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What is driving the U.S. housing prices during the Covid-19 pandemic? An exploratory analysis

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Abstract

Housing markets have been the centre of many studies during the Covid-19 pandemic. Contrary to what is expected during such period, they have reached their highest in some developed countries and, in particular, in the United States (U.S.). This paper aims to explain this unprecedented phenomenon by conducting an exploratory analysis of the drivers of the U.S. housing prices during the Covid-19 pandemic. Using panel data on 999 U.S. counties between January 2017 and March 2021, I apply a Fixed-effects model to explain prices growth in the U.S. real estate and rental markets. I find that, during the Covid-19 pandemic, the U.S. real estate prices are mainly driven by the favourable market conditions associated with low interest rates. Although a temporary effect of the pandemic severity in prices, it does not last behind 2020. Furthermore, it appears to be compensated by the government aids in place during the same period to overcome the negative effects of the pandemic in the market. The overall attractiveness of the real estate market, and the subsequent switches between rentals and sales, has enhanced the opposite development between the real estate and the rental market. While the former recovered and even outperformed its previous growth during the Covid-19 pandemic, the latter declined significantly during the entire year of 2020. Lastly, I find evidence in both markets of an increasing householders' demand for properties located in lower population density and income areas.

CONTENTS

1. INTRODUCTION AND LITERATURE REVIEW

In the beginning of 2020, the Covid-19 pandemic hit the United States. Following the pathway of the majority of the other countries, the number of Covid-19 infections and deaths increased exponentially and, consequently, shutdowns were gradually imposed across the different States. According to the U.S. Bureau of Labour Statistics (2021), the national unemployment rate reached 14.85% in April 2020, the highest level since 1948. Despite the health, social, and economic crises, the U.S. real estate market showed its resilience. As will be shown in Section 2, almost all housing indicators returned to their year-over-year (YoY) previous levels in the Summer of 2020, three months after the outbreak in the U.S. If the resilience of the housing market is already well documented during previous pandemics (Francke & Korevaar, 2021; Ouazad, 2020; Wong, 2008; Zhao, 2020), the exponential rise of house prices during these periods is unprecedented. Beginning in the third quarter of 2020, the U.S. house prices exceeded their pre-pandemic growth and, in some regions, reached higher growth rates than in any other period during the housing bubble of 2008 (Zhao, 2020).

This paper aims to explain this unprecedented phenomenon by exploring the drivers of the U.S. housing market prices during the Covid-19 pandemic. In particular, it aims to understand whether prices have been driven by the pandemic itself or by the subsequent social and economic consequences of it. On the one hand, it can be the case that prices have grown in accordance with the pandemic severity and subsequent responses to that, such as the non-pharmaceutical interventions (NPIs) implemented during the period. On the other hand, prices may be explained by the social and economic consequences of the pandemic. For instance, the lowering of interest rates. Using panel data on 999 U.S. counties between January 2017 and March 2021, I apply a linear Fixed-effects model to explain price variations. In an attempt to fully understand the interactions between short and long-term dynamics in the housing market, I divide this research analysis into two different scopes. First, an exploratory analysis on the growth of prices in the real estate market, i.e. prices of properties sold. Second, an exploratory analysis on the growth of prices in the rental market, i.e. prices of properties rented. While the latter market is likely to reflect the current demand for housing, the former also includes expectations of future demand.

This paper contributes to the literature on the following topics. First, analyzing housing markets during extreme events. Second, analyzing housing markets during the Covid-19 pandemic. Lastly, on the increasing literature body of housing market resilience. In particular, it enables to fill two main gaps in the literature. The majority of the authors analyzing housing markets during the Covid-19 pandemic focus on the impact of the pandemic by describing changes in prices, demand, and supply. However, housing markets across the world have been growing exponentially and Covid-19 itself should not be the reason. Thus, understanding the key drivers of housing prices during this period is fundamental and innovative. Furthermore, to the best of my knowledge, this is the first paper covering data beyond 2020 and, therefore, it allows to understand the current state of the U.S. housing market.

In the following four paragraphs, I review the literature on the topics mentioned above. Francke & Korevaar (2021) analyze the effects of the historical epidemics of plague and cholera in the Amsterdam and Paris housing markets, respectively, between centuries XVI and XIX. According to the authors, house prices declined significantly during the first six months after the outbreaks, especially in highly affected regions. However, they quickly returned to their initial values, possibly explained by the increasing migrations and births in those cities. Moreover, the authors find a lower effect of these epidemics in rental prices. Similar results are given by Ouazad (2020), who studies the effect of the September 11 terrorist attack in New York in the local housing market. According to the author, this extreme event had a temporary and immediate effect on the housing market, which did not last beyond 2001. Ambrus et al. (2020) find that the London cholera epidemic in 1854, which affected one single neighborhood, was responsible for a 15% decline in rental prices in that area. Contrary to the housing market resilience theory, they argue that the effect persists over the following 160 years after the outbreak. Furthermore, in opposition to Francke & Korevaar (2021), they do not find large differences between highly and weakly affected areas within the same neighborhood. A much more moderate effect is found in Wong (2008), who studies the impact of the 2003 SARS pandemic in the Hong Kong housing market. According to the author, when controlling for local fixed effects and historical trends, average prices declined less than 2% after the outbreak, pointing out a “wait-and-see” market strategy instead of overreaction.

This paper also contributes to the recent literature analyzing housing markets during the Covid-19 pandemic and, in particular, to the literature analyzing the key

drivers of housing prices during this period. The majority of the literature on this topic (Liu & Su, 2020; Ouazad, 2020; Zhao, 2020) finds an immediate deterioration of housing markets, followed by a rapid recovery. The exception of these findings is Qian et al. (2021), who study the impact of Covid-19 in the Chinese housing market between October 2019 and April 2020. According to the authors, regions with higher number of infections and worse medical conditions faced a 2.47% house prices reduction. The effect persists for the remaining three months and becomes more significant as time goes on. Contrary to this argument, Ouazad (2020) does not find any correlation between sale prices and the number of infections, suggesting that prices may have not been driven by the prevention of infections. However, they may be driven by the direct responses to the pandemic. One example is the shutdown orders, which were implemented in the U.S. from March 2020. On the one hand, they should prevent the spread of Covid-19 infections and, therefore, return market confidence. On the other hand, they reduce economic activity and disrupt housing demand and supply by impeding efficient housing search and viewings. Whether such NPIs affected the housing market positively or negatively during the Covid-19 pandemic is still not clear in the literature. For instance, D'Lima et al. (2020) find a moderate negative impact of shutdowns on sales and prices, while Ling et al. (2020) find that REITs with higher exposure to such measures perform better during the period. By analyzing the abnormal returns of a sample of U.S. REITs over the pandemic period, they find that the NPIs reduced the negative impact of the number of infections in the real estate market. Zhao (2020) discusses the role of an expansionary monetary policy during the pandemic in the U.S. housing market. The combination between the unprecedented low level of interest rates introduced by the Federal Reserve in March 2020 and the Covid-19 related government aids have enhanced the "fear-of-missing-out" for high-income householders and "relaxed liquidity constraints" for low-income householders. Ouazad (2020) adds that such market conditions may have favored the real estate market relative to the rental market. This can explain why both markets developed in the opposite way during 2020 (see Section 2). Liu & Su (2020) argue that, although the market recovery after June 2020, areas with higher density do not show a reversal, suggesting that changes in density demand may persist in the future. The authors argue that one reason for this is the lower value of living nearby the workplace and consumption amenities. Ouazad (2020) finds similar results and adds the role of supply elasticity as one of the main drivers for the current phenomenon of suburbanization. The limited housing

supply in some metropolitans may have increased the propensity of population flow to more affordable areas. In line with the two latter authors, Gupta et al. (2021) show that, during the pandemic, sale and rental prices have increased more in suburban areas than in central areas, contributing to flatten the bid-rent curve. These migrations seem to be facilitated by the shutdown policies in city centres and the possibility of teleworking. However, they are not evenly distributed across the U.S. urban population. According to Coven et al. (2020), they were mainly done by younger, whiter, and wealthier citizens, suggesting that the Covid-19 pandemic has increased inequalities across the U.S. population. Contrary to the density argument, Zhao (2020) argues that changes in house prices, demand, and supply are similar across different metropolitans, micropolitan, small-towns, and rural areas. Other local characteristics like racial composition, income, and house price levels previous to the pandemic are analyzed by Liu & Su (2020). While racial composition does not show significant results, lower income and higher house prices before the pandemic decrease significantly housing demand.

Lastly, this paper contributes to the increasing literature on housing market resilience. Housing markets have shown their resilience during past pandemics (Francke & Korevaar, 2021; Wong, 2008), terrorist attacks (Ouazad, 2020), past housing crisis (Wang, 2019), and, more recently, during the Covid-19 pandemic (Liu & Su, 2020; Ouazad, 2020; Zhao, 2020). Shocks may temporarily disrupt housing prices and demand but, in the short run, both indicators seem to return to their initial levels. This is in line with the concept of a metropolitan equilibrium path in Ouazad (2020). According to the author, metropolitan areas have an equilibrium and any shocks that may occur seem to be a short-run deviation from this equilibrium. Wang (2019), who analyzes the U.S. housing market after the housing bubble of 2008 in different neighborhoods, argues that the market resilience varies across space and time. Initial market and local conditions, such as the cost of loans and racial composition, play an important role in defining whether a neighborhood is more or less resilient. These findings can explain differences across the literature. For instance, Francke & Korevaar (2021) find an immediate and temporary effect of the cholera epidemic in the Parisian housing market, while Ambrus et al. (2020) show that, even after 160 years of the outbreak, the effects of cholera are visible in the London housing market.

