The background is a dark blue color with several thin, gold-colored lines that form abstract, angular shapes. These lines radiate from the central text box, extending towards the corners of the frame. The lines vary in length and orientation, creating a sense of movement and depth.

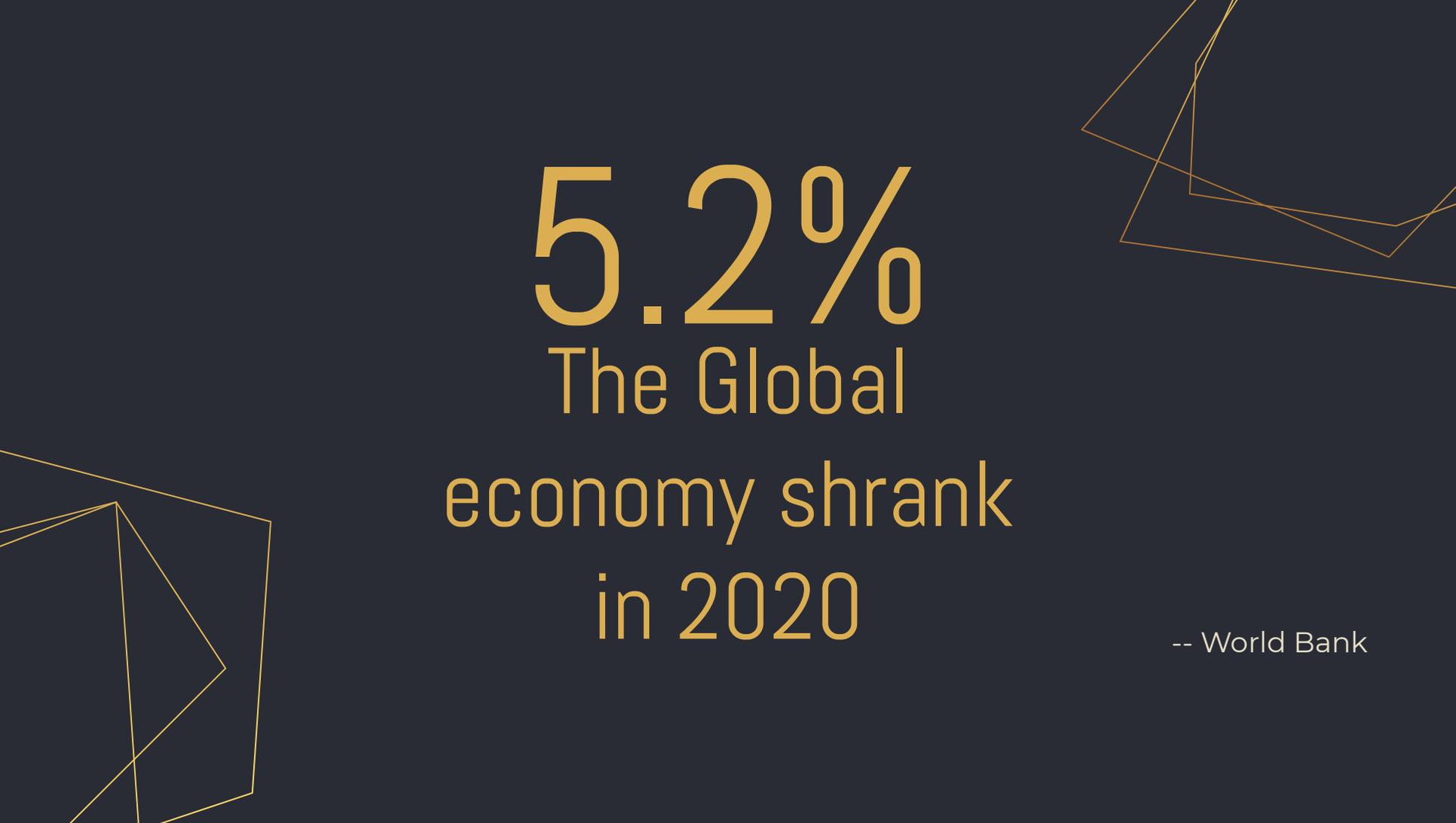
# Housing during COVID-19

A comparative analysis of the housing market  
response to COVID-19 fueled recession

## Current Situation

As of Dec 3, there are total 49M infected cases and 787K deaths in the U.S.

WHO identifies the new COVID variant as Omicron which might cause an increase on infection and hospitalization. As of Dec 4, the Omicron variant is detected in 13 US states.



5.2%  
The Global  
economy shrank  
in 2020

-- World Bank

## Facts of COVID-19 Recession

- In 2020, The United States suffered a decrease of 9.1% on GDP in the second quarter of 2020, while quarterly GDP had never dropped more than 3% since 1947
- The U.S. lost more than 22 million jobs between February and April.
- The national house spending dropped 8.7% in March 2020.

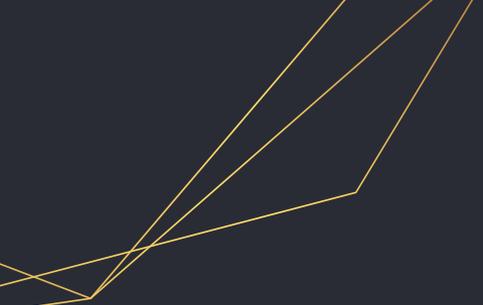
# More on Housing Market

In 26 states, more than one in five households with total over 8 million households were behind on rent in July 2020.

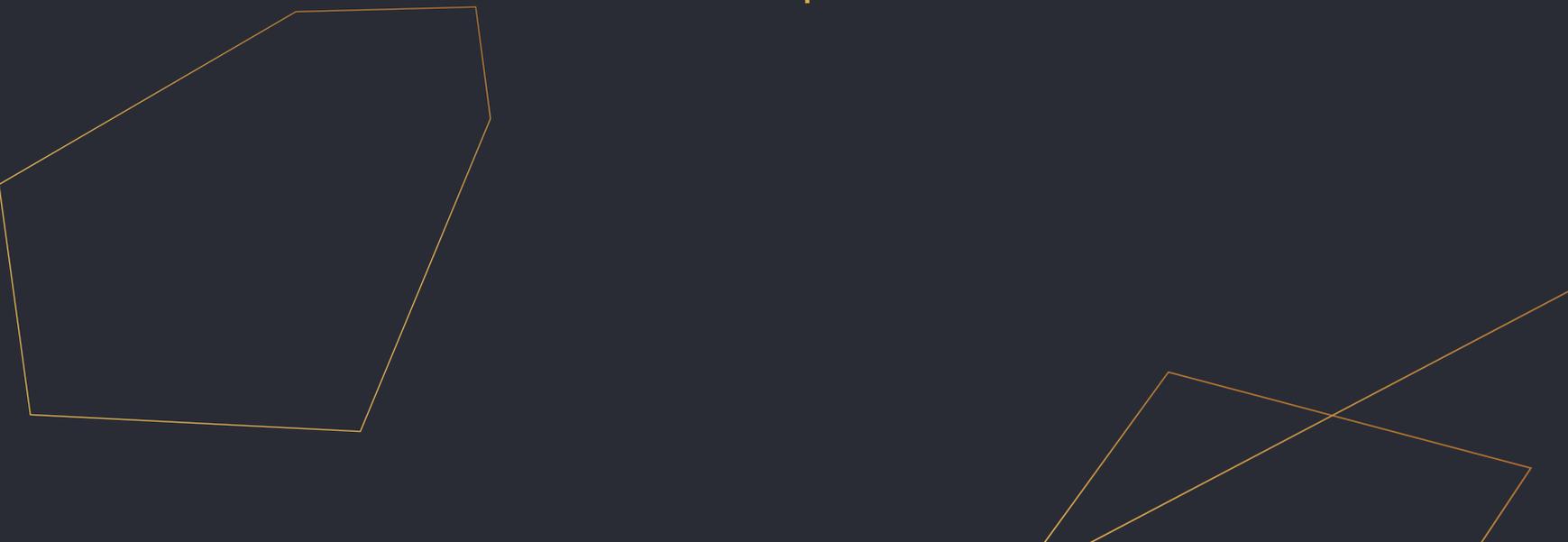


# More on Housing Market

- The households that fell behind at least 3 months on mortgage payment increased 250% to over 2 million. Collectively, these households owned almost \$90 billion in various payments.
- There were a significant number of families faced the risk of losing their houses because of the unemployment and overall decrease on economy.
- The housing insecurity, referring to families who do not have access to stable and affordable housing, increased dramatically especially for communities with color and minorities.
- The housing insecurity is closely associated with psychological symptoms such as depression. It is crucial in the midst of pandemic because it could made it difficult for households to comply with public health measures such as quarantine.



