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A Continuing Role for Minimum Parking Requirements in a Dense Growing City? Evidence from New York City.

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ABSTRACT

Many cities throughout the United States require developers of new residential construction to also provide off-street parking, presumably to ensure that new projects absorb any additional parking demand. However, these requirements may potentially increase housing costs directly and indirectly by bundling parking with new housing and reducing the number of units developers can fit on a lot. They may also reduce the subsequent costs of car ownership, increasing car-use and associated externalities. Our research explores the role of minimum parking requirements in New York City, given its shortage of affordable housing and the emphasis policymakers have placed on sustainable growth. After a review of their history, we use lot-level data to calculate and map two measures of parking requirements to better understand their intersection with transit accessibility and development opportunity. Our results indicate that the per-unit parking requirement is generally lower in areas near rail transit, consistent with the City's development goals. However, we also find that the required number of spaces per square foot of lot area is generally higher in transit accessible areas. This raises the possibility that parking requirements are working counter to the city's stated development goals in transit-accessible neighborhoods.

1. Introduction

High housing costs present an ongoing challenge to many New York City households. As of 2008, more than half of all renter households in the City spent more than 30% of their income on rent, a common definition of “rent burdened” (Furman Center, 2009). And despite recent declines, the cost of market-rate for-sale housing in the City remains extremely high by national standards. Absent significant policy interventions, projected population growth of nearly a million new residents over the next two decades is likely to add further pressure to the City’s already tight housing market.

The current New York City mayor has articulated a central policy goal of accommodating the projected population growth while increasing access to affordable housing and improving the City’s overall environmental performance. In support of these goals, the City has developed a long term sustainable growth plan, *PlaNYC 2030* (City of New York, 2008), is engaged in an active land use and planning program that has rezoned almost a fifth of the City’s land area (Been et al, 2010), and is spending hundreds of millions of dollars subsidizing the construction or preservation of income-restricted housing. *PlaNYC 2030* envisions these strategies working together to more efficiently use the City’s limited space, allowing for almost one million extra New Yorkers to be accommodated while enhancing quality of life for all the City’s residents and increasing affordable housing options.

Potentially running counter to these interrelated goals, however, is the longstanding requirement in the City’s zoning code that new residential construction in most neighborhoods be accompanied by a minimum number of off-street parking spaces. Such parking requirements, critics argue, are an inefficient use of scarce land and could increase the direct cost of new housing by forcing developers to incur the construction costs of building more parking than otherwise demanded by the market or needed by low and moderate income tenants. Required oversupplies of parking, by consuming land area, might also reduce the density at which developers would otherwise be able to build new housing, potentially restricting the supply of new units. Additionally, if it is requiring the construction of an oversupply of new parking spaces, the City may also be facilitating higher levels of car ownership and thwarting efforts to affect modal shift, reduce traffic congestion and emissions of carbon and other pollutants.

In this research, we explore residential off-street parking requirements in New York City, the most transit-accessible city in the U.S, but one in which housing affordability is a central problem. We begin with a brief background of New York City residential parking requirements, before exploring their evolution and discussing their possible unintended consequences. Those include frustrating housing affordability, transportation, and environmental policy goals. We present this discussion in the context of prior academic research regarding parking requirements and related topics. Next, by analyzing the New York City zoning code and using Geographical Information Systems (GIS), we describe the geographical implications of the current parking requirements at the City, borough and neighborhood level, and the requirements’ relationship to transit accessibility and potential development sites. We conclude by outlining the further steps that would boost

our understanding of the relationship between parking requirements, on the one hand, and housing affordability and transportation behavior, on the other. In this way, we add to the growing debate about the role of minimum parking standards and their potential to undermine some of the City's other key policy goals.

2. Background

The Development of Parking Requirements in New York City

Although New York City was the first large city to implement a comprehensive zoning code (DCP, 2006), it was not until just before the Second World War, in the face of growing car ownership, that policymakers began addressing off-street parking. Because New York City's relatively old housing stock was generally built without accommodation for off-street car storage, increases in car ownership in the City resulted in heightened competition for the limited supply of common pool parking space (e.g. unregulated on-street) (Stern, 2003; Fogelson, 2003).¹ Policymakers then, as now, had three types of interventions available: (1) actively discouraging automobile use (through congestion pricing or increases in parking fees, for example) to promote modal shift to other modes such as public transit; (2) increasing the public supply of parking spaces (on-street or municipally financed public garages); or (3) promoting private sector production of parking spaces, through incentives, regulations, or mandates. In general, New York City, like all American cities, relied on the second two strategies to address the shortage of spaces.

The City's zoning code first acknowledged the growing shortage of parking spaces in 1938 when new provisions were added to regulate the construction of off-street lots and garages. By the 1950's, New York City was also experimenting with using its own resources to increase public parking capacity, both by constructing municipal parking facilities and by metering public spaces (Fogelson, 2003). However, these interventions were limited in scale and did not directly increase the supply of public parking available to car users at their residences. In 1954, however, the City's zoning code first began to require developers of certain types of projects to absorb the additional parking demand generated by their projects through the construction of off-site parking (NYCCPC, 1954; Stern, 2003; Fogelson, 2003; DCP, 2006). This approach, which requires no direct outlay of funds by the City, became the bedrock of the City's parking policy.

In 1961, the City overhauled its land use regulations by adopting the zoning code still in use today (the "Zoning Resolution"), in which minimum off-street parking requirements were increased and imposed for all residential, commercial and manufacturing districts. Excepted from the new requirements were congested areas in Lower Manhattan where policymakers feared additional traffic and where the requirements would impose "uneconomic and impractical" restrictions because of higher building densities (Felt, 1961). In the early 1980s, the exemption was extended to new construction in most of Manhattan because of air quality concerns (New York Times, 1981). In fact, new off-street parking in this zone is generally prohibited.

¹ Even today, the median age of the City's building stock is over 70 years old, dating much of it to a time when car ownership was less than prevalent (Furman Center, 2009).

