Cityscape

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Two Essays on Unequal Growth in Housing
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U.S. Department of Housing and Urban Development Office of Policy Development and Research

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Contents

Symposium
Two Essays on Unequal Growth in Housing 1
Guest Editor: John Carruthers

Note from the Managing Editor 3

The Closing of America's Urban Frontier 5
by Edward L. Glaeser

Housing Inequality in Developing Asia and the United States: Will Common Problems Mean Common Solutions? 23
by Toshiaki Aizawa, Matthias Helble, and Kwan Ok Lee

Departments 61

Data Shop
Parcel Tax in California: Findings from New Data Sources 63
by Soomi Lee

Foreign Exchange
How Finland Ended Homelessness 75
by Marybeth Shinn and Jill Khadduri

Graphic Detail
Early Interstate Policy and Its Effects on Central Cities 81
by Jeffrey Brinkman and Jeffrey Lin

The "Punitive Push" on Mobile Homes 87
by Graham Pruss and Karen Cheng

Industrial Revolution
Upcycling Shipping Containers for Houses 95
by Mike Blanford and Stephen Bender

Policy Briefs
Opportunity Zones: A Place-Based Incentive for Investment in Low-Income Communities 101
by Daniel Marcin

A Comprehensive Look at Housing Market Conditions Across America's Cities 111
by Anita Yadavalli, Brenna Rivett, James Brooks, and Christiana K. McFarland

SpAM
Applying Spaghetti and Meatballs to Proximity Analysis 133
by Alexander Din

Referees 2019–20 149

Call for Papers
***Cityscape* Symposium on Opportunity Zones** 151

Symposium

Two Essays on Unequal Growth in Housing
Guest Editor: John Carruthers

Note from the Managing Editor

Mark D. Shroder
Department of Urban Housing and Development

In 2018 I accepted a proposal from John Carruthers of Cornell University to present a symposium in this issue on the housing problems posed for all levels of government by the growth and decline of metropolitan areas. Between our agreement and the deadline for this issue, various barriers to completion of the symposium arose, most notably the coronavirus pandemic that interrupted the work of several participants. As a result, Professor Carruthers was only able to approve two studies that represent contributions to knowledge directly related to the mission of the Department of Housing and Urban Development (HUD).

Although two studies would not constitute a symposium under normal circumstances, we are still fortunate to be able to bring these works to our readers.

In "The Closing of America's Urban Frontier," Edward Glaeser of Harvard University and the National Bureau of Economic Research notes that the movement of people to productive cities was historically responsible for a large part of the growth in the American economy and living standards, but that in the past 50 years the most productive cities have become resistant to increases in the housing stock. This has been a factor in rising inequality and reduced rates of overall growth. He sees two alternative policy paths for the nation: one in which the states and the Federal government find means of removing local regulatory barriers, and one in which Federal policy increasingly favors relatively depressed areas.

In "Housing Inequality in Metropolitan Areas in Developing Asia and the United States: Will Common Problems Mean Common Solutions?" Toshiaki Aizawa of the University of York, Mathias Helble of the Asian Development Bank, and Kwan Ok Lee of the National University of Singapore investigate and contrast housing inadequacy in 10 developing Asian countries and in the United States. The Asian nations are Bangladesh, Cambodia, India, Kyrgyzstan, Myanmar, Nepal, Pakistan, Philippines, Tajikistan, and Timor-Leste. The data source for information on housing in those nations is the Demographic and Health Survey—an ongoing collaboration between the U.S. Agency for International Development and the governments of the named nations; the data source for information on housing in the United States is HUD's American Housing Survey. The authors find that larger urban areas with greater income inequality tend to have greater amounts of inadequate housing, and they review possible policy responses.

The Closing of America's Urban Frontier

Edward L. Glaeser
Harvard University and National Bureau of Economic Research

Abstract

For most of America's history, migrants have moved in large numbers from less productive places to more productive places. For the past 150 years, the movement to the urban frontier has been distinctly more economically important than movement to areas with little human settlement. Over the past 50 years, migration to America's most productive cities has been increasingly checked by the regulation of new construction. The closing of the urban frontier is associated with unaffordable housing, widening gaps in housing wealth, a spatial mismatch between local productivity, population growth, and the end of regional income convergence. One policy response to the change is to encourage state legislatures to take more regulatory power over construction or to provide localities with stronger financial incentives to build. Federal highway funding could be tied to the level of construction in high-demand areas. A second response is to accept the closed urban frontier and to embrace place-based policies that reduce joblessness in depressed areas through employment subsidies, social insurance reform, and experimental vocational training programs.

I. Introduction

In 1893, Frederick Jackson Turner presented his essay, "The Significance of the Frontier in American History," to the American Historical Association in Chicago. Turner claimed that "up to our own day, American history has been in a large degree the history of the colonization of the Great West," and that, "[t]he existence of an area of free land, its continuous recession, and the advance of American settlement westward, explain American development." Even in Turner's day and certainly afterward, however, American development was tied more closely to the country's urbanization than to the exploitation of empty land.

Turner was correct that "so long as free land exists, the opportunity for a competency exists." The free land that mattered most was not ranchland in the Dakotas; it was the land on the edge of Chicago or Los Angeles or New York City. In Turner's own day, less than one-fifth of aggregate national payments were produced by agriculture and mining (U.S. Census Department, 1975). By

1930, agriculture and mining would produce only 8.1 percent of the national income. Between 1890 and 1930, America's urban population increased by 212 percent, from 22 million to 69 million, while America's rural population rose by only 32 percent.

As Section II of this article discusses, the most significant trend during Turner's lifetime was the open urban frontier, by which I mean the space to build up and out within already developed urban areas.[1] Between 1861 when Turner was born, to 1932 when he died, America reorganized itself into an urban nation. Certainly, as Cronon (1991) amply documents, the history of America's western cities was closely linked to the natural resources that surrounded them. Those resources, however, were only transformed into national prosperity because tens of millions of Americans were able to urbanize. In a sense, America's urban frontier became more open during Turner's lifetime because the traditional downsides of urban crowding, such as contagious disease, became less problematic.

The urban frontier remained largely open during the dynamic 25 years that followed World War II. African-Americans migrated north by the millions to flee the Jim Crow South and take advantage of urban industrial jobs. Americans built new car-oriented cities in Sun Belt states like Arizona and Texas. The movement of people and firms diminished the vast income differences that once existed between locations.

Sometime around 1970, the urban frontier began to close. Community groups mobilized and opposed new housing and infrastructure. Highway revolts slowed urban expansion in car-oriented suburbs. Historic preservation made it more difficult to add new density in older cities (Been et al., 2016). Suburbs crafted land-use restrictions that stopped new construction (Glaeser and Ward, 2009). While some productive Sun Belt cities still permitted significant amounts of new housing, even those one-time refuges of affordable urbanism had begun to be more restrictive.

In Section III, I discuss the closing of the urban frontier and its consequences. Migration has fallen dramatically over the past 20 years, and poorer migrants no longer move disproportionately to richer places (Ganong and Shoag, 2017). Housing costs have risen sharply in more productive places, which has generated a wealth shift from the young to the old (Glaeser and Gyourko, 2018). Income convergence across regions has stalled (Berry and Glaeser, 2005). Hsieh and Moretti (2019) estimate that U.S. gross domestic product is substantially smaller than it would be if people could more easily move to wealthier areas. America's growing geographic sclerosis makes it increasingly difficult for out-migration to solve the problems of local joblessness. Consequently, targeted spatial policies may be worth reconsidering (Austin, Glaeser, and Summers, 2018).

The closing of America's urban frontier seems to be a far more significant event in American economic history than Turner's motivating fact that "the unsettled area has been so broken into by isolated bodies of settlement that there can hardly be said to be a frontier line." Vast amounts of the American West were unpopulated in Turner's time and remain so today. Cheap land could still be had for homesteading in 1893, and there remains plenty of inexpensive ranchland today for

[1] Wade (1959) uses the phrase "urban frontier" to specifically define the cities on America's western border. Those cities would be included in my definition, but I would also include tenements in Philadelphia and high rise apartment buildings in New York City's Central Park West as part of the urban frontier.

anyone who wants the rugged life of a mid-19th century frontiersman. By contrast, the high price of accessing America's most productive urban areas today is an important fact of life for tens of millions of Americans.

In Section IV, I turn to policy approaches of the closed frontier. One approach tries to reopen the frontier by inducing productive places to build more housing. The fundamental challenge facing this task is that communities have stopped building because residents do not want more construction. Opposition to new construction could perhaps be reduced if the financial benefits from new construction were higher; opposition could be further reduced if individual states can provide stronger incentives to encourage new development. Alternatively, states can reduce local sovereignty over land-use decisions. I outline a federal policy proposal linking highway funding to new construction that could nudge state legislatures toward action of this kind.

The second approach gives up on encouraging new construction and focuses on aiding the depressed parts of America. While I have long been skeptical about significant redistribution from rich places to poor places, there is a case for targeting policies toward the needs of specific areas. For example, social insurance could be restructured to encourage work in areas with higher levels of long-term joblessness. Employment subsidies could be directed to places with persistent nonemployment. Section V concludes.

II. The Urban Frontier and Frederick Jackson Turner

Frederick Jackson Turner presented his thesis in 1893 in the building that would become Chicago's Art Institute but was then occupied by the World Congress Auxiliary of the city's great Columbian Exposition. The exposition symbolized both Chicago's economic muscle and abundant space. Chicago beat out New York City for the privilege of hosting the exposition both because the city's merchants offered more money and because Chicago had "ample space," whereas, in New York, there was "not a house to buy and not a rock to blast," at least according to Chicago's boosters (Lederer, 1972).

The most iconic images of the exposition show its "White City" either gleaming during the day or lit up at night by Westinghouse's then-novel alternating current electrification. The city contained 14 great buildings organized around a central pool that demonstrated Chicago's reservoir of architectural talent. Louis Sullivan designed the Transportation Building, which was a pioneering early modernist structure. Daniel Burnham was the director of works for the entire exposition.

Early in their careers, Burnham and Sullivan had both worked in the Chicago office of William LeBaron Jenney, who would later build Chicago's Home Insurance Building. The Home Insurance Building is sometimes credited as being the first skyscraper due to two of its walls were held up by a steel frame. Burnham and Sullivan would both play central roles establishing the steel-framed skyscraper as the central tool for opening cities upward and enabling far more usable space to be built on modestly sized lots of urban land.

The Opening of the Urban Frontier

With the benefit of hindsight, the opening of the urban frontier was a more important economic event than the closing of America's wilderness frontier in 1890. The 10 states and territories that made up America's post-Civil War frontier together had only 1.6 million inhabitants or 2.5 percent of America's total population. The U.S. Census count of Manhattan's population in 1890 was 1.5 million, and the New York Police Census count of the island's inhabitants was 1.7 million. Perhaps Turner was correct, and the closing of the actual frontier was a cultural event of the first magnitude. There certainly were not that many people interacting with the frontier throughout Turner's life.

By contrast, Turner lived from 1861 to 1932, during an age of stupendous urban growth. In 1860, America had a mere 6.2 million urbanites. By 1890, in the census before Turner presented his frontier thesis, the urban population had grown to 22 million. By 1930, right before his death, America's urban population had expanded to 69 million. Despite the dramatic urban growth that was happening right before Turner's eyes, the word "city" appears only four times in his famous essay. Arthur M. Schlesinger, Sr. (1940) correctly responded to Turner's essay by noting that, "[h]istorians in their preoccupation with the dispersion of settlers over the wide expanse of the public domain have given little attention to this countermovement which even more profoundly altered the tissue of American life." By "this countermovement," Schlesinger meant urbanization. Fred Shannon (1945) also responded to Turner's essay by writing, "it is in fact too apparent to require much argument that the population movement, from 1860 to the end of the century, was preponderatingly from the farm to the city, rather than the reverse."

America's late 19th-century urban growth, like urban growth throughout most of history, reflected rising agricultural productivity that enabled more of humanity to do something other than provide food. America's late 19th-century urbanization was also a more localized event that can be called the opening or expansion of the urban frontier. Large cities had historically been limited by the downsides of urban density. These downsides were diminished by technological revolutions that spread during Turner's lifetime.

In the early 19th century, the horizontal spread of cities had been checked by the slow speeds of pedestrian travel. Over the century, cities added horse-drawn omnibuses, streetcars, railways, and subways that enabled their spread. Walking the length of the island of Manhattan to get to work is practically impossible. By 1879, however, a commuter could take the Ninth Avenue elevated railway (el) from 155th Street to downtown Manhattan. The city could expand because so much more land became functionally connected to the core business districts.

When Turner was born, buildings essentially topped out at five or six stories, which was generally the upper limit on people's willingness to climb stairs. Elevators first started appearing in buildings as a novelty and then became the crucial last leg of the city's transport network. Architects, like Jenney, Sullivan, and Burnham, then combined elevators with steel frames to create skyscrapers that enabled cities to expand vertically. The commuters who got on the el at 155th Street may have lived in short houses, but many of them worked in tall, steel-framed office buildings with elevators.

Americans who chose to live in a city in 1861 reduced their chances of a long life or healthy children. When Turner was born, New York City still experienced water-born cholera epidemics that killed thousands. By 1893, those epidemics had largely ceased, and by 1932, New York City was as healthy as the country as a whole. The improvements in America's urban health occurred due to massive public investment in water and sewerage (Cutler and Miller, 2005) and because public health authorities imposed penalties on tenement owners who did not connect to the system (Ashraf, Glaeser, and Ponzetto, 2016). Improvements in sanitary conditions eliminated a third major barrier to urban growth.

As cities became healthier, more connected, and taller, people came by the millions. As cities grew, agglomeration economies meant that they became more productive as well. America in 1920 was a predominantly urban nation, and by 1926, per capita gross national product exceeded $14,000 in 2019 dollars (Romer, 1989). The opening of the urban frontier had enormously positive consequences for American prosperity.

The Urban Frontier After Turner

When Turner died in 1932, America's urban growth was checked first by the Great Depression and then by World War II. Even during the Depression, however, inter-city migrants could substantially better their lot by moving to the right urban area (Feigenbaum, 2015). After the war, Americans continued their process of moving to new cities for opportunities. From 1952 to 1990, more than 6 percent of Americans moved across counties every year. In some cases, this movement represented the standard path from farm to factory. In other cases, migration moved from urban area to urban area as people sought higher-paying jobs, shorter commutes, or warmer winters.

The most dramatic of the post-war urban movements was the "Great Migration" of African Americans from the rural South to the urban North. They fled both extreme poverty and terrible legal discrimination. Much of the reduction in the African-American-White earnings gap since 1945 occurred because of this migration to urban centers (Smith and Welch, 1989). The urban frontier provided an escape from the stultifying life of an African-American sharecropper.

Moving across cities also continued to provide better wages for White Americans. Ganong and Shoag (2017) showed that poorer migrants moved disproportionately to richer areas between 1960 and 1980. The migration from poor places to rich places helps to explain the mean reversion of income levels across space that was documented by Barro and Sala-i-Martin (1992). From 1860 to 1980, richer places experienced slower income growth than poorer places. Meanwhile, from 1950 to 1970, income differences across areas narrowed.

Americans, however, had grown so rich after World War II that migrants increasingly moved for amenities rather than just higher incomes. Los Angeles attracted residents initially not because of its job opportunities, but rather because its weather is so much more moderate than the American Midwest. Glaeser, Kolko, and Saiz (2001) found that measures of amenities strongly predict urban area growth from 1980 to 1990.

Finally, populations left cities that were built around walking and rail lines and moved to areas that were built around the car. Baum-Snow (2007) showed that interstate highways predicted patterns

of suburbanization. Duranton and Turner (2012) found that highways predicted urban area growth in post-war America. Cities like New York and Boston tried to retrofit themselves for the automobile, but for a short, car-based commute, it was easier to move to Atlanta or Dallas.

All of this movement was possible until the 1960s because communities made it easy to build. Land-use regulations were modest, and infrastructure could be easily added, at least in the newer urban areas. As a consequence, housing price differences across space remained modest, and even California was only slightly more expensive than the nation as a whole in 1970 (Glaeser, Gyourko, and Saks, 2005a).

III. The Closing of the Urban Frontier

During the 1950s, activists began to protest again the Jim Crow system that had pushed millions of African Americans to the North. Their methods were then borrowed by other groups who influenced public policy, and some of those groups wanted to block urban change. As community groups increasingly blocked new construction, prices rose, and migration rates fell. As a result, we now live in a far more geographically static nation.

Activists Against Change

As a young woman, Shirley Hayes acted on Broadway with Leslie Howard. She married one of her fellow actors, had four sons, and lived in Greenwich Village. Hayes was a natural activist who unsuccessfully fought against the large public housing projects that New York's master builder, Robert Moses, was building near Washington Square Park. She took her children regularly to play in that park, and when Moses announced his plan to run a 48-foot road through the park, she sprang into action. As the *New York Times* wrote in her 2002 obituary, "She collected 16,000 signatures and the endorsements of politicians, newspapers, 12 parent-teacher associations, and the Lions Club" (Martin, 2002). Eleanor Roosevelt was one of the residents who supported Hayes' fight.

Hayes battled Robert Moses for 7 years until Tammany Hall kingpin, Carmine DeSapio, stopped the road. Washington Square Park remains the way that it is today largely through Shirley Hayes' efforts. She proved the power of community activists to stop even the most entrenched builders. Her fight was the training ground for the next generation of activists against urban change, like Jane Jacobs. Jacobs would later lead the successful fight to stop Robert Moses' Lower Manhattan Expressway.

Jacobs also became a prime mover in the campaign to turn Greenwich Village into a historic district. Penn Central's destruction of the old Beaux-Arts Penn Station became a rallying cry for preservationists throughout the city. Their movement gathered steam in the 1960s, and in response to its political pressure, New York enacted its Landmarks Law in 1965. The resulting Landmarks Commission became an institution that would respond to citizen demands for preservation by creating historic districts where large change was impossible. While Jacobs had argued that preserving old structures would ensure affordability, prices rose as the city restricted housing supply.

On the opposite side of the continent, other extremely capable women were organizing against change outside of San Francisco. Catherine "Kay" Kerr, the wife of the president of the University

of California system, was one of a trio of women who founded the Save the Bay Association in 1961. That group successfully used environmental arguments to stop new construction. In 1973, the Supreme Court ruled in *Friends of Mammoth v. Board of Supervisors of Mono County* that all major new construction in California needed to undertake an environmental impact review. While greater San Francisco was affordable in 1961, just like Greenwich Village, robust demand combined with limited supply to make both areas expensive today.

Berkeley, California, was also the site of early organized opposition to highway construction. In 1952, the Berkeley Department of Public Works proposed building an Ashby Freeway that would connect Interstate 80 and California Highway 24. Thousands objected, and the Berkeley City Council eventually shelved the idea in 1961. Throughout the 1960s and 1970s, communities staged highway revolts against new road construction. Fewer highways meant less ability to access urban cores from more far-flung suburbs.

Throughout America, communities found big and small ways to limit growth. Cities, like New York, made their zoning codes increasingly onerous. In Massachusetts suburbs, Glaeser and Ward (2009) detailed the rise of special wetlands protections, minimum lot sizes, and septic provisions that make building more difficult. These regulatory hurdles appear to both limit construction and raise prices.

While limits on density do raise prices, Massachusetts communities do not seem to value lower density enough to offset the social value that is lost when construction is prevented. The Henry George Theorem is a standard result in urban economics that posits that local policies increase welfare if and only if they increase total land value (Arnott and Stiglitz, 1979). Yet it seems that Massachusetts' towns are being too restrictive, and that total land value would increase if they allowed additional building.

Total land value is defined as the value of housing minus total construction costs. Permitting an extra home increases total land value directly by adding a new home that is valued more than its construction cost, and it indirectly decreases the total land value by increasing crowding, which lowers the value of all the other homes. The value of building that maximizes total land value exactly balances those two effects so that the difference between price and construction cost divided by the price equals the percentage decrease in price associated with a 1 percent increase in crowding, which is referred to as the elasticity of price concerning density.[2] Glaeser and Ward (2009) found that the elasticity of housing prices, concerning density, is less than 0.15, and land's share of value is over 0.5, suggesting that communities' regulations are overshooting and destroying land value.

In the 1950s, builders of highways, suburbs, and skyscrapers enjoyed a relatively free hand. In some cases, their construction damaged older neighborhoods and the environment. Motivated by these ills, communities limited growth, but these new rules were not surgical strikes that eliminated only the worst excesses. Instead, throughout the United States, higher demand urban areas became far less elastic, and the urban frontier began to close.

[2] Formally, the elasticity is the derivative of the logarithm of price with respect to the logarithm of density.

The Consequences of the Closed Frontier

In this section, I discuss seven events that are potentially linked to the reduced new supply of housing in America's most productive cities. Two of these events concern the price of housing: the increasing cost of living in America's most productive places and the changing distribution of housing wealth that favors the old and the rich. Five of these events reflect changing migration patterns and the consequences of the reduced growth of productive places: declining levels of migration in general and directed migration in particular, increasing segregation of the skilled, persistent pockets of joblessness, the end of regional income convergence, and the spatial misallocation of people and employers. These events have causes that go far beyond the regulation of new growth, but the regulation of housing is a policy choice that is intertwined with all of these outcomes.

High prices are the most commonly cited woe that occurs when supply is artificially constrained. In 1970, price differences across the United States were modest, and even the most expensive areas were only 30 percent more expensive than the national average (Glaeser, Gyourko, and Saks, 2005a). In the third quarter of 2019, according to the National Association of Realtors®, the median sales price across the entire United States was $280,000. The median sales price in San Jose, California, was $1.24 million. The median sales price in San Francisco was $964,000.

The extraordinary cost of California's coastal real estate reflects demand as much as supply. If the region's economy was not red hot, then it would not be so expensive. The desultory 8,744 housing units permitted in the San Jose urban area, however, is unlikely to do much to slack that demand. By contrast, New York City permitted over 100,000 units annually in the early 1920s when the city's expansion was at its peak.

The first wave of studies that looked for a link between land-use controls and high prices looked at specific policies, like California's growth controls (Glaeser and Ward, 2009; Katz and Rosen, 1987). While many of these studies found positive effects, this approach is challenged by the endogeneity of these policies and their correlation with other policies, the difficulty of capturing the full range of local anti-growth policies, and the spillover of prices across jurisdictions. A second approach focuses on variation at the urban area level (Saiz, 2010). Across urban areas, the expensive places do not build much, and the places that build are not expensive. There are also strong correlations between urban area measures of land use and higher prices, just as there is a correlation between natural limits on construction—such as hilliness—and higher prices.

The third approach compares the value of housing with the cost of construction. The logic of this approach is that when prices exceed construction costs, then builders should want to build, and there must be some regulatory hurdle that prevents adding new housing. This approach is easiest to implement in dense cities, where the marginal cost of new space is just the cost of another floor. In suburban areas, new construction typically also involves more land, and there must be some means of valuing land, such as estimating the value of extra acreage in a hedonic regression. A hedonic regression statistically estimates the impact of housing attributes on sales prices holding all other housing attributes constant. These studies find dramatic "zoning taxes" that can exceed one-half of the price of a house (Glaeser, Gyourko, and Saks, 2005b).

The rising price of housing, especially in coastal markets, has created vast disparities in housing wealth and a shift in wealth from the young to the old. Glaeser and Gyourko (2018) use the Survey of Consumer Finances in 1983 and 2013 to look at housing wealth net of mortgage debt. The downward shift in housing supply and the associated shift in housing prices has both increased wealth inequality within age groups and generated a shift in housing wealth from the young to the old.

In 1983, the median 55-to-64-year-old had $94,000 in housing wealth (in 2013 dollars). In 2013, the median 55-to-64-year-old had only $60,000 in housing wealth. The 95th percentile 55-to-64-year-old owned $353,000 in housing wealth in 1983 and $543,000 in 2013. The 99th percentile 55-to-64-year-old household had $760,000 in 1983 and $1.5 million in 2013. The upper tail of owners has much more housing wealth than they did in the past, while the median owner has less wealth.

There has also been a shift between young and old. In 1983, the median 35-to-44-year-old had $56,000 in housing wealth, but in 2013, the median 35-to-44-year-old's housing wealth was only $6,000. The median 65-to-74-year-old owned $82,000 in housing wealth in 1983 and $100,000 in 2013. The 75th percentile 35-to-44-year-old's wealth fell from $119,000 to $58,000. The 75th percentile 65-to-74-year-old's wealth increased from $150,000 to $225,000. The disaffection of younger Americans for capitalism may partially reflect the fact that they cannot buy the same decent housing in high-wage areas that their parents could afford.[3]

For every year from 1952 to 1992, intercounty migration rates never fall below 6 percent per year. For the past decade, intercounty migration rates have never risen above 4 percent per year. This shift represents a one-third drop in the spatial mobility of Americans. While there are many possible causes of this shift, the inability to buy homes in the most attractive parts of America must remain a possible cause of America's reduced mobility (Molloy, Smith, and Wozniak, 2011).

Ganong and Shoag (2017) also show that the migration of poorer people to richer places that occurred between 1960 and 1980 has largely disappeared since that time. A higher wage for a plumber in San Francisco cannot cover the high cost of housing. Consequently, our richer cities are turning into boutique towns for the highly educated.

The migrants who do come to San Jose or Boston are more likely to be highly skilled since they are the only ones who can afford the housing. Over the past 80 years, there has been a strong tendency for skilled places to become more skilled. The increased segregation of the skilled has many possible causes, but one explanation is the dearth of new housing in skilled, successful cities (Berry and Glaeser, 2005).

The segregation of the skilled in places like Seattle and San Francisco means that the unskilled create their own pockets of poverty. Austin, Glaeser, and Summers (2018) show that the joblessness rate among 25-to-54-year-old men in 1980 is closely correlated with that rate in 2015 across Census Public Use Microsample Areas. As the skilled leave these areas, their local problems

[3] For example, a 2018 Gallup poll reported that among 18-to-29-year-old respondents 45 percent had a positive view of capitalism and 51 percent had a positive view of socialism (Newport, 2018).

become worse. This process of hollowing out lies behind the local dysfunction that is painfully common in America's Eastern Heartland.[4]

America's increasing geographic sclerosis, which has been abetted by limited housing supply, may also explain the decline in regional income convergence. Barro and Sala-i-Martin (1992) documented the strong tendency of the poor regions of America to see their incomes catch up in the years before 1990. That income convergence process seems to have ended since then (Berry and Glaeser, 2005). One explanation for why income convergence has stopped is that housing supply limitations stop people from coming to high wage areas and pushing wages downward.

A final consequence of limitations on urban growth is that there is a spatial mismatch between people and productivity that has significant implications for overall national productivity. As productivity is much higher in Silicon Valley than in the Eastern Heartland, the overall gross domestic product would increase in people who could move from the Eastern Heartland to Silicon Valley. Hsieh and Moretti (2019) estimate that an efficient spatial reallocation would have a noticeable impact on America's overall level of output.

The closing of America's urban frontier is a major change for America. Housing never used to be a barrier to urban growth. It is now, and the policy question is whether anything can be done about it. I now turn to policy options for the future.

IV. Two Policy Approaches to the Closed Frontier

In this section, I discuss two policy responses to the closing of the urban frontier. The first path refuses to accept that the urban frontier is permanently closed. It imagines federal and state policies that could potentially generate more permitting in high demand areas. The second path accepts that the reduction in permitting will be permanent. If out-migration will not provide an escape valve from local poverty in the future, then there is a stronger case for targeting policies to reduce the suffering of depressed areas.

Reopening the Frontier

What would it take to induce significantly more permitting in high demand localities? The opposition to new construction is based on real, local costs. More housing supply will depress the value of local housing, and most Americans are homeowners. A greater population density will create more congestion on the streets and crowding in the schools. Communities have shown little willingness to overlook those costs. Consequently, more permitting will require either compensating the communities or eliminating their ability to veto new building or some combination of both.

Massachusetts laws illustrate these two options. Massachusetts Chapter 40B, which was enacted in 1969, decreases local sovereignty over new construction. If less than one-tenth of a community's housing is deemed affordable, then builders of affordable housing have access to a state permitting

[4] We define the Eastern Heartland to mean those non-coastal states that were admitted to the Union prior to 1840 and West Virginia.

process that largely bypasses local control. The full impact of the law is difficult to assess because even when it is not explicitly used, it improves bargaining power to builders. Massachusetts Chapters 40R and 40S were enacted in 2004 and 2005; they provide modest financial incentives to encourage communities to build.

Massachusetts tried to use state dollars to encourage local building, but another model is to make developers directly compensate localities for adding density, as they sometimes already do through impact fees. These fees could be shared between the community as a whole, to compensate for lower prices and increased costs of public services, and the new construction's nearest neighbors, to compensate for local crowding. In theory, a system where developers pay for speedy permits is attractive. Ideally, such a system would ensure that building only occurs where enough surplus is generated to compensate localities for the costs of new construction.

There are reasons, however, to think a pure compensation model will not be enough to achieve optimal amounts of new construction. Inevitably, the compensation will be imperfect so that some owners are hurt more than their allotted compensation. Those owners will still have incentives to use the permitting process and the courts to block new building. Our political system is not well suited to produce neat bargains in which winners from policy changes nicely compensate those who lose from the change. Moreover, it is at least possible that existing owners overestimate the actual costs of new building and will oppose new building even if they are fairly compensated.

By contrast, reducing local sovereignty is a surer path toward new construction. Simply moving to a larger jurisdiction is likely to promote more permitting since local jurisdictions internalize more of the benefits of building. If the polity includes business owners, then they typically have incentives to support new building, since lower housing costs translate into lower wages. If bankers and builders are at the table, then the voices for more permissive permitting become even louder. Tricaud (2019) shows that when small bedroom communities are incorporated into larger governmental units in France, then the amount of permitting increases.

Only state governments, however, have the power to redefine the permitting authority of localities and states have shown limited willingness to take power away from local homeowners. California has the worst housing affordability problem in the nation, but its legislature failed to pass Senate Bill 50 and Senate Bill 827, which would have preempted the local ability to block high-density building near transit stops. California's legislatures will never represent the interest of non-Californians who might someday want to live in Silicon Valley or Los Angeles.

Only the federal government has the geographic scope to consider the benefits of building to all Americans, and yet, the federal government cannot directly overrule local zoning power. One possible path for federal action is to create incentives that would nudge state governments to act. Federal highway funding is the most natural and appropriate tool to create those incentives.

There is a history of using federal highway funding to push states to take action. In 1984, the U.S. Congress enacted the National Minimum Drinking Age Act, which required states to raise their drinking age to 21 or lose one-tenth of their highway funding. A higher drinking age was seen as

a tool for reducing traffic fatalities on the highways. By 1988, every state but Louisiana had raised their drinking age to 21.

The case for tying transportation funding to new construction is that new highway spending is particularly necessary when communities are expanding. If populations are static, then there is less need to provide new infrastructure. Federal financial incentives can be seen as a way to induce states to internalize the benefits that new building creates for out-of-state residents who might like to move in-state sometime in the future.

The act could mimic the Drinking Age Act by having a flat reduction, such as 10 or 20 percent, in the level of highway funding if the state is unaffordable or fails to build. Alternatively, the act could specify a sliding scale so that the percentage of funding lost could start at 30 percent, but then the losses could be mitigated if there was more building in expensive areas.

The initial definition of affordability might be based on the share of the population that lives in counties (or census tracts) where less than 10 percent of homes are deemed to be affordable. The building threshold would then specify a minimum number of new homes built in these unaffordable areas. A state in which 50 percent (or more) of its population lived in unaffordable communities that are adding fewer than 3 percent of the current annual housing stock could be deemed to be in non-compliance and lose one-fifth of its transportation spending.

Alternatively, a sliding scale act could start with the share of the population that lives in counties that are unaffordable and that have little building. This share would then be multiplied by a factor, and the resulting product would reduce total highway aid. For added incentives, the money could then be shared among states with robust housing demand that are permitting more building.

One important detail is that the population weights used to determine the share of population living in unaffordable counties should be held fixed. Otherwise, states would have an incentive to prevent growth in expensive counties because that would make the level of unaffordability seem worse. A simpler design that would avoid these issues would be to define unaffordability based on a statewide share of affordable housing, but it would still be necessary to base the building requirements on permitting in the state's more desirable counties. More permitting in Buffalo, New York, does little to ease New York City's affordable housing problem.

The exact details of the scheme are less important than the message it sends. Some federal push for new building would aid the advocates of permitting in state legislatures throughout the country. The fear of losing highway funds is a potent bargaining tool. Senate Bill 50 might have passed if more legislators feared losing their steady stream of federal highway funds.

While the advocates of affordable housing have every reason to support national policies that would push state legislators to promote more permissive permitting, it is hard to be too optimistic. Congress may not be willing to pass such an act. Even if highway funds were tied to state-level building, homeowner activists may still be able to block state action. Consequently, it is also appropriate to consider efficient policies if the urban frontier remains closed. I turn to those policies next.

Spatial Policies in an Age of Reduced Geographic Mobility

America has always had striking geographic disparities of income, but those differences seemed like less of a problem if people could easily move from poor areas to rich areas. When high housing costs prevent migration from poor to rich places, then it becomes more reasonable to consider place-based policies that can potentially aid people who remain in depressed regions. Europeans have embraced place-based policies since the formation of the European Union, partially because European migration rates were so low relative to the United States. As U.S. geographic mobility becomes more European, the case for European-style, place-based policies becomes somewhat stronger.

Austin, Glaeser, and Summers (2018) divide America into three regions: the coasts, the Eastern Heartland, and the Western Heartland. The coasts are wealthy and have restrictive housing policies. The Eastern Heartland is the epicenter of American joblessness and social dysfunction. Incomes in the Western Heartland, which includes all non-coastal states that joined the union after 1840, are lower than on the coasts, but joblessness is low, and housing is affordable. If America was divided evenly between rich restrictive areas and poor areas, then it would be easier to simply embrace policies that aid the poor areas. Since the residents of Detroit and eastern Kentucky can still readily move to places in the Western Heartland, like Texas or the Dakotas, subsidies to the Eastern Heartland may still end up inefficiently deterring migration to more functional local economies.

Austin, Glaeser, and Summers (2018) also present evidence suggesting that joblessness for prime-aged[5] males is far more problematic than low incomes. The jobless are far less satisfied with their lives than the working poor. They have higher suicide and divorce rates. Moreover, joblessness generates a fiscal externality because when people do not work, they use social programs that impose costs on other taxpayers and do not pay taxes themselves.

These considerations suggest a more nuanced spatial policy than simply taxing California to subsidize Ohio. Spatially targeted pro-employment and pro-education policies can directly attack the high levels of joblessness. These policies can be designed so that they only modestly distort the decision on whether to remain in a declining region. Pro-employment policies can either take the form of new tax credits, like the earned income tax credit, that promote working in the Eastern Heartland or reform of existing social insurance policies in these regions that would make work more appealing.

Uniform labor policies across the United States seem just as problematic as our one-size-fits-all housing policies. When housing supply is perfectly elastic, then supply subsidies, like the low-income housing tax credit, will have little impact on the overall quantity of housing and, therefore, little impact on the equilibrium price. When housing supply is perfectly inelastic, then demand subsidies like Section 8 housing vouchers will push up prices and, under extreme conditions, do nothing to promote affordability. This logic suggests that housing policy should promote supply in inelastic San Francisco but not in elastic Houston and should provide demand-side vouchers in Houston but not in San Francisco.

[5] "Prime aged" is defined as being from 25 to 54 years old.

Austin, Glaeser, and Summers (2018) present evidence suggesting that employment rates are far more sensitive to changes in wages in places where joblessness is high. Consequently, subsidizing employment will reduce joblessness more if the subsidies are targeted toward areas with high levels of joblessness. If America is willing to expand the earned income tax credit so that this policy becomes more relevant to prime-aged men, then that spending will have more impact if the subsidies are more generous in high joblessness regions of the country.

When designing social insurance policies, like disability insurance, there are two key policy elements: the maximum level of social insurance (the intercept) and the degree to which benefits decline with earnings (the slope). Social insurance deters employment more when the slope is steeper, but a steeper slope also reduces the cost of the program. If the program costs are held constant, then a flatter slope must be offset by a lower intercept, or equivalently, the maximum benefit level must be lower if benefits fall less with earnings.

When employment is more elastic, as it appears to be in states with high joblessness levels, then a steep slope does more to deter working. A reasonable response to differential employment elasticities across space is for the maximum benefit to be lower in high joblessness areas, but people receiving benefits can keep more of their earnings. In that way, the program will do less to deter working at the same overall cost. This twist would imply that the maximum payment for workers with disabilities would be lower in Kentucky than in Massachusetts, but workers with disabilities in Kentucky would be able to earn more without risking their benefits.

An added employment subsidy in the Eastern Heartland might deter migration, but it would discourage emigration among those who are employed. A policy twist that reallocates money within a social program should have little or no impact on out-migration. If anything, workers who know that they will not work under any circumstances have a stronger incentive to move out, while workers who anticipate some employment will stay. If one hope is to reduce the concentration of the long-term jobless, then these modest migration distortions can even be benign.

