Thomas Woodside

ECON 428

Home Values and Rents During COVID-19

1. Introduction

COVID-19 has entirely changed the nature of work, especially for highly-skilled service workers. Millions of workers who had worked from an office before the pandemic continue to work remotely. Some major companies have announced policies to allow remote work even after the pandemic;[1] others have even announced that they will be "remote first" even after the pandemic.[2]

The changing nature of work has large implications for the growth of some cities that may persist after the pandemic. In the fourth quarter of 2020 alone, San Francisco saw 35,855 residents leave the city, a 61% increase from the previous year.[3] Some western and southern states have seen many new residents since the start of the pandemic, according to moving company data.[4]

One way to investigate the changes that COVID-19 has brought to cities is by looking at changes in rents. Rents are usually renewed yearly or even more frequently, and as such are good short-term proxies for supply and demand in a city. Some cities have seen reduced rents as a result of an exodus of highly-skilled workers. Rent gives a good short-term picture of changes in demand for various cities.

Another aspect that may be even more important is changes in home values. Since homes are often owned for many years, home values are likely to reflect a longer-term view of expected growth and desirability of a city. If most workers plan to return to cities after the pandemic, home values are likely to remain more stable than rents.

This research aims to assess home values and rents by zip code, to determine factors that can explain changes in those values during the COVID-19 pandemic.

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[1] Conger, "Facebook Starts Planning for Permanent Remote Workers."
[2] Armstrong, "Post-COVID-19, Coinbase Will Be a Remote-First Company."
[3] "CalExodus."
[4] "Atlas Van Lines - Migration Patterns | Atlas Van Lines."

2. Theoretical Concepts

The Rosen-Roback Model provides a framework of estimating changes in city populations. It estimates the utility earned from "bread" (c), housing (q), and amenities (a).[5] The model establishes that consumers prefer cities with higher amenities, and will pay larger housing costs in order to access those amenities.

Certain amenities, especially those with large economies of scale, are more present in cities; this has been hypothesized as a reason for the continued growth of cities.[6] Some amenities that are strongly related with city growth, such as climate, are not likely to be affected by COVID-19. However, others, such as the number of live performance venues or restaurants per capita, have become irrelevant, at least temporarily, due to the closure or restriction of such businesses.

On the business side, the nature of industry agglomeration has been studied extensively. For reasons such as the transfer of ideas and reduced transportation costs, firms often prefer to be physically located nearby other, similar firms. This has been documented widely, and some industries (such as the automobile industry) have been found to be highly agglomerated.[7] COVID-19 potentially throws some of these agglomeration effects into doubt. For instance, if workers work from home and are discouraged by public health authorities from interacting with others in person, the benefits of living near other workers in the same industry may be diminished. For this reason, agglomeration effects may be weakened, in turn driving down property demand by workers.

3. Data

3.1 Home and Rental Values

Zillow serves as the source for home and rental values. Zillow is a popular site for searching for homes for sale and for rent, and collects large quantities of data on both measures. Specifically, it presents measures of typical home values and rents, taking into account not merely homes currently for sale and for rent, but also estimations of those that are not on the market. The

[5] Roback, "Wages, Rents, and the Quality of Life."
[6] Glaeser, Kolko, and Saiz, "Consumer City."
[7] Ellison and Glaeser, "Geographic Concentration in U.S. Manufacturing Industries."

indices are also seasonally adjusted, which is important when studying variation during a single year. Data for both rent and home values is available on a zip code basis.[8]

3.1.1 Historical Growth

Historical growth might serve as a good indicator of future growth. Areas that have seen declines in rents and home values in the past may be more likely to see continued declines, while growing areas might continue to grow. To account for this, annualized growth over the past one, three, five, and ten years was used.

3.2 Demographic Characteristics

The U.S. Census Bureau provides a wealth of demographic data for each zip code in the United States.[9] The American Community Survey provides estimates of these values for each year. In contrast to the decennial census, ACS data is less accurate, but still very useful for understanding the characteristics of a particular dataset. Data for 2020 is not yet available, so 2019 data must be used for the 2020-2021 analysis.

3.2.1 Population density

A particularly important demographic characteristic is density; namely, the number of people living in an area per square mile of land. During the pandemic, it has been suggested that very dense cities are suffering declines; using population density provides a way to test this assumption. For each zip code, the Census provides information about the amount of land as well as the population, so density can easily be calculated. The distribution of density in American zip codes is roughly log-normal, with a small number of zip codes having extremely high density (the densest zip codes can be found in New York City). However, through the course of the analysis it was found that both the raw density value and its logarithm could provide useful information. The raw value serves to differentiate very dense cities from the rest of the country, while the logarithm can help differentiate less-dense cities or suburbs from rural areas.

3.2.2 Age

[8] "Housing Data."
[9] "Explore Census Data."