In general, the Zoning Resolution specifies a minimum number of off-street parking spaces developers must provide for each type of permitted use in each zoning district. For residential buildings, the Zoning Resolution expresses the requirement as a ratio of parking spaces per new housing unit; for instance, a 50% requirement generally requires one new off-street parking space for every two new housing units. Zoning districts that permit higher density typically have relatively low per-unit parking requirements. Table A, below, outlines the basic requirements for each zoning district. In certain zoning districts, reductions or waivers are offered for small or narrow lots and developments that would result in only a small number of required parking spaces. Certain low density neighborhoods, in contrast, are subject to additional requirements, topping out at two spaces per unit in much of Staten Island and parts of the Bronx. The City adopted these additional requirements in the last decade not only to accommodate high auto ownership in these neighborhoods, but also to limit future development to match perceived neighborhood capacity constraints (DCP, 2006).

Table A: Minimum Parking Requirements of Group Provided Parking Facilities

| Zoning District² | Required Parking Ratio (% of Total Dwelling Units) |
|---|---|
| R1, R2, R3, R4, R5A | 100 |
| R5 | 85 |
| R6, R6HF | 70 |
| R4/R5 Infill, R5B | 66 |
| R7-1 | 60 |
| R6QH, R6A, R6B, R7-2, R7QH, R7A, R7B, R7X | 50 |
| R8, R9, R10 | 40 |

Reductions for Affordable Housing:

In addition to reductions for small or narrow lots, minimum requirements are reduced for units in affordable and elderly housing developments. The provision of affordable housing and housing affordability in general has always been of concern to policymakers in New York City. The City’s most recent strategy, *The New Housing Marketplace 2004-2013*, sets the goal of creating or preserving 165,000 units of affordable housing for half a million low- and moderate-income New Yorkers (HPD, 2005). Central to achieving this goal is the use of innovative strategies to maximize “one of New York’s most precious resources: land” (HPD, 2005). The Zoning Resolution sets out five classes of buildings that can receive reductions in minimum parking requirements (Section 25-25 of the Zoning Resolution, in effect as of October 14, 2009). Publicly assisted housing receives the smallest reductions (approximately 20-25% less than market-rate housing) while developments designated for the elderly receive the highest reductions (approximately 60-75% less than market-rate housing). Public housing developed and

² If not specifically designated, the outlined zoning districts include subsets of those districts (e.g. R1-1, R1-2 etc.)

managed by the New York City Housing Authority receives a reduction of 50-70%. The final two categories (certain federally subsidized projects approved before 1974 and buildings that were rehabilitated through the City's 10 year plan for reconstructing *in rem* buildings and vacant lots) received reductions similar to the publically assisted housing category, but are no longer relevant to any new development.

The varying reductions in minimum parking requirements based upon housing type suggest that policymakers believe(d) that housing for the elderly is generally the least likely to generate additional demand for parking, while publically assisted housing is only a quarter less likely to be in need of a parking space than populations in market rate units. This difference is presumably based on the assumption that the socio-economic characteristics of residents in these residences made them less likely to own cars, resulting in lower demand for parking (Jia and Wachs, 1998, Salama et al, 2005, USEPA, 2006, DCP, 2009).

3. Literature and Theory

The common pool nature of public parking stocks has militated against leaving the provision of parking solely to market forces. Researchers since Shoup and Pickrell (1978) have argued for the introduction of price signals to regulate demand for on-street parking. However, policymakers generally continue to respond to perceived parking shortages instead by requiring developers of new parking demand generators (including new housing) to provide associated off-street parking (DCP, 2009; Sterner, 2003; Fogelson, 2003; Shoup, 1999). Existing users of a local pool of on-street parking (typically local residents or businesses) have a vested interest in keeping the price of parking low. These users also exert influence on local policymakers to limit the demand for that pool of parking because of their ability to exert only usership rights over that space; that is, ownership only while the space is occupied. As demand increases, the heightened competition can result in a perceived shortage of public parking, one of the most difficult and politically explosive local issues (Epstein, 2002). The political outcome is that elected policymakers tend to enact legislation to require that developers of new parking generators mitigate the potential impact on the existing pool of public parking spaces.

However, this responsiveness to local and short-term concerns about additional demand for existing spaces may have unintended longer-term consequences on housing affordability (in exclusionary jurisdictions, those effects may be intended), environmental quality and transportation. Those consequences are not well understood (Shoup and Pickrell, 1978; Weinberger et al, 2008). Unless the full cost of building and operating required parking spaces is borne by the developer or passed on as a separate, optional fee only to the residents who wish to use the spaces, minimum parking requirements require developers to "bundle" at least some of these costs with the prices they charge for the housing itself. As a result, non-car owning residents are either required to subsidize the construction of spaces they will not use, or will be forced to purchase more "parking space" than they otherwise would have preferred. Parking requirements almost certainly increase the supply of off-street parking spaces beyond what the market would provide independently, critics argue, or else they would not be so firmly entrenched in local

zoning codes (Shoup, 2005). While such an oversupply may reduce or eliminate the externalities that new residents impose on an existing pool of public parking, the costs of such an oversupply are likely passed on to all homebuyers and renters, increasing the cost of all new housing subject to the requirements (AIA, 2003; Salama et al, 2005).

In addition to the direct construction and operating costs parking requirements may add to new housing, any required oversupply of spaces can carry high opportunity costs where land is scarce or development budgets tight. Those opportunity costs are particularly significant for developers in the affordable housing sector. In developments at densities insufficient to support structured parking, for example, the surface area consumed by required spaces may be at the expense of additional housing units, or at the very least, green space that would have served as an environmental amenity. Where parking structures are constructed, the marginal cost of building additional space, if not recouped from parking fees, reduces the funding that can be spent on unit construction. Despite the reduced minimum parking requirements for certain classes of affordable housing, practitioners and affordable housing policy analysts still call for a further reduction or even elimination of these minimums (AIA, 2003; Salama et al, 2005; Lubell, 2009; Weinberger et al, 2008).

More broadly, parking requirements that require developers to devote finite land area to parking (particularly surface parking) may also create *de facto* density caps below what otherwise would have been permitted by the applicable zoning requirements. Requiring lower density, in this case through parking requirements, can restrict the supply and increase the cost of new housing (Glaeser et al, 2005).