Education significantly determines both regional success and local employment rates. Targeted education policies can complement targeted pro-employment policies. A particularly natural area to innovate is vocational training. Competitively sourced vocational programs structured with pay-for-performance could provide the skills needed to take advantage of the employment subsidies. One attractive aspect of vocational training is that typically it is possible to measure skills at the point of graduation. Payment for running a program that trains plumbers can be made contingent upon graduating a fully licensed plumber.

For example, vouchers could be issued for taking vocational training courses for teenagers on weekends, after school, and during summers; vouchers could also be given to selected adults. These courses can be offered by an accredited source, including labor unions, private companies, and community colleges. The courses could be given in public school spaces that are underutilized off-hours or in local community colleges. The vouchers can only be redeemed by the educators when the graduating students have been independently tested or licensed.

As we have a limited track record with successful training programs, it makes sense to experiment and evaluate, ideally with randomized control trials. More skills would help poorer places catch up to richer places, but it is less clear how to deliver those added skills. Experimentation, therefore, is vital.

V. Conclusion

This article has argued that the fluidity of America's economic geography has radically changed over the last 50 years. For most of the period from 1870 to 1970, the urban frontier was a great escape valve from local poverty. High levels of geographic mobility helped people find better jobs and helped regions transform themselves. Since 1970, successful urban areas have made building increasingly difficult, and the urban frontier has begun to close.

This article suggested two policy responses to this change. The first response ties federal highway funding to local construction levels in an attempt to reverse the downward trend in building across wealthier coastal cities. The second response accepts that migration to successful cities will be permanently limited and tries instead to improve conditions in less successful cities. Possible place-making policies include targeted employment subsidies, social insurance reforms that deter working less, and experimental vocational training that encourages competition among skills providers and pay-for-performance.

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Housing Inequality in Developing Asia and the United States: Will Common Problems Mean Common Solutions?

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Abstract

We analyze housing inequality, an important and common issue in both developing and developed countries. To do so, we use two different samples: one from the 2012–2017 Demographic and Health Survey data for 10 developing countries in Asia and one from the 2017 American Housing Survey for the United States. Our findings suggest that while cities generally have more advantages for housing adequacy because of their population size, not all cities manifest these advantages. In the United States, residents in central cities have lower access to adequate housing than suburban residents. In addition to urban-rural or urban-suburban housing inequality, another dimension of housing inequality is associated with household economic status. We find a significant concentration of inadequate housing among households with lower wealth and income both in Asian developing countries and the United States. Finally, our results suggest spatial heterogeneity in household-level housing inequality. Areas with a larger population, higher economic inequality among residents, and lower housing affordability tend to experience greater housing inequality among households with different levels of wealth and income. After presenting these empirical findings, we discuss various policy measures that attempt to mitigate housing inequality.

1. Introduction

Much attention has been paid to rising economic inequalities in many developed countries and their metropolitan areas (Piketty, 2014; Wetzstein, 2017). Although income and wealth have been the focus of such inequality research, the distribution of adequate housing and associated living conditions has received much less attention. That distribution, however, is another important dimension that determines the actual level of household-level inequality. As housing adequacy has a significant effect on household wellbeing (Ineichen, 2003; Krieger and Higgins, 2002), housing inequality reinforces health and socioeconomic inequalities at the household level. Inequalities at the national and metropolitan level are associated with lower growth of income and population, higher crime rates (for example, Fajnzylber, Lederman, and Loayza, 2002), and a lower level of happiness (Oishi, Kesebir, and Diener, 2011). At the same time, the distribution of adequate housing influences how households sort into metropolitan areas and neighborhoods and contributes to spatial inequality that manifest in economic segregation and the concentration of poverty (Jargowsky and Wheeler, 2017).

Existing research tends to separate housing inequality into two dimensions: household-level and spatial inequality. Studies mainly done in the United States and other western contexts have looked into unequal homeownership opportunities among racial and ethnic minorities (for example, Borjas, 2002; Krivo and Kaufman, 2004). Others have studied neighborhood-level residential segregation to address spatial inequality in the degree of housing consumption (for example, Charles, 2003; Charles, 2006; Iceland and Weinberg, 2002). What is seemingly obvious but less known is the extent to which household economic inequality plays a role in household-level inequality in access to adequate housing. Another under-researched question is whether spatial attributes such as population size and local housing markets matter for housing adequacy gaps between rural and urban areas and across metropolitan areas. Furthermore, there is scant evidence on metropolitan heterogeneity in the extent of housing inequality by household economic status, as most existing research focuses on inequality at the household or smaller geographic level.

This article aims to provide systematic evidence of two dimensions of housing inequality in Asian developing countries and the United States. We begin by investigating the spatial heterogeneity in housing adequacy by population size, focusing on urban-rural and urban-suburban gaps and heterogeneities across metropolitan areas. Then, we move to the estimation of housing inequality by household economic status, such as wealth and income. Lastly, we look at how metropolitan-level spatial attributes, such as population size, economic inequality, and local housing markets, are associated with household-level housing inequality. Given the large difference in economic status and urban development between developing Asia and the United States, the main purpose of our article is not directly comparing their housing adequacy. We instead attempt to report whether different types of metropolitan areas—in terms of household income, urban growth, and geographic factors—have experienced similar or different patterns of housing inequality and to discuss how policy measures have coped with these issues.

In doing so, we use two different samples, one from the 2012–2017 Demographic and Health Survey (DHS) data for 10 Asian developing countries and one from the 2017 American Housing Survey (AHS) for the United States. To account for housing adequacy for our DHS sample, we use

the information on four-dimensional criteria including the durability of the building, crowding, access to improved water, and access to sanitation. For the AHS sample, we rely on housing quality information provided by AHS. We argue that this inconsistency in housing adequacy measures is not critical for our research because our main interest lies in the level of housing inequality within a given country or metropolitan area. For the same reason, all our analyses are done separately for the DHS and AHS samples. As we have uniform data and more household-level information, we can perform more in-depth analyses for our DHS sample, whereas our analysis for the AHS sample is mostly descriptive. For the comparison of housing inequality by household wealth among 10 Asian developing countries, we plot the concentration curve and calculate the concentration index (Kakwani, Wagstaff, and van Doorslaer, 1997; O'Donnell et al., 2008). We also use the DHS sample for our regression analysis at both the household- and metropolitan area-level that attempts to investigate the association between spatial attributes and housing inequality.

Our analyses using the DHS sample report serious housing inequality problems in Asian developing countries. We first observe the significantly lower share of adequate housing in rural areas than cities. Our analysis results also confirm a significantly higher probability that wealthier households reside in adequate housing. Then, we find that areas with a larger population, higher wealth inequality, and lower housing affordability experience more serious housing inequality by household wealth. Our regression results show that, although large and small cities in developing Asia offer more adequate housing than rural areas, many urban households with a lower wealth level do not enjoy this benefit. Both the standard deviation of household wealth and price-to-income ratio (PIR) have negative associations with overall housing adequacy, and they contribute to a wider gap in housing adequacy between households with different wealth levels. Metropolitan area-level regressions confirm that the concentration indices in cities and areas with higher wealth inequality are significantly higher than those in other areas.

Although the differences in economic status and the degree of development across U.S. metropolitan areas are less substantial compared to the urban-rural differences in developing countries, residents in some cities like Boston and New York show lower access to adequate housing than suburban residents. Unlike Asian developing countries, where economic deprivation in rural areas is found to be a main driver for the urban-rural housing inequality, spatial inequality in the United States appears to be mainly related with other factors, such as income inequality and housing market circumstances within a given metropolitan area. Along with spatial inequality, the concentration of inadequate housing among lower-income households also exists in the United States. With respect to the spatial heterogeneity in such household-level housing inequality, U.S. results show a consistent pattern with our evidence from Asian developing countries. The concentration of housing inadequacy among lower-income households is much higher in metropolitan areas than in non-metropolitan areas. Such concentration is also more significant in U.S. metropolitan areas with higher income inequality and higher PIRs.

We contribute to the inequality research by presenting housing inequality as an important dimension of household inequality. By bridging household-level housing inequality with spatial inequality at the metropolitan level, we try to understand why lower-income residents have limited access to adequate housing in some areas with a relatively higher share of adequate housing.

Our analysis also fills a knowledge gap for developing countries that have more serious housing adequacy problems than those in developed countries. Despite the importance of housing inequality for sustainable urbanization, there is surprisingly little systematic evidence on related issues in Asian developing countries that have been rapidly urbanizing in the past three decades. Finally, we discuss housing inequality issues across different contexts in developing and developed countries, which is rare in the existing literature.

The article is structured as follows: we first provide a scholarly background on the importance of housing inequality and potential reasons for it, along with a brief spatial background of developing Asia and U.S. metropolitan areas. Next, we present the main data sources and methods we used for our analyses. In the following section, we present our findings on spatial inequality, housing inequality by household economic status, and spatial heterogeneity in household-level housing inequality separately for Asian developing countries and the United States. We also discuss how these inequality patterns are comparable between developing Asia and the United States and how various policies have attempted to mitigate them. Finally, we conclude with implications of our findings and directions for future research.

2. Background

2.1. Importance of Housing Adequacy and Housing Inequality

According to the United Nations General Assembly (1948), the right to housing is recognized as an important element, along with health care and other social services to achieve an adequate standard of living.[1] Despite broad recognition of the importance of the right to adequate housing as a basic human right (United Nations, 1966), there is no internationally agreed-upon definition of adequate housing. The United Nations (1991) recognizes that adequacy is determined by various social, economic, cultural, climatic, ecological, and other factors. The general guidelines provided by the UN Habitat (2009) cover not only the physical and territorial dimensions but also cultural adequacy, accessibility for disadvantaged groups, and legal security of tenure. Independent of the definition, housing adequacy is closely associated with household housing consumption, which encompasses broader ranges of housing quality and quantity from the physical condition to housing tenure and investment.

While the definition of adequate housing itself has not received much scholarly attention, as housing adequacy is country-specific and highly contextualized, more research has been done on the link between housing adequacy and various societal outcomes. Existing research suggests that adequate housing is an important determinant of human well-being and other core development outcomes, such as educational achievements. In particular, many scholars have observed a relationship between poor housing and poor health, both for communicable and non-communicable diseases (see Ineichen, 2003 and Krieger and Higgins, 2002 for a review of relevant literature). Also evident is that poor housing is associated with lower educational achievement. For example, children in the United States who live in a crowded household at any time before the age

[1] In several countries, the right to adequate housing is enshrined in the national constitution. For example, the constitution of Bangladesh suggests a general responsibility of the State for ensuring adequate housing and living conditions for all.

of 19 are less likely to graduate from high school and tend to have lower educational attainment at age 25 (Lopoo and London, 2016).

The unequal distribution of adequate housing also has been a popular research topic; it has been discussed in two dimensions: household-level inequality and spatial inequality. The former refers to the difference in the level of housing adequacy by household economic status or ethnicity, whereas the latter addresses unequal access to adequate housing in relation to household residential locations. Most research on housing inequality in the United States and western contexts tends to separate these two dimensions and deal with homeownership attainment or home equity rather than the physical dimension of housing adequacy. Much research on household-level inequality has focused on homeownership disparities by race and ethnicity (for example, DeSilva and Elmelech, 2012), whereas other scholarly attention has been paid to housing adequacy among lower-income households and specific investigation of subsidized housing and homelessness (Shinn et al., 1998). Research on spatial inequality tends to focus a lot more on residential segregation at the neighborhood level rather than metropolitan inequality (for example, Charles, 2003; Charles, 2006; Iceland and Weinberg, 2002). Although limited, some studies have investigated how slums in developing countries emerge from unequal housing situations (for example, O'Hare, Abbott, and Barke, 1998).

Due to the importance of housing adequacy to household well-being mentioned earlier, housing inequality by household economic status has the potential to create equivalent health and social inequalities. With respect to the spatial dimension, the unequal distribution of adequate housing influences how households sort into metropolitan areas and neighborhoods, and in turn, contributes to socioeconomic inequality across and within metropolitan areas. At the macro level, a higher level of inequality has been linked to lower economic growth (Stiglitz, Sen, and Fitoussi, 2009). Glaeser, Resseger, and Tobio (2009) report that metropolitan-level income inequality is similarly associated with a lower growth of income and population, holding skills constant, in the United States. In addition, there is evidence that higher urban inequality is associated with higher crime rates and lower levels of happiness (Daly, Wilson, and Vasdev, 2001; Luttmer, 2005). At the more micro level, housing inequality between neighborhoods can lead to a concentration of poverty, thereby affecting children's outcomes negatively and exacerbating the degree of economic segregation (Jargowsky and Wheeler, 2017).

2.2. Potential Reasons for Housing Inequality

Housing adequacy refers typically to the quality of the dwelling and its location, including access to services. Both dimensions are two main determinants of housing prices in hedonic housing price regressions. It is, therefore, no surprise that the economic capacity of each household is an important determinant of the level of its housing adequacy, and economic inequality is the precondition of housing inequality. Spatial inequality of adequate housing is a geographic manifestation of household economic inequality as it happens by the sorting of households into metropolitan areas and neighborhoods based on their economic status. At the metropolitan area level, we would also expect that areas with higher income and wealth inequality among residents suffer from unequal distribution of adequate housing. Based on their analysis of the U.S. metropolitan areas, however, Glaeser, Resseger, and Tobio (2009) demonstrate that the extent of

unequal housing consumption is much lower than the level of income inequality. They suggest that the distribution of metropolitan housing prices may have a heterogeneous impact on households with different economic statuses.

Next, the residential sorting mentioned earlier has a dynamic relationship with the distribution of adequate housing. This distribution is influenced by spatial attributes such as urbanity and housing market attributes. Urbanity that can be measured by population size or population density is known to be an important predictor of housing demand and supply. On the one hand, the lack of adequate housing in rural areas has a strong association with scarce housing demand accompanied by lower population density and lower income. On the other hand, as population density rises, housing supply elasticity falls (Green, Malpezzi, and Mayo, 2005). In this regard, metropolitan areas with rapid urban growth are more likely to experience a shortage of adequate housing than rural areas, especially adequate housing for lower-income in-migrants. Depending on the extent of urban growth and supply elasticity, the distribution of affordable housing would also be unequal across and within metropolitan areas; in turn, it would aggravate the unequal access to adequate housing by household economic status in certain places.

Finally, other factors that could influence housing inequality include residential segregation driven by non-economic reasons and governmental actions. In the United States and other western contexts, many scholars have investigated racial and ethnic disparities in the level of household housing consumption (for example, Borjas, 2002; Faber and Ellen, 2016; Gabriel and Rosenthal, 2005; Krivo and Kaufman, 2004). Physical segregation by race and ethnicity has dynamically interacted with such disparities and contributed to spatial inequality of housing consumption in terms of quantity and quality. For example, the decay of housing stock is concentrated in certain U.S. city centers where African-American immigrants took up residence and where their presence increased over time through the process of hypersegregation (Andersen, 2019; Massey and Denton, 1993). Government policies that can affect housing inequality are not finite, ranging from general redistributive policies and financing measures to enhance household-level inequality to housing programs aiming to reduce spatial gaps in adequate housing. We discuss the outcomes of actual policies and cross-country lessons in section 4 in this article.

2.3. Contexts of Asian Developing Countries and the United States

In this study, we focus on housing inequality in cities in Asian developing countries while performing an analogous analysis in the United States and attempting to report similarities and differences in the patterns of housing inequality. Hence, it is useful to understand the differences between the two contexts. The first element to note is the general degree of housing adequacy is much lower in developing countries. Although several national constitutions of Asian countries recognize the right to housing,[2] UN Habitat (2016) estimates that around 560 million people lived in slums in Asia and the Pacific in 2014, which corresponds to about 30 percent of the population. Although the relative number of people living in slums has fallen in the region, the absolute number has risen by about 100 million since 1990 due to overall population growth.

[2] Armenia, Bangladesh, India, Nepal, Pakistan, Philippines, Republic of Korea, Sri Lanka, and Vietnam (Golay and Özden, 2007).

One of the most important factors that contribute to lower housing adequacy in developing countries is fast urbanization accompanied by the high pressure of housing demand. According to United Nations (2018), the average annual growth of urban populations between 1950 and 2018 was about 2.3 to 4.2 percent in developing countries, whereas the urbanization rate was only about 0.5 to 2.4 percent in developed countries. At the same time, housing supply in developing countries has not adequately responded to a fast increase in housing demand. Dasgupta, Lall, and Lozano-Gracia (2014) demonstrate that the economic status of countries is closely related with the elasticity of housing supply to urban growth. Based on the typology of housing investment patterns that they developed, they report that most developing countries belong to the "lagging" category where housing investment lags urbanization by up to 10 years, whereas many wealthy Organisation for Economic Co-operation on Development (OECD) countries fall in the "leading" category where housing investments occur ahead of the increase in housing demand.

There is no clear-cut relation between economic development and household economic inequality. Since Kuznets (1955) first proposed an inverted U-shaped relationship between income inequality and a country's aggregate income level, many studies have attempted to test this relationship. Although older empirical studies (for example, Anand and Kanbur, 1993) find support for Kuznets' curve, more recent evidence shows (for example, Frazer, 2006) that, when using a nonparametric regression approach, Kuznets' evidence wanes. Frazer (2006) also highlights that changes in economic inequality across countries that go through similar economic growth are significantly heterogenous. For example, although France and Italy have experienced significant and sizeable decreases in inequality as they have grown, the inequality has increased significantly in the United States and the United Kingdom.

With respect to spatial inequality and economic development, the similar inverted-U-shaped relationship is evidenced by Lessmann (2014). Although this relationship suggests that spatial inequality may increase at very high levels of economic development, absolute economic deprivation in certain areas is more substantial in developing countries. For example, in rural areas in India, many households still belong to scheduled castes and tribes and suffer from limited access to basic amenities and substandard living standards (Drèze and Sen, 2015; Kumar, 2015; Mohanan and Chakraborty, 2008; Srinivasan and Mohanty, 2004). In China, rising rural-urban income differentials caused by urban-biased policies and institutions are found to be the main driver of increasing overall inequality (Yang, 1999; Zhu and Wan, 2012). In contrast, although most U.S. cities have lower economics status than suburban areas, the majority of urban residents do not experience significant economic deprivation.

3. Data and Methods

3.1. Data

Our analysis focuses on housing inequality in Asian developing countries and the United States. For the analysis of Asian developing countries, we rely on the data from the Demographic and Health Survey (DHS) project, an ongoing collaboration between the United States Agency for International Development and country-specific agencies. One of their main tasks is to conduct household surveys in low- and middle-income countries (Corsi et al., 2012). The DHS data have

been collected based on a comparable sample of nationally representative households in more than 85 countries worldwide since 1984. Respondents selected in the DHS are representative for the entire country or regions of interest.[3] Key advantages of the DHS include the national coverage and high response rates that typically exceed 90 percent. In addition, the DHS questionnaire has been standardized and pre-tested to ensure comparability across populations and over time. Standard data collection procedures and interviewer training in the DHS ensure that its survey data are both reliable and comparable.

This study analyzes the following 10 developing countries in Asia as listed in exhibit 1: Bangladesh, Cambodia, India, Kyrgyzstan, Myanmar, Nepal, Pakistan, Philippines, Tajikistan, and Timor-Leste. We choose these countries as their DHS data are available after 2011 and they have longitude and latitude coordinate information that ensures spatial precision.[4] To explore spatial heterogeneity by population size, we categorize geographic boundaries into the following three types: rural areas, small cities, and large cities. The distinction between rural areas and cities follows the definition suggested by the Asian Development Bank (ADB, 2019). To develop a new database with a common definition of urban spaces across countries and over time, ADB (2019) defines the area by using satellite imagery combined with gridded population data. The benchmark for a city is a population of more than 100,000 in the year 2000.[5] The distinction between smaller cities and large cities is based on the population size. A city with more than 1 million is considered a large city herein. The cut-off of 1 million is often used to describe patterns of urbanization by many studies, including the United Nations (2018).[6]

Exhibit 1 displays the summary statistics for our DHS sample. The number of sample households is heterogeneous by countries and India has the largest sample size. Because the number of sample households is not necessarily proportional to the population size of each country, we apply the weight by population size for all of our analysis. The numbers of rural areas, small cities, and large cities depend on where our DHS sample respondents reside. Although the distribution of rural areas and small and large cities is heterogeneous, we find that the number of rural areas is largest in all countries in our sample. This number suggests the presence of a large rural population despite the rapid urbanization in developing countries.

[3] The DHS respondents are selected using a two-stage sampling process stratified by urban and rural location. In the first stage, primary sampling units (PSUs), also known as clusters, are selected from a frame list with probability proportional to a size measure. In the second stage, a fixed number of households are selected from a list of households in the selected PSUs. A cluster is usually a geographically constructed area or a part of an area called an enumeration area containing a number of households created from the most recent population census (Aliaga and Ren, 2006). The DHS also collects the GPS coordinate information in each cluster. For more details see Perez-Heydrich et al. (2013).

[4] We exclude Afghanistan, Indonesia, and Maldives as they do not have longitude and latitude coordinate data. Also, our sample does not include Kazakhstan, Sri Lanka, Thailand, and Uzbekistan as their last surveys were collected only in the early 2000s or before.

[5] For more information see Asian Development Bank (2019: 59).

[6] The United Nations (2018) reports that in 2018, 1.7 billion people representing 23 percent of the world's population lived in a city with at least 1 million inhabitants. The next common cut-offs are 5 million and 10 million, above which a city is labelled as "megacity" (United Nations, 2018).

Exhibit 1

Sample of Asian Developing Countries and Summary Statistics from the Demographic and Health Survey

Sample Country	(1) Sample Year	(2) Number of DHS Sample Households	(3) Number of Rural Areas	(4) Number of Small Cities	(5) Number of Large Cities	(6) Population Size
Bangladesh	2014	17,300	7	7	2	154,520,167
Cambodia	2014	15,825	19	2	2	15,274,503
India	2015	601,511	619	216	186	1,310,152,403
Kyrgyzstan	2012	8,040	7	3	2	5,607,200
Myanmar	2015	12,500	15	9	3	52,680,726
Nepal	2016	11,040	5	3	1	27,261,131
Pakistan	2017	14,540	8	4	5	207,896,686
Philippines	2017	27,497	17	14	5	105,173,264
Tajikistan	2017	7,843	5	3	2	8,880,268
Timor-Leste	2016	11,502	13	2	0	1,219,288

Note: Population sizes are shown for respective sample years.
Sources: Demographic Health Surveys (DHS), columns (1) and (2); Asian Development Bank (2019), columns (3)-(5); and World Bank (2019), column (6)

One of the most important pieces of information that the DHS data provide for our analysis of Asian developing countries is housing adequacy. DHS survey respondents provided detailed information on four dimensional criteria including: (1) structural quality or durability of dwellings, (2) sufficient living area, (3) access to improved water, and (4) access to improved sanitation.[7] In this study, we define adequate housing units as those that meet all of these four criteria. These criteria coincide with UN Habitat (2018), which defines inadequate housing as one in which the inhabitants suffer one or more of the following household deprivation criteria: lack of access to an improved water source, lack of access to improved sanitation facilities, lack of sufficient living area, lack of housing durability, and lack of security of tenure. One should note that we may apply more modest criteria to define adequate housing than the universal standard as we do not consider the security of tenure due to data unavailability.

Household wealth information is also critical to study the unequal distribution of adequate housing by household economic status. The DHS data provide the wealth index as a measurement of living standards of each household. Derived by the U.S. Agency for International Development, the wealth index is based on principal component analysis from indicators of households' various asset

[7] First, structural quality is measured by roof materials. A house or housing unit is considered to be structurally qualified if its roof is made of finished materials: cement or concrete, ceramic or clay tiles, burnt bricks, cement blocks, wood, roof shingles, metal (zinc, galvanized iron, or aluminum) sheets, asbestos sheets, slates, and so on. Second, a house or housing unit is considered sufficiently spacious if not more than three people share a sleeping room. Third, a house or housing unit is considered to have adequate access to improved water if the main source of drinking water for household members is from piped water, a protected dug well, protected spring water, or bottled water. Lastly, accessibility to improved sanitation is based on whether a house or housing unit owns a flush toilet or ventilated improved pit, and whether a toilet is not shared with more than two other households. Related questions and their response alternatives for each criterion are described in appendix A.

ownership and housing characteristics that are related to wealth status and living standards (Filmer and Pritchett, 2001). The total asset scores are standardized so that they have a standard normal distribution with a mean of zero and a standard deviation of one. The validity of this approach is tested by Montgomery et al. (2000) and Rutstein and Staveteig (2014). The advantage of using wealth over income is that the former, as a stock of income, is suitable as an indicator reflecting the long-term living standards of households. In addition, wealth is less susceptible to temporary economic shocks and seasonal events such as drought, which is important for the analysis of developing countries where agriculture is the main industry. All respondents in our sample are classified into one of the five quintile levels of wealth in respective rural areas and cities. For an economic inequality measure among households, we use a standard deviation of wealth index in each rural area and city.

After the comprehensive analysis of housing inequality in Asian developing countries based on DHS, we attempt to compare it with patterns of housing inequality in the United States. To do so, we rely mainly on the American Housing Survey (AHS) that offers in-depth information of both housing adequacy and household economic status at the metropolitan area level. The AHS classifies each sample unit into three degrees of housing adequacy: "severely inadequate," "moderately inadequate," and "adequate." Units are classified as "severely inadequate" based on conditions of plumbing, heating, electricity, wiring, and upkeep and as "moderately inadequate" based on upkeep and other factors such as toilet, heating, or kitchen issues.[8] The standard of housing adequacy clearly differs between DHS and AHS samples.[9] We claim, however, that this should not be a major concern because our research focus is on the distribution of adequate housing within each sample rather than comparing housing adequacy itself across the sample. To analyze spatial heterogeneity in housing inequality, we follow the AHS 2013 Metropolitan Statistical Areas (MSA) that classify central cities, non-central cities, and non-metropolitan areas.[10] If we compare their

[8] Units are classified as "severely inadequate" if at least one of the following conditions is met: *(1) plumbing* (lacking hot or cold piped water, lacking a full bathroom, or sharing a bathroom with non-household members), *(2) heating* (having been uncomfortably cold last winter for 24 hours or more because the heating equipment broke down, and it broke down at least three times last winter for at least 6 hours each time), *(3) electricity* (having no electricity), *(4) wiring* (having all of the following electric problems: exposed wiring, a room with no working wall outlet, and three blown fuses or tripped circuit breakers in the last 3 months), *(5) upkeep* (having at least five of the following six maintenance problems: (a) water leaks from the outside in the last 12 months, such as from the roof, basement, windows, or doors; (b) leaks from inside structure in the last 12 months, such as pipes or plumbing fixtures; (c) holes in the floors; (d) holes or open cracks (wider than a dime) in the walls or ceilings; (e) more than 8 by 11 inches of peeling paint or broken plaster; or (f) signs of rats in the last 12 months. Units are classified as "moderately inadequate" if at least one of the following conditions is met: *(1) upkeep* (having only three or four of the six problems listed under "severely inadequate—upkeep"), *(2) other* (having any one of the following conditions: (a) on at least three occasions during the last 3 months, all the flush toilets were broken down at the same time for 6 hours or more; (b) having unvented gas, oil, or kerosene heaters as the main heating equipment; (c) lacking a kitchen sink, lacking a working refrigerator, lacking cooking equipment (stove, burners, or microwave oven), or sharing the kitchen with non-household members.

[9] For example, the AHS does not consider sufficient living area whereas the DHS focuses on structural components rather than detailed housing quality such as plumbing, heating, electricity, and upkeep.

[10] Metropolitan areas are composed of whole counties that have significant levels of commuting and contiguous urban areas in common. Non-metropolitan areas include micropolitan statistical areas that are smaller than MSAs and rural areas. Most MSAs have at least one central city. Also, any city with at least 250,000 population or at least 100,000 people working within its corporate limits qualify as a central city. Some smaller cities are identified as central cities based on the commuting requirements and relative size to the MSA's largest city. For more information, see https://www2.census.gov/programs-surveys/ahs/2013/2013%20AHS%20Definitions.pdf.

population size with that of the DHS sample, some central cities fall into the category of smaller cities. As we focus on six major MSAs and their main central cities including Boston, New York, Philadelphia, Seattle, Dallas, and San Francisco, however, the population sizes of these cities are large enough to be comparable with large cities in the DHS sample.[11]

Finally, to account for local housing market circumstances in Asian developing countries, we use the city-level price-to-income ratio (PIR) from Helble, Lee, and Arbo (2020), which provide PIR estimates for 211 cities in 27 countries for the year of 2018.[12] They collect housing prices from Numbeo,[13] which is supposedly the world's largest database on housing prices based on information provided by private contributors and includes housing prices per square meter. The city-level household income data are estimated using household income and expenditure surveys (HIES) from four developing countries in Asia, of which three are included in our sample, namely India, Pakistan, and the Philippines. For countries without HIES, the authors use the World Bank's Povcal data on national monthly household per capita income and expenditure and derive city-level household income data by exploiting the fact that household income is a function of city size. In this article, we assume that the average housing size is 50 m^2 based on United Nations' statistics (2000) and use the average household income and housing prices for the non-city center.[14]

3.2. Methods

We first investigate the extent of housing adequacy by population size and by household wealth quintiles for each country. Then, we explore the relationship between household wealth distribution and housing adequacy. To visualize this relationship and quantify household-level housing inequality for cross-country comparisons, we attempt to plot the concentration curve and calculate the household wealth-based concentration index. The concentration curve plots the cumulative percentage of the outcome variable against the cumulative percentage of the population ranked from poorest to richest (Kakwani, Wagstaff, and van Doorslaer, 1997; O'Donnell et al., 2008). The concentration index corresponds to twice the area between the concentration curve and the perfect equality 45-degree line (Kakwani, Wagstaff, and van Doorslaer, 1997; O'Donnell et al., 2008). The concentration index ranges from -1 to +1. If an outcome variable is equally distributed across wealth levels, then the concentration curve coincides with the 45-degree line and the index becomes 0. If, for example, the concentration index is positive, then it means adequate housing is more concentrated among the rich. The concentration index can be calculated simply by the following formula:

[11] Among the AHS 15 metropolitan areas, we chose these six areas based on the extent of housing inadequacy (high vs. low) and population size. See exhibit 10 for the summary statistics.

[12] We acknowledge that DHS sample years differ from 2018. If PIRs have not changed very rapidly within 1 to 6 years in DHS sample cities, this would not critically affect our regression results. If PIRs have increased significantly in these cities, we may underestimate the role of PIRs.

[13] https://www.numbeo.com/cost-of-living/.

[14] According to the United Nations (2000), the floor area per person in 64 percent of cities in less developed regions ranges from 5 to 14 m2. We believe that the average income is a better measure for cities with high economic inequality. Numbeo inputs are divided into city centers and non-city centers. As city center inputs tend to be extremely high prices concentrated in the most prime area within a city, we believe that average housing prices should be closer to non-city center inputs.

$$CI = \frac{2}{\mu} cov(y_i, r_i)$$

Where y_i is the outcome variable for household i, r_i is the fractional ranking of individuals according to the wealth, and μ is the mean of y_i. The value of this index falls between -1 and +1. In essence, the concentration index (CI) measures the correlation between an outcome variable and the wealth rank. The higher the absolute value of the CI is, the greater the extent of inequality. It is known, however, that the range of the CI becomes smaller when the variable of interest is a binary indicator because the lower and the upper bounds of the CI depend on the mean of the outcome variable (Wagstaff, 2005). Erreygers (2009) suggests alternative normalization of the concentration index, which is defined by $EI=4\mu CI$. In this article, we report the normalized concentration index unless otherwise indicated.

Next, we perform regression analyses to account for the direct relationship between household wealth level and their housing adequacy with a focus on the role of spatial attributes in this relationship. These attributes include population size, economic inequality, and housing affordability. For example, we consider the spatial heterogeneity by population sizes as follows:

$$Y_{ick} = \beta_0 + \sum_{q=2}^{5} \beta_q W_{qic} + \gamma_1 Large_c + \gamma_2 Small_c + \sum_{q=2}^{5} \gamma_{q1} W_{qic} * Large_c + \sum_{q=2}^{5} \gamma_{q2} W_{qic} * Small_c + \alpha_k + u_{ick},$$

where Y_{ick} is the binary variable of adequate housing and it equals 1 if a household i in area c in country k lives in an adequate house; W_{qic} is a q_{th} wealth quintile dummy variable in area c; $Large_c$ and $Small_c$ are large and small city dummy variables, respectively. Lastly, α_k denotes a country fixed effect and u_{ick} is an error term. The coefficients of the interaction terms capture the heterogeneous association between wealth and housing adequacy across areas with different population sizes. We calculate the robust standard errors at the cluster level to enable the dependence of observations within clusters that are much smaller geographic areas than rural areas and cities.[15]

In addition, we use two other specifications. One includes $s.d.(wealth)_c$ in area c, which is a standard deviation of W_{qic}, and the interactions terms of $s.d.(wealth)_c$ and W_{qic}. The other includes PIR_c, a price-to-income ratio in area c, and the interactions terms of PIR_c and W_{qic}. Finally, we regress the area-level concentration index, CI_{ck}, on the above three spatial attributes in area c, including population size ($Large_c$ *and* $Small_c$), economic inequality ($s.d.(wealth)_c$), and housing affordability (PIR_c) as follows:

$$CI_{ck} = \beta_0 + \beta_1 s.d.(wealth)_c + \beta_2 Large_c + \beta_3 Small_c + \beta_4 PIR_c + \alpha_k + u_{ick},$$

where CI_{ck} stands for the concentration index in area c in country k.

[15] In each city or rural area, there are 10 to 50 clusters.

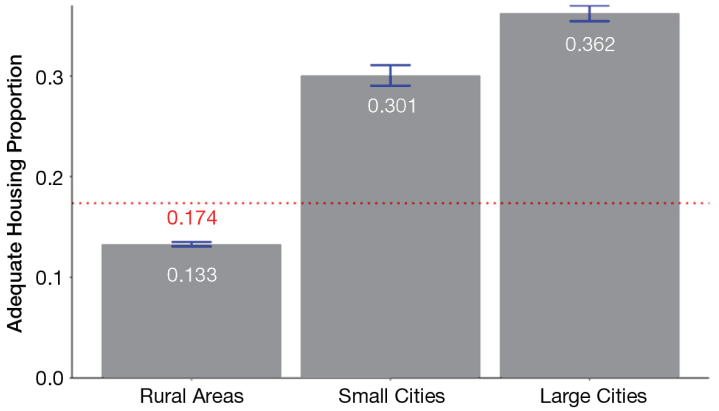
4. Results

4.1. Urban-Rural Housing Inequality in Asian Developing Countries

First, we investigate the extent of housing adequacy in urban and rural areas based on our Demographic and Health Survey sample of 10 developing countries in Asia. Exhibit 2 plots the share of adequate housing by population size with the 95-percent confidence interval. It vividly illustrates that urban areas offer better housing quality than rural areas in developing countries. While 30.1 percent and 36.2 percent of households live in adequate housing in small and large cities, respectively, only 13.3 percent of households reside in adequate housing in rural areas in developing countries. Such unequal access to adequate housing between urban and rural areas could potentially lead to urban-rural inequality in other dimensions, such as household health outcomes, life quality and satisfaction, and economic status (Howden-Chapman, 2004; Keall et al., 2010; Krieger and Higgins, 2002).

Exhibit 2

Heterogeneity in the Share of Adequate Housing by Population Size



Source: Calculations based on Demographic and Health Survey data

Next, to see how physical and economic differences can be related with the urban-rural inequality in housing adequacy, we perform cross-country comparisons. Exhibit 3 confirms that the share of adequate housing in rural areas is significantly lower than that in small and large cities in all countries, although the degree of the urban-rural gap differs between countries. Although it is unsurprising that population density in cities is much higher than that in rural areas, it is notable that the global human footprint index[16] in large cities is almost twice larger than that in rural areas in most Asian developing countries. With respect to global cell production,[17] Kyrgyzstan and the

[16] Global human footprint index is a composite measurement of the human influence index created from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use or land cover), and human access (coastlines, roads, railroads, navigable rivers). It ranges from 0 (least urban) to 100 (most urban).

[17] Gross cell production measures a regional economic activity level, which is measured in purchasing power parities (PPP) adjusted to U.S. dollars (USD). The conceptual basis of gross cell production is equivalent to that of the gross domestic product (GDP), except that the geographic unit is measured at a 1-degree longitude by 1-degree latitude resolution on a global scale.

Philippines are two countries that show substantial urban-rural differences. These results indicate that heterogeneity in the degree of urban development and productivity-driven economic status could be important drivers of urban-rural housing inequality in Asian developing countries.