# Methods of Analysis and Data Sources from Related Research Papers



# Methods of Analysis: Effects of COVID Shutdown

## COVID-19 and Housing Market Effects: Evidence from U.S. Shutdown Orders

52 Pages • Posted: 10 Jul 2020 • Last revised: 3 Dec 2021

**Walter D'Lima**

Florida International University (FIU) - Hollo School of Real Estate

**Luis A. Lopez**

University of Illinois at Chicago

**Archana Pradhan**

CoreLogic (Headquarters)

Date Written: September 23, 2020

Methodology: Create models on housing prices based on:

- Shutdown dates
- Local demographics
- Infection rates
- Property Characteristics

[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3647252](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3647252)

# Methods of Analysis: Effects of COVID Shutdown



## PERFORMANCE you can count on.

CoreLogic® Listing Management Platform (Matrix™)

**1M+**

end users

**28M**

log ins per month

**1.6B**

sub-second  
page loads  
per month

**4M**

home  
transactions  
enabled  
per year

**1.4B**

images

### Data Sources:

- MLS: Multiple Listing Service
- Bureau of Labor Statistics
- Scraped Data
- FRED Economic Research

# Methods of Analysis: Demand and Rates

## US Housing Market During COVID-19: Aggregate and Distributional Evidence

47 Pages • Posted: 8 Dec 2020

[Yunhui Zhao](#)

International Monetary Fund (IMF)

 [There are 2 versions of this paper](#)

Date Written: September 1, 2020

Methodology: panel regressions and nonparametric models from:

- **Housing Demand**
- Income
- Mortgage Rates

[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3744679](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3744679)

# Methods of Analysis: Demand and Rates

The logo for realtor.com, featuring a red house icon with a white chimney to the left of the text "realtor.com" in a red, lowercase, sans-serif font.The Freddie Mac logo, featuring a green house icon above the text "Freddie Mac" in a blue, sans-serif font, with the tagline "We make home possible®" in a smaller, grey, sans-serif font below it.

Data Sources:

- Realtor.com
- Freddie Mac (Primary Mortgage Market Survey)
- American Community Survey



AMERICAN  
COMMUNITY  
SURVEY

U.S. CENSUS BUREAU

# Case-Shiller National Home Price Index

Goal: How home prices move over a prolonged period of time

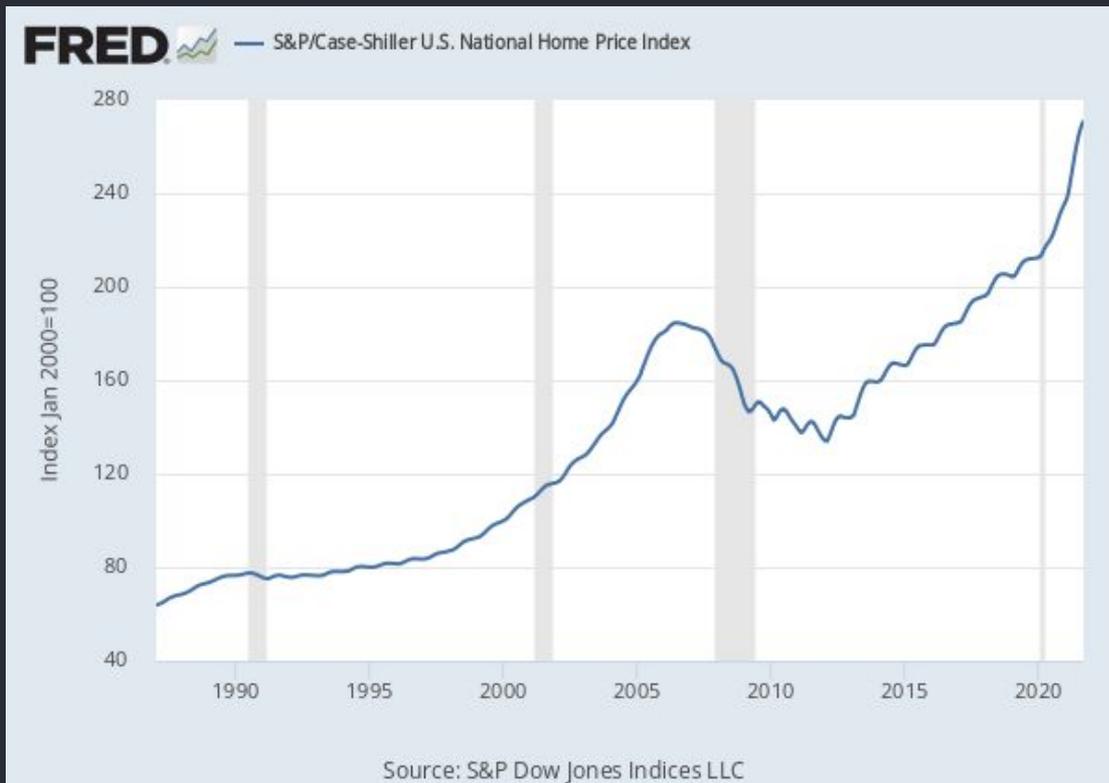
Where: United States

What: single-family homes

How: formulated by tracking repeat sales of SF homes across the country

Why: "The national index is widely viewed as a barometer of the U.S. housing market and the broader economy"

