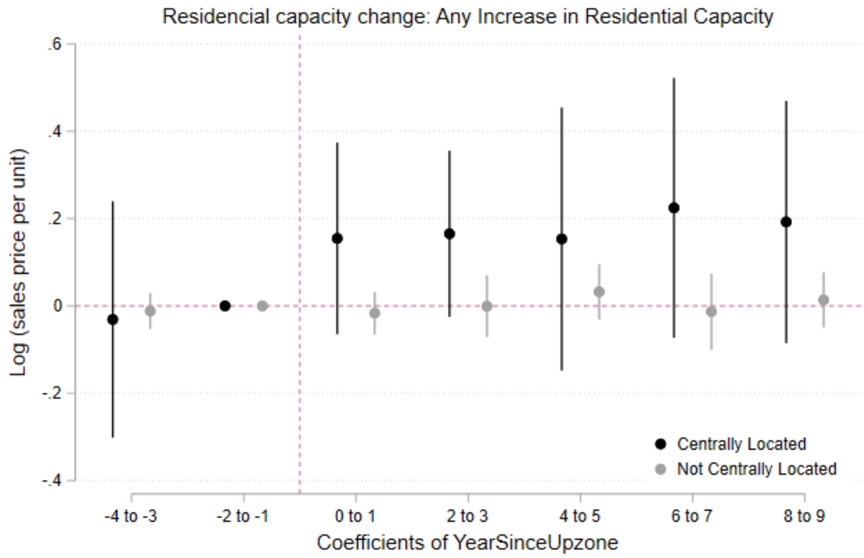
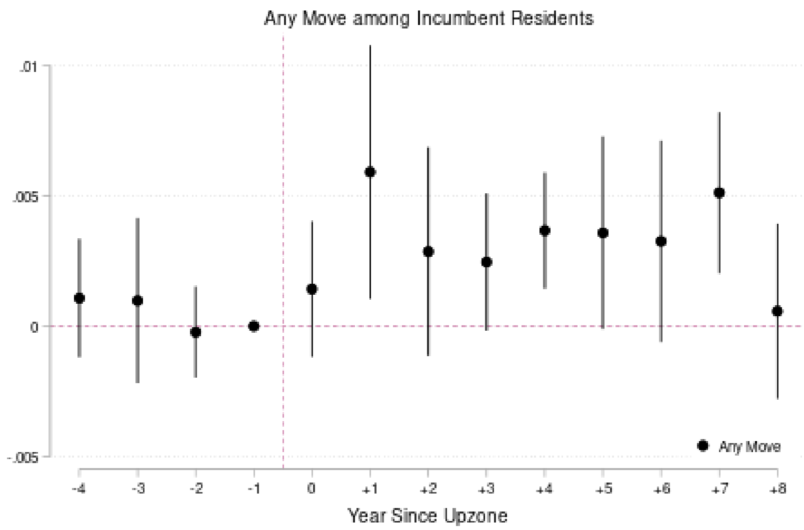
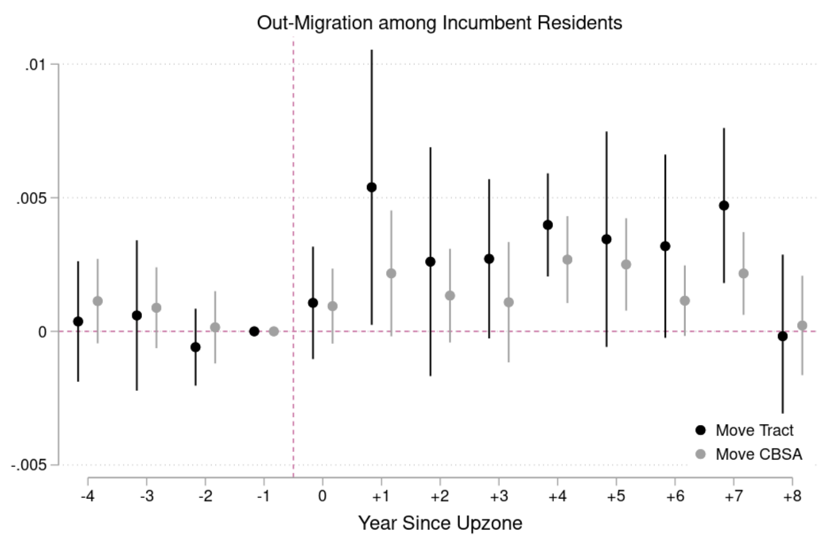


