The Impacts of the Mandatory Housing Affordability (MHA) Program on Spatial Variation in Rents and Housing Prices in Seattle[1]

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Abstract

Reforms aimed at addressing housing affordability have been implemented across the country and the world. In Seattle, the Mandatory Housing Affordability (MHA) program was implemented in 2019. The MHA upzoned certain zones within the city, with new developments in MHA zones required to either build rent-restricted affordable housing units for low-income people, or pay into an affordable housing fund. Studies have shown mixed impacts of programs like the MHA on the housing supply; studies relating to housing and especially rent prices are limited. In this paper, I test for changes caused by the MHA in rent and housing prices in Seattle overall using a difference-in-differences analysis. I also test for spatial variation within Seattle in these rent and housing prices by analyzing the effect of an increase in MHA zone concentration on a ZIP code's rent and housing prices. I find that the MHA caused an overall decrease in housing prices and rents in Seattle. Additionally, I find that the MHA created a spatial increase in housing prices but a decrease in rents. These results provide insight into how policymakers can balance the incentives of such programs with its costs, and how to shape future policies.

The Impacts of the Mandatory Housing Affordability (MHA) Program on Spatial Variation in Rent and Housing Prices in Seattle

1. Introduction

Affordable housing has recently emerged as a central focus of many policymakers' agendas, especially in big cities. Although we have been searching for solutions to homelessness and housing crises for many decades now, the rapid growth of some cities in recent years has exacerbated these issues, in turn making housing that much more unaffordable. In navigating the web of housing affordability policy agendas, it is important to evaluate which ones are effective and which aren't, as well as the characteristics that make certain policies effective.

Though tax credits, homeownership assistance, and rehabilitation programs were the main policy tools used in the past and are still used today, housing policy has evolved and seen a shift in focus. Much of the affordable housing policy space has recently been focused on land-use and regulatory incentives, like upzoning, inclusionary zoning, and mixed-income housing. These policies have gained traction because they can be implemented more locally and tailored to specific neighborhoods.

Such policies offer incentives to developers like tax rebates or permits for increased development capacity. In the case of upzoning, this is not accompanied by any requirements. However, inclusionary zoning policies require developers to either build a certain number of rent-restricted units, or pay into a fund for affordable housing. The goals of such policies are to balance out the cost that the new requirement poses to developers with an incentive. Ultimately, the goal is to increase the supply of affordable housing in the market as well as the overall supply of housing, and to bring prices down. The short term success of such policies rests upon whether the incentive provided to each developer outweighs the added costs, and for how many developers this is the case. In the long run, however, inclusionary zoning policies are likely to generate more affordable housing since once these requirements are imposed they are never removed. If a policy is implemented across most of a city, there is little a developer can do to substitute development in another area, especially if the goal is a high-rise or multifamily development.

One such affordability policy implemented recently was the Mandatory Housing Affordability (MHA) program in Seattle. The MHA created zones within the city, with new developments in MHA zones required to either build a certain number of rent-restricted affordable housing units for low-income people, or pay into a fund for affordable housing (Sightline, 2016, p. 2). Additionally, development capacity within the zones was increased, thus providing an incentive for new developments while requiring a contribution towards affordable housing. The program was initially tested out in 2017 in parts of the city, then rolled out citywide in 2019 after initial success under the preliminary program. Most multifamily and commercial developments are included in MHA zones, and zones with more changes have a higher affordability requirement[2]. MHA zone levels were determined by risk of displacement and access to opportunity, so there can be a variety of rezones within the same neighborhood.

Interestingly, most developers have chosen to pay into the MHA fund, rather than build new units (Trumm, 2021). This suggests that the cost of building units was high compared to the benefits provided by the capacity increase. As of December 31, 2022, the total payments to the MHA were $246.1 million (Seattle Office of Housing, 2023). These funds will be awarded to low-income housing projects. The total payment towards the fund for a development is

[2] Specifically, the zone levels were labeled with suffixes (M), (M1), or (M2), with the suffix M indicating a zone changed to a zone in the same category, M1 indicating a zone was moved to the next highest category, and M2 indicating the zone was moved two or more categories higher. Thus, the suffix indicates the amount of change in zoning. As indicated in the Director's Report, 78% of rezones were M rezones.

determined by its size and zone. For example, a 22,000 sq ft commercial development in Downtown/South Lake Union, with 16,400 sq ft being chargeable for the MHA, is required to pay $171,872 into the MHA (Seattle Department of Construction and Inspections, 2023). The MHA has raised a lot of money, but the contributions required from developers tend to be high, so this might cause developers to choose not to build in MHA zones.

The goals of the MHA were to improve housing affordability by increasing the supply of housing, both overall and specifically for low-income communities. With the potential effects of either improving affordability through increased supply and/or decreased prices, or the opposite, the MHA is a very relevant program within the policy space of affordable housing. Critics of the policy have brought up concerns of the new requirements acting as a tax on developers and new homeowners, thus reducing the housing supply, and preliminary studies have supported this claim. However, there have been similar policies that have resulted in successful creation of affordable housing (Kalugina, 2016). Evaluating the effects of the MHA on other aspects, such as rent and housing prices, homelessness, and affordability measures is the next important step.

Many studies analyzing the MHA and similar policies have focused mainly on the change in new development, both in terms of quantity and location. This paper attempts to shift the perspective to rent and housing prices, and how they vary based on the zones of implementation of the MHA. While the change in supply of housing is important, the change in rent and housing prices is just as significant in measuring the impacts of the MHA and provides a crucial dimension to analyzing such policies. Since these measure the direct costs to anyone looking to rent or buy a home, they will reflect the affordability of housing in the market. Rent prices especially have a relationship with housing affordability, since most people requiring affordable housing intend to rent, not buy. Rent and housing prices together also reflect the condition of the overall market in the area, and how they vary based on location. Thus, this study analyzes the impacts of the MHA on rent and housing prices, as well as the effects of the MHA on spatial variation on rent and housing prices.

I use a two-way fixed effects difference-in-differences model to analyze the spatial impacts of the MHA within Seattle, with the treatment variable defined by an intensity design based on the ratio of MHA zones in a ZIP code. I also conduct a cross-city comparison to analyze the effects of the MHA on rent and housing prices in Seattle overall. I find that a percentage increase in the ratio MHA zones in a ZIP code causes a 14.3% increase in prices and a 13.9% decrease in rents. For Seattle as a whole, the MHA caused a 12.6% decrease in housing prices and a 18.7% decrease in rents. I also find that the effects of the MHA tend to become more negative over time, suggesting its success in the long run to improve housing affordability by reducing rents and housing prices. Thus, the MHA overall helped to increase housing affordability, though there was variation in the areas that reaped the benefits of this improvement.

These results are robust to model specifications such as the comparison cities, the implementation date, and the implementation period. However, the parallel trends assumption for difference-in-difference models cannot be proven, and is not robust for rents. Thus, further analysis of pre-trends is suggested. Additionally, further analysis of the heterogeneity in zoning levels is essential to analyzing the conditions under which programs like the MHA will be successful. The long run impacts of the MHA are also an important factor to consider.

My results add to the literature by analyzing the effects of inclusionary zoning policies on housing prices and rents. Most studies surrounding such policies analyze the effects on the supply of housing, but prices are an important piece of the puzzle. My findings of the spatial increase in prices lines up with findings about the strategic substitution of new developments away from MHA zones. However, the spatial decrease in rents diverges from this finding. This is explained by the workings of the MHA: since most developers choose to pay into the MHA fund rather than build new units, it was possible to have a decrease in rents (through using these funds) while not seeing an increase in housing supply. The increased development capacity also led to increased property values in MHA zones, resulting in the spatial increase in prices. Additionally, while most studies found no significant change in the overall supply of housing in a city where an inclusionary zoning policy was enacted, my findings about the decrease in housing prices and rents remove the ambiguity about the overall effects of such a program. The year heterogeneity analysis also lines up with my expected findings based on previous studies, i.e., that housing prices and rents should begin to decrease in the logn run.

To that end, it appears that the benefits of the MHA program outweighed the costs. Whether a similar program in a different city would have the same results depends on how such a program would be designed and who it would apply to. The MHA strategically chose to designate MHA zones in areas that were at lower risk of displacement due to the rezone, and had higher access to opportunity. Thus, the areas that got the MHA were likely better off to begin with. This creates a discrepancy between the population that essentially received the treatment and the population that didn’t, which may need to be explored more in order to replicate a program like the MHA and its results in another city. Generally, inclusionary zoning policies are likely to see similar results to the MHA if they are structured in the same way, though other policies that may already be in place as well as distinctions in populations may be confounding factors.

The rest of this paper proceeds as follows. In Section 2, I survey the literature related to affordable housing policies and more specifically inclusionary zoning policies. I also look at studies about changes in rent and housing prices due to a policy change, as well as studies about spatial variation in prices. In Section 3, I provide a detailed description of the MHA and its mechanisms. Section 4 describes the data and Section 5 describes the methodology I use for my difference-in-difference analysis. Section 6 presents the main results. Section 7 covers the heterogeneity analysis for heterogeneity by year as well as by MHA zone level. Section 8 discusses the results and their implications. Then, in Section 9, I provide additional analysis to ensure the robustness of my main results. Section 10 concludes.

