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Is This Recession Different for the Housing Market?

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Abstract

Our study analyzes home price indices (HPIs) for 20 metro areas to determine which regional housing markets depict a leading or lagging behavior since 2000.

We create three dashboards to succinctly visualize regional HPI trends. The dashboard analysis is split into two phases; the first phase focuses on the post-Great Recession era, and the second phase focuses on the post-COVID pandemic era. Denver, Dallas, Boston, San Francisco and Charlotte were leaders during the post-Great Recession era, and New York, Las Vegas, Chicago and Atlanta were the followers. During the post-pandemic era, Denver and San Francisco maintained their leadership status, while Dallas and Boston became coincident markets and Charlotte drifted toward lagging. Meantime, all four post-Great Recession followers held onto their follower status in the post-pandemic era. We also utilize a Granger causality test to confirm the structural break in some of the regional HPIs.

The second section of the study estimates the fed fund rate's effect on HPI growth. Specifically, our model estimates that HPI growth was boosted by 3.5 and 2.4 percentage points during the 2020 recession and the post-Great Recession era, respectively. Looking ahead, we estimate that HPI growth will be 4.95 percentage points weaker than the 2020 recession, based on the FOMC's fed funds rate forecast for 2024 and its correspondingly higher mortgage rate. The estimated cost based on the Bloomberg consensus forecast for the fed funds rate in 2024 is 3.85 percentage points. In short, our analysis suggests that the current business cycle may be different for the housing market compared to the past two cycles.

In sum, our analysis cautions decisionmakers that this housing market is different in the sense that the benefits from easy policy during the past cycles may not re-appear in the near term.

Keywords: Recession; Housing Market; Regional Markets; Dashboard.
JEL Classifications: R21; R31; E32.

Is This Recession Different for the Housing Market?

1. Introduction

After enjoying double-digit growth during much of the 2021-2022 period, the S&P CoreLogic Case-Shiller national home prices index (HPI) in April 2023 reached its first negative year-over-year growth rate since April 2012. Decades-high inflation and the rapid pace of monetary policy tightening are key drivers of the recent HPI bust. Moreover, financial market participants and economists look for a recession in the near-term picture. At the same time, the consensus forecast looks for the FOMC to keep its benchmark rate above 4% through most of 2024. Consequently, the housing market is facing some crosscurrents and analysts are wondering if the forecasted recession would be different for the housing market. For example, during the past four recessions, the FOMC reduced interest rates, but today's inflationary environment may differentiate the forecasted recession from the last four downturns.

We present a new framework to shed light on the near-term housing market outlook. The first phase of our study analyzes regional HPIs to determine which markets depict a leading or lagging behavior overtime. That is, twenty metropolitan statistical area (MSA) HPIs are characterized by the business cycle to examine which MSA's HPI shows a consistent leading or lagging behavior. We also test the possibility of a pandemic-related structural break in the HPIs to examine if the behavior of some MSA HPIs has changed overtime. For instance, an MSA's HPI was leading in the post-Great Recession era, but it lost its leading character in the post-COVID pandemic age. We believe our work helps decisionmakers closely watch activities in the leading markets to gauge the path of the national housing market.

The second and final phase of our analysis estimates the potential effect of the forecasted recession on home prices. During the past four recessions, the FOMC reduced the fed funds rate drastically—the fed funds rate hit the zero-lower bound first during the Great Recession and then again in the 2020 recession. Moreover, the average 30-year fixed mortgage rate hit some of the lowest levels on history during the past two recoveries and expansions, as the fed funds rate is an important input to overall borrowing costs. The present cycle's inflation is at a decades-high, and both the FOMC and the financial sector participants are forecasting an elevated fed funds rate for the near

future.[1] Put differently, it is highly unlikely (based on the Bloomberg and FOMC forecasts) that the forecasted recession will see ultra-low interest rates akin to the past two recessions. Indeed, Federal Reserve Board Chair Powell has said multiple times in 2023 that the Fed needs to keep interest rates "higher for longer" to bring inflation back down to the Fed's 2% inflation target. Thus, we build an econometric model to estimate the fed funds rate's effect on mortgage rates and its passthrough to annual growth in the national HPI. Our approach utilizes the post-Great Recession era as a base-case and estimates the effect of the forecasted recession on the housing market compared to those effects which were observed during the last business cycle.

Our statistical analysis utilizes the S&P CoreLogic Case-Shiller home prices index (HPI) as a measure of home prices. We include aggregate measures of home prices, such as the national HPI, the 20-City HPI (20 major MSAs), the 10-City HPI (10 major MSAs) and individual metro area HPIs. Most of the HPI data go back to 2000 and therefore our analysis' sample period covers 2000 through May 2023.

In Section 2 of this paper, we employ a few dashboards to succinctly visualize HPI trends by metro area. The section's analysis is split into two phases; the first phase focuses on the post-Great Recession era, and the second phase focuses on the post-COVID pandemic era. We use two dashboards in first phase. Dashboard 1 shows each metro area's HPI trough from the fallout of the Great Recession, while Dashboard 2 shows when each metro area's HPI recovered back to (or surpassed) its pre-Great Recession peak. Using the dashboards as an aid, we designate a metro area as a leading indicator of the national housing market if its HPI troughs *and* recovers to its pre-Great Recession peak before the national HPI. On the flip side, a metro area's HPI that troughs *and* recovers after the national HPI is considered a lagging indicator or follower. Following these conditions, Denver, Dallas, Boston, San Francisco and Charlotte were leaders during the post-Great Recession era, and New York, Las Vegas, Chicago and Atlanta were the followers.

The second phase of our dashboard analysis utilizes data from 2000 to present to determine if any regional markets have seen their leading or lagging status change in the pandemic era. Specifically, if a metro area's HPI peaked ahead of the national HPI in June 2022, then it is considered a leading market. On the other hand, if a metro area's HPI peaked after the national HPI, then it is considered

[1] The FOMC's median projection (June 2023 summary of economic projections) put the fed funds rate at 4.6% at the end of 2024, and the Bloomberg consensus suggests 3.9%.

a lagging indicator or follower. We employ Dashboard 3 in this phase, which shows when each HPI recovered from the Great Recession, as well as data through the present day that includes the HPIs' pandemic-related peaks. Denver and San Francisco maintained their leadership status, while Dallas and Boston became coincident markets and Charlotte drifted toward lagging. Meantime, all four post-Great Recession followers (Las Vegas, New York, Chicago and Atlanta) held onto their follower status in the post-pandemic era.

In addition, we employ the Granger causality test, and that analysis confirms there was a structural break in some of the metro area HPIs following the 2020 recession. We believe that the dashboard and Granger causality approaches complement each other. For instance, an analyst may want to test the historical average relationship with the help of the causality test and then validate a point-in-time leader using the dashboard measure. Moreover, some MSAs may experience stronger growth than the national HPI, and they are also potential leaders in terms of growth rates. The San Francisco HPI is the only MSA which shows up as a leading HPI in both approaches. In the post-pandemic era, the national HPI hit a double-digit growth rate in December 2020 and then breached 20% growth in February 2022 for the first-time ever in our analysis. On the other hand, the San Francisco HPI hit double-digit growth in October 2020 (2-month lead time for double-digit growth), and then crossed 20% growth in April 2021. Moreover, the San Francisco HPI not only hit 20% growth 10 months before the national HPI, but it remained above the 20% line from April 2021 through June 2022. In retrospect, a persistently strong growth in San Francisco home prices would have been an indication that the national HPI would experience a robust growth as both of our methods identify San Francisco as a leading HPI for national home prices.

The final method estimates the effects of past recessions, and their corresponding monetary policy easing cycles, on the HPI growth. Using the FOMC's projections and the Bloomberg consensus forecast for year-end fed funds rate, we estimate the effect of the potential upcoming recession and easing cycle on the housing market. Our analysis suggests that the 2020 recession benefitted the most (3.5 percentages point higher HPI growth) from low interest rates, which is not surprising given the average 30-year mortgage rate hit a record low in 2020. The post-Great Recession era HPI annual growth rate benefitted from the lower mortgage rate as well by 2.4 percentage points, all else equal. On the other end of the spectrum, based on the FOMC's 2024 fed funds rate forecast, our model suggests the largest cost of a 4.95 percentage point reduction in the national HPI's annual growth due to elevated mortgage rates. The estimate predicated on the Bloomberg

consensus forecast is a 3.85 percentage point reduction in national home price growth, but that is still a smaller cost compared to the FOMC-based estimate.