Figure 6: Effect on Out-Migration



(A) Any Move



(B) Move Tract and Move CBSA

Figure 7: Effect on Neighborhood Tract Income among Movers

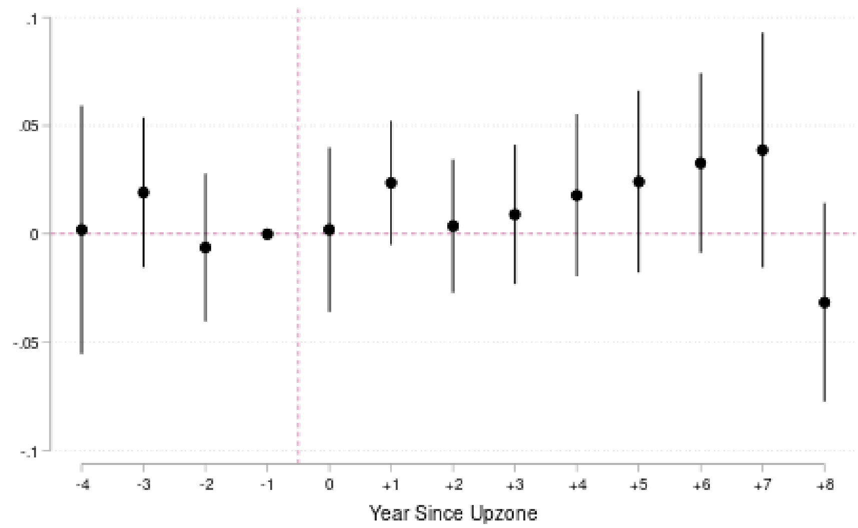


Figure 8: Out-Migration by Imputed Race/Ethnicity

