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## A Sociospatial and Regulatory Analysis of Mobile Home Parks in the Houston Metropolitan Area

Esther Sullivan  Carrie Makarewicz  Andrew Rumbach 

### ABSTRACT

**Problem, research strategy and findings:** Mobile home parks (MHPs) are a major source of unsubsidized affordable housing in the United States but are poorly understood in planning research and practice. Here we present findings of one of the first and most comprehensive studies of MHPs in a U.S. metropolitan area. We located and spatially analyzed MHPs in the Houston (TX) metropolitan statistical area, comparing the sociodemographics, built environment, and environmental exposure of census block groups with higher shares of MHP land to block groups with fewer or no parks. We examined the relationship between land use regulations and the location of MHPs by coding government documents for the 132 jurisdictions in the metropolitan statistical area. We found that MHPs are an important component of the regional housing system and are located in areas with more diverse populations, lower socioeconomic status, and larger families. MHPs are concentrated in moderately urbanized areas relatively close to the central business district with lower housing costs and moderate job opportunities. They are clustered near other MHPs in areas with less access to transportation and urban amenities and greater exposure to environmental hazards. We demonstrate that the location of MHPs is associated with exclusionary land use regulations, which indicates future parks will likely be in areas with significant inequalities.

**Takeaways for practice:** MHPs are difficult to analyze because they are not identified in typical sources of planning data like the U.S. Census. Planning departments should use alternative methods, like those described in our study, to map and plan for MHPs. Most major cities and metropolitan regions are facing an affordable housing crisis, and the anti-MHP regulatory stance we observed in our study is concerning for regional equity. The concentration of MHPs in areas with significant environmental hazards indicates that planning actions are likely necessary to protect these residents from future flood events.

**Keywords:** affordable housing, flood risk, land use regulations, mobile/manufactured homes, regional equity

### Manufactured Housing and Mobile Home Parks

**M**anufactured homes—housing units with a permanent chassis that are built in a factory and transported to a site for installation—are a major source of affordable housing in the United States. There are more than 8.5 million manufactured homes in the United States, in virtually every state and metropolitan region (U.S. Census Bureau, 2017). Although the census refers to these as *mobile homes*, the count represents all factory-built homes on a permanent chassis, which includes both mobile homes and manufactured homes. There is a semantic tendency to conflate the two, but they are distinct housing types. A *manufactured home* refers to a factory-built home on a permanent chassis that was built after 1976 when the Department of Housing and Urban Development (HUD) instituted the Manufactured Home

Construction and Safety Standards (the “HUD code”). A *mobile home* is a factory-built home on a permanent chassis built prior to the 1976 HUD code. The 2011 American Housing Survey estimates 26% of all manufactured homes are technically pre-1976 mobile homes (Furman, 2014). *Modular homes* are not governed by the HUD code and are not located in rental mobile home parks (MHPs) because they must be constructed on a permanent foundation and built to the same state and local building codes as site-built homes.

In this article we use the term *manufactured home* to refer to both mobile and manufactured homes. About one-third of manufactured homes are placed in MHPs, which are unique land lease communities where households own their housing unit but rent the land underneath (Housing Assistance Council, 2011; Kochera, 2001; Manufactured Homeowners Association of America, 2011). This divided tenure contributes to

“extreme levels of affordability” in MHPs because households place lower-cost homes on land they can rent from month to month (Durst & Sullivan, 2019, p. 891).<sup>1</sup> We use the common term *mobile home park* to refer to the land lease communities where these homes are placed, because most regulatory planning documents use this term.

Economies of scale are achieved through the factory production of manufactured homes. These prefabricated homes cost, on average, half as much per square foot (\$59.14) as site-built, single-family homes (\$122.12; U.S. Census Bureau, 2021). Lower production costs, combined with a need for affordable housing, have enabled the spread of manufactured homes over the last 4 decades (Sullivan, 2017a). Approximately 18 million U.S. residents live in manufactured housing, especially in the southern and western parts of the country (U.S. Census Bureau, 2017). These homes provide one of the largest sources of unsubsidized affordable housing in the United States, as well as the country’s primary mechanism for low-income homeownership (Corporation for Enterprise Development, 2011). In 2011, manufactured homes accounted for 30% of new homes under \$200,000, 50% of new homes under \$150,000, and 71% of new homes under \$125,000 (Manufactured Housing Institute, 2012).

Manufactured homes located in MHPs are uniquely affordable due to the divided tenure where households rent the land under their homes. MHPs house a population with lower incomes than are living in other forms of housing or in manufactured housing outside of MHPs. Durst and Sullivan (2019) found that 31% of households in MHPs nationally are living in poverty, a higher rate than that among conventional homeowners (9%), renters (15%), and manufactured homeowners living on owned land in informal subdivisions (20%). Divided tenure also contributes to *housing insecurity* in MHPs, because households live “at the whim of property owners” and parks themselves are vulnerable to closure and redevelopment (Consumers Union, 2001, p. 1; Sullivan, 2018).

The affordability of housing in MHPs, along with the insecurity of residents in them, makes MHPs a crucial subject of study, yet MHPs remain largely invisible in the planning literature, with some important exceptions (e.g., Pierce et al., 2018). Our study aims to fill that gap by identifying and characterizing MHPs across a large metropolitan region. We asked several fundamental questions: How are MHPs spatially distributed within a regional housing system? How do the sociodemographic characteristics, built environment features (housing, density, accessibility), and exposure to environmental hazards in areas with more MHPs compare with those of areas with fewer or no MHPs? And how

are the locations of MHPs associated with local land use regulations?