After considering key drivers raised in the literature above and adding others, I find that the U.S. real estate prices growth during the Covid-19 pandemic has been driven

by the favourable market conditions associated with low interest rates. This latter effect is likely to be the main reason behind the opposite development between the real estate and the rental markets. Furthermore, I find a temporary negative effect of the Covid-19 infections rate on real estate prices, which appears to be compensated by the positive effect of government aids distributed during the same period. Lastly, I find that both markets, i.e. the real estate market and the rental market, were impacted by the changes in householders' demand for properties located in lower population density and income counties.

This paper proceeds as follows. Section 2 presents a YoY aggregate analysis of the U.S. housing market. Section 3 explains data, empirical strategy, and reports the main results. Section 4 concludes the research analysis, presents its limitations, and provides guidance for future research on the topic. Supplementary material is provided in the Appendix.

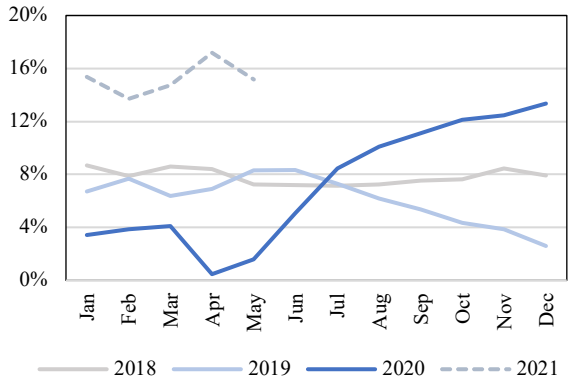
2. A FIRST GLANCE AT THE U.S. HOUSING MARKET DURING THE COVID-19 PANDEMIC

In an attempt to understand the developments of the U.S. housing market during the Covid-19 pandemic, I provide an analysis at the national level in this section.

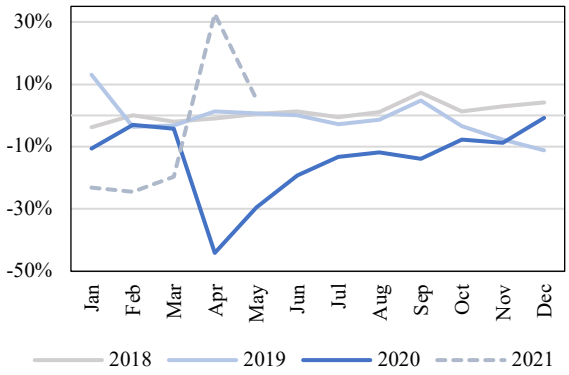
Figure 1

The U.S. housing market between January 2018 and May 2021: YoY aggregate analysis

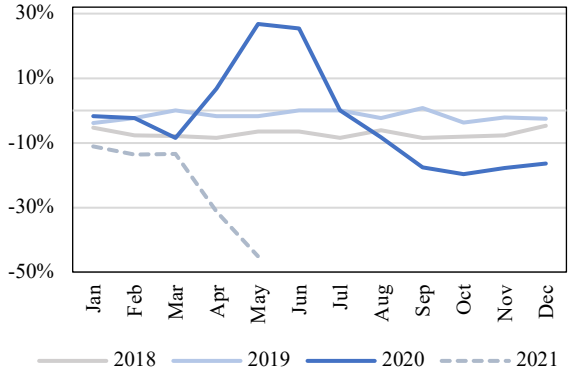
(a) YoY Median Listing Prices



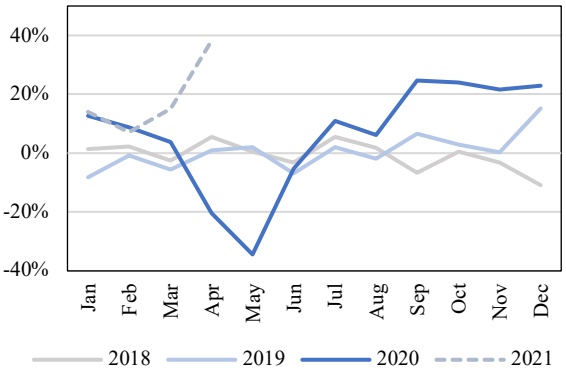
(b) YoY Number of Houses Sold

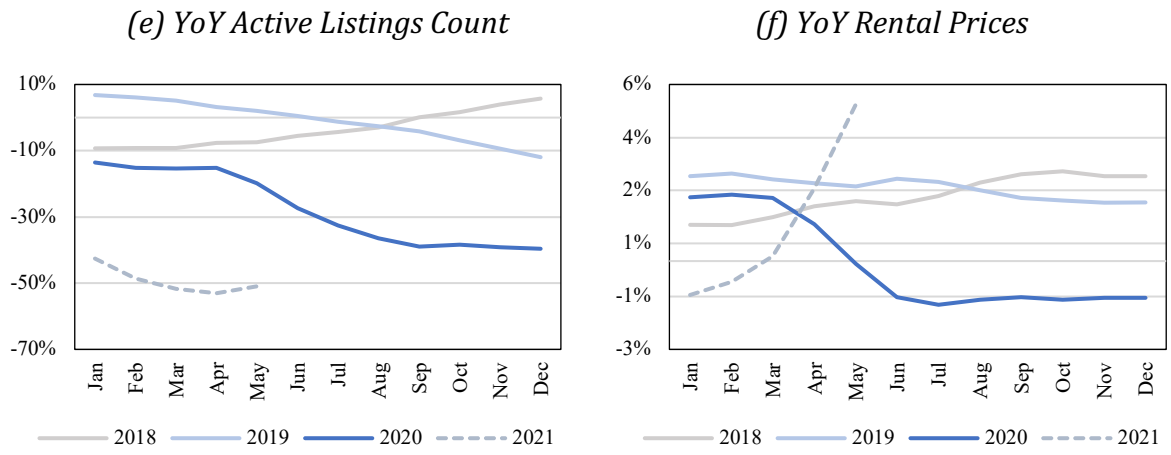


(c) YoY Median Days on the Market



(d) YoY New Listings Count





Note. Panel (a) through (e) refer to the real estate market. Panel (f) refers to the rental market. Adapted from Apartment List (2021) Data & Rent Estimates (Panel (f)), Realtor.com Data Center (2021) (Panel (a), (c), (d), and (e)), and Redfin Data Center (2021) (Panel (b)).

Figure 1 illustrates the year-over-year[1] growth rates between January 2018 and May 2021 of some of the main housing market indicators: (a) median listing prices, (b) number of houses sold, (c) median days on the market, (d) new listings count, (e) active listings count, and (f) rental prices. In general, it can be seen that, although the decline in the months immediately after the outbreak, the market started recovering during the Summer of 2020 and, for some of these indicators, exceeded its pre-pandemic performance. This trend is enhanced in 2021, suggesting that the U.S housing market will carry a growth pathway in the following months, at least.

The median listing price YoY growth (see Panel (a)) declined from 4% in March 2020 to less than 0.5% in the following month. Nevertheless, it started recovering from May and, in April 2021, reached a growth of more than 17%, corresponding to a median listing price of $375,000. Similarly, the YoY growth rate of houses sold (see Panel (b)) increased from -20.3% in April 2020 to approximately 38% in April 2021. In absolute numbers, this corresponds to a total of 608,883 houses sold in the U.S. during April 2021, compared to 440,699 houses in April 2020 and 552,709 in April 2019. The median days that houses spend on the market (see Panel (c)), i.e. the time that houses take to be sold, increased significantly between March and July 2020, reaching a YoY growth rate of 26.8% in May 2020. This trend changed drastically in the following months, to an annual

[1] A YoY analysis is chosen because it takes into account the seasonality in the housing market.

growth rate of -16.5% in December 2020, which corresponds to a median of 66 days on the market. In 2021, the decline was even more significant. From March to May 2021, the median days on the market decreased approximately 24%, reaching 39 days in May, the lowest value in the considered period. Contrary to these findings, the number of listings and rental prices declined after the outbreak and kept their downward trends during the following months. Both have reasonable explanations that will be discussed in the following paragraphs.

New listings YoY change (see Panel (d)) declined drastically in the first quarter of 2020, reaching approximately -44% in April and, despite improvements, remained negative over the year. A slight recovery has been seen during 2021 but the displayed trend does not give evidence of a continuing pathway. For active listings (see Panel (e)) the scenario is worse. The YoY change decreased significantly over the years of 2020 and 2021, from -13.6% in January 2020 to approximately -50.9% in May 2021. The first point that is important to raise when explaining the downward movement in the number of listings over the period is its long-term previous trend. According to the data provided in Realtor.com Data Center (2021), in 2019, new and active listings totalized approximately 5.27 million and 15.25 million, respectively, compared with 5.31 million and 15.47 million in 2018. In 2020, the number of listings decreased more drastically to 4.45 million and 11 million, respectively. A similar trend is observed in other databases such as Zillow Housing Data (2021). This long-term trend may be explained by the number of new residential constructions in the United States, which according to data released by the United States Census Bureau (2021), have been slow to recover their values previous to the 2008 recession. Second, zooming into 2020, one can observe that the number of listings declined sharply in the following months after the outbreak. According to Liu & Su (2020), this may be explained by the lockdowns imposed across different states after March 2020 and the subsequent social interaction restrictions, which may have lowered the propensity for homeowners to list their properties during this period.

