Does Housing Growth in Washington, D.C., Reflect Land Use Policy Changes?

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Abstract

Across the United States, rising housing costs have increased the political pressure on local elected officials to encourage more housing production. Local and state governments are experimenting with changes to land use regulations that could allow more housing to be built through infill development. Between 2000 and 2020, Washington, D.C., engaged in substantial infill development, increasing the housing stock by about 15 percent. This article examines whether areas in the city with particularly high growth saw large zoning changes. The authors find that most housing development occurred where underused commercial or industrial land was repurposed into high-density residential uses. Some high-growth neighborhoods experienced rezoning; others saw conversions of existing structures with little zoning changes. Notably, high-growth areas initially had very little land zoned for single-family homes.

Introduction

Since the Great Recession, the United States has failed to build enough homes to keep up with the growth in demand driven by population and job increases (Bernstein et al., 2021; Up for Growth, 2022). Housing costs have risen faster than household incomes, creating more financial pressure on low-to-middle-income households, especially renter households. This issue, in turn, has raised the political salience of housing affordability among elected officials seeking ways to encourage more housing production (Schuetz, 2022).

As part of this response, local and state governments across the United States are beginning to experiment with zoning reforms. These efforts include attempts to legalize "gentle density," such as accessory dwelling units and duplexes, to statewide requirements to allow more dense housing

("upzone") around transit stations (Chesto, 2021; Grabar, 2018; Tobias, 2022). To guide future policy decisions, it is important to understand which reforms have the most potential to expand housing production, where, and under what market conditions. However, most of these reforms are too recent to have yielded measurable results in housing outcomes.

To provide insights into the relationship between housing production and land use policies, this article applies a different lens: looking retrospectively at 2 decades of rapid housing growth in Washington, D.C., what can be inferred from the neighborhoods that saw the greatest increases in housing? Did high-growth neighborhoods enact notable changes in zoning or other land use policies? What was their initial zoning status?

The authors care about the answers to these questions because, although regulatory constraints are one—potentially very important—determinant of housing production, they are certainly not the sole determinant. Housing development also depends heavily on market factors, such as land values, the cost of construction labor and materials, and the expected prices or rents of newly built homes. Overly restrictive zoning can limit housing growth, but permissive zoning will not produce growth if market factors are not favorable. Additionally, zoning is not the only possible regulatory constraint on housing growth; current residents and elected officials have a variety of political and legal channels to deter unwanted development.

Washington, D.C., provides an intriguing empirical setting to examine the relationship between redevelopment and zoning. It has benefited from a strong labor market and increased housing demand during the past 2 decades. However, aside from parks, the city has almost no undeveloped land. Virtually all land was developed by the 1950s or designated as protected open space. Therefore, nearly all housing growth occurs through infill development, redeveloping parcels currently occupied by other uses (Brooks, Deneoux, and Schuetz, 2020). The District's elected leaders have been actively discussing how changes to zoning and housing approvals could facilitate more infill housing production (Baca, 2020; McCartney, 2019). (Like most older cities in the Northeast and Midwest, the District's boundaries are fixed. It is surrounded by independent political jurisdictions and cannot grow in land area by annexing unincorporated areas.)

As exhibit 1 shows, Washington, D.C., grew from slightly more than 570,000 residents in 2000 to about 700,000 in 2020. This 21-percent increase reversed more than 2 decades of population decline. Although the population can grow without new housing, Washington, D.C., had increases in population and housing units during this period. This growth occurred in the absence of any wholesale upzoning to allow multifamily zoning in single-family neighborhoods; such single-family neighborhoods account for most of the city's land. Thus, Washington, D.C., provides insights into where housing production takes place in the absence of large-scale changes to land use regulation.

Exhibit 1

Washington, D.C., Population Declines Through 2000 and Then Grows

Washington, D.C., Population by Decade
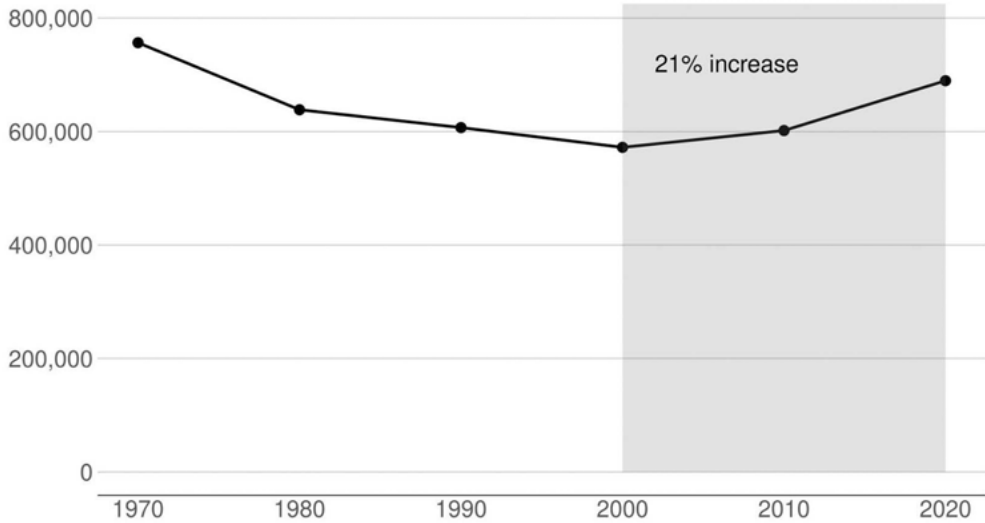
In the remaining sections, the authors provide descriptive statistics on where housing growth occurred—and did not occur—in Washington, D.C. This study examines how growth correlates with initial zoning status and zoning changes at the neighborhood level.[1] To better understand the mechanisms at work, the article undertakes qualitative case studies of two neighborhoods that added unusually large amounts of housing during this period. The analysis relies primarily on data from the 2000 Census and the 2020 American Community Survey; details on data sources and empirical methods are provided in the technical appendix.

During the 2000–20 period, the District revised its zoning laws, with new zoning districts and rules taking effect in 2016. Although this revision was a major legislative effort, the fundamental components of zoning—what size structures and what uses are allowed by right—changed on only a modest share of land in most neighborhoods (Flanagan, 2016). Notably, virtually all the land previously zoned for single-family homes remained zoned as single-family. Nearly 15 percent of land previously zoned for multifamily housing was downzoned—rezoned to allow less intensive use—to allow only single-family. The neighborhoods with the largest share of downzoned land are historically Black Wards 7 and 8, east of the Anacostia River. Most of the zoning changes that added capacity for new housing occurred by rezoning the land from non-residential districts (specifically a catch-all "Other" category) into single-family, multifamily, and mixed-use districts.