In sum, the year-over-year percent change in the national HPI turned negative in recent months (April and May 2023), and with expectations of rate cuts by the FOMC in the near future, the natural option is to look at past easing cycles to gauge the near-term outlook for the housing market. Our work contributes to existing literature by quantifying the effects of monetary policy easing cycles (past and potential future) on the HPI growth. It seems the past cycles' benefits are long gone, and the current cycle's higher inflation is dictating historically elevated interest rates, which stands in contrast to the past two cycles' ultra-low interest rates. Our analysis cautions decisionmakers that this housing market is different.

2. Lords of the Housing World: Dashboard Visualizations

In our dashboard analysis, we employ the national HPI as a benchmark to determine the peaks and troughs of the housing market. Ahead of the Great Recession, the national HPI peaked at an index level of 184.6 in July 2006 prior to the economic downturn. Throughout the recession, the national HPI declined on trend and eventually troughed at 134.0 in February 2012. (Consequently, the peak-to-trough percentage change in national home prices equated to a stunning 27% decline.) The national HPI recovered back to its pre-Great Recession peak in January 2017.

At the regional level, we consider a metro area a leading indicator for the national housing market if two criteria are met. Specifically, a metro area's HPI should trough (first condition) and then recover to its pre-recession peak (second condition) before the national HPI to be considered a leading market. For instance, Boston's HPI troughed in March 2009 and surpassed its pre-Great Recession peak in July 2015, establishing Boston as a leading housing market during the Great Recession era. On the flip side, a metro area that troughs and recovers after the national HPI is considered a lagging market or follower. For example, Las Vegas's HPI bottomed in March 2012 and did not recover to its pre-Great Recession peak until June 2021.

2.1 Dashboard Phase One: The Post-Great Recession Era

We break up our dashboard home price analysis into two major phases. The first phase utilizes data from 2000 through 2019 to determine leaders in the housing market during the post-Great Recession era. Following the criteria outlined above, we created two dashboards for this first

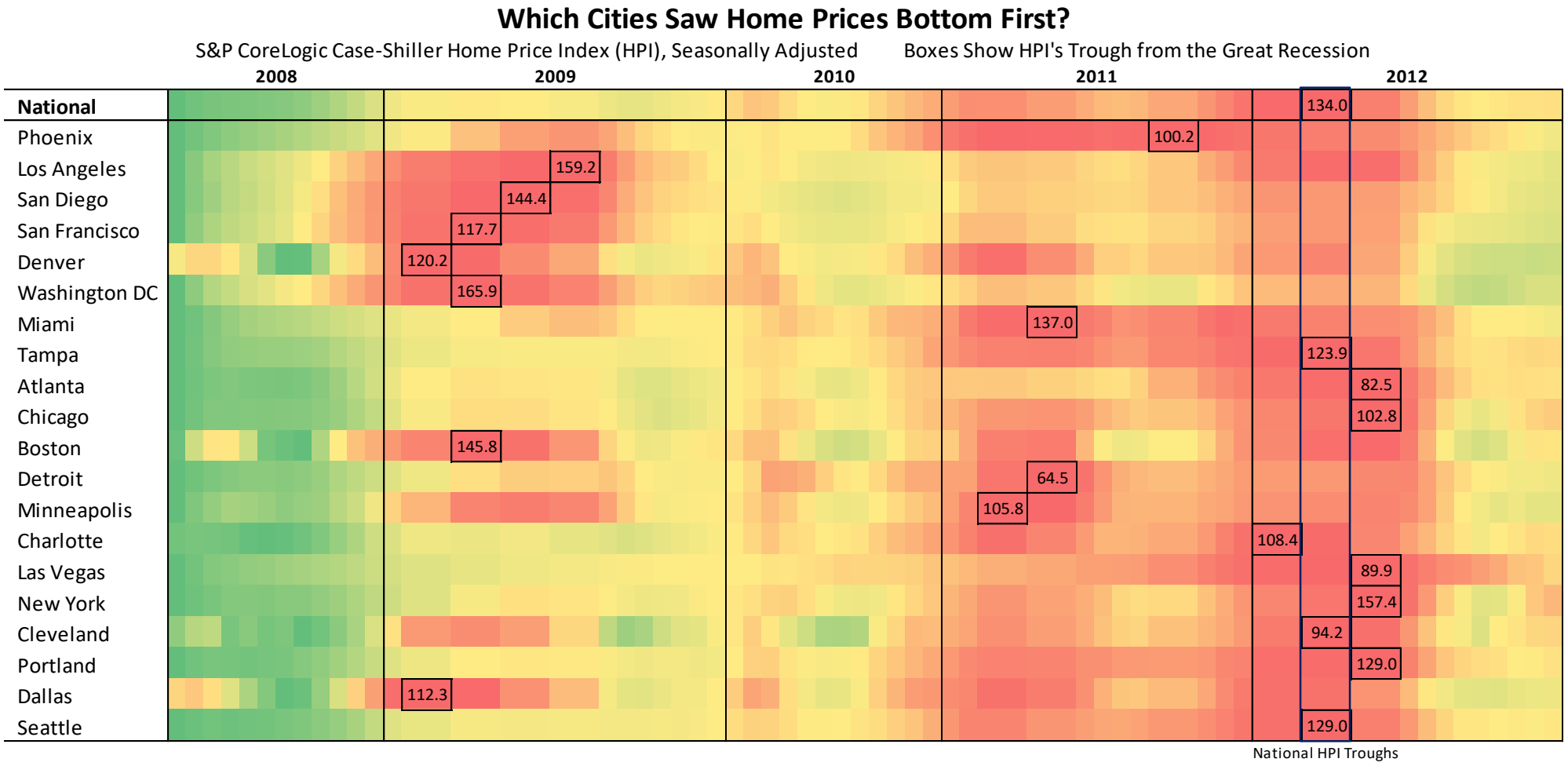
phase. Dashboard 1 (see Page 7) shows each metro area's HPI trough from the fallout of the Great Recession. Dashboard 2 (see Page 8) shows when each metro area's HPI recovered back above its pre-Great Recession peak.

The first dashboard shows that home prices troughed at varying times during the Great Recession era. Of the 20 MSAs we evaluated, Denver (120.2) and Dallas (112.3) were the first metro areas to see their HPI bottom out in February 2009. One month later, the HPIs for San Francisco, Washington DC and Boston each troughed in March 2009. San Diego and Los Angeles followed suit, bottoming in April and May 2009, respectively. A year or so later, Minneapolis, Detroit, Miami and Phoenix all troughed during 2011. Charlotte's HPI troughed just one month prior to the national HPI's bottom in February 2012. All these metro areas meet the first criterion to be considered a housing market leader, as they each troughed ahead of the national HPI. Tampa's, Cleveland's and Seattle's HPIs all troughed in the same month as the national HPI, while Atlanta's, Chicago's, Las Vegas's, New York's and Portland's HPIs troughed in March 2012.

Turning to the second condition, we look to the second dashboard to assess which MSA recovered to (or surpassed) its pre-Great Recession peak before the national HPI did in January 2017. Denver and Dallas were the first two metro areas to see their HPI recover to their pre-recession peaks, both rebounding in May 2013. Boston came in at a distant second in July 2015, followed by Portland (Sep 2015), San Francisco (Feb 2016), Charlotte (Mar 2016) and Seattle (Mar 2016). The national index was the sole HPI to recover in the first quarter of 2017, followed by Atlanta in April of that year. In 2018, Los Angeles (Feb), San Diego (Feb), Minneapolis (Jun) and Cleveland (Aug) all recovered. Subsequently, Detroit was the only HPI to recover during 2019. The remaining metros—Tampa, Washington DC, New York, Miami, Las Vegas and Chicago—did not see their HPIs recover until the COVID pandemic was underway.