Age is clearly related to mobility; a 25-year-old clearly has very different mobility patterns than a 45-year-old, for instance. Age could also be related to change in home values and rents during the pandemic; retirees might be less likely to move than younger people, seeing as they do not have workplaces that could be affected by the pandemic. The census bureau provides information on several age groupings. For the simplicity of this analysis, two age variables are used: the proportion of the population that is 65 or over, and the proportion of the population that is 17 or under. These variables provide information on two particularly important demographic groups: retirees and families.

3.2.3 Education

Education may also be related to mobility. Regardless of industry, educated people may be more likely to hold high-skilled jobs, which could make them more likely to move during the pandemic. This analysis uses a single variable for education: the proportion of the population over the age of 25 with a bachelor's degree or more.

3.2.4 Race

In the United States, race has long been related to the trajectories of individual neighborhoods. Historical redlining, social sorting, and other phenomena mean that race remains an important demographic feature in rents and home values. For this analysis, three variables are used: the proportion of the population that is Asian, Black, and Hispanic/Latino.

3.2.5 Income

Income, of course, is clearly related to home values and rents; higher income residents are more likely to reside in locations with high home values and rents. However, higher-income residents might also be more able to move, or even buy/rent second homes, for purely the duration of the pandemic, which might produce more extreme swings in home values and rents. For this analysis, a single variable of median income was used. Since the distribution of median income by zip code is log-normal, the log of income was used.

3.3 Occupational Characteristics

3.3.1 Number of Workers

One variable of interest is simply the proportion of the working-age population is currently employed. This can help to understand factors such as the number of households with two parents working as well as the number of retirees. It could be expected that areas where more people are actively working might be more affected by the pandemic, which strongly affected workplaces.

3.3.2 Working From Home

The ACS provides information about the number of individuals who worked from home *prior* to the pandemic. This could serve as a rough indicator of which places people choose to live in if they have the option to work from home. During the pandemic, with many more people able to work from home, these areas could see continued growth.

The ACS also provides information about which industries residents of the zip codes work in. Using data from Dingel & Newman[10], it is possible to compute a rough measure of the number of residents who are *able* to work from home. For instance, employees in the information technology sector are highly likely to be able to work from home, while employees in the construction sector are unlikely to be able to work from home.

3.3.3 Commutes

Commuting is an especially important factor for work; for many, however, commuting has disappeared during the pandemic. It could be expected that areas relatively far from employment centers, which previously required long commutes, might have become more desirable during the pandemic. The census bureau provides information on the length of commutes, grouped into various time ranges. For this analysis, only the approximate median commute was used, to give a rough sense for how long residents in a zip code typically commute to work.

3.4 County Effects

Lastly, the county of a zip code was incorporated as a predictor in the model. This variable was intended to account for region-specific aspects of the real estate market that are not captured by any of the other variables. This could include weather, regional culture, amenities, or other

[10] Dingel and Neiman, “How Many Jobs Can Be Done at Home?”

geographically-linked variables. The purpose of adding county effects is to determine which counties were most strongly associated with growth before and during the pandemic.

4. Methods of Analysis

It is first important to note that this analysis does not attempt any investigation into causality; it is purely correlational. The bulk of the research will be devoted to determining which factors are most correlated with change in home values and rents during COVID-19, which is defined as the twelve months from February 2020 (before most economic effects of COVID-19 in the US) to February 2021. First, a regression was fit to predict changes in home prices prior to 2020, as a baseline model. Second, a regression was fit to predict the difference between predictions of the baseline model for 2020-2021 and the true growth rates in that time. We should expect zip codes that saw growth driven by COVID-19 to grow much faster from 2020-21 than the baseline model expected, and the opposite for zip codes that saw declines due to the pandemic.

4.1 Baseline Model

The simplest way to determine the zip codes most affected by COVID-19 would be to simply find the highest- and lowest-growth zip codes in the nation. However, this analysis would fall prey to a wide range of confounding factors. For instance, perhaps many of the zip codes that declined in 2020 would likely have declined even if there had been no pandemic, due to factors unrelated to COVID-19. To attempt to disambiguate COVID-19 from other factors, I construct a baseline model that aims to be a rough estimation of growth in home values absent the shock of COVID-19.

The baseline model is a linear regression that predicts year-over-year changes in home values from 2015 to 2019. It is intended to be a generalized predictor of changes in home values during this relatively recent period. The same model is intended to predict, for instance, the change in home values from February 2015 to February 2016 as well as the change from February 2018 to February 2019. All predictors only include data from the time of the start date; for instance, predictors for 2015-2016 data are based on 2015 demographic information.

Simply concatenating data from all of these time periods would not work as expected, because some years experienced higher growth nationwide than others. As a result, the model was trained

to predict relative growth rather than absolute growth. Specifically, for each year-over-year period, all regressors as well as the dependent variable were normalized. As such, the baseline model can be thought of as identifying characteristics of zip codes that made them likely to grow faster than other zip codes during the 2015 to 2019 period.

4.2 COVID-19 Model

After the baseline model was fitted, it was used to make predictions about changes in home values from February 2020 to February 2021. February 2020 was the last month in which the US experienced relatively few economic changes as a result of the pandemic. The model can be thought of as predicting what growth would have been absent the exogenous shock of the pandemic.

