Density Seems to Matter: The IMPACT OF COVID-19 PANDEMIC ON HOUSING PRICES ON OAHU ISLAND, HI

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**INTRODUCTION**

This paper aims to investigate the multifaceted impacts of the COVID-19 pandemic on the housing market of Oahu Island, Hawaii. Despite recording comparatively lower death rates than other states in the United States, the tourism-dependent economy of Hawaii has not been immune to the adverse consequences of the ongoing crisis. The first positive case in Hawaii was detected on March 6, 2020, when a Grand Princess passenger returned to the island. As the pandemic unfolded, fears and uncertainties gripped society, compelling businesses to suffer, schools to close, and the healthcare system to strain. This study examines how these circumstances have influenced the housing market dynamics on Oahu Island.

During the progression of the COVID-19 pandemic, an escalation in positive cases prompted the former Mayor of Honolulu to announce stay-at-home orders, effective from March 23, 2020, until April 30, 2020. In an unprecedented move, the Hawaii Tourism Authority requested media outlets to discourage travel to all the islands in Hawaii. Former Governor David Ige approved a subsequent stay-at-home order spanning from August 27 to September 24, 2020. Oahu eventually reopened on March 11, 2021. This study aims to assess how households perceive the prevailing housing market conditions amidst the COVID-19 pandemic, and whether these perceptions have exerted a negative, positive, or neutral influence on housing prices. Hawaii, often referred to as a paradise, exhibits a median housing price exceeding one million dollars. Despite a consistently growing demand for housing in Hawaii, the present inquiry scrutinizes whether the pandemic has altered individuals' aspirations of residing in Hawaii and subsequently diminished their enthusiasm for property acquisition on Oahu Island. Paradoxically, an intriguing phenomenon has emerged during the pandemic, as housing prices on Oahu Island experienced a significant upsurge especially in the single-family housing market.

The unusual surge in housing prices on Oahu Island can be attributed to a confluence of factors, namely historically low mortgage rates and the perceived safety and desirability of living in Hawaii. The low mortgage rates have incentivized buyers to acquire multiple properties, capitalizing on the reduced costs associated with homeownership. The appeal of Hawaii's relatively safer environment compared to other states has also prompted individuals to seek housing for the sake of health and safety. The low elasticity of housing due to the combination of increased demand and limited supply has further driven up housing prices in Hawaii. Notably, the escalating prices of lumber have played a significant role, with prices nearly tripling since 2020. The amplified demand stemming from home renovation projects, new home constructions, the Honolulu Rail Transit construction, coupled with reduced global production, has contributed to the upward trajectory of housing prices in Hawaii.

This study significantly contributes to the existing literature by conducting the first island-wide analysis encompassing the spatial patterns and heterogeneity of housing price fluctuations in both the single-family housing and condo markets of Hawaii during the COVID-19 pandemic crisis. Even though there is one literature examined the impact of the COVID-19 pandemic on Honolulu’s housing market, it is not island-wide and its results are negative revealing a pessimistic outlook, which diverges significantly from our research findings. Our study, in contrast, adopts a comprehensive island-wide approach and reveals results that present a different perspective. The primary objective of this research is to comprehensively explore the repercussions of the COVID-19 pandemic on housing prices specifically on Oahu Island, Hawaii. By undertaking this investigation, we aim to enhance the understanding of the unique dynamics shaping the housing market amidst the pandemic and provide valuable insights for policymakers, industry professionals, and prospective homebuyers.

**LITERATURE REVIEW**

The studies on the relationship between the COVID-19 pandemic and housing values can be grouped into four categories: studies that find no measurable effects on property values; studies that find all negative impacts on property values; studies that find all positive impacts on property values, and studies that find mixed results from different study areas or different periods during the pandemic.