Given the analysis above, five metro areas emerge as housing market leaders. Denver and Dallas are tied for having the greatest amount of lead time, followed by Boston and San Francisco. Charlotte is the final leading market, although it troughed and recovered within eyeshot of the national HPI. Four metro areas fall into the lagging or follower category (i.e., trough and recovery each happened after the national HPI): New York, Las Vegas, Chicago and Atlanta. Of these followers, Chicago's HPI saw the longest stretch to recovery, while Atlanta's HPI saw the shortest.

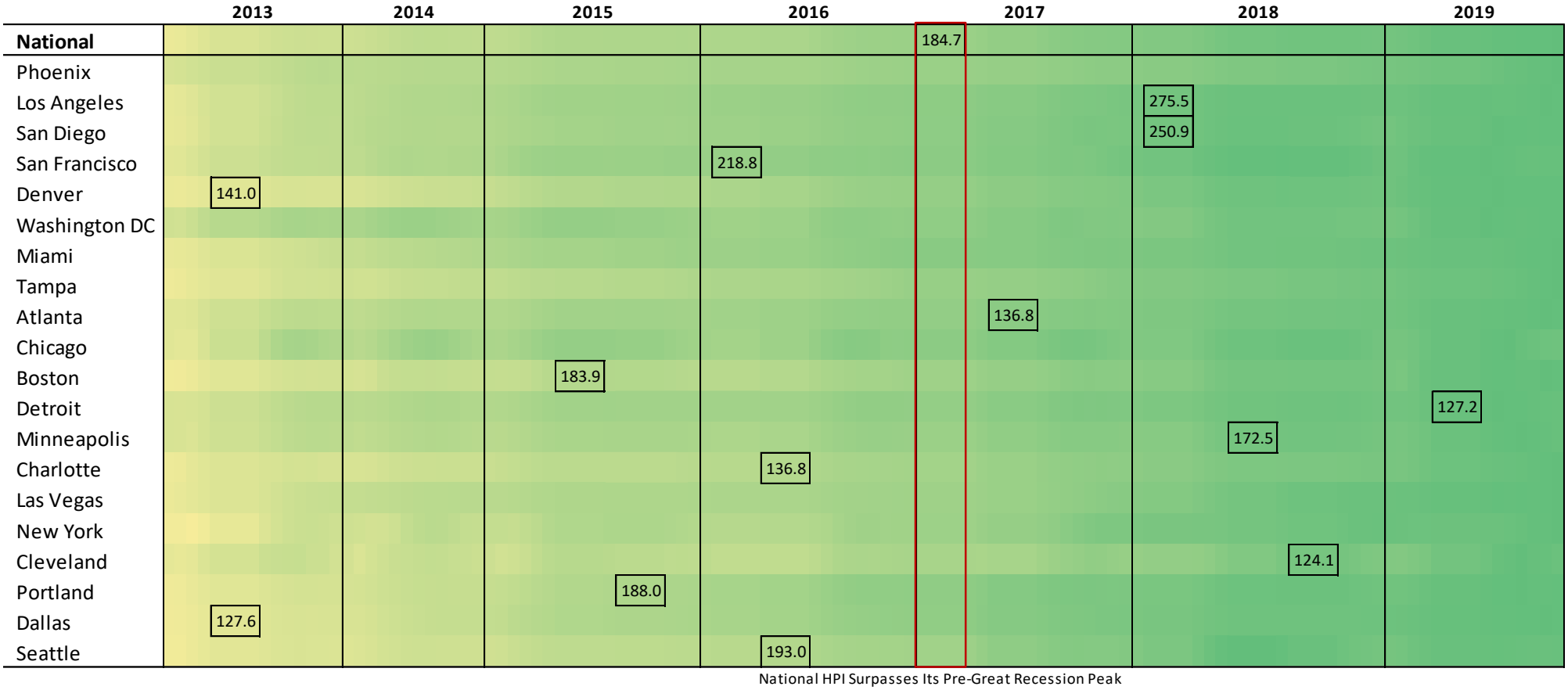
Dashboard 1


Which Cities Saw Home Prices Bottom First?
S&P CoreLogic Case-Shiller Home Price Index (HPI), Seasonally Adjusted
Boxes Show HPI's Trough from the Great Recession
2008
2009
2010
2011
2012
National
Phoenix
Los Angeles
San Diego
San Francisco
Denver
Washington DC
Miami
Tampa
Atlanta
Chicago
Boston
Detroit
Minneapolis
Charlotte
Las Vegas
New York
Cleveland
Portland
Dallas
Seattle
134.0
100.2
159.2
144.4
117.7
120.2
165.9
137.0
123.9
82.5
102.8
145.8
64.5
105.8
108.4
89.9
157.4
94.2
129.0
112.3
129.0
National HPI Troughs

Dashboard 2

Which Cities Saw Home Prices Recover First?

S&P CoreLogic Case-Shiller Home Price Index (HPI), Seasonally Adjusted Boxes Show When HPI Surpassed Its Pre-Great Recession Peak



Several metros saw their HPIs trough before the national HPI (Feb 2012) and then recover after the national HPI (Jan 2017). For instance, Phoenix saw its HPI trough in late 2011 and it took 111 months before it eventually recovered to its pre-Great Recession peak in late 2020. Los Angeles and San Diego's HPIs each troughed in 2009 and recovered in early 2018. Furthermore, Washington DC's HPI troughed in 2009 and took 139 months to recover in 2020. Miami is another standout, where the metro's HPI bottomed in 2011 and recovered 119 months later in early 2021.

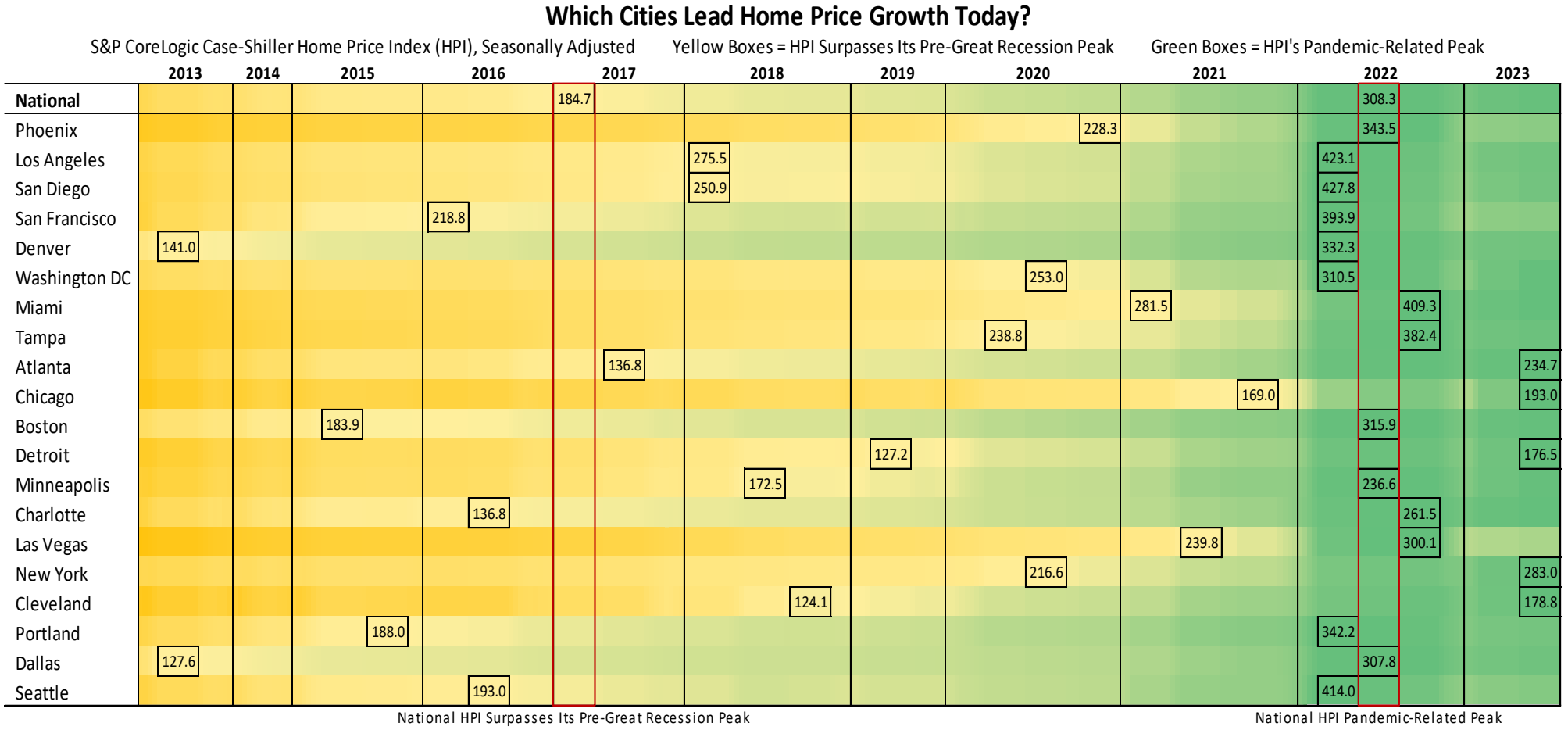
2.2 Dashboard Phase Two: The Post-Pandemic Era