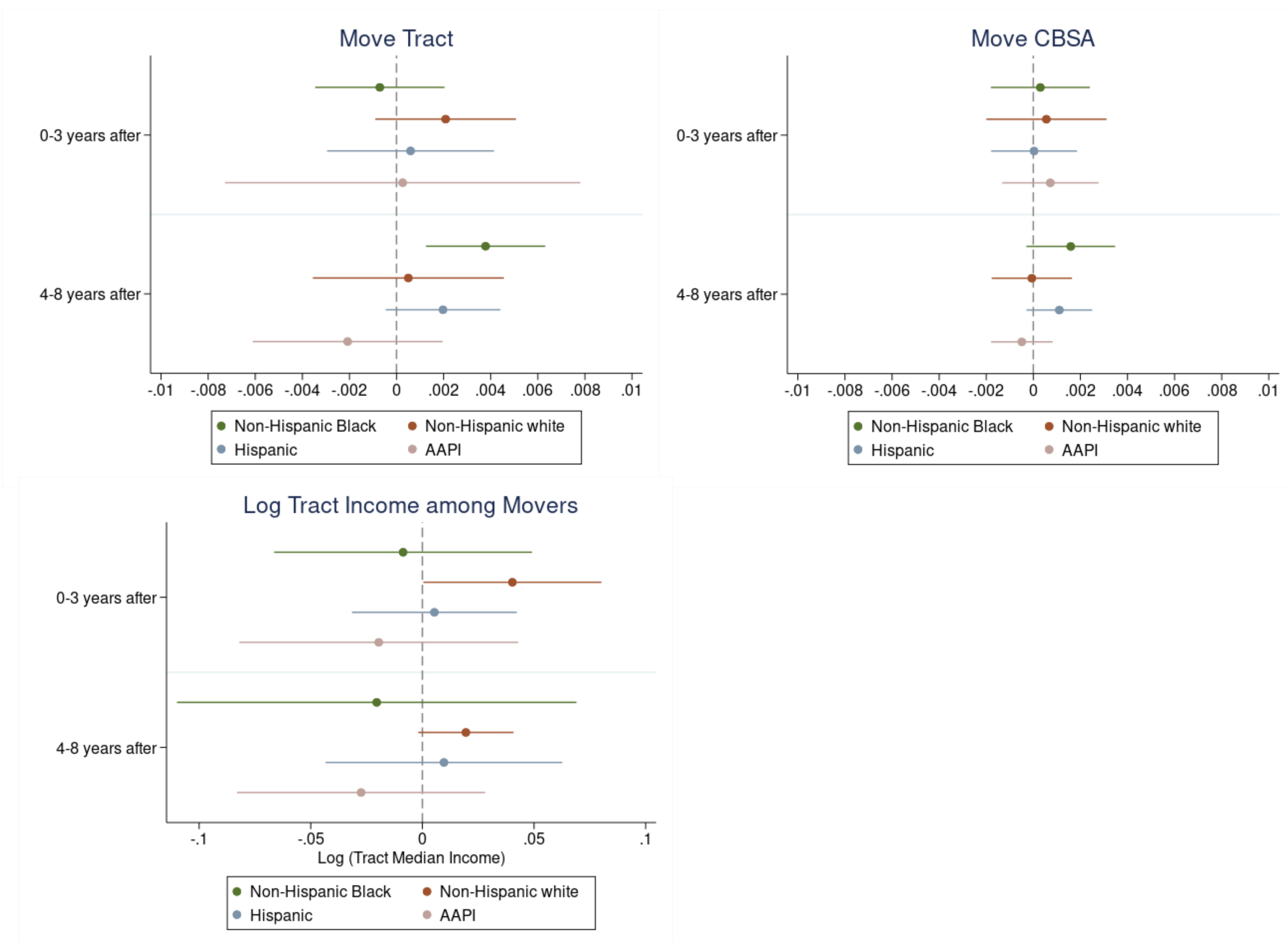
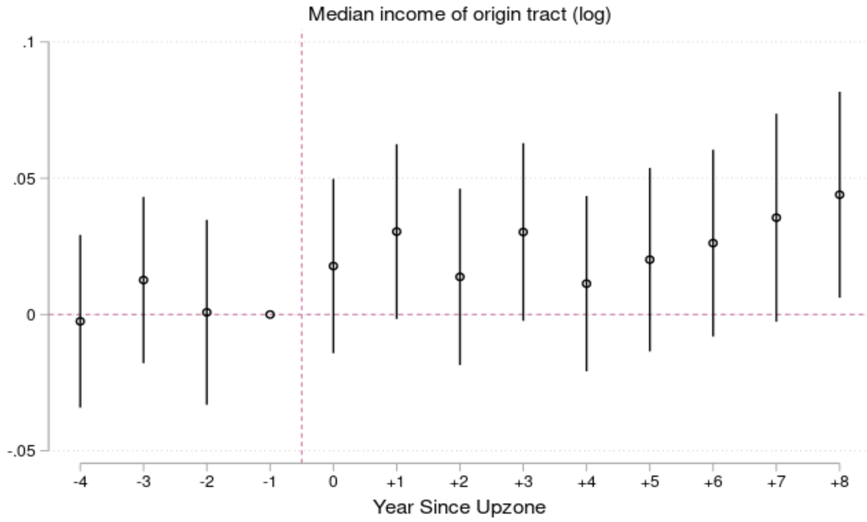


Figure 9: Effect on In-Migrants



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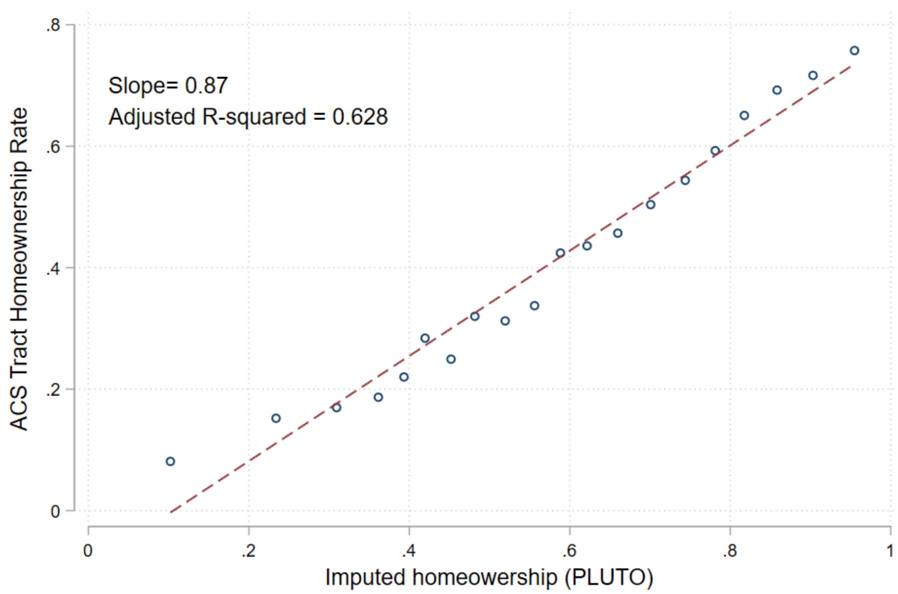
Appendix A: Data Construction and Descriptive Statistics