Exhibit 3

Cross-Country Comparisons of Urban-Rural Inequality in Housing Adequacy

Country	Area Type	Proportion of Adequate Housing	95% Confidence Interval	Population Density	Global Human Footprint Index	Global Cell Production
Bangladesh	Rural areas	0.008	(0.010, 0.007)	1,350.8	43.4	1,213.0
	Small cities	0.048	(0.058, 0.037)	3,477.2	74.9	1,229.3
	Large cities	0.191	(0.209, 0.174)	27,670.6	79.5	1,101.7
Cambodia	Rural areas	0.100	(0.104, 0.095)	442.4	38.6	1,528.8
	Small cities	0.537	(0.622, 0.452)	2,786.3	68.4	1,569.8
	Large cities	0.595	(0.628, 0.563)	13,776.0	68.9	1,356.9
India	Rural areas	0.129	(0.130, 0.128)	671.7	41.2	2,198.4
	Small cities	0.331	(0.335, 0.326)	1,328.0	68.1	2,521.4
	Large cities	0.364	(0.368, 0.361)	7,748.5	73.4	2,836.7
Kyrgyzstan	Rural areas	0.084	(0.092, 0.077)	109.3	39.7	1,695.9
	Small cities	0.217	(0.242, 0.193)	2,717.2	60.7	1,604.3
	Large cities	0.385	(0.412, 0.357)	5,336.0	64.9	2,444.9
Myanmar	Rural areas	0.125	(0.131, 0.119)	189.3	35.4	-†
	Small cities	0.312	(0.356, 0.269)	448.9	68.7	-†
	Large cities	0.350	(0.382, 0.318)	11,231.2	80.1	-†
Nepal	Rural areas	0.229	(0.237, 0.221)	552.6	36.8	998.0
	Small cities	0.365	(0.414, 0.316)	3,686.3	65.1	905.4
	Large cities	0.441	(0.484, 0.398)	21,032.0	71.2	1,000.2
Pakistan	Rural areas	0.075	(0.081, 0.069)	-	-	-
	Small cities	0.106	(0.130, 0.082)	-	-	-
	Large cities	0.295	(0.309, 0.280)	-	-	-
Philippines	Rural areas	0.441	(0.448, 0.435)	935.3	37.9	2,267.9
	Small cities	0.593	(0.614, 0.571)	4,542.6	64.3	2,288.2
	Large cities	0.632	(0.647, 0.617)	15,663.5	78.0	4,990.5
Tajikistan	Rural areas	0.090	(0.098, 0.082)	283.5	45.2	1,475.3
	Small cities	0.377	(0.412, 0.343)	1,032.6	65.1	1,661.0
	Large cities	0.593	(0.614, 0.572)	6,254.5	76.7	1,554.4
Timor-Leste	Rural areas	0.195	(0.202, 0.187)	165.3	26.4	204.9
	Small cities	0.559	(0.589, 0.529)	4,240.6	57.9	27.4

† The DHS data of global cell production in Myanmar report null in more than 70 percent of all clusters. We suspect that the average of area-level values is not reliable and thus it is not shown here.

Note: Population density, global human footprint index, and global cell production are the averages of area-level values.

Source: Calculations based on Demographic and Health Survey data

4.2. Housing Inequality by Household Wealth in Asian Developing Countries

First, we analyze the general pattern of housing inequality by household economic status in Asian developing countries. Exhibit 4 shows the share of adequate housing across household wealth quintiles at the national level based on our DHS sample.[18] The tendency that wealthier households reside in adequate housing is significantly higher across all countries, indicating the strong inequality in housing adequacy by household wealth. The probability that households in the first wealth quintile reside in adequate housing is close to zero except in Nepal and the Philippines; this raises a serious concern on housing inadequacy for very low-income households in developing Asia. Moreover, only less than 10 percent of households up to the third quintile have access to adequate housing in most countries, suggesting that the housing inadequacy issue is prevalent not only to low-income households but also to middle-class households.

Exhibit 4

Housing Adequacy across Household Wealth Quintiles (1 of 2)

Country	Wealth Quintile	Proportion of Adequate Housing	95% Confidence Interval	Mean Wealth Index
Bangladesh	1st	0	(0.000, 0.000)	-9.853
	2nd	0.001	(0.002, 0.000)	-7.093
	3rd	0.001	(0.002, 0.000)	-3.476
	4th	0.007	(0.010, 0.005)	3.528
	5th	0.193	(0.206, 0.180)	16.296
Cambodia	1st	0.001	(0.003, 0.000)	-10.851
	2nd	0.003	(0.005, 0.001)	-7.082
	3rd	0.021	(0.026, 0.016)	-3.392
	4th	0.131	(0.143, 0.119)	1.9
	5th	0.546	(0.562, 0.531)	14.521
India	1st	0.002	(0.003, 0.002)	-12.953
	2nd	0.021	(0.022, 0.021)	-5.929
	3rd	0.095	(0.097, 0.094)	0.598
	4th	0.277	(0.279, 0.274)	7.229
	5th	0.589	(0.592, 0.586)	15.159
Kyrgyzstan	1st	0.021	(0.028, 0.014)	-5.821
	2nd	0.039	(0.048, 0.029)	-4.271
	3rd	0.036	(0.045, 0.027)	-3.535
	4th	0.109	(0.124, 0.094)	0.036
	5th	0.483	(0.506, 0.460)	11.403

[18] We also look at housing inequality by household wealth with respect to four dimensions of adequate housing in each country. We find a clear pattern that wealthier households enjoy better housing conditions. Results are not shown but available upon request.

Exhibit 4

Housing Adequacy across Household Wealth Quintiles (2 of 2)

Country	Wealth Quintile	Proportion of Adequate Housing	95% Confidence Interval	Mean Wealth Index
Myanmar	1st	0.007	(0.010, 0.003)	-12.201
	2nd	0.038	(0.045, 0.030)	-6.027
	3rd	0.097	(0.109, 0.085)	-0.764
	4th	0.187	(0.202, 0.171)	5.46
	5th	0.489	(0.509, 0.468)	16.121
Nepal	1st	0.155	(0.169, 0.141)	-10.898
	2nd	0.238	(0.255, 0.220)	-5.837
	3rd	0.174	(0.190, 0.158)	-0.579
	4th	0.19	(0.207, 0.174)	6.557
	5th	0.492	(0.515, 0.469)	16.923
Pakistan	1st	0.005	(0.008, 0.002)	-14.109
	2nd	0.052	(0.061, 0.043)	-6.646
	3rd	0.115	(0.129, 0.102)	0.398
	4th	0.173	(0.189, 0.158)	6.391
	5th	0.306	(0.323, 0.288)	13.568
Philippines	1st	0.121	(0.128, 0.114)	-11.864
	2nd	0.317	(0.329, 0.306)	-3.844
	3rd	0.532	(0.545, 0.518)	2.177
	4th	0.736	(0.748, 0.723)	8.378
	5th	0.87	(0.880, 0.859)	16.607
Tajikistan	1st	0.024	(0.032, 0.017)	-10.507
	2nd	0.039	(0.051, 0.028)	-7.426
	3rd	0.047	(0.060, 0.035)	-4.792
	4th	0.09	(0.106, 0.075)	-1.302
	5th	0.649	(0.666, 0.632)	9.822
Timor-Leste	1st	0.006	(0.009, 0.003)	-10.831
	2nd	0.103	(0.115, 0.091)	-6.006
	3rd	0.252	(0.269, 0.234)	-1.243
	4th	0.391	(0.411, 0.370)	5.919
	5th	0.637	(0.659, 0.615)	18.183

Notes: Wealth quintiles are defined as country-level quintiles. Wealth inequality is measured by the country-level standard deviation of wealth index.
Source: Calculations based on Demographic and Health Survey data

Second, we further look into heterogeneity in the degree of household-level housing inequality across developing countries with different economic inequality. Exhibit 5 shows the household wealth-based concentration index of housing adequacy along with the standard deviation of wealth

index based on our DHS sample. Among the five countries with the highest wealth inequality, India, the Philippines, and Timor-Leste also display concentration indices close to or over 0.5, meaning that the degree of concentration of adequate housing among wealthier households is very high. For example, there is a more than 60-percentage-point gap in housing adequacy between households in the lowest and highest wealth quintiles in the Philippines. Exhibit 6 consistently shows that corresponding concentration curves are positive and are all significantly far from zero; those concentration curves confirm that adequate housing is more concentrated among wealthy households.[19] Although exhibits 5 and 6 do not show a clear linear pattern between the concentration index and wealth inequality, our regressions further investigate this later.

Exhibit 5

Household Wealth-Based Concentration Index of Adequate Housing

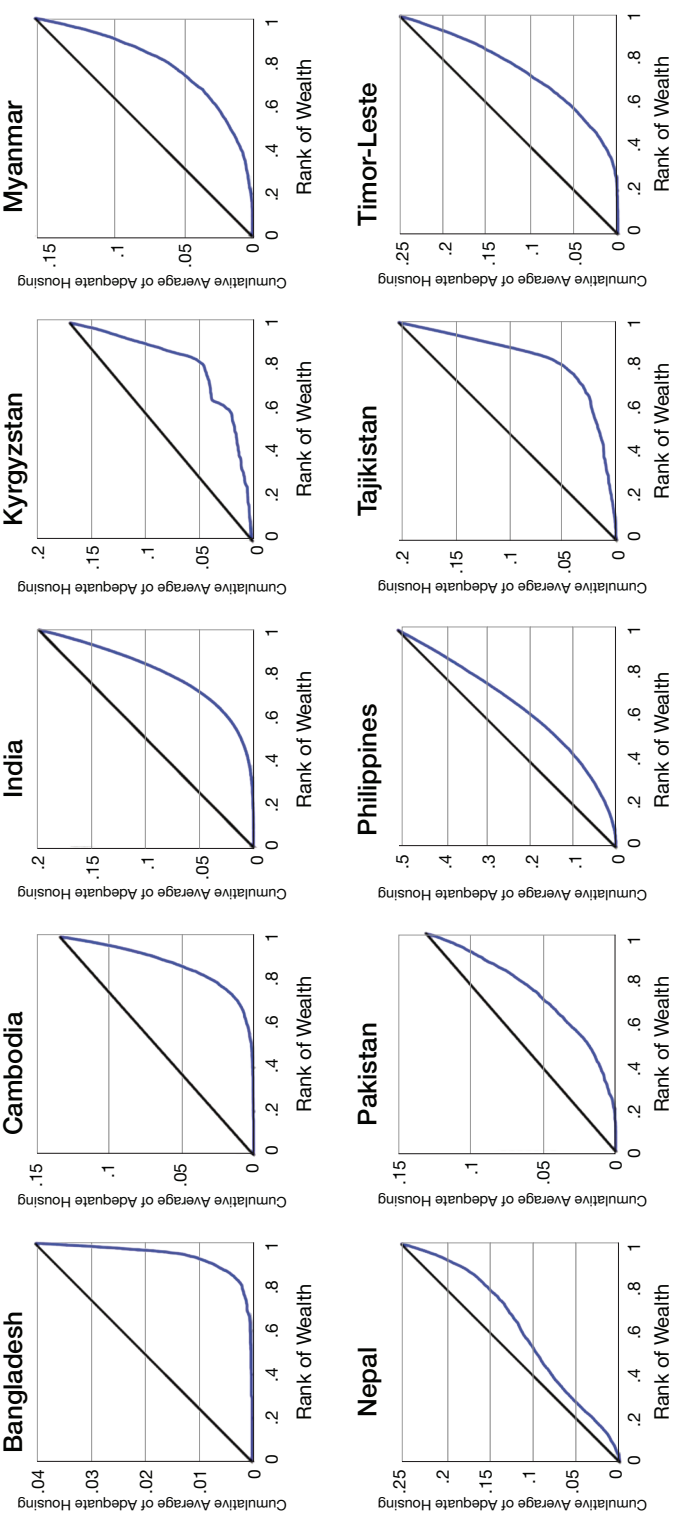
	Concentration Index	Standard Error	Wealth Inequality
Bangladesh	0.142	0.003	9.810
Cambodia	0.400	0.005	9.121
India	0.480	0.001	10.117
Kyrgyzstan	0.415	0.008	7.194
Myanmar	0.369	0.007	10.076
Nepal	0.232	0.009	10.174
Pakistan	0.242	0.007	9.921
Philippines	0.637	0.006	10.024
Tajikistan	0.538	0.009	8.096
Timor-Leste	0.500	0.008	10.255

Note: Wealth inequality is measure by the standard deviation of wealth index at the country level.
Source: Calculations based on Demographic and Health Survey data

[19] Although the panel of Bangladesh in exhibit 6 gives the impression that housing inequality by household wealth is larger than other countries, Bangladesh has the smallest concentration index value among all the 10 countries; this discrepancy is because the absolute difference between rich and poor groups is smaller in Bangladesh than that in other countries.

Exhibit 6

Concentration Curve by Country



Source: Calculations based on Demographic and Health Survey data

4.3. Spatial Heterogeneity in Household-Level Housing Inequality in Asian Developing Countries

We now move to investigate spatial heterogeneity in household housing inequality by household wealth. In the previous section, we observe that households in cities in Asian developing countries are more likely to live in adequate housing, compared with those in rural areas. This finding does not necessarily mean that adequate housing is equally distributed among households with different economic status within cities, however. Asian developing countries have experienced rapid urbanization and economic growth, and many cities in these countries have suffered from issues like housing unaffordability and economic inequality. For example, as a recent report by the Asian Development Bank (ADB, 2019) shows, the price-to-income ratio (PIR) of cities in developing Asia is 15.8 and thus substantially higher compared with the United States.

Exhibit 7 reports the household wealth-based concentration index of adequate housing by population size for our DHS sample of 10 developing countries along with area-level household wealth inequality. We observe that in most countries the values of concentration index in cities are significantly larger than that in rural areas, implying higher household-level housing inequality in cities. Hence, if these households have relatively lower economic status within cities, they are less likely to have access to adequate housing compared with those that have similarly lower economic status within rural areas. Also, this finding does not suggest that richer households in rural areas would have access to adequate housing in urban areas because our concentration index measures the degree of dependence between housing adequacy and the relative wealth rank among respective rural areas, small cities, and large cities. With respect to household wealth inequality, cities do appear to be more unequal than rural areas in Asian developing countries. Therefore, the urban-rural heterogeneity in household-level wealth inequality is less likely to be the main driver of the significant urban-rural gap in housing adequacy presented in the previous section.

Exhibit 7

Household Wealth-Based Concentration Index of Adequate Housing by Population Size (1 of 2)

Country	Area type	Concentration Index	Standard Error	Wealth Inequality (s.d. wealth index)
Bangladesh	Rural areas	0.029	0.002	7.324
	Small cities	0.156	0.011	10.282
	Large cities	0.497	0.017	8.725
Cambodia	Rural areas	0.304	0.005	7.722
	Small cities	0.535	0.088	7.767
	Large cities	0.590	0.033	7.353
India	Rural areas	0.347	0.001	9.272
	Small cities	0.562	0.004	8.764
	Large cities	0.592	0.003	8.345
Kyrgyzstan	Rural areas	0.212	0.008	4.860
	Small cities	0.526	0.024	7.468
	Large cities	0.514	0.029	6.853

Exhibit 7

Household Wealth-Based Concentration Index of Adequate Housing by Population Size (2 of 2)

Country	Area type	Concentration Index	Standard Error	Wealth Inequality (s.d. wealth index)
Myanmar	Rural areas	0.292	0.007	8.877
	Small cities	0.553	0.044	10.845
	Large cities	0.583	0.032	8.439
Nepal	Rural areas	0.161	0.010	9.095
	Small cities	0.479	0.052	7.716
	Large cities	0.580	0.044	6.380
Pakistan	Rural areas	0.140	0.007	9.141
	Small cities	0.120	0.028	7.963
	Large cities	0.254	0.017	6.756
Philippines	Rural areas	0.629	0.007	9.600
	Small cities	0.634	0.021	9.371
	Large cities	0.551	0.015	7.818
Tajikistan	Rural areas	0.216	0.009	5.627
	Small cities	0.806	0.028	7.722
	Large cities	0.765	0.018	8.971
Timor-Leste	Rural areas	0.403	0.008	8.448
	Small cities	0.427	0.033	8.455

s.d. = standard deviation
Note: We measured wealth inequality by calculating the standard deviations of wealth index at the level of each rural area and city and taking their average.
Source: Calculations based on Demographic Health and Survey data

Exhibit 8 reports results of the household-level regressions of housing adequacy with three main spatial attributes—including population size, economic inequality, and housing affordability—as well as their interaction terms with household wealth. It first shows that both large city and small city dummy variables display positive associations with housing adequacy, implying that households in cities are more likely to live in adequate housing than those in rural areas (column 2). When the interaction terms between wealth quintiles and area dummy variables are added, the result shows that all the interaction terms exhibit positive signs with larger coefficients for higher quintiles (column 3). These positive signs indicate that adequate housing is more prevalent among wealthier households in larger cities, compared with rural areas. Alternatively, they suggest that the association between adequate housing and living in cities is stronger for wealthier households.

Exhibit 8 also reports the important role of wealth inequality and housing affordability to housing inequality. We find a significant negative association between the probability of residing in adequate housing and wealth inequality in a given area (column 4). With respect to interaction terms, the result suggests that the negative association is significantly stronger for households belonging to the second and third wealth quintile levels (column 4). Hence, the probability that lower- and middle-income households have access to adequate housing becomes lower if they

reside in areas with higher wealth inequality. On the contrary, the positive association is observed among households belonging to the top wealth quintile level, suggesting that the access to adequate housing increases for wealthier households if the area of their residence becomes more unequal in terms of household wealth. Then, exhibit 8 indicates that the PIR in a given area has a negative association with the probability that residents have the access to adequate housing (column 5). It also reveals that the association with the PIR is negative and more significant for lower wealth quintiles, thus implying that the access to adequate housing is affected more negatively by housing unaffordability for lower-income households.

Exhibit 8

Household-Level Regression of Housing Adequacy (1 of 2)

	(1)	(2)	(3)	(4)	(5)
Wealth 2nd quintile	0.0551***	0.0548***	0.0330***	0.134***	0.148***
	(0.00185)	(0.00191)	(0.00136)	(0.0127)	(0.0232)
Wealth 3rd quintile	0.118***	0.117***	0.0707***	0.217***	0.299***
	(0.00263)	(0.00250)	(0.00183)	(0.0177)	(0.0278)
Wealth 4th quintile	0.208***	0.206***	0.135***	0.245***	0.424***
	(0.00341)	(0.00317)	(0.00239)	(0.0231)	(0.0307)
Wealth 5th quintile	0.379***	0.377***	0.302***	0.245***	0.574***
	(0.00414)	(0.00379)	(0.00366)	(0.0284)	(0.0285)
Large city		0.233***	0.0771***		
		(0.00590)	(0.00519)		
Small city		0.199***	0.0698***		
		(0.00682)	(0.00602)		
wealth q2*Large city			0.0755***		
			(0.00675)		
wealth q3*Large city			0.169***		
			(0.00888)		
wealth q4*Large city			0.255***		
			(0.0104)		
wealth q5*Large city			0.277***		
			(0.0105)		
sd(wealth)				-0.0412***	
				(0.00152)	
wealth q2*sd(wealth)				-0.0102***	
				(0.00155)	
wealth q3*sd(wealth)				-0.0129***	
				(0.00215)	
wealth q4*sd(wealth)				-0.00489*	
				(0.00286)	
wealth q5*sd(wealth)				0.0174***	
				(0.00354)	

Exhibit 8

Household-Level Regression of Housing Adequacy (2 of 2)

	(1)	(2)	(3)	(4)	(5)
PIR					-0.00879***
					(0.00110)
wealth q2*PIR					-0.00243
					(0.00165)
wealth q3*PIR					-0.00389*
					(0.00205)
wealth q4*PIR					-0.00231
					(0.00250)
wealth q5*PIR					0.000956
					(0.00201)
Observations	724,924	724,924	724,924	724,924	35,895
r2	0.136	0.200	0.212	0.151	0.227
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Wealth quintiles* small city	No	No	Yes	No	No

PIR = price-to-income ratio.
** p < 0.1, ** p < 0.05, *** p < 0.01*
Notes: Standard errors are in parentheses and cluster-robust to heteroscedasticity.
Including the city-level PIR reduces the number of observations dramatically as we have the PIR only for selected small and large cities.
Source: Calculations based on Demographic and Health Survey data

Lastly, exhibit 9 reports the results of the area-level regressions of household wealth-based concentration index, in which all independent variables are measured in the level of rural areas and cities. We first observe a significant positive unconditional correlation between the size of concentration index and wealth inequality (column 1). Even when adding country fixed effects (column 2), the significance of wealth inequality does not change. Hence, the result confirms that areas with higher wealth inequality have a higher concentration of adequate housing among wealthier households. Column 3 indicates that housing inequality by household wealth is more significant in cities than in rural areas, which is again consistent with the previous finding that population size is a strong predictor of the degree of concentration of adequate housing among wealthier households. When we additionally control for PIR, we still observe a significant, positive association between the size of concentration index and wealth inequality (column 4) whereas the added role of PIR appears to be negative but insignificant. Across all specifications presented in exhibit 5, therefore, wealth inequality between households is the most significant predictor of housing inequality in Asian developing countries.

Exhibit 9

Area-Level Regressions of Household Wealth-Based Concentration Index

	(1)	(2)	(3)	(4)
sd(wealth)	0.0176***	0.0136***	0.0161***	0.0421***
	(0.00449)	(0.00477)	(0.00460)	(0.0120)
Large city			0.167***	-0.00671
			(0.0151)	(0.0405)
Small city			0.146***	
			(0.0145)	
PIR				-0.000842
				(0.00249)
Cambodia		0.170***	0.228***	-
		(0.0593)	(0.0517)	-
India		0.170***	0.197***	0.247**
		(0.0493)	(0.0413)	(0.101)
Kyrgyzstan		0.115	0.147*	0.369**
		(0.0879)	(0.0777)	(0.172)
Myanmar		0.182***	0.200***	0.366***
		(0.0580)	(0.0519)	(0.0929)
Nepal		0.123	0.141*	0.398***
		(0.0897)	(0.0731)	(0.103)
Pakistan		0.0776	0.0737	0.0959
		(0.0609)	(0.0558)	(0.108)
Philippines		0.390***	0.394***	0.263***
		(0.0552)	(0.0513)	(0.0985)
Tajikistan		0.223**	0.237***	-
		(0.0944)	(0.0807)	-
Timor-Leste		0.241***	0.305***	0.163*
		(0.0569)	(0.0511)	(0.0936)
Observations	1162	1162	1162	84
r2	0.0139	0.0640	0.200	0.208

PIR = price-to-income ratio.
** p < 0.1, ** p < 0.05, *** p < 0.01*
Notes: Standard errors are in parentheses and cluster-robust to heteroscedasticity.
In column 4, as the PIR is not available in rural areas, small city is dropped to avoid multi-collinearity.
Including the PIR reduces the number of observations dramatically as we have the PIR only for selected cities. We have no PIR data for Cambodia.
Source: Calculations based on the Demographic and Health Survey data

4.4. Housing Inequality in the United States

So far, we have suggested that cities in developing countries have a higher level of housing adequacy than rural areas whereas these cities suffer from higher housing inequality by household wealth. In this section, we attempt to see whether the United States experiences similar patterns of housing inequality based on our AHS sample. We first look into spatial inequality in housing adequacy, which was significant in Asian developing countries. Exhibit 10 shows that U.S. central cities do not have a strong advantage for housing adequacy. Their share of adequate housing is only slightly higher than non-metropolitan areas and lower than non-central cities. This is inconsistent

with our previous finding on the positive relationship between population size and the level of housing adequacy, based on our DHS sample.

Exhibit 10 continues to suggest that, although the share of adequate housing is much higher compared to that from our DHS sample, more than 10 percent of households reside in inadequate housing in some U.S. metropolitan areas such as New York and Boston. Results also report a significant heterogeneity in housing adequacy across U.S. metropolitan areas. For example, residents in Boston have an 8-percent higher probability of residing in inadequate housing than those in Seattle. Housing adequacy and population size in selected cities in our AHS sample do not seem to have a distinct, linear pattern. What is distinct among cities with a lower level of housing adequacy is higher poverty rates. For example, the median household income is higher, but poverty rates are also higher in Boston than in Dallas, and Boston shows a larger population residing in inadequate housing than Dallas. This finding implies that income inequality and other factors may be more related to the distribution of adequate housing.

Exhibit 10

Spatial Inequality in Housing Adequacy in the United States

	All Metropolitan Areas		Non-Metropolitan Areas	Central City in Selected Metropolitan Areas					
	Central City	Non-Central City		Boston	New York	Philadelphia	Seattle	Dallas	San Francisco
Share of Adequate Housing (%)	94.33	96.05	93.45	88.25	89.97	90.60	96.40	95.02	94.01
City Population Size				694,583	8,398,748	1,584,138	744,955	1,345,047	883,305
MSA Population Size				4,875,390	19,979,477	6,096,372	3,939,363	7,539,711	4,729,484
Median Household Income ($)	50,000	63,300	42,500	68,500	50,000	38,000	80,000	52,500	95,000
Share of Households below Poverty Level (%)	17.26	10.81	17.29	19.22	19.15	29.52	8.56	13.28	10.91

Notes: Except for population sizes data that are based on 2018 estimates from the U.S. Census Bureau, all information is based on 2017 American Housing Survey (AHS). All geographic definitions follow AHS's 2013 Metropolitan Statistical Areas (MSA) that are delineated by the U.S Office of Management and Budget and are the result of the application of published standards to U.S. Census Bureau data. For more information on these definitions, see footnote 10 in this article. AHS classifies each sample unit into three degrees of housing adequacy: "severely inadequate," "moderately inadequate," and "adequate." For more information on how these degrees are defined, see footnote 8 in this article. A unit is deemed "adequate" if it does not meet the definitions of "severely inadequate" or "moderately inadequate." Households below the poverty level are those below the national poverty threshold established by family size, number, and characteristics.

Source: 2017 American Housing Survey and U.S. Census Bureau

We further investigate spatial heterogeneity in housing adequacy by comparing central cities and non-central cities within each metropolitan area. Although non-central cities are located within metropolitan areas, they are mostly suburban areas as their population size is smaller than 250,000, or they do not function as an employment location. Exhibit 10 indicates that residents have better access to adequate housing in non-central cities than in central cities in all selected metropolitan areas in our AHS sample. Lower household income in central cities could be, of course, one important factor that explains this urban-suburban inequality of housing adequacy.[20] We also find that housing affordability problems in central cities are far more serious than non-central cities within the same metropolitan area. Central cities in all selected metropolitan areas in our AHS sample display a higher PIR, higher median burden of rent payment, and higher share of cost-burdened renter households than non-central cities. The New York metropolitan area exhibits a particularly high urban-suburban gap in housing affordability for both homeowners and renters, and it also experiences substantially unequal access to adequate housing between urban and suburban locations.

Next, we look into housing inequality by household economic status in U.S. metropolitan areas. We are not able to estimate the concentration index due to data limitation, so we use the extent of concentration of inadequate housing among households that have an annual income less than $30,000. Exhibit 11 reports that among all inadequate housing in the United States, more than 13.61 percent of housing units are occupied by these lower-income households. When restricting the sample to housing units in the U.S. metropolitan areas, however, the unequal distribution by income becomes much more serious—more than 45 percent of inadequate housing concentrates among lower-income households. Most of the selected metropolitan areas show a similarly high level of unequal distribution of inadequate housing across different income groups, and Philadelphia is the one experiencing the highest level of household-level housing inequality. This finding is consistent with the previous finding from the DHS sample that cities tend to suffer more from housing inequality by household economic status than rural areas.

Finally, we observe a significant heterogeneity in the household-level housing inequality between U.S. metropolitan areas. Exhibit 11 shows that metropolitan areas with a larger population size, such as New York, Philadelphia, and Dallas, have a higher concentration of inadequate housing among lower-income households. In the last section, we have identified a similar, positive association between population size and housing inequality based on our DHS sample. Economic inequality and housing market performance appear to be other important potential factors that are related with housing inequality by household economic status. For example, New York and Boston are two metropolitan areas with the highest top-to-bottom income ratio based on our AHS sample and more than 33 percent of inadequate housing concentrates among lower-income households in these areas. These two areas also show significantly higher levels of housing unaffordability for both owners and renters. Although San Francisco also experiences a relatively higher income gap and serious housing affordability issue, its household-level housing inequality is lower than those of New York and Boston potentially because the general quality of housing stock and general household economic status in San Francisco are higher.

[20] One should note, however, that inequalities in economic status and the degree of development between urban and suburban areas and across metropolitan areas in the United States are not as significant as in developing countries.

Exhibit 11

Housing Inequality by Household Income in U.S. Metropolitan Areas

	United States	U.S. Metropolitan Areas		Boston		New York		Philadelphia		Seattle		Dallas		San Francisco	
		Central City	Non-Central City	Central City	Non-Central City	Central City	Non-Central City	Central City	Non-Central City	Central City	Non-Central City	Central City	Non-Central City	Central City	Non-Central City
Share of Adequate Housing (%)	95.07	94.33	96.05	88.25	95.78	89.97	96.40	90.60	96.41	96.40	97.51	95.02	96.63	94.01	96.38
City Population Size				694,583		8,398,748		1,584,138		744,955		1,345,047		883,305	
Concentration of Inadequate Housing among Households with Income below $30,000 (%)	13.61	45.78		33.07		37.34		42.3		30.45		41.04		21.78	
MSA Top-to-Bottom Income Ratio	25.3			30.6		39.3		21.07		21.63		24.82		30.5	
Median Household Income ($)	55,100	50,000	63,300	68,500	81,850	50,000	80,000	38,000	78,000	80,000	79,130	52,500	70,000	95,000	100,000
Median Price-to-Income Ratio (PIR)	3	3	3	4.4	4.0	6.7	3.6	2.8	2.5	4.5	3.9	2.4	2.4	6.9	6.1
Median Burden of Rent Payment (%)	22	25	22	26	24	31	26	26	22	24	23	24	22	26	25
Share of Cost-Burdened Renter households (%)	37.97	43.14	35.78	41.83		56.23	44.40	47.52	35.13	39.51	37.14	39.63		44.18	

MSA = metropolitan statistical area.

Notes Except for MSA top-to-bottom ratios that are based on 2013 American Community Survey, all information is based on 2017 American Housing Survey. In 2017, the Federal Poverty Level (FPL) is $20,420 for three-person households and $24,600 for four-person households. Medicaid eligibility (138% of FPL) is $28,180 and $33,948 for three- and four-person households, respectively. Top-to-bottom income ratios are measured by the ratio of top 1 percent to bottom 99 percent income in 2013. The median burden of rent payment excludes households with zero or negative income and no cash rent. Cost-burdened renter households are those that spend more than 30 percent of their income on rent payment. Burden of rent payment is monthly total housing costs as percent of household income for renters

Sources: 2017 American Housing Survey and 2013 American Community Survey

4.5. Policy Efforts to Reduce Housing Inequality

Countries around the world have used various policies to resolve the issues of housing inequality. We begin with policy measures to mitigate spatial inequality in housing adequacy. To tackle the urban-rural inequality in developing countries, improving economic deprivation and reducing poverty in rural areas have been, of course, one important policy agenda. There are also serious financial challenges; providing basic infrastructure in rural areas is typically more costly than in denser urban areas. To ensure a progressive expansion of the provision of services, therefore, the public sector should be actively engaged rather than relying on the private sector. In India, the government has launched several programs and schemes over the past decades to improve and ensure access to basic household amenities in rural areas with a special focus on the poor, excluded, and marginalized groups (Sen and Drèze, 1999). Alternatively, developing countries could use some returns on investment in urban areas to expand basic services in rural areas.

In developed countries, policymakers would be more interested in reducing the urban-suburban housing inequality and improving housing adequacy in certain central cities where a lot more population reside compared to rural areas. One potential measure is strict implementation of building codes that could help prevent urban households from residing in inadequate housing. This change may come at a high administrative cost, however, and may be less effective if housing markets are tight. In central cities that are already built up, low-cost adequate housing could be provided through proper upgrading and infill redevelopment strategies. Here, the government could provide not only financial incentives but also planning support, including expediting the approval processes for multi-family developments that have been often lengthy and uncertain in the outcome, as well as relieving requirements that unnecessarily drive up redevelopment costs (Dain, 2019).

Second, policy measures attempt to reduce housing inequality by household economic status by focusing on households that do not have the proper access to adequate housing. Both supply- and demand-side measures have been used to enhance such access. When most low- and middle-income households suffer from housing inadequacy due to acute housing shortage, policy measures to expand housing supply have been used in many countries. Several countries, including South Korea, have opted to publicly provide housing at low cost on a large scale (Kim and Park, 2016). In Singapore, around 80 percent of its resident households reside in public housing that the Housing and Development Board, a government agency, built and managed (Phang and Helble, 2016). These supply-side measures are useful to ensure a certain minimum standard of housing adequacy while providing access to adequate housing for households in need.

On the other hand, if the extent of housing inadequacy is small and only a small number of households need improved access to adequate housing, demand-side deep subsidies have been a more popular method. The housing voucher program in the United States is one of the most prominent examples.[21] Despite many advantages of demand-side subsidies, inelastic supply in many large metropolitan areas may hinder their success in reducing housing inequality. If the problem is more related to physical housing conditions than housing availability or tenure,

[21] In addition to classic vouchers, new demand-side assistances have been discussed. U.S. Senator Kamala D. Harris reintroduced the so-called Rent Relief Act, which would create a new, refundable tax credit for households whose housing costs exceed 30 percent of their income, including rent and utilities (Harris, 2019).

providing targeted demand-side subsidies can be useful to improve housing adequacy. For example, under the National Affordable Housing Program Project in Indonesia, low-income households can apply for governmental support either in cash or building materials.

Finally, to reduce spatial heterogeneity in household-level housing inequality, some policy measures have considered targeting specific areas that experience severe housing inequality. For many large, global cities in developing countries, informal settlements are a major source of housing inequality. Several countries including India, Indonesia, Pakistan, and the Philippines have used slum resettlement programs that relocate informal settlers to sites outside the city with basic infrastructure. Similar to the U.S. policies, such as Moving to Opportunity or homelessness policies that offer rental housing, these programs incentivize household mobility with the provision of adequate housing. The downside is that program participants are often forced to leave their home and relocate to areas far from their employment.

As housing unaffordability is one of the main drivers of housing inequality, policies have also focused on enhancing housing affordability in large cities. Some cities in developing countries have experienced difficulties in providing affordable, adequate housing due to inefficient planning processes (Hussnain et al., 2016) and particularly low floor-area ratios (Shenvi and Slangen, 2018). Therefore, in addition to the various supply- and demand-side policies mentioned earlier, lifting strict zoning restrictions is another policy option for these cities. For example, in the United States, Minneapolis state government implemented "upzoning" every single-family neighborhood at once. Another commonality in most large cities is that affordable housing tends to be located in areas with lower access to important services—such as education and healthcare—which could be considered important elements of housing adequacy in broader terms. An efficient and affordable public transportation system could greatly enhance this access and help lower-income households enjoy housing that is both adequate and affordable.

5. Conclusion

In this article, we provide new evidence on housing adequacy and related inequality in 10 developing Asian countries and explore how these patterns of housing inequality are comparable to those in the United States. Our finding first elucidates spatial inequality in housing adequacy, represented by the urban-rural gap in Asian developing countries and disparities between urban and suburban areas and across metropolitan areas in the United States. Although the significant difference in economic status and the degree of development between urban and rural areas is mainly relevant in Asian developing countries, spatial inequality in the United States appears to be also associated with housing affordability and economic inequality in certain metropolitan areas. Next, households with lower economic status are more likely to face the challenge of housing inadequacy in both developing Asia and the United States. The scale of affected households differs significantly, however. Although even some middle-class households suffer from housing inadequacy in developing countries, the general extent of housing inadequacy is a lot lower, and it concentrates only among very low-income households in the United States. Finally, results from both Asian developing countries and the United States consistently suggest spatial heterogeneity in household-level housing inequality at the metropolitan-area level. Areas

with a larger population, higher economic inequality among resident households, and higher housing unaffordability tend to experience a greater concentration of inadequate housing among households with lower economic status.

Our findings provide important policy implications that are not necessarily limited to Asian developing countries. Developed countries, including the United States, are facing equally serious wealth inequality with aspects like intra-generational divergence and intergenerational transfers compared to developing countries. We suggest that such economic inequality is highly related to housing inequality. In both developing countries and the United States, we find that spatial attributes such as economic inequality and housing unaffordability aggravate the unequal access to adequate housing by household economic status in a given metropolitan area. In fact, although housing adequacy itself may be less of a concern in the United States than in Asian developing countries, we have seen that high poverty rates and acute shortage of affordable housing have risen to homelessness and substandard housing in some U.S. cities like New York. According to the National Low Income Housing Coalition (2020), the United States is facing a shortage of 7 million affordable and available rental homes. Households without access to appropriate low-cost housing pay an unproportionally high share of their income for rent and, in the worst case, become homeless. U.S. policymakers should recognize the unequal nature of access to adequate housing; they should design policies to address the concentration of inadequate housing among the lower end of the central city population and prevent a further spatial concentration of housing wealth.