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[1] Throughout, block groups are the neighborhood unit. A census block group is a small neighborhood, designated by the Census for statistical purposes, designed to contain between 600 and 3,000 residents (see Census documentation).

Examining the patterns of housing growth, the study found that most growth is concentrated where previously industrial or commercial land—often underused—was repurposed into housing. Relatedly, growth is also concentrated in areas with the least land zoned for single-family housing. Growth was not, however, tied to large-scale neighborhood rezonings.

The District's experience suggests that, in many cities, targeted land use interventions can accommodate substantial amounts of new housing. In the District's case, the city reallocated very small amounts of land from non-residential to high-density residential uses. This analysis does not shed light on the potential effects of upzoning existing residential areas because the District did not undertake this type of rezoning. Instead, it points to the conditions under which infill development can occur without such upzoning.

Which Washington, D.C., Neighborhoods Saw the Most Housing Growth?

As expected of a city whose population expanded by more than 20 percent, most District neighborhoods—measured in this analysis as Census block groups—saw increases in population density between 2000 and 2020.[2] Exhibit 2 shows a scatterplot of housing unit density (thousands of housing units per square mile) in these 2 years. Dots in the shaded triangle represent neighborhoods that increased in housing unit density, and dots outside the shaded area represent block groups that lost housing density. If a dot were to lie on the diagonal of the triangle, it would have the same housing density in 2020 as in 2000. More than 60 percent of the District's 433 block groups gained population during this time, although most saw only modest increases. However, a few neighborhoods account for a strikingly large share of the District's housing growth: block groups noted with larger dark circles are the five with the greatest change in the total number of housing units; block groups noted with squares are the neighborhoods with the next five-greatest increases in total housing units.[3] The article analyzes these fast-growing neighborhoods in greater detail in the following sections.

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[2] See footnote 1 for definition of neighborhoods.

[3] An alternative classification is to examine the 10 neighborhoods with the greatest percentage increase in housing units. Of the 10 neighborhoods with the greatest increase in absolute number of units, 5 are in the top 10 when ranked by percentage change in units, and 7 are in the top 13 by percentage change in units.

Exhibit 2

Most District Neighborhoods Saw Modest Increases in Housing Unit Density From 2000 to 2020

Thousands of Housing Units per Square Mile by Census Block Group, 2000 and 2020
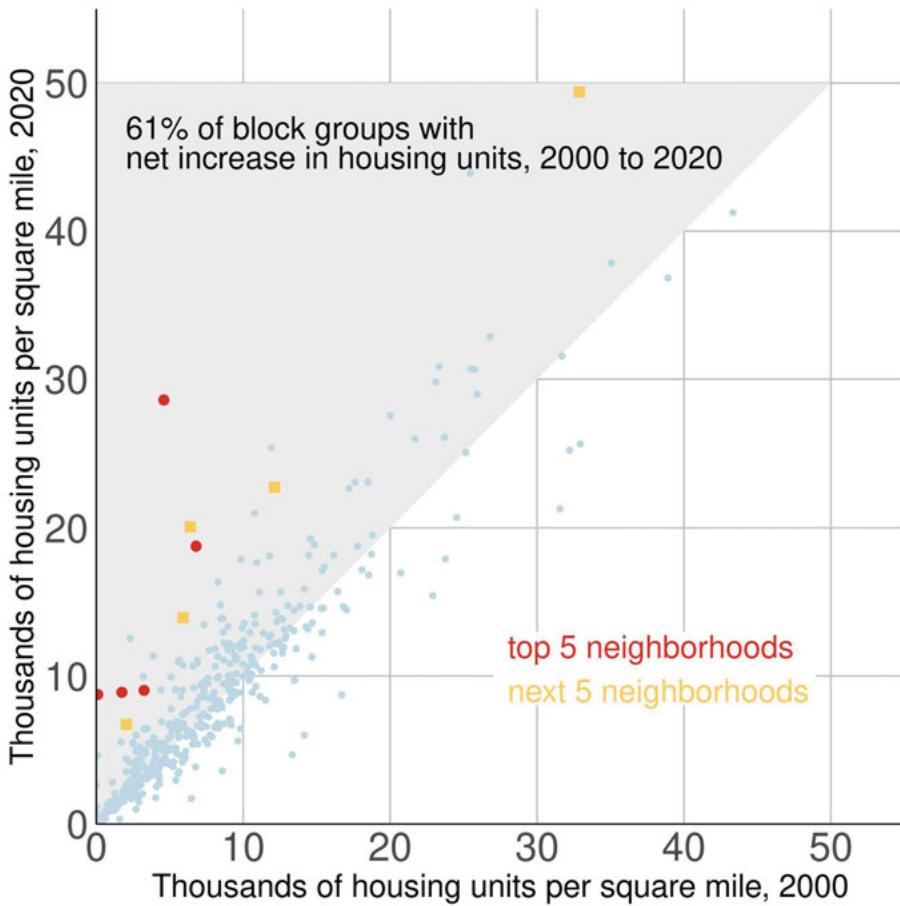
Notes: Housing density is calculated as housing units per square mile. Larger, darker circles represent the five block groups with the largest increases in the total number of housing units; squares represent the block groups with the next five largest increases in total housing units. All remaining block groups are the lighter, smaller circles. Some lighter, smaller dots lie above the darker circles and squares because the highest-growth neighborhoods are called out by growth in total units rather than by population density.
Sources: 2000 Decennial Census; 2020 American Community Survey

This housing growth was not spread evenly across the District's neighborhoods: the five greatest growth block groups account for nearly 30 percent of additional housing created from 2000 to 2020, and the next five block groups account for roughly 10 percent of additional housing (exhibit 3). For context, these 10 block groups account for well under 5 percent of land in the District. The remaining 432 block groups make up more than 95 percent of the land but only 60 percent of new housing.

Exhibit 3

Housing Growth Was Highly Concentrated in a Handful of Neighborhoods

Percent of New Housing Units, 2000 to 2020, and Percent of Total Land Area, 2020

(a) Percent of New Housing Units

(b) Percent of Land Area

Notes: Exhibit 3(a) shows the share of new housing units in the five block groups with the greatest increase in the number of housing units, the share of new housing units in the five block groups with the next greatest increase in housing units, and the share of new housing units in the remaining 423 block groups. Exhibit 3(b) shows the share of land area in each of those three categories using the same scheme.

Sources: 2000 Decennial Census; 2020 American Community Survey

Which Neighborhoods Saw the Greatest Increase in Housing?