*Investopedia*



# Index Response to Recessions

We will examine two equal length zones of the index

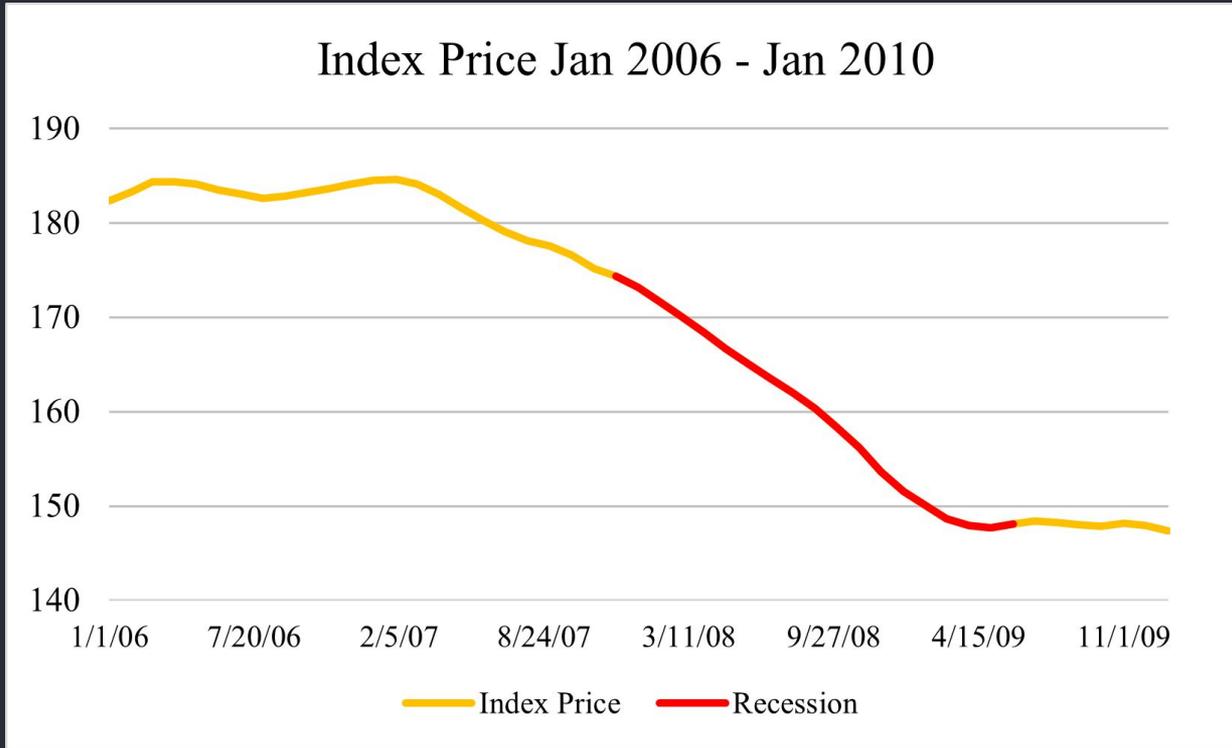
**Zone 1:** Jan 2006 - Jan 2010  
Includes effects of housing recession

**Zone 2:** Jan 2017 - Jan 2021  
Includes effects of COVID - 19 recessions

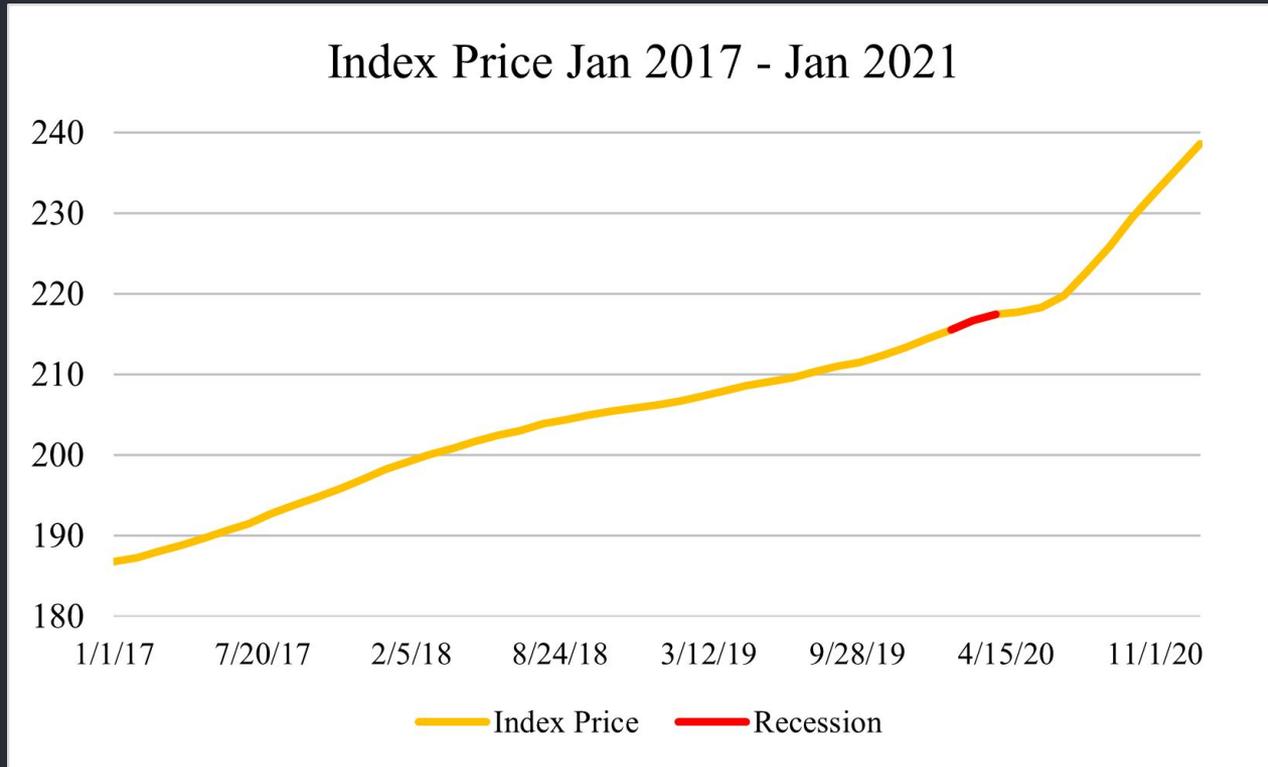
Both regions contain periods of recessions and general economic slowdown

N = 49	Zone 1	Zone 2
Total Change	-19.16%	27.75%
Avg Annual Chng	-5.18%	6.31%
# of months in drawdown	35	0

# Case-Shiller NHP Index



# Case-Shiller NHP Index

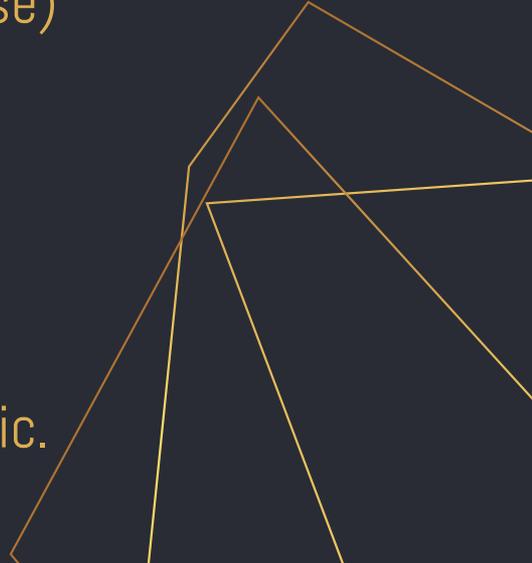




Why is there a boom in median house price and the NHP index despite high levels of home insecurity, unemployment, and economic downturn?

**Question:** Is this phenomenon revisiting how Americans respond to recessions (home-wise) or can this be explained by some data phenomenon?

**Thesis:** This odd phenomenon is fueled by a supply and demand tension with unique characteristics that take place in a pandemic.



# Months' Supply Metric (1987 - 2021)



monthly data

## Zone Analysis Methodology (2)

Case-Shiller is a price index and hence is best represented as differenced time series

The home supply ratio (HS) NSA is ultimately a standalone metric and hence was not altered