**Group A: studies that find no measurable effects on property values.**

Yörük, B. K. (2022) studied 100 metropolitan areas in 2020 and found that state-level policies implemented to combat the COVID-19 pandemic, particularly the closure of non-essential businesses in certain states, resulted in significant decreases in new home listings (up to 11%) and total inventory (up to 3.5%) compared to the same period in 2019. However, the percentage change in median list price in 2020 is relative to the same period in 2019. Zeng and Yi (2022) used the hedonic price model to compile the second-hand housing price index in Wuhan and its neighboring capital cities and then uses the difference-in-difference (DID) model to conduct a comprehensive study on new commercial housing and second-hand housing market. Their results showed that the negative impact of the pandemic on the housing market was mainly reflected in the volume and area of housing transactions, with little impact on housing prices. Delgado and Katafuchi (2020) studied the impact of the COVID-19 state of emergency declaration on the real estate market using monthly prefectural-level panel data sets in Japan. Their findings revealed that the treatment effect estimated by the DID model was not statistically significant for all real estate market outcomes, indicating that the state of emergency declaration did not significantly influence long-term consumption decisions in the housing market, possibly due to consumers' resilience to short-term shocks caused by COVID-19.

**Group B: studies that find all negative impacts on property values.**

Hu et al. (2021) examined five Australian cities and found that for every doubling of newly confirmed COVID-19 cases, housing prices dropped by 0.35% to 1.26% annually. Qian et al. (2021) demonstrated that housing prices are negatively affected in regions with higher infection levels or inadequate healthcare, with a 2.47% reduction observed in Ireland as the pandemic persisted. Allen-Coghlan and McQuinn (2021) also observed an 18-month decline in housing prices in the Irish housing sector due to the COVID-19 pandemic. Francke and Korevaar (2021) noted a temporal increase in housing risk premia in Amsterdam and Paris caused by growing uncertainty and economic disruption from the pandemic, resulting in a reduction in housing prices. Liu and Su (2021) examined the COVID-19 pandemic's impact on housing location demand, revealing a shift away from high-density neighborhoods due to decreased necessity for proximity to telework-compatible jobs and declining value of access to consumption amenities. They also found that neighborhoods with higher pre-pandemic home values experience a greater drop in housing demand, and there is a significant but smaller shift away from large cities. Del Giudice et al. (2020) conducted a study in the Campania region of Italy, which revealed a short-term decrease of 4.16% and a mid-term decrease of 6.49% in housing prices between late 2020 and early 2021 because of the global pandemic.

**Group C: studies that find all positive impacts on property values.**

Yang and Zhou (2021) examined COVID-19's impact on the housing market in the Yangtze River delta region in China by using the average selling price of commercial housing to capture the performance of local housing market. They found out that the COVID-19 has significantly increased housing prices, reflecting the need for families to stay together. Yang and Zhou (2021) examined the effects of the pandemic on the housing market in China and found a considerable and statistically significant increase in housing prices following the emergence of the pandemic, indicating the need for improved home quarantine measures. Kadi et al. (2020) conducted a study on the rental housing market in four major Austrian cities, analyzing real estate listings, and identified that property owners reconsidered their usage of units for tourism purposes, subsequently converting them back to the regular rental market due to increasing rental prices. Verma and Husain (2020) assessed the resilience and strength of the Canadian housing market during the pandemic and observed that cities near urban centers experienced an upswing in housing prices. In terms of reported COVID-19 cases, Arcaya et al. (2020) found that housing values increased with rising COVID-19 cases, primarily due to housing displacement pressures caused by the pandemic.