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 the building code and the 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, condo, co-op, 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 30 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



A.2 Race Imputation

To impute the race of individuals in Infutor, we 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. That said, BISG is still commonly adopted by social scientists to impute race. More technical details can be found in their paper.

When first names cannot be matched and the individual cannot be assigned racial probabilities, we apply the BISG method 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, we 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 ethnic characteristics of the census tract associated with the individual's past and estimate the posterior probabilities for the six racial/ethnic groups. I test how the imputed results look different when we use different addresses from the same individual's residential history. It turns out that the imputation results are not sensitive to the addresses we use, especially when we apply the probability threshold when assigning race.
- First name: Following Voicu (2018), we 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 of race/ethnicity r for each of the six categories:

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

I follow Diamond, McQuade, and Qian (2019) and only assign imputed race when I only assign a race to an individual if the probability of that race is above 80 percent. In my final sample, I imputed 71 percent of the incumbent residents living in the treatment or control areas.

I validate the imputation results using the 2019 ACS. When comparing against the 2019 ACS, we see that 82.9 percent of individuals are assigned a race when we don't apply the threshold of 0.8 when assigning race. 17 percent of the individuals are not assigned a racial/ethnic group either because their first names cannot be matched to the list from the mortgage dataset, their surnames cannot be matched to the list of most common names from the Census, or census tracts cannot be property assigned to their residence. 75.4 percent of individuals are assigned a racial/ethnic group if we apply the 0.8 threshold. In general, we seem to over count whites, especially in Manhattan.

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

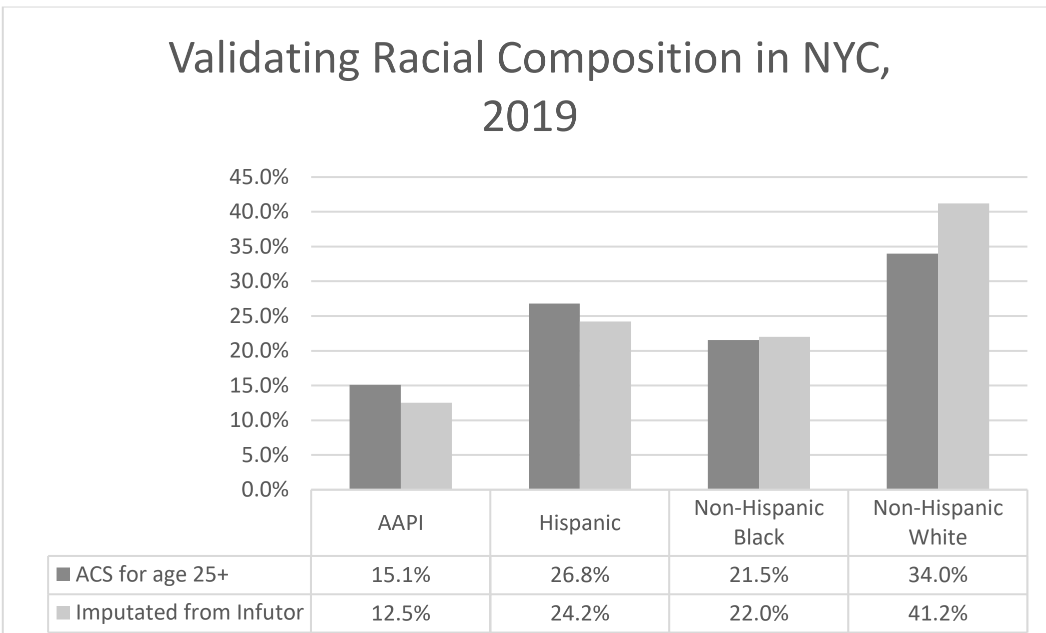
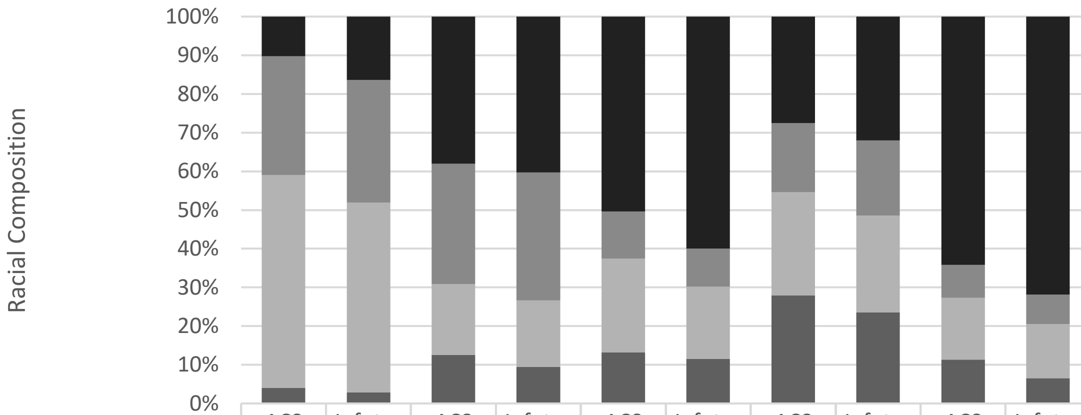