2. Literature Review

Reforms aimed at increasing the affordability of and access to housing have been implemented in a variety of cities and neighborhoods across the US as well as internationally. Upzoning, rent control, mixed-family housing, and low-income housing credits are a few of the most popular of these reforms. A mix between upzoning and mandatory requirements from developers towards housing affordability, Seattle's MHA program borrows from some of these tools to allow for incentive-based zoning.

a. Affordable Housing Policies

In 1968, the Rental Housing Assistance Program (Section 236) was created by the HUD to provide housing to the low and middle-income population. It required owners to provide units at HUD-approved rents to low and middle income families (National Housing Preservation Database). This program was largely successful, leading to the creation of over 500,000 affordable housing units (Kalugina, 2016). However, they were inflexible during inflationary times because revenue from these affordable rents could not cover the expenses of owning and operating a building. In 1986, the Low Income Housing Tax Credit was introduced, giving state and local authorities the power to issue tax credits for the sake of rehabilitation, acquisition, or construction of low-income homes. Since then, housing affordability policies have evolved down to the local level, specifically through regulatory and land-use incentives. These approaches include upzoning, rezoning, inclusionary zoning, and mixed-income housing, among others.

Upzoning involves changing a city or state's zoning code to allow for more development capacity. These were usually implemented not as one-time policies but rolled out over periods of time. For example, New York upzoned about 5% of its lots (over 200,000 lots) between 2004 and 2013 (Been et al., 2014). More recently, cities have been implementing upzoning as large-scale policies, like Chicago did in 2013 and 2015 (Freemark, 2020). The effects of upzoning on the local housing market point towards an increase in prices in both cases. In New York, there was an increase in the supply of housing as a result of the upzoning, while in Chicago, there was no significant impact of the upzoning policies on the number of new permits. It was also found that increases in housing supply were driven by parcels that had a greater increase in building capacity. In Chicago, already existing buildings that saw an increase in capacity also experienced higher prices, presumably due to the increased value of the land. These findings suggest that upzoning has the potential to be successful in increasing the supply of housing, but housing affordability still remains an issue. Without any mandates, developers and landowners seem to be using the increased capacity to increase the value of their properties, rather than build more units at stable prices. The Chicago findings also suggest that upzoning policies don't have significant impacts on housing supply within the first five years of implementation. Thus, there is a need for a reform that addresses the affordability of housing as well.

b. Inclusionary Zoning

Inclusionary zoning programs typically require developers in relevant zones to either contribute to an affordable housing fund or to build a certain number of rent-restricted units. Often, they are accompanied by incentives like an increase in development capacity or a tax rebate. Interestingly, the Mandatory Inclusionary Housing (IH) program in London, UK, provides no new incentives for developers, since land development rights are nationalized under urban planning laws (Li & Guo, 2022). Most inclusionary zoning programs employ both a carrot and a stick to achieve their goals. For such a policy to be successful, it is necessary that the incentive provided by upzoning or tax rebates offsets the new costs to developers posed by the affordable housing requirements. If policymakers don't strike the right balance, they face the risk of affordable housing requirements (the so-called sticks) acting as a tax to developers, or of the incentives being too large resulting in a case similar to that of upzoning where prices soar along with housing supply. So, the balance between the upzoning incentive and the affordable development quota in such a program is important, and could potentially determine its outcome.

By providing incentives while also enforcing a requirement, inclusionary zoning policies might solve the problems caused by a lack of resources or incentives to provide affordable housing. When compared to other affordability policies, inclusionary programs have had better outcomes in the past (Brunick, 2004). However, there have also been programs that haven't seen much objective success, like London's Mandatory IH (Li & Guo, 2022). Due to these mixed outcomes, it is important to further investigate the effectiveness of programs that employ mandatory affordable housing as a policy tool.

In London's version of inclusionary zoning, developers were required to build a certain number of affordable units with every development over a certain capacity. Unlike the MHA, London neither provided any incentives like increasing capacity restraints, nor did it have the option to pay into a fund in place of building new units. Li & Guo (2022) found a significant decrease in the number of developments under the Mandatory IH program in London. Additionally, they also found an increase in the number of developments that fell slightly below the threshold above which the Mandatory IH program would apply.

The supply side of the MHA has also been studied. Krimmel & Wang (2023) found that there was a decline in construction and new developments in MHA zones, and an increase in construction in non-MHA zones. Thus, it seems that an interesting policy effect of inclusionary zoning seems to be a "strategic substitution" of new developments right outside the boundaries of the new zones or right below the capacity limit.

Interestingly, there was no overall decline in housing supply in these two examples. These studies have shown that inclusionary zoning reforms, including the MHA, have been ineffective in increasing the supply of housing in the areas where they were supposed to increase housing affordability. However, the lack of overall decline in supply might suggest that the decrease in supply in MHA zones is made up for in non-MHA zones. One caveat is that Krimmel & Wang's study measured the housing supply based on the number of new permits issued by the City, not the number of housing units. Similar policies in other cities have had results consistent with these (Schuetz et al., 2011). This is why it is important to gauge not only the changes in new developments and housing supply, but also the effects of such programs on prices and rents. Such analyses would reveal whether these policies are actually helping people as they intend to, or causing them harm through increased prices as a direct result of the policy, or truly changing nothing, as is the case with housing supply.

c. Rent and Housing Prices

As seen above, the effects on rent and housing prices of inclusionary zoning policies hasn't been studied as much. Prices are a direct measure of affordability, both for low-income communities and overall. Since there was no significant overall decline in the supply of housing in both cases mentioned above, and there was an increase in new developments outside of mandated zones, there is the potential for a decline in overall rent and housing prices. Another important aspect is the change over time. Since prices may be sticky in the short run, analyzing the effects of such policies over time is another way to reveal their effectiveness in making housing more affordable.

Although the cost of owning or renting is a major factor in considering whether an individual can afford a home, there is a lack of research into the impacts of mandatory affordability policies on rent and housing prices. Studies of upzoning or mandatory programs that include an analysis of housing prices have generally pointed to an increase in housing and property prices. Freemark (2020) found that local property prices increased as a result of upzoning in Chicago. In Boston, inclusionary zoning contributed to an increase in housing prices (Schuetz et al., 2011). Thus, evidence points to an increase in housing prices due to inclusionary zoning programs. It appears then that current inclusionary zoning policies are not achieving their goal of balancing the carrot and the stick. What, then, is the correct balance?

London's policy had no incentives baked into the program; it was all stick. Upzoning policies for which prices have been analyzed have the opposite problem: there are no requirements, they are purely incentive based. For inclusionary policies that strike a balance between the two, it seems that results are better than other programs, but still do not achieve their goal of decreasing prices and increasing affordable housing production. In the case of Los

Angeles, inclusionary housing had no statistically significant impact on the housing market (Mukhija et al., 2010). To drive prices down, the incentives would have to outweigh the costs posed to developers, and this would have to happen for enough developers to make up for those that choose not to develop in newly zoned areas.

The costs posed to developers in inclusionary zoning policies are the biggest hindrance to their effectiveness in increasing housing supply and decreasing prices. These costs are particularly large in the short run, but in the long run these are more likely to be absorbed by landowners (Mukhija et al., 2010). Housing prices are also likely to be sticky in the short run. Thus, I expect some heterogeneity by year resulting in decreases in prices and rents over the years for the five years that I study. Since rents are more responsive in the short run, they would be more responsive to policy changes and thus more indicative of them. However, since rents are less sticky in the short run, the heterogeneity effects by year may not be as large and would diminish quicker over time. Though studies on the intertemporal impacts of such policies are limited, it remains an important area of study in evaluating these policies, along with evaluations of housing supply, prices, and rents.

d. Spatial Variation

It is also important to evaluate the direct impacts of the MHA on those that it is supposed to serve, so the spatial variation in prices must also be studied. Spatial variation is generally seen to have an effect on housing prices, due to various characteristics relating to a neighborhood like location, proximity to transportation, employment, and education, demographics, etc. (Bitter et al., 2006; Kamal et al., 2016). Then, it makes sense that the introduction of a new policy would likely cause spatial variation as well (Liang et al., 2018). Since a policy would address one or more characteristics mentioned above (in the case of the MHA, these are location and proximity to transit), it would cause a significant change in those characteristics and thus the neighborhood. Studying the effects of a policy on spatial variation, or a change in spatial variation, provides insight into what changes were caused by the policy and how it affected different neighborhoods. Specifically with the MHA, it would address where rent and housing prices did or didn't change, and if so, by how much.

In terms of the MHA, the main characteristics of a neighborhood in consideration would be the presence of an MHA zone. Other important characteristics associated with the MHA include income, employment, and education, since the MHA was zoned by the risk of displacement and access to opportunity. Based on the literature, since there was a decline in housing supply, there would be an expected increase in prices in MHA zones. Accordingly, there should also be a decrease in prices on MHA boundaries, and no change in non-MHA zones.