We answered these questions through a study of mobile home parks in the Houston (TX) metropolitan statistical area (MSA), the fifth most populous and second fastest-growing MSA in the United States (U.S. Census Bureau, 2019). In the section that follows, we describe the Houston MSA, our method for geolocating MHPs, the spatial variables for our analysis, and our collection and analysis of land use regulation documents. We then present the findings from a comparative analysis of block group characteristics in the Houston MSA by the share of block group land occupied by MHPs. We compare how MHP locations intersect with the planning and regulatory frameworks of the 132 local governments in the Houston MSA. Finally, we discuss four key findings from our study. First, MHPs provide significant affordable housing, particularly in moderately dense urban areas. Second, MHPs are home to diverse populations that face significant spatial inequalities, including greater exposure to industrial and flood hazards. Third, the regional landscape of land use regulations will continue to locate MHPs in areas with significant inequalities relative to other areas in the region. Finally, existing data sources and methods are insufficient for planners to adequately account for MHPs, but further research could substantially improve planners’ understanding of this important source of housing.

## Spatial Inequality and Mobile Home Parks

We define *spatial inequality* here as patterns in the built environment whereby burdens and amenities are unequally distributed across geographic space. Studies of spatial inequality demonstrate that people living in lower-cost housing in metropolitan areas contend with segregation, less access to job opportunities, inadequate infrastructure, and disproportionate losses from hazards, disasters, and the effects of climate change (e.g., G. R. Carter, 2011; Hendricks et al., 2018; Mohai & Saha, 2007; Peacock et al., 2007; Rodríguez-Pose & Storper, 2020). Yet, these studies focus on site-built owned or rented housing and largely exclude MHPs.

The relatively limited research on manufactured homes—and an even more limited literature on MHPs—documents their residents’ specific challenges. In North Carolina, Shen (2005) found that manufactured homes are sited on land further from community facilities, services, and employment centers compared with other housing. Hazards researchers have shown that manufactured homes are more likely to be located in hazardous areas like floodplains than site-built housing (Baker et al., 2014; Shen, 2005; Simmons & Sutter, 2007). Pierce and Jimenez (2015), in a rare study that examined

MHPs separately from all manufactured housing, found that living in an MHP is significantly and negatively correlated with water service reliability compared with other housing. In addition, Pierce et al. (2018) mapped the inferior environmental and basic service conditions in neighborhoods with MHPs across Los Angeles County (CA).

Our study builds on these studies in three important ways. First, we investigated MHPs across the entire Houston MSA, a large and geographically diverse region that encompasses 132 urban, suburban, and rural jurisdictions. Second, we built an original data set that uses multiple independent sources rather than a sole secondary source. Our rigorous methodology for MHP identification, discussed below, rendered these MHPs visible and gives a more accurate account of the number and location of all MHPs in the MSA. Third, we examined the explicit ways in which jurisdictions in the MSA treat MHPs in their land use plans and regulations, which furthers the understanding of their spatial development patterns, now and in the future. *Land use plans and regulations* is a broad term we use to refer to the policy frameworks and regulatory mechanisms that governments use to govern land development (Berke et al., 2015). Local governments play a central role in the U.S. housing system because they typically allocate land for future development; use zoning and other regulations to specify housing structures permitted on private land; and set standards for density, design, infrastructure, and basic service delivery (Hirt, 2015). In other words, local governments can typically influence *where* development happens and *what* is built, including MHPs.

Readers may wonder whether Houston—which famously does not use zoning regulations—is representative of other metropolitan areas. We have two responses. First, an extensive body of research shows the City of Houston’s use of other land use tools, along with the widespread use of private deed restrictions and covenants, shapes urban development in ways similar to zoned U.S. metros (Buitelaar, 2009; Fisher, 1989; Kapur, 2004; Phillips, 1990; Qian, 2010; Siegan, 1972; Vojnovic, 2003). Second, the City of Houston is just one jurisdiction among many. We included all of Houston’s 132 jurisdictions in this study. Across the MSA, more than two-thirds (67%) of the jurisdictions have zoning regulations, like other metropolitan regions.

From a planning and administrative perspective, large metropolitan areas like the Houston MSA are a collection of local governments, each with their own authority to regulate land uses and control development within their jurisdictional boundaries. Municipalities in Texas have the power to enact a zoning ordinance to regulate the height and size of buildings, the size of lots and density of population, the location and use of buildings, and other aspects of land

and improvements thereon, and the uses to which they are put. (Texas Municipal League, 2019, p. 34; Local Government Code 211.003)

Historically, researchers have shown that manufactured homes are the object of exclusionary zoning (Dawkins & Koebel, 2009; Flippen, 1974; Sanders, 1986). This has kept them out of wealthy, suburban areas (Papke, 2009) and located them in industrial and commercial zones in less desirable locations on the periphery of cities (Beamish et al., 2001; Dawkins et al., 2008; Drury, 1972; Pierce et al. 2018) and rural areas (Geisler & Mitsuda, 1987). The regulatory treatment of manufactured homes has led developers to locate MHPs adjacent to or outside of city boundaries in what Hirt (2015) classified as areas with “different land area standards.” This has produced spatial clustering of manufactured homes in places that allow them. Durst and Sullivan (2019) demonstrated that manufactured homes in the United States are highly segregated from other types of housing. Our study is the first to empirically test these relationships across a large metropolitan area with dozens of local governments, which is important for understanding the likely *future* patterns of park development given the uneven landscape of local land use regulations.