A second regression model was used to predict growth rates from February 2020 to February 2021, the peak of the pandemic's economic effects. Coefficients in this model can be compared with coefficients from the baseline model. If COVID-19 had an effect on growth that caused zip codes with particular characteristics to grow very differently than would otherwise have been expected, the coefficients should differ between the two models.

For ease of interpretation, a third regression model was also used to predict the difference between growth expected by the baseline model and actual growth. This is equivalent to computing the difference in coefficients between the two models.

5. Results

5.1 Home Values (see also Appendix I)

5.1.2 Baseline Model

The baseline model is not the target of this analysis; nevertheless, it is important to understand which factors have historically contributed to changes in home values and rents over time. Appendix I shows the results of the regression output.

Historically, zip codes with higher initial home values saw reduced growth compared with zip codes with lower home values. This is consistent with prior results that suggest faster growth in

lower-priced areas.[11] In addition, areas that saw higher growth over the preceding year were likely to see less growth in the future. Perhaps such zip codes tended to have already realized their growth potential, and so had less room to grow in the future.

Density had a mixed effect on home value changes. The logarithm of density had a negative correlation with home value increase, suggesting that denser areas grew slower. On the other hand, the absolute density had a positive correlation, indicating that the very densest zip codes were growing faster than their log densities would suggest.

The presence of more children was positively related to home value growth, possibly due to families wishing to upsize their homes and thus putting pressure on local real estate. In addition, the presence of more people older than 65 also had a positive correlation with home value growth, perhaps because the growing retired population in America is increasing prices in popular retirement areas.

A high number of workers working from home was predictive of lower growth. It is possible that workers working from home (prior to the pandemic) were doing so out of necessity or a lack of jobs, which would indicate that the area could be in decline. Areas with a higher proportion of working adults, on the other hand, grew faster; this is consistent with the hypothesis that such areas are employment centers and thus more desirable. Areas with high numbers of workers who are able to work from home had higher growth in home values than those that didn't, suggesting a premium afforded for areas with many workers in the knowledge economy. Length of commute for the median worker didn't have a significant effect on home values.

Education and income were both negatively related with relative home price growth. This is consistent with the idea that high-value areas had reached a saturation point during this time period, and were not growing particularly fast compared with (perhaps gentrifying areas) with more lower-income and less-educated individuals.

Race was also a significant factor in the growth of home values. Areas with more Black and Hispanic residents saw higher home value growth, perhaps due to the effects of gentrification. Areas with more Asian residents, however, saw reduced home values; this could be related to the

[11] Guerrieri, Hartley, and Hurst, "Endogenous Gentrification and Housing Price Dynamics."

fact that Asian Americans tend to have higher incomes and thus live in areas that already have high prices that aren't growing as fast.

States varied widely in terms of their correlation with home value growth. States in the West were associated with higher growth, while Louisiana, North Dakota, and Connecticut were all associated with sluggish growth. An illustration of this is shown in Figure 1.

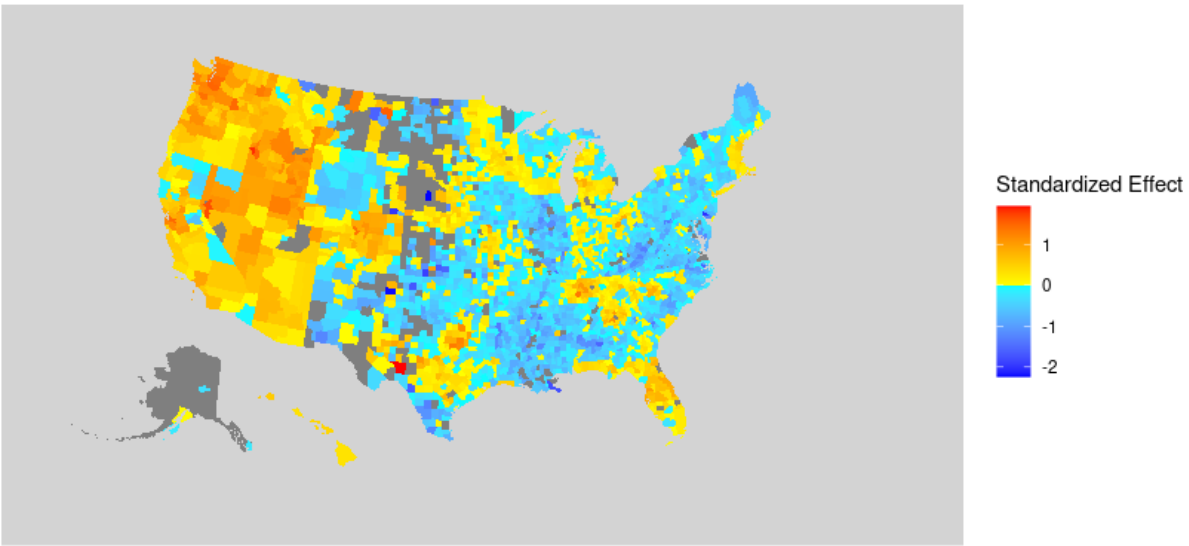

Figure 1: Standardized Effect of County on Relative Growth Rates in Home Values, 2015-2019

5.1.2 COVID-19 Model

The results of the residual model can help determine how COVID may have changed the importance of various factors relative to previous years.