The required overproduction of spaces and bundling of costs can also impact the City's transportation patterns and environmental quality in ways at odds with the City's stated goals. *PlaNYC 2030*, the City's sustainability plan, envisions a pattern of growth characterized by high density living in transit-accessible neighborhoods intended to lessen the environmental footprint of each new resident and the City as a whole. To combat chronic traffic congestion, the administration of Mayor Michael Bloomberg expended significant political capital unsuccessfully championing a road congestion pricing plan for much of Manhattan (City of New York, 2008). But bundling can change the incentives for car ownership, by requiring the consumption of parking spaces that may not have been demanded in the first place, or by spreading the construction and operating costs of parking spaces across all new units. In the latter case, automobile owners are subsidized by their non-car owning neighbors. The reduction in the cost of car ownership through underpriced parking may induce additional demand for autos (Downs, 1992; Mukhija and Shoup, 2006). That increased demand may in turn, lead to a cycle in which policymakers require the provision of still more parking to alleviate perceived local shortages created by that demand, but thereby inducing yet further demand for autos (Mukhija and Shoup, 2006; Litman, 2007). Furthermore, increased car ownership resulting from subsidized parking may hinder modal shift to transit or non-motorized forms, a crucial component of the City's transportation and environmental goals. Dueker et al (1998) point out that that a central connection between parking and transit usage lies in the supply and price of parking. If car ownership and, by extension,

use is subsidized through parking requirements, the already underpriced nature of private car use will be exacerbated, further increasing congestion and other externalities. These externalities, including traffic congestion and air pollution (both local and global), noise pollution and energy security, are created individually but borne collectively by society (Hensher and Brewer, 2001; Sterner, 2003).

It is also well understood that higher densities are generally associated with wider selections of accessible mixed use destinations and more sustainable transportation patterns (USEPA, 2006). Density is also correlated with lower car ownership; some research has found that with each doubling of residential density, auto ownership declines by 32-40% (Holtzclaw et al, 2002). To the extent they serve as a *de facto* density cap in some cases, then, parking requirements hinder the realization of the environmental benefits of density.

To date, there is little empirical work examining the direct impact of required parking construction costs on affordability, though multiple sources have pointed to the requirements as a barrier to affordable housing in New York City (AIA, 2003; Salama et al, 2005). Research by Jia and Wachs (1999) indicated that single family housing units and condominium units in San Francisco were more than 10 percent more costly if they included off-street parking, controlling other factors.

Likewise, though the impacts of minimum parking requirements on transportation and development patterns are receiving an increased focus from policymakers and academics alike, the empirical evidence is thin. At present, New York City does not have any accurate estimate of the number of residential parking spaces actually constructed pursuant to the requirements³ (nor, for that matter, does it estimate the number of on-street parking spaces, despite the City's Climate Protection Act (2007) which requires the NYCDOT to provide on-street parking information for every block in the City (Council for the City of New York, 2007)). However, researchers such as Weinberger et al (2008), in work commissioned by *Transportation Alternatives*, an advocacy group, and New York City's Department of City Planning (DCP, 2009) have explored different aspects of minimum parking requirements. Weinberger et al. (2008) uses data from the City's Primary Land Use Tax Lot Output (PLUTO) database to assign parking requirements to the City's residential zoning districts and estimate required off-street parking spaces per acre. The analysis also projected auto ownership and vehicle miles traveled (VMT) for the estimated 265,000 additional dwelling units needed to accommodate one million additional residents by 2030 (City of New York, 2008). The authors estimate that the most likely development scenarios (using existing minimum parking requirements) will produce an additional 1 to 1.55 billion annual VMT and approximately 450,000 annual metric tons of carbon. They conclude that minimum parking requirements are likely to undermine or even reverse the City's goal for carbon reduction. However, unlike this research, it does not focus on minimum parking requirements in relation to transit accessibility.

³ In late 2009, the City began making available certain data about parking facilities licensed by the Department of Consumer Affairs. We are still exploring future uses of this data in analyzing the effects of residential parking requirements, future research will explore these relationships.

The DCP Study (DCP, 2009) combines vehicle registration data from the New York State Department of Motor Vehicles with new construction data from Department of Buildings Final Certificate of Occupancy filings for 1995 to 2005 to match car ownership to occupants of new housing units in 48 out of the 59 Community Districts in New York City. The study asserts that car ownership per new housing unit is affected mostly by location and building type, as well as by income and family structure. The study's focus is on recently constructed unit. It analyzes car ownership near transit, but focuses only on access to subways, ignoring both the Long Island Rail Road (LIRR) and Metro-North. Both commuter railroads, however, constitute very significant elements of the transit network, especially further from the Manhattan CBD. The DCP's study also ignores much of Manhattan and Staten Island, the City's most and least dense boroughs respectively. Further, while the DCP Study explores the relationship between housing densities and parking requirements, it ignores the potential role of minimum parking requirements as a *de facto* cap on the density of new housing construction independent of other zoning restrictions and the resultant impact on affordability. In contrast to researchers like Clark (2007) and Weinberger et al (2008), the DCP study assumed that car ownership is largely exogenous to the local policy process, determined more by socio-economic factors and building type rather than transit accessibility and/or minimum parking requirements (DCP, 2009, p.51). Critically, it also questions whether government policy should or even can engage in parking demand management by influencing "the public's propensity to own cars" as an alternative to simply accommodating it (DCP, 2009, p.56). This accommodation strategy is counter to *PlaNYC 2030*, which foresees a role for active policy intervention to direct development to transit-rich areas to facilitate more sustainable transportation patterns.

The research presented in this article extends the literature on parking requirements in New York City in several ways. Although we can not presently address head on the impact of parking requirements on construction costs or development patterns, or critique the absolute level of the requirements, we are able to compare the relative burden they impose on different groups of lots, and to explore the relationship between variations in the requirements and transit accessibility. Our analysis is based on lot-level data, which should yield more precise estimates than the approach Weinberger et al (2008) used, which relied on zoning districts to assign parking requirements. The lot level approach allows us to estimate the effects of waiver provisions that reduce parking requirements for certain types of developments and to calculate the average requirements applicable to lots underdeveloped as of 2007, which are the lots with the greatest potential for redevelopment as new housing. Further, our analysis looks at the relationship between minimum parking requirements and transit accessibility, including transit and commuter rail, unlike the prior literature. These analytic advances should provide an important foundation for further investigation of parking requirements in New York City.