Following the initial lockdowns from the COVID pandemic in early 2020, frenzied homebuying in the United States led to an acceleration in home prices. The second phase of our analysis utilizes data from 2000 to present to determine if any regional markets have seen their leading or lagging status change over the past few years. This phase's benchmark for leading and lagging markets is set at June 2022, when the national HPI reached its pandemic-related peak of 308.3. Specifically, if a metro area's HPI peaked ahead of the national HPI, then it is considered a leading market in the post-pandemic era. On the other hand, if a metro area's HPI peaked after the national HPI, then it is considered a lagging indicator or follower.

To visualize these data, Dashboard 3 (see Page 10) shows when each HPI recovered from the Great Recession, as well as data through the present day that includes the HPIs' pandemic-related peaks. As a reminder, the leader markets going into the pandemic era were Denver, Dallas, Boston, San Francisco and Charlotte. The follower markets were New York, Las Vegas, Chicago and Atlanta.

Zeroing in on the post-Great Recession leaders, the HPIs for Denver (332.3) and San Francisco (393.9) reached their pandemic-related peaks in May 2022. Dallas's and Boston's HPIs peaked in the same month as the national HPI, June 2022. Meanwhile, Charlotte's HPI peaked in July 2022. Reviewing the lagging markets, Las Vegas's HPI reached its pandemic-related peak of 300.1 in July 2022. Home prices have continued to rise in New York, Chicago and Atlanta in recent months, and the latest data show their HPIs reaching a pandemic-related peak of 283.0, 193.0 and 234.7, respectively, in May 2023.

Dashboard 3


Which Cities Lead Home Price Growth Today?
S&P CoreLogic Case-Shiller Home Price Index (HPI), Seasonally Adjusted
Yellow Boxes = HPI Surpasses Its Pre-Great Recession Peak
Green Boxes = HPI's Pandemic-Related Peak
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
National
Phoenix
Los Angeles
San Diego
San Francisco
Denver
Washington DC
Miami
Tampa
Atlanta
Chicago
Boston
Detroit
Minneapolis
Charlotte
Las Vegas
New York
Cleveland
Portland
Dallas
Seattle
184.7
308.3
228.3
343.5
275.5
423.1
250.9
427.8
218.8
393.9
141.0
332.3
253.0
310.5
281.5
409.3
238.8
382.4
136.8
234.7
169.0
193.0
183.9
315.9
127.2
176.5
172.5
236.6
136.8
261.5
239.8
300.1
216.6
283.0
124.1
178.8
188.0
342.2
127.6
307.8
193.0
414.0
National HPI Surpasses Its Pre-Great Recession Peak
National HPI Pandemic-Related Peak

The current cycle has been a much closer race than the prior cycle. Sixteen metro area HPIs peaked during May-July 2022, with the remaining four are still reaching for their zeniths. By comparison, the HPI peaks were scattered across a 24-month span (2005-2007) in the lead up to the Great Recession. Despite the close rase, we determine that Denver and San Francisco have maintained their housing market leadership status through the pandemic since their HPIs peaked ahead of the national HPI in June 2022. Furthermore, we label Dallas and Boston as coincident housing markets, as their HPIs peaked in the same month as the national HPI. Meanwhile, Charlotte's HPI has drifted toward lagging status having peaked after the national HPI in July 2022. In terms of the laggards, all four post-Great Recession followers (Las Vegas, New York, Chicago and Atlanta) have held onto their follower status.

Looking beyond our post-Great Recession leaders and followers, the HPIs for Los Angeles, San Diego, Washington DC, Portland and Seattle all peaked in May 2022—one month before the national HPI. Tampa's and Miami's HPIs both peaked one month after the national HPI (July 2022). Meantime, Detroit's and Cleveland's HPIs have seen continued growth over the past few months, with their pandemic-related peak currently showing up in May 2023.

2.3 Predicting the Next Trough

The national HPI has peaked in June 2022, and the most recent months (April and May 2023) are the first two consecutive months of negative annual growth since 2012. When will the national HPI trough? What would be the pace of recovery (i.e., weak or strong)? We believe, unfortunately, the past recent HPI recoveries may not be helpful to shed light on the near-future path of the national HPI. Specifically, one of the key drivers of home prices is the borrowing cost, such as the mortgage rate, and the borrowing cost is experiencing a structural break compared to the past two recessions. That is, the fed funds rate—a key input to overall borrowing costs—hit the zero-lower bound during the past two recessions and those episodes of the lowest fed funds are attached to the lowest mortgage rates in our sample period.

Put differently, the past two HPI recoveries benefitted from historically low mortgage rates and those benefits may be absent from the near future HPI recovery. As mentioned earlier, both the FOMC and financial market participants are forecasting rate cut for 2024, but the forecasted fed

funds rate would be higher than the highest rate of the post-Great Recession era.[2] Therefore, the mortgage rate, although likely lower than current rates, will be significantly higher than it was during the past two business cycles.

To quantify the potential path of the HPI in the near-term, we suggest that decisionmakers employ our approach. That is, decisionmakers must consider the possibility of a structural break in the behavior of metro area HPIs, as suggested by our dashboard analysis. The major benefit of the dashboard approach is that the analysis can be updated using real-time data and forecasts.

As a robustness check, we built an econometric model to estimate the potential benefits from low interest rates in the past, as well as the expected cost of the relatively higher mortgage rate today and in the near future. Precisely, we estimate the potential HPI boost from lower mortgage rates during the past two recoveries. We also estimate the potential cost (pain from relatively higher mortgage rates) by using FOMC and Bloomberg forecasts. The econometric model is discussed in Section 4, and we present a formal statistical test to examine the lead or lag relationship between metro area HPIs in the next section.

3. Regional Leaders of the National Housing Market: Granger Causality Test

For decisionmakers, there are some major benefits to identify lead/lag relationships between MSAs and the national trend. Namely, these relationships help them design effective policies to avoid a housing bubble. For example, by definition, leading MSAs will see major price swings ahead of other markets, providing a heads up on future price movement. Moreover, it is much easier to forecast the future path of an HPI for a handful of MSAs than it is to accurately predict the HPI for all MSAs. Additionally, the pace of growth of a leading MSA HPI would be a very useful indicator for the near-term boom (a significantly higher growth) or bust (negative growth rates) for other regions. In addition, decisionmakers may be able to predict whether a region's "bubble" would be replicated in other markets and spread throughout the whole country (if leading MSAs) or remain the regional phenomenon (if lagging or not leading other MSAs).

