THE BIZARRE 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. Additionally, former Governor David Ige approved a subsequent stay-at-home order spanning from August 27 to September 24, 2020. Notably, Oahu 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.

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. To the best of our knowledge, no previous studies have specifically examined the impact of the COVID-19 pandemic on an island's housing market. 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 three 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.**

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.

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

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. 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.

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

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. Delgado and Katafuchi (2020) studied the relationship between the COVID-19 pandemic and the Japanese housing market during the state of emergency declaration. Their findings revealed a favorable demand for housing during this period. Regarding COVID -19 restrictions, 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. Wang (2021) argued that stay-at-home orders and business restrictions have contributed to a surge in housing prices, particularly in properties with better amenities. Yang and Zhou (2022) 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.

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

Bricongne, Meunier, and Pouget (2022) analyze a large database and find that the listing prices after the lockdown experienced a continued decline in London but increased in other regions. Yang et.al. (2023) analyze 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. Cheung et.al. (2021) investigate the COVID-19 epicenter in China and find the house prices fall immediately 4.8% by using hedonic pricing model and 5.0-7.0% by using price gradient model after the breakout. They also find 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) conclude that the influence of the COVID-19 pandemic crisis on housing price change varied across space in the U.S. They also conclude that COVID-19 may make Americans more cautious about buying property in densely populated urban downtowns that had higher levels of virus infection.

**DATA**

The data is obtained from the Hawaii Board of Realtors and contains sales data from 2016 until 2023. The raw data contains 57,217 arms-length transactions from the island of O’ahu which is the location of Honolulu and Pearl Harbor. The data is cleaned to remove missing observations and typographical errors in the key variables leaving a final total of 50,802 observations. Of these, 36,628 homes were sold only once over the nearly 7.25 years of the sample, 24% of the remaining observations were sold twice and the remaining 4% selling more than twice, but no home was sold more than five times in the sample period. Table One below shows the summary statistics for the full sample, pre- and post-Covid (defined as starting in March of 2020), and for a restricted sample that includes only the most recent transactions for homes sold more than once. The restricted sample is created and used for spatial regressions which required that observations only appear once in the dataset so that the weight matrix can be created and utilized.

As is standard, the variables can be broken down into groups: policy, home characteristics, home type, home amenities, locational factors, and neighborhood factors. For the policy variable we have two indicator variables for properties sold after the start of the Covid pandemic, specifically, March 2020. We see in the full sample, 42% of the observations are from after the covid pandemic while 50% are sold after the start of the pandemic in the restricted dataset. A second indicator variable is created for homes sold after March 2020, but before January 2023 to capture the idea that near the end of 2022, with the wide availability of vaccines and other medical interventions, many individuals acted as if the pandemic was over despite the official end not occurring in the U.S. until June of 2023. With this limited definition, we see that 37% and 41% of the homes sold during this window in the respective samples.

[Insert Table One]

All listed prices are converted to real 2022 dollars using the CPI with the average listing price being $956,534 with an average real closing price of $945,364 yielding a difference of just over $9,000. While not statistically significant, the mean listing price before March 2022 is about $55,000 lower than after and the mean closing price is more than $73,000 lower. In the restricted sample the average listing and final sale price is higher, just over $1.2 million in both cases with an average difference of about $22,000. Again, both the asking and closing prices are higher after the start of the pandemic than before with the mean listing price about $80,000 after March 2022, and the mean closing price about $110,000 higher. Another key factor seen in the data is that the difference between the listing and final closing prices is higher before March 2022 (about $14,600 in the full sample and $22,200 in the restricted sample) than after the start of the pandemic when the difference drops to just over $1,000 in the full sample and closing prices exceed listing prices by about $2,000 in the restricted sample. While not statistically significant, these values seem to indicate that something is different after the start of the pandemic in the housing market.

Given the data available, we include variables for the number of full and half bathrooms, number of bedrooms, indicator variable for one story, two story, or multiple story homes, the total covered square footage of the home, the age at the time of sale, that age squared, and an indicator variable for a basement. Comparing the Pre-Covid and Post-Covid columns of both the full and restricted samples, we see that homes that sold before and after the start of the pandemic are mostly the same with only the age being greater in the post-Covid sets, as one would expect.