4. Geographical Analysis Methodology

Our quantitative analysis explores how parking requirements differ across various geographical areas and across different types of lots. Specifically, after estimating parking requirements for each lot (with and without taking into account available waivers), we calculate the average parking requirement for the city as a whole, its five boroughs, and areas that are inside and outside 1/2 a mile of a rail transit station, which we define as a New York City Transit operated subway station, Metro-North station or Long Island Rail Road station. Building upon the work of Been et al (2009), we also explore the relationship between underdeveloped sites in New York City and the parking requirement to better understand which levels of the requirement apply to those lots most likely to be redeveloped.

For our analysis of each group of lots (e.g., geographic area or type of lots), we calculate two different measures of the average parking requirement, each of which is aimed at capturing different measures of required parking. The first is the average per-unit requirement specified by the Zoning Resolution (which we refer to as average required parking ratio). For groups of lots, we weight this per-unit requirement by the maximum permitted building area for each lot in the group.

The second measure is more complex and is an estimate of the average number of parking spaces that are required per 1000 square feet of mapped parcel land area (i.e., not including public streets and public parks), weighted by the land area of each lot. This measure not only takes account of the per unit requirement of each lot, but the allowable building density as well, to estimate the actual number of parking spaces required per land area. Our specific methodology for calculating these measures is described later in this section.

Our methodology is an extension of one developed for a project investigating the rate of lot-level underdevelopment and redevelopment in the City between 2003 and 2007 (Been et al, 2009). As part of that project, the authors created a database of every parcel of land in New York City (i.e., excluding condominium units and air rights lots) in 2003 and 2007 based upon GIS basemaps from the private data provider LotInfo (for 2003) and PLUTO (for 2007). The authors then joined the database to the 2003 and 2007 versions of the New York City Real Property Assessment Database (RPAD), a proprietary data set maintained by the New York City Department of Finance for property tax assessment purposes. This annually updated database contains detailed information about each unique owned parcel of real property recognized by the City of New York (known as “tax lots”). Included in the data are tax identification numbers, details about each lot’s land area, the building area on the lot, the zoning district the lot is in, and several other characteristics about the lot and any building(s) on the lot. The lot database was further augmented with information derived from a GIS analysis performed for each lot in 2003 and 2007, including whether the lot was included in a city-initiated rezoning study area; whether the lot fronted or was within 100 feet of a wide street (with a right of way more than 75 feet wide); whether the lot was in a Special District or Inclusionary Housing Area

(areas with specific zoning rules); and the distance from the lot to the nearest rail transit station.

Similar to Been et al (2009), we estimate for every 2007 residentially zoned lot in the database the applicable maximum allowable floor area ratio (FAR). A lot's FAR represents the ratio of the gross building square footage built on that lot to the lot's land area. A maximum FAR, set by the Zoning Resolution, effectively caps the amount of building area that can be built on a lot to a multiple of its land area (for example, a 10,000 square foot lot with a maximum FAR equal to 2 cannot be developed with a building larger than 20,000 square feet). In order to estimate a tax lot's maximum FAR, we start with the default maximum FAR specified by the Zoning Resolution for the zoning district in which the tax lot is located (as indicated by RPAD) and then adjust that default maximum FAR based on other lot characteristics that, pursuant to the Zoning Resolution, affect the maximum FAR (generally determined using GIS). The maximum FAR estimates also make several assumptions regarding discretionary and bonus programs in the Zoning Resolution that permit developers to either exceed the base maximum FAR if they include certain amenities (affordable housing, for example), or exclude the square footage of certain building elements (enclosed garages, for example) when calculating FAR. For a full description of the model for determining maximum FAR, including the assumptions it relies on, see Been et al (2009). For our analysis, we expand this FAR estimation process to include lots in non-residential zoning categories (e.g., commercial) that permit some level of residential use. For these lots, we perform the estimation process based on the "residential equivalent" category the Zoning Resolution assigns to these other zoning categories.

By multiplying the maximum FAR assigned to each lot by that lot's land area (contained in RPAD), we calculate the maximum amount of residential building area that can be built on it. Although other regulations, including parking requirements, may indirectly limit the amount of building area that can be developed on a lot, for simplicity, we assume that the maximum building area calculated from the maximum FAR is attainable. This assumption effectively ignores the possibility that parking requirements constitute a *de facto* density cap that is lower than the maximum FAR set by the Zoning Resolution, which is one of the theoretical criticisms of the requirements we discussed above. In further research we hope to investigate whether parking restrictions in fact prevent developers from attaining the maximum FAR.

We calculate our two measures of parking requirements as follows:

Average Required Parking Ratio

For our average required parking ratio measure, we first identify for each lot the required parking ratio that the Zoning Resolution assigns to the zoning category that the lot is in (from RPAD). In doing so, we use the lower parking requirements specified for the "Quality Housing" option available in certain zoning districts (see Been et al, 2009). For lots in Lower Density Growth Management Areas (which we determine using GIS), we apply the higher ratio required by the Zoning Resolution.

Average Required Parking Density

To calculate the average required parking ratio for groups of lots (e.g., the City as a whole, a borough, or lots near transit, etc.), we weight each lot by the maximum allowable building area. Our measure, accordingly, is the average required parking ratio (i.e., spaces per residential unit) for a square foot of allowable building area in that geography or group of lots. We use allowable building area for our weight instead of lot area to account for the fact that individual lots have widely variant development potential based on their zoning district.

For our average required parking density measure, we translate the maximum allowable building area for each lot into a count of required parking spaces, and then further into a rate per land area. To do this, we first use 2007 PLUTO to identify all residential buildings constructed between 1961 (the year the current version of the Zoning Resolution was introduced) and 2007. We then divide these buildings by borough and into three groupings based on their zoning categories, representing high, medium and low density (designated in the Zoning Resolution as residential categories R1-R4, R5-R7 and R8-R10, respectively). For buildings in each borough-zoning group (15 groups in all), we calculate the average gross square feet per unit using unit counts and actual building area in PLUTO.