Figure A.3: Racial Composition by Borough/County in New York City, ACS v.s. Imputation from Infutor (2019)



	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%

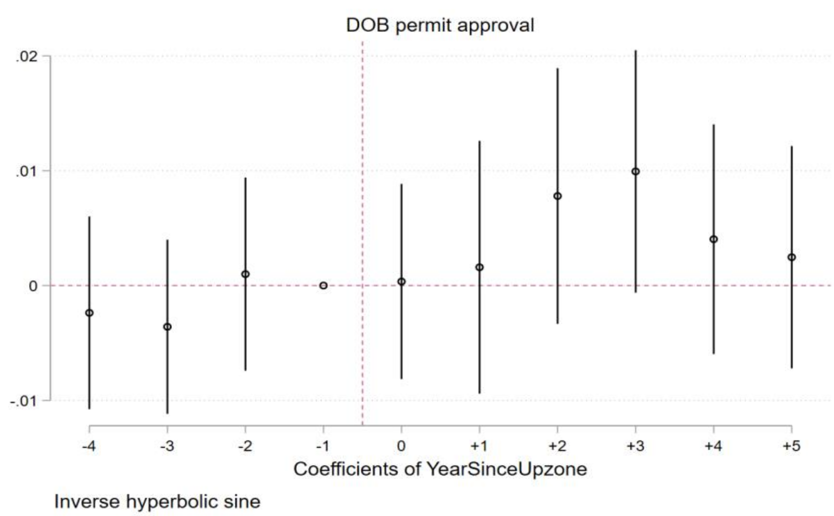
Appendix B: Additional Figures for Main Results and Robustness

B.1 Housing Supply: Alternative Measurement of Housing Supply

Aside from using the NYC Certificate of Occupancy dataset from the NYC Department of Buildings (DOB) and the number of residential units on a parcel from Primary Land Use Tax Lot Output (PLUTO) to measure housing supply, I also use the 2000-2018 DOB Permit Issuance dataset from the NYC Open Data as an alternative measure to identify the timing and location of new building permit approval.[20] I include only permits approved for new buildings. The dataset includes location, timing, and the characteristics of the approved new development. The permit approval data indicates how many new building permits (in terms of total number of new residential units) developers apply for have been *approved for construction* (regardless of whether the construction is followed through or completed) while the Certificate of Occupancy data in the main analysis shows how many residential units in the building have been newly *completed*. We can interpret the results using new building permits issued as the effect of upzoning on developers' behavioral response and intention to build more new buildings in the upzoned neighborhoods.

Figure B.1 plots the coefficients for the event study specification in terms of approved new housing permits in terms of the number of residential units per BBL. It shows no pre-trend difference between the upzoned areas and the surrounding buffer after controlling for tract fixed effects and borough-specific time trend. The number of housing units permitted for construction gradually increases by about 1 percent two to three years after upzoning in the treatment area relative to the 1000-feet ring. However, the difference between the two groups becomes smaller in the longer term. The magnitude of the increase may be small because many parcels in the sample do not receive any permit during the sample period.