The condition and structure of the living unit is measured with an indicator variable for if the home is reported as in excellent, above average, average, or fair condition, and an indicator if the building is classified as a Low Rise, High Rise, Townhouse, Condotel, Single Family, Duplex, Multi-Dwelling, or a Walk Up. It is important to note that in the data, these are not mutually exclusive categories. We also include indicators for the land use code of the parcel on which the living unit is located, the homeowner association feed (HOA), if any, indicators for the number of parking spaces allocated to the unit, an indicator if the home as a remodel date listed and the number of elevators in the building where the unit is located. Again, the pre and post characteristics are nearly identical in both samples shown in Table One.

To capture the importance of the location of the unit that is sold, we calculate the shortest straight-line distance to the outer boundary of the island as a measure to the ocean (beach), and then, utilizing shapefiles made available by the State of Hawaii, we calculate the shortest distance to a park of any type, the airport, and the closest hospital. Additionally, using maps from the same source, we determine the elementary, middle or junior, and high school assigned to the individual parcels and then calculate the distance from the parcel to the school building. The exact location of the parcel is measured by the x and y coordinates based on the map projection (lon and lat), and then the flood zone that each parcel is assigned to by the State of Hawaii. The only noticeable difference here is that the homes sold after the start of the Covid-19 pandemic are slightly (about 200 meters) closer to the ocean, on average, than homes before the pandemic, however, this difference is not statistically significant.

Finally, using census tract maps provided by the U.S. Department of Census, and data from the most recent ACS two-year samples, we list the neighborhood characteristics in terms of race, percentage of living units occupied, and percentage of units occupied by owners. Again, the pre- and post-pandemic subsets show nearly identical means.

Another way to see the changes in the housing market and identify any structural changes caused by the pandemic, Figures One and Two show the average monthly closing price and number of transactions per month over the course of the sample. The vertical line in each figure represents the start of the pandemic while the horizontal segments indicate the annual average for the respective dependent variable. Figure One clearly shows a higher annual after the pandemic that grows even higher during 2021. We also see some rather unusual activity near the start of 2023 which should be accounted for in the regressions.

[Insert Figure One and Two]

Figure Two shows the number of transactions each month with the horizontal line segment showing the average monthly transactions for that year. While there is a clear downturn in transactions during the early days of the shutdowns in 2020, the transactions quickly recover, and the annual average is much higher in 2021 only to fall back to a range closer to normal in early 2023. This, again, indicates that something seems to be different after the start of the pandemic in March of 2020.

**METHODOLOGY**

Hedonic analysis has been applied to data on heterogeneous goods to estimate shadow prices of bundled characteristics such as housing attributes and public good amenities acquired through the housing market (Ohsfeldt and Smith, 1985). Traditional hedonic estimation has been frequently used for the purpose of making inferences about non-observable values of different attributes like air quality, airport noise, and access to transportation (Espey and Lopez, 2000). There have been many critical views about traditional hedonic models such as information asymmetry, measurement validity of explanatory variables, market limitations, multicollinearity, and price changes. It is thus better to explore additional research designs or to use the hedonic price technique with application to other models.

Assuming P is a vector of house prices associated with a vector of structure variables S and set of location variables N then it follows that their relationship can be represented by the following model:

                                                (1)

where ln(Pi) = natural logarithm of house sale price of property i; Sip = physical attribute p of property i; Niq = location variable q of property i; β0, βp, βq= intercept and coefficients; εi= error. If the neighborhood feature affects house sale prices positively, the first-order relationship of house price with respect to the location variable is:

Shape

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The hedonic pricing model was first proposed by Lancaster (1966) and later further expanded by Rosen (1974). This model might generate biased results, however, when the relationship between price and housing characteristics is not linear and in the presence of endogeneity. Additionally, the advantage of the hedonic pricing model is only realized in the presence of very reliable and detailed property records. Another issue is 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” an axiom supported by Moran’s I test results indicating that there are strong spatial dependences existing in the house sales data for this study, in other words, there are significant spatial relationships between the houses’ locations and their property values. To address the omitted variable bias, this study uses fixed neighborhood effects model. Fixed effects model assumes that something within the same neighborhood may impact the house prices and those within-neighborhood effects have to be controlled. This model helps remove the effect of unobserved time-invariant or neighborhood-invariant variables from the regression process. The general fixed neighborhood effects model is constructed as follows:



where:

Ln(Pnt)is the housing price for the home located in the *nth* neighborhood in the tth year.

*Snt* is the structural variable for the home located in the *nth* neighborhood in the tth year.

*Lnt* is the location variable for the home located in the *nth* neighborhood in the tth year. is the error term that accounts for the variations between the same neighborhood and the same year.  represents all unobserved factors that vary across neighborhoods but are constant over time while represents all unobserved factors that vary both across the neighborhoods and the years.

 is the constant in the regressions.