The initial typical home value was still negatively related to growth, but less so than in previous years. The same was true of the effect of growth over the preceding year. The results indicate that

COVID-19 may have pushed growth towards the status quo, rather than towards a reversion to the mean.

The effect of population density reversed during COVID-19. Previously, the logarithm of density was associated with lower growth, but during COVID-19 it was associated with higher growth. Similarly, the effect of absolute density changed from positive to negative. The effect indicates that COVID-19 had a largely positive effect on cities towards the middle of the density distribution, and negative effects on the least and most dense areas.

The effect of the proportion of people already working from home intensified, with such areas likely to experience lower growth. Such zip codes might contain households where one member was already working from home, which could mean that households were more willing to leave the area if the other lost a job or was able to work remotely as well. Zip codes with more workers estimated to be able to work from home, previously associated with higher growth, became associated with lower growth during COVID-19.

In the period studied, education did not have a significant effect on changes in home value, in contrast to before the pandemic, when it had a negative effect. The effect of income reversed: previously associated with lower growth, areas with higher median incomes became associated with higher growth. The results suggest that areas with higher income and education did better than they had before the pandemic.

Racial effects were largely the same before and after the pandemic. One exception is the proportion of the population that is Hispanic or Latino. While still positive during the pandemic, it was significantly less so than it had been before.

County effects varied widely. New England and especially Connecticut zip codes, previously associated with sluggish growth, saw a complete reverse of fortune during the pandemic, perhaps due to New Yorkers moving to the state. Arizona and New Mexico zip codes also did well. Meanwhile, Nevada zip codes suffered greatly, likely due to the depressed hospitality and tourism industries during COVID-19. Figure 2 shows the change in county coefficients during the 2020-21 period.

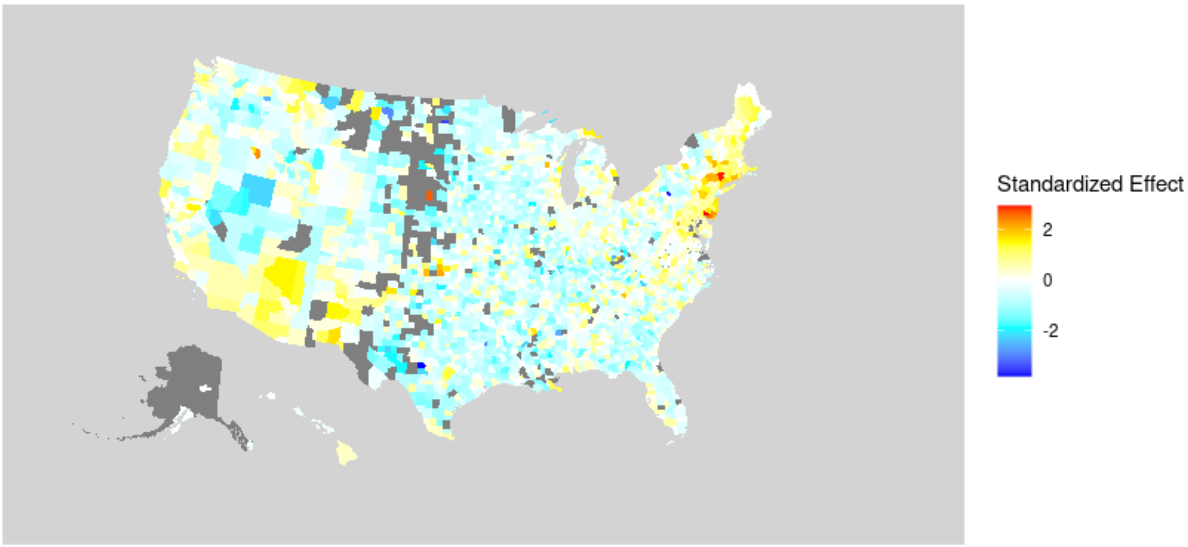

Figure 2: Change in Standardized County Effects on Home Values Relative to Baseline Model

5.2 Rents (see also Appendix II)

5.2.2 Baseline Model

Many of the trends observed for rent in the baseline model matched trends for home values. High initial values for rents, as well as high growth in the preceding year, were associated with lower future growth in rents. Zip codes with a higher proportion of residents of Asian ethnicity were observed to have lower growth than other zip codes; the effects of other races was insignificant.

Unlike with home values, the percentage of the population that was employed (before the pandemic) was negatively correlated with rents, indicating that areas with many workers had lower growth in rents. Density was negatively related to rent changes, though not strongly. The logarithm of density was not significantly related to growth in rents. However, it must be noted that Zillow rent data, unlike home value data, only covers relatively urban areas, so the effect of density could be expected to be lower.