## Spatial and Regulatory Analysis of the Houston Metropolitan Region

Our study spans the nine-county Houston MSA, a region roughly the size of Massachusetts (Figure 1). The MSA includes the City of Houston and Harris County—the population, industrial, and commercial core of the region—as well as coastal counties with significant tourism, shipping and petrochemical industries, and inland rural and agricultural counties. Texas has the second most manufactured homes of any state in the United States (following Florida). The largest share of Texas’s roughly 1.9 million mobile home residents (17.7%) live in the Houston area (U.S. Census Bureau, 2017). There is no available inventory of MHPs in Texas, which is typical in the United States and an important data limitation for planning researchers. The U.S. Census does count manufactured homes but does not indicate whether they are located in MHPs, thereby combining manufactured homes located in MHPs with those located on privately owned land. Most states rely on local and county governments to keep records of MHPs, but these vary significantly in their accuracy—if they exist—and are difficult to standardize (Furman, 2014).

It was therefore necessary to create a unique geolocated database of MHPs in the Houston MSA. Following the methodology formulated by Sullivan (2017b), we gathered County Appraisal District (CAD) land use records from each county for the year 2017 to

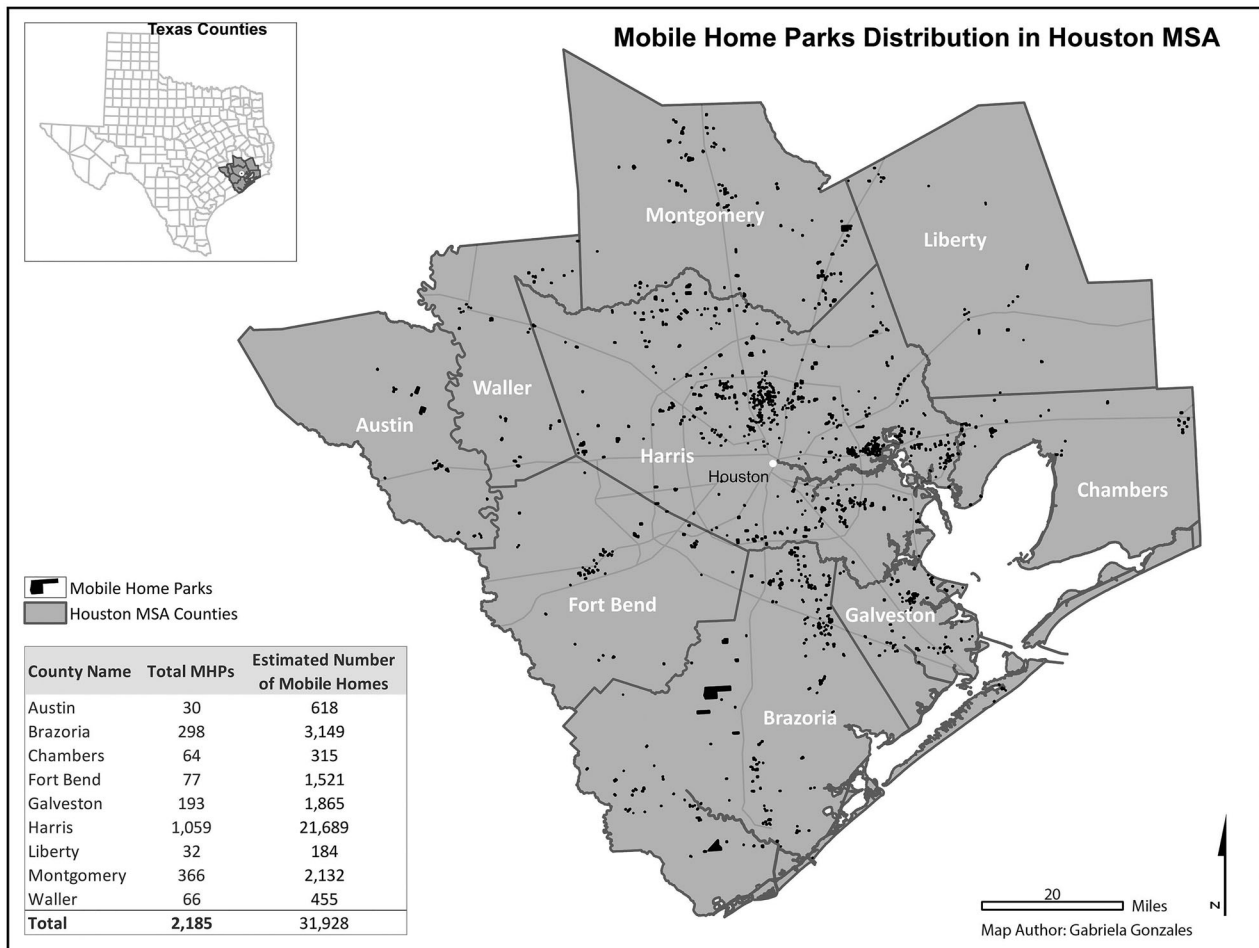


Figure 1. Mobile home parks distribution in the Houston MSA (2017).

track MHP land uses. CAD records are a crucial source of accurate land use data in Texas because they are updated for each parcel (lot) within a county every year and are thus more up to date and nuanced than data from other sources, including the U.S. Census Bureau (Hayslett & Kane, 2011). We imported the assembled CAD land use records into a GIS environment, where we used parcel identifiers to geo-locate all parcels where the CAD had a code for “mobile home park,” or the like, as a land use. We then cross-checked these parcels with national data sets on the locations of MHPs from the U.S. Department of Homeland Security (DHS, 2018), Reference USA business data (Data Axle, 2018), and a real estate website for MHPs, MHVillage (n.d.). We geo-coded the locations and addresses and then visually and manually adjusted them to actual parcel boundaries using Google Earth. This process revealed significant gaps in each of these data sources. Notably, DHS’s geospatial MHPs layer—which is constructed via a combination of aerial photography, satellite imagery, and web crawling of existing databases—significantly undercounted the number of MHPs and included many misclassified parcels like self-storage lots, tractor-trailer

parking lots, and businesses that sell manufactured homes and RVs.<sup>2</sup> We return to this point in the discussion below.