From August 2019 to May 2020, the YoY growth rate of median rental prices (see Panel (f)) decreased but remained positive. Afterward, they became negative, decreasing at a nearly constant rate since June 2020. In December of the same year, the YoY growth rate reached -1.2%, corresponding to a median rental price of $1,114, compared to $1,128 in December 2019. These findings illustrate how rental prices have developed in the opposite way of sale prices. This contrary movement is supported by two theories. In

line with Ouazad (2020), with the standard principle of housing prices, which implies that rental prices reveal the current housing demand while sale prices reveal both current and future demands. Therefore, considering an uncertain period as the Covid-19 pandemic, where the unemployment rate reached its highest values, rental prices were expected to decline. On the other hand, if the long-term expectations were promising, sale prices should reflect it and keep their upward growth. Furthermore, it also reveals the resilience of the U.S. real estate market due to the low effect of a pandemic on the long-term expectations of homebuyers. Both theories are investigated in the empirical analysis (see Section 3). Nevertheless, the U.S. rental market has recovered since the beginning of 2021.

The findings presented in this section allow to draw preliminary conclusions on the U.S. housing market during the Covid-19 pandemic. In the following section, I perform an exploratory analysis to understand the drivers of such developments.

3. EMPIRICAL ANALYSIS

3.1. Data Description

Following the findings in the previous section, I attempt to further investigate the U.S. housing market during the Covid-19 pandemic. Although similar trends in other developed countries, this paper focuses on the U.S. housing market. The main reasons behind this choice are cross-sectional (i.e. between U.S. counties) and time-series (i.e. historical and recent) data availability.

Data is collected between January 2017 and March 2021. After correcting for datasets errors, 999 U.S. counties[2] remain in the panel data. This corresponds to approximately 33% of the total counties in the U.S. and, therefore, it is a representative sample. The dependent variables are monthly growths of sale prices and rental prices, retrieved from Realtor.com Data Center (2021) and Apartment List (2021) Data & Rent Estimates, respectively. Following the literature body on the topic (see Section 1), I divide the explanatory variables into three main dimensions. They are pandemic related variables, economic variables, and local and housing characteristics.

[2] A list of these U.S. counties can be found in Table A1 (see Appendix).

A. Pandemic related variables

To understand the impact of the Covid-19 pandemic in the U.S. housing market, I incorporate the monthly infection rate at the U.S. county level from a dataset released by The New York Times (2021), based on reports from local health agencies. This dataset provides daily total cumulative confirmed cases at the county level and, therefore, a few transformations were needed. Total cumulative daily cases were transformed into total cumulative monthly cases by looking at the count on the last day of each month. I believe that using monthly cumulative cases is the most effective approach to incorporate the severity to which the pandemic impacted a specific county. Lastly, in an attempt to control for differences in counties' sizes, I divide the cumulative number of infections by the U.S. population estimates of 2019.

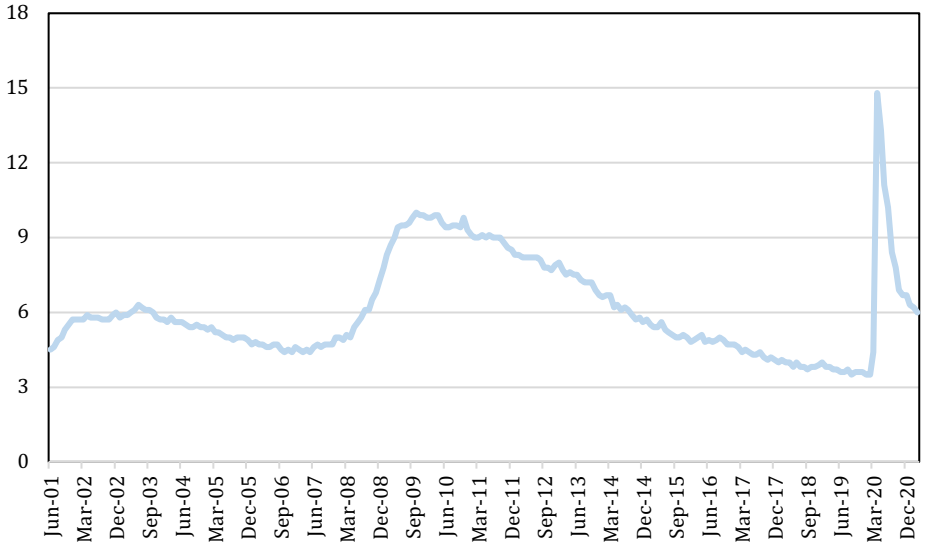
To corroborate the findings related to the impact of the Covid-19 pandemic in housing prices, I incorporate a variable measuring one of the direct responses to the pandemic. In particular, I introduce a non-pharmaceutical intervention measure, the stay-at-home orders at the state level, which is retrieved from the KFF (2021) Dashboard of Covid-19 U.S. policy responses. As discussed in Section 1, such policy measures may have disrupted housing demand and supply due to the imposed social interaction restrictions.

B. Economic variables

I introduce two economic variables, which can directly affect the housing market. First, the monthly unemployment rate for each county, retrieved from the U.S. Bureau of Labour Statistics (2021). As the U.S. unemployment rates increased exponentially immediately after the outbreak (see Figure 2), families' capacity to pay for housing may have declined and, therefore, impacted housing prices. Second, the average 30-year fixed mortgage rate retrieved from the Federal Reserve (2020a) database, which is the interest rate paid for loans associated with house purchasing. This rate is set based on the Federal Reserve effective rate, which corresponds to the interest rate used to implement monetary policy in the U.S. While mortgage rate has a direct impact on real estate demand, it also plays an important role on the price-to-rent ratio and, therefore, on how population shifts from the real estate to the rental market and vice-versa.

Figure 2

U.S. Unemployment Rate, Seasonally Adjusted



Note. Adapted from U.S. Bureau of Labour Statistics (2021).

C. Local and housing characteristics

The majority of the authors studying housing markets during the Covid-19 pandemic (D'Lima et al., 2020; Gupta et al., 2021; Ling et al., 2020; Liu & Su, 2020; Ouazad, 2020), argue that the number of infections, NPIs, and the increasing possibility of teleworking changed housing demand. Householders may have been shifting from central and highly dense areas to suburban regions, where they can find larger and higher-quality residences at a more affordable price. In an attempt to incorporate these views, I introduce three variables representing local and housing characteristics. First, the U.S. personal income per capita of 2019 at the county level, which is retrieved from the Bureau of Economic Analysis (2020). Second, population density at the county level, which is measured with the combination of two datasets: the 2019 population estimates from the United States Census Bureau (2019) Population Division and the 2010 land area calculations, in square miles, from the United States Census Burau (2010). Lastly, I introduce the median square feet of each house listed for sale, at the county level, retrieved from Realtor.com Data Center (2021). In an optimal scenario, other housing characteristics such as the presence of garden, the type of house, and the year of construction would be

considered. However, due to the lack of recent data, I do not include them in the empirical analysis. This issue is even more pronounced when considering the rental market analysis.

To control for differences in measurement units and extreme values, all variables are transformed into their natural logarithm[3]. To test whether the panel data is stationary or not, I perform an Augmented Dicky Fuller (ADF) Fisher-type test, which conducts a unit root test for each panel individually and, at a later stage, combines the p-values from the individual tests to generate the overall result. According to Barbieri (2009), the Fisher-type test has two specifications that offer advantage in this empirical analysis. First, it enables individual fixed effects and time trends. Second, it works perfectly in unbalanced panels or series with gaps. After conducting the test[4] for all variables, I find that the Covid-19 infection rate and unemployment rate have a unit root and, therefore, follow more than one trend in the series. To overcome this issue, both variables are transformed into their first-difference. Due to the latter transformation, the two variables have different interpretations. They measure the impact in prices growth of a change in the growth of Covid-19 infection rate or unemployment rate, respectively. This allows to directly understand the impact of changes of both variables in the housing market.

3.2. Summary Statistics

Table 1 provides the summer statistics of the variables used in this research analysis. Although these variables suffered a few transformations before being used in the analysis, I first present the summary statistics of the original variables, i.e. before transformations, because they provide richer insights.

[3] Because the Covid-19 infection rate can take the value of zero, the logarithmic transformation was made by adding a very small number to the infection rate: $Log(InfectionRate) = Log(InfectionRate + 0.0001)$.

[4] Note that I use the demean option to control for cross-sectional correlation (Levin et al., 2002).

Table 1

Summary Statistics of variables used in the empirical analysis, before transformations

Variables	Observations	Mean	Std. Deviation	Minimum	Maximum
$Price_{Sale}$	50,898	288,165.30	171,017.30	59,900.00	2,845,000.00
$Price_{Rental}$	16,031	1,238.86	356.61	549.00	2891.00
$CumulativeCovid$	50,833	2,492.66	16,468.01	0.00	1,220,217.00
$StayHome$	50,898	0.09	0.29	0.00	1.00
$UnemplRate$	50,898	5.20	2.76	0.70	36.00
$MortgageRate$	50,898	3.83	0.60	2.68	4.87
$Density$	50,490	544.59	1,092.88	3.07	14,557.07
$Income$	49,623	50,288.81	13,582.93	27,415.00	141,735.00
$MedianSQF$	48,680	1946.98	385.52	150.00	4,816

Note. This table provides the summary statistics of the original variables used in the empirical analysis. It covers the period between January 2017 and March 2021. $Price_{Sale}$ and $Price_{Rental}$ are measured in dollars; $CumulativeCovid$ is measured in absolute number; $StayHome$ is a dummy variable that takes the value 1 if, in the observed period, there is a stay-at-home order in the corresponding State; $UnemplRate$ and $MortgageRate$ are measured in percentage; $Density$ is measured as the number of people per square mile; $Income$ is measured in dollars per year. $MedianSQF$ is measured in median square feet.