Figure 3 shows county effects on rental growth. Zip codes in many midwestern cities were associated with low rent growth, while those around cities like Boston, New York, Phoenix, Los Angeles, and Seattle were associated with high rent growth.

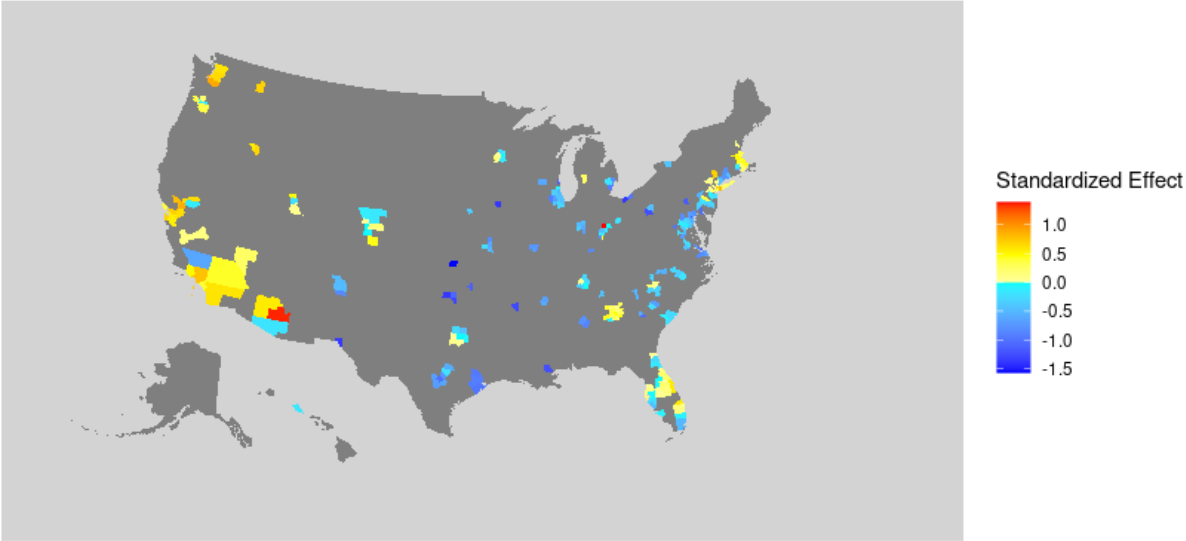

Figure 3: Standardized Effect of County on Relative Growth Rates on Rents, 2015-2019

5.2.2 COVID-19 Model

There were several significant changes between the baseline and COVID-19 models. While higher rents and higher growth in rents in the preceding year were still associated with lower growth, the effect was much lower than before COVID-19, indicating that 2020 was a better year than usual for zip codes with already high rents. Similarly, median income, which was not significantly related to rent growth before the pandemic, was significantly positively related to rent growth during the pandemic.

Density effects were markedly stronger during COVID-19 than before. Both the logarithm and the absolute value of density were significantly negatively correlated with rental growth,

indicating that denser and especially the very densest zip codes saw rents decline drastically. This is, of course, consistent with the idea that density is less appealing during COVID-19.

Variables related to working from home, which before COVID-19 were not good predictors of changes in rents, became significantly related with rent growth during COVID-19. The percentage of people working from home was significantly negatively related with growth in rent values. The proportion of people estimated to be able to work from home was the single largest non-geographic variable in the COVID-19 model; for each standard deviation increase in that variable, rent growth was estimated to drop by 0.21 standard deviations. The percentage of the population that was working, which was negatively related to rent growth before the pandemic, became even more negatively related to it during the pandemic, indicating that working neighborhoods experienced low rent growth in the time of COVID-19. Lastly, the median length of commute (before COVID-19), which wasn't a significant predictor of growth prior to the pandemic, was significantly related to higher rental growth during the pandemic. Since many did not need to commute prior to COVID-19, it makes sense that areas further from jobs would experience higher rent growth.

Figure 4 shows the difference in standardized county effects between 2020-2021 and previous years. Many of the high growth metro areas before the pandemic, like the Bay Area, Seattle, and Boston, saw a reversal of fortune during the pandemic. However, others, most notably the Atlanta area, saw relative rent growth consistent with before the pandemic. Similarly, many midwestern cities saw higher relative rent growth than they had prior to the pandemic.

5.3 Case Study: The Northeast

This paper now turns to a particular region, to investigate intra-region trends in home values and rents. The Northeast of the US was selected for this, because it is a good microcosm of the county as a whole: it contains the largest city in the US, New York, but also many suburbs, smaller cities, and rural areas.

5.3.1 Before the Pandemic

Figures 4 and 5 show county effects on home values and rents prior to COVID-19. Both home values and rents were growing faster than expected in a wide swatch of eastern New England,

stretching from Rhode Island to Maine and including the city of Boston. In addition, counties in New York City and Long Island were also associated with both higher rent and home value growth. One exception is New York County itself, which experienced sluggish growth in home values (though still higher growth in rents). Every county in Connecticut was associated with slower rent and home value growths prior to COVID-19.