Not only was housing growth concentrated in a few block groups, these block groups are quite spatially clustered (exhibit 4). The first part of exhibit 4 shows the 10 neighborhoods with the greatest housing growth, as measured by the increase in the absolute number of units. The second part of the exhibit locates those neighborhoods within the city at large. Although the District is 10 square miles, this city map shows that all the high-development neighborhoods are reasonably close to the central business district, in an area roughly 2 by 4 miles.

One large cluster of high-growth block groups appears adjacent to downtown near the Archives-Penn Quarter-Convention Center area in near Northwest. Another includes the near Northeast area slightly north of Union Station, near the NoMa metro (which opened for service in 2004)

and Union Market. Other areas of high growth include the Navy Yards area in Southeast, near the Nationals baseball park; the Shaw and U Street corridors in Northwest; and slightly north of the Foggy Bottom area in Northwest.

Exhibit 4

Fastest-Growing Neighborhoods Were Adjacent to Downtown, Near Union Station and Navy Yards

Top 10 Block Groups by Housing Growth, 2000-2020
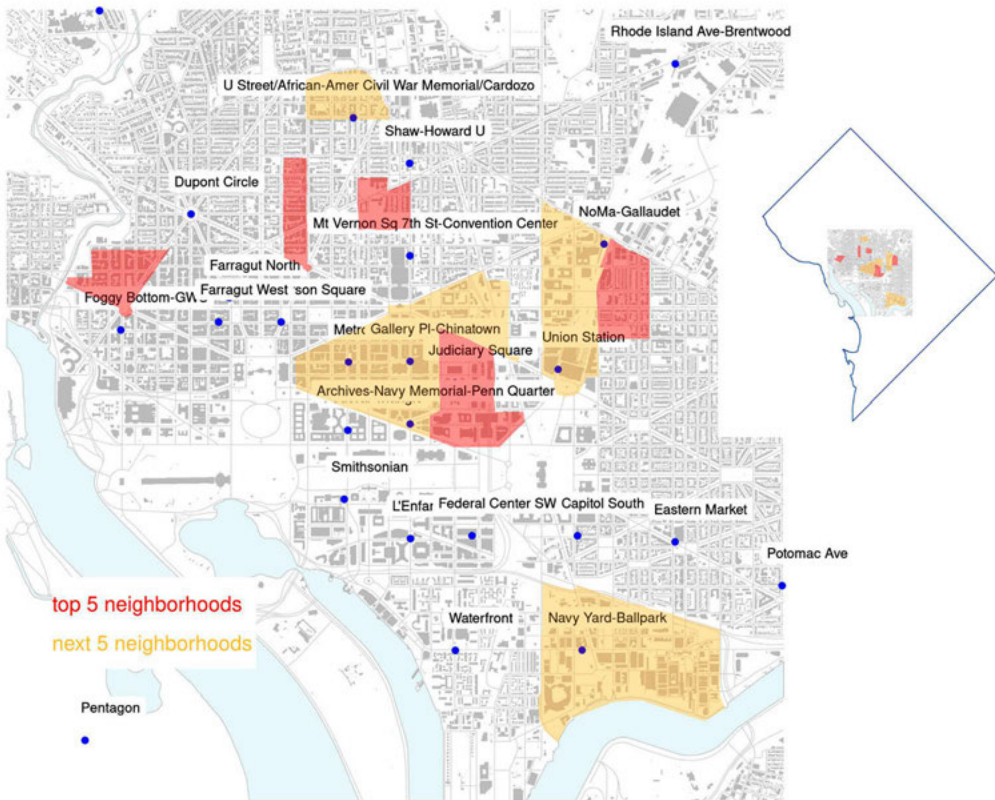
Notes: The map shows 10 block groups with the largest increase in total housing units. Dots are Metro stations. See the data appendix for details on other map sources.
Sources: 2000 Decennial Census; 2020 American Community Survey

How Did Zoning Change in Washington, D.C., Between 2000 and 2020?

Cities promulgate zoning regulations to define allowed land uses, building dimensions, and density. Planners assign a zone to each piece of land in a city; in the District, planners currently have 164 zones from which to choose. For example, the R-1-A zone limits a piece of land to single-family homes, limits the total square footage of the building on the lot, requires a set number of parking spaces, and sets a minimum lot size. Originally, zoning was intended to separate commercial and

industrial uses from residential areas, protect homes from noise and pollution, and preserve light and air by limiting building height and bulk (Hirt 2014). Many critics of zoning argue that it goes much farther, reinforcing economic and racial segregation and limiting access to high-opportunity communities (Hsieh and Moretti, 2019; Rothstein, 2017; Schertzer, Twinam, and Walsh, 2021; Trounstine, 2020).

The share of land allocated to each zone varies considerably across the District's neighborhoods. Downtown and commercial corridors are zoned to allow offices, retail spaces, and various other types of commercial land uses, in most cases also allowing new residential development. Much of the District's land outside downtown is reserved for residential uses, with some small-scale neighborhood-serving commercial activity permitted.

This analysis focuses on the revisions to Washington, D.C., zoning that took effect in 2016. In most cases, these revisions were only technical and left in place the basics of zoning: what structures and uses are allowed by right. For this analysis, the study aggregates the District's 164 zones into five broad categories: single-family, multifamily, mixed-use, commercial/industrial, and other. This method necessarily limits the precision of the analysis but leaves the authors with a tractable and comprehensible set of categories. Exhibit 5a shows the share of District land allocated to these five categories under the prior zoning rules (in 2003), and exhibit 5b shows how much land originally zoned for each category stayed the same or was reallocated to a different broad category.

In 2003, about 36 percent of the District's land was zoned exclusively for single-family residential uses, whereas about 16 percent was zoned as multifamily residential.[4] The "other" category was the largest non-residential category, accounting for roughly 35 percent of District land. The largest component of this land is parks, including the very large Rock Creek Park and the National Mall; this category also includes land used for federal and local government buildings and other uses. About 12 percent of the land was zoned as commercial-industrial, with a very small amount designated as non-residential mixed-use.[5]

Notably, virtually all the land initially zoned for single-family housing was still zoned exclusively for single-family homes as of 2016. (Land zoned initially as mixed-use or commercial-industrial was also left in the same broad categories). Single-family exclusive zoning, particularly when paired with large minimum lot sizes, has been identified as one of the greatest barriers to increasing housing in already developed neighborhoods, where adding housing would require replacing existing single-family homes with multifamily, multi-story buildings (Ellickson, 2021; Furth and Gray, 2019; Glaeser, Schuetz, and Ward, 2006).