The number of observations exceeds 48,000 for all variables considered in the real estate market analysis. For the rental market analysis, the number of observations is significantly lower, approximately 16,000. The reason for such discrepancy is the lack of data on rental prices at the county level. The median listing sale prices vary between $59,900 and $2,845,000, with a mean price of $288,165.30. Median rental prices vary between $549 and $2,891, with a mean price of $1,238.86. The lowest prices are found in states like Indiana, Iowa, Ohio, Pennsylvania, and Texas, while the highest prices are found in California and New York. The cumulative Covid-19 monthly infections vary between 0 and 1,220,217 cases, with a mean of approximately 2,492 cumulative cases in a month. The stay-at-home order is a dummy variable that takes the value 0 or 1 and, therefore, its statistics do not provide any relevant interpretation. The unemployment rate ranges between 0.7% and 36.0%. The mortgage rate ranges between 2.68% and 4.87%. As previously discussed, this rate is set based on the U.S. Federal Reserve effective rate

and decreases after March 2020 as a pandemic recovery tool. Population density in a county varies between approximately 3 people and 14,557 people per square mile, with a mean of approximately 545 people per square mile. Income per capita at the county level varies between $27,415 and $141,735, with a mean value of $50,288.81 per year. Finally, the median listing square feet varies between 150 and 4,816 square feet, with a mean value of 1946.98 square feet.

Table 2 shows the summary statistics after the required variable transformations.

Table 2

Summary Statistics of variables used in the empirical analysis, after transformations

Variables	Observations	Mean	Std. Deviation	Minimum	Maximum
$Log(\Delta Price_{Sale})$	49,900	0.007	0.041	-0.766	1.046
$Log(\Delta Price_{Rental)})$	14,438	0.002	0.011	-0.109	0.104
$Log(CovidInfection)$	45,678	0.191	0.565	-0.065	8.895
$StayHome$	50,898	0.09	0.29	0.00	1.00
$Log(UnemplRate)$	45,908	-0.014	0.211	-1.353	2.752
$Log(MortgageRate)$	50,898	1.331	0.163	0.987	1.582
$Log(Density)$	50,490	5.471	1.230	1.123	9.586
$Log(IncomePC)$	49,623	-1.176	0.908	-5.038	0.960
$Log(MedianSQF)$	48,680	7.554	0.202	5.011	8.480

Note. This table provided the summary statistics of the transformed variables used in the empirical analysis. It covers the period between January 2017 and March 2021.

As mentioned above, to control for differences in measurement units and extreme values, all variables[5] are expressed in their natural logarithm. Sale prices, rental prices, Covid-19 infection rate, and unemployment rate are expressed in monthly changes. Furthermore, the Covid-19 cumulative monthly infections and the income per capita variables are expressed in per capita terms, dividing them by the population estimates of 2019.

[5] Except for the variable $StayHome$ because it is a dummy variable.

3.3. Methodology

Using panel data on 999 U.S. counties between January 2017 and March 2021, I apply the following linear regression to explain prices growth in the U.S. housing market during the Covid-19 pandemic:

$$\Delta Price_{i,t} = \alpha + (\beta_1 + \beta_2 CovidDummy_{i,t}) \,.\, (X_{Pandemic} + X_{Economic} + X_{Local/Housing} + \pi_{i,t} + \varepsilon_{i,t}) \quad (1)$$

Where $\Delta Price_{i,t}$ is the monthly growth of prices for both outcomes, either sale prices or rental prices, in county i in month t. $CovidDummy_{i,t}$ is a dummy variable that takes the value 1 if the number of Covid-19 infections is positive in county i and month t. $X_{Pandemic}$, $X_{Economic}$, and $X_{Local/Housing}$ are the sets of variables discussed in Subsection 3.1. In particular, $X_{Pandemic}$ incorporates the variables $CovidInfection_{i,t}$, and $StayHome_{i,t}$. The former variable represents the monthly change of the Covid-19 infection rate in county i and month t, while the latter is a dummy variable that takes the value 1 if there is a stay-at-home order in county i and month t. $X_{Economic}$ incorporates the variables $UnemplRate_{i,t}$ and $MortgageRate_{i,t}$, which represent the monthly change of unemployment rate and the mortgage rates, respectively, in county i and month t. $X_{Local/Housing}$ incorporates the variables $Density_{i,t}$, $IncomePC_{i,t}$, and $MedianSQF_{i,t}$. The former two variables represent the population density and annual income per capita, respectively, in county i and month t, while the latter represents the median square feet of the houses listed for sale in the sample. $\pi_{i,t}$ represents the time fixed effects for each county i in month t, which accounts for time variations such as seasonality in the housing market. Lastly, $\varepsilon_{i,t}$ is the error term. Because I believe that each U.S. county has its own specific characteristics that may impact price variations during the Covid-19 pandemic, I apply a Fixed-effects model. Furthermore, I use robust standard errors clustered at the county level to control for heteroscedasticity.

The coefficients β_1 and β_2 respond to the research question of this paper. By comparing the estimates given by both coefficients, I am able to understand what is driving the U.S. housing prices during the Covid-19 pandemic and how these drivers respond differently between a pre and a during-pandemic period. In particular, it allows to

understand whether the pandemic severity, measured by the Covid-19 infection rate, is relevant to explain prices growth during the pandemic or, it is rather the social and economic consequences of it. Furthermore, focusing the analysis on the coefficient β_2 enables to draw relevant conclusions on how the different price drivers evolve during the pandemic across counties with different characteristics.

3.4. Results

In this section, I present the results of the application of Equation 1. As already mentioned, the analysis is split into two different scopes: the real estate market and the rental market.

A. Real Estate Market

Table 3 provides the outcome of Equation 1 when the dependent variable is the monthly growth of sale prices.

Table 3

The drivers of the U.S. real estate prices during the Covid-19 pandemic

	Log ($\Delta Price_{Sale}$)		
Variables	(1)	(2)	(3)
Log ($CumulativeCovid$)	0.6812	0.7479	-0.3475
	(0.6882)	(0.7079)	(0.6308)
$XCovidDummy$	-0.6826	-0.7492	0.3458
	(0.6882)	(0.7078)	(0.6308)
Log ($StayHome$)		0.0053	
		(0.0083)	
$XCovidDummy$		-0.0036	
		(0.0083)	
Log ($UnemplRate$)			-0.0012
			(0.0027)
$XCovidDummy$			0.0010
			(0.0035)

$Log(MortgageRate)$			0.0268
			(0.0212)
$XCovidDummy$			-0.1158***
			(0.0168)
$Log(Density)$			
$XCovidDummy$			-0.0017**
			(0.0005)
$Log(Income)$			
$XCovidDummy$			-0.0022***
			(0.0006)
$Log(MedianSQF)$			0.0425***
			(0.0038)
$XCovidDummy$			0.0211***
			(0.0025)
County FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	45,678	45,678	42,676
R^2	0.1066	0.1067	0.1158

Note. This table provides the coefficients and the robust standard errors (in brackets) clustered at the county level from Equation 1 when the dependent variable is the monthly growth of sale prices. Columns (1) and (2) provide the estimates of Equation 1 when considering only the pandemic related variables. Column (3) provides the estimates of Equation 1 when all independent variables are considered, except for *StayHome*. *CovidDummy* is a dummy variable that takes the value 1 if the number of Covid-19 infections in a certain county and month is positive. To understand how the Covid-19 pandemic changed the drivers of the U.S. real estate prices, each variable interacts with this dummy. Data was collected between January 2017 and March 2021. *p<0.01.**p<0.005.***p<0.001.

I do not find any significant effect of Covid-19 infection rate on prices growth. The same remains true when the pandemic effect is added, i.e. when I introduce the Covid-19 dummy (Column 1). This suggests that the U.S. real estate prices have not been driven by the severity of the Covid-19 pandemic. However, as mentioned before, they may have been driven by the direct responses to that. To proxy for such direct responses, I introduce the stay-at-home orders at the state level. Again, they do not seem to affect prices growth (Column 2) and, therefore, it is likely that, during the considered period, the U.S. real estate prices have been driven by the social and economic consequences of the

pandemic rather than by its severity and direct responses. Note that similar findings are found when I introduce the economic variable and the local and housing characteristics (Column 3).

Concerning the economic variables, only the U.S. mortgage rate seems to be a significant driver of prices during the pandemic. Without the Covid-19 dummy, mortgage rate has a positive, although not significant, effect on prices, but as soon as I introduce the pandemic effect, the coefficient becomes negative and significant. A 1% increase in the U.S. mortgage rate is associated with a 11.58% decrease in real estate prices growth. In other words, during the pandemic, periods with lower mortgage rate are associated with higher prices growth[6]. Note that the latter effect is in line with a market in recession responding to the monetary policy implemented by the Federal Reserve after March 2020. In particular, the lowering of interest rates, which may have enhanced the attractiveness of the real estate market and, therefore, increased prices.

The local characteristics show evidence of relevant dynamics during the pandemic. For instance, a negative correlation between population density and real estate prices growth, suggesting that, during the pandemic, counties with lower population density were the ones with higher increase in prices growth. Similar results are found for the income per capita variable. Counties with lower income per capita seem to have higher prices growth. Note that these two variables, i.e. population density and income per capita, are set at their 2019 values and, therefore, only vary at the cross-sectional level. This has two implications for the analysis. First, the interpretation that, as suggested above, should only consider cross-sectional variations, i.e. differences between counties. Second, the fact that the main effect is omitted when using a Fixed-effects model. In line with the majority of the literature on this topic (D'Lima et al., 2020; Gupta et al., 2021; Ling et al., 2020; Liu & Su, 2020; Ouazad, 2020), the findings presented in this paragraph suggest that, during the Covid-19 pandemic, homebuyers changed their preferences for density and shifted from higher to lower population density areas. As discussed before, this may be related to the higher risk of infection in highly populated areas (Ling et al., 2020) or due to the lower value of living nearby the workplace and consumption amenities (Liu & Su, 2020). At the same time, it seems that homebuyers shifted to lower-income areas

[6] Note that mortgage rate is a variable at the state level and, therefore, only varies with time.

during the pandemic. This result is not unexpected considering the correlation between population density and income of approximately 30%.