**Group D: studies that find mixed impacts on property values.**

Yang et.al. (2023) analyzed the association between to-metro and by-metro accessibility and house prices in Chengdu, China and find different impacts on low-priced houses and high-priced houses. Gupta, A., et al. (2022) found that the COVID-19 pandemic led to house price and rent declines in city centers, while prices and rents increased in areas away from the center, resulting in a flattening of the bid-rent curve in most U.S. metropolitan areas. They also found that there was an urban revival in the housing markets with urban rent growth expected to surpass suburban rent growth as the prevalence of working from home diminishes. Jim and Huang (2022) empirically investigated urban residents' reaction to the Covid-19 pandemic, finding mixed evidence for a shift in housing preference to suburbs, with strong support for urban flight within metro areas but uneven geographical disparity across the United States, highlighting the local and regional nature of housing market conditions. D'Lima et al. (2022) found that the housing markets' pricing effects during COVID-19 government shutdown responses varied based on population density and property size, with densely populated locations experiencing a 1.4% decrease in three-bedroom property prices while low-density areas saw a 1.5% increase, and markets under shutdowns experienced a significant decrease in sales. Bricongne, Meunier, and Pouget (2022) analyzed a large database and found that the listing prices after the lockdown experienced a continued decline in London but increased in other regions. Balemi, N., et al. (2021) offered a comprehensive review of scientific papers on the impact of the COVID-19 pandemic on real estate markets, encompassing commercial real estate, residential property, and the mortgage market. Their findings revealed that the outbreak affected all real estate markets differently due to their heterogeneity and various transmission channels from initial macroeconomic shocks, underscoring the significance of understanding these differences for governments, national banks, and investors in both private and public markets. Cheung et.al. (2021) investigated the COVID-19 epicenter in China and found that the house prices fell immediately 4.8% by using hedonic pricing model and 5.0-7.0% by using price gradient model after the breakout. They also found that the house prices in the 62 areas in Wuhan City where the COVID-19 pandemic originated rebounded after the lockdown period, and price gradients were flattened from the epicenter to the urban peripherals. Li and Zhang (2021) examined housing price change rates across 2,856 U.S. counties during the COVID-19 pandemic. They found that the impact of the pandemic on housing prices varied spatially, with hotspots shifting away from densely populated urban areas to more affordable suburbs and smaller cities, suggesting a change in Americans' property-buying behavior in response to the virus. Wang (2021) investigated the impact of COVID-19 on house prices using individual-level transaction data and a revised difference-in-differences method. Among the studied areas (Houston, Santa Clara, Honolulu, Irvine, and Des Moines), this paper concluded that Honolulu witnessed significant house price declines, potentially linked to its heavier reliance on service industries; while Santa Clara and Irvine demonstrated the highest house price increase rates, highlighting the positive effects associated with stronger housing market fundamentals, better amenities, and reduced dependence on service industries.

**METHODOLOGY**

Hedonic analysis is the standard methodology for data involving a heterogeneous good to estimate the shadow prices of the various characteristics that make up that good (Ohsfeldt and Smith, 1985) and is most frequently used for making inferences about non-tradable aspects of housing units which are, by definition, a heterogenous good that is always sold as a bundle (Espey and Lopez, 2000). Assuming *P* is a vector of house prices associated with a vector of structure variables (*S*), a set of location variables (*N*), and any policy and amenity variables (*A*), then the shadow prices for the structural, locational, and amenity variables, along with the impact from any policy changes on price, can be estimated via the following model:

(1)

Unfortunately, this model may generate biased results when the relationship between price and housing characteristics is not linear and in the presence of unobserved local factors lead to endogeneity. Additionally, the likelihood of spatial dependence, which is derived from Tobler’s first law of geography (1970), “everything is related to everything else, but near things are more related than distant things,” may lead to further bias in the results. Addressing spatial dependence has received a great deal of attention since Anselin’s (1988) original work and is best summarized in LeSage and Pace (2009). Despite the large literature, both theoretical and empirical, there are still several pitfalls that must be addressed when controlling for the spatial dependence of data including endogeneity, missing variable bias, and the choice of weight matrix. As pointed to in LeSage and Pace (2009), many of these issues can be addressed by estimating a Spatial Durban Model (SDM) via Loglikelihood estimation techniques.

Specifically, we use maximum likelihood to fit the model:

(2)

where indicates the natural log of the sale price for property , is a row-standardized weight matrix modeling the spatial dependance in the data and is an estimated parameter measuring the extent of the dependence. The vector is a combination of the physical attributes and locational variables related to property ; is another row-standardized matrix, typically assumed , with being an estimated parameter measuring the extent to which the neighboring characteristics impact the value of property . The advantage to this model, according to LeSage and Pace (2009) is that if the true data generating process is of any of the variety of spatial models in the literature (SAR, SEM, or SAC), the estimates from the SDM are still unbiased. This leaves only the issue of the choice of weight matrix, and this can be determined using the Log Likelihood statistic produced from the estimation of various spatial models.

A final modeling concern is that impacts may be heterogenous across different types of housing units. Specifically in Hawaii, there is a large portion of the housing that is classified as condominium or townhouse in addition to the standard single family housing unit. To address this concern, we estimate equations (1) and (2) with the full sample of units and then with subsamples of the data split across the two different types of units.