One limitation of broad-brush zoning categories is not being able to observe more nuanced changes to zoning rules, such as revisions to dimensional requirements or procedural rules, that could alter the effective housing capacity within zoning categories. In theory, keeping land zoned for single-family but cutting the minimum lot size in half might allow property owners to
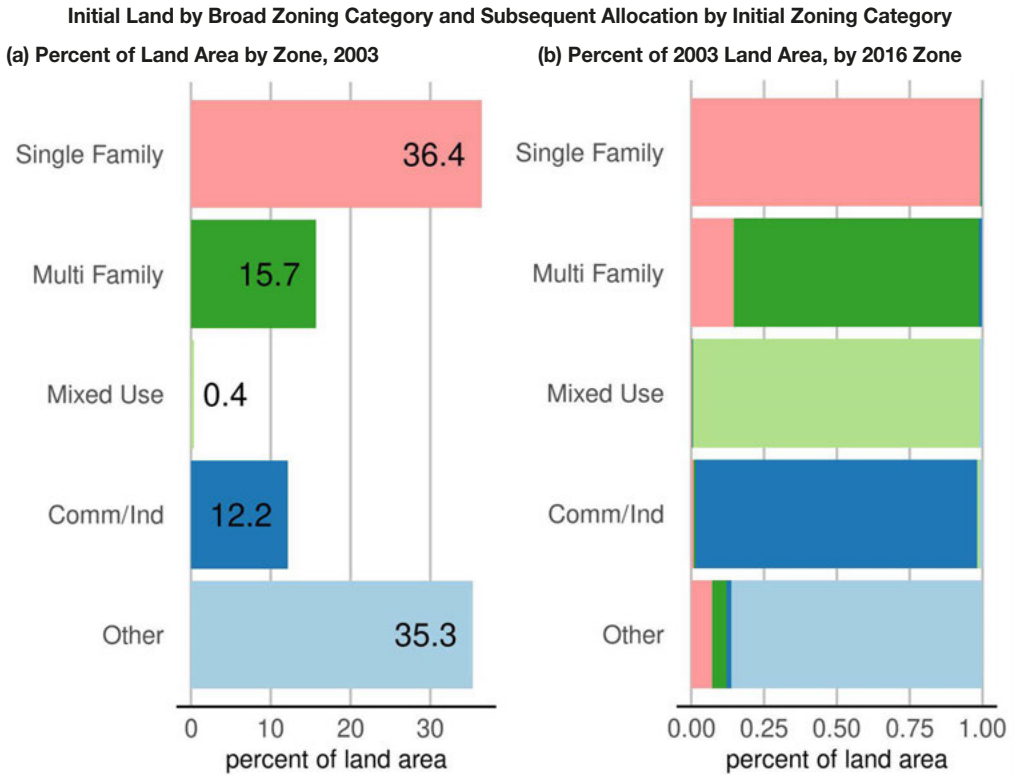
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[4] For this analysis, mixed residential-commercial zones were assigned to residential categories, according to which type of housing was allowed by right. The core downtown areas permit multifamily housing by right, so they are counted as "multifamily" throughout the analysis.

[5] Commercial-industrial zones do not allow residential uses, with a few exceptions (onsite janitor, artist studios, and homes built before 1958).

subdivide parcels and build additional homes on the new lots. In practice, D.C.'s rezoning made at most modest changes to dimensional requirements that did not substantially alter housing capacity in residential areas (Flanagan, 2016).

Exhibit 5

Zoning Changes Added Housing Capacity by Reallocating Non-Residential Land to Residential Uses

Initial Land by Broad Zoning Category and Subsequent Allocation by Initial Zoning Category

(a) Percent of Land Area by Zone, 2003   **(b) Percent of 2003 Land Area, by 2016 Zone**

Sources: Washington, D.C., 2003 and 2016 zoning shapefiles (full details are in appendices A and B)

Nearly 15 percent of the land previously zoned for multifamily was downzoned to allow only single-family homes. The neighborhoods that experienced the largest amount of downzoning are east of the Anacostia River in Wards 7 and 8; these historically Black neighborhoods are some of the least affluent parts of the District.

Most of the increased housing capacity that resulted from rezonings came from reallocating land previously in the "other" category: 7 percent of this land was changed to single-family, 5 percent to multifamily, and roughly 1.5 percent to commercial/industrial. The "other" category accounts for quite a lot of land, so in theory, the District could keep adding housing capacity by rezoning parcels from this category to allow multifamily and mixed-use development. In practice, however, much of this land is occupied by local or federal government facilities, including parks owned by the National Park Service, and is unlikely ever to be converted.

How Was Housing Growth Correlated With Initial Zoning Status and Zoning Changes?

In exhibit 6, the authors evaluate whether any zoning change at all—to any category—is correlated with new construction. Specifically, they plot each block group's share of land with zoning change versus each block group's change in total housing units during this period. They use the scheme as in exhibits 3 and 4 to denote neighborhoods with the largest housing growth. Between 2003 and 2016—the years for which zoning designations were observed—the median block group had zoning changes to about 1.5 percent of its land. Among the top 10 block groups with the greatest increase in housing units, 9 of these block groups had zoning changes to less than 7 percent of land area. Only one of the highest-growth block groups, located in the Navy Yard, had nearly 25 percent of its land rezoned.

Many neighborhoods with very large changes in zoning had very small changes in housing units. However, this result reflects the nature of the zoning changes in these locations. Of the 10 block groups with the greatest percentage changes in zoning, all are east of the Anacostia River. In all 10, most of the change was to downzone multifamily land to single-family, effectively reducing capacity.