Lastly, the floor area appears to be positively correlated with real estate prices growth, either I introduce the pandemic effect or not. During the pandemic, a 1% increase in the median listing square feet is associated with a 2.11% increase in prices growth.

Before drawing a final conclusion, I attempt to divide the analysis into the different phases of the U.S. housing market during the Covid-19 pandemic. This allows to understand how the different price drivers have evolved during the pandemic period. A close look at the analysis displayed in Section 2 shows that the development of the real estate market during the pandemic was not homogeneous across the period. In a first phase, approximately between March and June 2020, the market indicators declined significantly compared to previous years as an immediate response to the Covid-19 outbreak. In a second phase, approximately between July and November 2020, the same indicators recovered their previous growth pathways, except for the number of listings. In the last phase, approximately between December 2020 and March 2021, the majority of the indicators started outperforming their values of previous years.

Table 4

The drivers of the U.S. real estate prices during the Covid-19 pandemic – split into three Covid-19 pandemic phases

	Log ($\Delta Price_{Sale}$)		
Variables	(1)	(2)	(3)
Log ($CovidInfection$)	0.0068	0.0069	0.0065
	(0.0061)	(0.0061)	(0.0062)
$XCovidDummy1$	-0.0067	-0.0068	-0.0062
	(0.0062)	(0.0062)	(0.0063)
$XCovidDummy2$	-0.0180*	-0.0176*	-0.0191*
	(0.0066)	(0.0067)	(0.0068)
$XCovidDummy3$	-0.0154	-0.0136	-0.0141
	(0.0104)	(0.0106)	(0.0108)
Log ($StayHome$)		-0.0021	
		(0.0031)	
$XCovidDummy1$		0.0048	
		(0.0033)	
$XCovidDummy2$		0.0047	
		(0.0035)	
$XCovidDummy3$			
Log ($UnemplRate$)			-0.0013
			(0.0027)
$XCovidDummy1$			-0.0035
			(0.0036)
$XCovidDummy2$			0.0155*
			(0.0056)
$XCovidDummy3$			0.00002
			(0.0134)
$Log(MortgageRate)$			0.2121***
			(0.0445)
$XCovidDummy1$			0.0672*
			(0.0256)
$XCovidDummy2$			-0.1104**
			(0.0383)
$XCovidDummy3$			-0.2093***
			(0.0371)
$Log(Density)$			
$XCovidDummy1$			0.0002

			(0.0007)
$XCovidDummy2$			-0.0041***
			(0.0008)
$XCovidDummy3$			-0.00009
			(0.0013)
$Log(IncomePC)$			
$XCovidDummy1$			0.0003
			(0.0010)
$XCovidDummy2$			-0.0050***
			(0.0011)
$XCovidDummy3$			-0.0002
			(0.0017)
$Log(MedianSQF)$			0.0413***
			(0.0038)
$XCovidDummy1$			-0.0018
			(0.0036)
$XCovidDummy2$			0.0266***
			(0.0044)
$XCovidDummy3$			0.0417***
			(0.0064)
County FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	45,678	45,678	42,676
R^2	0.1071	0.1073	0.1189

Note. This table provides the coefficients and the robust standard errors (in brackets) clustered at the county level from Equation 1 when the dependent variable is the monthly growth of sale prices. Columns (1) and (2) provide the estimates of Equation 1 when considering only the pandemic related variables. Column (3) provides the estimates of Equation 1 when all independent variables are considered, except for $StayHome$. $CovidDummy1$ is a dummy variable that takes the value 1 if, between March and June 2020, the number of Covid-19 infections in a certain county is positive. $CovidDummy2$ is a dummy variable that takes the value 1 if, between July and November 2020, the number of Covid-19 infections in a certain county is positive. $CovidDummy3$ is a dummy variable that takes the value 1 if, between December 2020 and March 2021, the number of Covid-19 infections in a certain county is positive. To understand the drivers of the U.S. real estate prices during the different pandemic waves, each variable interacts with these dummies. Data was collected between January 2017 and March 2021. *p<0.01.**p<0.005.***p<0.001.

Table 4 shows the results of Equation 1 for each of the phases specified above. Combining both outcomes, i.e. Table 3 and Table 4, allows to develop a detailed analysis on the drivers of sale prices during the Covid-19 pandemic.

Pandemic related variables

Once again, the pandemic related variables do not seem to have a significant effect on real estate prices growth across the different phases of the pandemic (Columns 1 and 2). The only exception is between July and November 2020. When considering all sets of explanatory variables (Column 3), a 1% increase in the growth of the Covid-19 infections rate is associated with a 1.91% decrease in prices growth. Nevertheless, this effect is temporary and does not last more than five months. For the stay-at-home orders, the evidence of insignificance is similar. Note that I do not incorporate such NPIs in the analysis of the third phase of the pandemic because the number of states with such measures during this period is reductant. These findings confirm the previous idea that, except for the period between July and November 2020, the U.S. real estate prices have not been driven by the severity of the pandemic, neither by the direct responses to that.

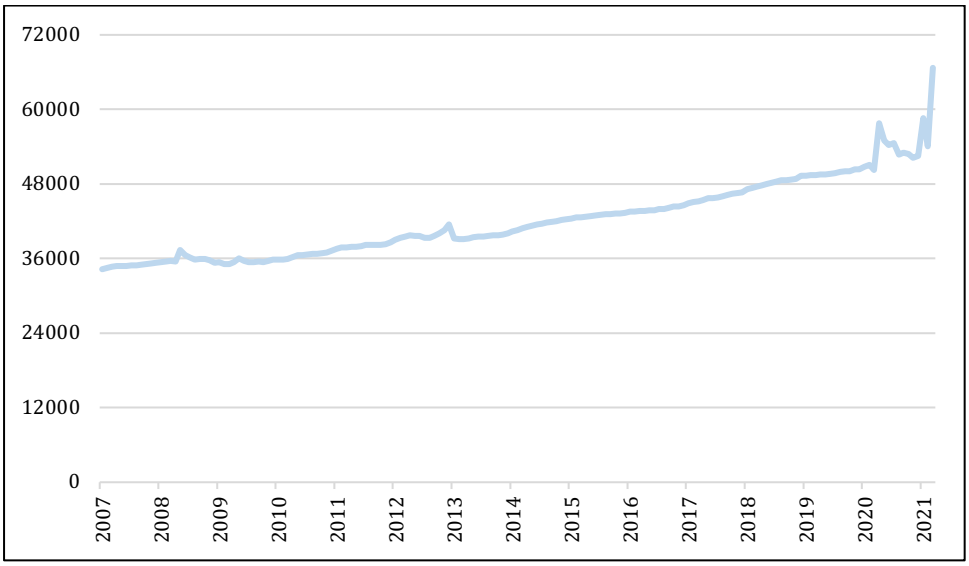
Economic variables

In line with the results of Table 3, unemployment rate does not appear to be a significant driver of prices during the pandemic. The only exception for this is during the second wave, where (the growth of) unemployment rate is positively correlated with prices growth. This is not in line with what is predicted by the economic theory. The positive growth of unemployment rate should reduce disposable income and, therefore, impact negatively the real estate market. For instance, Claussen (2013) finds that disposable income explains approximately 62% of prices growth in the Sweden real estate market, while the accumulated financial wealth only explains 8%. One possible explanation for this controversial finding is government unemployment benefits, which aim to keep householders' spending level during unemployment periods. This is particularly visible during the Covid-19 pandemic, where through the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) (U.S. Department of the Treasury, n.d.), unemployment compensations and homeowners' reliefs were delivered across the country. As a consequence, the U.S. disposable income rose by approximately 15% between March and April 2020 and by 31% between January 2020 and March 2021 (see Figure 3). Note that the period where I find a positive and significant effect of unemployment rate in prices

growth corresponds to the period where I find a negative and significant effect of Covid-19 infection rate in prices growth. Furthermore, in line with the aggregate analysis of Section 2, this period, i.e. between July and November 2020, corresponds to the recovery of the real estate market, where the YoY prices growth was increasing through the months. Therefore, it seems that the negative impact of the pandemic severity in prices growth was compensated by the government aids in place during the same period, which allowed householders to keep, and even increase, their disposable income and overcome the negative effect in sale prices.

Figure 3

Disposable Personal Income Per Capita (Current Dollars)



Note. Adapted from Federal Reserve (2021a).

Once again, there is evidence that the effect of mortgage rate on the real estate market changes during the pandemic, from a positive correlation to a negative one. In other words, without the pandemic effect, periods with lower mortgage rates were associated with lower real estate prices growth. But when the pandemic effect is introduced, periods with lower mortgage rate are associated with higher prices growth. This is particularly visible during the second and third phases of the pandemic, where the coefficients seem to increasingly decrease. As discussed before, these findings show evidence of the market response to the monetary policy introduced by the Federal Reserve after

March 2020, suggesting that the attractive market conditions are one of the main drivers of the increase of the U.S. real estate prices during the Covid-19 pandemic.

Local and housing characteristics

I find that the relationship between population density and sale prices growth changes during the pandemic, switching from a positive (in the first phase of the pandemic) to a negative and significant at the 0.1% level (in the second phase of the pandemic) correlation. As discussed before, this is in line with the theory of changes in consumers' preferences (as in D'Lima et al., 2020; Gupta et al., 2021; Ling et al., 2020; Liu & Su, 2020; Ouazad, 2020), which states that, during the pandemic, homebuyers may have increased their demand for lower density areas and decreased their demand for higher density areas. However, the effect disappears during the third phase of the pandemic, suggesting that such population migrations did not last beyond 2020. The latter idea is enhanced by the similar results given by the income per capita variable. Nevertheless, one can argue that the spatial aggregation used in this analysis, i.e. at the county level, is not the optimal approach to develop a detailed understanding of such local dynamics.