**DATA**

The sales data is obtained from the Hawaii Board of Realtors and contains sales data from 2016 until 2023 and the demographic data is from the ACS 5-year summaries at the block group level from the years 2016 through 2021.[[1]](#footnote-1) The raw data contains 57,217 arms-length transactions for 51,239 unique units from the island of O’ahu, the location of Honolulu and Pearl Harbor. The data is cleaned to remove missing observations, typographical errors in the key variables, and remove any sales that do not match with available demographic data[[2]](#footnote-2) leaving a final total of 50,394 observations for 43,057 unique units. Of these, 36,367 units were sold only once over the nearly 7.25 years of the sample, 6,075 of the remaining observations were sold twice, 586 were sold three times, 28 were sold four times and one unit was sold five times. Additionally, about 70% of the townhouse/condo units sold only once while about 73% of the single-family units sold only once over the sample.

[Insert Table One]

Table One shows the variable definitions and the summary statistics for the three key samples employed in this paper (all units, townhouse/condo units only, and single-family units only) and we instantly see one major difference is the sale prices with the average townhouse/condo units selling for about $660,000 while the average single-family home sells for about $1.25 million. Additionally, single family homes tend to have more bathrooms and bedrooms and the averages square footage is about twice that of townhouse/condo units while nearly half of the townhouse/condo units are in multistory structures. Both types have similar ages, with single-family units being only slightly older when they sale indicating the housing stock between the two types are mostly of the same vintage, however slightly more townhome/condo units are classified as excellent condition while slightly more single-family units are classified as average or fair.

Most of the differences between the two key samples are in the land use classifications as one might expect. There are no units in the townhouse/condo subsample classified as Duplex or Multi-Dwelling Units while there are no units classified as Low-Rise, High-Rise, Townhouse, Walk-Up, or Condo-Hotel in the single-family sample.[[3]](#footnote-3) Most of the single-family housing is in land zoned as residential while most of the townhouse/condo units are split between low and medium density, and other zones. As a result of the location, there are also slightly more elevators located in the structures for townhouse/condo units while single family homes are slightly more likely to be remodeled. An interesting result from the summary statistics are that the townhouse/condo units are located about .75 kilometers closer to the ocean than the single-family homes and this is reflected as well in the percentage of units in the various flood zone classifications. Additionally, we see that single family units are located further away from hospitals and airports and slightly further away from the middle and high schools to which they are assigned. Finally, we see that the population racial statistics are similar across both subsamples, however, a slightly higher percentage of the single-family units are occupied and owner-occupied compared to the townhouse/condo subsample.

[Insert Figure One]

While it may not seem obvious as to why we split the sample into these two groups given the fact that many differences between single-family and townhouse/condo units should be controlled for with control variables in the model, we are concerned about unobservable preferences related to the fact that the Covid-19 virus is an airborne virus with increased likelihood of spread among more dense environments; the exact conditions one might expect in the townhouse/condo type units more than in single-family units. On the other hand, given that more townhouse/condo units are closer to the beaches, there may be a preference to be closer to these amenities in response to the stay-at-home orders and the increase of work-from-home. The expected heterogenous impact from the pandemic can be seen visually in Figure One. The upper line is the monthly average sale price for single-family units while the lower line is the monthly average sale price for townhome/condo unit. The horizontal lines located across the graph represent the annual average for each unit type and the vertical line indicates the start of the Covid-19 pandemic. We see there does not appear to be much of a change in the value for the townhouse/condo units; however, this is not the case for the single-family units. While in the months initially after the declaration of the pandemic shows a dip in sales price, the market quickly rebounds leading to the overall annual average to be higher in 2020 compared to 2019 and higher still in 2021.

[Insert Table Two]

Table Two breaks each of these samples into the pre- and post-Covid periods. All units sold before March 2020 are classified as pre-Covid while all units sold during or after March 2020 are classified as post-Covid.[[4]](#footnote-4) Comparing columns three and five show the averages for most of the characteristics and location control variables are very similar across the pre and post Covid periods for the full sample. Some key elements that are different are the average sale price is higher, days on the market (DOM) are lower. Columns seven and nine show the split for the townhouse/condo subsample and, like the full sample, the characteristics and location variables are very similar across the two periods except for sale price and days-on-market. For townhouse/condo units both the average sale price and days-on-market fall. The difference in sale price is not statistically significant, indicating that, at best, the sale price did not change due after the start of the Covid pandemic although units on the market did sell faster than before indicating a speed up in the market.