For each lot, we divide the maximum allowable building area by the average gross square feet per unit for the applicable borough and zoning density group to estimate the maximum number of units that can be built. Next, we multiply this maximum unit count by the applicable required parking ratio to obtain an estimate of required parking spaces for that lot. Finally, we divide the number of spaces by the lot area (from RPAD) to obtain the required number of parking spaces per square feet of land and multiply by 1000. To calculate an average for this measure across groups of lots, we weight each lot's required parking density by its land area.

The Zoning Resolution allows for several full and partial exemptions from the parking requirements in certain zoning districts based on lot conditions or proposed lot uses. Unlike previous research, we estimate the effect of some of these waivers by adjusting our two measures of parking requirements based on the individual characteristics of each lot. Specifically, we use RPAD data to estimate lot size and width to determine whether a lot qualifies for a full or partial waiver for small and narrow lots. We also use our estimate of required parking spaces for each lot (calculated as an interim step in our required parking density estimate) to determine whether a lot is eligible for waivers available to developments that would otherwise require only a small number of spaces (see DCP (2009) for a complete list of lot width size and low parking count waivers). Because of data limitations, we do not account for other types of waivers, however, such as those for "infill" housing. Nor do we account for the reductions available to different types of affordable housing discussed above, which are based not on lot characteristics, but on the type of a particular development. However, because the reductions for affordable housing are calculated as a percentage of the applicable requirement for market rate housing, the relative differences in the requirements across different

geographies or groups of lots we explore below will generally hold true for affordable housing as well.

In order to investigate how residential parking requirements differ, if at all, when other forms of transportation are nearby we explore the relationship between parking requirements and proximity to rail transit. We use GIS to identify lots that are within half a mile of a rail transit station in the City and then compare the minimum parking requirements for these lots to those outside these “catchment areas.” To do this, we select all 2007 lots that are at least partially within ½ mile buffers created around all New York City Transit Subway stations and 45 Commuter Rail stations (Long Island Rail Road and Metro-North).

Building upon the work of Been et al (2009), we also investigate the parking requirements of lots that were significantly underdeveloped as of 2007 (developed to less than 50% of their permitted maximum building area, determined by their individual maximum FAR and lot land area). By matching new construction building permits issued between 2003 and 2007 to our database of 2003 and 2007 lots, we estimate that about 80% of all such permits were filed on these underdeveloped lots, highlighting their significance to development in New York City.

5. Results

All Lots (No Waivers):

As a baseline for our analysis, Rows 1 and 2 of Table B (below) report for New York City as a whole and each borough:

- The average required parking ratio (i.e., the average number of spaces required for each new housing unit, weighted by the maximum allowable building area for each lot); and
- The average required parking density (i.e., the estimated number of spaces per 1000 square feet of lot area, weighted by the land area of each lot).

In both cases, the averages are not adjusted to take into account any of the as-of-right parking waivers described in the previous section. For New York City as a whole, the average required parking ratio for a permitted square foot of development capacity in 2007 was 58%. In other words, for every 100 new housing units constructed in New York City, developers must also build, on average, 58 new off-street parking spaces. However, this number varied widely from borough to borough; Manhattan, much of which has a parking requirement of zero, only requires one new space for every 10 units on average. Staten Island, in contrast, which is dominated by low density zoning districts and is also regulated by lower density growth management areas, requires 134 new parking spaces for every 100 new units on average.

The average required parking density results paint a more complicated picture of the City. For New York City as a whole, our estimate of the average required parking density was 0.6 spaces per 1000 square feet of lot area. This means that on average, developing a residential lot to its full zoning capacity (i.e., to its maximum allowable FAR), with average unit sizes, would require the construction of 0.6 parking spaces per 1000 square

feet of lot area - equal to about 26 spaces per acre. This measure, too, varied widely from borough to borough. Staten Island, which had the highest average required parking ratio, had the *lowest* average required parking density, at only about one half space per 1000 square feet of lot area. The Bronx had the highest average required parking density at more than 0.8 spaces per 1000 square feet. This somewhat counter-intuitive finding is the result of the interaction between housing unit density (a function of maximum allowable building area and unit size) and required parking ratios. Although zoning districts that allow more unit density have lower required parking ratios, the reduction in required parking ratio from low building density to medium building density zoning categories is not proportional to the increase in allowable units they permit. Consequently, fully built out lots in medium density districts are required, on average, to produce the parking space densities and highest total number of off-street parking spaces.

Lots by Proximity to Transit (No Waivers):

Rows 3 through 6 of Table B report the results of the same analysis as above, but this time looking separately at lots within a half mile radius of a rail station entrance (rows 3 and 4) compared to lots beyond half mile from a rail station entrance (rows 5 and 6). In the City as a whole, the average required parking ratio for lots near rail was only about 46%, less than half that of the lots located further away from transit. This large difference is generally the result of the fact that areas with subway access (which outnumber areas served only by LIRR and Metro-North stations) tend to have relatively high density zoning classifications and correspondingly low required parking ratios. On its face, this appears to be consistent with the City's goals of encouraging transit usage, or at least not facilitating car ownership in transit-accessible areas. Looking at the borough level, we see that Manhattan and Staten Island buck this trend. In Staten Island, the average parking ratio is essentially unaffected by transit access, while in Manhattan (which is unique given its large area with a required ratio equal to zero and the fact that over 90% of its residential lots are within half a mile of rail transit), the average required parking ratio for transit-proximate lots is actually higher than that for lots further from transit. In both cases, though, it is still very low. The top portion of Map 1 shows the average required parking ratio for all of New York City at the census tract level (without regard to any waivers) and the location of rail transit stations.