3. Program Description

The simple framework of the MHA is as follows. If a neighborhood was previously zoned as multifamily or commercial, it will likely fall under the MHA rezone. Other zones determined by the City are also rezoned, usually in neighborhoods where citizens are less likely to face displacement due to the rezone. Then, these rezones will be assigned a suffix of either M, M1, or M2. These levels determine the amount of development capacity that was added and how much the developer of a new development would have to contribute to the MHA. These apply to most rezoned areas, though not all. Contribution amounts are also determined based on whether the development is in a low, medium, or high-cost zone. So, if a new development is permitted, then the developer will either allocate a certain percentage of new units to affordable housing, or pay an amount determined by the city into the MHA fund. So, for each such new development, we are either adding new units of affordable housing, or supplying more money towards affordable housing, ultimately increasing the supply of affordable housing and housing in general. Thus, I expect some variation based on the ratio of each zone type in each ZIP code. This analysis will be interesting because each level increases the costs to developers, but also increases the incentives. Thus, the heterogeneity based on this metric could also be ambiguous.

OUTSIDE Downtown/SLU/SM-U 85 Zones	Initial payment calculation amount per code	Adjusted payment calculation amount						
Effective date of payment amount per 23.58C.040.A.2	*9/16/2016 through 2/28/17*	*3/1/2017 through 2/28/18*	*3/1/2018 through 2/28/19*	*3/1/2019 through 2/29/20 [Double-underlined amounts effective 4/19/19 - 2/29/20]*	*3/1/2020 through 2/28/21*	*3/1/2021 through 2/28/22*	*3/1/2022 through 2/28/23*	*3/1/2023 through 2/29/24*
LOW AREAS								
Zones with an (M) suffix	reserved	$7.18	$7.43	$7.64	$7.92	$8.11	$8.35	$9.25
Zones with an (M1) suffix	reserved	$11.54	$11.94	$12.28	$12.72	$13.04	$13.43	$14.87
Zones with an (M2) suffix	reserved	$12.82	$13.27	$13.64	$14.14	$14.49	$14.92	$16.52
MEDIUM AREAS								
Zones with an (M) suffix	reserved	$13.59	$14.07	$14.46	$14.98	$15.36	$15.81	$17.51
Zones with an (M1) suffix	$20.00	$20.51	$21.24	$21.83	$22.62	$23.18	$23.87	$26.43
Zones with an (M2) suffix	reserved	$22.82	$23.62	$24.29	$25.16	$25.79	$26.55	$29.40
HIGH AREAS								
Zones with an (M) suffix	$20.75	$21.28	$22.03	$22.65	$23.47	$24.05	$24.76	$27.42
Zones with an (M1) suffix	$29.75	$30.51	$31.59	$32.47	$33.64	$34.48	$35.50	$39.31
Zones with an (M2) suffix	$32.75	$33.59	$34.77	$35.75	$37.04	$37.96	$39.08	$43.28

Table 1: Adjusted Payment Calculation Amounts (City of Seattle, 2023).

Using the capacity increase as a carrot and the affordable housing requirements as a stick poses the problem of how much carrot and how much stick to use. There is the possibility of the increase in development capacity being sufficient to outweigh the affordable housing requirement, thus increasing housing supply and decreasing prices within MHA zones. However, the incentive may also be enough to offset the costs to developers posed by the affordable housing requirements, causing new developments to move away from MHA zones and into non-MHA zones.

Thus, a developer in Seattle must determine whether to take advantage of the benefits from the rezoning while also taking on the significant costs of contributing to affordable housing with new units or a payment. The decisions of each developer will determine if there has been a collective increase or decrease in the supply of housing within MHA zones, and a corresponding change in prices. Theoretically, this would depend on whether the benefits of building in an MHA zone outweigh the costs.

Another factor is the zoning levels, since the MHA requires higher contributions from certain zones. Although Krimmel & Wang (2023) articulate the changes in MHA vs. non-MHA zones, there is no evidence on the effects based on different zone levels. Particularly, each zone level, M, M1, and M2 increases the development capacity, while also increasing the affordability requirement. The affordability requirement would also depend on if the development was in a low, medium or high-cost area, as seen in Figure 1. Due to this heterogeneity in zones, there could be a variation in the changes in prices based on the zone. Thus, this heterogeneity is an additional potential cause of spatial variation. Finally, the costs that act as a tax on developers are likely to be offset in the long run, as evidenced in the literature review. Thus, I expect a decrease in rents and housing prices over time.

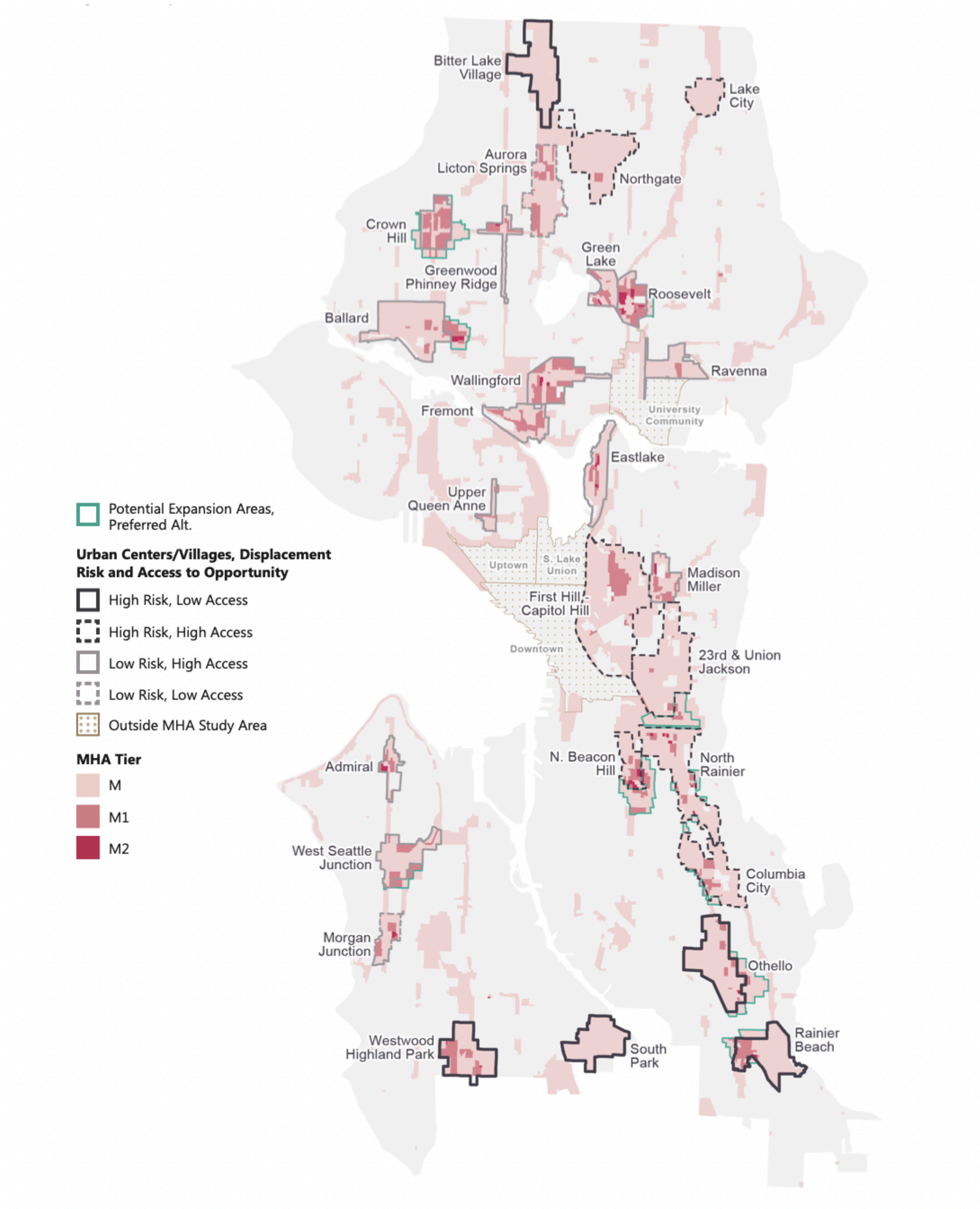

Figure 1: MHA zoning levels map (City of Seattle, 2018).

4. <u>Data</u>

I use data from the Zillow Housing Value Index (ZHVI), the Zillow Observed Rent Index (ZORI), City of Seattle, and the Census Bureau. I combined these into a single dataset that includes monthly price data, MHA zone counts, and MHA level counts (M, M1, and M2) for each ZIP code in Seattle for the years 2000-2023. I constructed a similar dataset[3] for rents instead of prices. I also used data from cities other than Seattle as counterfactuals.

I used ZHVI data for housing data. The index is produced by Zillow, updated every month, and separated by ZIP code. It contains monthly data for housing values in the 35th to 65th percentile range at the ZIP code level, for all ZIP codes in the United States. The data includes all types of homes, including single-family homes and condos. These home values are calculated using "Zestimates," Zillow's estimate of home market value (Hryniw, 2019). While the calculation of the Zestimate, as well as the ZHVI, is not the most transparent process, they tend to be accurate and provide better visibility and coverage of the market than most other data sources. Additionally, they are the most flexible data in terms of how housing values are organized: data is separated down to the ZIP code level, which is essential in analyzing a parcel-level policy like the MHA. Thus, while the lack of transparency of the ZHVI may pose some reliability and bias issues, it is a solid data source.

Similarly, for rent data, I use the Zillow Observed Rent Index. This data is organized and calculated in the same way as the housing data, and is also produced by Zillow. It contains monthly housing rates, using the mean of the 40th to 60th percentile of rents of all homes and apartments that fall in the ZIP code.