Lastly, the floor area also shows interesting results. Despite its overall positive correlation with prices growth during the entire period, i.e. between January 2017 and March 2021, there is evidence of a negative correlation immediately after the Covid-19 outbreak. A 1% increase in the median listing square feet is associated with a 0.18% decrease in prices growth. The correlation between both variables becomes positive and significant at the 0.1% level during the remaining two pandemic phases. More interesting, it seems that such correlation becomes higher as time goes on, suggesting an increasing demand for more spacious properties. In the last phase of the pandemic, a 1% increase in the median listing square feet is associated with a 4.17% increase in prices growth.

In conclusion, the overall increase in real estate prices during the Covid-19 pandemic appears to be driven by two main components. First, the unprecedented low level of interest rates and the consequent market response to such expansionary monetary policy, especially in the last phase of the pandemic. Second, the housing market dynamics during the pandemic, related to the increasing demand for more spacious properties

located in lower density and more affordable counties. Although a temporary negative impact of Covid-19 infections in prices growth, this effect does not seem to last beyond the second phase of the pandemic. Furthermore, the positive effect of the unemployment rate on prices growth in the same period suggests that government aids were in place to overcome the negative impact of the pandemic in the market.

B. Rental Market

The question that remains is why rental prices were developing in the opposite way to the real estate prices during 2020. At a first glance, I raise two (non-mutually exclusive) possible reasons for that. First, the standard principle of housing prices. Second, the attractiveness of the real estate market and subsequent switches from rentals to real estate. I develop both theories in the next paragraph.

According to the standard principle of housing prices, rental prices reveal the current housing demand while sale prices reveal both current and future demands. During the Covid-19 pandemic, where a global pandemic was declared, economic activity deaccelerated significantly, and the unemployment rate reached its highest since 1948, it is very likely that the market conditions in this period affected negatively the demand for rentals and, therefore, their prices. The same is not entirely true for the real estate market. If market expectations are promising, real estate prices should reflect it. This is especially visible in the U.S., where the economic projections were encouraging. In particular the projections of a decreasing unemployment rate, the persistence of low interest rates (Federal Reserve, 2021b), and the rapid widespread of Covid-19 vaccination (CDC, 2021). These promising expectations, combined with the Covid-19 related government aids that have allowed householders to keep their disposable income, have increased the attractiveness of the real estate market. According to Zhao (2020), this is especially true for the two extremes of income since it enhanced the "fear-of-missing-out" for the higher-income householders and "relaxed liquidity constraints" for the lower-income householders. As a consequence, switches between the rental and the real estate market may have increased during the period, contributing to the opposite development in prices verified in the data.

To investigate both theories, I apply the same methodology as before to understand the drivers of rental prices during the Covid-19 pandemic. Note that the objective

is not to replicate the entire previous analysis into the rental market but rather to understand how the drivers differ between both markets through the pandemic period. For that, I present Table 5 with the results of Equation 1 for each of the Covid-19 pandemic phases specified before, when the dependent variable is the monthly growth of rental prices. Note that the pandemic phases of the rental market coincide with the ones in the real estate market (see Section 2). In a first phase, approximately between March and June 2020, the YoY growth of rental prices declined significantly as an immediate effect of the Covid-19 outbreak. In a second phase, between July and November 2020, the YoY growth of rental prices stabilized in approximately -1%. In the last phase, between December 2020 and March 2021, rental prices recovered and outperformed their growth of previous years.

Table 5

The drivers of the U.S. rental prices during the Covid-19 pandemic – split into three Covid-19 pandemic phases

	Log ($\Delta Price_{Rental}$)		
Variables	(1)	(2)	(3)
Log ($CovidInfection$)	0.0017	0.0017	0.0016
	(0.0011)	(0.0011)	(0.0010)
$XCovidDummy1$	-0.0010	-0.0011	-0.0010
	(0.0011)	(0.0011)	(0.0011)
$XCovidDummy2$	-0.0002	-0.0002	-0.0020
	(0.0017)	(0.0017)	(0.0016)
$XCovidDummy3$	0.0035	0.0034	0.0038
	(0.0040)	(0.0042)	(0.0041)
Log ($StayHome$)		0.0001	
		(0.0007)	
$XCovidDummy1$		-0.0010	
		(0.0008)	
$XCovidDummy2$		0.0003	
		(0.0018)	
$XCovidDummy3$			
Log ($UnemplRate$)			-0.0019
			(0.0012)
$XCovidDummy1$			0.0009

			(0.0013)
$XCovidDummy2$			0.0018
			(0.0018)
$XCovidDummy3$			-0.0011
			(0.0022)
$Log(MortgageRate)$			0.0533***
			(0.0043)
$XCovidDummy1$			0.0095***
			(0.0018)
$XCovidDummy2$			0.0285***
			(0.0034)
$XCovidDummy3$			0.0226***
			(0.0017)
$Log(Density)$			
$XCovidDummy1$			0.00008
			(0.0003)
$XCovidDummy2$			-0.0026***
			(0.0007)
$XCovidDummy3$			-0.0002
			(0.0003)
$Log(IncomePC)$			
$XCovidDummy1$			0.0004
			(0.0005)
$XCovidDummy2$			-0.0027*
			(0.0011)
$XCovidDummy3$			-0.0003
			(0.0003)
County FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	14,300	14,300	14,026
R^2	0.1834	0.1835	0.1885

Note. This table provides the coefficients and the robust standard errors (in brackets) clustered at the county level from Equation 1 when the dependent variable is the monthly growth of rental prices. Columns (1) and (2) provide the estimates of Equation 1 when considering only the pandemic related variables. Column (3) provides the estimates of Equation 1 when all independent variables are considered, except for $StayHome$. $CovidDummy1$ is a dummy variable that takes the value 1 if, between March and June 2020, the number of Covid-19 infections in a certain county is positive. $CovidDummy2$ is a dummy variable that takes the value 1 if, between July and November 2020, the number of Covid-19 infections in a certain county is positive. $CovidDummy3$ is a dummy variable that takes the value 1 if, between December 2020 and

March 2021, the number of Covid-19 infections in a certain county is positive. To understand the drivers of the U.S. rental prices during the different pandemic waves, each variable interacts with these dummies. Data was collected between January 2017 and March 2021. *p<0.01.**p<0.005.***p<0.001.

Pandemic related variables

The pandemic related variables do not appear to be significant drivers of rental prices during the pandemic (Columns 1 and 2). The same result is found when I add the economic variables and local characteristics (Column 3). This suggests that rental prices have not been driven by the pandemic severity or the direct responses to that. In other words, if rental prices were affected by the current market uncertainty associated with the pandemic, that does not appear to be directly linked to the Covid-19 infections or responses. For the same reason mentioned in the real estate market analysis, I do not include the stay-at-home orders in the last phase of the pandemic.

Economic variables

In respect to the economic variables, again only mortgage rate seems to be a relevant explanatory variable of prices growth through the period. Without the pandemic effect, a 1% increase in the U.S. mortgage rate is associated with a 5.33% increase in rental prices growth. With the introduction of the pandemic effect, the correlation between these two variables remains positive and significant at the 0.1% level in all three pandemic phases. For instance, between July and November 2020, a 1% decrease in the mortgage rate was associated with a 2.85% decrease in rental prices growth. This shows evidence that, during the pandemic, the mortgage rate has been impacting the rental market in the opposite way it has impacting the real estate market[7]. This suggests that the introduction of an expansionary monetary policy and the consequent lowering of interest rates during the pandemic has increased the attractiveness of the real estate market relative to the rental market. As a consequence, switches between both markets may have increased during the period, pressuring the opposite development seen in the data.

[7] Recall that, as discussed before, the real estate prices growth and the U.S. mortgage rate are negatively correlated during the Covid-19 pandemic.

The fact that the unemployment rate does not appear to be a significant driver of rental prices[8], suggests that the market risk perception during the pandemic period does not negatively impact rental prices. Therefore, the opposite development in the rental and real estate markets may not have been driven by that. To further investigate this idea, I use the U.S. Consumer Confidence Index (CCI) retrieved from OECD Data (2021) as an indicator of householders' perception of the general economic situation. Table 6 confirms the previous theory. Without the pandemic effect, rental prices growth correlates positively and significantly with the confidence index. However, with the pandemic effect, this correlation disappears. In the third phase of the pandemic, i.e. between December 2020 and March 2021, the correlation between both variables reappears. Note that this period coincides with the recovery of the rental market (see Section 2).

Table 6

Correlation between U.S. CCI and monthly rental prices growth

	Log ($\Delta Price_{Rental}$)
Variables	(1)
Log ($Confidence$)	0.00015***
	(0.00003)
$XCovidDummy1$	-0.00006
	(0.0004)
$XCovidDummy2$	-0.00007
	(0.00011)
$XCovidDummy3$	0.00067***
	(0.00006)
Observations	14,438
R^2	0.0085

Note. This table provides the coefficients and the robust standard errors (in brackets) clustered at the county level when the dependent variable is the monthly growth of rental prices and the independent variable is the U.S. Consumer Confidence Index at the national level. $CovidDummy1$ is a dummy variable that takes the value 1 if, between March and June 2020, the number of Covid-19 infections in a certain county is positive. $CovidDummy2$ is a dummy variable that takes the value 1 if, between July and November 2020, the number of Covid-19 infections in a certain county is positive. $CovidDummy3$ is a dummy variable that

[8] Note that this is also true at the 10% significance level.

takes the value 1 if, between December 2020 and March 2021, the number of Covid-19 infections in a certain county is positive. To understand the correlation between rental prices growth and the CII through the different phases of the pandemic, Log ($Confidence$) interacts with each of these dummy variables. Data was collected between January 2017 and March 2021. *p<0.01.**p<0.005.***p<0.001.