NOTE: *z-score technique*

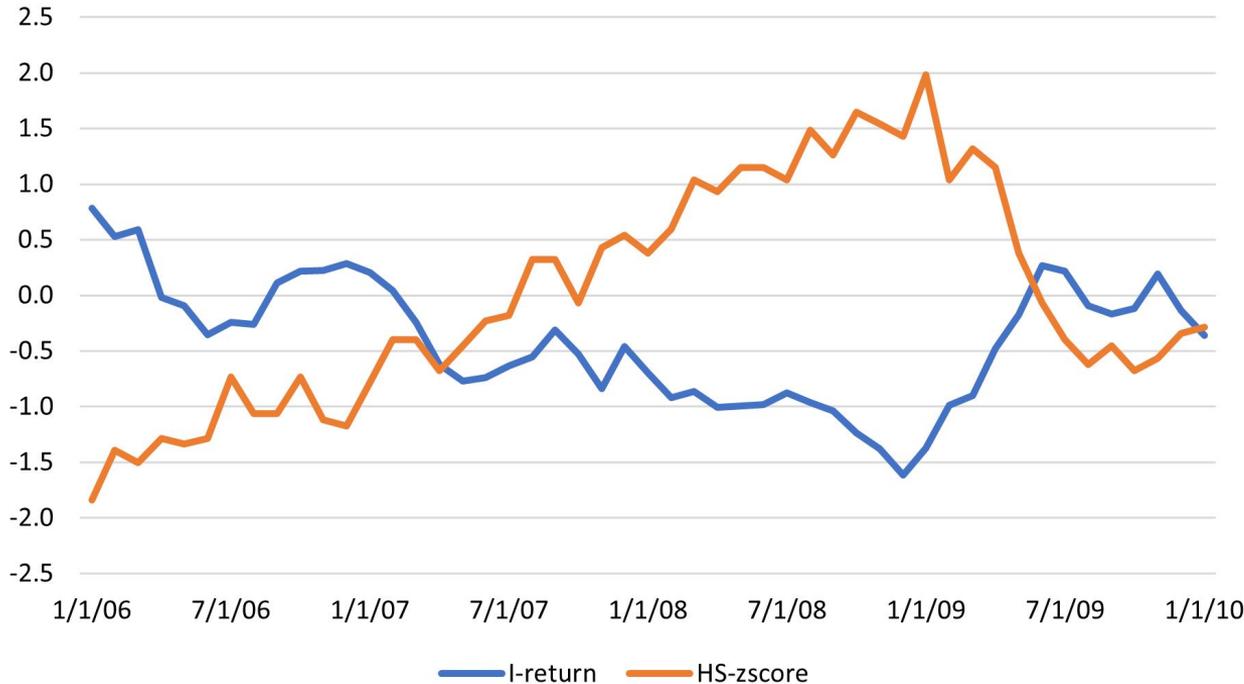
However, due to its natural seasonality and the nature of extreme values during recessions and downturns it becomes easier to observe the metric as a “z-score” or distance from a mean.

$$Z = (X - \text{mean})/sd$$

Where mean and sd will be parameters estimated by each zone sample

# Zone 1 (Jan 2006 - Jan 2010) Analysis

Case-Shiller Index changes vs HS-ratio zscore (zone 1)



Very clear and almost perfectly obvious association

Negative association

Increases in home supply have a strong association with decreasing returns on the NHP price index!

However, we need quantitative evidence



# Zone Analysis Methodology (1)

The national home price index is ultimately a barometer of the market's in-built pricing model

Hence, it is logical to consider home supply as a mathematical factor in driving home prices

U.S Census Bureau - Monthly Supply of Houses in the United States [MSACSR]

- Ratio of homes for sale versus homes sold
- Liquidity and supply measure of residential homes

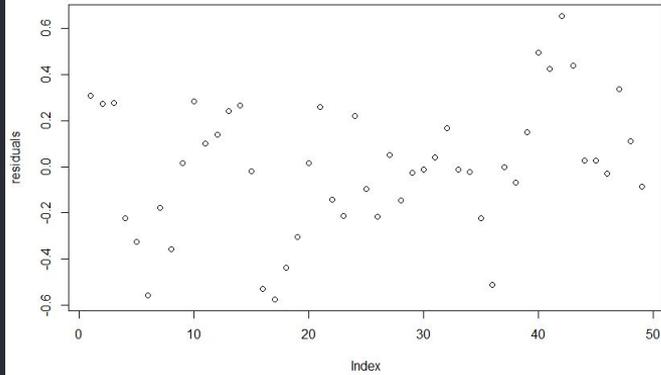
*“The months' supply indicates how long the current for-sale inventory would last given the current sales rate if no additional new houses were built”*



# Zone 1 (Jan 2006 - Jan 2010) Analysis

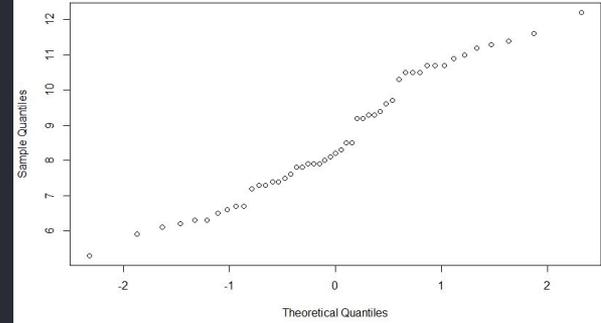
## Regression Assumptions

Residuals are homoskedastic and random

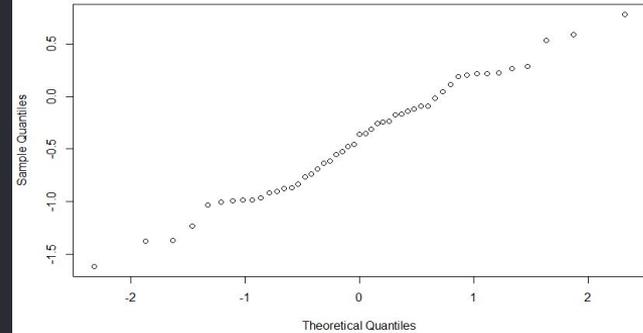


SW-test p-value: 0.69

HRatio Normality

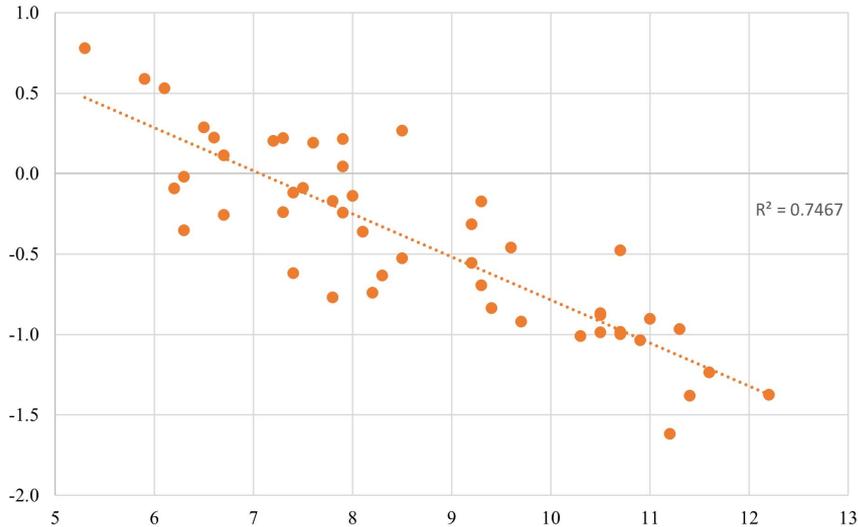


NHP Index Return Normality



# Zone 1 (Jan 2006 - Jan 2010) Analysis

HS-ratio vs Case-Shiller NHP returns (zone1)



NHP changes ~ HS-ratio  
Regression

Residuals:

Min	1Q	Median	3Q	Max
-0.57357	-0.17717	-0.00245	0.21810	0.65165

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	1.88968	0.20006	9.446	1.95e-12 ***
z1.HSratio	-0.26744	0.02272	-11.769	1.29e-15 ***