Exhibit 6

High-Growth Neighborhoods Did Not Undergo Large Zoning Changes

Percent of Block Group Land That Changed Zoning and Change in Housing Units, 2000–20
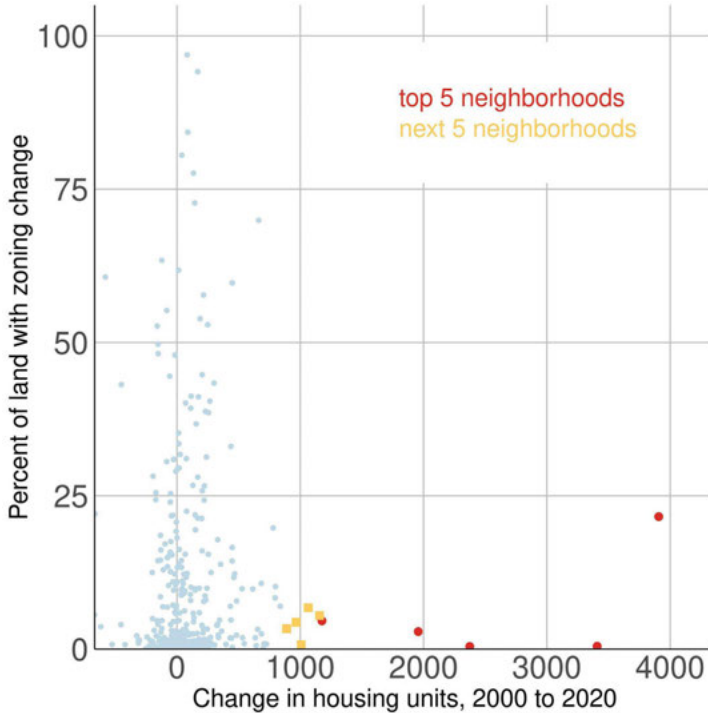
Notes: Zoning change is defined as movement between one of the five broad zone codes employed in this analysis. Larger and darker circles are the five block groups with the greatest absolute increase in housing units from 2000 to 2020; squares are the second five block groups with the next greatest housing increase. More details on the methodology are in appendix A.
Sources: 2000 Decennial Census; 2020 American Community Survey

Although high-housing growth neighborhoods did not experience large rezonings, they share another zoning trait: relatively little land initially zoned exclusively for single-family homes (exhibit 7). Across all District block groups, the median block group has nearly 60 percent of land zoned exclusively for single-family homes. Among the 10 top housing growth neighborhoods, eight block groups had less than 10 percent of land zoned for single-family homes. The two outliers, with more than 50 percent of land zoned for single-family in 2000, had substantial vacant or extremely underused land. These neighborhoods are slightly west of Logan Circle and one, now known as NoMa, is slightly east of Union Station.

Exhibit 7

High-Housing Growth Neighborhoods Had Relatively Little Single-Family Zoning in 2000

Change in Housing Units, 2000 to 2020 Versus Percent of Block Group Land Zoned for Single-Family Housing in 2003
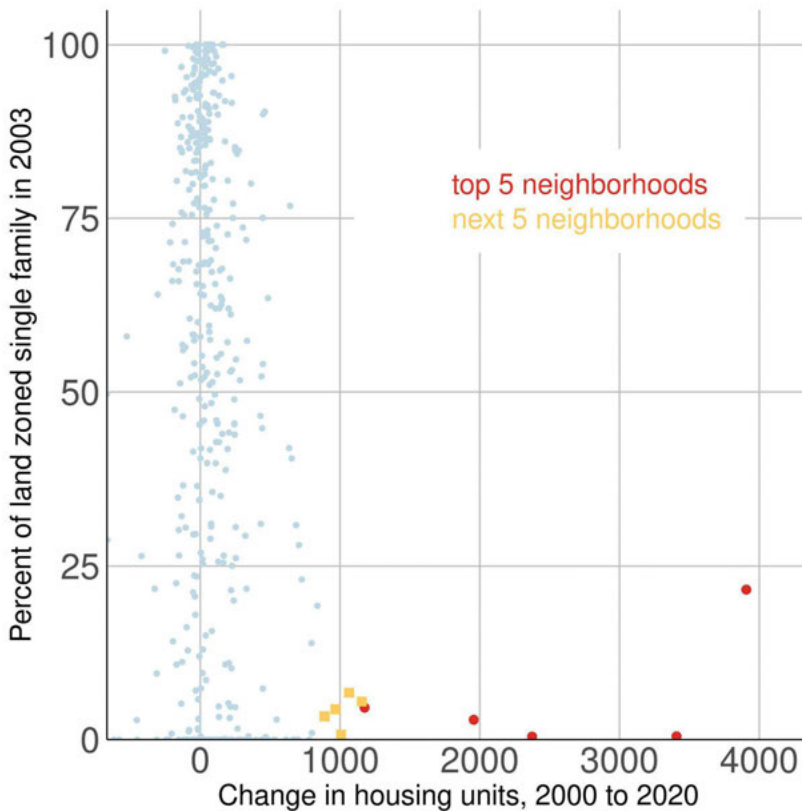
Notes: Single-family zoning is the share of land in a block group covered by a single-family zoning designation and comes from the 2003 zoning designations. Zoning data were measured in 2003 and 2016. The larger, darker circles are the five block groups with the greatest absolute increase in housing units from 2000 to 2020; squares are the second five block groups with the next greatest housing increases. More details on the methodology and sources are in appendix A. Sources: 2000 Decennial Census; 2020 American Community Survey

Deeper Look: What Happened in Unusually High-Growth Neighborhoods?

To better understand what happened in high-growth neighborhoods, this study provides context for these block groups' demographic, economic, and physical characteristics at the beginning and end of the period. The focus now narrows to two block groups. One is in the Navy Yard and experienced the greatest absolute growth in housing units for all District neighborhoods. The other is in the West End and ranks in the next five-highest growth areas. These two neighborhoods illustrate somewhat different stories about where housing growth occurred (exhibits 8 and 9).

Exhibit 8

West End and Navy Yard Had More Housing and Population Growth Than the District Average (1 of 2)