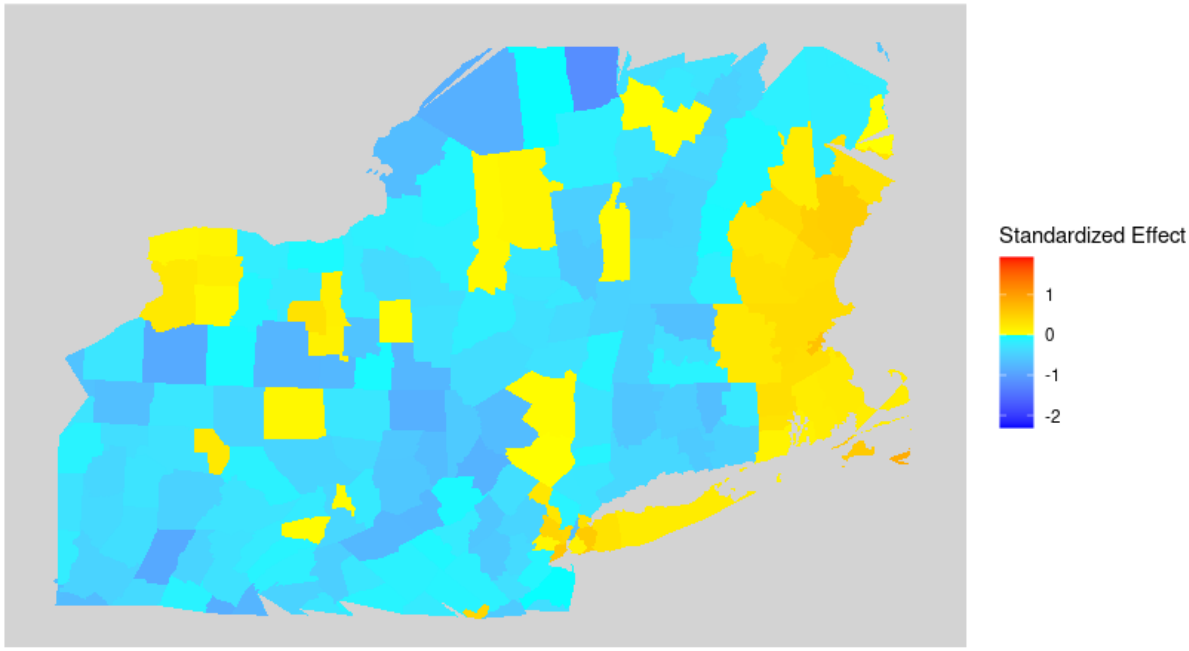

Figure 4: Standardized County Effects on Home Values in Northeastern States, 2015-2019

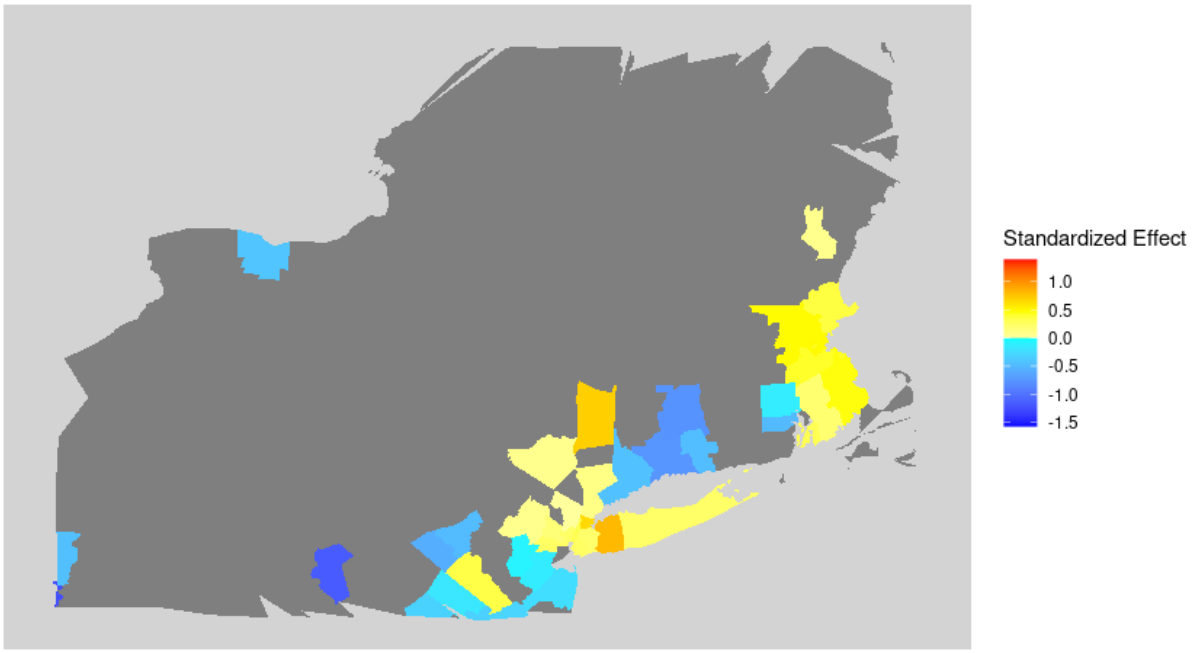

Figure 5: Standardized County Effect on Rent in Northeastern States, 2015-2019

5.3.2 Change During COVID-19

Figures 6 and 7 show changes in county effects during COVID-19. Note that the effects are adjusted for changes in effects of the other variables mentioned. This means, for instance, that if a particularly dense county is associated with slower growth, that association should be due to factors other than density, since density is already accounted for in the model.