To address the spatial dependence problems, this study uses semiparametric model to include geographical coordinates as its nonparametric part. The parametric models always assume strict functional forms, in which the dependent variable is determined by the regressors and unobserved errors are identically and independently distributed (iid). Nonparametric models, on the other hand, impose very few restrictions on the functional form leaving little room for misspecification. However, the precision of estimators which impose only nonparametric restrictions is poor (Powell, 1994) and there is a “curse of dimensionality”. Semiparametric models include the merits of both parametric and purely nonparametric models and is estimated in this study in the form:



where:

β = average coefficient of X.

Xi = a vector of structural and locational variables of for house i.

Zi1 = latitude of house i.

Zi2 = longitude of house i.

λ = error term.

m = purely nonparametric function.

The nonparametric part of the semiparametric model could be explained by the locally weighted regression (LWR) model or LOWESS (locally weighted scatterplot smoothing). It is a purely nonparametric procedure for fitting a regression surface to data through multivariate smoothing: the dependent variable is smoothed as a function of the independent variables in a moving fashion analogous to how a moving average is computed for a time series (Cleveland and Devlin, 1988). Detailed application of this model applying to housing market is found in McMillen and Redfern (2010): The LWR estimator is derived by minimizing the following equation with respect toand:



The kernel function K (*z*) determines the weight that each house sold as an observation in estimating the housing price at target point *X* with *Xi – X* defined as the distance between the target point and the *i*th neighboring house and *h* is a smoothing parameter called the bandwidth. As the distance increases, the weight declines; thus a kernel represents a decreasing function of a distance between two objects. There are various types of kernel functions such as rectangular, triangular, bisquare, tricube or Gaussian, however, the choice of kernel weight function usually has little effect on the results (this study uses the tricube kernel weighting function). The real challenge is the choice of *h* as it determines how rapidly the weights decline with distance.[[1]](#footnote-1) By placing less weight on more distant observations, high values of *h* imply local regressions that produce more smoothing than do smaller bandwidths (McMillen & Redfern, 2010). The choice of optimal bandwidth in this study is based on Silverman’s Rule of Thumb. Silverman (1998) proposes the rule-of-thumb bandwidth as , where is the sample standard deviation, v is the order of the kernel, andis a constant depending on the type of kernel used. Since this study uses the tri-cube kernel, according to Silverman, the constant is 3.15 when the kernel order is 2.

**RESULTS**

We start with a simple OLS regression 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 Two. We see that when only the COVID variable is regressed on the natural log of the real closing price, there is a 6.6 percent increase in the value of the homes sold after the start of the Covid pandemic. Given the overall average of homes sold over the sample, this equates to an increase in value if the home is sold after the start of the pandemic of more than $63,000. The significance and the magnitude of this result, as expected, falls after the inclusion of year fixed effects to control for other, unobserved market conditions. Specifically, the coefficient on the COVID variable loses all statistical significance and the magnitude is cut in half. Another interesting result seen in the second column of estimates is that the days on the market (DOM) is shown to have a slightly positive impact, albeit economically insignificant, which is not expected. Additionally, all the annual fixed effects are statistically significant, referenced to the year 2016, with the exception of the fixed effect for the year 2020.

[Insert Table Two]

Column three of Table Two shows the coefficient estimates when characteristics of the unit sold are added to the model. Each of the characteristics variables provide estimates that are in line with expectations as more bedrooms, full and half baths, and square footage all increase the value of the home while older homes decrease the value at an increasing rate. Two story homes tend to sell for slightly less than one story homes; however, homes in multi-story buildings do see a bit of an increase in the value of the home. This is likely due to most of the multi-story units being part of larger complexes. Very few homes in Hawaii have basements and, as a result, the fact of having a basement provides for a discount, albeit not statistically significant, on the sale price. Finally, homes that are listed as being in excellent or above average condition sell for a higher price compared to those listed as average with the former demanding a higher premium than the latter, and homes listed as fair see a discount compared to those ranked as average. The addition of these controls further reduces the impact of the COVID measure bringing the impact down to about 1.3% (just over $12,000), although the estimate can still not be differentiated from zero with any stand level of confidence.

Column four adds some additional characteristics of the building the unit is located within and the land on which the unit sits. Again, these coefficients generally follow expectations with units on land designated as resort, other, or business seeing a premium over that listed as residential, while units located on multi-family designated land see a slightly discount compared to residential land. More parking increases the value of a home as does having access to more elevators. Higher homeowner association assessments lead to lower sale prices (as these are expected to be capitalized into the price); however, so does having a home that has been remodeled, which is unexpected.