Change in Population, Housing Units, Median Rent, and Median Income for Block Groups in the West End and the Navy Yard, an Average of All District Block Groups, and the Average of Above-Median Income (2000) Block Groups.
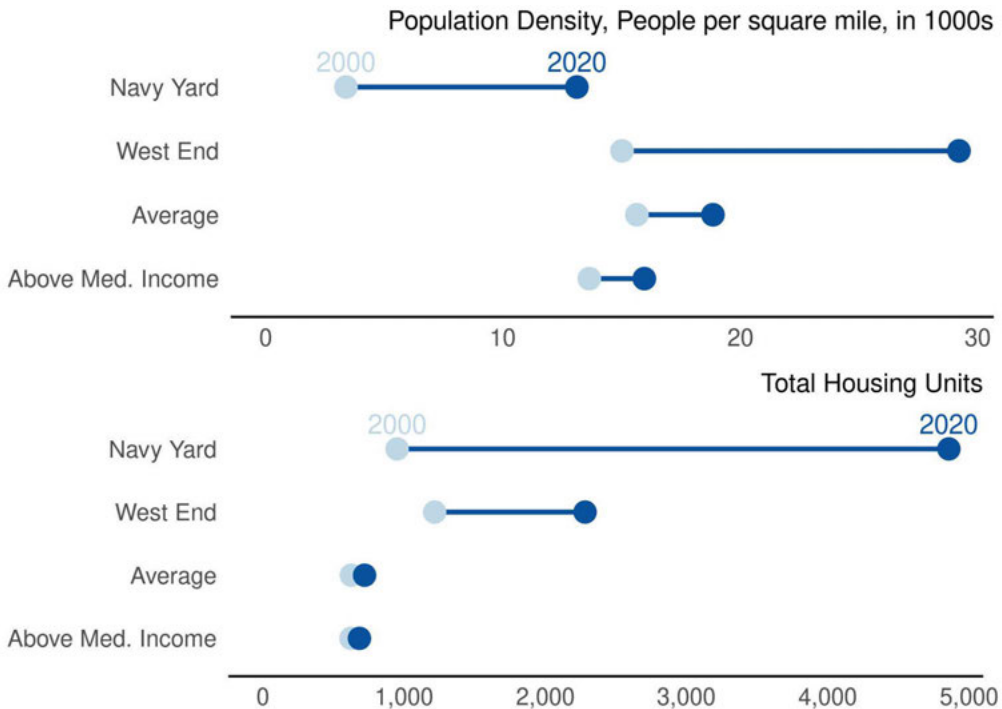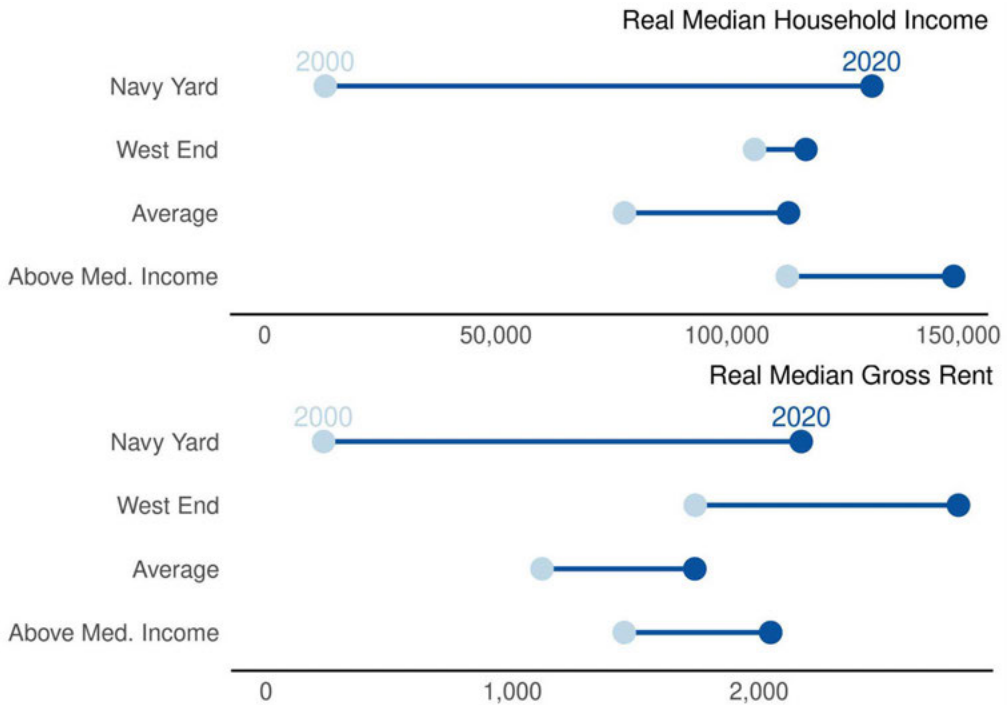
Exhibit 8

West End and Navy Yard Had More Housing and Population Growth Than the District Average
(2 of 2)

**Change in Population, Housing Units, Median Rent, and Median Income for Block Groups in the West
End and the Navy Yard, an Average of All District Block Groups, and the Average of Above-Median
Income (2000) Block Groups.**

Notes: Income and rent are in 2021 dollars. "Average" reports the average value across all District neighborhoods. "Above Median Income" neighborhoods are
those with median income above the citywide median (as calculated from block group data).
Sources: 2000 Decennial Census; 2020 American Community Survey

The West End block group illustrates how a substantial amount of housing can be added by
converting existing structures, even without major zoning changes. The West End block group—
bordered by Pennsylvania Avenue to the west/southwest, New Hampshire Avenue to the east/
northeast, and N Street to the north—had a small but fairly affluent residential population as of
2000 and grew larger and richer during the subsequent decades.

The block group has seen substantial development of apartment and condominium buildings and
several high-end hotels, restaurants, and retail stores. It also saw at least two very large conversions
of commercial property to residential uses: one large office building (located at 1255 25th Street)
became a residential rental and a hospital (the Columbia Hospital for Women) became condos
(Foggy Bottom Association, 2021; Pennsylvania State University, 2009). Although the mixture of
zoning as measured by land area has not changed much during this period—roughly two-thirds
mixed-use and one-third multifamily in 2003 and 2016—the total number of units is strikingly

higher and does not account for the large number of hotel rooms built in this area during the past 2 decades (exhibit 9).

Although there is little change in land zoned by major category, it is not uncommon for large development (or conversion) projects to be facilitated by variances or other minor changes to zoning rules. The District government does not systematically record these variances, making them difficult to measure.

Exhibit 9

Change in Land Use Composition for West End, Navy Yards, and Average Block Group

Percentage of Land by Broad Zoning Designation in 2003 and 2016
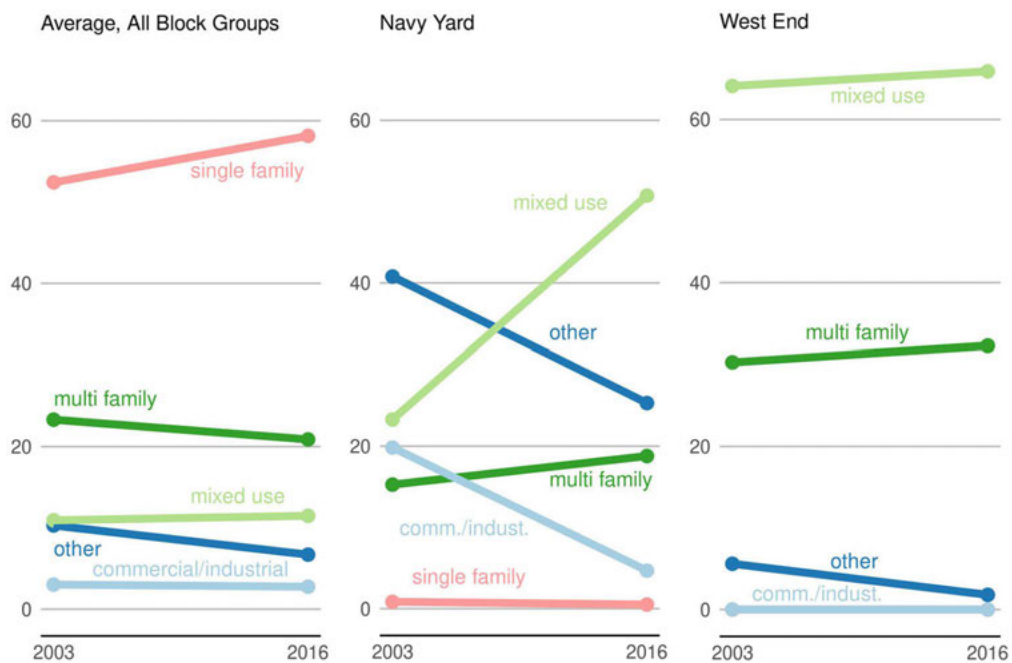
Note: Shares of land area are reported by zoning category.
Sources: 2000 Census block groups; 2003 and 2016 zoning shapefiles