Some caveats should be mentioned. Due to data limitations, we do not use the same definition of housing adequacy for developing Asia and the United States. Although the DHS definition includes dimensions of crowding and access to water and sanitation, the AHS definition focuses more on the structural quality of the dwelling. We argue that the level of household housing consumption should not be extremely biased toward these different dimensions. If the difference in housing adequacy definitions significantly affects the distribution of adequate housing across households with different economic status and across geographic areas, however, our analysis results on housing inequality in developing Asia and the United States may not be very comparable. Also, because of data shortcomings, our findings do not allow for causal interpretations and remain largely descriptive.

The future research agenda on housing inequality is large. First, as alluded to in the previous paragraph, it would be useful to obtain a more comprehensive picture of housing adequacy. This requires access to more detailed information on housing conditions and household attributes. Little information has been collected through surveys in developing countries, hampering the understanding of their housing adequacy. One solution to overcome the data constraint in developing countries is to use big data collected via nighttime lights, web mapping services, or mobile phone usage. As AHS data provide rich information on housing units but lack household attributes, it will be desirable to expand data collection. Second, as many developing countries are experiencing economic growth and urbanization, it would be interesting to examine how housing inequality and its determinants change over time. For example, as countries develop economically, the rural disadvantage in terms of access to adequate housing is most likely to shrink. Lastly, more

research is needed to identify macroeconomic policies that work best to address housing inequality. For example, it may be interesting to study whether housing inequality is less pronounced in countries with systems of larger income redistribution.

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Appendix A.

We define the four-dimensional housing adequacy criteria from the following questions in the Demographic and Health Survey.

Structural Quality

Structural quality is measured by roof materials. A house is considered to be structurally qualified if it has finished roofing. Relevant question in the DHS is No.143 (hv215): *Main material of the roof of the dwelling (Observation by an interviewer)*

Exhibit A.1

Roof Materials	
Natural	No roof
	Thatch/palm leaf
	Mud
	Sod/mud and grass mixture
	Plastic/polythene sheeting
Rudimentary	Rustic mat
	Palm/bamboo
	Raw wood planks/timber
	Unburnt bricks
	Loosely packed stone
	Wood planks
	Cardboard/makeshift
	Tin
	Plastic sheet
Finished	Metal (zinc/galvanized iron/aluminium)
	Wood
	Calamine/cement fibre
	Asbestos sheets
	Ceramic tiles
	Clay tiles
	Cement/rcc/rbc/concrete
	Roofing shingles
	Tiles
	Slate
	Burnt brick
	Ruberoid

Sufficient Living Area

A house is considered sufficiently spacious if not more than three people share a sleeping room. Relevant question in the DHS is No.117 (hv216): *How many rooms in this household are used for sleeping?*

Access to Improved Water

A house is considered to have adequate access to improved water if the main source of drinking water for household members is from piped water, protected dug well, protected spring water, or bottled water. Relevant question in the DHS is No. 101 (hv201): *What is the main source of drinking water for members of your households?*

Exhibit A.2

Drinking Water Sources	
Piped water	Piped into dwelling
	Piped to yard/plot
	Piped to neighbor
	Public tap/standpipe
Dug Well	Protected well
	Unprotected well
Water from spring	Protected spring
	Unprotected spring
Others	Tube well or borehole
	Rainwater
	Tanker truck
	Cart with small tank
	Surface water (river/dam/lake/pond/stream/canal/ irrigation channel)
	Bottled water
	Others

Access to Improved Sanitation

Accessibility to improved sanitation is based on whether a house owns a flush toilet or ventilated improved pit, and whether a toilet is not shared with more than two other households. Relevant questions in the DHS are No.109 (hv205): *What kind of toilet facility do members of your household usually use?*; No.110 (hv225) : *Do you share this toilet facility with other households?*; and No.111 (hv238): *Including your own household, how many households use this toilet facility?*

Exhibit A.3

Sanitation	
Flush or pour flush toilet	Flush to piped sewer system
	Flush to septic tank
	Flush to pit latrine
	Flush to somewhere else
	Flush, don't know where
Pit latrine	Ventilated improved pit latrine
	Pit latrine with slab
	Pit latrine without slab/open pit
Others	Composting toilet
	Bucket toilet
	Hanging toilet/hanging latrine
	No facility/bush/field
	Public facility
	Others

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Departments

In this issue—

- *Data Shop*
- *Foreign Exchange*
- *Graphic Detail*
- *Industrial Revolution*
- *Policy Briefs*
- *SpAM*

Data Shop

Data Shop, a department of Cityscape, presents short articles or notes on the uses of data in housing and urban research. Through this department, the Office of Policy Development and Research introduces readers to new and overlooked data sources and to improved techniques in using well-known data. The emphasis is on sources and methods that analysts can use in their own work. Researchers often run into knotty data problems involving data interpretation or manipulation that must be solved before a project can proceed, but they seldom get to focus in detail on the solutions to such problems. If you have an idea for an applied, data-centric note of no more than 3,000 words, please send a one-paragraph abstract to david.a.vandenbroucke@hud.gov for consideration.

Parcel Tax in California: Findings from New Data Sources

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Abstract

This article examines parcel taxes in California counties, cities, and special districts. Unique to California, the parcel tax is commonly known as a lump-sum tax applied to parcels of real property to finance local public services. Some scholars and practitioners argue that the parcel tax can be a good source of local revenue because of its simplicity. Since the 1980s, parcel tax adoption has grown, despite requiring two-thirds approval in a local referendum. In 2018 alone, California had about 100 parcel tax elections. Despite the increase in adoption, scholars and practitioners have not had a good understanding of the nature and use of the parcel tax. I fill this gap by collecting and analyzing parcel tax ballot measures from 1995 through 2018. Since 2016, the state has mandated that local governments submit parcel tax financial reports, which I also use. I find that parcel tax structure is far more fragmented across local governments than previously understood.

Parcel Tax in California

A parcel tax is an unusual form of property tax that is unique to California. A property tax usually refers to an *ad valorem* tax (that is, a tax on the assessed value of a property), but the parcel tax is defined as "a non-ad valorem tax imposed as an incident of property ownership" (California State Controller's Office, 2015). This non-ad valorem tax can be based on any tax base other than the assessed value of a parcel. Scholars and practitioners commonly understand the parcel tax as a lump-sum tax on an incidence of a parcel, but it could take other forms other than a lump-sum tax.

This unique property tax originated from the 1978 state constitutional amendment known as Proposition 13, or Prop 13. Prop 13 prohibits local governments from raising ad valorem property tax rates beyond 1 percent of the acquisition value of the property. The state constitution does, however, allow for a locally assessed property tax—such as the parcel tax—provided it is not ad valorem, is for a special purpose, and gains at least two-thirds approval in a local referendum.

The number of parcel tax elections has steadily grown in California cities, counties, and special districts as a way to circumvent Prop 13's 1-percent rule. Between 1995 and 2018, voters decided 661 local ballot measures that proposed a parcel tax—this accounted for about one election every 2 weeks for 24 years. Voters increasingly adopt parcel taxes, despite the high threshold for approval.

Their growing fiscal importance notwithstanding, information on parcel taxes is difficult to find.[1] The Legislative Analyst's Office stated in its 2012 report, "We were not able to locate information on the statewide amount of parcel tax revenue collected by cities, counties, and special districts." In 2014, the state passed legislation that requires local agencies to report information on assessed parcel taxes to the State Controller's Office (Government Code 12463.2). The state published the first meta-report for the 2016 fiscal year. In this article, I introduce this parcel tax official data available for the first time and parcel tax election data collected between 1995 and 2018. I will describe variables extracted from the two datasets as a benchmark for an initial understanding of the parcel tax.

When exploring the two datasets, I assess the efficiency and equity of the parcel tax by focusing on its design elements, including property classification (that is, a grouping of properties based on similar land use) and tax base. Economists agree that a tax on real property is a good tax because it is stable, efficient, and fair (Youngman, 2016). Ihlanfeldt (2013) points out, however, that a property tax is efficient when its tax base is fair market value. He argues that if a property tax is non-ad valorem, it loses its merit as an efficient tax. Based on his assertion, we may question whether the parcel tax is potentially an efficient tax as Sonstelie (2015) argues, when it is non-ad valorem by definition. When the tax base can be anything but the market value, local governments may come up with various tax bases to meet their revenue needs. Especially with no state guidance about parcel tax assessment, locally designed parcel taxes can be fragmented, complex, inefficient, unfair, and obscure. Thus, when extracting variables, I pay particular attention to the tax base of the parcel tax.

[1] The Department of Education has collected school parcel tax data since the first parcel tax adoption in 1983. That is why prior studies on parcel tax have mainly focused on school districts (Brunner, 2001; Lang and Sonstelie, 2015; Lee, 2019).

In addition, I look for the practice of property classification. Sonstelie (2015) argues that the parcel tax could be a useful financing tool for local governments, but he cautioned that all types of properties must be treated equally. Excessive property tax rate differentials based on classification can diminish the simplicity and efficiency of a property tax because the different treatments can distort land-use decisions (Youngman, 2016). In California, the statewide 1-percent ad valorem tax is uniform to all properties including residential, commercial, and industrial properties, which satisfies the efficiency condition for a good tax. However, later we will find out that a significant number of parcel taxes treats different classes of properties differently.

Data Description

The datasets used in this article consist of two separate data sources. First, I collected all reported local ballot measures that proposed a parcel tax in cities, counties, and special districts in California between 1995 and 2018. Data availability determined the timeframe. The primary source of the data came from the "County, City, School District & Ballot Measure Election Results" published by the California Secretary of State.[2] The reports provide a short description and results of local ballot measures between 1995 and 2017. I obtained election data in 2018 from the "Digital Encyclopedia of American Politics and Elections." Together, I identified 661 parcel tax elections during the 1995-through-2018 period.

The "Election Results" reports provide a summary of parcel tax proposals in PDF files. Unfortunately, the reports do not offer the full text of ballot measures. The summaries are useful for necessary information such as the name of the local government, year and month of the election, the amount of tax and tax base, the number of votes cast, percentage of votes in favor of the proposal, and whether it passed or failed. They often omit substantial details on the tax base, classification, and tax amount and rates, particularly for older ballot measures. I supplement the missing information with other sources, such as the "Digital Encyclopedia of American Politics and Elections,"[3] articles in various local newspapers available online, official documents of local agencies, and agency websites. The variable list extracted from the text of ballot measures is presented in exhibit 1.

[2] These reports can be found on www.sos.ca.gov.

[3] The Digital Encyclopedia of American Politics and Elections can be found at www.ballotpedia.org.

Exhibit 1

Variable List

Parcel Tax Measure Election Data	Parcel Tax Financial Data
• Agency name	• Agency name
• County location	• Parcel tax name
• Election date	• Revenue
• Number of votes cast	• Number of parcels subject to parcel tax
• Percentage of votes supporting a parcel tax	• Number of parcels exempt from parcel tax
• Election results: approved or failed	• Expiration date
• Proposed parcel tax amount	• The number of effective years
• Property classification	• Property classification
• Tax base	• Tax base
• Sunset provision	

Note: Not all texts provide comprehensive information about all of the variables.
Sources: Parcel tax election data were from the "County, City, School District & Ballot Measure Election Results," 1995–2017, California Secretary of State (www.sos.ca.gov) and the "Digital Encyclopedia of American Politics and Elections Parcel Tax Elections in California," 2018. Parcel tax financial reports were from "Government Financial Reports," 2016–2018, State Controller's Office (www.bythenumbers.sco.ca.gov).

Second, I collected the state's official financial data on parcel tax revenue as a part of the "Government Financial Reports" from 2016 through 2018. The State Controller's Office makes raw financial data publicly available online,[4] but does not release a single integrated file on parcel tax revenues. Users must visit three separate web pages of cities, counties, and special districts to download the raw data each year to obtain parcel tax information. At the end of each Excel file, either one tab (2016 data) or three tabs (2017–2018 data) contain parcel tax information. Users may identify six state-required information items: the type and rate of parcel tax, the number of parcels subject to the parcel tax, the number of parcels exempt from the parcel tax, whether there is an expiration (sunset) date if any and the number of effective years, the amount of revenue received from the parcel tax annually, and the manner in which the revenue received from the parcel tax is being used.[5]

Descriptive Analysis

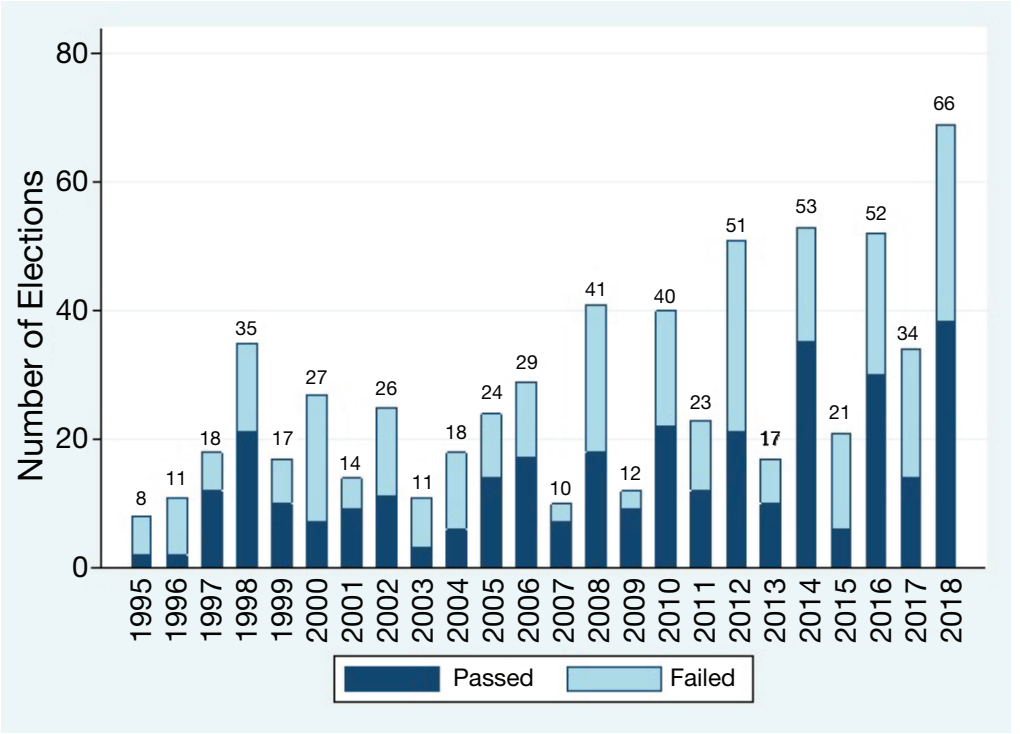
From 1995 to 2018, local governments proposed 661 parcel tax ballot measures in California counties, cities, and special districts. The number indicates the significance of the parcel tax as a viable local revenue source. These 661 measures are spread across 47 of the state's 58 counties; local governments in Marin County most frequently held parcel tax elections (100 elections), followed by El Dorado County (57 elections). Based on school parcel taxes, researchers previously believed the San Francisco Bay area had a heavy concentration of parcel tax elections and adoption (Lang and Sonstelie, 2015; Lee and Sun, 2018). The data, however, reveal that parcel tax elections in non-school districts are widespread across California.

[4] This raw data can be found at www.bythenumbers.sco.ca.gov.

[5] See Parcel Taxes Financial Transactions Report Instructions at https://www.sco.ca.gov/Files-ARD-Local/LocRep/Parcel_Tax_FTR_Instructions_Final_7-14-2015ADA.pdf.

Exhibit 2

Number of Parcel Tax Elections between 1995 and 2018: California Cities, Counties, and Special Districts



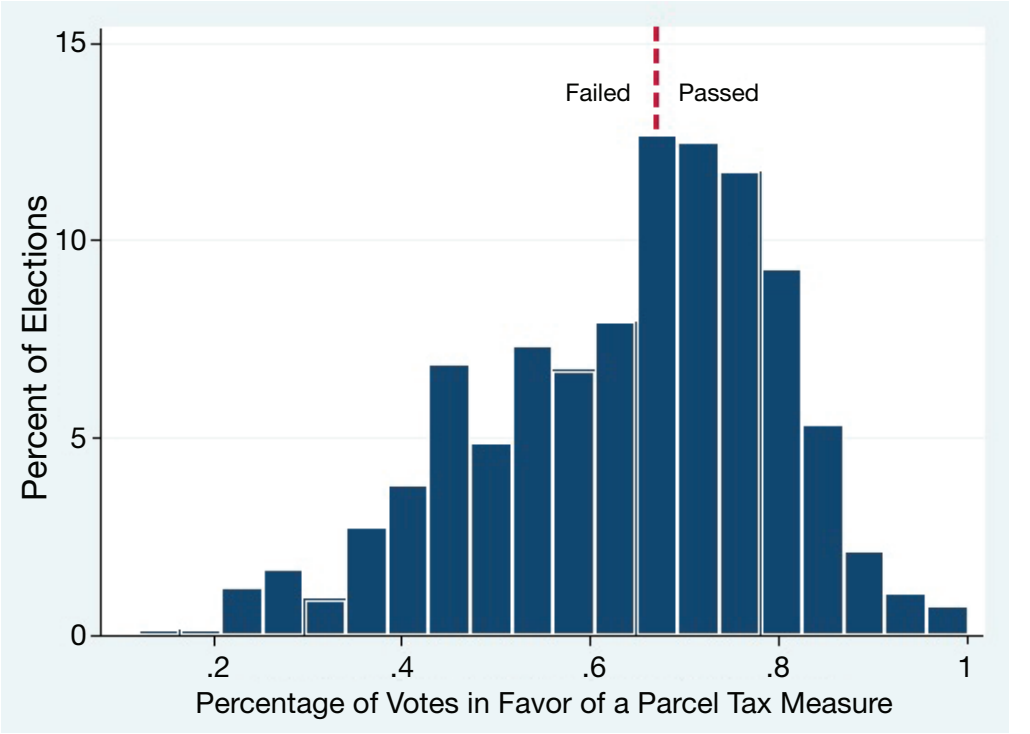
Data sources: "County, City, School District & Ballot Measure Election Results" from the California Secretary of State and "Digital Encyclopedia of American Politics and Elections" available at https://ballotpedia.org/Parcel_tax_elections_in_California.

Exhibit 2 shows the number of parcel tax ballot measures between 1995 and 2018. An upward trend has been apparent since 2008. The Great Recession may have placed local governments in extreme budget constraints, forcing them to find a new tax base. The year of 2018 had a record-high number of elections. This trend is also consistent with recent literature on the proliferation of special districts to circumvent local limits on taxation (Goodman and Leland, 2018). Local governments held a more significant number of elections in even-numbered years to coincide with general elections, both to save election costs and to take advantage of the relatively high voter turnout in those years (Lee, 2019). Despite the two-thirds supermajority requirement, voters approved approximately 50 percent of the 661 proposals from 1995 through 2018. Exhibit 2 also shows the distribution of elections that passed (in the darker shade) and failed (in the lighter shade).

Exhibit 3 shows the distribution of votes in favor of a parcel tax measure. Local governments on the left side of the vertical dashed line (66.7 percent threshold on the x-axis) failed to adopt a parcel tax, and the ones on the right side succeeded. If the state required a simple majority instead of the two-thirds supermajority, more than 79 percent of the proposals would have been adopted.

Exhibit 3

Percentage of Votes in Favor of Parcel Tax Ballot Measures: California Cities, Counties, and Special Districts between 1995–2018



Data sources: "County, City, School District & Ballot Measure Election Results" from the California Secretary of State and "Digital Encyclopedia of American Politics and Elections" available at https://ballotpedia.org/Parcel_tax_elections_in_California.

The total number of votes cast varies greatly. The smallest number of votes cast is 2 (a road improvement zone in San Luis Obispo County in 1999), whereas the largest number of votes was more than 3.16 million votes (Los Angeles County's parks and open space parcel tax in 2016). Total votes typically do not exceed more than 1,800, however. In three-fourths of the elections, less than 5,500 votes were cast.

Parcel taxes must be set aside for a special purpose. They are proposed to finance various local public services such as police and fire protection, emergency medical services, public works, landscaping, street lighting, library services, hospitals, public health, environment protection and open space, water management, water conservation, flood control, cemetery services, public transportation, snow removal, and even general services including non-specified administrative purposes. Nearly one-half of parcel tax measures were proposed to finance public safety, such as police and fire protection and emergency medical services. The next most frequent service items include parks and recreation, road maintenance, and library services.

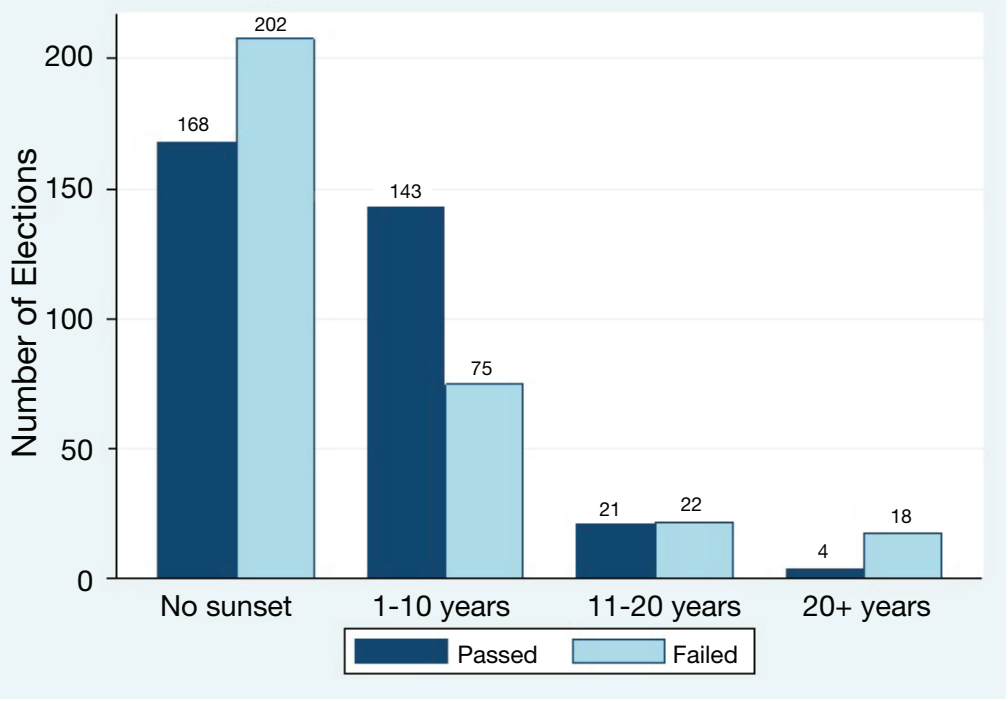
Contrary to the belief that parcel taxes are mostly temporary, most parcel tax measures were proposed as a permanent tax. About 57 percent of the elections were for ballot measures with no sunset date.

Even when there is a sunset, some extend to more than 40 years from the date of inception. The lack of a sunset provision in cities and counties shows that local governments consider the parcel tax not as a short-term alleviation of fiscal stress but as a long-term revenue source.

Exhibit 4 shows election outcomes by sunset provision. Parcel taxes are less likely to be approved with a longer effective period. The approval rate is less than 50 percent without a sunset provision. With between 1 and 10 effective years, the success rate jumps up to 65 percent. The rate drops to 49 percent for measures with between 11 and 20 effective years and 18 percent for those measures with more than 20 effective years.

Exhibit 4

Passage of Parcel Tax Ballot Measures by Sunset Provision: California Cities, Counties, and Special Districts between 1995–2018



Notes: The total number of observations is 660. One observation is missing. The expiration date for Measure I in the City of Davis in 1997 was not located in any of the data sources.
Data sources: "County, City, School District & Ballot Measure Election Results" from the California Secretary of State and "Digital Encyclopedia of American Politics and Elections" available at https://ballotpedia.org/Parcel_tax_elections_in_California.

Despite California not allowing different tax rates by property classification, 44 percent of parcel tax proposals classify properties and treat them differently. Exhibit 5 shows that 56 percent of parcel tax measures propose a uniform tax on all properties regardless of land use.

Exhibit 5

Property Classification in Parcel Tax Ballot Measures: 1995–2018

Property Classification	Number of Parcel Tax Ballot Measures	Percent
UNIFORM RATE	371	56.13
DIFFERENT RATE	254	38.43
Different rate	190	28.74
Residential only	33	4.99
Single-family home only	24	3.63
Residential and unimproved parcels only	3	0.45
Airpark only	1	0.15
Commercial parcels only	1	0.15
Non-residential parcels only	1	0.15
Vacant parcels only	1	0.15
UNKNOWN	36	5.45
TOTAL	661	

Note: Percentages may not add to 100 percent due to rounding.
Data sources: "County, City, School District & Ballot Measure Election Results" from the California Secretary of State and "Digital Encyclopedia of American Politics and Elections" available at https://ballotpedia.org/Parcel_tax_elections_in_California.

Of the ballot measures analyzed, 254 proposals imposed different rates on residential, commercial, industrial, and institutional properties. In some cases, local agencies impose a more substantial tax on hotels, motels, churches, clubs, shopping centers, schools, theaters, supermarkets, veterinary hospitals, gym/health spas, parking lots, office buildings, nurseries, golf courses, and restaurants/cocktail lounges to pay a specific amount of parcel taxes. Some parcel taxes are raised only from residential properties, such as single-family homes.

Parcel taxes seem to be raised as a benefit tax. When local governments differentiate tax rates and amounts by land use, it is often only the improved parcels that are subject to the parcel tax; this is probably because a parcel tax must be a special tax for a specific local service. One case, however, had only vacant parcels as subject to taxation. The City of Desert Hot Springs proposed a $372.68 per acre tax on vacant parcels, in which the municipal government sought to raise revenues from unproductive land.

Exhibit 6 shows that 457 measures proposed a lump-sum tax on each parcel of land regardless of property classification. The lump-sum tax is often referred to as a uniform tax. Nonetheless, a non-negligible fraction of measures differentiated properties by land use, building or lot size, location, and even assessed values. Contrary to the common understanding that a parcel tax is a lump-sum tax equally imposed on all parcels, the tax base described in local ballot measures is not always limited to a parcel of land.

Exhibit 6

Tax Bases in Parcel Tax Ballot Measures: 1995–2018

Proposed Tax Base	Number of Parcel Tax Proposals	Percent
Parcel	457	69.14
Mixed (a combination of parcel, size, unit, and others)	109	16.49
Size (Sq.ft., sq.m, acre, front-footage, and so on)	27	4.08
Living/Dwelling Unit	11	1.66
Unit (unknown/unclear)	11	1.66
Service/Benefit Units	10	1.51
Other (assessed value, bedroom, and so on)	4	0.61
Not available	32	4.84
Total	661	99.99[a]

Data source: "Government Financial Reports," 2016–2018, California State Controller's Office (www.bythenumbers.sco.ca.gov).
[a] The percentages may not add up to 100 percent due to rounding.

The tax base of parcel taxes is heterogeneous, as, by definition, it is a non-ad valorem tax that can take any tax base other than assessed value. The data show a variety of tax bases, including the size of lot and structure (such as square meter, acreage, square footage, and front-footage), number of dwelling/living units, number of service/benefit units, number of bedrooms or rooms, types of businesses, improvement structures, unimproved structures, occupied structures, vacant structures or land, and combinations of the above.

From the newly adopted state mandate for parcel tax information reporting, we now know three pieces of information for the first time. First, exhibit 7 shows how much parcel tax revenue has been raised since 2016. Parcel tax revenue has grown from $1.49 billion in 2016 to $1.91 billion in 2018—a 28-percent increase in 2 years.

Exhibit 7

Summary Statistics from Official Financial Reports in FY 2018

	Cities	Counties	Special Districts	Total
Revenue ($ million)	749	543	619	1911
Revenue Increase from the previous year	0%	18%	45%	17%
Number of Entities	144	13	252	409
Number of Parcels Subject to a Parcel Tax	4,302,598	5,825,265	7,119,500	17,247,363
Number of Parcels Exempted	34,689	693,558	106,793	835,040
Percent of Parcel Taxes without an expiration date	62%	50%	71%	66%

Data source: "Government Financial Reports," 2016–2018, California State Controller's Office (www.bythenumbers.sco.ca.gov).

The largest revenue increase occurred in special districts between 2017 and 2018, with a 45-percent climb, which appears consistent with the recent proliferation of special districts and their increasing role in local public good provision (Bauroth, 2015). Because many parcel taxes are

permanent and more parcel taxes are getting approved, parcel tax revenues are expected to grow cumulatively in the future.

Second, in 2018, the total parcel tax revenue of $1.9 billion was raised from more than 17 million parcels. Approximately 835,000 parcels were exempt from the tax for various reasons. Third, more than one-half of parcel taxes are a permanent tax without an expiration date.

Economists have advocated for the property tax as a good tax because it leads to the least market distortion. They agree that ad valorem property taxes with few exemptions and classifications are essential for efficient and equitable property tax design (Ihlanfeldt, 2013). From this perspective, the newly available data reveal that the parcel tax deviates from a good tax. In practice, the parcel tax is plagued with excessive classification and subclassification of land use, atypical non-standardized tax base, and lenient exemption policies. Although the parcel tax is one of the few ways to extract local revenue from real estate wealth, it is clear that it has lost the simplicity, efficiency, and equity advantages of property taxes.

Conclusion

This article presents compiled parcel tax election data and the state's official parcel tax data resulting from a new state mandate. The data can be used to assess the effect of parcel taxes on local fiscal conditions (Lee and Tosun, 2019), a distributional impact of parcel taxes on households by the design variations, the role of special districts in local public good provision, the effect of parcel taxes on land use decisions, and the effect of overlapping tax jurisdictions on tax incidence. The data also can be useful for political scientists to understand the factors that affect the success and failure of local parcel tax elections.

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How Finland Ended Homelessness

Marybeth Shinn
Jill Khadduri

This article is adapted from a discussion in the authors' book, In the Midst of Plenty: Homelessness and What to Do About It*, published in March 2020.*

In June 2019, *The Guardian* ran a piece entitled "'It's a miracle': Helsinki's radical solution to homelessness," noting that Finland was the only European country where levels of homelessness were falling (Henley, 2019). Indeed, Finland has largely ended homelessness as the U.S. Department of Housing and Urban Development (HUD) defines it. Because Finland uses a broader definition of homelessness, including living temporarily with family or friends, the Finns have not yet met their own goals. Even by this broad measure, Finland more than halved homelessness as observed in annual point-in-time counts, from more than 18,000 people in 1987 to less than 5,000 in 2019 (ARA, 2019, updated by Hannu Ahola). This article surveys Finland's success and analyzes what the United States can learn from it.

How Finland Ended Homelessness

The Finnish government first set a goal of eliminating homelessness in 1987 and instituted an annual survey analogous to a U.S. Point-in-Time count to monitor progress (Pleace, 2017). In 1987, 17,110 single people and 1,370 families were recorded as experiencing homelessness. At the time, Finland, like other Nordic countries, largely used a "staircase" approach to homeless services, in which service users move from one level of accommodation to the next by meeting treatment goals.

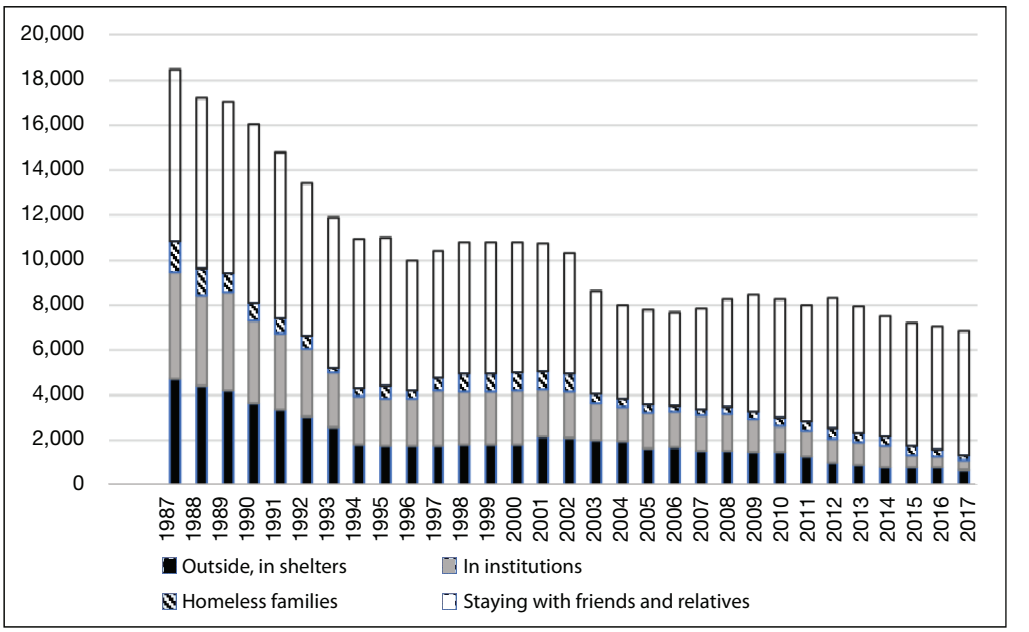
Using the staircase approach, Finland more than halved homelessness by 1994, but then progress slowed, as shown in exhibit 1. In particular, between 2004 and 2008, the number of single homeless individuals hovered between 7,400 and 7,960. Finland's annual homeless reports attributed the stalled progress to a group of people with high support needs who were experiencing long-term homelessness, analogous to chronic homelessness in the United States (Pleace, 2017).

Researchers suggested that the staircase approach "can work well with those who have opted for substance abuse rehabilitation and can cope with shared housing. However, the insistence on service users being intoxicant-free and able to take control of their lives has proven to be an insuperable barrier for many homeless people with multiple problems" (Tainio and Fredriksson, 2009: 188).

A group of Finnish experts who analyzed the problem and issued a report called "Name on the Door" argued that eliminating long-term homelessness "requires adopting the Housing First principle where a person does not have to first change their life around in order to earn the basic right to housing. Instead, housing is the prerequisite that allows other problems to be solved" (Y-Foundation, 2017: 9). "In the Housing First model, a dwelling is not a reward that a homeless person receives once their life is back on track. Instead, a dwelling is the foundation on which the rest of life is put back together" (Y-Foundation, 2017: 10). Residents echo this perspective: "An apartment means security—now I have a home to return to. I feel important again now that I am responsible for my own life. I am someone again, I am me. I feel that I have to take care of my own business now" (Y-Foundation, 2017: 57).

Exhibit 1

Literal Homelessness and Staying with Family and Friends in Finland



Notes: "Outside, in shelters" includes overnight shelters and dormitory-type housing or boarding houses where people stay with the help of daily social assistance vouchers. "In Institutions" includes substance abuse and other treatment and rehabilitation services, and "sheltered homes," provided that people do not have rental agreements, do not intend to stay permanently, and seek other housing solutions. Staying temporarily with friends and relatives is considered as homeless in Finland, but is not included in comparable annual counts in the United States. These three categories refer to "lone individuals." Because very few families experience any type of homelessness in Finland, types of homelessness are not reported separately for families. Thus, the "Homeless families" category includes an unknown proportion of families staying with friends and relatives.
Sources: ARA, 2019; underlying numbers supplied by Hannu Ahola

The Finnish National Program to reduce long-term homelessness, adopted in 2008 and renewed in 2012, built on this housing first principle. A person who is homeless goes directly into a rental apartment, either an independent apartment or a unit in a supported housing development, and has the opportunity to choose services and supports. Staff in supported housing developments treat clients as equals and strive to build community (Y-Foundation, 2017: 15).

The program was a broad partnership between national and municipal authorities and the non-profit sector. The Y-Foundation led a collaborative effort. Founding bodies included the Association of Finnish Local and Regional Authorities, five cities, the Evangelical Lutheran Church, the Red Cross, the Confederation of Finnish Construction Industries, the construction trade union, and the Finnish Association of Mental Health (Taino and Fredriksson, 2009).

A Housing First approach requires housing, and Finland set about converting shelters into apartment units and buying and constructing housing for Housing First. In 1985, Helsinki had 2,121 shelter and hostel beds[1], and by 2016, the number had shrunk to 52. Meanwhile, supported housing units in Helsinki grew from 127 to 1,309, and independent rental apartments for (formerly) homeless people increased from 65 to 2,433 (Y-Foundation, 2017: 30). The Y-Foundation is currently the fourth largest landlord in Finland.