Columns eleven and thirteen show the means for the single-family subsample and, as with the other samples, the means for most characteristics are similar except for the sale price and days-on-market. There is a clear and statistically significant increase in the average sales price of single-family units after the start of the pandemic and a decrease in the days-on-market indicating a faster pace to the housing market. While these summary statistics and the image in Figure One seem to support the idea that there was a fundamental shift in preferences of buyers leading to higher single-family prices after the start of the pandemic and that this shift did not occur or faced an offsetting factor for townhouse/condo units, we need to ensure that confounding factors are not driving this result.

**RESULTS**

*Linear OLS Regressions*

We start with a standard OLS hedonic regression of the indicator variable for sales occurring after the start of the Covid-19 pandemic and build on that by adding variables from each of the general categories discussed above. The results from the OLS estimations are shown in Table Three and we see that when only the COVID variable is regressed on the natural log of the real closing price, there is an 8.1 percent increase in the value of the homes sold after the start of the Covid pandemic equating to a premium of about $75,000. On its face, this runs contrary to Wang (2021)’s study showing decreases in home values in Honolulu. In Wang’s analysis of home values shortly after the start of the pandemic, the author shows that the home values between July 2018 and October 2020 fell in Honolulu, with the largest deceasing rate of 6.7% in April 2020 relative to before the outbreak. Once we add more data to the analysis, however, we see this was a temporary negative shock (see Figure One) that quickly rebounded once the initial confusion surrounding the disease was resolved.

[Insert Table Three]

The significance and the magnitude of this result, as expected, falls after the inclusion of year fixed effects to control for annual market conditions and days-on-market (DOM) to control for time between listing and closing. After adding these market controls, the coefficient on the Covid indicator is cut nearly in half and the significance drops. Model three of Table Three shows the results from adding unit characteristic and condition variables to the model. The coefficient on the Covid indicator drops further and its statistical significance drops below the 10% threshold. The remaining coefficients: however, are in line with expectations as more bedrooms, full and half bathrooms, and square footage all increase the value of the home while having multiple stories and being older at the time of the sale all lower the value of the home. Furthermore, homes rated in Excellent or Above Average condition see a slightly higher premium compared to homes with an Average rating, while homes with a Fair rating see a lower value. Only the variable for the existence of a basement is not significant which is likely due to the very few homes with basements and the fact that basements are likely a flooding risk given the units are located on an island.

Model four in Table Three adds variables indicating the type of building and land use code of the parcel upon which the unit is located and some characteristics about the building within which the unit is located. The covid indicator variable sees an increase in value, yielding an increase in value of about $20,000, and moves back within the 10% statistical significance threshold. Among the added variables, the building type indicators should be viewed as descriptive keywords about the building within which the unit is located, and more than one can be applied to a specific unit. For example, a unit may be in a planned unit develop (PUD) property that is a high-density building.[[5]](#footnote-5) Additionally, model four adds zoning information with the reference category as residential, and we see that high- and low-density properties see lower values while business, other, and resort classifications all see increases in value compared to residential and use. More parking demands a higher premium, however, once a property has two parking spaces, the gain does not increase with more spaces. Having elevators in the structure is also viewed as a positive factor and homeowner association (or condominium association) fees (HOA) are capitalized into the value, however, the negative impact is quite small in magnitude. Finally, being remodeled shows a slight decrease in value, however, this result, which is unexpected, eventually turns slightly positive as more controls are added to the model.

Model five adds measures of straight-line distance to various amenities and variables denoting the latitude and longitude for the centroid of the parcel upon which the unit is located. Being located further from positive amenities such as parks and the ocean, and services such as hospitals and airports all decrease the value of a home. Each kilometer away from the ocean sees a drop of about $8,000 while being the same distance from a park of any type costs a great deal more indicating the importance of green space in this market. Being located further from the elementary school assigned to the property does not impact the property significantly, however, residents seem to prefer to be further from the middle or high schools assigned to the parcel. Column seven, showing model six, adds census controls to the model and there are few unexpected results here. More non-whites in the census track lowers the value while having more owner-occupied units increases values compared to more rental units. What is unusual is that more occupied units, compared to vacant ones, decreases the value of a unit.[[6]](#footnote-6)

The full model, which shows an R2 of 0.814, indicates that we can expect the value of a unit to increase by about $18,000 if it is sold after the start of the Covid pandemic, however, it is important to measure the sensitivity of these results. The first test is shown in the last column of Table Three where the estimates are reported for the model estimated with robust standard errors clustered by zip code. Our variable of interest maintains significance at the 5% level with the more robust standard errors and we see that some of our unexpected results, such as the negative sign on the percentage of occupied units and the coefficients on the land use codes, are no longer significant at the 10% level.