Navy Yard presents a more intentional story of housing growth as part of a broader redevelopment plan. During the course of 2 decades, joint efforts of the District local government, the federal government, private sector developers, and a newly formed Business Improvement District have transformed a low-density, low-value commercial-industrial site into a high-density, high-value, mixed residential-commercial area (Cassius, 2019; Stevens, 2012). In the early 2000s, then-Mayor Anthony Williams led efforts to recruit a major-league baseball team—formerly the Montreal Expos, now the Washington Nationals—to the region with the promise of a new ballpark. In addition to the ballpark (which opened in 2008), the neighborhood now has nearly 15,000 residents, extensive retail and entertainment corridors, hotels, and parks and recreation facilities along the Anacostia River. The newly built residences include quite a diversity of housing types,

including rental and owner-occupied homes, market-rate and subsidized properties, and at least one mixed-income subsidized property that replaced public housing (Lerner, 2019). Projects such as Navy Yard demonstrate that rezoning even small amounts of land for high-density multifamily units can yield substantial amounts of new housing.

As of 2000, the West End (but not the Navy Yard) had income above the citywide average (exhibit 8). Most neighborhoods that had above citywide median income likely had high demand. However, these neighborhoods had modest changes in population density and very small changes in housing units, combined with appreciable increases in rent.

Conclusion and Policy Recommendations

As housing affordability becomes a politically contentious issue in more parts of the United States, cities and states are experimenting with different policy levers to boost housing production. Targeted research is needed to fill in knowledge gaps about what types of policies are most effective in different housing market conditions. This analysis focuses on the experience of Washington, D.C., a city that has seen strong population growth and housing demand during the past 20 years yet had little undeveloped land.

The District has built substantial amounts of new housing in recent decades, almost entirely through infill development converted from other uses. New housing is spatially concentrated in a handful of neighborhoods. Although most high-growth neighborhoods did not see large zoning changes, they entered the period with very small amounts of land zoned exclusively for single-family homes. Case studies of two high-growth neighborhoods illustrate two different patterns. The West End added housing by converting a few large commercial and institutional buildings into housing without a substantial change in zoning. By contrast, Navy Yard is an example of long-term planned redevelopment, with intentional partnerships between local government and private sector developers to transform underused land into high-density mixed-use housing, retail, and entertainment.

These results offer several insights into how policies may constrain or support greater housing production. First, growth is more likely in predominantly non-residential or mixed residential-commercial neighborhoods. This outcome likely reflects the limits imposed by low-density residential zoning and the political process that guides development: having fewer neighbors to complain makes it easier for developers to build. This pattern may also reflect economies of scale in construction—especially with infill development in high-cost markets—that drive concentrated growth of large buildings in a few areas. Both soft costs of development (financing, design and engineering, and legal approvals) and materials and labor costs of vertical development contribute to economies of scale. Second, rezoning even small amounts of land can yield large increases in housing supply—if the rezonings allow sufficiently high density and the rents are high enough to support construction.

The District has so far chosen not to upzone its single-family neighborhoods—and some residents of single-family neighborhoods raised considerable opposition to any zoning changes during the

2022 Comprehensive Plan revision[6]—so the ability to draw inferences from this analysis about how much additional housing could be produced by legalizing "gentle density" (or for that matter, larger multifamily development) across large swathes of residential areas is limited. Some moderate-density neighborhoods (such as Columbia Heights, Shaw, and Petworth) have seen substantial numbers of conversions or replacement of rowhouses into small multifamily buildings, which is allowed under existing zoning. The District's more affluent residential neighborhoods prohibit this type of infill development. Traditionally, rezoning non-residential areas for residential has been an easier sell than convincing affluent residents in low-density neighborhoods to accept more development—although the pro-housing movement is gaining political momentum in the D.C. region and across the country (Pearson and Schuetz, 2022).

The District has relatively little industrial land that could be repurposed for residential or mixed-use space, because the District never had a large manufacturing sector (unlike many Northeast cities). The Ivy City and Union Market areas, which did contain warehouses for shipping and logistics, are already undergoing rapid redevelopment. This pattern of substantial housing growth in previously industrial space is not limited to the District. For instance, notable redevelopments of Atlantic Yards and Long Island City in New York follow this model. To this end, New York City intentionally rezoned industrial spaces to better reflect changes in labor and land markets (New York City Office of Planning, 2022). The New York City example shows the importance and limitations of this approach: formerly industrial sites have driven the city's housing production, but the number of such sites is finite and increasingly few.

Thus, this analysis ends on a note of caution. Although relaxing zoning can potentially yield greater density, it need not always. Relaxing zoning *allows* developers to build at higher density, but it does not and cannot *mandate* them to do so. Ultimately, developers will determine what types of structures and densities to build based on the financial returns of each project. Furthermore, the low-hanging fruit for the creation of urban housing units on a large scale is now underused commercial and industrial land. In the wake of the pandemic, neighborhoods with high concentrations of vacant retail and office space that have been hit hard by the shift to remote work may also be promising targets for new housing.

Appendix A. Data and Methodology Notes

Maps

Digital maps are used for 2000 and 2020 block group definitions.

Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 17.0 [data set]. Minneapolis, MN: IPUMS. 2022. http://doi.org/10.18128/D050.V17.0.

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[6] The Comprehensive Plan is the city's outline for its overall land use goals. All zoning must be consistent with the goals laid out in the Comprehensive Plan.

For exhibit 4, the following were used:

- Map of water in the District, from D.C. Open Data.