Since the ZHVI and ZORI contain national data, I was able to extract subsets of these datasets corresponding to each of the counterfactual cities[4]. I included both Seattle and Shoreline

[3] Data available upon request.

[4] The counterfactual cities for the price models were Spokane, Tacoma, Denver, Fresno, Phoenix, and Sacramento. The counterfactual cities for the rent models were Tacoma, Denver, Las Vegas, Phoenix, and Sacramento. Counterfactual cities were chosen based on how similar they were to Seattle in size, population, and social factors, whether data was available for the required time periods, and whether parallel trends with Seattle were evident.

in my Seattle datasets, since Shoreline ZIP codes (98133, 98155, and 98177) partially fell under Seattle city limits in the data I used for MHA zones.

I used data from the City of Seattle for MHA zoning data. The City of Seattle publishes maps of MHA zones, including data tables that were used to create the maps. These data are organized by zone, as well as zone type and level. For this dataset, I manually coded each MHA zone as falling into one or more ZIP codes. I used City of Seattle ZIP code maps to match these data. If an MHA zone fell into more than one ZIP code, I created separate observations and coded each to a respective ZIP code. After coding the MHA zone data, each ZIP code in the Seattle subsets of the ZHVI and ZORI datasets were assigned a count for the number of MHA zones in that ZIP code, as well as the number of zones designated as M, M1, or M2.

I used the ZCTA to Census Tract relationship files from the Census Bureau and City of Seattle Census Block data to create counts of the number of blocks in each ZIP code. Zip Code Tabulation Areas (ZCTA) are "generalized areal representations of the geographic extent and distribution of the point-based ZIP Codes built using 2020 Census tabulation blocks" (United States Census Bureau). The City of Seattle Census Block data contains data for each block in the city and its corresponding tract. I matched each block to a tract, and then each tract to a ZIP code based on the ZCTA relationship files. I then aggregated this as the number of blocks per ZIP code.

From these data, I was also able to calculate an "intensity" variable for MHA zones as well as M, M1, and M2 designated zones. These are defined as the ratio of the number of MHA, M, M1, or M2 zones to the total number of blocks in a ZIP code. The MHA intensity variable was the main treatment estimator in my difference-in-difference models.

Descriptive Statistics

The mean price in Seattle was $487,143.300 in 2015 and $798,450.900 in 2023. The range was $236,048.600 to $843,416.500 in 2015 and $456,787.800 to $1,297,468.000 in 2023. The mean rent in Seattle was $1,870.316 in 2016 and $2,115.683 in 2023. The range was $1,258.147 to $2,568.809 per month in 2016 and $1,752.111 to $2,535.512 in 2023. Clearly, prices and rents are on the rise. Table 2 describes the summary statistics for prices over the relevant time period (2012-2023) in each city. Table 3 describes the summary statistics for rents per month over the relevant time period in each city.

	N	Mean	St. Dev.	Min	Max
Seattle	7,464	505,945.80	206,692.80	175,515.10	1,431,741.00
Spokane	4,608	197,218.40	91,001.69	70,028.66	530,217.50
Tacoma	3,166	263,765.50	121,047.30	90,863.30	699,847.80
Denver	8,843	309,381.20	156,339.40	71,448.60	976,511.20
Fresno	5,933	199,553.60	107,985.80	44,238.22	643,671.60
Phoenix	13,524	231,892.60	136,065.30	34,381.63	931,101.50
Sacramento	6,414	292,549.90	165,050.00	45,582.89	1,141,344.00

Table 2: Number of observations, mean, standard deviation, and range of prices in each city over 2012-2023.

	N	Mean	St. Dev.	Min	Max
Seattle	1,995	1,896.20	262.967	1,258.15	2,595.82
Tacoma	590	1,470.81	328.398	802.42	2,073.93
Denver	2,113	1,725.50	291.47	1,089.80	2,815.73
Las Vegas	3,253	1,405.02	395.064	689.217	3,074.50
Phoenix	3,335	1,337.72	407.27	614.668	2,966.17
Sacramento	891	1,809.14	330.327	980.599	2,665.98

Table 3: Number of observations, mean, standard deviation, and range of rents in each city over 2012-2023.

Prices over time in Seattle have seen a relatively steady incline. Rents tend to fluctuate more, as the graphs below depict:

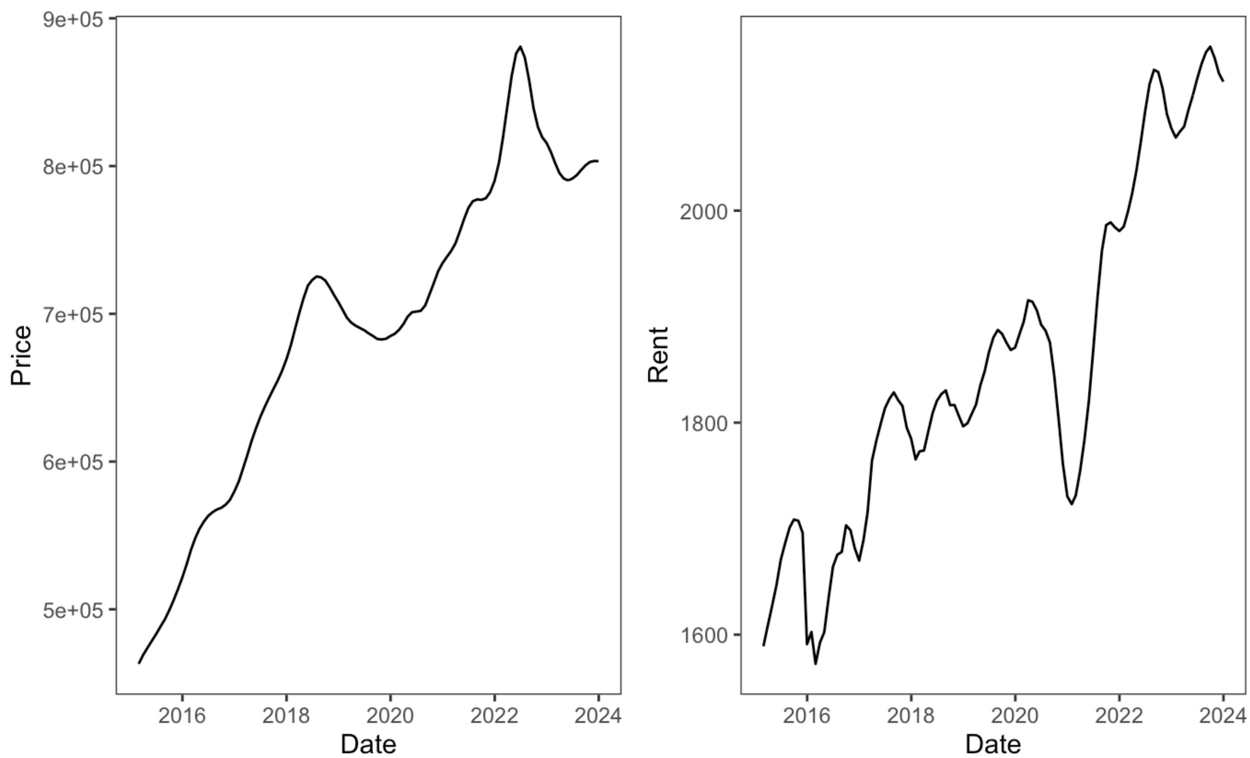

Figure 2: Seattle Housing Prices and Rents (Per Month) over Time.

A key assumption for the difference-in-difference model is that parallel trends exist before the enactment of the policy. From the data, it looks like there are pretty consistent parallel trends between Seattle and the counterfactual cities for prices, but these are not as consistent with rent. Parallel trends are more clear when comparing ZIP codes within Seattle, as seen in Figure 5. Although the trends between the treatment and the counterfactual are roughly the same for all these cases, parallel trends cannot be proven. As such, I have not conducted any pre-trends analysis, so my models are not robust to the parallel trends assumption. Thus, more analysis of the pre-2019 trends are needed to confirm the findings in this paper. The graphs below depict parallel trends. They include cutoff date indicators of 2017 and 2019.