---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

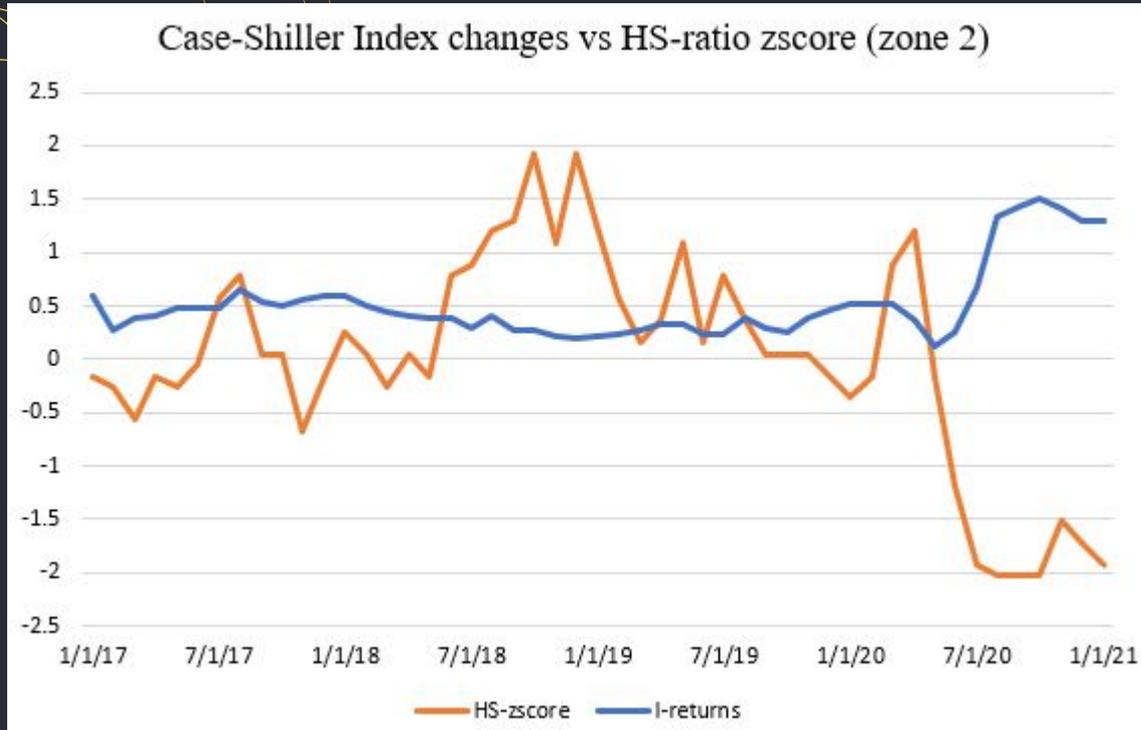
Residual standard error: 0.2846 on 47 degrees of freedom  
Multiple R-squared: 0.7467, Adjusted R-squared: 0.7413  
F-statistic: 138.5 on 1 and 47 DF, p-value: 1.293e-15

Highly significant regression with F-statistic of 139

Both terms are highly significant and model has good explanatory power

Evidences association quantitatively

# Zone 2 (Jan 2017 - Jan 2021) Analysis



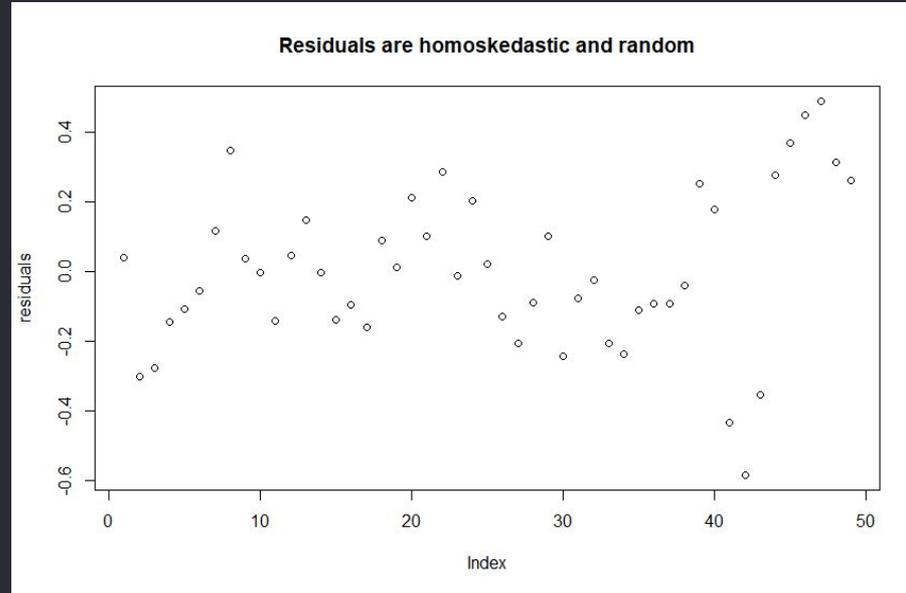
Visually we can observe a weaker association.

COVID recession still clearly showcases this negative relationship (March 2020)