    ○ https://opendata.dc.gov/datasets/waterbodies-2017

- Map of building footprints in the District, from D.C. Open Data.

    ○ http://opendata.dc.gov/datasets/building-footprints, downloaded May 2019

- Metro map from D.C. Open Data.

    ○ http://rtdc-mwcog.opendata.arcgis.com/datasets/metro-rail-stations, downloaded May 2019

Demographic Data

The source for demographic data (population, housing units, etc.) is the U.S. Census Bureau.

- 1970 to 2020 at the city level, for exhibit 1.

    ○ Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 16.0 [data set]. Minneapolis, MN: IPUMS. 2021. http://doi.org/10.18128/D050.V16.0.

- 2000 block group data.

    ○ Summary File 3 at the block group level.

    ○ Downloaded via the Census Bureau's Application Programming Interface (API), July 7, 2022.

- 2020 block group data.

    ○ American Community Survey, 2016–20.

    ○ Block group level data.

    ○ Downloaded via the Census Bureau's API on July 7, 2022.

Zoning Data

These data detail which land in the District is subject to which zone code in 2003 and 2016.

- 2003 Zoning Data.

    ○ From https://opendata.dc.gov/documents/dcgis-data-archive-july-2003/explore.

    ○ We use layer ZoningPly.

- 2016 Zoning Data.

    ○ Shapefile from https://opendata.dc.gov/datasets/DCGIS::zoning-regulations-of-2016/.

Consumer Price Index

The consumer price index was used to convert all relevant dollar values into 2021-year dollars.

The All Urban Consumers series was used, downloaded from https://data.bls.gov/pdq/ SurveyOutputServlet on May 16, 2022.

Annual average values are from Column N.

Appendix B. Analytical Methods

Consistent 2000 Block Groups

The goal of this study is to make time-consistent block groups to analyze the same area over time. To do so, the 2020 block group data were put into 2000 block group terms.

The original 2000 block group map has 433 block groups, and the original 2020 block group map has 571 block groups. The final analysis sample uses 433 block groups.

To make this sample, the maps of the 2000 and 2020 block groups were overlaid. Many block groups have the same borders or change little. Usually, block groups split over time to ensure that their population does not grow too much.

When a 2020 block group does not have the same borders as the 2020 one, the demographics of the 2020 block group were weighted to attribute it to a 2000 block group. For example, suppose that 40 percent of the land area of 2020 block group A lies in 2000 block group X, and the remaining 60 percent of 2020 block group A lies in 2000 block group Y. In this case, the authors assigned 40 percent of block group A's population to 2000 block group X and the remaining 60 percent to 2000 block group Y.

Zoning and Zoning Change

To study zoning change, the authors first re-categorize zoning codes into five broad categories—single-family, multifamily, commercial/industrial, mixed-use, and other—to facilitate analysis.

By overlaying the 2003 and 2016 zoning maps, the team then evaluated which pieces of land changed from one of these broad categories to another. Therefore, each piece of land was classified by combining its broad 2003 zoning code and its broad 2016 code.

The 2003 and 2016 zoning status of each block group was found by intersecting the 2003/2016 zoning map with the 2000 block group map. The authors then calculated, for each block group, the amount of land in each combination of 2003 and 2016 zoning codes.

Appendix C. Information on Neighborhoods With Large Zoning Changes

The map in exhibit C-1 shows the 10 neighborhoods with the largest shares of land rezoned from one of the five broad categories to another.

Exhibit C-1

Neighborhoods With the Largest Change in the Percent of Total Land Area Rezoned, 2003 to 2016

Darker shaded areas have largest zoning changes
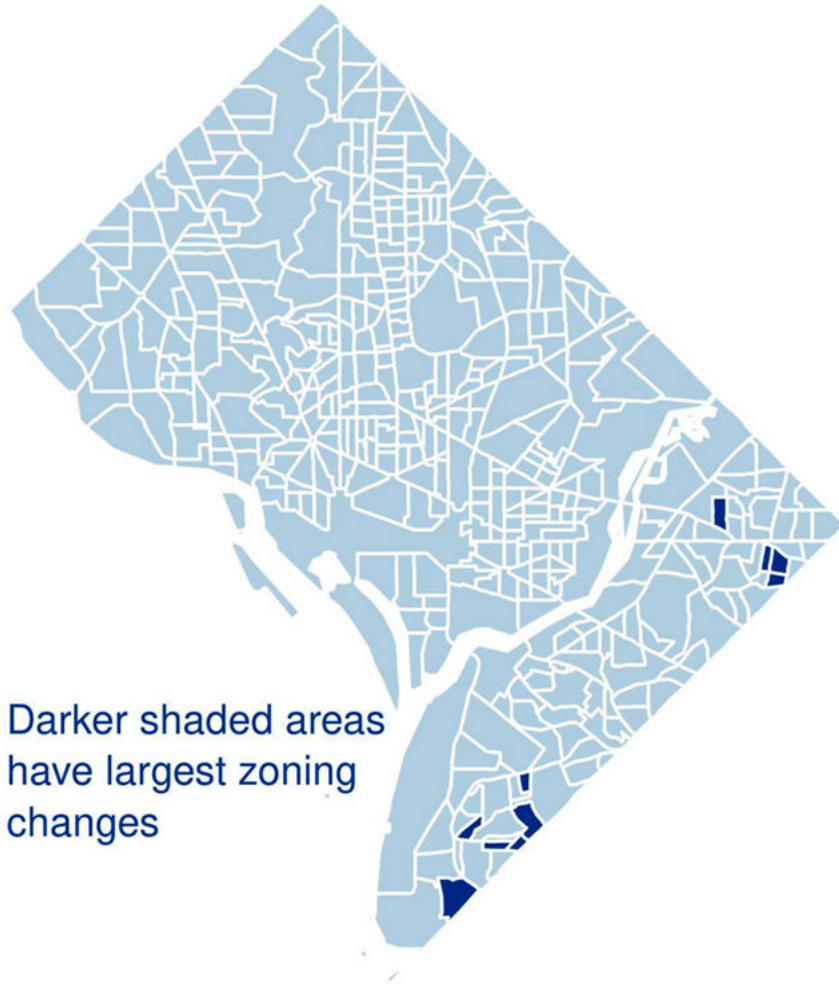
Notes: This exhibit shades the 10 neighborhoods with the largest change in the percent of total land area rezoned, 2003 to 2016. See appendices A and B for complete details and citations.
Sources: Washington, D.C., 2003 and 2016 zoning shapefiles (full details are in appendices A and B)

Acknowledgments

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