In its greater reliance on congregate as well as scattered-site housing models, the Finnish approach to Housing First differs from the evidence-based programs pioneered by Pathways to Housing in New York City (Tsemberis, Gulcur, and Nakae, 2004) and again proven successful for people with serious mental illnesses in the five-city Canadian At Home/Chez Soi experiment (Aubry et al., 2016; Stergiopoulos et al., 2015). Scattered-site housing may be less available in Finland, where only 19 percent of the housing stock is private rental units (Edwards, 2018). Finland applies its Housing First model to everyone, whereas the United States tends to reserve supportive housing (the term commonly used here) for people with mental illnesses and other disabilities. Supportive housing in the United States is frequently considered congregate or single-site (project-based), financed by HUD's housing assistance programs and the Low-Income Housing Tax Credit program. The congregate model has not been as rigorously evaluated as the scattered-site approach, but a report by the National Academies of Sciences, Engineering, and Medicine (2018) deemed both forms of permanent supportive housing effective in ending homelessness.

Tenants in Finnish congregate programs live in buildings with other service recipients and engage in some communal activities, but they still have their own apartments and their own leases. Clients have a choice of programs: some ask for a commitment to sobriety; others do not. Programs focusing on younger people have some shared apartments. Instead of receiving housing subsidies linked to the rent of the apartment, tenants pay the entire rent, using a variety of income sources provided by the government. These include housing, child, disability, unemployment, student, and pension allowances, depending on the person's circumstances. If those sources of income do not suffice, social assistance (akin to welfare in the United States) fills the gap. Compared to the Pathways Housing First model in the United States, Finland also relies more on ordinary

[1] "Shelter and hostel beds" includes overnight shelters and "dormitory-type housing or … boarding houses with the help of daily social assistance vouchers."

community services, especially in the scattered-site apartments, rather than on dedicated services from a multi-disciplinary team.

Because programs that house a group of clients in the same building can encounter more community resistance than scattered-site apartments, the Finns have developed elaborate strategies to combat opposition from neighbors. Tenants engage in "neighborhood work," such as collecting litter or maintaining parks. In one neighborhood, residents donned safety vests and kept watch over a bus stop used by schoolchildren. Neighbors have access to a 24-hour hotline to report any problems (Y-Foundation, 2017). The Finnish approach also differs from Housing First as commonly used in the United States to refer broadly to a strategy of getting people into housing without prerequisites, regardless of whether or not that housing is permanently affordable.

Can the United States Replicate Finnish Success?

Finland is a small and homogenous society, but it is less wealthy overall than the United States. Size, by itself, is not a barrier to implementing the sort of program that has worked in Finland. Finland's social welfare programs are more effective at reducing poverty. Considering only market income, the United States has relatively high levels of poverty (as defined by the international standard of the proportion of the population with income less than 50 percent of median income), but it is not off the charts. By this measure, Finland has slightly higher poverty (32.4 percent versus 31.2 percent for the United States; Gornick and Jäntti, 2016); but social welfare programs do far less to reduce poverty in the United States than in other wealthy countries. After considering tax and social benefit programs, 16.2 percent of Americans are below this relative poverty line, compared to 7.2 percent of Finns. Other countries, such as the Netherlands, do better still at reducing poverty, where the population below the poverty line is 4.8 percent (Gornick and Jäntti, 2016). More homogenous societies, like Finland and the Netherlands, tend to have more generous social welfare programs compared to those in the United States (Alesina and Glaeser, 2004). The choice of spending on social welfare is essentially a political choice, not one dictated by homogeneity. We could choose differently.

Additional factors, perhaps more easily replicated, may account for Finland's success in ending homelessness. The Y-Foundation credits the housing first approach. One of the international group of experts that Finland brought in to evaluate their efforts in 2014 suggests that two other factors were critical: the focus on housing and the political consensus across different levels of government and the private sector (Pleace, 2017). The United States achieved substantial success in nearly halving homelessness among veterans by attaining the same sort of political consensus and providing resources—for example, greatly expanding a scattered-site supported housing program for veterans called the HUD-VASH program[2]. Without Finland's social benefit programs, the United States would need to rely more heavily on an expansion of housing subsidies, particularly the Housing Choice Voucher program.

We believe additional factors were important to Finland's success: continual reflection based on internal and external evaluations, along with a willingness to adapt models from other countries

2 HUD-U.S. Department of Veteran Affairs (VA) Supportive Housing (HUD-VASH) Program.

based on those evaluations, and continuing analysis of shifting needs. The most recent 2016 plan, adopted in the wake of success in essentially ending chronic homelessness, focuses on prevention and additional forms of homelessness for youth, women, migrants, and asylum seekers with residence permits (Pleace, 2017; Y-Foundation, 2017). This plan, too, is something the United States could emulate.

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Graphic Detail

Geographic Information Systems (GIS) organize and clarify the patterns of human activities on the Earth's surface and their interaction with each other. GIS data, in the form of maps, can quickly and powerfully convey relationships to policymakers and the public. This department of Cityscape includes maps that convey important housing or community development policy issues or solutions. If you have made such a map and are willing to share it in a future issue of Cityscape, please contact john.c.huggins@hud.gov.

Early Interstate Policy and Its Effects on Central Cities

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Jeffrey Lin
Federal Reserve Bank of Philadelphia

The views expressed here are solely those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. Any errors or omissions are the responsibility of the authors.

Interstate highways caused significant population declines in central cities. In a recent working paper (Brinkman and Lin, 2019), we argued that highways' adverse effects on local quality of life versus their regional accessibility benefits were a significant factor in U.S. central city decline. Those declines were presaged by initial policies that did not anticipate the disamenity effects of urban highways and slow responses to the protests against early urban interstate construction.

The Federal-Aid Highway Act of 1956 authorized and financed the Interstate Highway System to complete 41,000 miles of interstates by 1969. Commensurate with the ambitious scale and timeline, early construction was fast: planners faced few constraints and little opposition. Initial national design standards called cities to feature several radial interstate routes intersecting near the central business district and one or more circumferential beltways (AASHTO, 1957; U.S. Congress, 1944).

Interstate boosters emphasized highways' accessibility benefits but neglected negative quality-of-life effects. Central city mayors and downtown business groups argued that highways were "the most effective way to relieve traffic congestion … and enhance access to the business district" (Fogelson, 2001: 262). Few anticipated negative side effects. A plan for Detroit showed highways with a "'parkway' ambience … reinforced by groups of pedestrians ambling along only a few feet from the freeway, as though it were a Parisian boulevard" (DiMento and Ellis, 2013: 19). Even

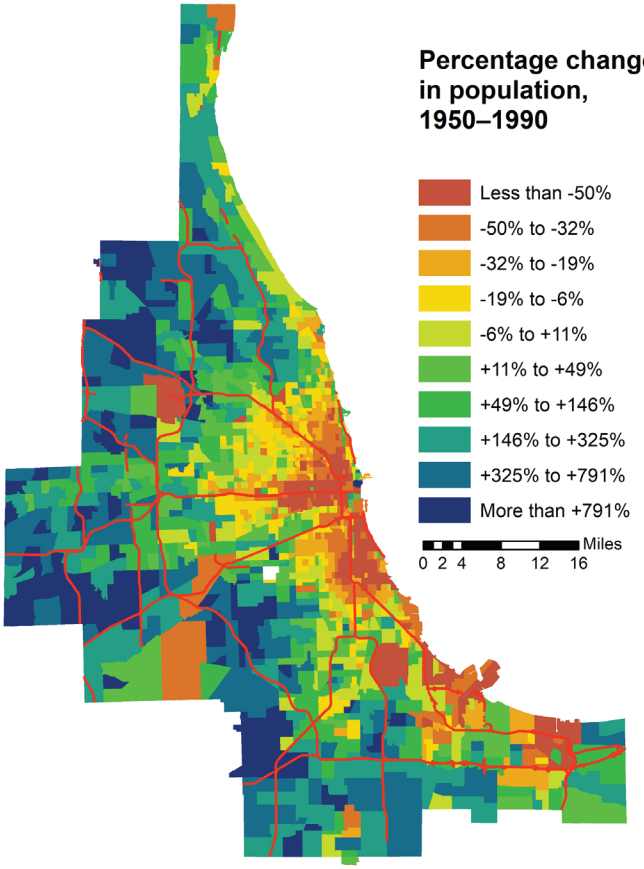
Lewis Mumford, later an important critic of urban highways, initially "viewed the automobile as a beneficent liberator of urban dwellers from the cramped confines of the industrial city" (DiMento and Ellis, 2013: 38).

Concerns about land taking, noise, pollution, and other negative quality-of-life effects, however, led to widespread protests known as the freeway revolts. Initially, protestors had little power to stop freeway planners. State and federal highway engineers "had complete control over freeway route locations" (Mohl, 2004). Slowly, policy shifted. For example, subsequent federal legislation required public hearings, economic impact analysis, environmental protection, and historical preservation. By 1967, "the freeway debates and protests [began] to erode formerly uncritical acceptance of urban freeways" (DiMento and Ellis, 2013: 140). By then, however, it was too late to alter many freeway plans: More than three-fourths of the originally designated mileage was already under construction or open to traffic by the end of 1967 (FHWA, 1967).

The negative quality-of-life effects on central neighborhoods were an important factor in central city decline. A key piece of evidence from our working paper (Brinkman and Lin, 2019) is the evolution since 1950 of central neighborhoods near and far from newly constructed highways. Unlike suburban locations, central neighborhoods already had superior accessibility circa 1950 (they were near the central business district); therefore, the effect of new interstates on central neighborhoods was mostly a reduction in local quality of life, leading to lower population and prices. Larger declines in neighborhoods near central highways indicate strong negative quality-of-life effects.

Exhibit 1

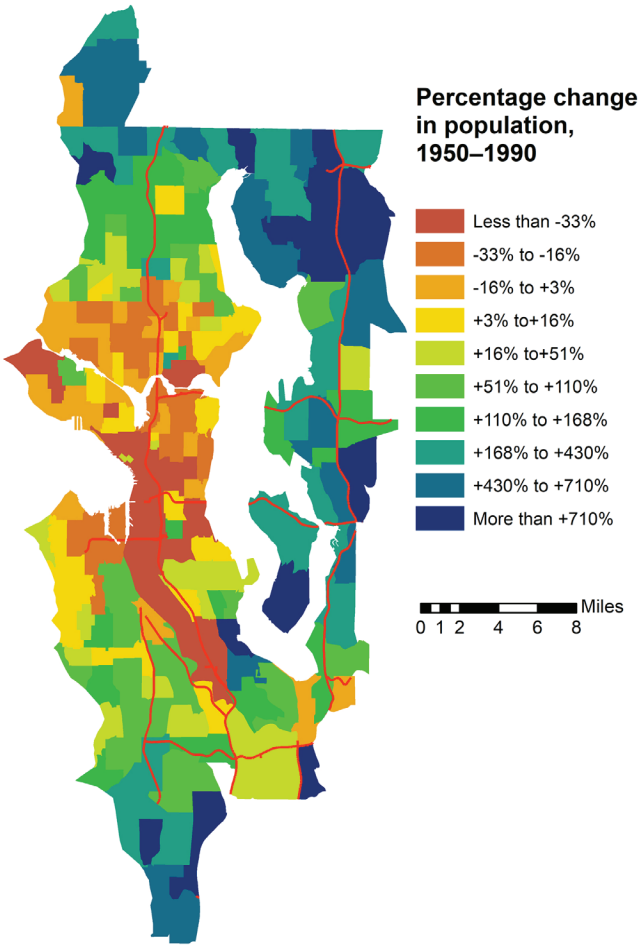
Change in Consistent-Boundary Census Tract Population in Chicago, 1950–1990



Notes: This map shows percentage changes in population for consistent-boundary census tracts in the Chicago metropolitan areas from 1950 to 1990. The geographic extent is determined by census tract data availability in 1950.
Sources: Census tract data and boundaries—Lee and Lin (2018) and Manson et al. (2019); limited-access highway routes—the U.S. Federal Highway Administration (2014)

Exhibit 2

Change in Consistent-Boundary Census Tract Population in Seattle, 1950–1990



Notes: This map shows percentage changes in population for consistent-boundary census tracts in the Seattle metropolitan areas from 1950 to 1990. The geographic extent is determined by census tract data availability in 1950.
Sources: Census tract data and boundaries—Lee and Lin (2018) and Manson et al. (2019); limited-access highway routes—the U.S. Federal Highway Administration (2014)

Those patterns are evident in the data. For example, exhibits 1 and 2 display changes in population between 1950 and 1990 for consistent-boundary census tracts in Chicago and Seattle (using data from Lee and Lin, 2018). In central areas, declines appear larger in neighborhoods closer to highways compared with neighborhoods slightly farther away. In central Seattle, this pattern appears as a visible north-south axis of decline paralleling the route of Interstate 5. In central Chicago, this leads to noticeable corridors of decline along the Eisenhower and Dan Ryan expressways. These patterns support our conclusion (Brinkman and Lin, 2019) that a significant part of the decline of U.S. central cities was due to lower quality-of-life in central neighborhoods following the construction of urban interstates. Our account contrasts with earlier work (Baum-

Snow, 2007) that emphasizes only the improved accessibility of suburban areas in understanding why highways led to suburbanization. In other words, an unintended cost of early interstate policies was to push people out of central neighborhoods, as opposed to pulling people toward newly accessible suburbs. Policymakers in the 1950s did not anticipate the negative quality of life of highways. The result was steep declines in central city populations.

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The "Punitive Push" on Mobile Homes

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Abstract

The number of people inhabiting vehicles in public parking has grown significantly during the 21st century in U.S. cities like Seattle, WA. Despite being the most frequently documented form of shelter among people who occupy public space, Seattle and the surrounding King County have few options for long-term vehicle residency and even less that are connected with social services. This article compares official annual reports on the habitation of cars, trucks, vans, or recreational vehicles (RVs) from 2006 to 2018 with an analysis of vehicle residency-oriented parking tickets, impounds, and police auctions in Seattle during this period.

Reconsidering the Mobile Home

Hundreds of thousands of Americans sleep in vehicles and mobile homes, both on and off the street. A vehicle residence frequently represents—and contains—vital remaining assets after a loss of housing from personal catastrophe, displacement, or natural disaster (Siegler, 2019). For some, a vehicle residence offers a step off the street or a way to avoid feared emergency shelters (Mendoza, 1997; Wakin, 2005, 2014). For many others, mobile homes are seen as the only available form of housing among persistent social, legal, and economic barriers to property rental or ownership (Arora, 2018; Bruder, 2017; Salamon and Mactavish, 2017; Sullivan, 2018; Talbutt, 2009).

To be clear, needs differ among millennials promoting the merits of "#VanLife" while employed in a wireless or "gig" economy (Allison, 2016; Monroe, 2017), older "snowbirds" migrating seasonally in an RV for medical purposes (Counts and Counts, 1996), single mothers with children who hide in a sedan while escaping an abusive intimate partner (Flynn, 2019), and veterans who may be "decompressing from the tribulations of service through the vicissitudes of travel" (Anderson, 2016) within a nondescript cargo van. A near-century of people inhabiting a mobile home or RV (Twitchell, 2014) seems to suggest that what defines their habitation as homelessness is less the form of shelter than its location in a public or private space. Mobile home parks, however, are reportedly "vanishing at a startling rate" (Denvir, 2015; Sullivan, 2018; Way, Fraser, and Davila,

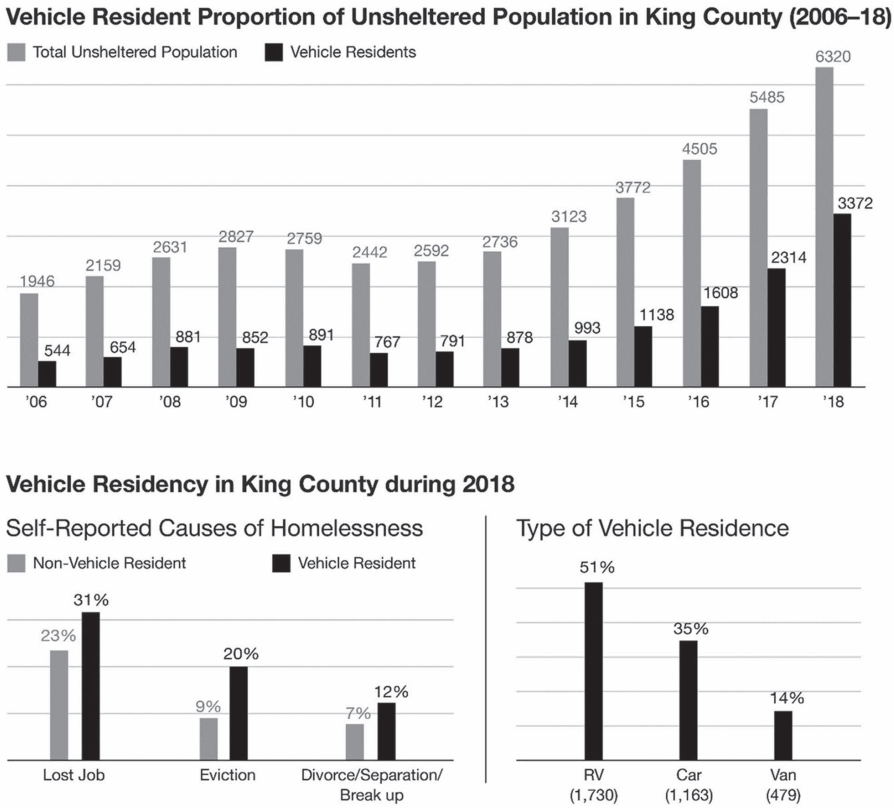
2020), and the few parks near cities often do not accept vehicles that are more than 10 years old (Ve Ard, 2018). With limited access to off-street areas, more and more of these private mobile homes occupy public parking spaces. Some cities have responded to a recent growth of vehicle resident communities with a "punitive push," enforcing internal migration through legal warnings, tickets, impounds, police auctions, and restrictions on access to public space (Davila, 2018a).

Vehicle Residency and its Criminalization in Seattle

Exhibit 1 shows the increase of vehicle residency in public parking across King County throughout the early 21st century (All Home King County, 2019; Pruss, 2019). The reported number of people who slept in cars, trucks, vans, and RVs grew more than six-fold during this time, from 544 in 2006 to 3,372 in 2018. By 2018, vehicles were the primary shelter for more than one-half (52 percent) of the unsheltered community who slept outside of the emergency, transitional, or supportive shelter system in King County. Less than 100 overnight parking spaces were provisioned for the more than 3,000 people inhabiting public parking throughout King County in 2018, including less than 20 for approximately 2,000 vehicle residents in Seattle.

Exhibit 1

Vehicle Residency in Seattle



Source: Pruss 2019; Seattle/King County Count Us In 2018

Exhibit 2 shows an analysis of six parking infractions most commonly issued to vehicle-homes in Seattle, determined in partnership with the Seattle Police Department Parking Enforcement Division and Municipal Courts, vehicle residents, vehicle residency advocates, and social service outreach specialists. Out of the 427,654 parking tickets issued in 2017, 1,109 were determined through public records analysis and parking enforcement supervisors as likely issued to vehicle residents. These vehicle residency-oriented tickets amounted to initial penalties of $65,852. An estimated $28,732 of these fines were paid, based on court records and discussions.

Exhibit 2

Analysis of 1,109 Parking Tickets Issued to Vehicle Residents in Seattle during 2017

Seattle Parking Citations Issued to the Vehicle Resident Population (2017)

	Est. Citations Issued to VR Pop	Number (%) of Tickets Paid	Fines Paid by VR Pop	Total Fines Due to Seattle
11.72.440 Parking Over 72 Hours ($44)	574	268 (47%)	$11,786	$25,234
11.72.145 Expired Tabs or Improper License Plates ($72)	181	91 (50%)	$6,530	$13,018
11.72.430 Trailer or Camper Detached ($47)	119	57 (48%)	$2,671	$5,593
11.72.330 Sign Posted Locations ($47)	111	87 (78%)	$4,089	$5,217
11.72.070 Large Size Vehicles in Non-Industrial Zone (47)	70	48 (69%)	$2,256	$3,290
11.72.500 Parking Junk Vehicle on Street ($250)	54	6 (11%)	$1,400	$13,500
TOTAL			**$28,732**	**$65,852**

Sources: Data based on public information requests, Seattle Municipal Court Records, and consultations with the Seattle Police Department Parking Enforcement Division

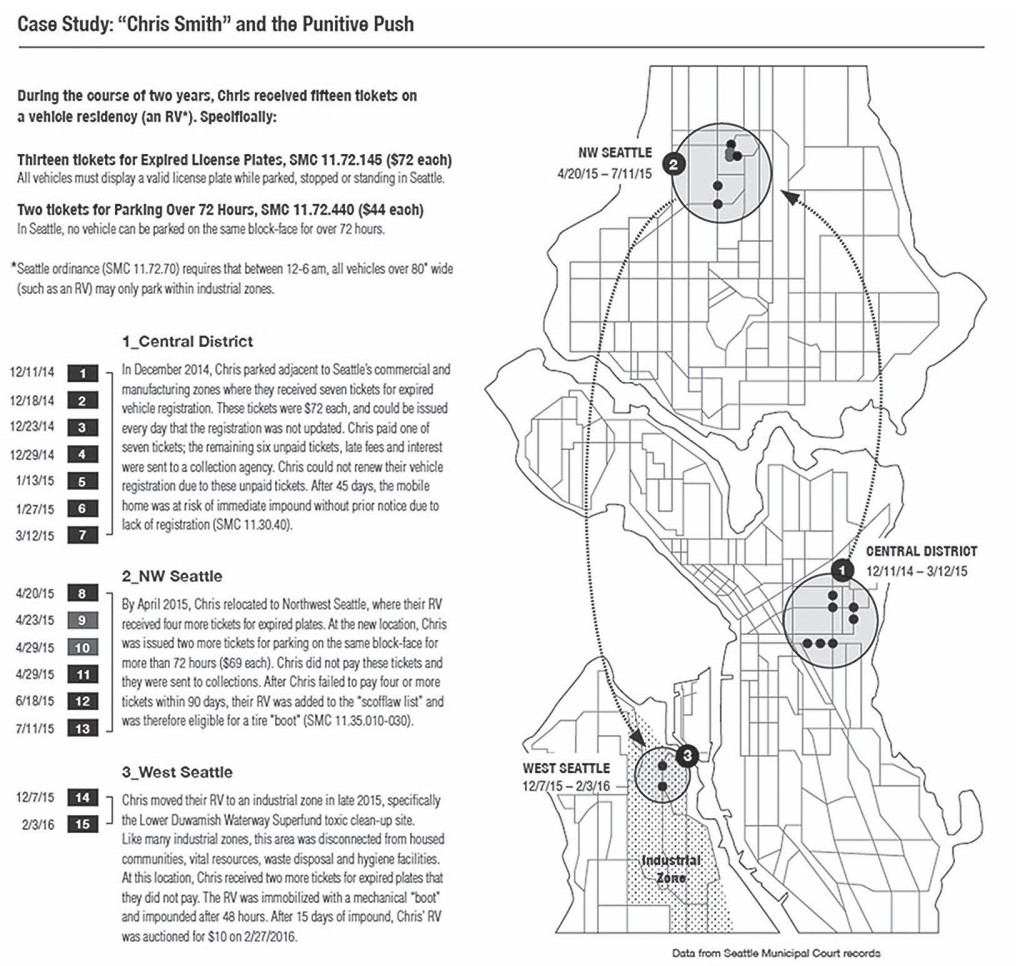
When unpaid, these fines go to collections, often leading to the impound of the vehicle and long-term damage to the credit rating of its owner and unsheltered homelessness (WCLP et al., 2019). Public records show that in 2017, 301 of these vehicles were sold at auction to recoup costs, recovering anywhere from $10 to $250. Local news has regularly reported RVs selling for $1, however (Archibald, 2017; Davila, 2019; Markovich, 2019). Seattle reportedly spent $225,000 impounding and destroying 152 RVs or trailers in 2017, all which were more than 10 years old (Archibald, 2018).

Exhibit 3 shows a brief case study mapping the year-long push of a single RV across Seattle, culminating in it being impounded and auctioned for $10. A recent Seattle University School of Law report shows how multiple laws have been woven into a net that penalizes vehicle-homes in public parking areas with legal warnings, tickets, impounds, and police auctions (So et al., 2016). Fines from these varied proscriptive and permissive ordinances often result in the inability to register the vehicle (ibid.), leading to the cascading series of tickets shown in our brief case study of "Chris Smith." According to a 2019 National Law Center on Homelessness and Poverty Report, anti-vehicle residency laws are among the fastest growing forms of criminalization targeting people who sleep in public space (Bauman et al., 2019). In Seattle and beyond, recent court cases regarding the legality of seizing a primary residence to pay fines could result in considerable future costs and potential class action suits[1].

[1] See: *Stephen Long v. City of Seattle*, and *Bloom et al. v. City of San Diego et al.*

Exhibit 3

How Public Parking Enforcement Disproportionately Affects Vehicle Residents



Sources: Data based on public information requests, Seattle Municipal Court Records, and consultations with the Seattle Police Department Parking Enforcement Division

Conclusions

A punitive response to vehicle residency has not decreased the habitation of public parking in Seattle. Rather, for nearly two decades these policies have legally enforced an internal migration of vulnerable people throughout public streets, disconnecting thousands of Americans from their communities and networks of care (Dawdy, 2006; Gillis, 2010). With few available alternatives, a punishment-oriented response has led to "compassion fatigue" (Figley, 1995)—or, a developing indifference based on frequent appeals for assistance—and even antipathy among law enforcement officers, social service providers, and surrounding communities regarding vehicle residency (Davila, 2018b). Without a supportive alternative to public parking for the thousands of people inhabiting

vehicles in Seattle, these policies have contributed to increasing densities of vehicle residency in diminishing legal spaces (Pruss, 2012), the seizure of private property directly producing unsheltered homelessness (WCLP et al., 2019), public expense and mounting community tensions (Burkhalter, 2013; Greenstone, 2019; Groover, 2016), while disproportionately harming vulnerable people and their housed neighbors (Green, 2019; Jaywork, 2017).

A growing number of people need space for their mobile homes in their local communities, in addition to "safe parking programs" for the thousands of vehicle residents who may benefit from social services (Bendix, 2018; Davila, 2018a; Mendoza, 1997; Pruss, 2019; Wakin, 2005, 2014). With no place for their private home, many vehicle residents see no possibility beyond sleeping in public parking spaces. Cities can alleviate the occupation of public space and help to meet the need of unhoused people through inclusive, consensual sites for vehicle residency. Off-street space, civic infrastructure, and social support could empower tens of thousands of private vehicle-homes currently on American streets as emergency, transitional, and affordable housing units.

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Industrial Revolution

Every home that is built is a representation of compromises made between different and often competing goals: comfort, convenience, durability, energy consumption, maintenance, construction costs, appearance, strength, community acceptance, and resale value. Consumers and developers tend to make tradeoffs among these goals with incomplete information which increases risks and slows the process of innovation in the housing industry. The slowing of innovation, in turn, negatively affects productivity, quality, performance, and value. This department piece features a few promising improvements to the U.S. housing stock, illustrating how advancements in housing technologies can play a vital role in transforming the industry in important ways. If you have an idea for a future department feature, please send your diagram or photograph, along with a few well-chosen words, to michael.d.blanford@hud.gov.

Upcycling Shipping Containers for Houses

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The views expressed in this article are those of the authors and do not represent the official positions or policies of the Office of Policy Development and Research, the U.S. Department of Housing and Urban Development, or the U.S. Government.

Abstract

The status quo for single-family home construction has been wood frame construction, commonly called "stick framing" because of the dominant use of 2" x 4" dimensional lumber. Wood frame construction has served the home building community well; however, alternative building approaches are beginning to catch on. One alternative—shipping containers—has captured the imagination of architects and homeowners.

Introduction

At the inaugural Innovative Housing Showcase (Showcase), shipping containers were front and center. The Showcase, which was co-hosted by the U.S. Department of Housing and Urban Development (HUD) and the National Association of Home Builders, was held June 1–5, 2019, on the National Mall in Washington, DC. The Showcase enabled tours and first-hand experience of a multitude of innovative, affordable housing solutions for the public. Among the exhibitors were three companies that featured shipping containers: indieDwell, a Boise, ID-based company that builds single-family and multifamily homes for underserved communities (show-unit shown in the following image); Piedmont Green, a Greenville, SC-based company that produces single-family and multifamily homes and new shipping containers for sale to other builders; and MinMax Spaces, which manufactures modular structures but used a shipping container as an exhibit space.

Indiedwell unit-construction on the National Mall for the Innovative Housing Showcase. Photo Credit: Dana Bres

The Status Quo

The typical American home is built onsite at the location of the new home. The construction crew frames the walls using dimensional lumber (typically 2" x 4" or 2" x 6"), which is a time-consuming building process that can leave the home's structure exposed to weather elements for an extended time.

Some disadvantages of the status quo for wood frame construction in homes:

- Low energy efficiency as measured by the R-value, the common measure of insulation effectiveness

- Time—it can take weeks for a home to be placed under a roof
- Skilled framing crew required for installation or construction
- Additional strengthening is necessary for homes built in high wind and seismic areas
- Uses a significant amount of timber resources

History of Shipping Containers

Although the U.S. military used small shipping containers to supply troops during World War II, the first standard shipping container that consumers are familiar with today was not realized until the 1950s. Malcolm McLean, a trucking company owner, is noted as the inventor of the intermodal shipping container (Mayo and Nohria, 2005). McLean submitted a patent for his shipping innovation in 1954 and was awarded a patent in 1958 (McLean, 1954). The first voyage of a ship retrofitted to carry shipping containers was from Newark, NJ to Houston, TX, in 1956 (Levinson, 2006).

Shipping Containers as Homes

Although ad hoc use of shipping containers for temporary housing likely began soon after the advent of shipping containers, their use as housing was formalized in 1987 when Phillip Clark submitted a patent for a "Method for converting one or more steel shipping containers into a habitable building at a building site and the product thereof" (Clark, 1987).

What to Know About Using Shipping Containers to Build a House

Containers are unique structural units. They are engineered to carry large loads using the least material, wherein each part of a container's structure relies on its other parts for strength. For example, a container's side panels—together with the bottom side rail, top side rail, and corner posts—act as a truss, a structural element. Modifying a shipping container changes its structural behavior; therefore, each change must be engineered. Many engineers are not generally familiar with containers' structural properties, so finding the right engineer can be difficult. Homeowners who want to make economical use of containers should do some preliminary planning and keep their designs simple. Here are a few guidelines:

- Use the containers in their original form and limit the amount of side panel removed
- Steer clear of cantilevered[1] designs. These designs are all over the internet, but they are either imaginative unbuilt designs, heavily reinforced constructions, or constructions built in countries with less restrictive building codes and enforcement. Building codes in the United States, especially in wind or seismic zones, require careful design to ensure safety.

[1] A cantilever design is when one shipping container is placed on top of another perpendicularly so that some of the top shipping container is not supported underneath.

- Minimize cladding[2] to maximize value. You may be interested in building with shipping containers because you like the way they look. If so, you are in luck—a container will require little maintenance over the years with the right industrial paint. If you add additional cladding, you are adding expense and maintenance.

- Make sure you can get financing and insurance before you jump in. Conventional mortgage lenders do not have a box to check for this type of construction. This same problem exists for insurers. You will have to look to "surplus lines" for a custom policy. It may not cost more, but it will require more work to get financing and insurance.

Benefits

Shipping containers seem like great choices for homes because of their strength and durability. The same characteristics that make shipping containers ideal for making multiple trips around the globe also support their use as a home building component. Possible benefits of shipping containers over wood framing include:

- Improved environmental performance by a reduction in the use of dimensional lumber and the minimization of waste. The interior frame-out of your container home is not structural[3], therefore, you can increase the space between studs. Smart planning will reduce material usage.

- Improved durability by increasing high-wind resistance. Container side panels are made of steel 1.6mm or more in thickness. This steel strength exceeds that of most exterior cladding products. Because containers are constructed using continuous welds, the overall continuity of their strength exceeds traditional buildings, which are made of individual pieces fastened together.

- Reduced carbon footprint by using used shipping containers. Upcycling used shipping containers lowers your global warming impact (along with other environmental impacts) over wood frame and concrete masonry construction.

Drawbacks

As noted above, the primary benefit of shipping containers is that they can be reused. However, reuse also introduces some possible drawbacks as noted below:

- Used shipping containers may have contained hazardous materials. Because containers are painted steel with treated wood or bamboo floors, however, the chance that they can hold onto any hazardous materials after the original floor is removed and a good scrubbing is conducted is low.

- Used shipping containers may have structural or cosmetic defects. Generally, structural damage is repairable, but unwanted dings and dents are hard to remove. Always inspect the

[2] Cladding is covering used to protect the exterior walls of a house. Typical claddings are made out of vinyl, fiber cement, and brick.

[3] Interior frame-out refers to the construction of interior walls, including those walls that abut the exterior walls of a shipping container. These walls allow for the installation of wiring, insulation, and drywall.

used units you plan to buy—with an engineer if you are worried—to make sure the shipping containers are up to your expectations and do not have unrepairable damage.

- Metal exterior offers poor thermal performance. Thermal bridging[4] can be avoided with proper architectural detailing, however.
- Convincing your local code official that this is a good idea could be a challenge. Most building codes do not prohibit the use of containers, but that does not mean that using them will be easy. Most jurisdictions will require that you provide plans sealed by a licensed architect or engineer before granting a permit. Think of this not as a problem but as an opportunity to engage with a professional who has some experience using shipping containers.

Manufacturers

Although homeowners can build their own shipping container home either by themselves or with an experienced homebuilder or architect, container homes will soon be increasingly available through manufacturers. The manufacturers recognize the strength and efficiency of the ready-made container and can put manufacturing systems in place to produce high-quality, energy-efficient container homes at affordable prices. Many manufacturers can use mass-customization practices to create location- and client-specific versions to satisfy the growing need for affordable housing solutions.

Further Reading

ICC G5-2019, Guideline for the Safe Use of ISO Intermodal Shipping Containers Repurposed as Building and Building Components, International Code Council, 2019.

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Opportunity Zones: A Place-Based Incentive for Investment in Low-Income Communities

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The views expressed in this article are those of the author and do not represent the official positions or policies of the Government National Mortgage Association, the Office of Policy Development and Research, the U.S. Department of Housing and Urban Development, or the U.S. Government.

Abstract

The Tax Cuts and Jobs Act of 2017 (TCJA) created Opportunity Zones. The latest in a long line of place-based initiatives, Opportunity Zones provide three tax benefits for taxpayers with existing capital gains. Opportunity Zones are mostly designated from low-income communities and are the Trump Administration's main locally targeted economic development tool.

Introduction

The Tax Cuts and Jobs Act of 2017[1] included several major revisions of the U.S. tax code. Although the press thoroughly covered changes to marginal tax rates, deduction rules, and corporate rates, at least one section only received its share of attention more recently. This section, 1400Z,[2] created a new place-based tax incentive intended to spur economic development and job creation in distressed communities designated as "Opportunity Zones." Although Opportunity Zones (OZs) are the latest place-based tax incentive, they also represent a sweeping expansion of the approach—both in terms of the potential tax benefits being provided and the huge scale of the geography now covered for reduced income taxes for investors.

Designation

Starting in early 2018, the U.S. Treasury began implementing the new law through a two-part approach. First, the Treasury established a designation process through which state governors would identify specific areas for OZs. Second, the implementation of tax benefits went through a lengthier, multi-stage process that included two rounds of proposed regulations. Although potential investors and fund managers had to work with some uncertainty during this interim period, final regulations were issued in December 2019.[3]

For the designation process, the Treasury first released a list of potentially eligible Census tracts in each state based on the threshold criteria provided for in the statute.[4] State governors would then be responsible for selecting a portion of those eligible tracts to receive the final designation. Eligible census tracts fit one of two categories: (1) tracts meeting the New Markets Tax Credit (NMTC) definition for "low-income communities,"[5] or (2) tracts that are "adjacent to low-income communities" and that also meet additional conditions. In general, the NMTC definition of a low-income community (LIC) is a census tract that has a poverty rate of at least 20 percent or has a

[1] The Tax Cuts and Jobs Act is available at https://www.congress.gov/bill/115th-congress/house-bill/1/text/enr; (see section 1400Z for Opportunity Zones).

[2] Section 1400Z is quite brief and can be read in the U.S. Code at https://uscode.house.gov/view.xhtml?req=granuleid%3AUSC-prelim-title26-chapter1-subchapterZ&saved=%7CZ3JhbnVsZWlkOlVTQy1wcmVsaW0tdGl0bGUyNi1zZWN0aW9uMTQwMFotMg%3D%3D%7C%7C%7C0%7Cfalse%7Cprelim&edition=prelim.

[3] One comprehensive resource on Opportunity Zone eligibility, designation, and mapping can be found on the CDFI Fund website at https://www.cdfifund.gov/Pages/Opportunity-Zones.aspx.