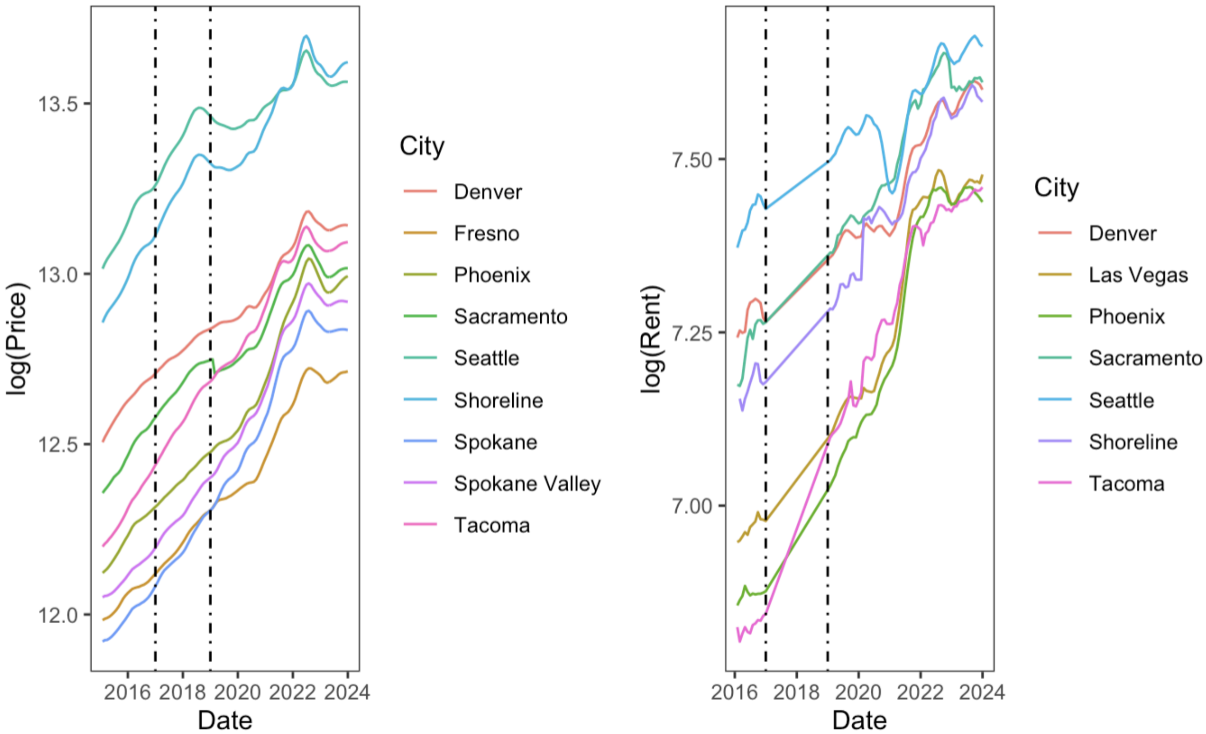

Figure 3: Price and Rent Trends for Seattle vs Comparison Cities.

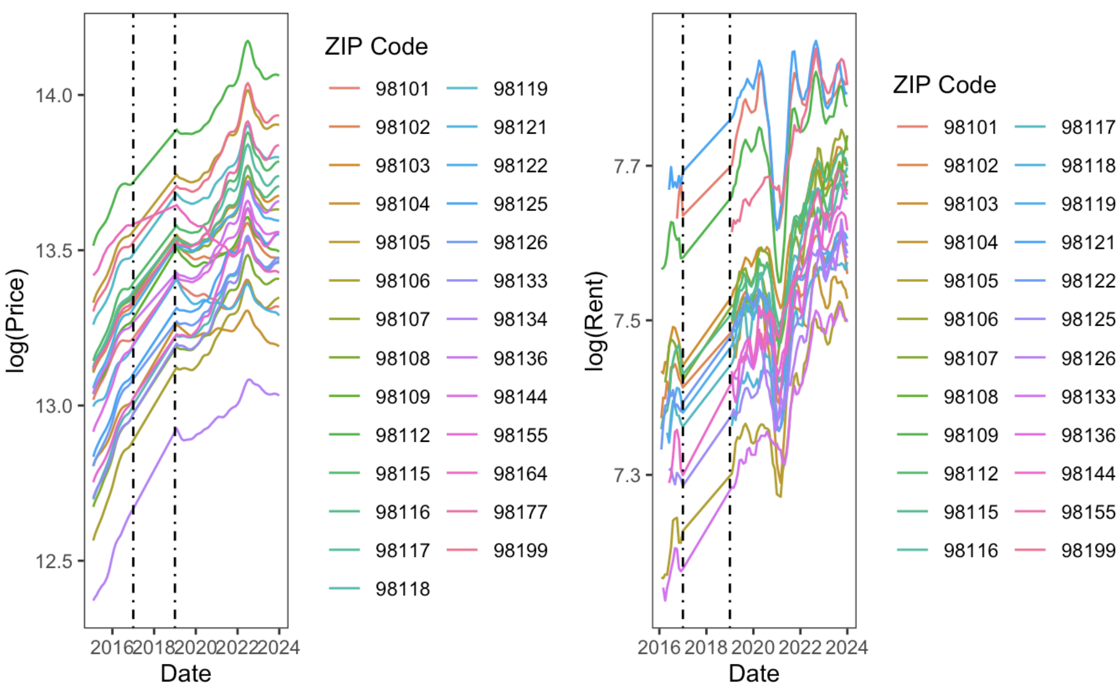

Figure 4: Price and Rent Trends for ZIP codes within Seattle.

2019 was chosen as the cutoff date for the MHA since that is when it fully went into effect. However, since there was a partial rollout of the program in 2017, I removed the 2017-2019 time period from the data that I analyzed. So, for prices, the pre-treatment period is 2015-2017, and for rents it is 2016-2017. The beginning years were chosen based on availability of consistent data across all comparison cities and ZIP codes.

Seattle ZIP codes contain anywhere between 0 and 264 MHA zones each. These range from 0% to 28% of the total number of blocks in each ZIP. Thus, a majority of the blocks were not affected by the MHA. Additionally, the M designation was the most common, followed by M1 and M2. So, the zoning changes were not very drastic, hinting that a larger rezoning may be required to incentivize more development. The skew in zone level designations also potentially creates bias in the findings related to zone level heterogeneity.

ZIP Code	MHA	M	M1	M2	Blocks	MHA%	M %	M1 %	M2 %
98101	33	14	0	0	328	10.06%	42%	0%	0%
98102	98	65	31	2	351	27.92%	66%	32%	2%
98103	242	188	50	4	1311	18.46%	78%	21%	2%
98104	59	37	0	0	539	10.95%	63%	0%	0%
98105	187	146	38	0	811	23.06%	78%	20%	0%
98106	77	68	7	2	402	19.15%	88%	9%	3%
98107	133	103	26	4	644	20.65%	77%	20%	3%
98108	82	77	4	1	1006	8.15%	94%	5%	1%
98109	127	86	9	0	529	24.01%	68%	7%	0%
98112	72	63	8	1	754	9.55%	88%	11%	1%
98115	213	163	33	17	1215	17.53%	77%	15%	8%
98116	120	107	11	2	570	21.05%	89%	9%	2%
98117	112	87	24	1	945	11.85%	78%	21%	1%
98118	257	222	29	6	962	26.72%	86%	11%	2%
98119	82	73	9	0	659	12.44%	89%	11%	0%
98121	27	0	0	0	193	13.99%	0%	0%	0%
98122	220	185	34	1	818	26.89%	84%	15%	0%
98125	145	142	2	1	783	18.52%	98%	1%	1%
98126	70	65	4	1	879	7.96%	93%	6%	1%
98133	106	97	9	0	526	20.15%	92%	8%	0%
98134	6	3	0	0	526	1.14%	50%	0%	0%
98136	51	40	10	1	442	11.54%	78%	20%	2%
98144	264	206	38	15	1176	22.45%	78%	14%	6%
98155	0	0	0	0	62	0.00%	0%	0%	0%
98164	0	0	0	0	64	0.00%	0%	0%	0%
98177	7	7	0	0	354	1.98%	100%	0%	0%
98199	35	34	1	0	488	7.17%	97%	3%	0%

Table 4: Breakdown of MHA Zone Levels by ZIP Code.

Note: The MHA% is the percentage of MHA zones in the ZIP code compared to total number of blocks. The M%, M1%, and M2% are the percentages of each type of zone in each ZIP code compared to the total number of MHA zones.

5. Methodology

My main analysis consists of a within-Seattle comparison and a cross-city comparison. I use a two way fixed effects model to carry out this analysis. For the within-Seattle comparison, I constructed an MHA intensity variable described previously, and similar intensity variables for M, M1, and M2 designated zones. The resulting coefficients on the difference-in-difference estimators for price and rent give the spatial effect created by an MHA zone, i.e., the effect on rent or price of increasing the ratio of MHA zones in a ZIP code. The regression specification is as follows:

$$Y_{it} = \beta_0 + \beta_1 Post2019_t + \beta_2 MHA_i + \beta_3 Post2019_t \, X \, MHA_i + M + M1 + M2 + MonthFE + TimeFE$$

Here, *i* refers to ZIP code and *t* refers to month. *Y* is the outcome variable, rents or housing prices, for which I take the log in order to interpret results in percentage terms. The *Post 2019* variable is a dummy for whether the observation was after 2019. *MHA* is the treatment variable, defined by the intensity as described above. Since most ZIP codes included at least one MHA zone (with the exception of), I chose not to use a binary variable for the treatment, and used an intensity design instead. *Post 2019 X MHA* is an interaction term between the two variables, which acts as the difference-in-difference estimator. This variable equals 0 if the observed rent or price was before 2019, and equals the MHA Intensity value if it was observed after 2019. The *M*, *M1*, and *M2* variables are defined similarly to the MHA intensity variable. They denote the ratio of the number zoning changes within a ZIP code that were identified by M, M1, and M2 codes, respectively, to the total number of blocks in that ZIP. Finally, *Month FE* and *ZIP FE* refer to month and ZIP code fixed effects. These are dummy variables for each month and each ZIP code.

The cross-city comparison uses two-way fixed effects as well to model the change in Seattle rents and housing prices compared to those in a group of other control cities. The regression specification is as follows:

$$Y_{it} = \beta_0 + \beta_1 Post2019_t + \beta_2 Seattle + \beta_3 Post2019_t \, X \, Seattle_i + MonthFE + TimeFE$$

Here, *i*, *t*, and the *Y*, *Post 2019*, *Month FE*, and *ZIP FE* variables are the same as the within-Seattle comparison, except for the additional observations added from ZIP codes of the comparison cities. The treatment variable is *Seattle*, a dummy for whether or not the ZIP code is in Seattle. The *Post 2019 X Seattle* variable is the difference-in-difference estimator. Its coefficient gives us the effect of being in Seattle on rents or prices, which I am hypothesizing to be caused by the MHA.