We employ the Granger causality test to verify the lead/lag relationship between MSAs and national measures of the house prices (Granger 1969). Granger causality is a statistical concept of

[2] For instance, the fed funds rate peaked at 2.50% in the post-Great Recession era, however, the FOMC's forecast put the fed funds rate at 4.6% by the end of 2024 and the Bloomberg consensus suggests 3.9%.

causality that is based on prediction (for more detail, see Greene 2011). The Granger causality test also indicates the direction of the causality, that is, whether it is a one-way or two-way causality. For instance, if X_t "Granger-causes" Y_t but Y_t does not "Granger-cause" X_t, then the relationship would be called one-way causality. On the other hand, if X_t "Granger-causes" Y_t and Y_t also "Granger-causes" X_t, then it indicates two-way causality. For instance, in the present case, we test whether the Miami HPI Granger-causes Charlotte HPI. In other words, whether the Miami HPI helps to increase the predictability of Charlotte's HPI. If we find a one-way causality from Miami's HPI to Charlotte's HPI, then that would indicate the Miami HPI is leading the Charlotte HPI. If we find no causality, then that would be a rejection of the lead/lag relationship and implies housing activities in one area may not lead the other MSAs.

Following the dashboard approach, we run the Granger causality test using two different sample periods. We first identify the leading MSAs for the post-Great Recession era using data from 2001-2016. As stated earlier, the national HPI crossed the pre-Great Recession era peak in January 2017 and thereby the 2001-2016 sample covers that period.[3] To incorporate the COVID pandemic-related structural break and to analyze which leaders survived the pandemic, we conduct the causality analysis for the complete period (2001-May 2023).

The complete Granger causality test results are in the Appendix. We place the results in the Appendix since there are 23 different HPI measures (1 national, 2 regional and 20 MSAs), and therefore 23 dependent (potential lagging) variables for our models. In the following section, we provide a summary of the causality analysis.

3.1 Regional Leaders of the Post-Great Recession Era

For the post-Great Recession era, the Granger causality results suggest that the Las Vegas, Los Angeles, Miami, New York and San Francisco HPIs lead the national HPI and most of the other MSAs. Put differently, during the 2001-2016 period, changes in these MSAs' HPIs mattered for the direction of the national and other regional housing markets. In retrospect, our results validate that a regional housing boom has the potential to become a national housing bubble (i.e., a spillover effect).

[3] Time series analysis, such as ours, usually suffer non-stationary and spurious regression when we use the level form of the variables (see Greene 2011 for more detail). Therefore, we utilize the year-over-year percent change of all HPIs in the causality analysis and start the sample period in 2001.

Another point we would like to stress is that aggregate measures of the home prices (the national, 20-City and 10-City HPIs) Granger-cause all 20 MSAs HPI. We would expect that the national HPI is a leading factor for all metro area HPIs in our sample, as the U.S. monetary policy is the same for all states and some global factory may also influences house prices in the United States. For more detail about those factors and monetary policy's role in housing market, see Vitner and Iqbal (2013).

3.2 The Post-Pandemic Era's Leaders

We repeat the causality analysis using the 2000-May 2023 data to determine if any of the metro areas' leading behavior has changed in the post-COVID pandemic era. The complete results are reported in Appendix (Table B), and here we discuss the summary of those results. Los Angeles, Miami and San Francisco maintained their leading behavior, but New York and Las Vegas failed to lead the national HPI. San Francisco's HPI is interesting in the sense that our dashboard analysis also identifies San Francisco as a leading MSA during both the post-Great Recession and post-pandemic periods. It is important to mention that the dashboard analysis uses the level form of all HPIs, and the causality analysis is based on the annual growth rates (as level form would produce spurious regression). Therefore, two different approaches could lead to two different conclusions.

We share some interesting observations about the San Francisco HPI, as it is the only MSA which shows up as a leading HPI in both approaches. In the post-pandemic era, the national HPI hit a double-digit growth rate in December 2020 and then breached 20% year-over-year growth in February 2022 for the first-time ever in our analysis. On the other hand, the San Francisco HPI hit double-digit growth in October 2020 (2-month lead time for double-digit growth), and then crossed 20% growth in April 2021. Moreover, the San Francisco HPI not only hit 20% growth 10 months before the national HPI, but it remained above the 20% line from April 2021 through June 2022. Essentially, in retrospect, a persistently strong growth in San Francisco home prices would have been an indication that the national HPI would experience a robust growth as both of our methods identify San Francisco as a leading HPI for national home prices.

We readily acknowledge that some selected leaders from the Granger causality analysis are different than those which are suggested by the dashboard approach. We do not believe it would pose an issue for analysts. On the contrary, we suggest—in some ways—causality analysis validates the dashboard conclusion. For example, the dashboards suggest a change in the behavior

of some metro area HPIs during the post-pandemic era compared to the post-Great Recession era. In other words, both analyses concluded there was a pandemic-related structural break in the behavior of some metro area HPIs. We believe that finding is crucial.

The major reasons behind the two different lists of leaders are that the dashboard approach is based on the level form of the HPIs and is a specific point-in-time analysis. That is, an MSA is a leader if its HPI peaked before the national HPI's June 2022 peak, for example. On the other hand, the Granger causality test employed growth rates (year-over-year percent change) of HPIs to avoid the spurious regression issue, as mentioned earlier. Moreover, the causality analysis utilizes the complete sample period (for example, the 2001-May 2023 period) and concluded that, on average, a particular metro area's HPI is a leader. In other words, we are talking about a point in time (dashboard approach) versus an average relationship for a certain sample period (the Granger causality test). Naturally, two different approaches are associated with two different sets of results.

We believe both approaches complement each other, as analysts may want to test the historical average relationship and then check it against a point in time leader. Moreover, some metros may experience stronger year-over-year growth than the national HPI. In an ideal world, we want a similar leading MSA—such as San Francisco—to show up in both lists, however, in the present case, we have two lists. Therefore, for decisionmakers who focus on near-term housing activities, a point in time approach may carry a higher weight and that would favor the dashboard approach.

4. Is This Recession Different for the Housing Market?

As stated earlier, the national HPI peaked in June 2022 and the most recent HPI noted a negative growth rate, which raised questions about the next trough as well as the pace of the HPI recovery. Moreover, financial market participants are forecasting a recession and corresponding rates cuts by the FOMC sometime in 2024. The most recent projections by the FOMC suggest no recession but rates cut in 2024.[4] Essentially, both entities agree that rates cut are coming and the FOMC's projection for year-end 2024 is 4.6%. The Bloomberg consensus expects a 3.9% fed funds rate by the end of 2024. The past two recessions were associated with rate cuts as well as some of the lowest mortgage rates in our analysis. The fed funds rate is a key input to borrowing costs in the

[4] The June summary of economic projections (June SEP) from the FOMC.

economy at large, and the mortgage rate is a major driver of the HPI (for more detail, see Vitner and Iqbal 2013).[5]

We believe the current cycle is different than the past two recessions and relying on the experience to project HPI recovery would be misleading. Indeed, the current cycle experienced a structural break and due to that break past relationships need to re-evaluate. Put differently, we suggest that the current cycle poses classic Lucas' critique challenge for decisionmakers (Lucas 1976). Simply put, Lucas's critique indicates when the underlying parameters (relationship) of a model change—due to a structural break—then decisionmakers should not utilize that model for policy decisions. The current cycle's higher inflation differentiates it from the past two recessions. Moreover, the Federal Reserve Chair Jerome Powell has repeatedly said that the FOMC is planning to keep interest rates higher for longer period to bring inflation down to the 2% target. On the other hand, the fed funds rate hit the zero-lower bound in December 2008 and the mortgage rate dropped below 4% in 2012, first time in our analysis of 2000-2023 period. The FOMC brought the fed funds to zero-lower bound again in 2020 and the mortgage rate hit all-time low (in our analysis) of 2.74% in Q4- 2020.

Moreover, with the FOMC's July 2023 meeting's rate hike, the fed funds hit the highest level since Q4-2000 and mortgage rate jumped to 6.71%, highest since Q1-2002. Therefore, the current cycle may have lost one key benefit of the lower mortgage rate. That is, during the past two recessions, the HPI benefited from the lowest mortgage rate and current cycle's rates cut may not be enough to kick start the HPI recovery, in our view.

Precisely, we built an econometric model to quantify potential benefits for the HPI from the lower mortgage rates of the past two recessions. By the same token, we estimate the potential cost (pain) for the current cycle's HPI from the expected relatively higher mortgage rates. We utilize the year-over-year percent change in the national HPI as our dependent variable along with three independent variables. The real GDP growth rate is included to capture business cycles properties and housing starts as a proxy for the housing supply. The average 30-year conventional mortgage rate (the mortgage rate) is our shock variable in the sense we estimate the potential monetary policy

[5] Bernanke (2010) and Greenspan (2010) also provided detail background about the monetary policy and housing sector relationship.

effect on the HPI through the mortgage rate.[6] As aforementioned, the fed funds is a key input to the mortgage rate and thereby we can utilize the mortgage rate as a proxy to capture changes in the monetary policy/fed funds rate.