Once again, however, the results from our estimate of average required parking density are less straightforward. Because of the higher building density permitted for lots near rail stations, at the citywide level, these lots have an average required parking density of almost 0.7 spaces per 1000 square feet of lot area, compared to only 0.5 spaces for lots outside a half mile radius of rail stations. This means that on average, developers fully building out a lot near transit must actually devote more square footage of lot area (or structured parking area) to parking than they would fully building out a lot of equal size located farther from transit. The full build out of the lot near transit would, of course, be a larger building with more units. The top portion of Map 2 maps the average required parking density for all of New York City at the census tract level (without regard to any waivers) as well as the location of rail transit stations.

Table B: Average Required Parking Ratio and Average Required Parking Density, Without Regards to Waivers

| | | The Bronx | Brooklyn | Manhattan | Queens | Staten Island | New York City |
|------------------------------------|--|-----------|----------|-----------|--------|---------------|---------------|
| ALL LOTS | | | | | | | |
| (1) | Avg. Required Parking Ratio (spaces/unit) | 56.6% | 68.5% | 10.6% | 76.9% | 134.4% | 58.3% |
| (2) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.84 | 0.78 | 0.53 | 0.52 | 0.47 | 0.61 |
| WITHIN 1/2 MILE OF TRANSIT | | | | | | | |
| (3) | Avg. Required Parking Ratio (spaces/unit) | 52.1% | 64.8% | 10.8% | 62.9% | 136.1% | 46.5% |
| (4) | Avg. Required Parking Spaces/ 1000 sf lot area | 1.01 | 0.85 | 0.57 | 0.50 | 0.62 | 0.69 |
| OUTSIDE 1/2 MILE OF TRANSIT | | | | | | | |
| (5) | Avg. Required Parking Ratio (spaces/unit) | 77.7% | 88.7% | 2.4% | 98.6% | 133.7% | 99.5% |
| (6) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.53 | 0.59 | 0.05 | 0.54 | 0.42 | 0.50 |

All Lots (With Waivers):

Table C reports the average required parking ratios and parking densities for the City as a whole and each borough, but this time the results are adjusted to take into account the as-of-right waivers of parking requirements described above, based on 2007 lot dimensions. Comparing Table C to Table B, we see that the waivers have a significant impact on our estimates of required parking ratios and densities. For the City as a whole, the average parking ratio falls from almost 60% to under 50%, and the average parking density falls from about 0.6 to 0.5 spaces per 1000 square feet of lot area. In Brooklyn the drops for both measures are particularly steep; Staten Island, in contrast, is almost unchanged, likely because its lots tend to be larger (both in size and width) or in zoning categories that do not permit lot and building size parking waivers. The bottom portions of Maps 1 and 2 show the average required parking ratio and density, respectively, for all of New York City at the census tract level, after adjusting for waivers and the location of rail transit stations.

Lots by Proximity to Transit (With Waivers):

Taking into account the parking requirement waivers also widens the gap in the average required parking ratio between lots near transit and lots further from transit. Specifically,

while the average ratio for lots further from transit barely budges (again, likely because of larger lot sizes in such areas and lower density zoning districts), the average required parking ratio for lots in transit accessible areas drops by 12 percentage points. For the required parking ratio measure, taking into account the waivers effectively erases the gap between lots within and outside a half mile of a transit station by lowering the required density for lots near transit.

As noted above, our estimates of the effects of waivers are based on the dimension of lots as of 2007. However, developers often change lot dimensions in anticipation of new construction by merging lots into adjacent parcels or subdividing lots into smaller pieces. Accordingly, using 2007 lot dimensions as the basis for this estimate may not accurately reflect the requirements that developers will in fact face. Accordingly, these estimates are merely suggestive about how significant a role waivers may play in new development. Better understanding whether and how developers manipulate lot lines in order to qualify for waivers is a topic for future research.

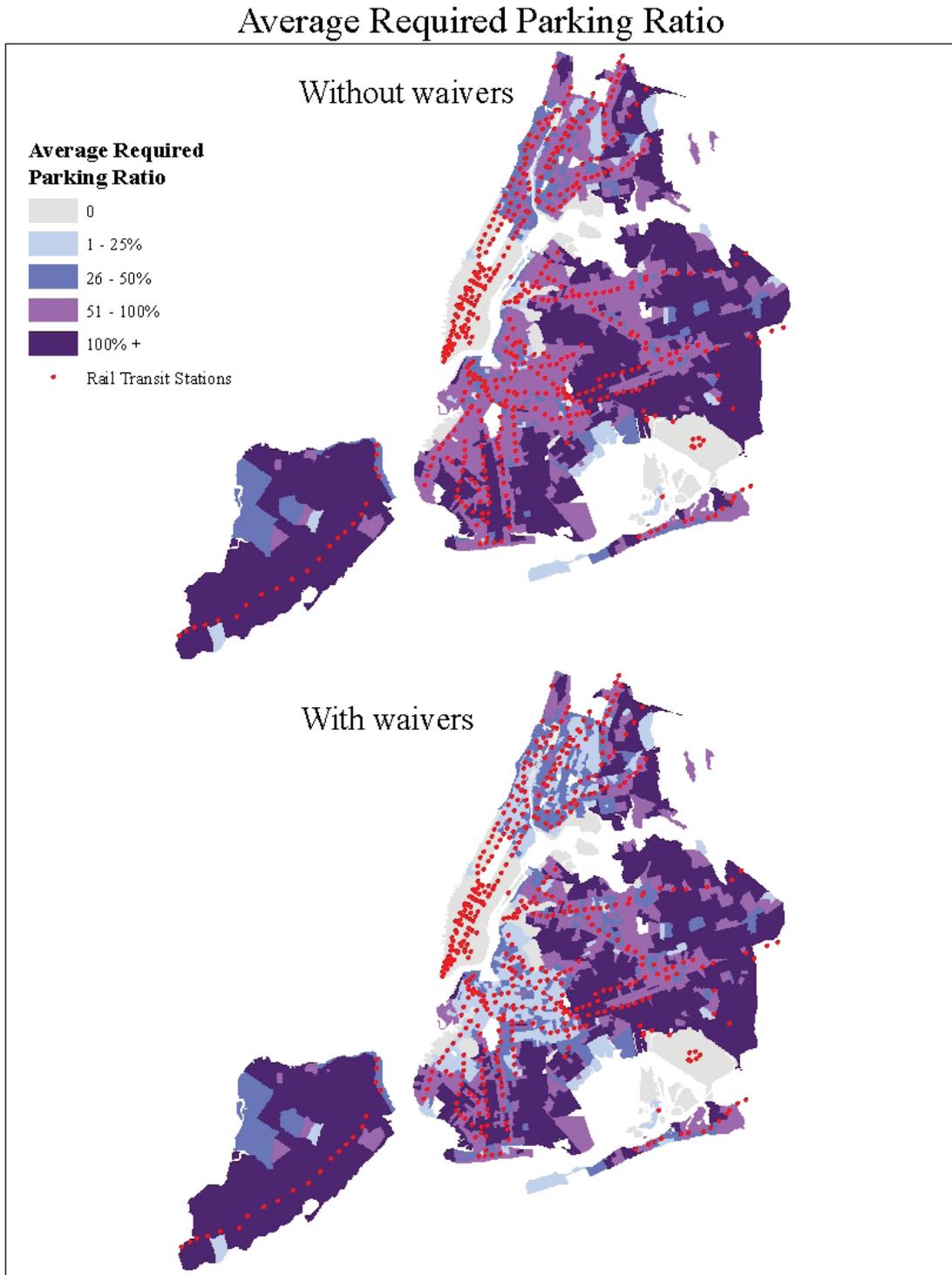
In addition to analyzing the results for all lots in our selected geographies, we also calculate our parking requirement measures for the subset of lots that were underdeveloped as of 2007, recognizing that they are likely sites for future development. Building upon the work of Been et al (2009), we define as underdeveloped all lots that were built out at less than 50% of their maximum allowable FAR. Again, we separate these lots into those near rail transit and those beyond a half mile, taking into account the lot and potential project size waivers. Table D reports the results of these calculations (still taking into account the waivers).