*Heterogenous Housing Types*

As observed in the summary statistics and Figure One, the impact of the pandemic on the sale price may be different for different types of units. The first three data columns of Table Four show the results of the full OLS model with robust standard errors of the townhouse/condo subsample only. The first column uses the full sample of units sold and we see that the indicator for units sold after the start of the Covid pandemic has dropped in magnitude equating to a premium of only about $9,000 given the average townhouse/condo units selling at about $660,000 and, more importantly, we can no longer reject the null hypothesis of this effect being equal to zero within the 10% level (the estimated p-value is 0.1641). This indicates that units classified as townhouse or condominium did not enjoy the post-Covid premium that is indicated in Table Three lending support to the idea that consumer preferences either did not change or that multiple changes offset each other resulting in no pandemic premium or discount for this type of living unit.[[7]](#footnote-7)

Among the other control variables, we do not see any unexpected results. The coefficient on the number of bedrooms is positive for these units compared to the negative found in the full sample and consumers seem to prefer the high-rise building over low-rise buildings. Additionally, being remodeled sees a slight increase in value while distance to the beach or parks are not considered, however, being further from a hospital seems to decrease value while further from the middle school assigned to the unit increases value. Finally, the demographic impacts are like those found prior.

The second and third columns of townhouse/condo results are estimates of the same model with slightly different subsamples. For the spatial analysis discussed shortly, repeated sales of the same unit had to be removed to ensure the weight matrix would be generated correctly. To accomplish this, two strategies are used. First, we retained only the most recent sale of a unit, a method we feel is the most logical approach given that the units that only appear once in our data are the most recent sales for those units (presumably they have sold before, just prior to the start of our data sample). While logically preferred, this will undoubtedly provide more observations after the start of the pandemic at the expense of information from before. To ensure this does not bias the results, we create a second restricted sample by retaining the first listed sale of the units sold multiple times. We include columns two and three to show that with the OLS modeling, there are no real differences between the parameter estimates without the filtering scheme or between the two methods.

Columns five through seven show the results of the full and two filtered samples using only units classified as a single-family property type. In all three cases, the coefficient on the indicator for units sold during the Covid-19 pandemic sees a statistically significant increase in value of between 3.7% and 3.9%, or between $46,000 and $49,000. This is in stark contrast to the estimates from the townhouse/condo subsample where the magnitudes were quite small and statistically insignificant.

Beyond this, the remaining coefficient estimates, when statistically significant, are in line with expectations except for the number of bedrooms, which has a negative and statistically significant, higher building heights and the existence of a basement lower the value; however, zoning of the land has no statistical impact. Distance to the beach, airport, or hospital does not seem to matter, however, being further from a park lowers the value while being further from a school increases the value. Finally, among the demographic variables, we see that being surrounded by more people identified as Black, while like the impact for townhomes and condo units, is not statistically significant, while areas with increased Asian and, especially, native Hawaiian residents see major discounts in value. Being surrounded by more owner-occupied units increases values, while again, being surrounded by more occupied units lowers the value.[[8]](#footnote-8)

*Spatially Controlled Regressions*

While the linear regressions show a clear, heterogeneous impact from the Covid-19 pandemic on the sale of units in Oahu Island, linear models are known to be biased in the presences of unmeasured spatial relationships. We, therefore, estimate a Spatial Durbin Model (equation (2) above) using maximum likelihood processes.[[9]](#footnote-9) Estimating spatial models requires the choice of weight matrix and given the size of the data sample and for computational efficiency, we choose to use a row-standardized, k-nearest neighbor approach and set k = 20.[[10]](#footnote-10) As discussed above, we remove repeated transactions in the data using the last reported sale and the first reported sale and estimate the models using both datasets to ensure robustness.[[11]](#footnote-11) When estimating a spatial model, care must be taken to correctly interpret the coefficients because of the numerous feedback effects in the model (LeSage and Pace, 2009). Therefore, aside from showing the coefficient estimates, we also show the direct, indirect, and total effects from the Covid indicator and the estimated p-value testing the null hypothesis that the specific impact is, in reality, zero.[[12]](#footnote-12) The direct result is the impact from the post-covid sale of the *i*th observation on the natural log of the *i*th unit while also accounting for how that change in the *i*th unit’s sale price impacts surrounding properties which, in turn, feedback into the *i*th unit’s price. The indirect impact is a measure of the *i*th unit’s neighbor being transacted after Covid on the *i*th unit’s final sale price. It is important to remember that this is only through the process of having been sold after the pandemic started, not through the price mechanism and any Covid premium or discount. The total impact is then the sum of these two. Table Five reports the estimates of the Covid indicator and its spatial lag for the full and two subsamples reported previously under both filtering methods, the estimates spatial parameter, , and its statistical significance, and the three estimated average impacts with significance stars.