For the model's estimation, we utilize a quarterly dataset for the 2000-2019 period. We ended our estimation period in Q4-2019 to avoid the COVID pandemic related volatility, particularly the GDP volatility.[7] Moreover, the model selection criterion—the Schwartz information criterion—suggested that the lag of the mortgage rate is a better predictor of the HPI compared to the current form of the mortgage rate.[8] The estimated coefficients of our model are follows and all coefficients are statistically significant at 1% level of significant.

$$HPI_t = -3.9297 + 1.0786\ \text{RealGDP}_t + 0.0112\ \text{HousingStarts}_t - 1.5728\ Mortgage_{t-1} \quad (1)$$

The coefficients' signs are expected as positive GDP and housing starts boost HPI growth and a higher mortgage would put downward pressure (-ve sign) on the HPI. Specifically, a one percentage point increase in the mortgage rate would reduce HPI growth by 1.57 percentage point, all else equal.

4.1 Estimating the Benefit/Cost of Changes in Monetary Policy Stances on Housing Market

In the next step, using the above model, we estimate the effect of changes in monetary policy stances on the HPI growth. In particular, the effects are estimated for the past two cycles as well as we project the cost/pain for 2024. Table 1 provides some useful statistic about the fed funds rate (a proxy for the monetary policy), the mortgage rate (30-year conventional mortgage rate) and the spread between the mortgage rate and the fed funds rate. The spread is a crucial input for the near-term (2024) analysis as we are going to use the FOMC as well as Bloomberg's 2024 Fed funds forecast to construct mortgage rate for 2024. That is, the mortgage rate is our shock variable in the

[6] The mortgage rate is a shock-variable and the real GDP as well as housing starts are control-variables. That is, we will change the mortgage rate to estimate the effect of the monetary policy on the HPI, all else equal. Put different, at given GDP and housing starts what would happen to the HPI when the FOMC changes the fed funds rate.
[7] The real GDP growth experienced unprecedented numbers during 2020 and those outliers would pose issues to the estimation process. Therefore, to avoid those outliers we ended the estimation period in Q4-2019.
[8] The model with a lagged mortgage rate produced a lower Schwartz information criterion (SIC) value than the one with current form of the mortgage rate. A model with the lower SIC value is better than a model which attached to a higher SIC value, see Greene (2011) for more detail about the model selection criterion such as the SIC.

model, and we have actual mortgage rates for the past two cycles, and we need to project mortgage rate for 2024.

For example, the average fed funds rate for the 2000-Q2:2023 period is 1.8% and 5.09% for the average mortgage rate for the same period, Table 1. The average spread for the same period is 3.29% and one possible way to estimate the 2024 mortgage rate is to add the spread in the FOMC's fed funds forecast of 4.6% and that would generate 7.89%. The mortgage rate at 7.89% seems high but not the highest in our sample period, in fact the highest number is 8.29% (Q2-2000). From Table 1, the spread is different for different periods with a range of 1.55% to 4.88%. Typically, the spread widens during an accommodative policy stance and narrows during rate hikes. For example, in the current cycle, the spread reduced to just 1.55% (Q2-2023) from Q4-2021 level of 2.96%.[9] Therefore, an average spread value may not depict a true picture of the expected cost for the 2024 HPI. The other options are the 2012 spread which is 3.15% and the mortgage rate hit its lowest level (at the time in our sample) or 2.49% spread for the 2020. Again, the 2020 experienced the lowest mortgage rate (at just 2.74%) in our analysis.

Table 1

Time Period	Fed Funds Rate (FFR) %	Mortgage Rate %	Spread (Mortgage - FFR) *Percentage Points*
Average (2000-2023)	1.80	5.09	3.29
Average (2009)	0.25	5.13	4.88
Lowest Mortgage (2012)	0.25	3.40	3.15
Average (2020)	0.50	3.10	2.60
Lowest Mortgage (2020)	0.25	2.74	2.49
FOMC's FFR 2024 forecast*	4.60	**6.15**	1.55
Bloomberg's FFR 2024 forecast**	3.90	**5.45**	1.55

Note: The Q2-2023 spread between the mortgage rate and FFR is 1.55%. We use that spread to project the mortgage rate for 2024. We choose 1.55% because it is the lowest spread in our analysis.
*The FOMC's year-end 2024 FFR forecast is 4.60 + 1.55 = 6.15
**Bloomberg's 2024 FFR forecast is 3.90 + 1.55 = 5.45

To calculate the mortgage rate for 2024 we use a spread value of 1.55% which is the latest available data (Q2-2023). Yes, that value is the lowest spread value in Table 1 and that also means the estimated cost for 2024 would be at the lower end. As the mortgage coefficient sign is negative (equation 1) and thereby a lower mortgage rate would boost HPI growth, all else equal. For

[9] It is worth mentioning that the spread started to widen with beginning of the accommodative policy stance and peaked sometime either toward the end of the accommodative policy period or beginning of the policy normalization. For example, the spread peaked at 4.5% in Q2-2022 (beginning of the current policy tightening cycle) but Q2-2009 was the peak date for the Great Recession.

example, the average spread value of 4.88% suggested mortgage rate of 7.89% when we use the FOMC's 2024 fed funds forecast. However, the 1.55% spread value reduces that number to 6.15% using the FOMC forecast and 5.45% based on the Bloomberg consensus projection (Table 1) and thereby lowers the estimated 2024 cost. Essentially, we suggest that our estimated cost is minimum given the latest available spread value along with the FOMC fed funds forecast. Moreover, given the average spread is higher and spread tends to widen during the rate cut environment and we suggest there is upside risk to our estimated 2024 cost. The nice part of our analysis is that analysts can update the cost using the updated FOMC/Bloomberg (or their own) fed funds forecast along with the spread value.

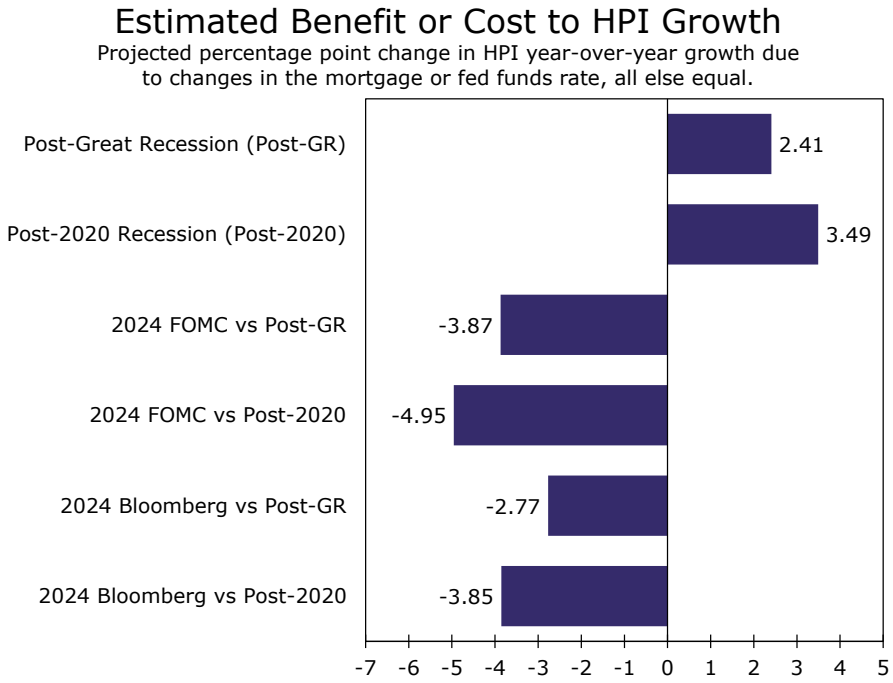
The mortgage rate is our shock variable to estimate the potential effect of the monetary policy on the HPI and we now have mortgage rates for the post-Great Recession era, 2020 recession as well as for the 2024 (based on the FOMC and Bloomberg fed funds forecasts). For the 2020 recession, we use the mortgage rate of 3.0% which is the average of 2020. During the post-Great recession era, Q2-2012 noted the first positive HPI growth and thereby we are using average of Q2:2012-Q1:2013 mortgage rates (3.69%). For 2024, we have two different numbers and one of them is based on the FOMC's fed funds forecast and the other is constructed using Bloomberg consensus. The Bloomberg consensus-based number is 5.45% as the consensus expects more rate cuts than the FOMC's projection (6.15% for the FOMC forecast).