Almost all of the Northeast saw was associated with higher relative growth in home values compared with before the pandemic. Two major exceptions were New York City and Boston, which were associated with lower relative growth in home values. Rent effects, for the most part, rose and fell in line with home value effects, but New York City experienced even more extreme rent effects.

Every county in Connecticut was associated with higher growth than before the pandemic, in both home values and rents. One standout change, in terms of home values, is Litchfield county, which is a mostly rural county in the northwest of Connecticut. Prior to the pandemic, it had

experienced sluggish home growth, similarly to the rest of Connecticut. The pandemic was associated with much higher relative growth rates in the county. The largest city in the county, Torrington, is about 2 hours from New York City in good traffic, probably too far for most to commute from during the pandemic. However, during COVID-19 it has attracted wealthy New Yorkers to the point that a small lake in the county has been dubbed "Lake Goldman" by the New York Post.[12]

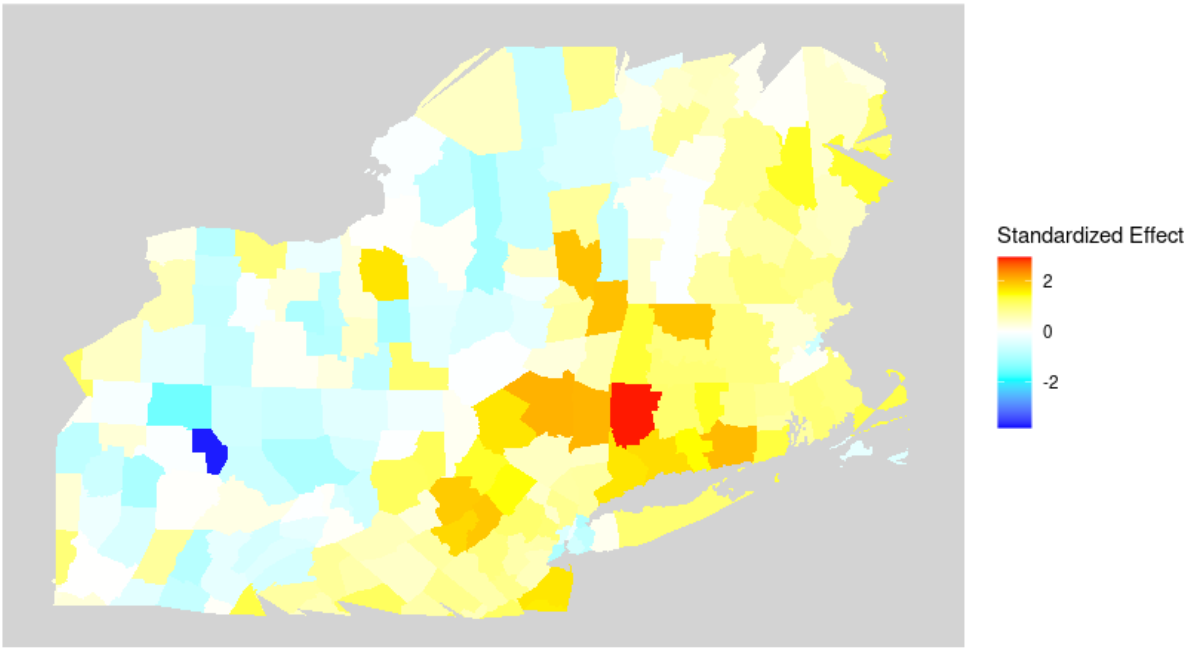

Figure 6: Change in Standardized County Effects on Home Values in Northeast, Relative to Baseline Model

[12] Ellwood, "This Ultra-Exclusive Connecticut Lake Has Earned a Crass New Nickname."