6. **Results**

I find a negative, significant causal impact of the MHA on housing prices and rents in Seattle. Additionally, an increase in the intensity of MHA zones in a ZIP code causes a significant increase in housing prices and a significant decrease in rents in that ZIP code. I also find that the decline in Seattle's housing and rent prices increases in magnitude each year, though the pattern for within-Seattle comparisons is not as clear.

Tables 5 and 6 show the main results; Table 5 contains results for the within-Seattle comparison, and Table 6 shows the results for the cross-city comparison. In both tables, the first two columns show the results for the model on prices, and the last two columns show the results for the model on rents. The key difference-in-difference estimator is shown in the third row.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
MHA	0.15	-5.742***	-0.571***	1.710***
	(0.11)	(0.33)	(0.21)	(0.10)
Post 2019	0.360***	0.552***	0.125***	0.316***
	(0.02)	(0.02)	(0.04)	(0.02)
Post 2019 X MHA	0.14	0.143***	0.14	-0.139***
	(0.14)	(0.04)	(0.21)	(0.05)
M		7.889***		1.069***
		(0.81)		(0.12)
M1		28.340*		-12.924***
		(15.14)		(0.30)
M2		-91.574***		-13.104***
		(33.12)		(0.85)
Observations	2,268	2,268	1,531	1,531
R^2	0.343	0.954	0.178	0.958
Adjusted R^2	0.342	0.952	0.177	0.956
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 5: Effects of the MHA Within-Seattle.

Note: Columns (1) and (3) show the results for the model without fixed effects. Columns (2) and (4) contain results for the full fixed effects.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
Seattle	0.752***	0.092***	0.376***	0.172***
	(0.03)	(0.01)	(0.03)	(0.01)
Post 2019	0.497***	0.761***	0.375***	0.535***
	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019 X Seattle	-0.112***	-0.126***	-0.205***	-0.187***
	(0.03)	(0.01)	(0.03)	(0.01)
Observations	14,927	14,927	9,117	9,117
R^2	0.287	0.977	0.233	0.957
Adjusted R^2	0.287	0.977	0.233	0.956
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 6: Effects of the MHA on Seattle overall.

Note: Columns (1) and (3) show the results for the model without fixed effects. Columns (2) and (4) display the coefficients on the cross-city comparison model including month and ZIP code fixed effects.

The respective coefficients show that, for every percentage increase in the intensity of MHA zones in a ZIP code within Seattle, prices increased by 14.3% and rents decreased by 13.9%. Thus, the MHA caused a spatial increase in prices and decrease in rents. Additionally, the MHA caused a 12.6% decrease in housing prices and an 18.7% decrease in rents in Seattle overall. These results are statistically significant at the 1% level and are robust to changes in the MHA zone intensity design, the cutoff date for the program, dropping one comparison city at a time, comparing to one city at a time, and including the 2017-2019 timeframe.

7. Heterogeneity Analysis

For the year heterogeneity analysis, I split my difference-in-difference estimator into five parts, reporting a coefficient for each year between 2019 and 2023. The regression specification was as follows:

$$Y_{it} = \beta_0 + \beta_1 Post2019_t + \beta_2 MHA_i + \beta_3 2019_t X\, MHA_i + \beta_4 2020_t X\, MHA_i + \beta_5 2021_t X\, MHA_i$$
$$+ \beta_6 2022_t X\, MHA_i + \beta_7 2023_t X\, MHA_i + M + M1 + M2 + MonthFE + TimeFE$$

Here, *i* refers to ZIP code and *t* refers to month. *Y* is the outcome variable, rents or housing prices, for which I took the log in order to interpret results in percentage terms. The *Post 2019* variable is a dummy for whether the observation was after 2019. *MHA* is the treatment variable, specified as the MHA zone intensity. For each of the five years, the *Year X MHA* parameter is the difference-in-difference estimator for that year. This variable equals 0 if the year does not correspond to the respective year, and equals the MHA intensity value if the observation does fall in the corresponding year. The *M*, *M1*, and *M2* variables are defined similarly to the MHA intensity variable, as previously explained. Finally, *Month FE* and *ZIP FE* refer to month and ZIP code fixed effects. These are dummy variables for each month and each ZIP code.

The regression specification for the cross-city year heterogeneity model is as follows:

$$Y_{it} = \beta_0 + \beta_1 Post2019_t + \beta_2 Seattle_i + \beta_3 2019_t\, X\, Seattle_i + \beta_4 2020_t\, X\, Seattle_i +$$

$$\beta_5 2021_t\, X\, Seattle_i + \beta_6 2022_t\, X\, Seattle_i + \beta_7 2023_t\, X\, Seattle_i + MonthFE + TimeFE$$

The *Seattle* variable is 1 if the ZIP code is in Seattle and 0 if not. For each of the five years, the *Year X Seattle* parameter is the difference-in-difference estimator for that year. All other parameters are identical to those in the within-Seattle model above.

For the MHA zone level heterogeneity analysis, I similarly split the difference-in-difference estimator into three parts, one for each zone-level designation. The regression specification is as follows:

$$Y_{it} = \beta_0 + \beta_1 Post2019_t + \beta_2 MHA_i + \beta_3 Post2019_t\, X\, M_i + \beta_4 Post2019_t\, X\, M1_i +$$

$$\beta_5 Post\ 2019_t\, X\, M2_i + MonthFE + TimeFE$$

Here, *i* refers to ZIP code and *t* refers to month. *Y* is the outcome variable, rents or housing prices, for which I took the log in order to interpret results in percentage terms. The *Post 2019* variable is a dummy for whether the observation was after 2019. *MHA* is the treatment variable, specified as the MHA zone intensity. For each of the three zoning levels, the *Post 2019 X* M_{level} parameter is the difference-in-difference estimator for that zone level. This variable equals 0 if the observation is before 2019, and equals the M level intensity value if the observation does fall after 2019. *Month FE* and *ZIP FE* refer to month and ZIP code fixed effects. These are dummy variables for each month and each ZIP code.

Tables 7 and 8 report the results for the year heterogeneity analysis. Table 7 shows the coefficients for the within-Seattle comparison, and Table 8 shows the coefficients for the cross-city comparison. The difference-in-difference estimators are reported in five parts, one estimator for each year between 2019 and 2023. The coefficients for these estimators are reported in rows 6 through 10 of Table 7 and rows 3 through 7 of Table 8.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
MHA	0.15	-5.742***	-0.571***	1.715***
	(0.11)	(0.33)	(0.19)	(0.10)
Post 2019	0.360***	0.556***	0.123***	0.319***
	(0.02)	(0.02)	(0.04)	(0.02)
M		7.889***		1.075***
		(0.81)		(0.12)
M1		28.340*		-12.930***
		(15.15)		(0.30)
M2		-91.574***		-13.197***
		(33.14)		(0.86)
2019 X MHA	-0.340**	0.151***	-0.12	-0.126**
	(0.15)	(0.05)	(0.19)	(0.06)
2020 X MHA	-0.21	0.138***	-0.10	-0.099*
	(0.15)	(0.05)	(0.19)	(0.06)
2021 X MHA	0.20	0.152***	-0.07	-0.189***
	(0.15)	(0.05)	(0.19)	(0.06)
2022 X MHA	0.675***	0.161***	0.459**	-0.127**
	(0.15)	(0.05)	(0.19)	(0.06)
2023 X MHA	0.392***	0.114**	0.567***	-0.156***
	(0.15)	(0.05)	(0.19)	(0.06)
Observations	2,268	2,268	1,531	1,531
R^2	0.376	0.954	0.325	0.959
Adjusted R^2	0.374	0.951	0.322	0.956
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 7: Year Heterogeneity within-Seattle.

Note: Columns (1) and (2) correspond to housing prices, and columns (3) and (4) correspond to rents. Columns (1) and (3) report the results for the model without fixed effects.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
Seattle	0.829***	1.630***	0.429***	0.563***
	(0.02)	(0.01)	(0.02)	(0.01)
Post 2019	0.508***	0.783***	0.389***	0.550***
	(0.01)	(0.01)	(0.01)	(0.01)
2019 X Seattle	-0.224***	-0.012**	-0.285***	-0.089***
	(0.03)	(0.01)	(0.03)	(0.01)
2020 X Seattle	-0.203***	-0.072***	-0.282***	-0.137***
	(0.03)	(0.01)	(0.03)	(0.01)
2021 X Seattle	-0.132***	-0.169***	-0.275***	-0.258***
	(0.03)	(0.01)	(0.03)	(0.01)
2022 X Seattle	-0.05	-0.228***	-0.174***	-0.269***
	(0.03)	(0.01)	(0.02)	(0.01)
2023 X Seattle	-0.099***	-0.254***	-0.153***	-0.266***
	(0.03)	(0.01)	(0.02)	(0.01)
Observations	14,927	14,927	9,117	9,117
R^2	0.398	0.981	0.299	0.971
Adjusted R^2	0.397	0.981	0.298	0.97
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 8: Year Heterogeneity in Seattle overall.