With our methodology we constructed a database that identified 2,185 mobile home parks in the Houston MSA. We then created a protocol for counting manufactured housing units within MHP boundaries and used Google satellite and Street View imagery to conduct a visual analysis of a sample of MHPs.<sup>3</sup> These counts allowed us to estimate the average per acre density of parks in different counties, which we then applied across the entire database to estimate the number of manufactured homes located within MHPs in our study area. We estimate there are 31,928 manufactured homes in MHPs in the Houston MSA, the most current accurate estimate for the MHP housing stock in a major metropolitan region.

### Block Group Characteristics and MHPs

Next, we collected sociodemographic, housing, measures of access, and environmental exposure variables for all block groups in the Houston MSA to compare



conditions in block groups with larger numbers of MHPs with those with fewer or none. We gathered basic sociodemographic and housing variables from the American Community Survey (ACS) 2013–2017 5-year estimates. We collected measures of access, including indicators of accessibility such as block size (for walkability) and density, transit quality, and employment mix and job density, from the HUD Location Affordability Index based on the 2013–2017 ACS and the Center for Neighborhood Technology's AllTransit database (2017). We also gathered land use data from the Houston–Galveston Area Council of Governments (H-GAC) to identify industrial land. Finally, we collected data on the regulatory (100-year) floodplains for each block group by assembling data from the Federal Emergency Management Agency's National Flood Hazard Layer (FEMA, 2019).

We then linked our inventory of MHP parcels to U.S. census block groups. We classified block groups as zero (Group 1), lower (Group 2), moderate (Group 3), or higher (Group 4) prevalence of MHPs based on the distribution of MHP land area within each block group using the *K*-means clustering method.<sup>4</sup> Because block groups vary in size based on population density and MHPs vary in size, we used percentage of land in MHPs rather than total acreage or number of parks in a block group (Table 1).<sup>5</sup>

### Land Use Regulation Analysis

We asked how local government land use regulations and tools influence the spatial distribution of MHPs across the metropolitan region. We first created a list of all local governments with land use regulating authority in the Houston MSA using the member directory of the Texas Municipal League and other sources like the H-GAC and HUD. We identified a total of 132 local governments (9 counties and 123 municipalities). We then collected electronic copies of each government's land use regulation documents using their website or by contacting local government staff. These included, if applicable, the local government's a) comprehensive plan, b) zoning code, c) development code, d) manufactured home park ordinance or overlay zone, e) subdivision ordinance, and/or f) land use plan. Private landowners and neighborhoods may further restrict development through the use of tools like restrictive deeds and covenants, often enforced through homeowners' associations. It was beyond the scope of this study to collect and analyze those private tools. Together the documents we analyzed constitute the regulatory framework for development in those jurisdictions.

For each community, a research assistant prepared a written summary of each land use regulation and/or tool and how it addresses MHPs. They then described the steps that would be required to gain approval for

developing a new MHP and to keep an existing park operating in each jurisdiction. This allowed us to see how MHPs are treated within the network of plans and regulatory policies that guide a jurisdiction's development (rather than relying on any single regulation or tool). We noted differences in language and administrative procedures between jurisdictions. Based on these summaries, we assigned each city or county a "tolerance score" that generally describes its regulatory posture toward MHPs.<sup>6</sup>

- Tolerance Score 0 (Jurisdictions  $N = 23$ ): There are no local government land use regulation documents available for review.
- Tolerance Score 1 (Jurisdictions  $N = 10$ ): The local government *explicitly* prohibits MHPs.
- Tolerance Score 2 (Jurisdictions  $N = 34$ ): The municipality or county *effectively* prohibits the development of MHPs. For example, a local government does not strictly prohibit parks but provides no viable pathway for their development because of other restrictions or requirements.
- Tolerance Score 3 (Jurisdictions  $N = 27$ ): The municipality or county allows the development of MHPs but with significant restrictions on their size or other characteristics like housing unit density. In other words, they are tolerant of some types of MHPs but not others.
- Tolerance Score 4 (Jurisdictions  $N = 38$ ): The city or county allows the development of MHPs of different kinds, with minimal requirements as allowed or required by state law.

At each step in the above analysis, we had another research assistant or author independently conduct the same analysis on a sample of jurisdictions or plans to test for intercoder reliability and reduce potential bias.

To understand how these different levels of tolerance in land use regulations shape the distribution of MHPs, we used a geospatial overlay to join all block groups to the boundaries of 132 jurisdictions within the MSA. We calculated the land area overlap of block groups and municipal boundaries. Of the 3,019 census block groups in the nine-county Houston MSA, the land area of 2,604 block groups is 80% or more within one municipality. The remaining 415 block groups span multiple municipalities. For these block groups, we used a weighted proportional share to assign a tolerance score, which we rounded to the nearest whole number to retain our categorical variable.