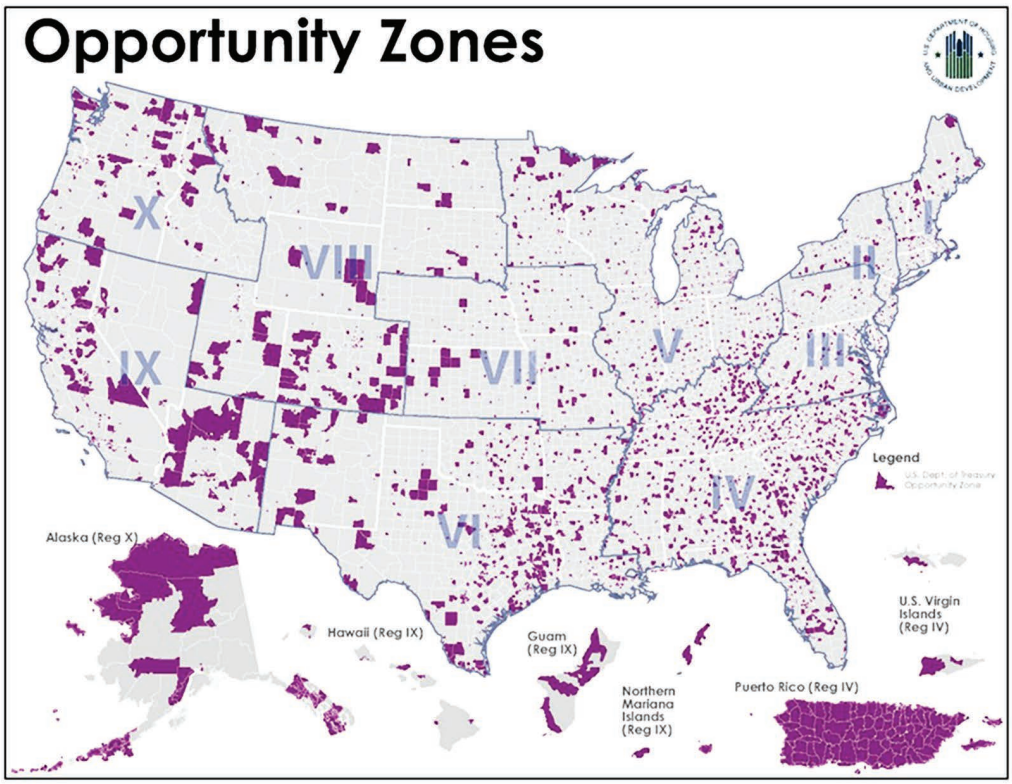
[4] IRS Notice 2018–48, "Designated Qualified Opportunity Zones under Internal Revenue Code § 1400Z–2," (July 2018). Available at https://www.irs.gov/pub/irs-drop/n-18-48.pdf.

[5] The NMTC definition, in section 45D(e) of the tax code, provides:
(e) Low-income community
For purposes of this section—
(1) In general, the term "low-income community" means any population census tract if—
(A) the poverty rate for such tract is at least 20 percent, or
(B)
(i) in the case of a tract not located within a metropolitan area, the median family income for such tract does not exceed 80 percent of statewide median family income, or
(ii) in the case of a tract located within a metropolitan area, the median family income for such tract does not exceed 80 percent of the greater of statewide median family income or the metropolitan area median family income.
Note some additional criteria are for limited exceptional cases in subsequent paragraphs (see (e)(2) - (5)).
Available at https://www.law.cornell.edu/uscode/text/26/45D.

median family income of 80 percent or less of its state or metropolitan area median income. Under the second part of the OZ definition, tracts contiguous to LICs, with family incomes less than 125 percent of the adjoining LIC, would also be eligible for designation. See exhibit 1 for the locations of all OZs.

Exhibit 1

Locations of Opportunity Zones in the United States



Source: HUD

Governors[6] were able to designate 25 percent of the eligible census tracts in their states as OZs. No more than 5 percent could be contiguous OZs, and a contiguous OZ could only be designated if the LIC that it touches is also designated (exhibit 2). An additional provision designated all LIC tracts in Puerto Rico as OZs; in effect, that provision means that nearly every tract in Puerto Rico is an OZ, due to high poverty rates. In total, more than 8,700 Census tracts were designated as OZs.[7] Nearly 32,000 LIC tracts were eligible for designation, and an additional 10,000 contiguous

[6] In this article, the word "governor" includes the governors of all states, the mayor of the District of Columbia, and the executives of every U.S. territory. In terms of the designation process, states (and territories and Washington, DC) that had fewer than 100 eligible tracts could still designate up to 25 tracts from the eligible list.

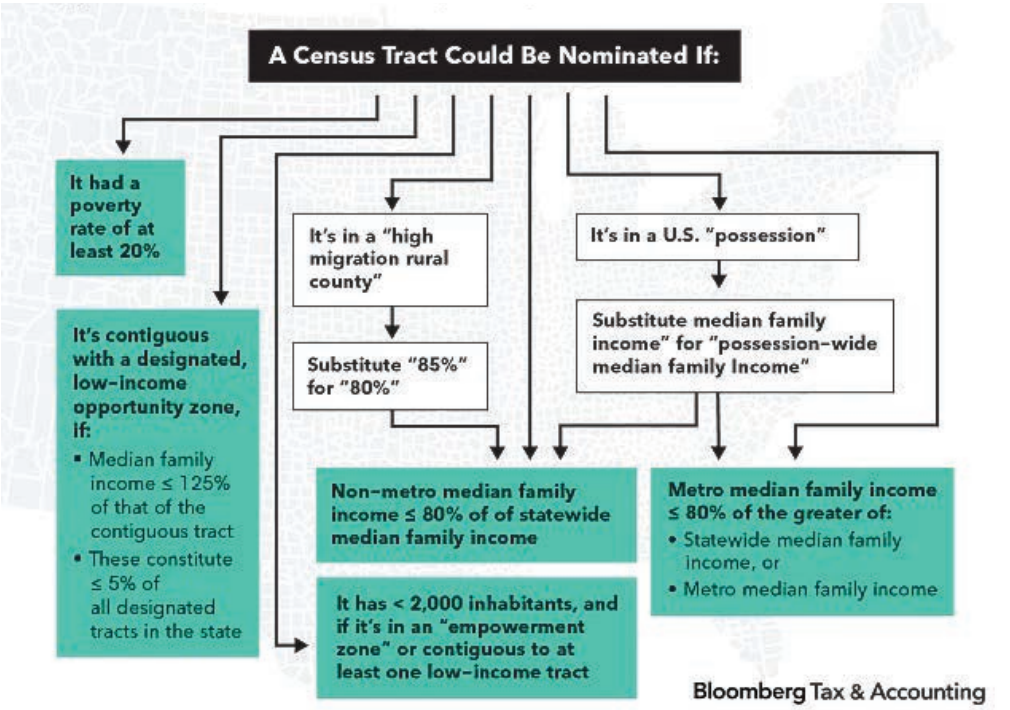
In addition to several notices identifying lists of eligible census tracts, the IRS provided guidance to governors on the process for designating census tracts as Qualified Opportunity Zones (QOZs) in Revenue Procedure 2018-16, available at https://www.irs.gov/pub/irs-drop/rp-18-16.pdf.

[7] To see a map, consult https://opportunityzones.hud.gov/resources/map.

communities met the criteria, but most—more than 95 percent—of OZs are LIC tracts. These numbers fit with the general requirements laid out in the designation procedure that around 25 percent of eligible tracts could be designated, and 5 percent could be contiguous communities.

Exhibit 2

Opportunity Zone Tract Eligibility Criteria



Source: Bloomberg Tax, https://news.bloombergtax.com/daily-tax-report/2020-census-could-expand-opportunity-zones-chosen-for-tax-breaks

Regulations

The Treasury issued final regulations implementing the investment and tax benefit provisions for OZs in December 2019 ("Opportunity Zones Resources," n.d.).[8]

The final regulations implement a number of key provisions from the Tax Cuts and Jobs Act. Under the law, an individual taxpayer cannot simply claim the various benefits and incentives. Instead, to be eligible, all investments have to be made through a business vehicle that meets various criteria provided in the law. The investment vehicle is called a "Qualified Opportunity

[8] The Opportunity Zone Final Regulation, with additional background materials, is available at https://www.irs.gov/newsroom/irs-and-treasury-finalize-opportunity-zone-guidance.
An FAQ provides additional information: FAQ from the IRS https://www.irs.gov/newsroom/opportunity-zones-frequently-asked-questions.
For the proposed rules, see:
October 2018 Proposed Rule: https://www.regulations.gov/document?D=IRS-2018-0029-0001
May 2019 Proposed Rule: https://www.regulations.gov/document?D=IRS-2019-0022-0001

Fund" (QOF)—a partnership or corporation that invests at least 90 percent of its assets in an OZ property. That property can be stock, a partnership interest, business property, or business. Some issues were rather thorny, such as the definition of an OZ business. It is easy to imagine two possible extremes: requiring at least $1 of revenue in an OZ to qualify or requiring 100 percent of revenue in an OZ to qualify. Neither one is a good definition; the first confers status on businesses with no real connection to an OZ other than a token transaction or a PO box, and the second eliminates the possibility of mail order fulfillment or growth outside OZ boundaries. After proposing a minimum standard of 90 percent of income, in the end, the IRS settled on three safe harbors around 50 percent of business occurring in an OZ, based on either an hours, payment, or tangible property test. Some simpler issues were quickly settled. For example, a business cannot fall into prohibited categories laid out elsewhere in the tax code, including golf courses, country clubs, massage parlors, tanning facilities, racetracks, casinos, or alcohol distributors. If the QOF chooses to invest in a business property, that property only qualifies as an OZ property if, in addition to its physical location in an OZ, the investors substantially improve the property to the point of doubling its basis.[9]

Tax Incentives

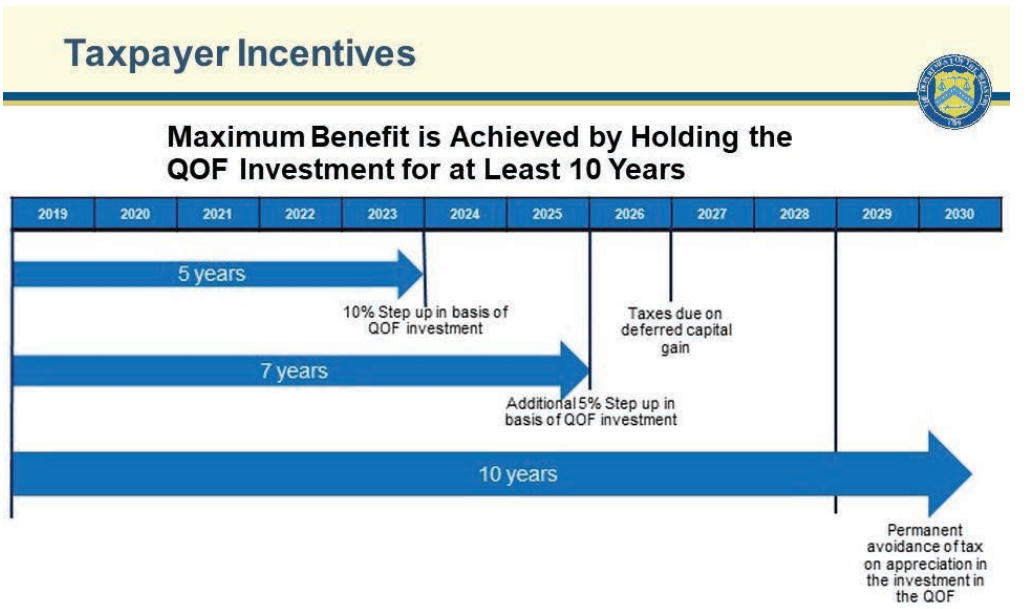
Investors who follow these rules are eligible for some very attractive tax incentives, as illustrated in exhibit 3. Three main categories of tax incentives are available: a 0-percent tax on new gains, deferred taxation, and a basis boost. First, the 0-percent tax on new gains; if an investor holds a stake in a QOF for 10 years, any capital gains that have accrued to the QOF investment are taxed at a federal rate of 0 percent. A capital gain is defined as income from the sale of property, including stock, business property, and financial instruments.[10] Capital gains are distinguished from ordinary income, like wages, rents, dividends, and interest. Worth noting is that the IRS has ruled that the QOFs may exist through 2047 to prevent a mass liquidation event at the expiration of OZ designation in 10 years. Many states also match their state capital gains tax to federal policy, so the state in those cases would also tax the gains at 0 percent.

[9] In short, the cost basis is the value of the investment made. If an investor buys a piece of property for $25, their basis is $25. If they then sink an additional $50 into improvements on the building, their basis increases to $75. This is a simple example and not intended to be representative of all of the complex ways in which real estate investment occurs in this country. For a brief explanation, see https://www.hrblock.com/tax-center/income/real-estate/how-to-calculate-cost-basis-for-real-estate/.

[10] The tax code provision defining the types of assets whose sale is eligible for reduced "capital gains" tax is provided in 26 U.S. Code § 1221. See https://www.law.cornell.edu/uscode/text/26/1221.

Exhibit 3

Taxpayer Incentives: Three Tax Changes



Note: Assumes investment on January 1, 2019.
QOF = Qualified Opportunity Fund.
Source: https://opportunityzones.hud.gov/investors

A second type of tax incentive is deferred taxation. If an investor places capital gains realized elsewhere into a QOF within 180 days of realization, the tax on those gains is deferred and potentially lowered. Investors would not have to pay federal capital gains tax on those gains until either the tax year in which they sell their stake in a QOF or the 2026 tax year, whichever comes first.

The third type of tax incentive is the basis boost: if the gains are held in the QOF for 5 years, the basis is increased[11] by 10 percent and an additional 5 percent if held in the QOF for 7 years.

For a brief numerical example of all three forms of the OZ incentive, imagine a taxpayer has an unrealized gain of $1 million in the form of an original investment of $4 million that has turned into $5 million on paper over time. Imagine further that the investor sells that holding in late 2019 and places $1 million[12] into a QOF the next month; then the investor keeps it in a QOF until 2036, where it turns into $3 million. The investor will owe capital gains tax on $850,000 from the original $1 million gain in tax year 2026, because 15 percent is written off for holding for 7 years.[13] The basis boost reduces the taxable amount from $1 million to $850,000, and the deferral means that this tax is due in 2026.

[11] This is equivalent to reducing the tax paid by the same percentage, in the case of a flat capital gains tax rate.

[12] It is important to note that only the gain is eligible for the OZ tax benefits; the original basis may be invested in a QOF but will not receive the 0-percent tax rate or the basis boost. The deferral is irrelevant in the case of the original basis. See sec. 1400Z-2(e)(1)(B) of the Internal Revenue Code.

[13] At this point, because fewer than 7 years remain between now and 2026, if the investor were to act today, they would only be eligible for a 10-percent basis step-up for holding for at least 5 years by 2026.

On the gain of $2 million, realized in 2036, the taxpayer will owe 0-percent capital gains tax, or $0. This is the 0-percent tax on new gains.

As a further incentive—but also a further complicating matter for program analysts—many states and localities have supplemented OZ federal tax incentives with incentives or spending of their own. Federal agencies, including HUD, under the guidance of the White House Opportunity and Revitalization Council, are also revising regulations and agency spending to support the mission of seeking positive economic outcomes in OZs.

Considerations for Evaluating Opportunity Zones

The stated purpose of OZ supporters in think tanks and in Congress is to improve economic outcomes for LICs.[14] At this stage—not even 2 years into the existence of the incentive and before nearly any investment has taken place—it is impossible to say what the outcomes will be. This country and others have a history of place-based incentives, with mostly inconclusive results. For example, Empowerment Zones from the mid-1990s to the mid-2000s combined federal grant spending with tax incentives, mostly on wages and hiring. One major shortcoming of evaluations of Empowerment Zones is data availability. Some studies rely on the 1990, 2000, and 2010 Censuses, although the incentive dates do not align nicely with these points. Additionally, data may not exist for the exact geographic area that the Empowerment Zones covered. Finally, Empowerment Zones were not chosen at random; both the cities and the locations within cities were chosen for a reason, which may not be apparent to an outside researcher.[15]

Researchers may have some advantages evaluating OZs rather than past place-based incentives; however, they also face many of the same challenges. In some respects, researchers may have a more difficult time in attempting to assess the effectiveness and cost-efficiency of OZs.

Because OZs are based on census tracts, the American Community Survey (ACS) will be a source of rich economic data, collected down to the census tract level, for future research. It should be noted, however, that, although ACS data are updated each year, the census tract level data are based on aggregations of rolling 5-year samples. Thus, ACS census tract data will not be available for exact point-in-time snapshots that would allow for straightforward "before and after" comparisons to estimate the impact of the tax incentives.

Challenges will certainly remain for analysts. OZs were also not chosen at random; governors were generally able to select 25 percent of their state's eligible tracts for designation. That means that usually 75 percent of tracts were not selected. Each governor likely emphasized different criteria in nominating OZs; some may have chosen already improving areas, whereas others may have chosen the most impoverished of the eligible tracts. The use of different criteria will mean that zone designation may be highly correlated with other factors, which will confound simplistic attempts at evaluation.

[14] For an example of a think tank advocating expansion of the geographic-targeted tax cuts and incentives, see "Unlocking Private Capital to Facilitate Economic Growth in Distressed Areas." 2015. Washington, DC: Economic Innovation Group. https://eig.org/wp-content/uploads/2015/04/Unlocking-Private-Capital-to-Facilitate-Growth.pdf.

[15] For more on place-based incentives, refer to HUD's Office of Policy Development and Research periodical Evidence Matters, Spring/Summer 2019 article on Place-Based Incentives, available at https://www.huduser.gov/portal/periodicals/em/SpringSummer19/index.html.

A common program evaluation technique is the use of a "counterfactual." For example, one may attempt to answer what would have happened without the various tax incentives by comparing actual outcomes for the OZs with the counterfactual, such as similarly situated census tracts that did not receive the OZ designation. That answer is also impossible to determine with certainty because we cannot use more sophisticated evaluation methods—such as random assignment—to see the effect of OZs. Knowing whether any investment in an OZ was merely shifted from outside or represents new investment will be difficult. In recent interviews, OZ boosters and critics alike agree that the initial round of OZ investment activity would have happened anyway. In the coming years, however, outcomes for OZ residents are also difficult to determine. For example, researchers may look at increased median incomes in an area, but that may represent new residents moving in and old residents moving out. Median incomes falling in tracts adjacent to OZs and median incomes rising in OZs might mean that OZs boost incomes, or it might mean that we have spent our tax incentive dollars shifting people between tracts, with no changes in aggregate income.

Finally, one remaining challenge for OZ researchers is the availability of administrative data. The IRS has released Form-8996 to collect the amount of investment by tract from every Opportunity Fund. It is not clear how easy it will be for researchers to access this data. Without this information, researchers will only be able to look at the OZ designation itself as a potential cause of change. The amount of investment within an OZ would be more interesting to explore, given that researchers could compare a range of outcomes against a range of investment dollar amounts; perhaps some OZs will receive a lot of investment, and others none or very little. It would be odd to expect outcomes to be similar in two such OZs. As stated, however, it is unclear to what extent data on actual investment amounts will be made available for research and evaluation efforts.

It is also notable what data are not being collected. The U.S. Impact Investing Alliance released an "Opportunity Zones Reporting Framework" (Bernstein and Hassett, 2015), a guideline that recommended Opportunity Funds to collect information on investment outcomes—like jobs, North American Industry Classification System industry codes, square footage of developments, and information on the investing fund. Some impact-investing advocates, fiscal conservatives, and advocates for low-income communities are interested in data collection in more categories so that the impact per dollar invested, or per dollar of tax reduced, can be computed.

Other challenges for researchers, as mentioned previously, are the overlapping incentives and tax benefits states and localities provide. At this time, no known complete database of state and local complementary incentives within OZs for community use exists. HUD's recently launched Opportunity Zones website contains a link to every state's OZ website ("Local Leaders," n.d.). It is not always clear whether a state has made additional incentives available, but did not list them on their website, or if they have not created any such additional incentives.

Potential Areas for Research and Evaluation

It will be important to track outcomes for original and new OZ residents. One excellent way to do this would be to use the IRS internal data file of tax returns. Researchers looking at anonymized cross-sections from year to year will never know whether the people in the cross-section remained

the same. With IRS tax return data, the IRS can identify where low-income people who live in OZs in 2019 might live in 2026 and how their incomes would change. Other panel studies will be useful so long as an address can be definitively mapped to a particular tract.

It is likely that one common way to invest in OZs will be with real estate. A previously distressed community may have many possible outcomes for increased real estate economic activity. One outcome is rapid gentrification and the displacement of long-time residents. Another outcome is a greatly improved housing stock with mixed-income tenants, and previous area residents financially comfortably kept in place with a mix of policy actions. HUD is greatly interested in knowing how this will turn out, but of course, will also be actively intervening in these housing markets; that intervention may distort results.

Previous place-based tax incentives offered direct wage or hiring tax credits, but OZs have no wage or labor component. The supporters of the TCJA legislation hoped that it would boost incomes in OZs. There are a variety of research questions around the idea of using a capital tax cut to improve outcomes for labor.

Acknowledgments

The author would like to thank Mark Shroder, Alastair McFarlane, Alfonso Costa, Jr., the HUD Opportunity Zone Work Group, and the staff of Sage Computing for many helpful discussions about Opportunity Zones and this publication. The author also thanks David Hardiman for several suggestions and improvements given through many rounds of review.

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A Comprehensive Look at Housing Market Conditions Across America's Cities

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Brenna Rivett
James Brooks
Christiana K. McFarland
National League of Cities

Editor's Note

David Hardiman
Editor

In this article, the authors present an example of using economic, demographic, and housing-market data to identify common socio-economic characteristics from among a dataset of 754 U.S. cities. The authors then match six categories of similar market types that they selected to a range of potential policy solutions of the type that local officials might consider. The paper presents one possible approach to developing a policy matrix, comparing market characteristics to potentially appropriate affordable housing and economic development strategies based on local needs. The approach here may help answer the question, "how can city governments start to approach the affordable housing problems of their residents?"

The paper is published here, in the Policy Briefs section of Cityscape, as a policy-oriented paper matching data to potential housing strategies or responses, and not as a peer reviewed research study.

It is an example of one approach to matching market types to a range of potential policy solutions. Other useful sources of potential policy actions, include the case studies and best practices on HUDUSER.GOV, for instance on The Edge, as well as HUD's Regulatory Barriers Clearinghouse, also maintained by PD&R at https://www.huduser.gov/portal/rbc/home.html.

The article is accompanied by a dataset compiled by the authors, with the complete set of variables and measures that are referenced in the article text. The complete table presents much more detail on the data used by the authors in sorting various city market types, based on similar characteristics selected by the authors. The dataset can be sorted based on alternative criteria

by readers who may find it useful to see how particular cities in different markets compare to each other, or to apply their own criteria based on their own alternative set of ranking priorities. The data set can be accessed here, HUDuser.gov/portal/sites/default/files/xls/CSAR_HousingMarketConditions_Appendix_4.xls.

Also, please note that the authors are all staff at the National League of Cities, and the paper does not necessarily represent the views of HUD.

Abstract

The narrative of the housing-in-crisis issue focuses on the lack of supply of low- and middle-income housing as the source of the problem. In some communities, however, factors such as slow wage growth, lack of transit options, and lack of access to credit play a larger role in explaining why families cannot afford housing with access to good jobs. To effectively address housing challenges and apply the right mix of policy and regulatory solutions, local leaders must first understand the unique aspects of their housing markets. This research examines the interactions between housing market characteristics—including demographic, economic, and housing supply factors—across 754 U.S. cities with populations greater than 50,000 to help guide solutions. The analysis finds that cities tend to cluster together based on how well the number of approved building permits meets the needs of residents.

Introduction

America is currently experiencing a crisis in housing. Residents increasingly have to pay more for housing while wages remain largely stagnant; those conditions make safe, high-quality, affordable housing harder to find (Pew Charitable Trusts, 2018; U.S. Census Bureau, n.d.a.). This dominant housing crisis narrative focuses on the lack of supply of low- and middle-income housing as the source of the problem. Slow wage growth, lack of transit options, and lack of access to credit are significant factors in some communities to explain why families cannot afford housing with access to good jobs.

Essentially, the challenge of what housing is available and where it is available is exacerbated by who can afford the market price. The narrative of housing in crisis goes beyond just an overall lack of low- and middle-income housing; it suggests a larger issue of demand that far outpaces supply when it comes to residents' ability to afford quality housing. Ultimately, we need a better understanding of not just housing supply versus demand but how this dichotomy manifests across America's cities, which are experiencing demographic and economic growth at differing rates. Specifically, we need to understand that America is facing a housing crisis and why that is (for example, slow wage growth, lack of good job opportunities, shortage of public transit options, and insufficient mix of available single-family and multifamily homes).

Although prior research has attempted to tackle those challenges, it has been largely locally focused, failing to provide city leaders with a deeper understanding of housing market conditions both within their regions and across America. City leaders need this deeper understanding to effectively implement policies that are likely to be successful in their communities. They can create those policies only by understanding the factors that have contributed to the national housing crisis and realizing the solutions that can enhance their housing markets.

This research examines the interactions among housing market characteristics—including demographic, economic, and housing supply factors—across 754 U.S. cities with populations greater than 50,000 to help guide solutions. To capture how those factors interact with one another, we conducted a cluster analysis. We are specifically interested in answering two questions: (1) given that not all local housing markets behave the same, how can we characterize cities in a way that effectively captures the most influential factors; and (2) how can we use these more nuanced groupings of city housing markets to identify preferable or advantageous policy tools?

The analysis finds that cities tend to cluster together based on how well a city issues permits for single-family and multifamily housing to meet the income levels and job growth opportunities of its residents. Although some city clusters prioritize multifamily housing to meet the demands of their predominately low-income residents, others prioritize single-family housing to meet the demands of their high-income residents. Also, whereas some city clusters are building relatively high levels of both, others are not. Those factors together produced six types of local housing markets.

- **High-Opportunity Cities:** Cities in this cluster tend to exhibit high median incomes and job growth. They approve low levels of single-family and average levels of multifamily building permits. In these cities, the overall stock of both single-family and multifamily housing does not keep pace with resident needs. Without policy action, these cities may fall short of producing the appropriate quantity and mix of dwellings to match their high job growth.

- **Growing Cities:** Cities in this cluster tend to exhibit average median income and job growth. They approve high levels of both single-family and multifamily building permits. They have growing populations of millennials and college-educated individuals and growing job opportunities within closer-than-average proximity. These cities could therefore use more multifamily units, such as duplexes, triplexes, or fourplexes. Without policy action, these cities may not be able to sustain their current state of net in-migration.

- **Rent-Burdened Cities:** Cities in this cluster tend to exhibit low median income and job growth. They approve the highest number of single-family and multifamily building permits of all the clusters. With low levels of college education and relatively high levels of rent burden, these cities should prioritize affordable multifamily housing to meet the demands of their predominately low-income populations. Without policy action, low-income residents in cities in this cluster will likely continue to experience rent burden or be priced out of the cities altogether.

- **Multifamily Deficit Cities:** Cities in this cluster tend to exhibit average median income and job growth. They approve average levels of single-family building permits but low levels of

multifamily building permits. These cities should consider whether the number of multifamily housing units being approved is sufficient to meet the rising demand of their middle-income residents. Without policy action, these cities may not be able to sustain their current state of net in-migration.

- **Wealth Pocket Cities:** Cities in this cluster tend to exhibit the highest median income and job growth of all the clusters. They approve high levels of single-family building permits but low levels of multifamily building permits. Interestingly, these cities also have the highest gender income gap. Without policy action, residents in these cities are likely to continue experiencing disparities in income and access to high-quality, affordable housing.

- **Transit-Desiring Cities:** Cities in this cluster tend to exhibit the lowest median income and job growth of all the clusters. They approve the lowest levels of single-family building permits and average levels of multifamily building permits. Given that median incomes are lower in these cities, increasing access to public transit will be extremely important for ensuring that residents can access jobs. Without policy action, residents in these cities may not be able to experience the economic mobility that would be gained through access to public transportation.

Regardless of the cluster, all cities have room to improve in deploying the right mix of housing and economic development strategies that will influence the affordability of their housing markets. When a city permits a number of single-family and multifamily housing units that do not meet the income levels and job growth opportunities of its residents, the city has a variety of policy levers to pull, as explained below. This report provides city officials with a unique, comprehensive perspective of their housing markets and a practical policy framework to achieve a healthy housing market that is better aligned with resident needs.

A Framework for Understanding Your Housing Market

The U.S. Department of Housing and Urban Development (HUD) provides a useful starting point for understanding the conditions that make up a given housing market (HUD, n.d.). In considering housing market needs, HUD accounts for three key factors:[1]

1. **Demographic characteristics,** including population growth, especially among educated individuals and families with high incomes; the prevalence of owner- and renter-occupied units; and incidences of rent and mortgage burden (U.S. Census Bureau, n.d.a.);

2. **Economic characteristics,** including nonfarm job growth and access to public transit; and

3. **Housing supply characteristics,** including the makeup of housing stock and the number of single-family and multifamily housing units; the prevalence of new homes and rental units permitted for construction; and home sales growth (U.S. Census Bureau, n.d.b.; Zillow, n.d.).

[1] Note: We also considered whether to include the prevalence of higher education institutions, presence of military personnel, area median income, and mortgage delinquency but, due to high variability across cities, did not include them.

The ability of residents to access affordable housing, whether renting or buying, is in large part determined by their demographic characteristics, such as income, race, age, and educational attainment. The gap between what residents are being asked to pay for homes and what they can afford is widening (Pew Charitable Trusts, 2018). The circumstance known as "cost burdened"—spending more than 30 percent of income on owned or rented housing units—affects workers everywhere (Herbert, Hermann, and McCue, 2018). One study found the rate of cost-burdened households, in particular non-White households, increased significantly between 2001 and 2015 (Pew Charitable Trusts, 2018).

Access to affordable housing is also determined by key economic factors, such as job growth, proximity to jobs, and access to transportation. Millennials, in particular, have a reported unemployment rate twice the national average and, as a result, have been more likely to move back into their parents' homes. This finding suggests that without good employment opportunities, millennial residents cannot afford stable housing (Thompson, 2012). In addition, communities with access to transportation, resources, and services have been shown to support strong housing markets that lead to improved prosperity and well-being among household members (Lee, Jordan, and Horsley, 2015). Access to transit means a reduction in transportation costs for the average resident, which is especially important for those facing economic hardship (Joint Center for Housing Studies of Harvard University, 2018).

Finally, access to affordable housing is determined by the mix of single-family and multifamily housing permits a city issues and the sale of those housing units. Because housing construction costs have not changed much over time—in fact, between 1980 and today, virtually no net efficiency savings have occurred in construction costs—developers are not able to pass down lower costs in the form of market prices to residents (Barbosa et al., 2017; RSMeans data, n.d.). One study found that during the recent housing crisis, housing sales values were more resilient for properties that had easy access to rail transit once those housing units came on the market (Welch, Gehrke, and Farber, 2018).

Each of those factors represents influences on the supply and demand of housing in a given place. When taken together, they interact in complex ways that are important for policymakers to consider when creating city-level housing policies. This analysis groups cities with similar characteristics together and helps us tell a new story of the current housing crisis.

Types of Housing Markets

Overview

To capture how demographic, economic, and housing supply factors interact with one another, we conducted a cluster analysis, which allows us to define housing market types by categorizing cities into mutually exclusive groups. We are specifically interested in two questions: (1) given that not all local housing markets behave the same, how can we characterize cities in a way that effectively captures the most influential factors; and (2) how can we use these more nuanced groupings of city housing markets to identify preferable or advantageous policy tools? Six types of local housing markets emerged from our cluster analysis (exhibits 1; 2a-f). For the second question, we focused

on whether each city's permitting of single-family and multifamily housing meets the income levels and job growth opportunities of its residents. Alignment of those factors, or lack thereof, determines the most appropriate policy levers (exhibit 3).

Exhibit 1

Demographic, Economic, and Housing Supply Features, by Cluster

	Cities in Sample (%)	Demographic and Economic Factors	Housing Supply
High-Opportunity Cities	13	High median income; High job growth	Low number of single-family permitting; Average number of multifamily permitting
Growing Cities	12	Average median income; Average job growth	High number of single-family permitting; High number of multifamily permitting
Rent-Burdened Cities	27	Low median income; Low job growth	Highest number of single-family permitting; Highest number of multifamily permitting
Multifamily Deficit Cities	12	Average median income; Average job growth	Average number of single-family permitting; Low number of multifamily permitting
Wealth Pocket Cities	7	Highest median income; Highest job growth	High number of single-family permitting; Low number of multifamily permitting
Transit-Desiring Cities	29	Lowest median income; Lowest job growth	Lowest number of single-family permitting; Average number of multifamily permitting

Notes: For a full list of cities in each cluster, see HUDuser.gov/portal/sites/default/files/xls/CSAR_HousingMarketConditions_Appendix_4.xls. To understand what housing-specific policies are available in each state, see the National League of Cities' report, Local Tools to Address Housing Affordability: A State-by-State Analysis.