We see that the average required parking ratio for underdeveloped lots is only 38% for the City as a whole, noticeably lower than the 48% shown in Table C for all lots. This suggests that, on average, for every 100 units built on the lots that were underdeveloped in 2007, fewer than 40 new off-street parking spaces would be required. For New York City as a whole and for its three most populous boroughs individually (The Bronx, Brooklyn and Queens), underdeveloped lots near rail transit had an even lower average required parking ratio.

At 0.3 spaces per 1000 square feet of land area, the average minimum parking density for the City as a whole is also much lower for underdeveloped lots than for all lots. But just as was the case for the entire sample of lots (Table C), for underdeveloped lots, the relationship with transit proximity is mixed. In the Bronx and Manhattan, the average required parking density for underdeveloped lots close to rail stations is significantly higher than for lots with less transit accessibility. In other words, in the Bronx, developers fully building out an underdeveloped lot near transit would be required, on average, to build many more parking spaces than if fully building out an underdeveloped lot of equal size further away from a rail station. The fully built out lot near the station would have many more units, on average, but this still raises interesting questions about the role of parking requirements in determining the use of scarce land resources near fixed transit infrastructure. For underdeveloped lots in Queens, in contrast, the average

required parking density is lower near rail stations than it is further away, just as it was for the sample of all lots (underdeveloped and further away and developed).

Map 1: Average required parking ratio, with and without adjusting for parking waivers, and rail transit stations, 2007



Map 2: Average required parking density, with and without adjusting for parking waivers, and rail transit stations, 2007