Both zones are evidently different on a first glance

# Zone 2 (Jan 2017 - Jan 2021) Analysis

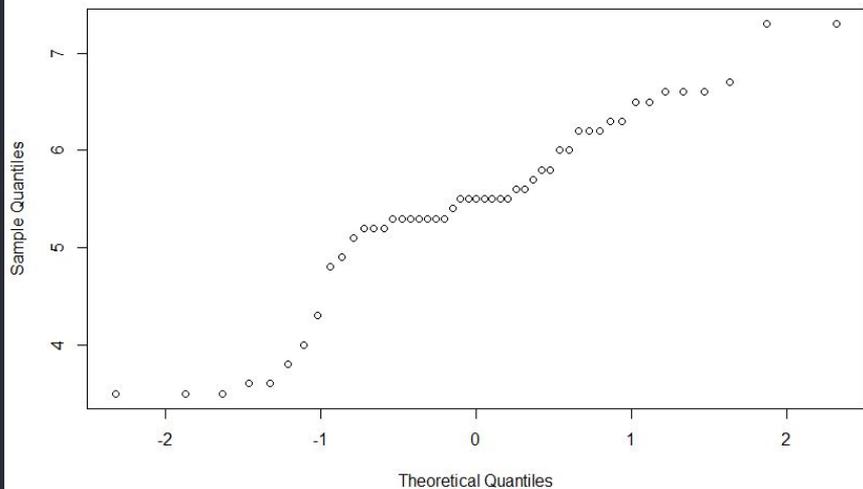
## Regression Assumptions



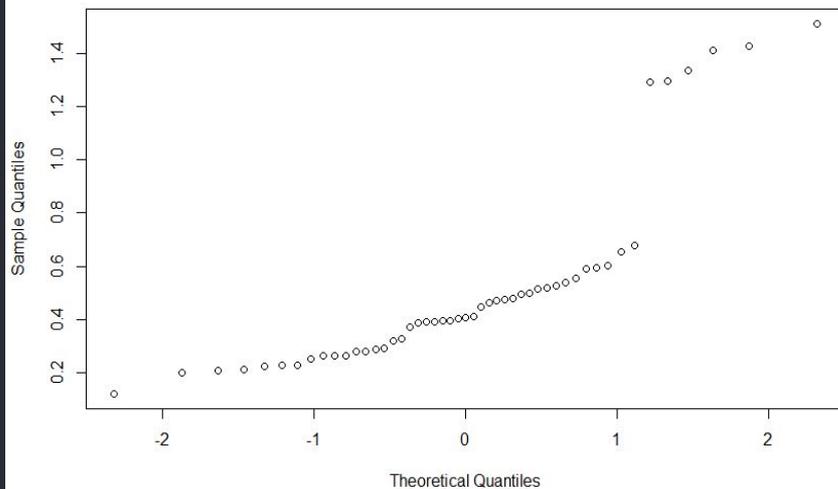
SW-test p-value: 0.93

# Normality Assumptions

Hs ratio QQplot



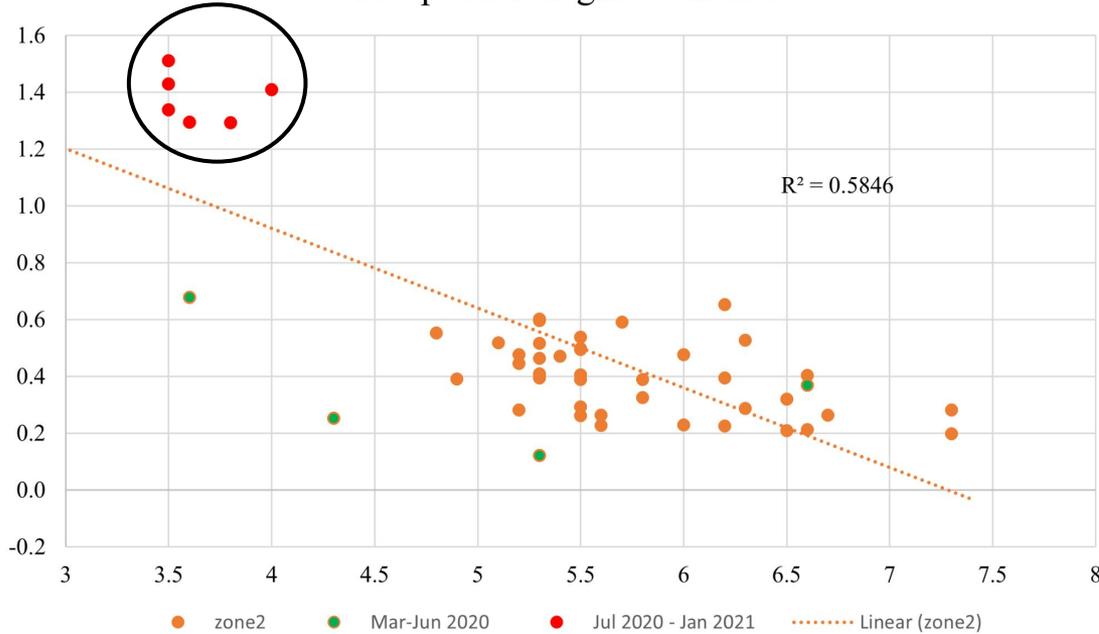
NHP index return QQplot



On first glance, the two variables have obvious skews from normality. However, we will soon find out the context behind this. Besides that, for a small sample the non-outliers can be described normal.

# Zone 2 (Jan 2017 - Jan 2021) Analysis

NHP price changes ~ HSratio



# Zone 2 (Jan 2017 - Jan 2021) Analysis

```
Residuals:
  Min       1Q   Median       3Q      Max
-0.58364 -0.13787 -0.01064  0.14837  0.48934

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    2.0426     0.1908  10.705 3.39e-14 ***
z2.HSratio   -0.2806     0.0345  -8.133 1.61e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2296 on 47 degrees of freedom
Multiple R-squared:  0.5846,    Adjusted R-squared:  0.5758
F-statistic: 66.15 on 1 and 47 DF,  p-value: 1.613e-10
```

All terms are highly significant

Regression itself is highly significant

The model does a fairly good job of explaining data

Given the context of our outliers, the model is quite good, but not as good as zone 1. What's missing?

There is a very clear demand story here as well. A post-recessive increased demand for homes causes the model to underestimate post COVID NHP price changes.

# Where is this demand coming from?

Historically record low 30y mortgage rates

Daryl Fairweather, Redfin's chief economist says the increase in home values is mostly a demand story: "People are scrambling to take advantage of plummeting mortgage rates that make the cost of buying a home much cheaper"



# Where is this demand coming from?

Post recession stock market boom

An increasingly online economy flourished generating billions of dollars for shareholders

This influx of value from tech companies that dominate the market creates a lot of cash

## Recession Market Drawdown length

Dot-Com	Housing	COVID
2.5y	2y	2.5m

Company	Ticker	Industry	Price change - 2020
Tesla Inc.	US:TSLA	Motor Vehicles	743%
Moderna Inc.	US:MRNA	Biotechnology	434%
Peloton Interactive Inc. Class A	US:PTON	Other Consumer Services	434%
Zoom Video Communications Inc. Class A	US:ZM	Software	396%
Pinduoduo Inc. Sponsored ADR Class A	US:PDD	Internet Retail	370%
DocuSign Inc.	US:DOCU	Software	200%
MercadoLibre Inc.	US:MELI	Internet Software/Services	193%
Okta Inc. Class A	US:OKTA	Software	120%
Nvidia Corp.	US:NVDA	Semiconductors	122%
PayPal Holdings Inc.	US:PYPL	Data Processing Services	117%
Advanced Micro Devices Inc.	US:AMD	Semiconductors	100%
Cadence Design Systems Inc.	US:CDNS	Software	97%
Atlassian Corp. PLC Class A	US:TEAM	Software	94%
Idexx Laboratories Inc.	US:IDXX	Medical Specialties	91%
Align Technology Inc.	US:ALGN	Medical Specialties	92%
Apple Inc.	US:AAPL	Telecommunications Equipment	81%
Synopsys Inc.	US:SNPS	Software	86%
Amazon.com Inc.	US:AMZN	Internet Retail	76%
Marvell Technology Group Ltd.	US:MRVL	Semiconductors	79%
T-Mobile US Inc.	US:TMUS	Wireless Telecommunications	72%

Source: FactSet

NASDAQ returns 2020 ~ 47%

# What is common in these demand factors?

Who can take advantage of low mortgage rates?

- Individuals with money to make offers or homeowners looking to refinance

Who can take advantage of flourishing stock markets?

- Stock ownership has historically been dominated by the wealthy and upper class

Which jobs have primarily gone remote, enticing home demand?

- White collar jobs
- Tech-based jobs
- Higher paying jobs

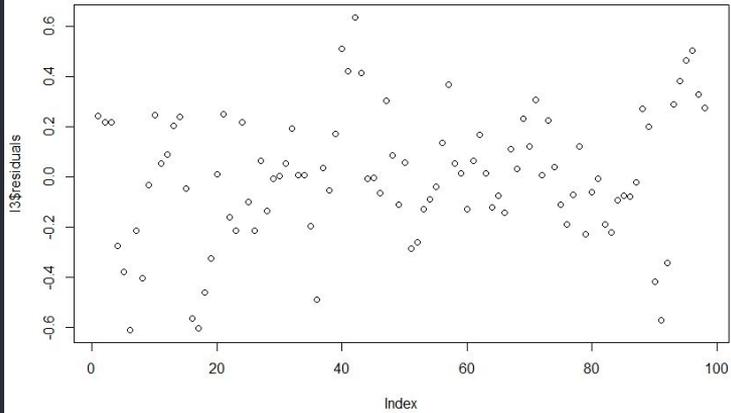
MOST home pricing models take into account inflow and demographic of buyers! It is not shocking these 3 factors HEAVILY associate with a certain financial demographic

Examining both recessionary zones

NHP change ~ HSratio

# Assumptions and Conditions for zone 1 +zone 2

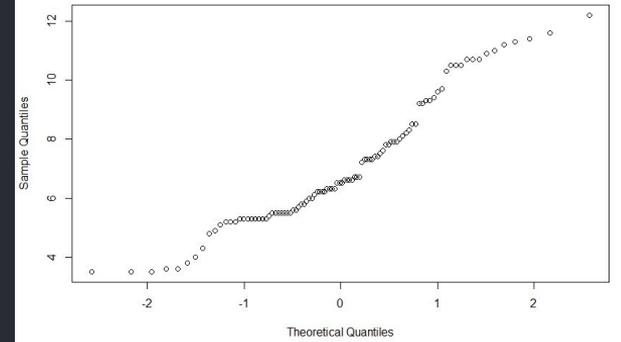
Residuals are homoskedastic and randomly distributed