When using all unit types and keeping the most recent sale when there are repeated sales, we see both the direct and lagged coefficient are positive and statistically significant. Additionally, the estimate of the spatial parameter is rather high and statistically significant as well. Looking at the average impacts we see that there is an average direct impact, the focus of this paper, of about 2%, while the average indirect and average total impacts are about 60%. In the next column, however, when we keep only the first of repeated sales, neither of the coefficient estimates nor the set of average impacts are statistically significant seemingly indicating no impact from covid on sale price. Another point of interest is that the lagged coefficient and average impacts are significantly lower in magnitude which we suspect may be related to the fact that in the second filtering scheme nearest neighbors are more likely previous sales rather than future sales.

The next pair of columns shows the results when the townhouse/condo unit subsample is used, and we see that the main effect coefficient is not statistically significant and while the coefficient on the lagged value is. This seems to indicate that any benefit obtained for these types of units occurs simply since neighbors are sold after the pandemic (and not any related price premium). This may reflect the possibility of multiple preference factors impacting the price of these units after the start of the Covid-19; however, we cannot be sure without more detailed data about what these preference changes may be. Furthermore, as in the case of the joint sample, we see the average direct, indirect, and total effects are significant for the recent sale filtered sample but not for the first sale filtered sample. We also see the magnitude of the average effects being much smaller in the latter case as before.

The final two columns look at only the single-family units and we see a much different set of results. The direct coefficient and the average direct impact are statistically significant regardless of the filtering method used and the lagged coefficient and indirect effects are not. Diving into these results further we see that selling a single-family unit after the start of the Covid pandemic results in a premium of about 4% or about $50,000, all else equal. By comparing the coefficient estimate with the average direct effect, we see that there is very little of this increase caused by feedback effects. Next we see that the average indirect effect is not statistically different from zero indicating that there is no non-price, neighboring impact from Covid, which one would expect given the nature of what is being modeled. Finally, there is no simulated total effect because of the noise in the distribution of the indirect effect offsetting the rather compact distribution of the direct impact distribution.[[13]](#footnote-13)

In summary we see that there does appear to be a covid premium for living units on the Oahu island of Hawaii, however, the existence and size of that premium depends on the unit being sold. For townhouse/condo unit types, consumer preferences are such that any premium is either not present or offset by some type of negative preference impact whereas for single-family units, sellers can expect to see a $50,000 increase in the value of their property after the pandemic indicating a clear positive preference for these types of units in the eyes of consumers. Concluding that it is related to the way the virus spread or some other factor is unfortunately beyond the ability of this data to determine.

**CONCLUSIONS**

The findings from our study suggest that there exists a Covid premium for living units on the Oahu Island of Hawaii, with the magnitude of this premium varying depending on the type of unit being sold. For townhouse/condo units, it appears that consumer preferences may either not be impacted by the pandemic or that multiple changes in preferences offset each other, resulting in no clear Covid-related premium or discount. Conversely, for single-family units, sellers can expect to see an increase of about 4% or approximately $50,000 in the value of their property after the pandemic, indicating a clear positive preference for this type of housing among consumers. However, we are unable to determine conclusively whether this preference is directly related to the way the virus spread or if other factors come into play, as our data does not allow for a definitive conclusion in this regard. It is important to acknowledge the potential impact of unmeasured spatial relationships in our study. To address this, we have utilized a Spatial Durbin Model, and while the results generally align with the linear OLS regressions, we observe some variation in the magnitudes and significance of the coefficients. This indicates that spatial factors may have influenced the results to some extent, and further research may be required to comprehensively address these potential effects.