### Spatial Analysis of MHP Location

In this section we compare sociodemographic, housing, measures of access, and hazard exposure characteristics

**Table 1. Classification of block groups by percentage of land occupied by MHPs.**

	<b>Group 1</b> <b>No MHPs</b> <b>(N = 2,400)</b>	<b>Group 2</b> <b>Lower share of MHPs</b> <b>(N = 153)</b>	<b>Group 3</b> <b>Moderate share of MHPs</b> <b>(N = 237)</b>	<b>Group 4</b> <b>Higher share of MHPs</b> <b>(N = 228)</b>	<b>Region</b> <b>(N = 3,018)</b>
% BG land in MHPs	0	>0–0.14	0.14–1.18	1.18–23.10	0.23
Total no. of MHPs	0	279	640	1,272	2,191
Average of BGs					
% of land in MHPs	n/a	0.06	0.54	4.03	0.35
BG size (mi <sup>2</sup> )	1.87	15.67	4.33	1.59	2.74
MHP size (acres)	n/a	2.62	6.06	20.28	10.46
MHP acres	n/a	4.51	12.25	37.56	4.03
No. of MHPs by county and group					
Austin	0	15	11	4	30
Brazoria	0	39	165	93	297
Chambers	0	22	29	13	64
Fort Bend	0	14	32	33	79
Galveston	0	12	53	129	194
Harris	0	93	271	699	1,063
Liberty	0	21	11	n/a	32
Montgomery	0	22	43	301	366
Waller	0	41	25	n/a	66

Note: The number of total MHPs in this table (2,191) is greater than the total number of parks in our database (2,185) due to six MHPs that span two block groups in which each block group is in a different classification group. BG = block group.

of block groups within the four groups described in Table 1, which broadly categorize block groups with zero, low, moderate, or high prevalence of MHPs. This allows us to compare characteristics across block groups based on how much land within a block group is occupied by MHPs. We used one-way analysis of variance tests, either the F-test for variables with data that were normally distributed, homogeneous, and linear (2 of the variables) or the Kruskal-Wallis test for the other variables that are nonparametric across the four groups.

There are several statistically significant sociodemographic differences across the four groups of MHP concentration (see Table 2). First, as the proportion of land area occupied by MHPs increases in a block group, that block group is characterized by households with characteristics that represent greater vulnerability. They have lower average household incomes, larger (4+ persons) households, more children under 5 years old (but fewer adults over 64 years old), lower educational attainment, lower shares of non-Hispanic Blacks, higher shares of Hispanic/Latino households, and higher shares of linguistically isolated households. There are also more family households.

The housing stock also differs significantly across the four groups. Similar to the sociodemographic variables, there is a similar positive or negative linear relationship as the share of land occupied by MHPs

increases. Population density, housing units per acre, and number of large multifamily buildings with 50 or more units are much lower in block groups with MHPs. The low densities identified in Groups 2 and 3, in which most of the block groups with MHPs are outside of Harris County (see Table 1), are consistent with other research that shows MHPs are absent from the densest and most highly urbanized parts of the city (Sullivan, 2017b). Notably, mobile homes (per the ACS housing type) make up nearly 23% of all housing units in blocks groups with the largest shares of land area occupied by MHPs but only 2% of all housing units in blocks groups with no MHP land (ACS 2015–2019). MHPs also tend to be clustered in block groups with other MHPs, indicating they are relatively segregated from both low-density single-family and higher density rental housing, a pattern that Durst and Sullivan (2019) observed nationally.

In terms of housing costs, both median gross rents and median home values fall as the share of MHP land increases. This indicates MHPs are highly represented in areas of the lowest-cost housing in the MSA. MHPs likely contribute to the lower average costs in these areas because they are generally not in the same block groups with large shares of multifamily properties. In this way, they fill a gap in market affordable housing left by a dearth of rental units. MHPs are also in areas with

**Table 2. Mean comparison of block group characteristics by share of block group with MHPs.**

	Group 1 No. MHPs	Group 2 Lower share of MHPs	Group 3 Moderate share of MHPs	Group 4 Higher share of MHPs	Total	Sig*
% of BG land with MHPs	0	>0–0.14	0.14–1.18	1.18–23.10		
Sociodemographics of BG						
Avg. HH income (\$)	94,739	82,607	79,575	67,788	90,897	.000
% Family HH	69	74	74	75	70	.000
% HH with 4+ persons	26.9	30.2	32.6	35.5	28.1	.000
% Children under 5	6.8	6.7	7.3	8.2	7.0	.000
% Adults over 64	12	13	11	10	12	.000
% Less than high school education	18.5	21.7	22.8	30.9	19.9	.000
% Black HH	18.8	11.3	10.7	10.2	17.1	.000
% Hispanic/Latino HH	36.1	34.8	45.6	57.4	38.3	.000
% White HH	65.1	77.6	77.4	75.5	67.5	.000
% Linguistically isolated	10	7	11	18	11	.000
Housing and density in BG						
Pop. density/mi <sup>2</sup>	6,225	1,267	2,116	3,603	5,453	.000
Housing units/acre	4.0	0.7	1.2	1.9	3.5	.000
% MF with 50+ units	7.1	2.1	2.8	2.5	6.2	.000
% Single-family detached	64	70	66	57	64	.000
% Mobile homes in ACS <sup>a</sup>	2.0	16.8	14.7	22.5	5.3	.000
Median home value (\$)	209,473	137,900	142,145	116,373	193,571	.000
Median gross rent (\$)	1,122	986	960	939	1,088	.000
Median year built	1978	1986	1983	1982	1979	.000
Measures of access						
Distance to Houston CBD	16	32	25	20	18	.000
Business/employment mix	90.9	86.3	88.1	89.5	90.3	.000
Access to all jobs in region	45,743	12,243	18,361	24,842	40,315	.000
No. of highway exits	0.2	0.8	0.8	0.3	0.3	.000
Walkability (blocks/acre)	0.14	0.05	0.08	0.09	0.13	.000
% Carpool to work	10.6	8.8	10.9	13.0	10.7	.000
% Drive alone to work	78.9	84.1	81.6	79.7	79.4	.000
% Public transit to work	2.8	0.9	0.8	1.3	2.5	.000
Transit connectivity index	3.4	0.5	1.0	1.3	2.9	.000
Park space/capita (ft <sup>2</sup> )	2,547	20,650	1,179	312	3,174	.000
Hazard exposure						
% Land in 100-year floodplain	18.7	31.0	24.8	18.9	19.0	.000
% Land zoned industrial	4.8	5.3	4.7	6.0	5.0	.000