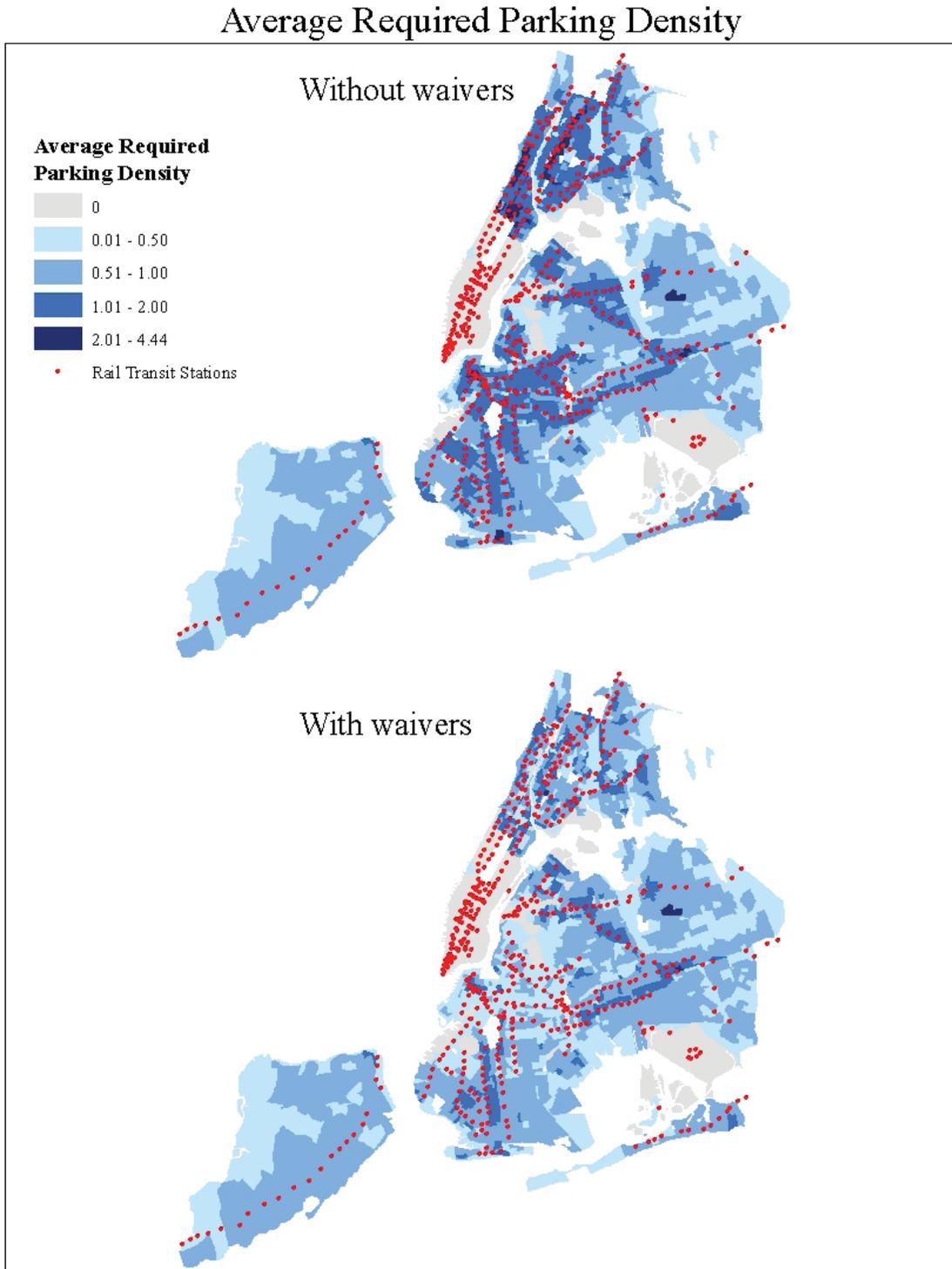


Table C: Average Required Parking Ratio and Average Required Parking Density, with Lot/Building Size Waivers

| | | The Bronx | Brooklyn | Manhattan | Queens | Staten Island | New York City |
|------------------------------------|--|-----------|----------|-----------|--------|---------------|---------------|
| ALL LOTS | | | | | | | |
| (1) | Avg. Required Parking Ratio (spaces/unit) | 43.6% | 46.6% | 5.4% | 70.8% | 134.4% | 47.6% |
| (2) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.64 | 0.53 | 0.27 | 0.48 | 0.47 | 0.49 |
| WITHIN 1/2 MILE OF TRANSIT | | | | | | | |
| (3) | Avg. Required Parking Ratio (spaces/unit) | 37.5% | 39.7% | 5.5% | 55.6% | 136.0% | 33.7% |
| (4) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.72 | 0.51 | 0.29 | 0.44 | 0.62 | 0.50 |
| OUTSIDE 1/2 MILE OF TRANSIT | | | | | | | |
| (5) | Avg. Required Parking Ratio (spaces/unit) | 72.7% | 84.1% | 1.7% | 94.3% | 133.7% | 96.2% |
| (6) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.49 | 0.56 | 0.03 | 0.51 | 0.42 | 0.48 |

Table D: Average Required Parking Ratio and Average Required Parking Density for Underdeveloped Lots (With Waivers)

| | | The Bronx | Brooklyn | Manhattan | Queens | Staten Island | New York City |
|------------------------------------|--|-----------|----------|-----------|--------|---------------|---------------|
| ALL LOTS | | | | | | | |
| (1) | Avg. Required Parking Ratio (spaces/unit) | 32.8% | 33.6% | 4.8% | 44.3% | 103.6% | 37.7% |
| (2) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.41 | 0.30 | 0.19 | 0.25 | 0.32 | 0.29 |
| WITHIN 1/2 MILE OF TRANSIT | | | | | | | |
| (3) | Avg. Required Parking Ratio (spaces/unit) | 28.3% | 30.1% | 4.9% | 36.0% | 110.4% | 27.8% |
| (4) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.48 | 0.30 | 0.21 | 0.22 | 0.52 | 0.30 |
| OUTSIDE 1/2 MILE OF TRANSIT | | | | | | | |
| (5) | Avg. Required Parking Ratio (spaces/unit) | 51.7% | 52.9% | 2.8% | 64.0% | 100.7% | 70.6% |
| (6) | Avg. Required Parking Spaces/ 1000 sf lot area | 0.29 | 0.28 | 0.03 | 0.31 | 0.26 | 0.28 |

6. Conclusion

As discussed above, minimum parking requirements have the potential to increase the cost of housing and encourage auto use in multiple ways. To that extent, their unintended consequences may run directly counter to the City’s goals of promoting housing affordability and “sustainable” development. At the extreme, if the Zoning Resolution requires more parking spaces than residents would otherwise have consumed from the pool of public access spaces, some portion of the expense of parking construction burdens homeowners without even providing a corresponding benefit to the surrounding community. More broadly, New York City generally does not assess “impact fees” on as-of-right new development to mitigate the pressure new residents place on public schools and other public services. It is not clear why the City treats parking differently – essentially imposing an exaction of parking spaces on new development rather than leaving off-street parking construction to the private market.

Using GIS and lot-level assessor’s data, we show that the parking requirement does vary in relation to transit accessibility, indicating that there is at least some fit between the

level of the requirement and the alternatives to automobile use residents have. Specifically, the per-unit parking requirement is, on average, significantly lower for lots within a half mile of a rail transit station than for lots farther from stations. This appears consistent with the City's goal of encouraging transit ridership and transit oriented development. We also find that per-unit requirements are lower for the many lots which, as of 2007 were underdeveloped, indicating that the sites of future building projects will require relatively few new parking spaces even without regulatory changes. The cost of new housing on these sites, then, seems less likely to be inflated by the bundling of required parking costs.

However, because of the interaction between permitted building density and per unit parking requirements, a second measure of parking requirements we calculate reveals a more complicated picture. Although per unit requirements are lower, developers are required to build just as many spaces per unit of land, on average, in areas near transit stations as they are in areas less accessible by transit. These areas are likely to permit larger developments, but because New York City land is finite and developable land scarce, this raises important questions about the possible opportunity costs of parking requirements, particularly if the economics of a development require the parking to be in surface lots.

Our research leaves many related questions unanswered. Because of data limitations, we are currently unable to track how many parking spaces developers have actually built in recent years as part of residential projects. Discerning whether or not developers build the absolute minimum of spaces, build more than zoning requires, or change lot lines and project sizes to qualify for waivers is a crucial step in better understanding the relationship between parking requirements and development. If all but the very largest developments are able to avoid the parking requirements because of waivers, their drag on affordability, obviously, is less significant. Case study analysis of specific building projects can provide further insight into the exact tradeoffs between building area and required parking spaces that developers may make.

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