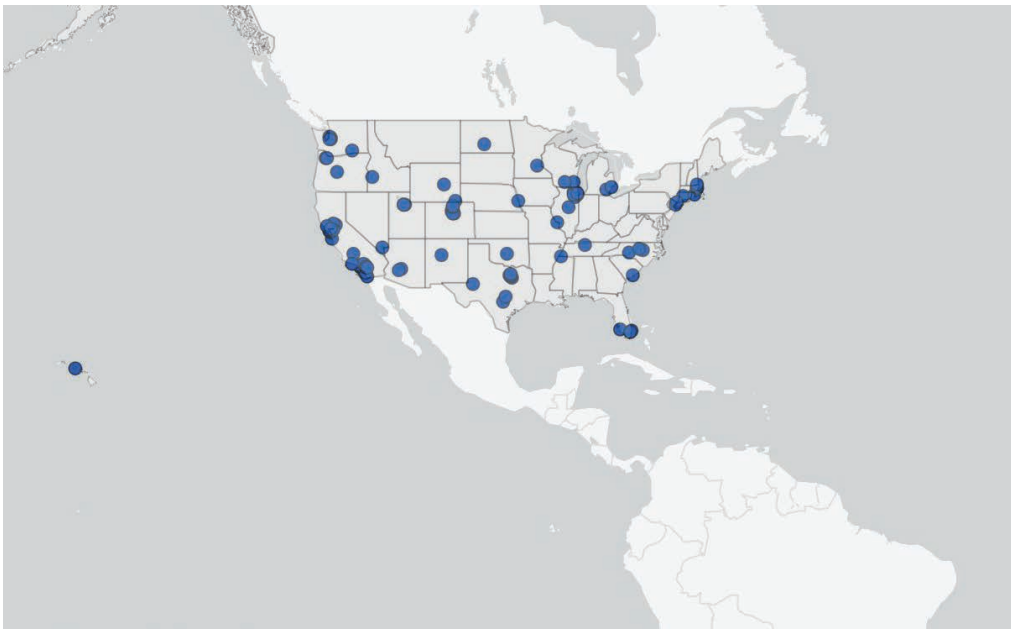
Exhibit 2a

Geographic Distribution of High-Opportunity Cities

Interactive maps with corresponding data points can be accessed here: https://storymaps.arcgis.com/stories/72b97be3784c4fef8a85938a6e7d1985

Exhibit 2b

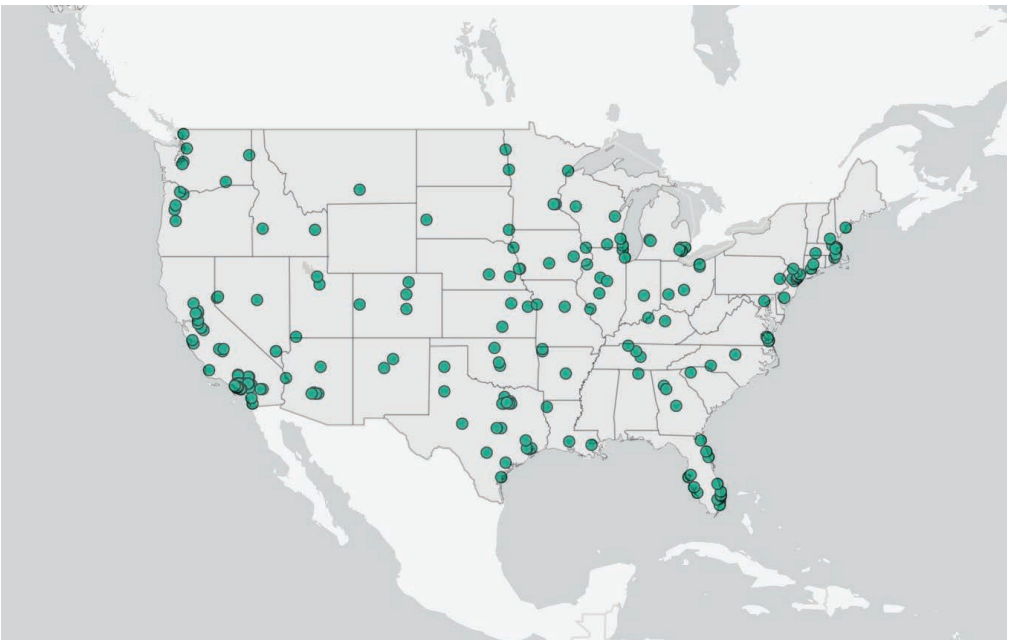
Geographic Distribution of Growing Cities



Interactive maps with corresponding data points can be accessed here: https://storymaps.arcgis.com/stories/72b97be3784c4fef8a85938a6e7d1985

Exhibit 2c

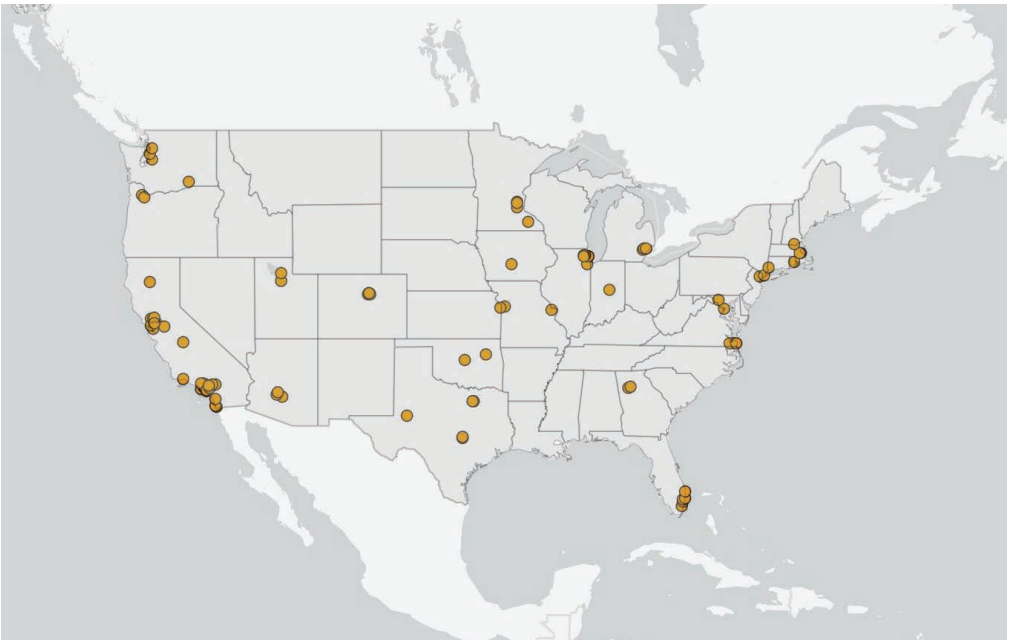
Geographic Distribution of Rent-Burdened Cities



Interactive maps with corresponding data points can be accessed here: https://storymaps.arcgis.com/stories/72b97be3784c4fef8a85938a6e7d1985

Exhibit 2d

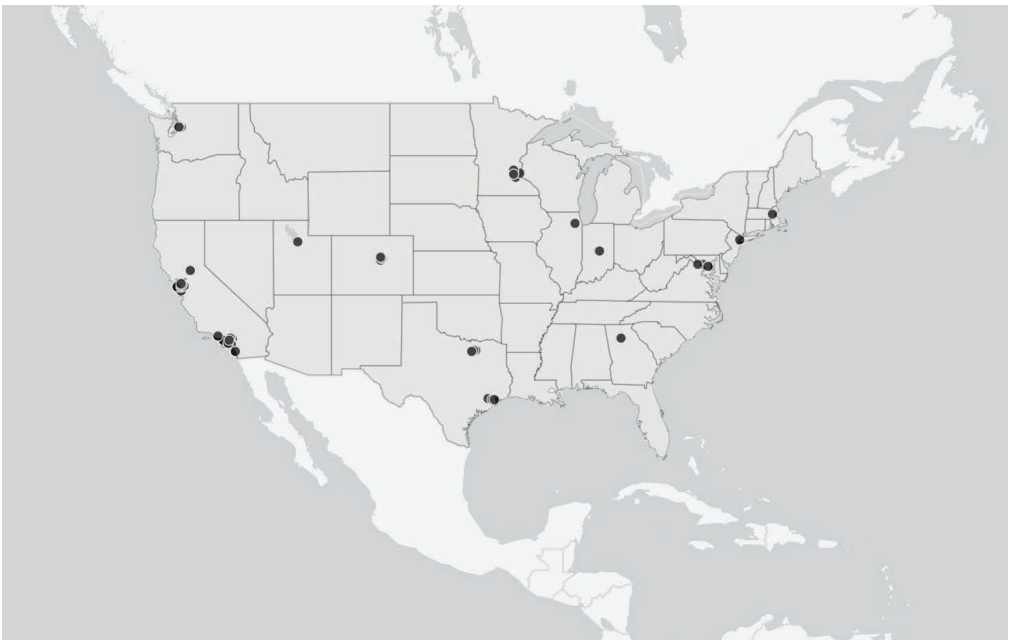
Geographic Distribution of Multifamily Deficit Cities



Interactive maps with corresponding data points can be accessed here: https://storymaps.arcgis.com/stories/72b97be3784c4fef8a85938a6e7d1985

Exhibit 2e

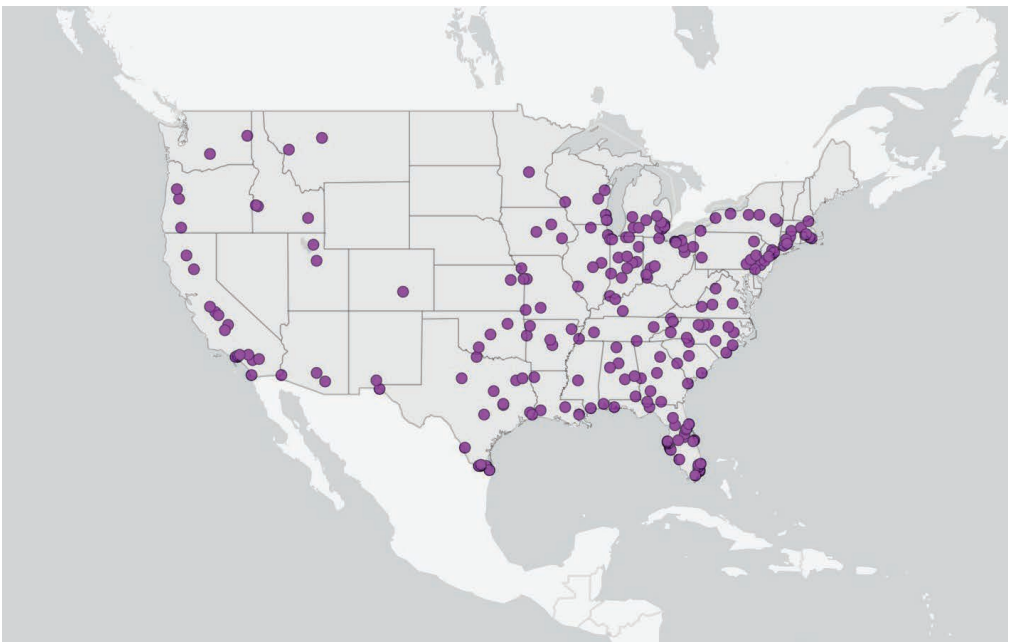
Geographic Distribution of Wealth Pocket Cities



Interactive maps with corresponding data points can be accessed here: https://storymaps.arcgis.com/stories/72b97be3784c4fef8a85938a6e7d1985

Exhibit 2f

Geographic Distribution of Transit-Desiring Cities



Interactive maps with corresponding data points can be accessed here: https://storymaps.arcgis.com/stories/72b97be3784c4fef8a85938a6e7d1985

Exhibit 3

Policy Recommendations, by Cluster (1 of 3)

	Policy Recommendation	Details
High-Opportunity Cities	Increase densities per acre through single-family attached units	Cease giving zoning preferences to single-family detached homes, and allow a mix of other housing types, including townhomes, duplexes, triplexes, fourplexes, and accessory dwelling units—all of which increase the population density of a geographic location.
	Streamline permitting and development fees	Increase the transparency of the steps and justifications in the permitting process, and include time limits for issuing permits; this action will tie fees to actual costs of new or updated infrastructure.
	Maintain public housing	Decrease the backlog of overdue maintenance on existing public housing units and complexes, and secure new financial resources to build more public housing either as part of existing footprints or on new sites.
	Offer tax increment financing for affordable rental housing	Make use of the tax code to incentivize rental housing development by refunding or diverting a portion of property taxes to help finance elements of the project, such as infrastructure.
Growing Cities	Launch or increase funding to a housing trust fund	Make use of own-source revenues to create a dedicated resource for increasing expenditures on priority housing initiatives, such as rental assistance or first-time homebuyer programs.
	Increase multifamily building permits for young and low-income residents	To support increasing population and job growth, permit higher numbers of small and large multifamily rental buildings, and focus less on homeownership as a priority.
	Use linkage or impact fees	Payments to a city (often to a housing trust fund) made by a developer that are intended to link the production of commercial development to the production of affordable housing, these fees often act as a catalyst to secure additional financial commitments.
	Build micro units and tiny homes	Increase access to housing by building units with smaller square footage or shared common space that are less costly and can be completed in a shorter timeframe.
	Give tax abatements and exemptions for affordable housing	Provide a reduction in the absolute ad valorem (assessed value) property tax to a developer as a condition to incentivize a particular type of development, usually housing units that can be rented for rates below the market rate.
Rent-Burdened Cities	Implement or increase rental assistance	Develop or expand financial assistance for households experiencing financial hardship to cover delinquent rent, a security deposit, first month's rent, or a utility bill.
	Offer tax-exempt municipal bonds	To increase the supply of affordable housing in their community, local governments should use their bonding authority to assist with financing affordable housing.
	Reduce barriers to homeownership	Create access to homeownership by providing down payment assistance and shared appreciation mortgages.
	Support minimum wage increases	Local governments should support a resolution or ordinance increasing the minimum wage to a rate that would allow low- and moderate-income households to rent or purchase a safe, high-quality, affordable housing unit.

Exhibit 3

Policy Recommendations, by Cluster (2 of 3)

	Policy Recommendation	Details
Rent-Burdened Cities, Continued	Invest in shared equity models and community land trusts	Develop or expand on the pipeline of permanently affordable housing units in a community through investment in shared-equity homeownership, such as community land trusts, shared-equity cooperatives, limited-equity resident-owned communities, and deed-restricted or below-market-rate programs.
	Prioritize multifamily permitting	Ensure that a sizable number of both affordable housing and middle-income housing units are available by placing an emphasis on multifamily developments over single-family developments that do not yield a variety of housing units (duplexes, triplexes, fourplexes, and/or single-family attached) for the community.
	Use landlord incentive funds	Implement a program to increase the number of landlords that accept housing choice vouchers to cover administrative fees and reimburse for losses and repairs.
Multifamily Deficit Cities	Provide density bonuses for multifamily housing	To achieve both goals of ensuring new housing development and increasing affordable housing, cities will award a developer rights to increase the number of housing units in a planned development to a level sufficiently high as to allow for a fixed percentage of those units (often 10 to 30 percent) to have rent prices set below market rates suitable for persons whose income is below 80 percent of area median income.
	Streamline permitting and development fees	Increase the transparency of the steps and justifications in the permitting process, and include time limits for issuing permits; this action will tie fees to actual costs of new or updated infrastructure.
	Approve more multifamily building permits tied to transit nodes	Prioritize multifamily developments that link housing and transit options (light rail, commuter rail, streetcar, and bike lanes) to give residents access to schools, employment hubs, grocery stores, and healthcare facilities.
Wealth Pocket Cities	Offer tax-exempt municipal bonds	To increase the supply of affordable housing in their community, local governments should use their bonding authority to assist with financing affordable housing.
	Advance legal assistance for at-risk renters and eviction cases	To equalize the disadvantages that tenants have in relation to landlords in an eviction process, provide legal counsel to tenants as part of an eviction proceeding to ensure due process of the laws.
	Strengthen "just cause" eviction policies	Ensure protections against arbitrary evictions, including adequate warning about eviction proceedings and clear definitions about the legal grounds to commence an eviction process.
	Increase multifamily building permits	Expand both affordable housing and middle-income housing units that are available by placing an emphasis on multifamily developments over single-family developments.
	Promote rehabilitation and preservation of existing affordable housing	Protect existing naturally occurring affordable housing (NOAH) and subsidized affordable housing; preserve both NOAH and subsidized affordable housing through safe, quality rehabilitation services.
	Provide rental assistance for female householders	Develop or expand financial assistance for female-led households experiencing financial hardship to cover delinquent rent, a security deposit, first month's rent, or a utility bill.

Exhibit 3

Policy Recommendations, by Cluster (3 of 3)

	Policy Recommendation	Details
Transit-Desiring Cities	Reduce impact fees and exactions	Although municipal governments generally require impact fees to ensure a project can be supported by the necessary infrastructure, those fees should be rationally connected to intended project outcomes.
	Foster entrepreneurship and cooperative business ownership models	New business development is a key factor for local economic prosperity; worker-owned cooperatives are one method to either launch a new business or sustain a legacy business through the sale of the business to a new collective ownership.
	Encourage joint development with transit agencies and other interagency partnerships	Link transportation investments highlighted by the metropolitan transit organization, regional council of government, or metropolitan chamber of commerce to land use planning for housing, recreation, and open space.
	Connect development to improved transit options and lock in permanent affordability	Because the true cost of housing includes costs associated with travel from home to job sites, pursue policies that tie new housing development to existing or proposed multimodal transportation nodes; also, use the power associated with municipal land ownership to include affordability covenants that will be in place for 70–99 years rather than the more typical 20–30 years.

High-Opportunity Cities

We classified 97 cities (13 percent) as having an insufficient number of building permits for their predominately high-income residents. These cities exhibit the following characteristics:

- High median income
- High owner occupancy
- High gender income gap
- Lowest non-White population
- Average population growth
- High job growth
- Average public transit access
- Low number of single-family home permits
- Average number of multifamily permits

Seattle, WA, represents this group well. Although the city's real estate market has slowed over the past year, market conditions have become more favorable to buyers of premium homes. Developers are increasingly building more luxury or premium housing catered to America's upper and upper-middle class (Picchi, 2017a). In fact, premium homes account for more than one-half of the real property market—a 14-percent increase between 2012 and 2016 (Picchi, 2017b).

For Seattle and other cities in this cluster, population growth, job growth, college degree attainment, and median income exceed the national average. In alignment with the fact that 46 percent of housing units are owner occupied, more than one-half of the current approved building permits are for single-family homes. Home sales growth was a modest 2 percent between 2016 and 2017 and -13 percent between 2017 and 2018, however. These data suggest that Seattle's residents are not interested in purchasing the single-family homes that are permitted by the city, but they may be interested in a wider range of multifamily housing instead. Although this cluster exhibits lower rent burden compared with all other clusters, nearly 50 percent of the population is still rent burdened. To address that issue, Seattle is poised to increase housing densities by mandating that all new multifamily housing developments either reserve a certain percentage of planned units as rent-restricted housing for low-income families or contribute to the city's housing fund to build affordable housing.

Gaithersburg, MD, is a small city with population and job growth closer to the national average. Gaithersburg boasts a higher-than-average median income, and its residents have good access to jobs. In this city, developers are building a similar mix of single-family and multifamily housing units, in alignment with the city's nearly 50-50 split by occupancy. Home sales have grown above the national average, however, at more than 14 percent between 2016 and 2017; that growth further signals the demand for single-family homes.

These cities should examine the existing neighborhood-by-neighborhood footprints of single-family housing and their residents' income levels to assess whether they are permitting the right mix of dwellings for their predominately high-income residents. For example, one-half of the housing units in both Seattle and Gaithersburg are owner occupied, yet about one-third of the residents are mortgage burdened. Although more single-family units than multifamily units are permitted in both cities, they will need to assess whether this mix of properties is sufficient to meet demand.

Multifamily Deficit Cities

We classified 88 cities (12 percent) as having an insufficient number of multifamily building permits for their predominately middle-income residents. These cities exhibit the following characteristics:

- Average median income
- Average owner occupancy
- Average gender income gap
- Low non-White population
- Average population growth
- Average job growth
- Low public transit access

- Average number of single-family home permits
- Low number of multifamily permits

Virginia Beach, VA, experienced population growth lower than the national average. In Virginia Beach, approximately 41 percent of the population is composed of millennials; 38 percent Generation Xers; and 21 percent baby boomers. More than 45 percent of its residents are college educated, with a median income above the national average. In this city, jobs are also not growing at a particularly rapid rate, yet its higher-than-average proximity to jobs sets it apart from others (other cities in this cluster that are experiencing slow job growth but high proximity to jobs are Burbank, CA; Bloomington, MN, and Palatine, IL). High proximity to jobs means more opportunity for economic growth, which bodes well for the in-migration of young singles and growing families.

Virginia Beach is approximately 64 percent owner-occupied, similar to the national average—and has nearly 20 single-family units for each multifamily unit. Although other cities with similar demographic and economic characteristics continue to prioritize single-family housing over multifamily housing, Virginia Beach is one of the few cities that has begun building a substantial proportion of multifamily housing—at 32 buildings versus an average of 13 buildings.

Marysville, WA, experienced huge population growth—almost doubling its population since 2007—and a higher-than-average job growth rate. Although only 29 percent of the population is college educated, an above-average median income and a below-average mortgage burden qualify the city, in some respects, as an economic growth engine. In this city, nearly six single-family homes were permitted for each multifamily building permitted. Because the city is experiencing high population and economic growth, it would do well to follow Virginia Beach's lead and increase its housing mix to accommodate its varied population of millennials, Generation Xers, and baby boomers.

These cities need to focus on the people who are attracted to them. Millennials, for example, may be interested in nontraditional housing options, such as micro-units. Furthermore, these cities could examine their residents' income levels to assess whether they are building the right mix of dwellings for their predominately middle-income residents and identify how local governments might support wealth-creation strategies. Maximizing density is key to ensuring both residents' ability to pay and ample housing options, such as multifamily or multi-story, single-family-style structures (that is, townhouses).

Rent-Burdened Cities

We classified 204 cities (27 percent) as having the highest number of single-family and multifamily building permits for their predominately low-income residents. These cities exhibit the following characteristics:

- Low median income
- Low owner occupancy
- Low gender income gap

- Average non-White population
- Low population growth
- Low job growth
- Highest public transit access
- Highest number of single-family home permits
- Highest number of multifamily permits

What sets these cities apart from the rest is their access to public transit and the proximity of residents to job centers. These cities deploy nearly twice as many public transit vehicles as the other cities, giving them the greatest advantage in accessing good jobs. So, although job growth and educational attainment could be improved, residents are better able to access jobs from various locations, meaning that the housing cost burden is slightly less, on average, than in other cities.

Interestingly, these cities are more geographically spread out than cities in other clusters. In terms of population, this group has the highest average population, at nearly 263,000. This group includes very large cities with populations of more than 2 million—New York City, Los Angeles, Chicago, and Houston—and smaller cities with populations of fewer than 60,000 residents—Carson, NV; Revere, MA; Manhattan, KS; and Coconut Creek, FL.

Residents in Columbia, MS, have average college degree attainment yet low median incomes. They are also farther from jobs than residents of many other cities in the nation. Columbia is experiencing high levels (nearly 56 percent) of residents who are rent burdened. Although the owner-to-renter breakdown is about 50-50, more than 12 times more single-family homes were permitted in 2017 than multifamily homes (albeit still a high number of multifamily homes), highlighting the misalignment in the mix of housing offered to the city's predominately low-income residents.

Meanwhile, New York City experienced population and job growth closer to the national average and has a median income of about $57,782. Commensurate with those characteristics, homeownership is about one-half the national average, about 50 percent of owners are mortgage burdened, and 50 percent of renters are rent burdened. Very little new housing has been built since 2014, and although many of the units permitted have been multifamily housing units, the city simply does not have an adequate mix of single-family and multifamily housing units to accommodate its varied population. Interestingly, Hempstead, a suburb "ring" community of New York City, is also experiencing this problem, suggesting a misalignment in the issuing of single-family and multifamily building permits with residents inhabiting the broader region.

These cities should examine their levels of rent and mortgage burden to identify whether they are offering an adequate mix of affordable dwellings for their predominately low-income residents. If these cities recognize the high rent burden and the demand for multifamily housing and concentrate on the development of more multifamily units, their low-income residents may have the opportunity to decrease their rent burden. Programs that deliver rental assistance to residents may prove to be the most valuable investments of both local and federal housing dollars. Follow-on

programs may include homeowner education programs, income-restricted first-time homebuyer assistance, and shared equity housing models via community land trusts.

Growing Cities

We classified 92 cities (12 percent) as having a high number of single-family and multifamily building permits for their predominately middle-income residents. These cities exhibit the following characteristics:

- Average median income
- Average owner occupancy
- Average gender income gap
- Low non-White population
- Average population growth
- Average job growth
- High public transit access
- High number of single-family home permits
- High number of multifamily permits

Nearly 52 percent of the Denver, CO, population is college educated, and the median income is approximately $60,000. About 50 percent of the housing units are owner occupied. The numbers of both single-family and multifamily permitting approvals are above average. More than 2,000 single-family homes were permitted in 2017, and the city has implemented innovative strategies to increase mixed-use, mixed-income development; increase affordable housing options near public transportation; develop strategies to combat issues of displacement; and provide increased incentives for private and nonprofit investment in affordable housing (Denver Economic Development and Opportunity, 2019).

Compared with Denver, Madison, WI, exhibits very similar demographic characteristics but lower population and job growth, albeit at or above the national average. Still, single-family and multifamily building permitting is high, just like for other cities in this cluster. With relatively low levels of mortgage burden but high levels of rent burden, the city could prioritize more multifamily housing. Madison approved nearly 10 single-family building permits for every multifamily unit permitted.

Investments in transit have made a difference for cities in this cluster. Regarding single-family development, these cities would do well to better understand the housing demands of their residents and ask whether the residents' income levels are sufficient to afford the very high number of single-family homes. If not, these cities should consider whether the number of multifamily

housing unit permits they issue is sufficient to meet the rising demand of their middle-income residents. These cities can also focus on increasing the variety of housing types and prices.

Wealth Pocket Cities

We classified 51 cities (7 percent) as prioritizing single-family building permitting over multifamily building permitting for their predominately high-income residents. These cities exhibit the following characteristics:

- Highest median income
- Highest owner occupancy
- Highest gender income gap
- High non-White population
- Highest population growth
- Highest job growth
- Lowest public transit access
- High number of single-family home permits
- Low number of multifamily permits

Nearly three-fourths of the Newport Beach, CA, population is college educated, with a median income of $119,379—well above the national average. The owner-occupancy rate is slightly above the renter-occupancy rate at 57 percent, and about six single-family homes have been permitted for each multifamily unit permitted, a rate above the national average. Most surprising is the nearly 27-percent decline in home sales between 2017 and 2018—well above the national average of only 2 percent.

Another city in this group is Naperville, IL. This city experienced positive job growth, albeit lower than the national average. In addition, the city boasts a very high median income and good job prospects; however, it exhibits a high gender income gap between female and male workers. In terms of permitting, 337 single-family buildings were permitted—above the national average of 315; however, home sales declined by nearly 19 percent. This decline could be due, in part, to the high cost of housing in Naperville. Although the cost of construction for a modest single-family home is about $270,000, the median sales price is more than $400,000.

Similarly, in cities such as Fremont, CA; Bellevue, WA; Parker, CO; Rockville, MD; and Flower Mound, TX, single-family home sales prices are much higher than the cost of construction. Although modest single-family homes in all five cities cost less than $240,000 to construct, the median home sales prices in those cities are more than double the cost of construction. This misalignment between home sales prices and the cost of construction makes it more difficult for residents to afford housing. It also creates an environment in which developers are keen to build

high-end housing, whereby they can increase their profit margins, further disadvantaging low- and middle-income residents.

These cities could benefit from preserving existing affordable housing, increasing attention to income disparities in accessing affordable housing, and looking at gender and race as factors when thinking about how to increase upward mobility and financial security. In these cities, wages could be distributed better between female and male employees, with a particular focus on supporting woman-headed households in rental housing. In addition, given the more evenly split generational mixes in these cities, city leaders will need to think about affordable housing for aging populations.

Transit-Desiring Cities

We classified 222 cities (29 percent) as those that prioritize multifamily building permitting over single-family building permitting for their predominately low-income residents. These cities exhibit the following characteristics:

- Lowest median income
- Lowest owner occupancy
- Lowest gender-income gap
- Highest non-White population
- Lowest population growth
- Lowest job growth
- Average public transit access
- Lowest number of single-family home permits
- Average number of multifamily permits

Large cities, such as Cincinnati and Cleveland in Ohio (both with populations of more than 300,000), find their way into this group. Although median incomes in both cities are well below the national average, Cincinnati's residents are about twice as likely to have a college degree as Cleveland's residents. Cincinnati also experienced positive job growth, whereas Cleveland did not. Cleveland deploys about 100 more public transit vehicles to its residents than Cincinnati and thereby provides its residents with opportunities to help bridge the economic gap. In addition, 60 percent of Cleveland residents and 50 percent of Cincinnati residents are non-White, highlighting the high diversity of residents in this group of cities and underscoring the need for the consideration of race in the development of housing policies.

In both of these cities, the rate of multifamily homes permitted is similar to that of the national average, at 315, but the rate of single-family homes permitted is much lower, at 163. About 50 percent of their renters are rent burdened, and more than 30 percent of their owners are mortgage burdened.

Given that median incomes of residents are lower in these cities, public transit is extremely important for ensuring that residents can access jobs. By examining the extent to which residents are using public transportation to get to work and public transit vehicles are deployed, cities can enhance opportunities for economic mobility for their residents. This kind of comparison can help build consensus for investments in transit-supportive land use planning, demonstrate the need for income-assisted housing or transit investments in particular areas, or simply raise awareness of a region's housing and transportation challenges.

Conclusion

Housing is a significant contributor to the well-being of residents and thus must remain a key issue for policymakers. Our nation's residents need high-quality, affordable housing, where living conditions are not tenuous or constantly in flux. The gap between what residents must pay for a home and what they can afford is widening, however. Overall, vibrant communities with greater opportunities for economic prosperity are grounded in strong housing stocks that serve the myriad needs of singles, families, and seniors across generations and income levels and are accessible to employment, healthcare facilities, and recreational opportunities.

Understanding the factors that compose housing markets and the extent to which a city's permitting of single-family and multifamily housing is meeting the income levels and job growth opportunities of its residents allows local leaders to apply the best strategies for their communities. In each of the housing market types identified in this analysis, tradeoffs are playing out against each other based on which housing values are the highest priorities—the mix of housing type and of owners and renters, the volume of new construction, and the investment in transit. All cities still have significant room for improvement in deploying the right mix of housing and economic development strategies and tools that will influence the affordability of the housing market. Cities must continue to ensure that all residents have equitable access to housing, jobs, and amenities.

This report provides a starting point for understanding the unique characteristics of city housing markets and can be a key tool in informing the work that local policymakers do every day.

Acknowledgments

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SpAM

SpAM (Spatial Analysis and Methods) presents short articles on the use of spatial statistical techniques for housing or urban development research. Through this department of Cityscape, the Office of Policy Development and Research introduces readers to the use of emerging spatial data analysis methods or techniques for measuring geographic relationships in research data. Researchers increasingly use these new techniques to enhance their understanding of urban patterns but often do not have access to short demonstration articles for applied guidance. If you have an idea for an article of no more than 3,000 words presenting an applied spatial data analysis method or technique, please send a one-paragraph abstract to rwilson@umbc.edu for review.

Applying Spaghetti and Meatballs to Proximity Analysis

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The views expressed in this article are those of the author and do not represent the official positions or policies of the Office of Policy Development & Research, the U.S. Department of Housing and Urban Development, or the U.S. Government.

Abstract

The spaghetti and meatballs technique is a geoprocessing method used in a Geographic Information System (GIS) that counts the number of overlapping polygons that are of unequal size and shape. Often, this method is used to calculate densities of coverage areas including, but not limited to, the extent of an oil spill over a period of time or the extent of a burn during a wildfire, or to compare perceptions of a region. In this demonstration, I use the spaghetti and meatballs technique to measure the density of proximity to points of interest, or amenities, in Washington, DC. I calculate summary statistics to describe the densities of amenities by the District's eight city council wards.

Background

The spaghetti and meatballs technique counts overlapping polygons of varying shapes and sizes in a geographic information system (GIS). The spaghetti and meatballs technique appears in many academic papers and various blog posts (Honeycutt, 2012), but researchers have not described it with sufficient explanation as to how it works when being applied to additional geoprocessing tasks. This article demonstrates how to create overlapping buffer polygons of unequal shape and size, how to apply the spaghetti and meatballs technique to identify densities of overlapping polygons, and finally, how to summarize the results by geography. The inconsistency of the shape and size of the polygons is important to simulate because, in many situations, the extent of the shapes being analyzed will vary greatly, such as wildfire extents, flood extents, oil spills, soil composition, or other phenomena that do not fit neatly into clearly defined areas such as census tracts, hexagon tessellations, or other forms of grids. If all areas used the same grid, there would be no need to perform the spaghetti and meatballs technique.

The scenario behind this demonstration is to identify areas in Washington, D.C., that are proximate to amenities. For this demonstration, I chose amenities as points of interest from the Washington, D.C., Open Data page.[1] By creating buffers from these points, which vary in number and location, polygons of unequal shape and size can be generated. The method to generate the buffers is specific to this demonstration to create polygons of unequal shape and size, but the need to count overlapping polygons is not limited to this example. Measuring the extent of wildfires, oil spills, or floods over periods of days are common examples of why an analyst may need to perform this task. Site selection is another reason why an analyst may perform this task. For example, guidance may advise that assisted or supportive housing be located within a certain distance from amenities; the spaghetti and meatballs method could be used to identify suitable areas by the density of overlap areas that meet the proximity criteria.

To create polygons of varying shapes and sizes, I performed a distance analysis to find the 25th percentile of distance from points of interest to a dense grid of points used to simulate any location within the District of Columbia. Once I identified the 25th percentile of each point of interest, I created buffers using that distance with each associated point of interest. The process of creating these buffered locations, and then counting the overlaps, is similar to counting the overlaps of an informal region (Bowlick et al., 2015). This article demonstrates how to apply the spaghetti and meatballs technique to a proximity analysis of points of interest in Washington, DC. This demonstration primarily uses ArcGIS for its graphical user interface (GUI) to help make the process clearer, but it can be performed with any GIS software, such as QGIS or another open-source platform.

The end of this demonstration includes how to create summary statistics describing the land area. Although I used the political boundaries of the nation's capital for this analysis, I used only the land area to create the statistics because people are typically interested in site selection of a land area. The reason I used the entire political boundary, however, including creating buffers that may go outside of the city limits, was to perform geoprocessing on the entire dataset, then reduce later where I deemed appropriate.

[1] http://opendata.dc.gov/

Using Points of Interest to Create Overlapping Polygons

To create a set of overlapping polygons of varying shapes and sizes, I chose 12 sets of points of interest (PoI) in Washington, DC, from the Open DC GIS Catalog. Each data set contained points representing location data, such as entrances to Metro stations, Capital Bike Share stations, or other places of interest. The reason for choosing 12 different location data sets is that they have different spatial distributions across the District. The difference in the spatial distributions indicates that the data sets will likely cover different regions of the city to varying degrees. Performing a Near analysis, and creating buffers based on the results of the Near analysis, will enable creating overlapping polygons of varying degrees and sizes across the city that will be unique and complex shapes. The goal here is to use a set of gridded points, representing all potential locations within the city, to determine locations relative to the PoI, allowing for adjustments to the potential size of the buffers. All datasets were projected into the Maryland State Plane Coordinate System[2] for this analysis to orient the geography to preserve shape and area to be consistent with data standards for the District of Columbia.[3]

To create the buffers, which are polygons of varying shapes and sizes, the first step was to create a fishnet grid that covered the District to measure distance at a more local (granular) level to assess any distance within the geography to a PoI. I created a fishnet grid using the extents of the District with 1,000 rows and 1,000 columns. I chose this number of rows and columns for the grid because it thoroughly covered the city, but other parameters may also be chosen to modify the distance at which the points are located from each other. Because the extents of Washington, DC, go further than much of the city's actual area, I removed points outside the city boundary using the Clip tool to keep the analysis within the city limits. The result was that 428,281 points (42.8 percent) remained of the original 1,000,000 points in the fishnet grid. Using the 1,000 by 1,000 points dimensions, the points were spaced 59.9 feet apart from each other to create a layer that measures local proximity in a systematic way across the city.[4] This layer allows an analyst to measure the proximity of any PoI to any other location within the coverage area.

I used the Near tool to measure the distance from each PoI to the grid points, appending the distance to the PoI layer. For each PoI, I calculated the minimum, 25th percentile, median, 75th percentile, maximum, and average distance from the grid network to each PoI. Exhibit 1 presents a set of distance statistics to assess the proximity in the city to one of the PoI types. Each percentile distance indicates that within that number of feet from the PoI is a percentage of the area within the political boundary of Washington, DC. For example, approximately 25 percent of the area of the city is within 856.5 feet of a Capital Bikeshare station, and one-half of the city is within 1,658 feet of a station, roughly double the distance that 25 percent of the district is within. I repeated this process for each set of amenity locations to create a table of distance statistics for each PoI.

[2] The District of Columbia uses the Maryland State Plane Coordinate System https://octo.dc.gov/page/coordinate-system-standards

[3] Maps in this paper are shown in North American Albers Equal Area Conic consistent with other work.

[4] A map of the fishnet grid is not shown because at a Districtwide scale, the points cover the entire geography and are not discernible.

Exhibit 1

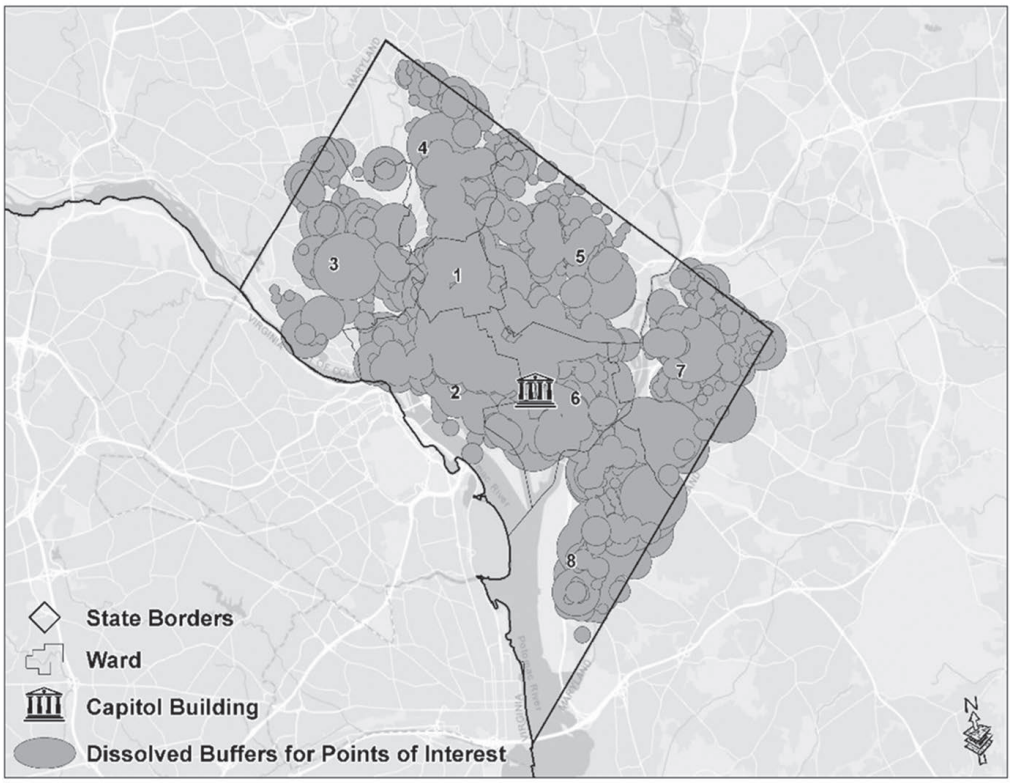
Distance from Fishnet Grid to Nearest Point of Interest (Feet)

Points of Interest	Minimum	25th Percentile	Median	75th Percentile	Maximum	Average
Books and Barber Shops	6.5	3,316.1	6,074.4	10,331.8	27,103.5	7,397.7
Capital Bikeshare	1.0	856.5	1,658.0	3,031.7	12,867.3	2,269.0
Elementary Schools	5.6	1,514.9	2,476.6	3,922.8	15,207.6	2,973.4
Farmers Markets	6.3	1,745.9	2,974.2	5,091.3	16,695.6	3,673.4
Libraries	4.1	2,483.7	3,796.9	5,256.5	16,698.7	4,026.1
Metro Station Entrances	5.6	2,169.5	3,977.9	6,686.1	24,184.2	4,897.4
Museums	6.2	2,294.1	4,317.5	7,550.8	29,284.8	5,689.6
Places of Worship	2.6	554.3	1,131.1	2,286.7	15,754.2	1,802.2
Police Stations	16.5	3,488.3	5,555.4	8,221.6	29,906.8	6,490.4
Public Art	1.0	1,091.6	2,056.1	3,504.4	16,695.6	2,615.5
Taverns	2.1	1,517.2	3,464.7	6,369.6	23,560.5	4,411.1
Urban Agriculture Sites	2.7	2,553.5	4,384.9	7,371.9	19,480.3	5,568.6

I then created buffers based on each PoI's distance at the 25th percentile to represent activity space around that point. For each buffer created, the Dissolve Type parameter must be set to all to create single, continuous polygons where possible. This parameter eliminates overlapping polygons for the same PoI. For each dissolved buffer layer created for each PoI, I exploded the buffers into multipart features to ensure that each feature is a separate record. I appended the resulting buffers for all 12 PoIs into a single map layer. All buffers become individual features within a single layer, rather than many features—including potential multipart features—in 12 layers. Ensuring that all features are in a single layer is important for the spaghetti and meatballs portion of the analysis. The resulting layer contains a series of overlapping buffers for all PoI, as shown in exhibit 2.