Note: a. The ACS counts mobile homes but not whether they are in parks. \* $p \leq .01$ . BG = block group; HH = household; MF = multifamily rental property.

relatively newer housing stock, based on the median year built, which is another indicator they are located in more recently developed areas rather than in the older urban core.

Measures of access related to employment opportunities, types of nearby businesses (e.g., for access to goods and services), transportation choices, and parks also vary significantly across the groups. Again, block



groups with no MHPs (Group 1) are distinct across the range of access measures we tested. These block groups have the lowest distance to the central business district (CBD) and lowest average number of highway exits. As a result, they have the highest access to all jobs in the region, a mix of nearby businesses, walkability (due to smaller and denser blocks), and transit connectivity. Among the block groups with MHPs, there remains a linear relationship with the share of block group land in MHPs. This linearity coincides with measures of greater urbanization. As the share of land in MHPs increases, so does the diversity of local businesses, access to the region's jobs, walkability, and transit connectivity and frequency. At the same time, distance to the CBD, the number of highway exits, and the percentage of commuters who drive alone all decrease as the share of land in MHPs increases. But Group 4 also exhibits two outliers: the share of workers carpooling is highest across the four groups and much higher than the regional average (13% vs. 10.7%), and the park acreage per capita is significantly lower than the other groups and the regional average, just 312 acres compared with 3,174 acres for the region. Considered alongside the housing trends, this indicates once again that MHPs are a considerable share of housing in areas that are urban-facing (i.e., within 20 miles of the CBD), where job opportunities are relatively higher than in further-out suburban and exurban parts of the region and where moderately dense housing is available and affordable via both newer single-family construction and manufactured homes.

Finally, we examined the potential exposure of block groups to environmental hazards based on two variables: the share of land in the regulatory (100-year) floodplain and the share of land zoned for industrial uses. Floods are the most common and costly environmental hazard in Houston and the United States. For block groups with MHPs, the average share of land in the 100-year floodplain was higher than the average in block groups without MHPs (Group 1), although the share in Group 4 (18.9%) was significantly lower than that for Groups 2 and 3 (31% to 24.8%, respectively) and nearly the same as that for Group 1 (18.7%). This is likely because the block groups with the largest share of MHPs are more urbanized, as discussed, which likely translates into greater infrastructural investment to reduce the size of the floodplain. Areas zoned for industrial uses have been shown to have higher exposures to environmental pollutants like airborne particulates and soil contamination (Gabbe, 2018; Maantay, 2001). All block groups where MHPs are present have a significantly higher portion of land zoned industrial and block groups with the largest share of MHP land (Group 4) also have the largest share of industrial land.

## Land Use Regulation and the Spatial Distribution of MHPs

These findings show that residents of mobile home parks in the Houston MSA likely face distinct inequalities relative to residents of block groups without MHPs. How are land use regulations in the MSA associated with the spatial patterns of MHPs we observe?

As described earlier, we coded each jurisdiction's collective land use plans and regulations and assigned them a tolerance score based on the permissibility of MHP development within that jurisdiction (Table 3). For the purposes of this analysis, tolerance scores of 1 or 2 are largely synonymous because both effectively prohibit new MHPs from being built within those jurisdictions, either by explicit prohibitions or by default. We then asked whether there were more MHPs, larger MHPs, and more MHP land in municipalities and counties that are more tolerant of such developments. We also asked how the demographic and housing characteristics of the 132 jurisdictions varied in relation to their tolerance scores.

First, we found that regulatory exclusion of MHPs is pervasive. Of the 114 jurisdictions with available land use plans and regulations, 36 jurisdictions (31.5%) prohibit or effectively exclude MHPs. Local governments' regulatory tolerance of MHPs is significantly related to the total number of MHPs located there, with more tolerant jurisdictions having more MHPs. Jurisdictions with the least restrictive regulations also have larger MHPs, more acreage of land devoted to MHPs, and larger shares of jurisdiction land devoted to MHPs; these differences are significant across categories. There is also more total MHP acreage in the most tolerant places; jurisdictions with a tolerance score of 4 (minimal restrictions) have nearly 12 million square feet of land for MHPs. The most tolerant places also have a much greater share of land devoted to MHPs, 8.2% versus just 2.4% and 0.5% in jurisdictions that prohibit or effectively exclude MHPs, respectively.

Among the jurisdictions we were able to code, those that are more tolerant of MHPs tend to have larger and more diverse populations, with fewer White households and more Black and Hispanic or Latino households. Jurisdictions that are tolerant of MHPs are characterized by lower socioeconomic status, measured in terms of significantly lower median household income, larger average household size, and fewer residents with college degrees. Jurisdictions that explicitly or effectively prohibit MHPs have 9% to 10% of households living in poverty, compared with 14% to 15% for jurisdictions that are more tolerant.