Local characteristics

Similar to the real estate market analysis, I find that the pandemic increased rental prices growth in less dense and lower-income counties. Once again, this effect is only visible during the second phase of the pandemic, i.e. between July and November 2020. As already mentioned, the spatial aggregation used in this paper is not the optimal approach to investigate such population migrations and, therefore, this limitation must be considered when interpreting the results.

In conclusion, the overall decline of rental prices growth during the Covid-19 pandemic appears to be driven by two main components. First, the population movements for lower density and income counties. Second, the attractiveness of the real estate market, enhanced by the lowering of interest rates, and the subsequent switches between the rental market and the real estate market. The latter conclusion explains the opposite development between the rental and the real estate markets during the pandemic period.

4. CONCLUSION

This research paper offers an exploratory analysis of the drivers of the U.S. housing prices during the Covid-19 pandemic. I find that the overall increase in real estate prices has been driven by the following components. First, the favourable market conditions associated with the lowering of interest rates after March 2020. Second, the increasing householders' demand for more spacious properties located in lower density and more affordable counties. Although a temporary negative impact of the pandemic severity in prices growth, this effect does not seem to last beyond 2020. Moreover, this effect appears to be compensated by the government aids that were in place to overcome the negative impact of the pandemic in the market. Additionally, and in line with Francke & Korevaar (2021) and Ouazad (2020), I analyze the rental market to fully understand the current demand in the U.S. housing market during the pandemic period. The U.S. rental market developed in the opposite way than the real estate market. The YoY growth of rental prices declined significantly and only showed signs of recovery in 2021. I find that the main explanation for this negative trend is the attractiveness of the real estate market during the pandemic period and the subsequent switches between rentals and real estate.

Overall, and in line with the literature on the U.S. housing market during the Covid-19 pandemic (e.g. Gupta et al., 2021; Liu & Su, 2020; Ouazad, 2020; Zhao, 2020), I find evidence of a resilient market. Although a slight decline in the beginning of the pandemic, almost all indicators have recovered over the following months. To go further, I also find evidence of an unprecedented phenomenon. The U.S. housing market exceeds its pre-pandemic performance three months after the outbreak. One cannot reject the role of governmental parties to achieve such development. As showed in this paper, through the decline of interest rates and attribution of government aids, they were able to partly cover the real economic effects of the Covid-19 pandemic and, consequently, strengthen the housing market. The question that remains is what the future of the housing markets across the world will be when such aids were lifted. Future research on this topic should be done to understand the impact of these entities on the health of housing markets.

Lastly, this paper is prone to some limitations. First, the fact that this empirical analysis only focuses on the demand side of the U.S. housing market. The reason for this is the lack of data related to supply mechanisms, such as the number of new constructions at the county level. Nevertheless, there is evidence (D'Lima et al., 2020; Ouazad, 2020)

that the shortage of housing supply is a significant determinant of prices during the Covid-19 pandemic. Second, as discussed in Section 3, the spatial aggregation used in the empirical analysis, i.e. at the county level, is not the optimal approach to develop a detailed understanding of the local dynamics that occurred during the Covid-19 pandemic. In particular, the changes in householders' demand for more spacious properties located in lower density and income counties. Again, the reason for not using another spatial aggregation is the lack of data availability.

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6. APPENDIX

Table A1

List of counties in the panel data analysis on the relationship between the U.S. housing prices and the independent variables

State	County
Alabama	Autauga
	Baldwin
	Blount
	Calhoun
	Coffee
	Colbert
	Cullman
	Dale
	Elmore
	Etowah
	Houston
	Jackson
	Jefferson
	Lauderdale
	Lee
	Limestone
	Madison
	Marshall
	Mobile
	Montgomery
	Morgan
	Russell
	Shelby
	St. Clair
	Talladega
	Tuscaloosa
	Walker
Alaska	Anchorage
	Fairbanks North Star
	Matanuska-Susitna
Arizona	Cochise
	Coconino
	Gila

	Maricopa
	Mohave
	Navajo
	Pima
	Pinal
	Yavapai
	Yuma
Arkansas	Baxter
	Benton
	Craighead
	Crawford
	Crittenden
	Faulkner
	Garland
	Jefferson
	Lonoke
	Pope
	Pulaski
	Saline
	Sebastian
	Washington
	White
California	Alameda
	Butte
	Contra Costa
	El Dorado
	Fresno
	Humboldt
	Imperial
	Kern
	Kings
	Lake
	Los Angeles
	Madera
	Marin
	Mendocino
	Merced
	Monterey
	Napa
	Nevada
	Orange
	Placer
	Riverside

	Sacramento
	San Bernardino
	San Diego
	San Francisco
	San Joaquin
	San Luis Obispo
	San Mateo
	Santa Barbara
	Santa Clara
	Santa Cruz
	Shasta
	Solano
	Sonoma
	Stanislaus
	Sutter
	Tehama
	Tulare
	Tuolumne
	Ventura
	Yolo
	Yuba
Colorado	Adams
	Arapahoe
	Boulder
	Broomfield
	Denver
	Douglas
	Eagle
	El Paso
	Garfield
	Jefferson
	La Plata
	Larimer
	Mesa
	Pueblo
	Weld
Connecticut	Fairfield
	Hartford
	Litchfield
	Middlesex
	New Haven
	New London
	Tolland

	Windham
Delaware	Kent
	New Castle
	Sussex
Florida	Alachua
	Bay
	Brevard
	Broward
	Charlotte
	Citrus
	Clay
	Collier
	Columbia
	Duval
	Escambia
	Flagler
	Hernando
	Highlands
	Hillsborough
	Indian River
	Lake
	Lee
	Leon
	Manatee
	Marion
	Martin
	Miami-Dade
	Monroe
	Nassau
	Okaloosa
	Orange
	Osceola
	Palm Beach
	Pasco
	Pinellas
	Polk
	Putnam
	Santa Rosa
	Sarasota
	Seminole
	St. Johns
	St. Lucie
	Sumter

	Volusia
	Walton
Georgia	Barrow
	Bartow
	Bibb
	Bulloch
	Camden
	Carroll
	Catoosa
	Chatham
	Cherokee
	Clarke
	Clayton
	Cobb
	Columbia
	Coweta
	Dekalb
	Dougherty
	Douglas
	Effingham
	Fayette
	Floyd
	Forsyth
	Fulton
	Glynn
	Gordon
	Gwinnett
	Hall
	Henry
	Houston
	Jackson
	Laurens
	Liberty
	Lowndes
	Muscogee
	Newton
	Paulding
	Richmond
	Rockdale
	Spalding
	Troup
	Walker
	Walton

	Whitfield
Hawaii	Hawaii
	Honolulu
	Kauai
	Maui
Idaho	Ada
	Bannock
	Bonneville
	Canyon
	Kootenai
	Twin Falls
Illinois	Adams
	Champaign
	Coles
	Cook
	Dekalb
	DuPage
	Grundy
	Henry
	Jackson
	Kane
	Kankakee
	Kendall
	Knox
	La Salle
	Lake
	Macon
	Macoupin
	Madison
	McHenry
	Mclean
	Ogle
	Peoria
	Rock Island
	Sangamon
	St. Clair
	Stephenson
	Tazewell
	Vermilion
	Whiteside
	Will
	Williamson
	Winnebago

Indiana	Allen
	Bartholomew
	Boone
	Clark
	Dearborn
	Delaware
	Elkhart
	Floyd
	Grant
	Hamilton
	Hancock
	Hendricks
	Henry
	Howard
	Johnson
	Kosciusko
	La Porte
	Lake
	Lawrence
	Madison
	Marion
	Monroe
	Morgan
	Porter
	St. Joseph
	Tippecanoe
	Vanderburgh
	Vigo
	Warrick
	Wayne
Iowa	Black Hawk
	Cerro Gordo
	Clinton
	Dallas
	Dubuque
	Johnson
	Linn
	Polk
	Pottawattamie
	Scott
	Story
	Warren
	Woodbury

Kansas	Butler
	Douglas
	Johnson
	Leavenworth
	Reno
	Riley
	Saline
	Sedgwick
	Shawnee
	Wyandotte
Kentucky	Boone
	Boyd
	Bullitt
	Campbell
	Christian
	Daviess
	Fayette
	Franklin
	Hardin
	Henderson
	Hopkins
	Jefferson
	Jessamine
	Kenton
	Laurel
	Madison
	Mccracken
	Oldham
	Pulaski
	Scott
	Warren
Louisiana	Acadia
	Ascension
	Bossier
	Caddo
	Calcasieu
	East Baton Rouge
	Iberia
	Jefferson
	Lafayette
	Lafourche
	Livingston
	Orleans

	Ouachita
	Rapides
	St. Charles
	St. Landry
	St. Martin
	St. Mary
	St. Tammany
	Tangipahoa
	Terrebonne
	Vermilion
	Vernon
Maine	Androscoggin
	Cumberland
	Kennebec
	Penobscot
	York
Maryland	Allegany
	Anne Arundel
	Baltimore
	Baltimore City
	Calvert
	Carroll
	Cecil
	Charles
	Frederick
	Harford
	Howard
	Montgomery
	Prince George's
	Queen Anne's
	St. Mary's
	Washington
	Wicomico
	Worcester
Massachusetts	Barnstable
	Berkshire
	Bristol
	Essex
	Franklin
	Hampden
	Hampshire
	Middlesex
	Norfolk