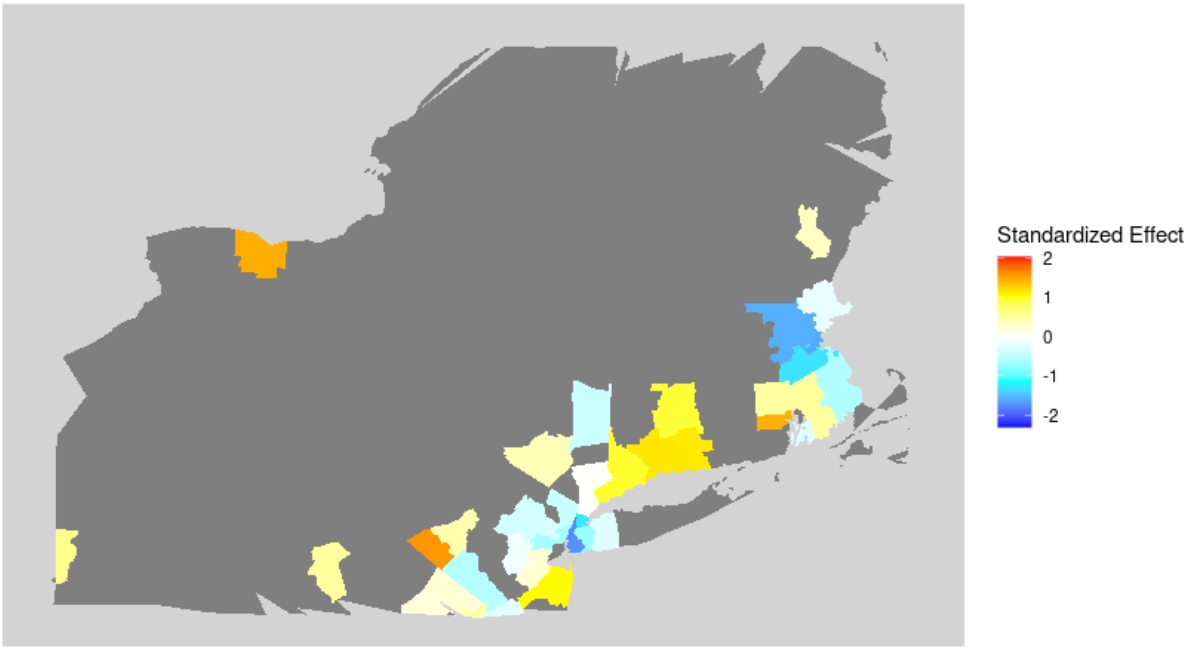

Figure 7: Change in Standardized County Effects on Rent in Northeastern States during COVID-19

6. Concluding Remarks

This analysis has demonstrated the association between COVID-19 and home value and rent changes. Overall, the pandemic can be linked to rent and home value increases in areas that already experienced high rents and had high-income residents before the pandemic. High-density areas fared poorly in terms of home values and rents during the pandemic. This research also suggests which changes during COVID-19 may be merely temporary. Areas with high numbers of individuals working in industries associated with the ability to work from home had lower growth in rents, but the effect on home values was not as pronounced. This indicates that there is at least some anticipation that many knowledge workers will eventually return to cities.

Despite some preliminary suggestions, the true effect of COVID-19 will not be known for many years. Will people return to New York City in droves? Will “Lake Goldman” continue to thrive, or will it become a ghost town? It remains too soon to say.

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Appendix I - Home Value Model

* = significant at α=0.05

	Coefficients		
Predictor	Baseline	COVID-19	Change
log(initial values)	-0.2437*	-0.1917*	0.0519*
Growth over the preceding year	-0.0533*	-0.0343*	0.0190*
log(population density)	-0.0127*	0.0435*	0.0562*
Population density	0.0324*	-0.0296*	-0.0620*
Percent under 18 years old	0.0083*	0.0381*	0.0298*
Percent over 65 years old	0.0128*	0.0540*	0.0413*
Percent of working age employed	0.0248*	0.0220*	-0.0028
Percent of workers working from home	-0.0438*	-0.0618*	-0.0186*
Median commute length	0.0008	0.0064	0.0056
Percent with bachelor's degree or more	-0.0234*	-0.0343*	-0.0109
Percent able to work from home	0.0141*	-0.0095	-0.0236*
Logarithm of median income	-0.0185*	0.0078	0.0263*
Percent Asian	-0.0372*	-0.0483*	-0.0112
Percent Black/African American	0.0506*	0.0609*	0.0130
Percent Hispanic/Latino	0.0501*	0.0330*	-0.0172*

Appendix II - Rent Model

* = significant at α=0.05

	Coefficients		
Predictor	Baseline	COVID-19	Change
log(initial values)	-0.4230*	-0.1368*	0.2862*
Growth over the preceding year	-0.1856*	-0.1123*	0.0734*
log(population density)	0.0093	-0.0526*	-0.0619*
Population density	-0.0422	-0.1059*	-0.0637*
Percent under 18 years old	0.0046	0.0412	0.0366
Percent over 65 years old	0.0022	-0.0301	-0.0323
Percent over age 16 employed	-0.0601*	-0.1568*	-0.0967*
Percent of workers working from home	0.0208	-0.0281	-0.0489*
Median commute length	-0.0196	0.0953*	0.1149*
Percent with bachelor's degree or more	-0.0159	-0.0806*	-0.0647*
Percent able to work from home	-0.0160	-0.2109*	-0.1950*
Logarithm of median income	0.0334	0.2043*	0.1709*
Percent Asian	-0.0629*	-0.0565*	0.0064
Percent Black/African American	0.0048	-0.0214	-0.0262
Percent Hispanic/Latino	0.0286	-0.1076*	-0.0136*