Figure B.1:



[20] The dataset can be downloaded here: https://data.cityofnewyork.us/Housing-Development/DOB-Permit-Issuance/ipu4-2q9a

Figure B.2: Housing Supply: Treatment Intensity Analysis using Certificate of Occupancy as the outcome variable

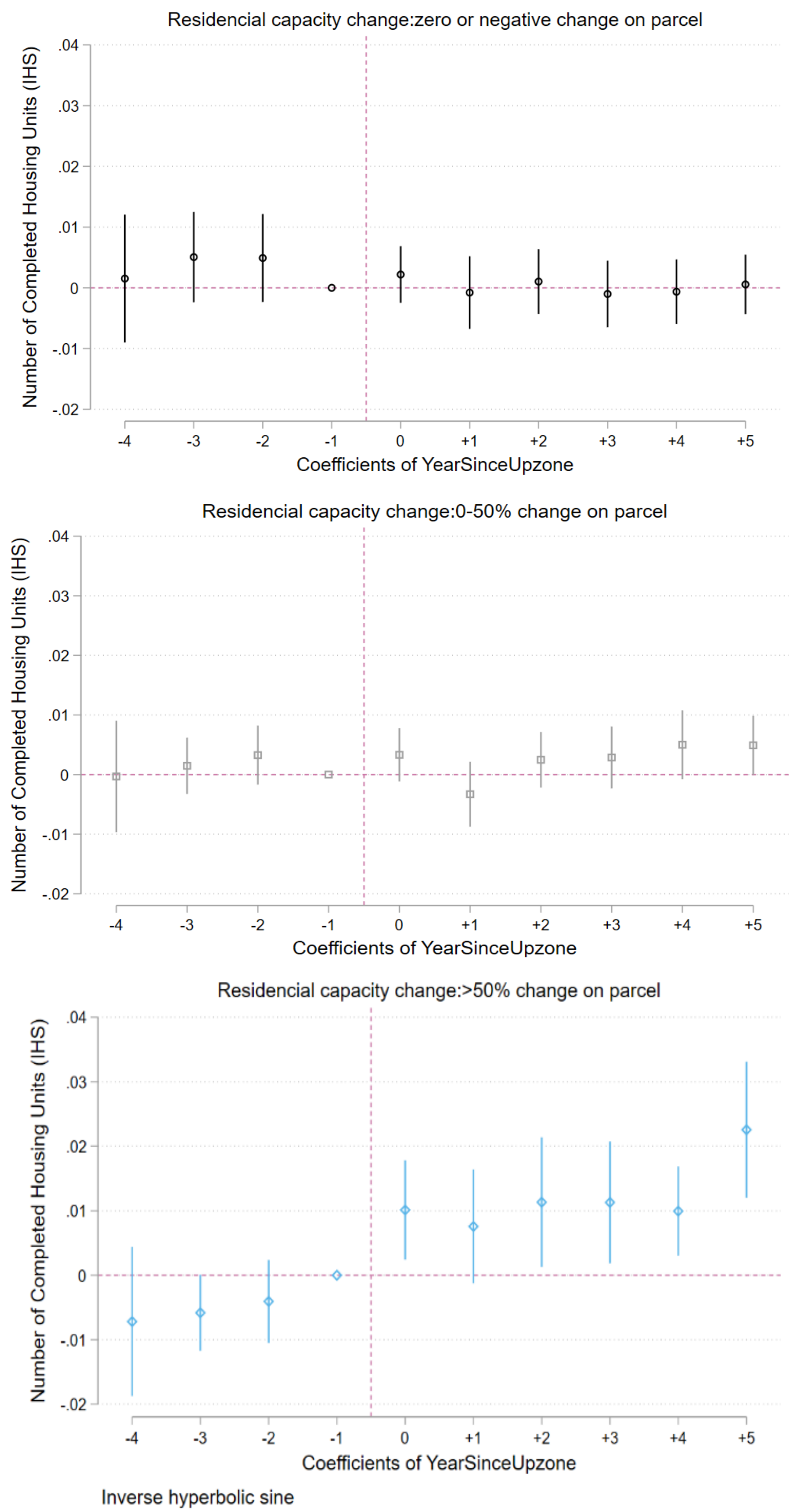
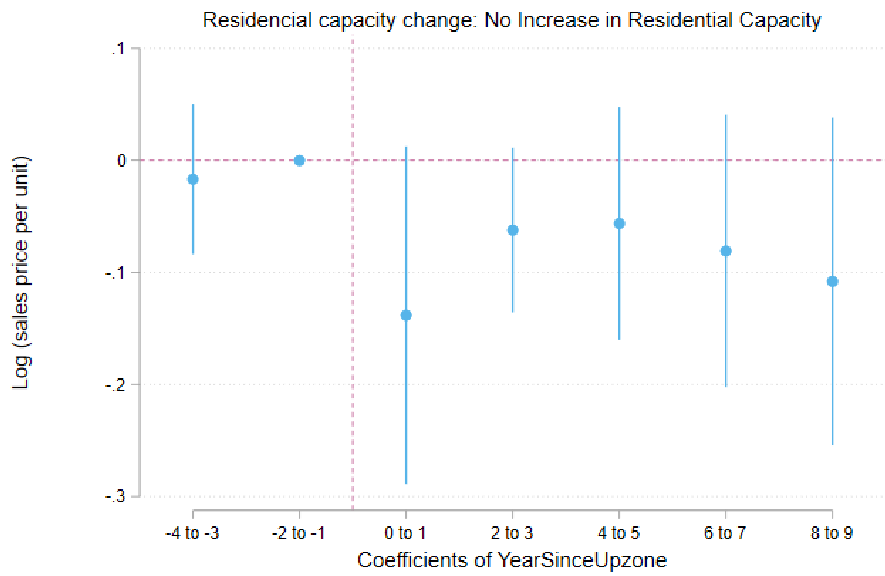
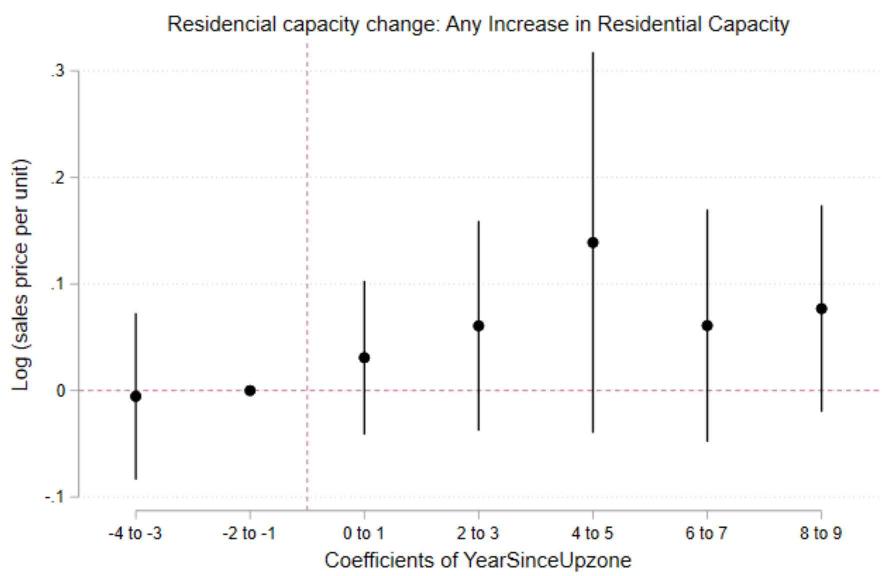


Figure B.3: Robustness of Housing Price Analysis Including New Buildings





Appendix C: Additional Tables for Main Results and Robustness

Table C.1: Effect on Housing Prices

	(1)	(2)	(3)	(4)
	Log(Sales Price)	Log(Sales Price)	Log(Sales Price): Centrally Located	Log(Sales Price): Not Centrally Located
-4 to -3 # rezone=1	-0.028			
	(0.033)			
0 to 1 # rezone=1	0.018			
	(0.029)			
2 to 3 # rezone=1	0.008			
	(0.033)			
4 to 5 # rezone=1	0.025			
	(0.052)			
6 to 7 # rezone=1	0.047			
	(0.052)			
8 to 9 # rezone=1	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 corener	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

Standard errors in parentheses; Standaard errors clustered at the tract level

* p<0.10 ** p<0.05 *** p<0.01