	Plymouth
	Suffolk
	Worcester
Michigan	Allegan
	Barry
	Bay
	Berrien
	Calhoun
	Cass
	Clinton
	Eaton
	Genesee
	Grand Traverse
	Ingham
	Ionia
	Isabella
	Jackson
	Kalamazoo
	Kent
	Lapeer
	Lenawee
	Livingston
	Macomb
	Marquette
	Midland
	Monroe
	Montcalm
	Muskegon
	Oakland
	Ottawa
	Saginaw
	Shiawassee
	St. Clair
	St. Joseph
	Van Buren
	Washtenaw
	Wayne
Minnesota	Anoka
	Blue Earth
	Carver
	Chisago
	Clay
	Crow Wing

	Dakota
	Goodhue
	Hennepin
	Olmsted
	Otter Tail
	Ramsey
	Rice
	Scott
	Sherburne
	St. Louis
	Stearns
	Washington
	Winona
	Wright
Mississippi	Desoto
	Forrest
	Hancock
	Harrison
	Hinds
	Jackson
	Jones
	Lafayette
	Lamar
	Lauderdale
	Lee
	Lowndes
	Madison
	Oktibbeha
	Pearl River
	Rankin
	Warren
Missouri	Boone
	Buchanan
	Cape Girardeau
	Cass
	Christian
	Clay
	Cole
	Franklin
	Greene
	Jackson
	Jasper
	Jefferson

	Johnson
	Lincoln
	Newton
	Platte
	Saint Louis City
	St. Charles
	St. Francois
	St. Louis
	Taney
Montana	Cascade
	Flathead
	Gallatin
	Lewis And Clark
	Missoula
	Yellowstone
Nebraska	Buffalo
	Douglas
	Hall
	Lancaster
	Sarpy
Nevada	Carson City
	Clark
	Douglas
	Elko
	Lyon
	Washoe
New Hampshire	Belknap
	Cheshire
	Grafton
	Hillsborough
	Merrimack
	Rockingham
	Strafford
New Jersey	Atlantic
	Bergen
	Burlington
	Camden
	Cape May
	Cumberland
	Essex
	Gloucester
	Hudson
	Hunterdon

	Mercer
	Middlesex
	Monmouth
	Morris
	Ocean
	Passaic
	Salem
	Somerset
	Sussex
	Union
	Warren
New Mexico	Bernalillo
	Chaves
	Curry
	Dona Ana
	Eddy
	Lea
	McKinley
	Otero
	San Juan
	Sandoval
	Santa Fe
	Valencia
New York	Albany
	Bronx
	Broome
	Cattaraugus
	Cayuga
	Chautauqua
	Chemung
	Clinton
	Columbia
	Cortland
	Dutchess
	Erie
	Franklin
	Fulton
	Genesee
	Herkimer
	Jefferson
	Kings
	Livingston
	Madison
	Monroe

	Montgomery
	Nassau
	New York
	Niagara
	Oneida
	Onondaga
	Ontario
	Orange
	Oswego
	Otsego
	Putnam
	Queens
	Rensselaer
	Richmond
	Rockland
	Saratoga
	Schenectady
	St. Lawrence
	Steuben
	Suffolk
	Tioga
	Tompkins
	Ulster
	Warren
	Washington
	Wayne
	Westchester
North Carolina	Alamance
	Beaufort
	Brunswick
	Buncombe
	Burke
	Cabarrus
	Caldwell
	Carteret
	Catawba
	Chatham
	Cleveland
	Craven
	Cumberland
	Davidson
	Durham
	Edgecombe
	Forsyth

	Franklin
	Gaston
	Granville
	Guilford
	Halifax
	Harnett
	Haywood
	Henderson
	Hoke
	Iredell
	Johnston
	Lee
	Lenoir
	Lincoln
	Mecklenburg
	Moore
	Nash
	New Hanover
	Onslow
	Orange
	Pender
	Pitt
	Randolph
	Robeson
	Rockingham
	Rowan
	Rutherford
	Stanly
	Stokes
	Surry
	Union
	Wake
	Watauga
	Wayne
	Wilkes
	Wilson
North Dakota	Burleigh
	Cass
	Grand Forks
	Ward
Ohio	Allen
	Ashland
	Ashtabula

Athens
Belmont
Butler
Clark
Clermont
Columbiana
Cuyahoga
Darke
Delaware
Erie
Fairfield
Franklin
Geauga
Greene
Hamilton
Hancock
Huron
Jefferson
Knox
Lake
Lawrence
Licking
Lorain
Lucas
Mahoning
Marion
Medina
Miami
Montgomery
Muskingum
Pickaway
Portage
Richland
Ross
Sandusky
Scioto
Seneca
Stark
Summit
Trumbull
Tuscarawas
Union
Warren

	Washington
	Wayne
	Wood
Oklahoma	Canadian
	Carter
	Cherokee
	Cleveland
	Comanche
	Creek
	Garfield
	Grady
	Le Flore
	Muskogee
	Oklahoma
	Osage
	Payne
	Pottawatomie
	Rogers
	Tulsa
	Wagoner
	Washington
Oregon	Benton
	Clackamas
	Columbia
	Coos
	Deschutes
	Douglas
	Jackson
	Josephine
	Klamath
	Lane
	Lincoln
	Linn
	Marion
	Multnomah
	Polk
	Umatilla
	Washington
	Yamhill
Pennsylvania	Adams
	Allegheny
	Armstrong
	Beaver

	Berks
	Blair
	Bradford
	Bucks
	Butler
	Cambria
	Carbon
	Centre
	Chester
	Clearfield
	Columbia
	Crawford
	Cumberland
	Dauphin
	Delaware
	Erie
	Fayette
	Franklin
	Indiana
	Lackawanna
	Lancaster
	Lawrence
	Lebanon
	Lehigh
	Luzerne
	Lycoming
	Mercer
	Mifflin
	Monroe
	Montgomery
	Northampton
	Northumberland
	Philadelphia
	Pike
	Schuylkill
	Somerset
	Venango
	Washington
	Westmoreland
	York
Rhode Island	Bristol
	Kent
	Newport

	Providence
	Washington
South Carolina	Aiken
	Anderson
	Beaufort
	Berkeley
	Charleston
	Cherokee
	Darlington
	Dorchester
	Florence
	Georgetown
	Greenville
	Greenwood
	Horry
	Kershaw
	Lancaster
	Laurens
	Lexington
	Oconee
	Orangeburg
	Pickens
	Richland
	Spartanburg
	Sumter
	York
South Dakota	Lincoln
	Minnehaha
	Pennington
Tennessee	Anderson
	Blount
	Bradley
	Carter
	Coffee
	Cumberland
	Davidson
	Dickson
	Greene
	Hamblen
	Hamilton
	Hawkins
	Jefferson
	Knox

	Loudon
	Madison
	Maury
	McMinn
	Montgomery
	Putnam
	Roane
	Robertson
	Rutherford
	Sevier
	Shelby
	Sullivan
	Sumner
	Tipton
	Washington
	Williamson
	Wilson
Texas	Angelina
	Bastrop
	Bell
	Bexar
	Bowie
	Brazoria
	Brazos
	Cameron
	Collin
	Comal
	Coryell
	Dallas
	Denton
	Ector
	El Paso
	Ellis
	Fort Bend
	Galveston
	Grayson
	Gregg
	Guadalupe
	Hardin
	Harris
	Harrison
	Hays
	Henderson

	Hidalgo
	Hood
	Hunt
	Jefferson
	Johnson
	Kaufman
	Kerr
	Lamar
	Liberty
	Lubbock
	McLennan
	Midland
	Montgomery
	Nacogdoches
	Nueces
	Orange
	Parker
	Potter
	Randall
	Rockwall
	Rusk
	San Patricio
	Smith
	Tarrant
	Taylor
	Tom Green
	Travis
	Victoria
	Walker
	Webb
	Wichita
	Williamson
	Wise
Utah	Cache
	Davis
	Salt Lake
	Tooele
	Utah
	Washington
	Weber
Vermont	Chittenden
	Franklin
	Rutland

	Washington
	Windsor
Virginia	Albemarle
	Alexandria City
	Arlington
	Augusta
	Bedford
	Campbell
	Charlottesville City
	Chesapeake City
	Chesterfield
	Danville City
	Fairfax
	Fauquier
	Franklin
	Frederick
	Hampton City
	Hanover
	Henrico
	Henry
	James City
	Loudoun
	Lynchburg City
	Montgomery
	Newport News City
	Norfolk City
	Pittsylvania
	Portsmouth City
	Prince William
	Richmond City
	Roanoke
	Roanoke City
	Rockingham
	Spotsylvania
	Stafford
	Suffolk City
	Virginia Beach City
	Washington
	York
Washington	Benton
	Chelan
	Clallam
	Clark

	Cowlitz
	Franklin
	Grant
	Grays Harbor
	Island
	King
	Kitsap
	Lewis
	Mason
	Pierce
	Skagit
	Snohomish
	Spokane
	Thurston
	Walla Walla
	Whatcom
	Whitman
	Yakima
West Virginia	Berkeley
	Cabell
	Harrison
	Jefferson
	Kanawha
	Marion
	Mercer
	Monongalia
	Ohio
	Putnam
	Raleigh
	Wood
Wisconsin	Brown
	Calumet
	Chippewa
	Columbia
	Dane
	Dodge
	Douglas
	Eau Claire
	Fond Du Lac
	Grant
	Jefferson
	Kenosha
	La Crosse

	Manitowoc
	Marathon
	Milwaukee
	Outagamie
	Ozaukee
	Portage
	Racine
	Rock
	Sauk
	Sheboygan
	St. Croix
	Walworth
	Washington
	Waukesha
	Winnebago
	Wood
Wyoming	Laramie
	Natrona