These more tolerant jurisdictions (scores of 3 and 4) also have a significantly different housing stock than jurisdictions that prohibit or exclude them; they have

**Table 3. Mean comparison of regulatory tolerance of MHPs by characteristics of MHPs and jurisdictions.**

Jurisdiction characteristics	Tolerance level of MHPs in jurisdiction planning regulations					Regional mean	Sig.
	N/AV (N = 18)	1–Explicit prohibition (N = 9)	2–Effective exclusion (N = 27)	3–Significant restrictions (N = 25)	4–Minimal requirements (N = 30)		
Land area and presence of MHPs							
Jurisdiction (mi <sup>2</sup> )	242	21	631	249	298	343	.195
No. of MHPs	4.6	2.8	4.3	9.0	43.3	16.4	.000
Avg. MHP size (ft <sup>2</sup> )	446,138	178,829	141,914	151,263	269,408	248,739	.000
Total MHP (ft <sup>2</sup> )	306,220	666,524	579,013	2,024,052	11,941,931	4,104,830	.000
% Land in MHPs	0.3	2.4	0.5	3.5	8.2	3.4	.000
Demographics							
Total population	1,107	6,759	15,120	17,876	146,263	50,362	.000
% Family HH	0.74	0.66	0.74	0.67	0.73	0.72	.013
Avg. HH size	2.8	2.4	2.8	2.7	2.9	3.0	.005
% White HH	0.80	0.86	0.78	0.74	0.73	0.77	.050
% Hispanic/Latino HH	0.18	0.16	0.23	0.28	0.34	0.26	.003
% Black HH	0.12	0.08	0.08	0.15	0.12	0.11	.042
Median HH income (\$)	70,758	77,317	109,270	59,665	64,999	77,534	.006
% Population in poverty	0.14	0.10	0.09	0.15	0.14	0.13	.007
% Bachelor's degree	0.12	0.21	0.21	0.15	0.15	0.17	.024
Housing							
Median house value (\$)	207,952	206,760	427,570	160,462	162,406	241,311	.044
Median gross rent (\$)	879	1,256	1,248	918	1,085	1,070	.004
% Rental housing	0.19	0.26	0.25	0.37	0.31	0.29	.004
% Single family	0.72	0.78	0.79	0.64	0.70	0.72	.028
% Mobile homes (ACS)	0.18	0.06	0.09	0.12	0.11	0.12	.002

Note: Significance based on  $p \leq .05$ . HH = household.

lower home values and rents, fewer single-family detached homes, and more renters.

Last, unincorporated (county) areas are more tolerant than incorporated municipalities—with an average tolerance score of 3.6 compared with 2.36 for all jurisdictions—and are home to 56% of the region's MHPs. This is partly due to the limited power of county governments to regulate development; although counties are able to require specific infrastructure and hazard mitigation requirements for park developments, most do not.

## Discussion and Conclusion

These findings show that MHPs play an important role in the larger system of housing, including affordable housing, in the Houston MSA. Although public perception and recent scholarship (e.g., Salamon & MacTavish, 2017) focus on MHPs as *rural* housing, our analysis

reveals that MHPs provide tens of thousands of housing units in urbanized metropolitan areas. Although MHPs are mainly absent in the densest parts of the metropolitan area (Group 1), the block groups with the greatest share of land in MHPs (Group 4) are in moderately dense areas. Our analysis also shows, for the first time, the statistical association between local land use regulations and broader patterns of spatial development of MHPs. Methodologically, our study indicates the need for new procedures to more accurately, and efficiently, track the location of MHPs and the millions of residents who live in them. In this final section we discuss several key findings from the above analysis and describe avenues for further research.

*MHPs are home to diverse populations and face significant inequalities.* MHPs are located in areas with many large households, households with children, Hispanic/Latino households, and households who have, on average, lower incomes and less education and are

more linguistically isolated. We also found that residents of nearly half the MHPs in the region likely face important spatial inequalities compared with residents in other parts of the region, like segregation by housing type and socioeconomic status, fewer transportation choices, greater distances to jobs, and higher exposure to environmental hazards. Further, residents in the block groups with the highest concentrations of MHPs (Groups 3 and 4) have only a small fraction of the park space per capita as residents in other areas. These findings largely support qualitative and case-based studies discussed earlier and add important empirical depth to a small but growing literature on the treatment of MHPs as a dimension of regional inequality in the United States.

*MHPs are market-rate affordable housing.* MHPs in the Houston MSA are located mostly in moderately urbanized census block groups compared with dense urban or sparsely populated rural places. Of the block groups with MHPs, as the share of MHP land increases, the block groups are significantly closer to the CBD, have significantly lower housing costs, and are closer to significantly more job opportunities. In light of these findings, we argue that MHPs likely provide an important source of market-rate affordable housing within a dynamic labor and housing market in areas where there are likely fewer affordable housing options, particularly multifamily rental units.

*MHPs are segregated from other housing.* About two-thirds of block groups in the MSA have no MHPs, and these block groups also have very few manufactured home units overall; manufactured homes account for only 2% of all housing units in block groups with no MHP land, according to ACS estimates. Meanwhile, manufactured homes account for more than one-fifth of housing units (22.6%) in block groups with the largest shares of land area occupied by MHPs. Block groups with the most MHPs also have the lowest share of single-family units (57%) and large multifamily rental properties, just 2.5% compared with 7.1% in block groups without MHPs.

*MHPs are excluded from wealthier, whiter, and incorporated areas.* Our analysis shows that MHPs are regulated differently across the MSA. Communities that exclude MHPs tend to have significantly higher median incomes, educational attainment levels, housing values, and mean rents and are less racially diverse. Conversely, communities that permit MHPs are less likely to be incorporated, which means the county acts as the local government and may not provide the same level of services as an incorporated municipality. Moving forward, these uneven patterns of land use regulation mean that MHPs will be built (or rebuilt, after disasters) in the places where they already tend to exist, namely, communities with larger shares of Hispanic/Latino

households, households with lower incomes, and households in poverty.