Figure 1 showed results based on the model, where a positive number such as 2.41 for the post-Great Recession era indicates that the HPI growth rate benefitted from the lower mortgage rate by 2.41 percentage point, all else equal. On the other side, the FOMC's forecast based mortgage rate reduced (cost) the HPI growth rate compared to the post-Great Recession era by 3.87 percentage point, ceteris paribus. The 2020 recession benefitted the most (3.49 percentage point) which is not surprising as the mortgage hit the lowest number in 2020. If the FOMC's 2024 fed funds forecast turns out to be accurate (along with the spread number) then fate of the HPI recovery is in peril as our model suggest the largest cost, a 4.95 percentage point reduction in the HPI growth due to the higher mortgage rate. Bloomberg consensus-based number is -3.85 (still growth reduction) but smaller cost compared to the FOMC's based pain.

A quick note about the background of these estimates. As mentioned earlier, the key input of our model is the mortgage rate and the 2024 mortgage rate is based on the fed funds (the FOMC and

Bloomberg consensus) forecast and on the spread. Naturally, if the spread and/or the fed funds forecast change then the 2024 cost would change. The second element of the estimated benefit/cost is a benchmark (or a base case) and for the post-Great Recession and 2020 recession the benchmark is the average mortgage rate.[10]

Figure 1



That is, the average mortgage rate for the 2000-Q2:2023 period is 5.22% and if we plug in that number (along with average values for the GDP and housing starts) in the Equation-1 then the estimated HPI growth is 4.28% (slightly different than the actual average growth number of 4.17%). Thereby, our base-case (or benchmark) is the estimated average HPI growth using the average mortgage rate (and GDP/housing start). In the second step, for the post-Great Recession era, we plug-in the average mortgage rate of Q2:2012-Q1:2013 period which is 3.69%. (Q2-2012 was the first quarter of positive HPI growth during the post-Great Recession era). The second step generates HPI growth rate of 6.69% and that is 2.41 more than the base-case and thereby benefit of 2.41 percentage point. Since we kept all else equal (GDP and housing starts), the boost in the

[10] Since GDP and housing starts are our control variables and we use average of the 2000-2023 period for those variables. Moreover, the GDP and housing starts values remain constant in all simulations and thereby all changes in the HPI are solely because of the changes in the mortgage rate. Therefore, all else equal, a one percentage point increase in mortgage rate would reduce HPI growth by 1.57 percentage point.

HPI growth is due to the lower mortgage rate and lower fed funds rate (a proxy for the accommodative monetary policy) is the key driver of the lower mortgage rate. Therefore, we labeled 2.41 percentage point benefit from the accommodative policy stance. We repeat the process for the 2020 recession and use average mortgage rate of 2020 which 3%.

For the 2024 analysis we use two different benchmarks and the first is the Great Recession and the other one is the 2020 recession. The reason to utilize those benchmarks instead of the average mortgage rate is that we are comparing this cycle's easy policy (rate cuts) to the past two cycles' easy policy. In other words, is this cycle different from the past two cycles? Using those cycles would help us to estimate the potential cost for the current cycle as the monetary policy (mainly due to the higher inflation) is different than the past two cycles. For instance, using the FOMC 2024 fed funds forecast, when we plug in the estimated mortgage rate of 6.15% in the Equation-1 then the estimated HPI growth for 2024 is just 2.82% which is 4.95 percentage point lower than the 2020 recession's HPI growth of 7.8%. Therefore, the estimated cost for 2024 compared to the 2020 recession is 4.95 percentage point lower HPI growth.[11] Put differently, the upcoming recession (according to the Bloomberg forecast) and/or rate cuts era (using the FOMC forecast) would be different for the HPI growth compared to the past cycle's rate cuts.

To estimate the 2024 cost compared to the post-Great Recession era, we compare the estimated HPI growth of 2.82% to the 6.69% growth of the post-Great Recession era and thereby a cost of 3.87 percentage point lower HPI growth. We repeat the process for the Bloomberg consensus-based mortgage rate of 5.45% and the estimated cost are -3.85 and -2.77 for the 2020 and the Great Recession, respectively,

Summing up, the national HPI growth rate turned negative in recent months and with expectations of rate cuts by the FOMC in 2024, the natural option is to look at past easing cycles to gauge the near-term outlook for the housing market. Our work contradicts that notion by quantifying the effect of the easing cycles (past and potential future) on the HPI growth. It seems the past cycles' benefits are long gone, and current cycle's higher inflation is dictating the historical elevated interest rates, which stands contrast to the past two cycles' ultra-low rates. Our work cautions decisionmakers that the upcoming easing cycle would be different for the housing market.

[11] It is worth mentioning that the estimated HPI growth is 1.46 percentage point lower than the average estimated HPI growth. Therefore, it is still a cost but lower compared to the last recession.

5. Concluding Remarks: This Time Seems Different for Housing Market

Our study analyzes HPIs to determine which regional housing markets depict a leading or lagging behavior overtime. We employ a few dashboards to succinctly visualize HPI trends by metro area. The analysis is split into two phases; the first phase focuses on the post-Great Recession era, and the second phase focuses on the post-COVID pandemic era. We use two dashboards in first phase; Dashboard 1 shows each metro area's HPI trough from the fallout of the Great Recession, while Dashboard 2 shows when each metro area's HPI recovered back to (or surpassed) its pre-Great Recession peak. We designate a metro area as a leading indicator of the national housing market if its HPI troughs *and* recovers to its pre-Great Recession peak before the national HPI. On the flip side, a metro area's HPI that troughs *and* recovers after the national HPI is considered a lagging indicator or follower. Denver, Dallas, Boston, San Francisco and Charlotte were leaders during the post-Great Recession era, and New York, Las Vegas, Chicago and Atlanta were the followers.

The second phase of our dashboard analysis utilizes data from 2000 to present to determine if any regional markets have seen their leading or lagging status change in the pandemic era. Specifically, if a metro area's HPI peaked ahead of the national HPI in June 2022, then it is considered a leading market in the post-pandemic era. On the other hand, if a metro area's HPI peaked after the national HPI, then it is considered a lagging indicator or follower. Denver and San Francisco maintained their leadership status, while Dallas and Boston became coincident markets and Charlotte drifted toward lagging. Meantime, all four post-Great Recession followers (Las Vegas, New York, Chicago and Atlanta) held onto their follower status in the post-pandemic era.

The Granger causality test confirms that there was a structural break in some of the metro area HPIs following the 2020 recession. We suggest that the dashboard and Granger causality approaches complement each other. For instance, we can test the historical average relationship with the help of the causality test and then validate a point-in-time leader using the dashboard measure. Moreover, an MSA may experience stronger growth than the national HPI, and that is a potential leader in terms of growth rates. The San Francisco HPI is the only MSA which shows up as a leading HPI in both approaches. In the post-pandemic era, the national HPI hit a double-digit growth rate in December 2020 and then breached 20% growth in February 2022 for the first-time ever in our analysis. Notably, the San Francisco HPI hit double-digit growth in October 2020 (2-month lead time for double-digit growth), and then crossed 20% growth in April 2021. Moreover,

the San Francisco HPI not only hit 20% growth 10 months before the national HPI, but it remained above the 20% line from April 2021 through June 2022. In retrospect, a persistently strong growth in San Francisco home prices would have been an indication that the national HPI would experience a robust growth as both of our methods identify San Francisco as a leading HPI for national home prices.