Note: Columns (1) and (2) correspond to housing prices, and columns (3) and (4) correspond to rents. Columns (1) and (3) report the results for the model without fixed effects.

The causal impacts of the MHA do not show any patterns by year within Seattle, though the effect of the increase in prices due to the MHA has decreased over time, from 15.1% in 2019 to 11.4% in 2023. The coefficient for rent decrease has increased in magnitude, from a 12.6% decrease in 2019 to a 15.6% decrease in 2023, but once again did not decrease consistently. The cross city comparison reveals that the effects of the MHA on prices and rents in Seattle overall became larger in magnitude over time. So, prices and rents decreased more each year following the enactment of the MHA. The coefficient on prices went from -1.2% in 2019 to -25.4% in 2023 and the coefficient on rents went from 8.9% in 2019 to 26.6% in 2023. Thus, the effect of the

MHA on prices and rents in Seattle overall became more negative over time. All results are statistically significant at the 1% level.

Finally, the results for the heterogeneity analysis between MHA zone levels (M, M1, M2) are in Table 9. The difference-in-difference estimator is broken up into three parts, with one interaction term for each zone level. The coefficients for these estimators are in rows 3 through 5.

	Dependent variable:	
	log(Price)	log(Rent)
	(1)	(2)
MHA	-14.589***	1.689***
	(0.33)	(0.18)
Post 2019	0.515***	0.256***
	(0.02)	(0.02)
M	0.836***	0.350***
	(0.06)	(0.06)
M1	-2.507***	-0.923***
	(0.20)	(0.14)
M2	3.906***	2.179***
	(0.89)	(0.58)
Observations	2,268	1,531
R^2	0.959	0.96
Adjusted R^2	0.957	0.957
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 9: Heterogeneity in MHA zone levels.
Note: Column (1) reports results for the price outcome variable and column (2) reports results for rent.

The coefficients show that when the intensity of MHA zones zoned as M increases by one percentage point, prices in that ZIP code increase by 83.6% and rents increase by 35%. A percentage increase in zones designated as M1, however, results in a 250.7% decrease in prices and a 92.3% decrease in rents. Finally, a percentage increase in zones designated as M2 resulted in a 390.6% increase in prices and a 217.9% increase in rents.

8. Discussion

The results are partially consistent with previous research surrounding inclusionary zoning policies. Since the MHA and programs like it were found to decrease the supply of housing spatially and overall in cities where they were enacted, I predicted an increase in housing prices and rents. Though my results indicate a spatial increase in prices within Seattle due to the MHA, they also indicate a decrease in both prices in Seattle as well as a decrease in rents both spatially and in Seattle.

The spatial increase in housing prices due to the MHA is consistent with the strategic substitution found by Krimmel & Wang (2023). They found that developers chose to build new developments right outside the borders of MHA zones. This suggests that the incentive of increased capacity did not outweigh the costs of contributing to the MHA for developers. The increase in prices that I found lines up with this. However, I also find a decrease in rents due to the MHA.

This decrease in rents in ZIP codes with higher intensities of MHA zones can be explained by the mechanisms of the MHA. Though the number of new developments within MHA zones decreased, causing an increase in housing prices, developers that did choose to build in MHA zones were still required to contribute to the MHA. Since most developers chose to pay into the fund rather than build new units, this explains why there was a decrease in the supply of housing. If developers had chosen to build affordable housing units, they could have made up for the decrease in the number of developers choosing to begin a project within MHA zones. Thus, there was a decrease in new developments in MHA zones and a resulting increase in prices in areas with higher concentrations of MHA zones. Developers could also build taller buildings, increasing their property values. However, the money that developers paid into the MHA fund was presumably used to supplement rents for low-income people looking for housing. As of 2022, of the total of $246.1 million in MHA funds received, $245.4 million were awarded to affordable housing (Seattle Office of Housing, 2023). Thus, the decrease in rents can be presumably attributed to the usage of the MHA fund towards supplying housing at affordable rental rates. Additionally, since MHA zones were intentionally chosen in neighborhoods where people were less likely to be displaced, if these were the more well off neighborhoods and new development as well as decreases in rent and prices were transferred to lower-income neighborhoods, this would be beneficial to the goal of the MHA to increase housing affordability for low-income communities. Thus, additional spatial analysis of the MHA and the communities it affects will also be revealing.

Turning to the case with the housing and rent markets in Seattle, I found a decrease in both prices and rents. Krimmel & Wang (2023) found that the MHA caused no significant change in the number of new construction permits issued in Seattle overall. Studies of similar policies have found similar results. The overall decrease in rents and housing prices in Seattle can be explained as follows: there was no change in the number of new permits issued in Seattle. However, those buildings that were built within MHA zones had higher capacity, and developers were thus able to build vertically instead of horizontally. So, there could have been an increase in the number of housing *units* supplied. Since those developers for whom the incentives did not outweigh the costs chose to develop outside the MHA, there was no decrease in the overall development – there was only a change in where these developments occurred. So, keeping the total number of developments about the same but increasing the capacity of some of them (i.e.

those within MHA zones) results in an overall increase in the number of housing units. This increase in supply thus results in a decrease in prices as well as rents. Since rents were also supplemented by MHA funds in addition to this, the magnitude of their decrease was higher than that of rents. Thus, the proverbial carrot of the MHA was more powerful than its stick in some cases, and there were enough of such cases to warrant a decrease in rents and housing prices.

The analysis for heterogeneity in years shows a steady decline in prices and rents in Seattle. This suggests that the effect of the MHA on increasing affordability increases over time. If the reason for this is price stickiness, then an intertemporal analysis of the MHA in the future would be beneficial to analyze what happens if or when rents and prices stabilize. Additionally, though a pattern is not clear, it seems that the spatial effect of the MHA on prices has decreased in magnitude over time, and the effect on rents has increased in magnitude, i.e., become more negative. Generally speaking, it seems that as more time passes, the effects of the MHA on rents and housing prices have become more negative both spatially and overall. However, the City of Seattle reported in 2022 that payments to the MHA decreased by 1.5% in 2022, so additional monitoring and analysis of long run impacts is essential to framing future policies.

Finally, the heterogeneity analysis by MHA zoning level revealed that decreases in prices and rents were driven by the M1 level: the M1 zones had a negative effect on both prices and rents, while the M and M2 zone levels had a positive effect on both prices and rents. However, 78% of the rezones were designated as M, which does skew the data. Since the M designation was given to rezones that were changed to a zone in the same category, there was little extra incentive for developers to choose to develop in such zones as opposed to non-MHA zones. This explains why there was an increase in rents and prices. M zones also had lower affordability requirements. M1 zones had higher capacity increases, so the decrease in rents and prices makes sense here as well. However, M2 was the designation for zones with the biggest capacity changes. The increase in rents and prices caused by these zones doesn't add up. However, M2 zones only made up for 2% of the total rezones, so their effects are likely skewed and the estimation may be biased. Additionally, since the required payment was calculated based not only on the zoning level but also on whether the zone was in a low, medium, or high cost zone, the heterogeneity in zone levels makes sense. It also lines up with the fact that the heterogeneity is seemingly without pattern. Thus, an analysis of heterogeneity not only in the zone levels but also in cost-level areas is required to gain conclusive insights on this.

9. Robustness Checks[5]

To ensure that none of the counterfactual cities were confounding, I conducted two types of robustness checks. The first involved comparing Seattle to only one city at a time to see if the sign and significance of the coefficients on the difference-in-difference estimators would change. These coefficients are reported in the third rows of Table A1 for prices and Table A2 for rents. Each column corresponds to the model with the indicated city as the only counterfactual.

The second robustness check on the comparison cities involved dropping one city at a time from my model to see if there were any changes in significance and sign of the coefficients for the difference-in difference estimators. These coefficients are reported in the third rows of Table A3 for prices and Table A4 for rents. All the coefficients are consistent with the main results.

Since the MHA was only rolled out partially in 2017, and implemented citywide in 2019, I chose 2019 as the cutoff date for my main difference-in-difference analysis. To ensure that this choice does not qualitatively affect the main results, I run the main models with 2017 as the cutoff date instead of 2019. These results are in Tables A5 for the spatial within-Seattle

[5] Tables for this section are available in Appendix 1: Supplemental Tables.

comparison and Table A6 for the cross-city comparison. The coefficients show that my results remain statistically significant at the 1% level and point in the same direction as the main results.

In my main analysis, I also excluded the 2017-2019 time frame since these years corresponded to the partial rollout of the program. Including this timeframe in the model doesn't affect the validity of the results, as shown in Tables A7 and A8. The coefficients were slightly smaller in magnitude, which makes sense since the effect of the MHA had already started taking place in 2017.

Thus, my main results are robust to changes in the difference-in-difference model specifications.

10. Conclusion

As a city with notoriously high rates of homelessness and even higher housing prices, Seattle faces a constant dilemma of how to tackle the issue of housing affordability. Policymakers across the world have come up with varying solutions to housing affordability problems. This paper analyzes the City of Seattle's recent choice to implement the Mandatory Housing Affordability program and its effectiveness. I find that the MHA caused prices in Seattle to decrease by 12.6%, and rents to decrease by 18.7%. The MHA also caused spatial variation in prices and rents, with higher percentages of MHA zones in a ZIP code causing 14.3% higher prices and 13.9% lower rents. These effects become more negative as years go by, suggesting an overall decrease in housing prices and rents in the long run. These results are robust to changes in the comparison methods and post-treatment period as described in Appendix 1. However, the parallel trends assumption may not be robust, so additional analysis of pre-trends is recommended as a future direction of this study.