*MHPs are disproportionately exposed to environmental hazards.* In line with a growing body of scholarship that finds MHPs are in areas exposed to environmental hazards (Flanagan et al., 2011; Shen, 2005; Simmons & Sutter, 2008), we found that areas with MHPs have, on average, greater amounts of land in the 100-year floodplain, which is particularly striking in the lower density areas (mainly Groups 3 and 4). This has potentially important equity implications because residents of MHPs are especially vulnerable before and after disaster due to a variety of socioeconomic and place-based factors (Rumbach & Makarewicz, 2016; Rumbach et al., 2020). Further study is needed to understand whether MHPs themselves are disproportionately located in regional floodplains and, if so, whether increasing urbanization may work to mitigate those threats. Most areas where MHPs are present also have a significantly higher portion of land zoned industrial compared with the regional average and block groups without MHPs, indicating MHP residents are likely exposed to higher levels of air and soil pollution that are correlated with industrial uses.

Our analysis here indicates three avenues for future research. First, the construction of our database revealed inadequate, inconsistent, or missing local records on MHPs and systematic errors of omission in national databases like the one maintained by DHS. These data gaps are notable because Texas, like most other states, does not keep an inventory of MHPs. The U.S. Census, which is a critical source of data on housing generally, only records whether a housing structure is a manufactured home, not its location inside or outside an MHP. Planners and plan-making processes that rely on these data sets are likely to have a wholly inaccurate understanding of this important source of housing. The construction of our database also revealed significant gaps in county data on the locations of MHPs. This oversight may itself contribute to vulnerabilities for MHP residents by leaving them out of local, county, and regional plans for additional infrastructure investments, such as sidewalks, schools, transit, commercial uses, social services, and jobs, as well as hazard mitigation. Our experience points to a need for a robust and comprehensive way to identify MHPs nationwide, perhaps using remotely sensed imagery and object classification (e.g., Durst et al., 2021).

A second avenue of future research is also a key limitation of this study. Though our study is innovative because of our database of MHPs, the scope of our analysis remains limited to a single metropolitan region. We believe the Houston MSA is comparable with other fast-growing cities in the Sun Belt region that are often characterized by sprawling land use patterns and weak state

land use controls. Nevertheless, additional studies of other metropolitan areas are crucial for comparison, especially in different regions of the United States.

The final avenue for future research builds on one of the primary contributions of this study. Our analysis of MHPs revealed the inequalities faced by MHP residents in Houston *today*. By analyzing the land use regulations of the local governments in the MSA, we also begin to understand the *future* trajectory of MHP development. Our findings show that MHPs will be excluded from large parts of the metropolitan area and relegated to areas where MHP residents will face significant spatial inequalities if local land use regulations stay the same and infrastructure and private sector investments follow their current paths. Yet, we know that land use regulations change over time, and in the case of MHPs, we expect local governments to become *more* prohibitive over time and often as a response to the presence of existing MHPs.

Notably, we found MHPs in places that are currently not tolerant of them, which indicates that jurisdictions' plans have changed, and although existing parks may be "grandfathered," new parks are unlikely. Sullivan's (2018) ethnographic account located in one Houston jurisdiction, for example, showed that the local government passed stricter MHP regulations in response to the proliferation of MHPs in that community, and new ordinances led to the closure of MHPs and the relocation of residents outside the jurisdiction. Are other local governments similarly "zoning out" MHPs, and what community characteristics predict the likelihood that they will become more exclusionary toward MHPs over time? What are the implications of most MHPs being located in unincorporated communities? To explore these issues it will be necessary to study the development of MHPs and planning documents longitudinally. This foundational analysis identifies networks of land use regulations and plans that range from tolerant to highly restrictive of MHPs and associates land use regulations with spatial patterns of MHP locations. With additional longitudinal analysis, researchers could make causal arguments about the evolution of land use regulations and their relationships to the growth and change of MHPs and their surrounding communities over time. This is a next crucial step in understanding this important source of housing.

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#### NOTES

1. Durst and Sullivan (2019) estimated that monthly housing costs for occupants of manufactured homes located in MHPs are \$660.61 compared with \$1,309.86 for site-built traditional owners and \$993.28 for site-built traditional renters.
2. Chambers County had only a corrupted parcel GIS file, so we used the H-GAC data, which we cross-referenced with the national data sets.
3. Project team members analyzed satellite imagery following a protocol for identifying and counting manufactured homes within MHPs. Because the density of manufactured homes tended to vary by size of MHP, we used a stratified random selection scheme based on size of MHPs to calculate average per acre density of MHPs for each MHP size group.
4. The K-means clustering method is a nonhierarchical partitioning method used to examine similarities among observations by engaging internal cohesion and external isolation (Cormack, 1971). We transformed the percentage of block group land in MHPs using a log transformation to create a more normal distribution, given variables with a highly skewed distribution and large number of zeros.
5. We tested these other variables, but the absolute numbers did not capture the geographic location of the MHPs because they do not account for the size of the block group, which varies by location in the region.
6. The purpose was to identify the unique regulation of MHPs, rather than barriers to manufactured housing generally. We acknowledge local land use regulations that restrict mobile homes to MHPs are an important regulatory barrier to the siting of mobile homes and may also constrain mobile homes located outside of traditional parks, but this was not our focus.

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