Exhibit 2

Buffered Polygons of All Points of Interest

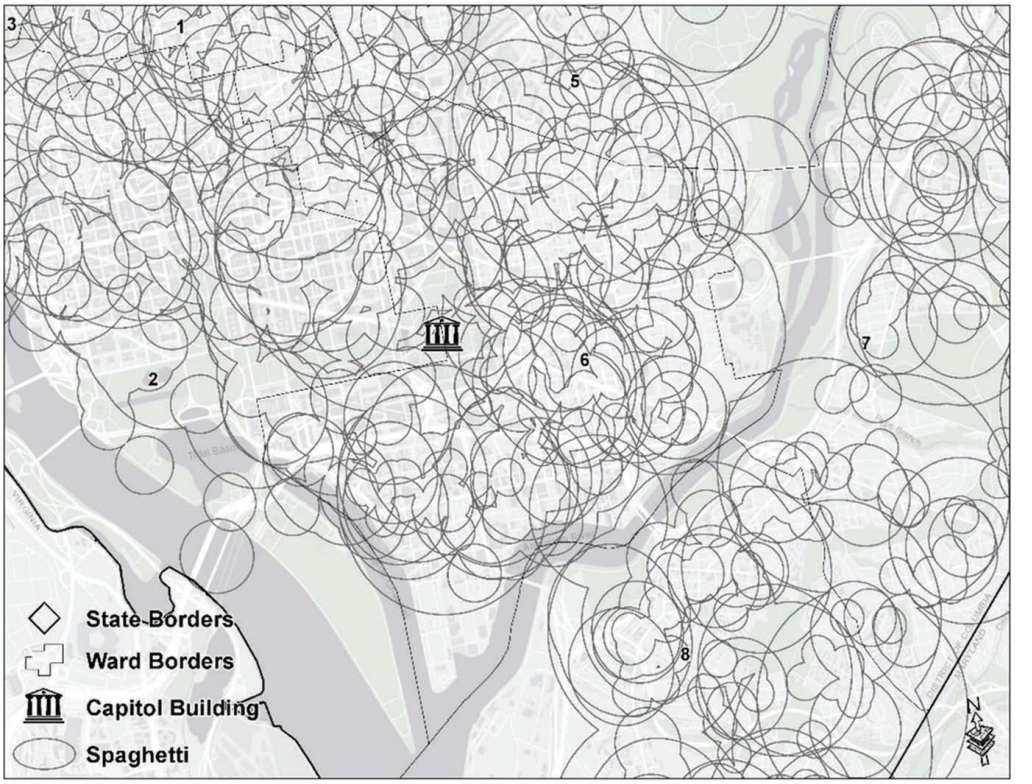


Spaghetti and Meatballs

After the overlapping buffers are created, the next step is to transform the polygons into spaghetti shapes using the "Feature-to-Polygon" tool, which divides the buffer polygons into smaller component polygons from each overlapping layer at the intersections of each overlapping buffer. That is, the tool creates buffer pieces that represent the intersecting areas of the overlapping buffers. In this example, the number of features grows from 359 in the layer of buffered polygons to 5,405 in the layer generated by the Feature to Polygon tool. The resulting spaghetti of polygons is shown in exhibit 3.

Exhibit 3

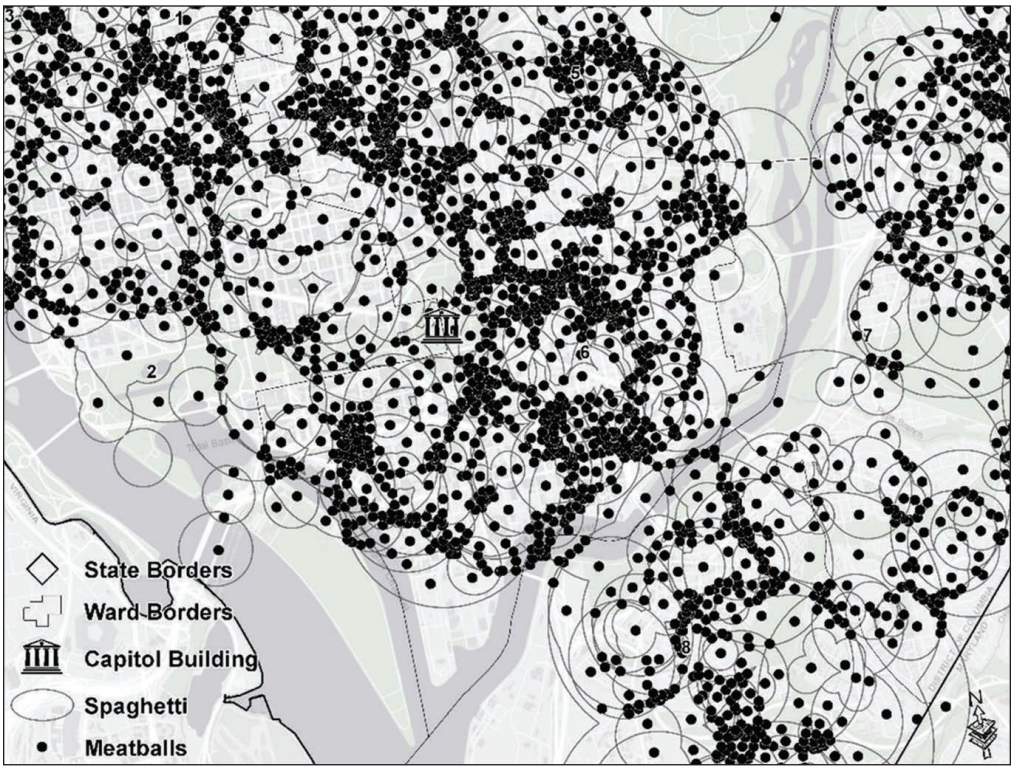
Spaghetti in and Around Ward Six



Using the spaghetti polygons, points (also called meatballs in this method) are made that represent the center of each polygon, that is, the centroid. These meatball center points are generated by converting each feature in the spaghetti layer to a point using the Feature-to-Point tool that identifies a polygon's center and creates a point at that location. When using this tool, it is important to define the center by using the Inside parameter. Because many of the shapes in the spaghetti layer are complex shapes, it is possible for the central point to be located outside the bounds of the corresponding polygon. Using the Inside parameter will ensure that the centroid point will remain within the shape of the polygon. A meatball is created for each spaghetti section, creating more meatballs than PoIs. The meatballs are the centroids for each section of overlapping PoI buffers. See exhibit 4.

Exhibit 4

Meatballs in and Around Ward Six



The number of overlapping polygons can be counted using the meatball points and the original set of polygons. To do this, I used the "Spatial Join" tool[5] to count the number of original polygons that intersect with each meatball, or central point, representing one section of each original polygon broken down into its smallest part. The Spatial Join is a tool available in many GIS software applications that computes the intersection between two layers. This computation can be a count of one layer intersecting with a second layer, like in this demonstration, or it can perform a more sophisticated calculation like that of an attribute of the first layer relative to the second layer.[6] In this process, the Spatial Join tool counts the number of overlaps that occur between the two layers, thus providing a frequency of the overlapping intersections. In this example, the sections of overlapping polygons range from 1 (indicating no overlap) to 12 (indicating the most overlap), with the buffers from all 12 PoIs overlapping in a given area. When configuring the Spatial Join, the "Target Feature" (input) is the meatballs, and the "Join Feature" is the original set of polygons before the spaghetti was created. The Spatial Join joins the number of original polygons to each point representing an overlap section. The original polygons are filled with the number of overlap parts, represented as points (meatballs). Exhibits 5 through 7 demonstrate the output of the Spatial Join tool.

[5] In ArcPro, the Summarize Within tool simplifies this process. Additionally, using Python and a combination of the Definition Query, Select Features by Location, SearchCursor, and UpdateCursor functions could be used instead in ArcGIS or ArcPro. Other alternatives are also available in open source and other platforms.

[6] An example of such a computation would be to use a Spatial Join between a point layer of apartment buildings and a polygon of census tracts to calculate the number of units in the apartment layer by census tract.

Exhibit 5

Spatial Join Tool Parameters

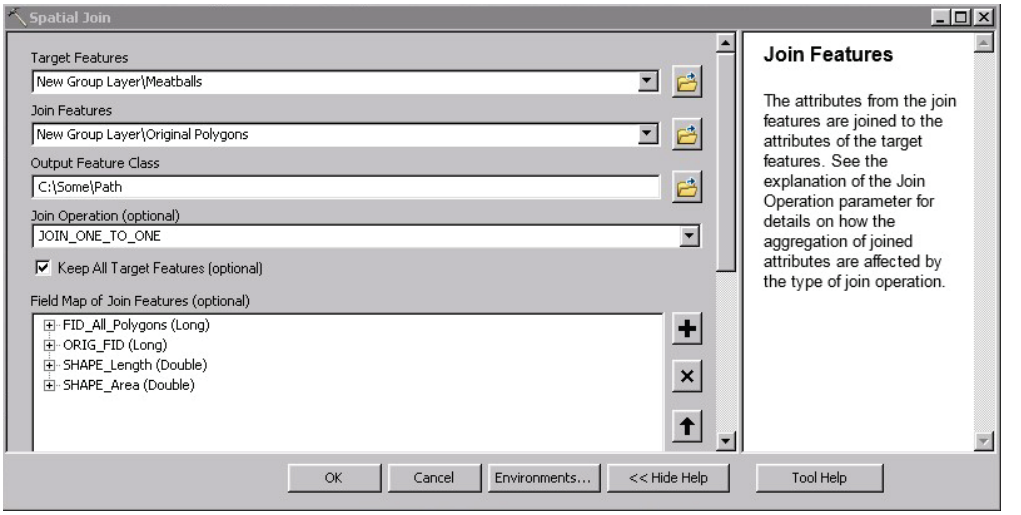


Exhibit 6

Point Layer Resulting from Spatial Join Overlaid on Original Polygons Layer in and Around Ward Six

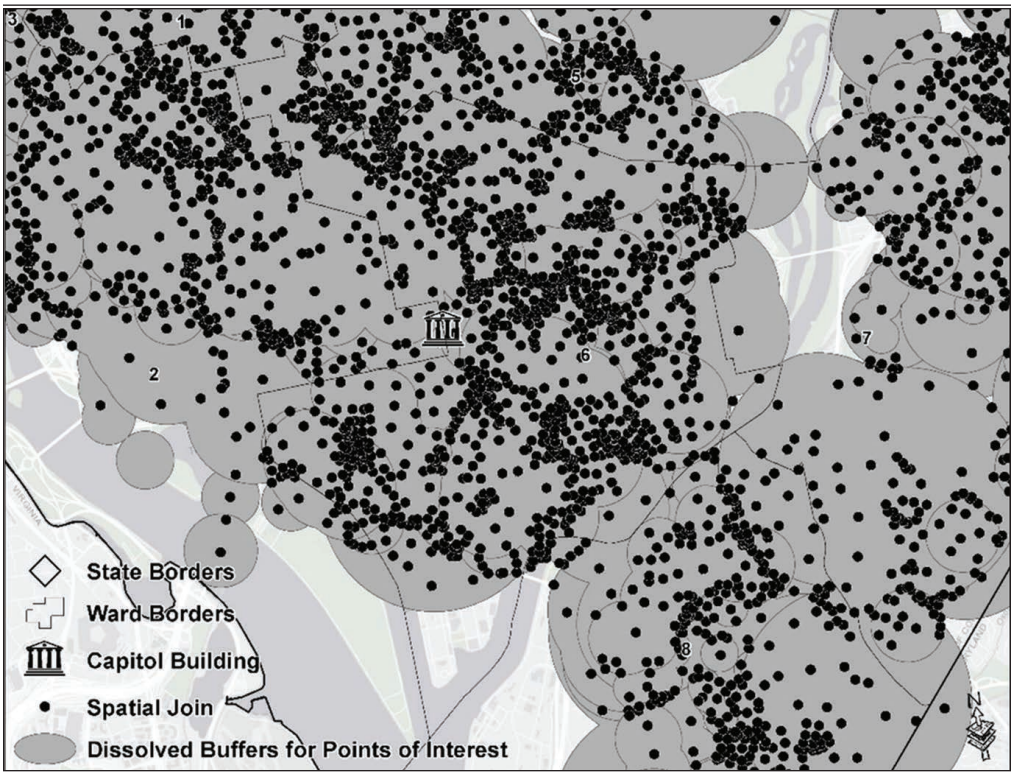


Exhibit 7

Point Layer Resulting from Spatial Join Attribute Table

Table

Spatial Join

OBJECTID *	SHAPE *	Join_Count	TARGET_FID	FID_All_Polygons	ORIG_FID
1	Point	1	1	-1	1
2	Point	1	2	-1	2
3	Point	2	3	-1	3
4	Point	2	4	-1	4
5	Point	3	5	-1	5
6	Point	1	6	-1	6
7	Point	2	7	-1	7
8	Point	4	8	-1	8
9	Point	2	9	-1	9
10	Point	3	10	-1	10
11	Point	3	11	-1	11
12	Point	1	12	-1	12
13	Point	3	13	-1	13
14	Point	4	14	-1	14
15	Point	3	15	-1	15
16	Point	1	16	-1	16
17	Point	4	17	-1	17
18	Point	6	18	-1	18
19	Point	5	19	-1	19
20	Point	1	20	-1	20
21	Point	6	21	-1	21
22	Point	4	22	-1	22
23	Point	6	23	-1	23
24	Point	5	24	-1	24
25	Point	6	25	-1	25
26	Point	3	26	-1	26
27	Point	7	27	-1	27
28	Point	5	28	-1	28
29	Point	4	29	-1	29
30	Point	4	30	-1	30
31	Point	5	31	-1	31
32	Point	1	32	-1	32
33	Point	6	33	-1	33

1 (0 out of 5405 Selected)

Spatial Join

The point layer resulting from the spatial join operation contains the number of overlaps in the Join_Count field, which is the result of the intersection of each buffer layer with a centroid. The ORIG_FID is the ID of the meatball centroids that are created from the spaghetti polygons. This field links the meatball points back to the spaghetti polygons for the purpose of visualizing the number of overlaps, described in the Join_Count field, in the spaghetti polygons. In the spaghetti

polygons, a numeric Frequency field is created that contains the number of points (meatballs) that represent the number of overlapping polygons. When the point layer from the spatial join is overlaid with the spaghetti layer, the OBJECT_ID from the point layer is transferred into the ORIG_FID field to link them if needed. These links enable rejoining the two layers by a common ID so that any additional data from each of the layers can be used together.

Once the values from the Join_Count field in the spatial join layer have been joined to the Frequency field in the spaghetti layer, there are records in the spaghetti layer that have a value of zero. Those records are the result of areas that were not within a polygon in the original polygon layer but were continuously bounded on all sides by polygons. Those records are deleted from the spaghetti layer, dropping the number of features from 5,405 to 5,392. The results are thematically mapped in the exhibits 8 and 9.

Exhibit 8

Overlapping Buffers of Points of Interest

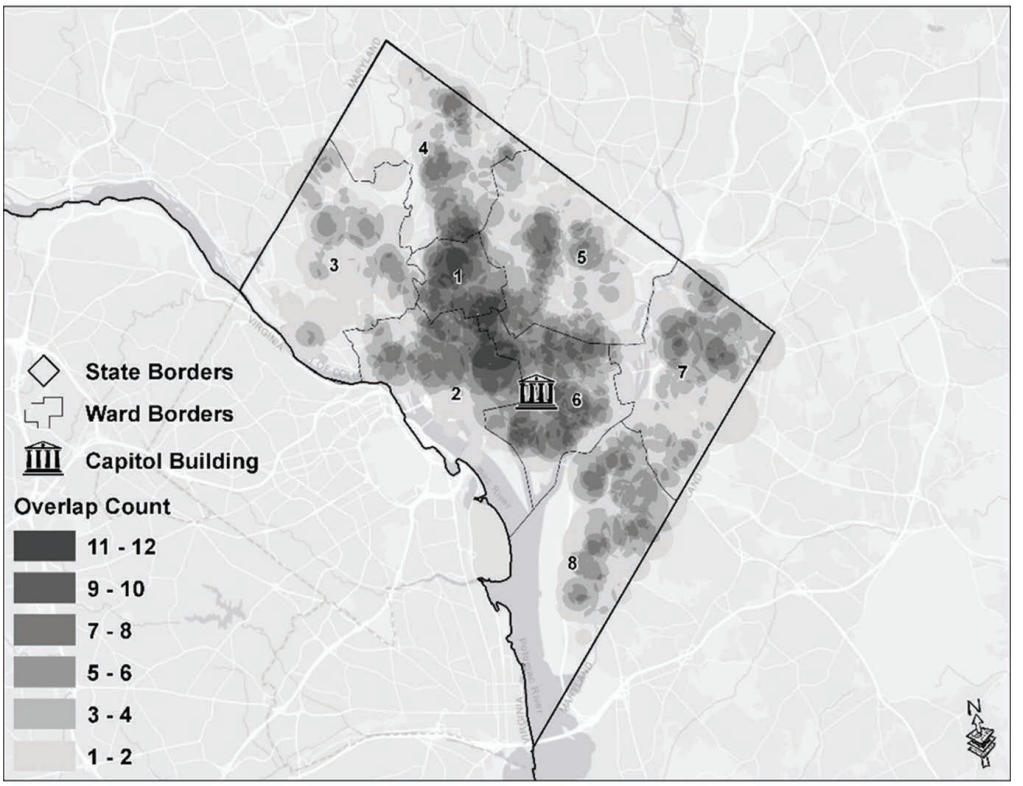
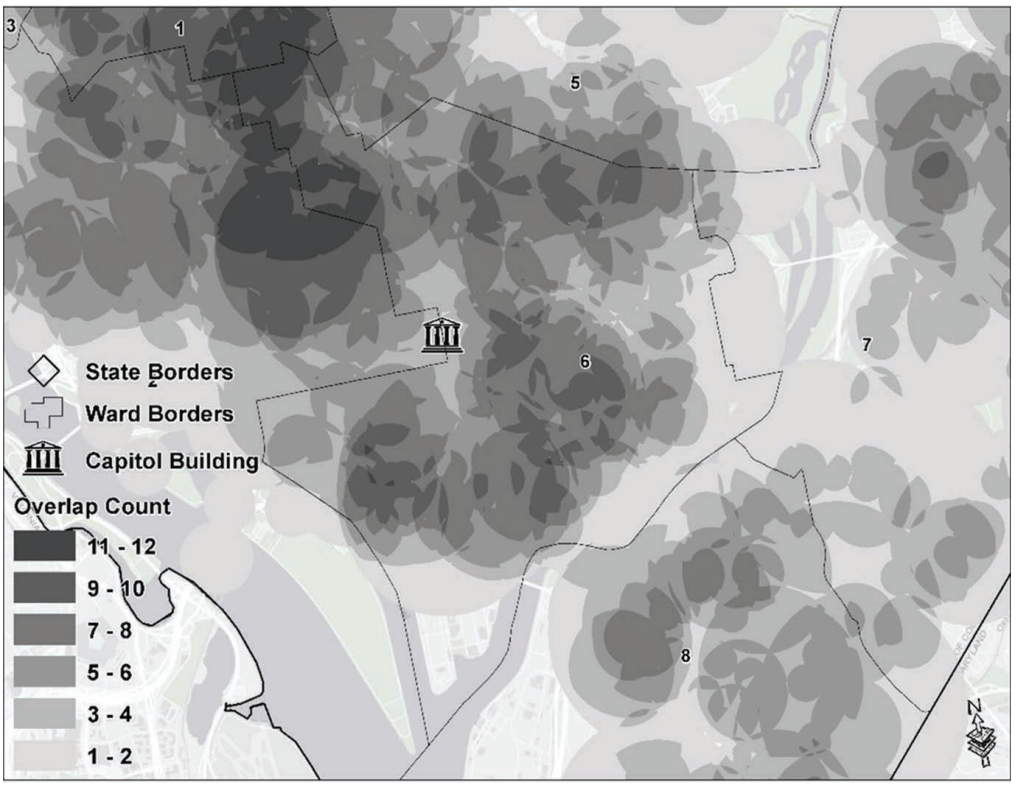


Exhibit 9

Overlapping Buffers of Points of Interest Around Ward Six



At a Glance—Visual Analysis and Histogram

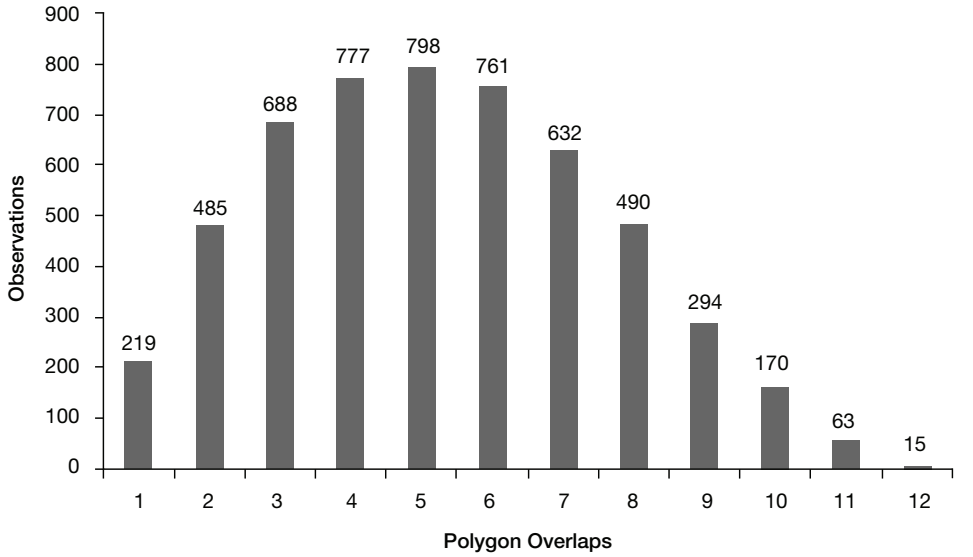
On visual examination of exhibit 8, Ward 1 appears to have the highest level densities of overlaps as a share of total area than any other ward. Ward 1 contains large portions of Howard University and Shaw in the southern area, Adams Morgan and Mt. Pleasant in the west, and Columbia Heights and Park View in the central area. These neighborhoods have all experienced a great deal of change over the past two decades, and, unsurprisingly, they are closer to more points of interest than other neighborhoods. Ward 2 also appears to have high densities of greater overlaps, continuing from Ward 1. Ward 6 appears to have a large concentration of moderate-to-high overlaps spread across the ward with few areas that have low numbers of overlaps—indicating that there are not many areas proximate to a low number of amenities in this ward.

To the east of Ward 6 and Ward 5 is a gap of overlapping polygons before reaching Wards 7 and 8. This gap is likely the Anacostia River because no PoIs were in the river and few were likely to be particularly close to the river. These wards have historically been isolated from the rest of Washington, DC, and contain a large portion of the city's poorest and most socially vulnerable populations. Even as the District has made progress on many metrics, the East-of-the-River sections of the city lag behind other area of the city.

The histogram in exhibit 10 shows the number of observations for each type of resulting polygons. The histogram appears to have a relatively normal distribution with a slight right-skew. Most polygons are in areas of five or fewer overlaps (54.9 percent). This finding is in keeping with the map in exhibit 6 and later maps that show relatively few areas of densities of proximity to greater numbers of sets of points of interest. The histogram does not show areas within the District that are not proximate to any of the 12 sets of PoIs. The histogram also does not demonstrate the size of each area. For example, more areas may overlap being proximate to three sets of PoIs than to two sets of PoIs, but the polygons that were made from only two overlaps comprise a larger geographic area. Lastly, neither the histogram nor the maps indicate to which PoIs the overlapping polygons are proximate.

Exhibit 10

Histogram of Polygon Overlaps



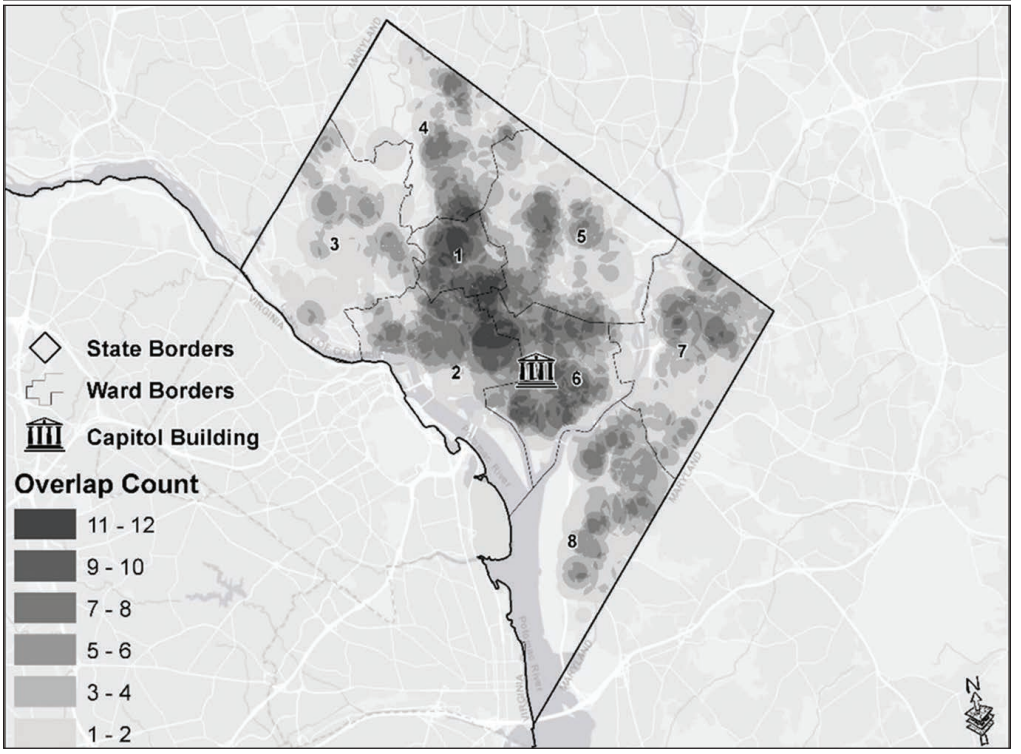
Intersection with Wards

Because this section is to provide summary statistics of the area within each number of overlaps, it is important to provide this information as *land* area rather than total area within the political boundaries of Washington, DC. To remove areas covered by water within the boundaries of DC, I erased areas that were defined as Freshwater Pond, Lake, or Riverine by the National Wetlands Inventory[7] from the political boundary layer. Next, I clipped the polygons with overlap information by political boundary of the District of Columbia to remove areas outside of the District. The result is shown in exhibit 11. This action primarily removed areas like the Anacostia and Potomac rivers, but it also took out areas like Lake McMillan in Ward 1 and created islands such as Roosevelt Island in Ward 2.

[7] https://www.fws.gov/wetlands/data/State-Downloads.html

Exhibit 11

Overlapping Polygons Clipped to Washington, D.C., Political and Land Boundaries



To accurately calculate the percentage of each Ward that had between 0 and 12 overlaps, the first step was to dissolve the spaghetti polygons by the overlap count. Next, I integrated the dissolved spaghetti polygons into the clipped Ward layer with the "Union" tool so that it contained only the land area within each ward. This step produced a layer of 131 polygons that described which Ward the polygon was a part of and the number of overlaps, or density, of that particular polygon. I created a new field to calculate the number of acres per polygon. A crosstab of areal percentages for each overlap count by Ward is shown in exhibit 12.

Exhibit 12

Percentage of Area by Ward by Overlap Count

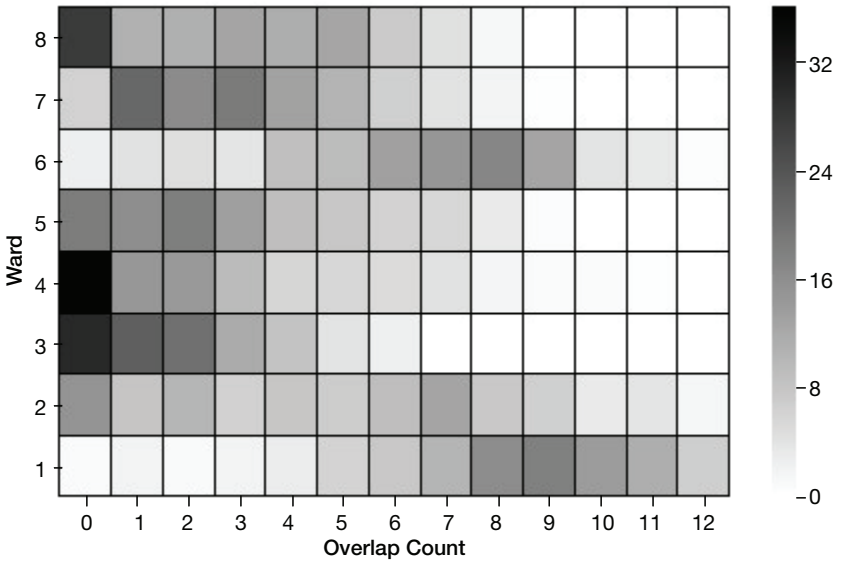
Ward	Overlap 1	Overlap 2	Overlap 3	Overlap 4	Overlap 5	Overlap 6	Overlap 7	Overlap 8	Overlap 9	Overlap 10	Overlap 11	Overlap 12
Ward 1	0.9%	2.0%	1.1%	2.1%	2.8%	6.2%	10.5%	16.3%	18.0%	14.0%	11.5%	6.9%
Ward 2	15.3%	8.1%	10.4%	6.5%	7.9%	7.1%	12.7%	7.7%	6.7%	3.1%	3.9%	1.6%
Ward 3	30.1%	22.6%	20.3%	12.0%	8.4%	4.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Ward 4	36.0%	14.7%	14.5%	9.4%	5.8%	5.7%	4.3%	1.8%	0.9%	0.9%	0.6%	0.2%
Ward 5	18.5%	16.1%	18.3%	13.6%	9.1%	7.8%	5.7%	3.3%	0.8%	0.3%	0.0%	0.0%
Ward 6	2.6%	4.3%	4.7%	3.9%	9.0%	9.4%	14.8%	17.1%	12.8%	4.0%	3.4%	0.6%
Ward 7	6.4%	21.3%	16.4%	18.8%	13.1%	10.6%	4.2%	2.0%	0.5%	0.0%	0.0%	0.0%
Ward 8	27.6%	11.1%	11.2%	12.7%	11.7%	12.6%	4.4%	0.0%	0.0%	0.0%	0.0%	0.0%

The output table in exhibit 12 also shows the percentage of area in the overlap count, or level of density of proximity to points of interest, by Ward. This tabular representation aligns with the map in exhibit 9. Reading this table, it is easier to make comparisons of overlap counts between Wards or comparisons of Wards between different overlap counts. The table also shows that Wards 4 and 5 have higher portions of land area that are within areas of higher densities of proximity to PoIs. For example, the table shows that Wards 3, 4, and 8 range between 27.6 percent and 36.0 percent with no overlapping buffers of PoIs. The reader can also see that many Wards have values of 0.0 for higher overlap counts, indicating that these Wards have no areas or a limited number of areas with high proximity to points of interest.

It may be difficult to read the table because it has 96 values. To overcome this difficulty, I created a heatmap to better visualize the data (exhibit 13). The heatmap is a shaded matrix and, in this example, visualizes the values by using darker colors for greater values (Din, 2019). In the visualization, the table comes to life. It becomes clear that many Wards have few, if any, areas that have areas of high density of proximity to PoIs. The visualization enables the reader to better understand how much of the land area is within each overlap count and the density of overlaps.

Exhibit 13

Heatmap of Percentage of Area by Ward by Overlap Count



Conclusion

The spaghetti and meatballs technique is a way to count the number of overlapping polygons in an area. This method can be used for proximity analysis, site selection, cost-surface modeling, or other applications yet to be considered. Ultimately, because this data processing used a wide range of datasets for points of interest, what this particular analysis describes is that the central portion of Washington, DC, has the highest density of being most proximate to selected amenities. The

real power and versatility of the analysis are derived from how the polygons are created to generate meaningful graphic representations that help to identify something of value. The fishnet grid to create the nth percentile distances in a given area is not required, and the buffers can be created from a predetermined distance that is relevant to the analyst. Rather than being close to a PoI such as within the 25th percentile, the area to form the polygon could be the distance from the PoIs to the 75th percentile or greater. Static, fixed PoIs are not always required; PoIs that are in different locations may be used. There are numerous possibilities to create areas of varying shapes and sizes that the spaghetti and meatballs method can be applied to for proximity and density analysis.

Author

Alexander Din is a social science analyst in the Office of Policy Development & Research at the U.S. Department of Housing and Urban Development.

Notes

While this article was in review, Esri released a tool to count overlapping polygons in their release of ArcGIS 2.5. As of the submission of this paper, the author has not yet had the opportunity to make the leap from ArcGIS 2.4 to test the new tool.

Appendix A: Points of Interest

http://opendata.dc.gov/datasets/capital-bike-share-locations

http://opendata.dc.gov/datasets/metro-station-entrances-in-dc

http://opendata.dc.gov/datasets/museums-in-dc

http://opendata.dc.gov/datasets/liquor-licenses

http://opendata.dc.gov/datasets/police-stations

http://opendata.dc.gov/datasets/public-schools

http://opendata.dc.gov/datasets/libraries

http://opendata.dc.gov/datasets/places-of-worship

http://opendata.dc.gov/datasets/books-and-barber-shops

http://opendata.dc.gov/datasets/washington-dc-public-art
[Page removed from the Open Data DC website at the time of publication]

https://opendata.dc.gov/datasets/urban-agriculture-sites-points

http://opendata.dc.gov/datasets/farmers-market-locations

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- Issues concerning combining multiple Federal tax incentives or funding sources
- Analysis of Opportunity Zone investments to date
- Additional incentives at the state and local level for Zone investments
- Coordination of federal incentives among agencies
- Comparison of the efficiency of Opportunity Zone incentives and other place-based initiatives

Please electronically submit an abstract describing your proposed paper to Daniel Marcin (Daniel.S.Marcin@hud.gov) by September 15, 2020. Authors of approved abstracts will be notified by October 15, 2020 and invited to submit full manuscripts by May 15, 2021. Authors will be responsible for addressing issues raised by the editors and/or reviewers by the designated deadline. Please direct questions or requests for additional information to Daniel Marcin using the contact information found above, or call (202) 402-2967.

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Symposium

Two Essays on Unequal Growth in Housing 1
Guest Editor: John Carruthers

Note from the Managing Editor 3

The Closing of America's Urban Frontier *by Edward L. Glaeser* 5

Housing Inequality in Developing Asia and the United States: Will Common Problems Mean Common Solutions? *by Toshiaki Aizawa, Matthias Helble, and Kwan Ok Lee* 23

Departments 61

Data Shop
Parcel Tax in California: Findings from New Data Sources *by Soomi Lee* 63

Foreign Exchange
How Finland Ended Homelessness *by Marybeth Shinn and Jill Khadduri* 75

Graphic Detail
Early Interstate Policy and Its Effects on Central Cities *by Jeffrey Brinkman and Jeffrey Lin* 81

The "Punitive Push" on Mobile Homes *by Graham Pruss and Karen Cheng* 87

Industrial Revolution
Upcycling Shipping Containers for Houses *by Mike Blanford and Stephen Bender* 95

Policy Briefs
Opportunity Zones: A Place-Based Incentive for Investment in Low-Income Communities *by Daniel Marcin* 101

A Comprehensive Look at Housing Market Conditions Across America's Cities *by Anita Yadavalli, Brenna Rivett, James Brooks, and Christiana K. McFarland* 111

SpAM
Applying Spaghetti and Meatballs to Proximity Analysis *by Alexander Din* 133

Referees 2019-20 149

Call for Papers
Cityscape Symposium on Opportunity Zones 151

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VOLUME 22 NUMBER 2 • 2020