Thus, the MHA caused a spatial increase in housing prices and decrease in rents, and a decline in both rents and housing prices in Seattle. These effects have become more negative over the years, and suggest that the implementation of the MHA struck a balance between incentivizing enough developers despite the costs it posed. Future analysis of the long run impacts of the MHA are needed to confirm this.

This study was limited in its ability to analyze the policy at the parcel-level, thus leaving a deeper spatial analysis of the policy out of scope. Future research should analyze the spatial variation caused by the MHA more closely, controlling for spatial heterogeneity through methods like geographically weighted regressions. This would be useful to analyze substitution effects on MHA boundaries characterized by developers choosing to build more right outside of MHA zones. Another aspect in the analysis of the MHA that this study was limited in was the heterogeneity of zoning increases. Since the rezones were categorized as either M, M1, or M2, and these were associated with increasing costs and incentives to developers, assessing the relative costs and benefits of each level could reveal important insights into the way zoning levels are decided on, and the effects of each one. I was also not able to stratify these zones by low, medium, or high-cost areas, which were a determining factor in the MHA contribution requirement for each new development. Though my models are robust to changes in variations in model specifications, the parallel trends assumption cannot be proven. Thus, other study designs such as synthetic controls or regression discontinuity design would be beneficial in strengthening the validity of my results.

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Appendix 1: Supplemental Tables

	Dependent variable:					
	log(Price)					
	Spokane	Tacoma	Denver	Fresno	Phoenix	Sacramento
Seattle	0.676^{***}	0.614^{***}	1.550^{***}	1.675^{***}	2.005^{***}	2.483^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019	0.838^{***}	0.816^{***}	0.622^{***}	0.701^{***}	0.821^{***}	0.687^{***}
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
Post 2019 X Seattle	-0.257^{***}	-0.239^{***}	-0.036^{***}	-0.119^{***}	-0.183^{***}	-0.112^{***}
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
Observations	3,612	3,192	4,956	4,032	6,216	4,259
R^2	0.982	0.977	0.983	0.988	0.975	0.986
Adjusted R^2	0.981	0.976	0.982	0.988	0.975	0.985
Note:						$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table A1: Single city counterfactual comparison for prices.
Note: Each column lists the coefficients for the model with only the indicated city as a counterfactual.

	Dependent variable:				
	log(Rent)				
	Tacoma	Denver	Fresno	Phoenix	Sacramento
Seattle	0.744^{***}	0.369^{***}	0.906^{***}	0.612^{***}	0.410^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)
Post 2019	0.494^{***}	0.349^{***}	0.516^{***}	0.597^{***}	0.465^{***}
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019 X Seattle	-0.190^{***}	-0.054^{***}	-0.200^{***}	-0.267^{***}	-0.156^{***}
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Observations	2,028	3,195	3,841	3,921	2,256
R^2	0.963	0.962	0.964	0.956	0.943
Adjusted R^2	0.961	0.961	0.962	0.954	0.94
Note:					$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table A2: Single city counterfactual comparison for rents.
Note: Each column lists the coefficients for the model with only the indicated city as a counterfactual.

	Dependent variable:					
	log(Price)					
	Spokane	Tacoma	Denver	Fresno	Phoenix	Sacramento
Seattle	1.618^{***}	1.623^{***}	2.001^{***}	1.633^{***}	1.617^{***}	1.634^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019	0.753^{***}	0.759^{***}	0.803^{***}	0.774^{***}	0.728^{***}	0.779^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019 X Seattle	-0.131^{***}	-0.138^{***}	-0.179^{***}	-0.152^{***}	-0.129^{***}	-0.154^{***}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	13,583	14,003	12,239	13,163	10,979	12,936
R^2	0.979	0.979	0.98	0.976	0.983	0.977
Adjusted R^2	0.979	0.979	0.98	0.976	0.982	0.977
Note:						*p<0.1; **p<0.05; ***p<0.01

Table A3: Cross-city comparison dropping single city for prices.
Note: Each column corresponds to the model that excludes the indicated city from the counterfactual group.

	Dependent variable:				
	log(Rent)				
	Tacoma	Denver	Las Vegas	Phoenix	Sacramento
Seattle	0.552^{***}	0.578^{***}	0.497^{***}	0.546^{***}	0.555^{***}
	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Post 2019	0.537^{***}	0.566^{***}	0.486^{***}	0.540^{***}	0.540^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019 X Seattle	-0.202^{***}	-0.233^{***}	-0.163^{***}	-0.203^{***}	-0.205^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	8,620	7,453	6,727	6,807	8,392
R^2	0.96	0.967	0.962	0.952	0.959
Adjusted R^2	0.959	0.966	0.961	0.95	0.958
Note:					*p<0.1; **p<0.05; ***p<0.01

Table A4: Cross-city comparison dropping single city for rents.
Note: Each column corresponds to the model that excludes the indicated city from the counterfactual group.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
MHA	-0.164***	-1.488***	-0.382**	2.061***
	(0.05)	(0.18)	(0.19)	(0.09)
Post 2017	0.541***	1.091***	0.160***	0.392***
	(0.02)	(0.02)	(0.04)	(0.02)
Post 2017 X MHA	0.454***	0.183***	(0.15)	-0.183***
	(0.09)	(0.02)	(0.19)	(0.05)
M		-2.315***		0.548***
		(0.48)		(0.11)
M1		174.530***		-12.393***
		(8.79)		(0.29)
M2		-406.428***		-13.322***
		(18.98)		(0.82)
Observations	7,464	7,464	1,995	1,995
R^2	0.505	0.979	0.162	0.96
Adjusted R^2	0.505	0.978	0.161	0.958
Note:				*p<0.1; **p<0.05; ***p<0.01

Table A5: Post-2017 within-Seattle comparison.

Note: Columns (1) and (3) show the results for the model without fixed effects. Columns (2) and (4) contain results for the full fixed effects.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
Seattle	0.788***	1.463***	0.453***	0.526***
	(0.01)	(0.01)	(0.02)	(0.02)
Post 2017	0.638***	1.274***	0.353***	0.596***
	(0.01)	(0.02)	(0.01)	(0.01)
Post 2017 X Seattle	-0.041***	-0.034***	-0.211***	-0.154***
	(0.01)	(0.00)	(0.02)	(0.01)
Observations	49,952	49,952	12,177	12,177
R^2	0.408	0.95	0.288	0.96
Adjusted R^2	0.408	0.949	0.288	0.959
Note:				*p<0.1; **p<0.05; ***p<0.01

Table A6: Post-2017 Cross City Comparison.

Note: Columns (1) and (3) show the results for the model without fixed effects. Columns (2) and (4) display the coefficients on the cross-city comparison model including month and ZIP code fixed effects.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
MHA	-0.179***	-1.539***	-0.709***	2.012***
	(0.05)	(0.18)	(0.09)	(0.08)
Post 2019	0.517***	1.095***	0.049**	0.378***
	(0.02)	(0.02)	(0.02)	(0.02)
Post 2019 X MHA	0.475***	0.164***	0.278***	-0.131***
	(0.11)	(0.02)	(0.10)	(0.03)
M		-2.064***		0.605***
		(0.48)		(0.11)
M1		170.224***		-12.587***
		(8.78)		(0.29)
M2		-397.434***		-13.772***
		(18.95)		(0.82)
Observations	7,464	7,464	1,995	1,995
R^2	0.378	0.979	0.201	0.961
Adjusted R^2	0.377	0.978	0.2	0.958
Note:				*p<0.1; **p<0.05; ***p<0.01

Table A7: Including the 2017-2019 timeframe, within-Seattle.
Note: Columns (1) and (3) show the results for the model without fixed effects. Columns (2) and (4) contain results for the full fixed effects.

	Dependent variable:			
	log(Price)		log(Rent)	
	(1)	(2)	(3)	(4)
Seattle	0.802***	1.476***	0.434***	0.513***
	(0.01)	(0.01)	(0.01)	(0.01)
Post 2019	0.686***	1.284***	0.344***	0.603***
	(0.01)	(0.02)	(0.01)	(0.01)
Post 2019 X Seattle	-0.114***	-0.110***	-0.237***	-0.180***
	(0.02)	(0.00)	(0.01)	(0.00)
Constant	12.145***	11.312***	7.039***	6.912***
	(0.00)	(0.01)	(0.00)	(0.01)
Observations	49,952	49,952	12,177	12,177
R^2	0.386	0.95	0.406	0.967
Adjusted R^2	0.386	0.95	0.406	0.966
Residual Std. Error	0.481 (df = 49948)	0.138 (df = 49486)	0.218 (df = 12173)	0.052 (df = 11906)
F Statistic	10,479.310*** (df = 3; 49948)	2,029.165*** (df = 465; 49486)	2,777.170*** (df = 3; 12173)	1,280.975*** (df = 270; 11906)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table A8: Including the 2017-2019 timeframe, cross-city.
Note: Columns (1) and (3) show the results for the model without fixed effects. Columns (2) and (4) display the coefficients on the cross-city comparison model including month and ZIP code fixed effects.