In summary, our study highlights the heterogeneity in the impact of the Covid-19 pandemic on the sale prices of two different types of housing units on Oahu Island in Hawaii. While the overall real estate market experienced a Covid premium, the extent of this premium varies based on unit type, with single-family units enjoying a more significant increase in value. The surge in demand for single-family units may be attributed to several factors, such as increased interest in larger living spaces with outdoor amenities and a desire for more autonomy and privacy amidst the health crisis. The potential for remote work arrangements may also have influenced individuals to seek properties that offer more space and conducive environments for a work-from-home setup. Despite the valuable insights gained from this study, there are inherent limitations that should be acknowledged. The data used in our analysis is specific to Oahu’s housing market and may not be fully representative of other regions or states. Our dataset's timeframe might not capture the full extent of the pandemic's influence, as its impact may continue to evolve in the coming years. Moving forward, it is crucial for policymakers, investors, and real estate professionals to interpret these findings in the context of the evolving economic landscape. Understanding the varying impacts of the pandemic on different housing types can inform strategic decision-making in the real estate market. For developers and investors, identifying the segments with the most significant Covid-related premium can help guide investment choices and marketing strategies. Government agencies may also use this information to formulate targeted policies to address specific market challenges and promote economic recovery.

Further research should delve deeper into the underlying drivers of consumer preferences during the pandemic and explore the potential long-term impacts on the housing market. Assessing how these preferences may evolve as the pandemic subsides and our economy stabilizes can provide valuable insights into this island market's resilience and prospects for growth in the post-pandemic era.

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1. Sale completed in 2022 and 2023 are matched with 2021 census data due to those 5-year estimate files not available at the time of this writing. [↑](#footnote-ref-1)
2. The demographic data is matched between the year of the sale and the year of the 5-year estimate files from the ACS. As a result, about 100 transactions did not have census block group data reported in 2016. [↑](#footnote-ref-2)
3. It is important to note that the classifications of Split-level, PUD, Low-Rise, High-Rise, Townhouse, Condo-Hotel, Single Family, Duplex, Multi-Unit and Walk-Up are not mutually exclusive categories in the realtor database resulting in means summing to more than unity. Additionally, the determination for the Townhouse/Condo and Single-Family subsample is taken from a different classification variable in the data which is mutually exclusive and unique for each property. [↑](#footnote-ref-3)
4. As a robustness check discussed in the results section, we also estimate models with a further restrictive definition of post-covid removing all units sold after the end of 2022 and the results are similar. [↑](#footnote-ref-4)
5. While there are likely econometric concerns with these variables, we include them for completeness in addition to the fact that they are likely doing some of the work with regards to the heterogenous impact from the two property types of classifications used later. [↑](#footnote-ref-5)
6. Estimates on the variables of interest are stable if we use percentage of vacant or remove this variable from the model. [↑](#footnote-ref-6)
7. Of interest, but beyond the scope of this paper, for units listed as townhouse/condo units, the difference between the list price and the close price is negative indicating that sellers were lowering their reservations prices which provides additional, albeit circumstantial, evidence that the higher density environment in which then units exist may have had a disutility associated with it. For the single-family units we do remove the cases of identical centroids ensuring that the nearest neighbors are not only different units, but also different buildings and the results are consistent to those reported. [↑](#footnote-ref-7)
8. We estimate the model removing these coefficients and the coefficient of interest remains stable. [↑](#footnote-ref-8)
9. We use the *lagsarlm* command from the *spatialreg* package available in R and the direct, indirect, and total impacts shown in table five are created using the *impacts* function with 1000 iterations to determine significance. The full code is available upon request. [↑](#footnote-ref-9)
10. The value of k is determined by maximizing the log likelihood value of the simple regression of prices on the covid indicator as outlined in Pace and LaSage (2009). [↑](#footnote-ref-10)
11. Another concern in creating the spatial weight matrix is that many of the townhome/condo and some of the single-family units are in the same structures. As a result, the centroid used to calculate distance will be the same for more than one parcel. We allow these units to be counted as nearest neighbors because they are different units. [↑](#footnote-ref-11)
12. The z-stats and p-values are determined by interaction built into the *impacts* command in the *spatialreg* R package. We run 5,000 iterations to obtain the distribution of impacts. [↑](#footnote-ref-12)
13. These views are based on the reported percentile values of the two distributions. These are not reported in the table but are available upon request. [↑](#footnote-ref-13)