Adding these controls increases the explanatory power of the model further as shown by the higher R-squared but does not change many of the existing coefficient estimates save a couple. The first change is in the variable of interest as the COVID estimate is once more significant and increases slightly to just about 2%. Additionally, the impact of having a basement also becomes more negative and statistically significant as well. Finally, the one expected result is that adding bedrooms is estimated to have a negative impact on the value of homes, which runs contrary to expected norms.

Column five adds a measure addressing the location of the unit in terms of the absolute location via the latitude and longitude variables, and the distance of the unit to several key amenities. Being located further from the beach, a park, a hospital, or an airport all decrease the value of the home, as one would expect, with proximity to a park having the largest impact. Being located further from the elementary school assigned to the unit has a slightly negative impact, however, being located further from the junior or high school assigned to the unit has a positive impact on the value. The latitude and longitude also see an increase in value indicating that the upper-right side of the island is more valuable than the lower-left. While the inclusion of the locational factors does increase the model explanatory power slightly, it is more productive in brining several of the other estimates more in line with expectations indicating a clear spatial dependence among the independent variables. First, we notice that being remodeled no longer lowers the value of the home nor do higher HOA fees. Secondly, being on land designed for business now also lowers the value of a home compared to residential property and the impact of having a basement is more negative. Finally, the bedroom coefficient is also positive again, as one would expect. The locational factors have little impact on the COVID coefficient leaving the estimate at about 1.8% increase in value.

The sixth column in Table Two adds controls for the characteristics of the larger community using data from the American Community Survey at the census tract level. A unit being sold in areas with higher minority populations, compared to white, lowers the value with the largest impact being for higher percentage of blacks followed by native Hawaiians. Areas with more occupied homes see a larger sale prices, however, areas with more owner-occupied homes see a lower value and there are no other major changes in the other coefficient estimates. For our variable of interest, however, there is a slight increase in the statistical significance of the estimate.

The inclusion of the locational controls indicates that there is, as one would expect with housing data, an element of spatial dependency in the data. This is confirmed by estimating the Moran’s I test for spatial dependence using a variety of weight matrices and having the tests reject the null hypothesis of no spatial dependency at the highest levels. One challenge with controlling spatial effects with home sale data is the lack of a panel dataset for all the observations. While several units have sold more than once, there are not enough of those units to limit the dataset to only those units. Furthermore, simply treating the data as a standard cross-section introduces another problem in the creation of a weight matrix in that a property sold previously can serve as its own neighbor resulting in problems with the structure of the weight matrix making estimation impossible. To resolve this, we restrict our sample to only one sale observation per unit in two ways. The first uses only the most recent transaction and discards all previous sales observed for that unit. To some degree, this is the most logical path given that all the homes in the data have, at some point in history, been sold at least one other time, it is only that the dataset does not extend far enough back in time. Therefore, for even those properties being observed only once in the data, the observed sale price is, in fact, the most recent transaction.

One concern with method is that it will result in a dataset too heavily weighted toward observations in the latter years and since we are estimating the impact of a temporal phenomenon, this might skew the overall results. Therefore, we create a second restricted sample that includes only the earliest sale price of a home and discards all of the subsequent sale prices. While there is a less logical justification for this method, it should serve as a check to ensure that our estimates from our first restricted sample are not skewed or biased. Table Three shows the estimates of the model with only the COVID variable and the full model with all of the independent variables for each of the restricted samples.

[Insert Table Three]

Columns one and three in Table Three show the estimates with the most recent sale and first sale restricted datasets respectively and each is estimated with clustered standard errors. The estimate of the model with only the COVID variable with the most recent sale retained is very similar, albeit slightly smaller in magnitude, to that found in the full model, while the estimate of the same model retaining only the first sale of a home, shown in column three, have a much larger coefficient, although not statistically significant. This seems to indicate that any bias is being caused by the latter of the two restriction methods. Columns two and four show the estimated coefficients on the COVID variable for the full model and we see that once the full set of controls are added to the model the two estimates are similar to one another in both magnitude and significance level, however, the value of the effect is slightly larger at about 3.3% compared to the 1.9% estimate in the full sample. As a result, when using the restricted data, we may want to assume that the estimate is slightly larger than what would be obtained using the full dataset.

**CONCLUSIONS**

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1. The tricube kernel is structured as D(t) =(1-|t|3)3*I*(|t|≤1) and 0 otherwise. [↑](#footnote-ref-1)