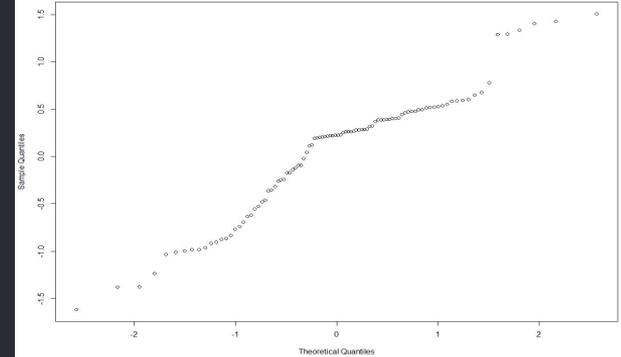
SW-test p-value: 0.57

NHP returns almost normal, showcases slight bimodality

Hs ratio

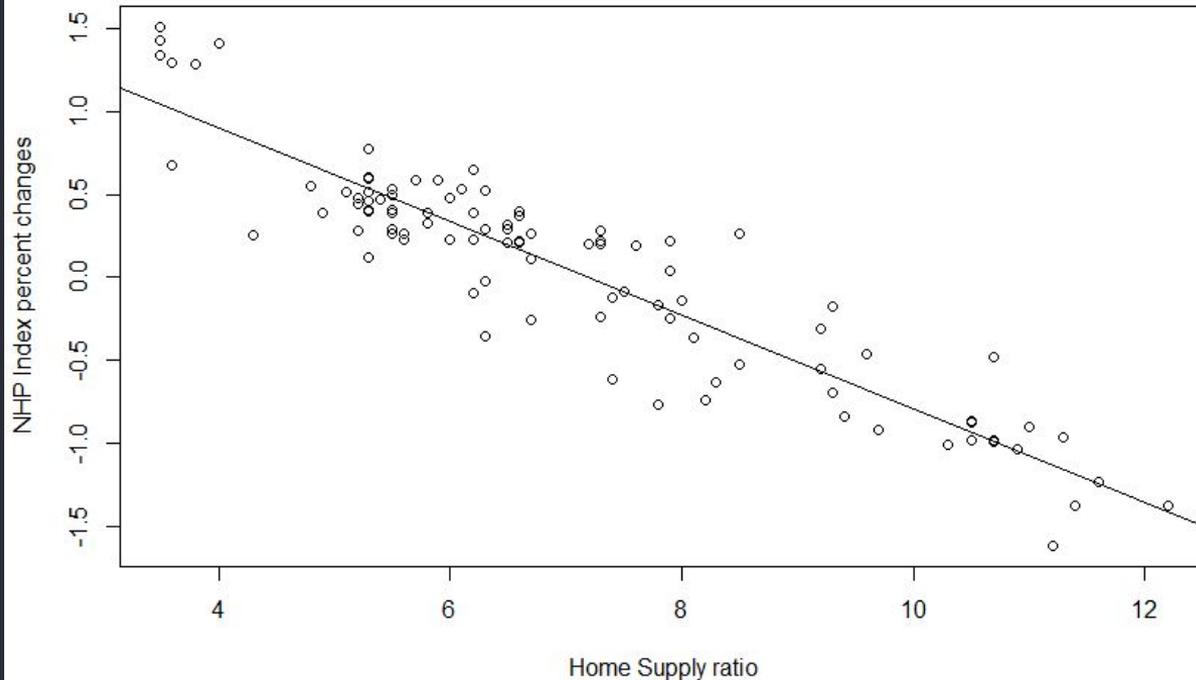


Normal Q-Q Plot



# Both recessionary zones 1 & 2 together

Zones 1 & 2 NHP returns ~ HS ratio



Significant association

Both recessions, despite significantly different characteristics describe this supply/demand relationship quite well

This relationship is a constant through two differently natured recessions

Obvious linear relationship

# Both recessionary zones 1 & 2 together

```
Residuals:
  Min       1Q   Median       3Q      Max
-0.60929 -0.13373  0.00456  0.19625  0.63356

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.03895    0.08936   22.82  <2e-16 ***
z3.HSratio  -0.28287    0.01215  -23.27  <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2571 on 96 degrees of freedom
Multiple R-squared:  0.8495,    Adjusted R-squared:  0.8479
F-statistic: 541.7 on 1 and 96 DF,  p-value: < 2.2e-16
```

Both regression terms are highly significant

Regression is highly significant

$R^2$  is very strong and the model does well explaining fluctuations in NHP price changes

Home supply is a clear probabilistic factor in home price movements during recessions

# Conclusions

Preface: COVID-19 is a pandemic that has been relevant for almost 2 years now. Economic downturn caused home insecurity for many along with rent anxiety and other factors that should negatively affect housing. Despite this, the housing market has appreciated significantly post 2020 as evidenced by the Case-Shiller National Home Price Index.

Main Question:

Is there a reason why? And could this phenomenon point to important probabilistic factors that affect a house pricing model during future pandemics and/or recessions?

1. Yes, in both the 2008 housing crisis and COVID-19 economic downturn zones, home supply--evidenced by a home supply ratio--has significant association with changes in the NHP index.
2. The associations in the COVID-19 zone regression shows some obvious model underestimations and a slightly weaker explanatory power. Why?
  - a. Increased demand contributes to the skews
    - i. Record low mortgage rates
    - ii. 90% smaller market drawdown period & large market returns in S&P + NASDAQ
    - iii. Transition to WFH environment and higher demand for home offices

## Conclusions (2)

The mentioned demand factors are indicative of a select socioeconomic group that is entering the housing market. This is the upper-middle class to wealthy individuals that reap primarily from the three demand points.

- The working class demographic are part of the statistics entailing home insecurity, mortgage delinquency, and rent anxiety.

A huge factor in the economic/market response to post-recession economy is the huge influence technology companies have on the overall health of U.S. economy. They are by far the largest most influential. It is a visible event of economic restructuring. Our economy is significantly more online/connected than in 2008.

Hence, we have reasonable evidence that a future pricing model for homes during a recession should include the following factors.

- Home supply
- Home mortgage rates
- U.S market drawdown and post recession recovery (dictated by corporate response to recession)
- Buyer inflow by socioeconomic demographic