We conclude the analysis by estimating the effects of past recessions, and their corresponding monetary policy easing cycles, on the HPI growth. Using the FOMC's projections and the Bloomberg consensus forecast for year-end fed funds rate, we estimate the effect of the potential upcoming recession and easing cycle on the housing market. Our analysis suggests that the 2020 recession benefitted the most (3.49 percentages point higher HPI growth) from low interest rates, which is not surprising given the average 30-year mortgage rate hit a record low in 2020. The post-Great Recession era HPI growth benefitted from the lower mortgage rate as well by 2.41 percentage points. On the other end of the spectrum, based on the FOMC's 2024 fed funds rate forecast, our model suggests the largest cost of a 4.95 percentage point reduction in the national HPI's annual growth due to elevated mortgage rates. The estimate predicated on the Bloomberg consensus forecast is a 3.85 percentage point reduction in national home price growth, but that is still a smaller cost compared to the FOMC-based estimate.

In conclusion, the national HPI growth rates turned negative in recent months, and with expectations of rate cuts by the FOMC in 2024, some analysts may look at the past easing cycles to gauge the near-term outlook for the housing market. Our work contributes to existing literature by quantifying the effects of monetary policy easing cycles (past and potential future) on the HPI growth. It seems the past cycles' benefits are long gone, and the current cycle's higher inflation is dictating historically elevated interest rates, which stands in contrast to the past two cycles' ultra-low interest rates. Our analysis cautions decisionmakers that this housing market is different.

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Appendix

Complete Granger Causality Test Results

The complete results based on the Granger causality are reported in Tables A & B. Given the large number of HPIs, we split results of each sample period in Part-1 and Part-2. That is, Table-A is based on the 2001-2016 period (the post-Great Recession era) and results based on the 2001-May 2023 (the post-Pandemic era) are reported in Table-B.

From Table-A, Part-1, the top row indicates the dependent variable, the national HPI is the first dependent variable followed by the 20-City HPI. There are 23 different HPIs (3 national/aggregate and 20 MSAs measures of house prices) and therefore 23 dependent (potential lagging) variables for our models. The first column from the left indicates the independent (or potential leading) variables. For example, the first dependent variable is the national HPI (first variable of the top row) and the first variable in the left column is also national HPI. Since we cannot estimate a model which has one dependent variable and the same independent variable, the second cell of the second row/second column is empty. The third cell of the second row/third column says "Yes" which indicates the national HPI Granger-causes 20-City HPI (20-City is the dependent variable). Furthermore, in the Table, "Yes" indicates the causality/leading and "No" indicate no-causality (not leading).

The Leaders of the Post-Great Recession Era

Table-A: Part-1: The Granger Causality Test Results for the 2001-2016 Period

	National	20-City	10-City	Atlanta	Boston	Charlotte	Chicago	Cleveland	Dallas	Denver	Detroit	Las Vegas
National		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
20-City	*Yes*		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
10-City	*Yes*	*Yes*		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Atlanta	*No*	*No*	*No*		*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*
Boston	*No*	*Yes*	*No*	*Yes*		*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
Charlotte	*No*	*Yes*	*No*	*Yes*	*Yes*		*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
Chicago	*No*	*Yes*	*No*	*No*	*Yes*	*Yes*		*Yes*	*No*	*No*	*Yes*	*Yes*
Cleveland	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*Yes*		*Yes*	*No*	*No*	*No*
Dallas	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*		*No*	*Yes*	*Yes*
Denver	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*		*Yes*	*Yes*
Detroit	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*	*No*		*Yes*
Las Vegas	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	
Los Angeles	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Miami	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Minneapolis	*No*	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*No*	*No*	*Yes*	*No*
New York	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*
Phoenix	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*
Portland	*Yes*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
San Diego	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
San Francisco	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Seattle	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Tampa	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
D.C.	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*

Table-A: Part-2: The Granger Causality Test Results for the 2001-2016 Period

	Los Angeles	Miami	Minneapolis	New York	Phoenix	Portland	San Diego	San Francisco	Seattle	Tampa	D.C.
National	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
20-City	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
10-City	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Atlanta	*No*	*No*	*No*	*No*	*No*	*Yes*	*No*	*No*	*Yes*	*No*	*No*
Boston	*Yes*	*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*
Charlotte	*No*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*
Chicago	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*No*	*Yes*
Cleveland	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
Dallas	*Yes*	*No*	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*
Denver	*Yes*	*No*	*Yes*	*No*	*No*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*
Detroit	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*
Las Vegas	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Los Angeles		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Miami	*Yes*		*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
Minneapolis	*No*	*No*		*No*	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*No*
New York	*Yes*	*No*	*Yes*		*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
Phoenix	*Yes*	*Yes*	*Yes*	*No*		*Yes*	*No*	*Yes*	*No*	*No*	*No*
Portland	*Yes*	*Yes*	*Yes*	*No*	*Yes*		*No*	*No*	*Yes*	*Yes*	*No*
San Diego	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*		*Yes*	*No*	*Yes*	*Yes*
San Francisco	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*		*Yes*	*Yes*	*Yes*
Seattle	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*No*		*Yes*	*No*
Tampa	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*		*Yes*
D.C.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	

Note: According to the Granger causality test analysis, highlighted MSAs are the regional leaders of the national market

The Post-Pandemic Era Leaders

Table-B: Part-1: The Granger Causality Test Results for the 2001- May 2023 Period

	National	20-City	10-City	Atlanta	Boston	Charlotte	Chicago	Cleveland	Dallas	Denver	Detroit	Las Vegas
National		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*No*
20-City	*Yes*		*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*
10-City	*Yes*	*Yes*		*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*
Atlanta	*No*	*No*	*No*		*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*
Boston	*No*	*Yes*	*No*	*Yes*		*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
Charlotte	*No*	*Yes*	*No*	*Yes*	*Yes*		*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
Chicago	*No*	*Yes*	*No*	*No*	*Yes*	*Yes*		*Yes*	*No*	*No*	*Yes*	*Yes*
Cleveland	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*Yes*		*Yes*	*No*	*No*	*No*
Dallas	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*		*No*	*Yes*	*Yes*
Denver	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*		*Yes*	*Yes*
Detroit	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*	*No*		*Yes*
Las Vegas	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	
Los Angeles	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Miami	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
Minneapolis	*No*	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*No*	*No*	*Yes*	*No*
New York	*No*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
Phoenix	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*
Portland	*Yes*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
San Diego	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
San Francisco	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Seattle	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Tampa	*No*	*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
D.C.	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*

Table-B: Part-2: The Granger Causality Test Results for the 2001-May 2023 Period

	Los Angeles	Miami	Minneapolis	New York	Phoenix	Portland	San Diego	San Francisco	Seattle	Tampa	D.C.
National	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*
20-City	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
10-City	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*
Atlanta	*No*	*No*	*No*	*No*	*No*	*Yes*	*No*	*No*	*Yes*	*No*	*No*
Boston	*Yes*	*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*
Charlotte	*No*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*Yes*	*Yes*
Chicago	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*	*No*	*No*	*Yes*
Cleveland	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*No*
Dallas	*Yes*	*No*	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*No*	*Yes*
Denver	*Yes*	*No*	*Yes*	*No*	*No*	*Yes*	*No*	*No*	*No*	*Yes*	*Yes*
Detroit	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*
Las Vegas	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Los Angeles		*No*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Miami	*No*		*No*	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
Minneapolis	*No*	*No*		*No*	*No*	*No*	*No*	*Yes*	*Yes*	*No*	*No*
New York	*Yes*	*No*	*No*		*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*Yes*
Phoenix	*Yes*	*Yes*	*Yes*	*No*		*Yes*	*No*	*Yes*	*No*	*No*	*No*
Portland	*Yes*	*Yes*	*Yes*	*No*	*Yes*		*No*	*No*	*Yes*	*Yes*	*No*
San Diego	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*		*Yes*	*No*	*Yes*	*Yes*
San Francisco	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*		*Yes*	*Yes*	*Yes*
Seattle	*Yes*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*	*No*		*Yes*	*No*
Tampa	*No*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*		*Yes*
D.C.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	

Note: According to the Granger causality test analysis, highlighted MSAs are the regional leaders of the national market