$$\Delta Y = B_1 * HS + f(M) + g(D, D_p) + \sum (B_i * S_i) + \varepsilon$$

*where Y = change in home price index*

*HS = month' home supply*

*f = function of M: (avg mortgage rate)*

*g = function of D, D<sub>p</sub>*

*D: (magnitude of max market drawdown)*

*D<sub>p</sub> = length of recession drawdown period*

*S<sub>i</sub> = rate of buyer inflow from income bracket i*

*B<sub>i</sub> = constant*

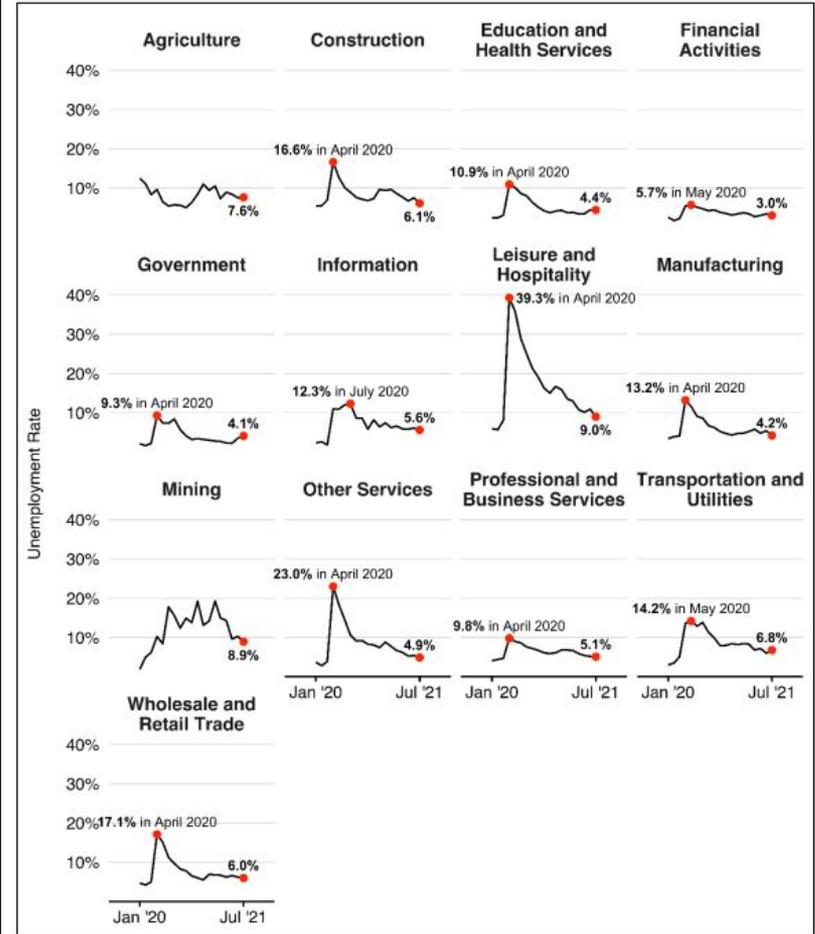
*ε = error*

A potential future recessionary home pricing model factors

Lower unemployment in white collar sectors (financial activities & professional and business services)

High unemployment in leisure and hospitality

**Figure 4. Unemployment Rates by Sector**  
Non-seasonally adjusted monthly data, January 2020 to July 2021



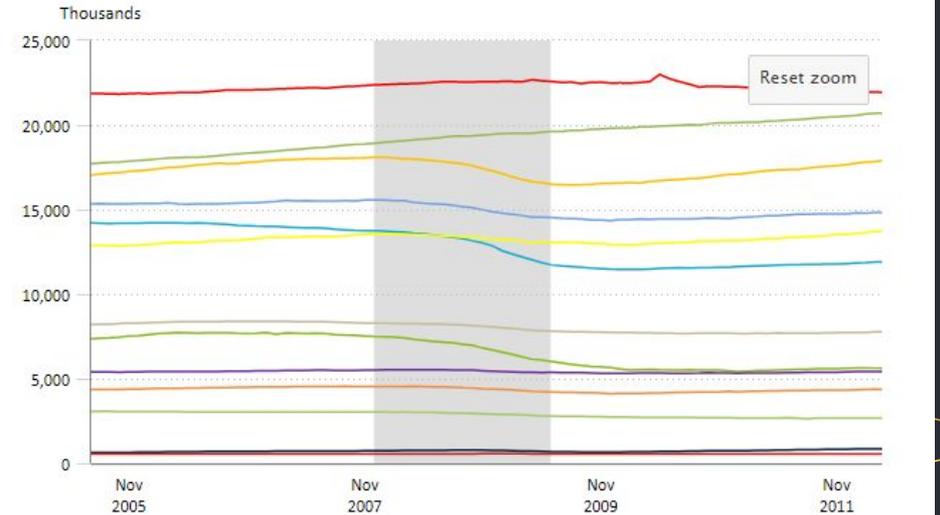
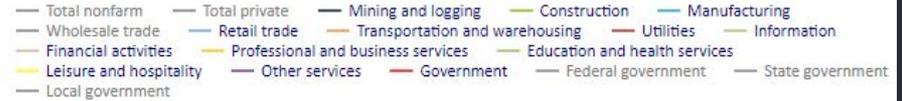
Same patterns were not present in 2008 recession

Higher employment decrease in professional and business services (orange)

Leisure and hospitality jobs (yellow) relatively unaffected

### Employment levels by industry, seasonally adjusted

Click and drag inside chart to change dates displayed



Lower unemployment rate among higher educated workers who likely earn more

### Unemployment rates for persons 25 years and older by educational attainment, seasonally adjusted

Click and drag within the chart to zoom in on time periods

- Less than a high school diploma
- High school graduates, no college
- Some college or associate degree
- Bachelor's degree and higher



# Housing pains on the working class

“Reflecting the broader economy, the pain in the U.S. housing market is most severe at the bottom. Surveys of large landlords whose units tend to be higher quality and more expensive have been remarkably resilient through the pandemic. Surveys of small landlords and low-income tenants show that late fees and debt are piling up.” NYtimes

# Yet Another Look At Possible Future Trends



We can further see that, historically, recessions led to a decrease in homeownership rate, but the Covid-recession led to a dramatic spike.

# Home Ownership Rate Change Across Different Socioeconomic Groups

Year/Quarter	Homeownership Rates (percent)					
	United States		Households with family income greater than or equal to the median family income <sup>a</sup>		Households with family income less than the median family income <sup>a</sup>	
	Rate	MOE <sup>b</sup>	Rate	MOE <sup>b</sup>	Rate	MOE <sup>b</sup>
2021						
Third Quarter	65.4	0.5	79.0	0.5	51.7	0.6
Second Quarter	65.4	0.5	78.9	0.5	51.9	0.6
First Quarter	65.6	0.5	79.4	0.5	51.7	0.6
2020						
Fourth Quarter	65.8	0.5	79.4	0.5	52.3	0.6
Third Quarter	67.4	0.5	80.2	0.4	54.7	0.6
Second Quarter	67.9	0.5	80.5	0.4	55.2	0.6
First Quarter	65.3	0.5	78.8	0.5	51.8	0.6

The spike in home ownership was actually more concentrated in the lower-class, contrary to what we assumed from our findings. Furthermore, following the 2008 recession, the progressive drop in home-ownership affected those above median income more so than those below.

# Rates between the Recessions

4th.....	67.5	82.9	51.2
2009			
1st.....	67.3	82.4	51.0
2nd.....	67.4	82.2	51.5
3rd.....	67.6	81.9	51.7
4th.....	67.2	81.8	50.2

2019			
1st.....	64.2	78.0	50.5
2nd.....	64.1	78.2	50.0
3rd.....	64.8	78.7	50.9
4th.....	65.1	78.8	51.4

The first column is total ownership rate. The second column is home ownership rate for households above median income. The third is for below median income.

Between the recessions, rates among wealthier households dropped 4%, while those among poorer households barely dropped or fluctuated

# What does this mean?

- Based on past trends, our conclusions may not seem to hold true for the general case: while we expected increased demand to come from wealthier groups, the opposite was true.
- However, as we can see, the spike was temporary regardless.
- More analysis and research would need to be done to test other variables, because as presented, this recession is unique and the factors within it make it unlike other recessions. Our proposed pricing model may need to consider other variables, and consider some more strongly than others. Overall, we don't necessarily have a complete picture yet.

Year/Quarter	Homeownership Rates (percent)					
	United States		Households with family income greater than or equal to the median family income <sup>a</sup>		Households with family income less than the median family income <sup>a</sup>	
	Rate	MOE <sup>b</sup>	Rate	MOE <sup>b</sup>	Rate	MOE <sup>b</sup>
2021						
Third Quarter	65.4	0.5	79.0	0.5	51.7	0.6
Second Quarter	65.4	0.5	78.9	0.5	51.9	0.6
First Quarter	65.6	0.5	79.4	0.5	51.7	0.6
2020						
Fourth Quarter	65.8	0.5	79.4	0.5	52.3	0.6
Third Quarter	67.4	0.5	80.2	0.4	54.7	0.6
Second Quarter	67.9	0.5	80.5	0.4	55.2	0.6
First Quarter	65.3	0.5	78.8	0.5	51.8	0.6

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