Impact of Remote Work on Regional Affordability

by Arun Suresh, Nick Wheatley and James Conner

Objective of Analysis

The goal of this analysis is to highlight the impact that remote work has had on regional affordability in the past two years. While remote work has been a feature of corporate workplaces for decades, it has not been historically common. The COVID-19 pandemic dramatically changed the face of remote work in the United States within a few short months, due to prohibitions placed on gathering in public spaces.

As companies and the workforce adapted to remote work as a primary mechanism of employment between 2020 and 2022, many well paid professionals were no longer tied to short commutes to the office (Coate 2021).

This led to an exodus from the high home value city centers to the more reasonably priced suburbs exurbs, which has had a side effect of increasing exurb median home values due to surging market demand (Markarian 2021).

Motivation

The purpose of this report is to analyze the effect on affordability caused by this migration from city center to exurb counties between 2020 and 2022. We will demonstrate this effect using an Affordability Index, comprised of income, home values, and utility costs per county in the United States. This index will then be used to create a national analysis, as well as a regional analysis for two large city centers.

The value of this analysis is in identifying the trend that remote work and the resulting metro center exodus has had on exurb communities and city cores, from the perspective of a potential home buyer. Using the data, notebooks, indexes and methods of analysis we have comprised in this project, readers can analyze any county of interest for their own needs.

Regional Concentration

The two regions that have been selected for our analysis are the San Francisco Bay area, and the New York City metropolitan area. These two metropolitan areas are classic examples of high cost city centers with a high concentration of professionals, and exhibit the “donut effect” (Ramani & Bloom 2021).

Remote Work by the Numbers:

In 2009, full time remote workers comprised 4% of the US workforce, which increased to 6% by 2019. By May 2020, that figure increased to an average of 35% of the US workforce. For professional and managerial roles, the number was substantially higher than the average at 57% (Lund et al. 2020).

Data Manipulation

Overall Data Sources and Scope

Manipulation

Three main datasets were used for our analysis. **Zillow's** *ZHVI* dataset contained typical monthly home values per county going back to 2000. Since our focus was on the impact of the COVID-19 pandemic on housing, we condensed our timeframe to 2016-2022. Before doing so, we melted our data since it was in wide-format, with each year as a separate column. We did this to ease our groupby on County, State, Year and aggregate the Home Value field by taking its median. **Equifax** provided utilities data such as gas and electricity for the years 2022 and 2027. We summed all the utilities to create a total utility cost field. Since only 2022 and 2027 data was provided, we backwards interpolated (took the difference of 2027 and 2022) on the 2017 to 2022 data to ensure utilities comparisons were possible across all years measured. Finally, **ACS** (American Community Survey) provided census data such as household income per county. Each **ACS** year was downloaded as it's own CSV file, from 2016 to 2021, so we concatenated each file to create one dataframe. **ACS** data was in wide format with each county as a column so we melted the data to ease with merging. Missing rows were dropped from each dataset as they composed a small percentage of the overall data. We merged (using an outer join) our datasets on County, State, and Year for the purpose of our analysis. Each dataset is linked in the table on the right.

	Format	Rows	Cols	Size	Years	Fields
Zillow	CSV	2843	284	4.9MB	2016-2022	Median Home Value, State, County, Year
Equifax	Excel	6284	24	1.2MB	2022, 2027	Total Utility Costs, Median Household Income, State, County, Year
ACS	CSV	17386	4	1.9MB	2016-2021	Median Household Income, State, County, Year

Data Issues, Assumptions & Limitations

Inconsistency with County names across each dataset resulted in missing county codes (needed for our choropleth visuals) so we had to manually fix County names across each dataset to ensure parity. E.g. "De Witt" county in Illinois fixed to "DeWitt". Since **Equifax** only provided 2022 utilities data and its 2027 projections, we are assuming those same projections can work backwards as we interpolated 2017 to 2021 utilities data using assumed linear increases each year from 2022 to 2027. The datasets had quite a few missing counties. Around 2800 counties were represented after the final merge, and roughly 500 were missing. This resulted in gaps in rural areas (as shown as empty/colorless areas in our national choropleth visual). Our analysis only operates on county, not zip, therefore there is much less granularity in our results.

Data Manipulation

Building the Indexes

Indexing to Filter External Factors

With an objective of assessing each region's affordability across the US, several systemic factors could muddy the results:

- Inflation
- Interest rate housing impact
- Minimum wage increases

A relative index taken each year filters these factors by considering the total cohort. Systemic changes such as inflation would be consistent across the regions, thus not impacting the index.

Total regional affordability could be determined by combining **income**, **utility cost**, and **housing cost** component indexes into one composite **affordability index**.

Index Composition

The sub-indexes used the following variables:

Income Index: Median Household Income
Housing Index: Median Home Value
Utility Index: Total Utility Cost

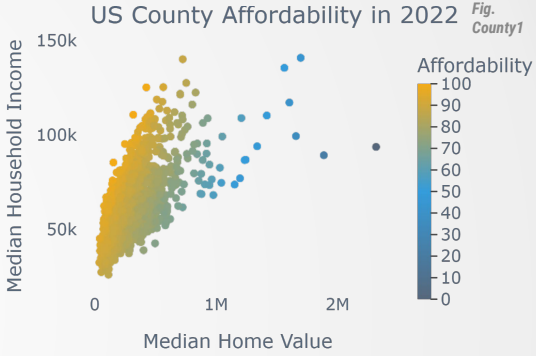
The indexes are calculated using min-max normalization scaling (Gupta 2021) as shown below:

$$z_i = \frac{(x_i - \min(x))}{(\max(x) - \min(x))} * 100$$

Where z is the index, i is a region, and x is an index variable. Cost-based indexes invert the index by subtracting it from 1.

The Affordability Index rates affordability based on the value of its component indexes (Figure County1). It is a weighted average of its components:

- Income Index (**25%**)
- Housing Index (**70%**)
- Utility Index (**5%**)



Data Sources: Equifax Utilities from Gale Business DemographicsNow, ACS 5 Yr from Census.gov, Zillow Home Index Value from Zillow.com
Data Collected in Jan 2023 | Visualizations via Plotly 5.10.0 in Feb 2023

Parquet Data Output

Final data output was stored in parquet files to be used in the analysis. Parquet was selected because, when compared to CSV, parquet files preserve column data types and read and write faster, especially when compression is enabled (Som 2022).

National Analysis

A View on National Housing Affordability

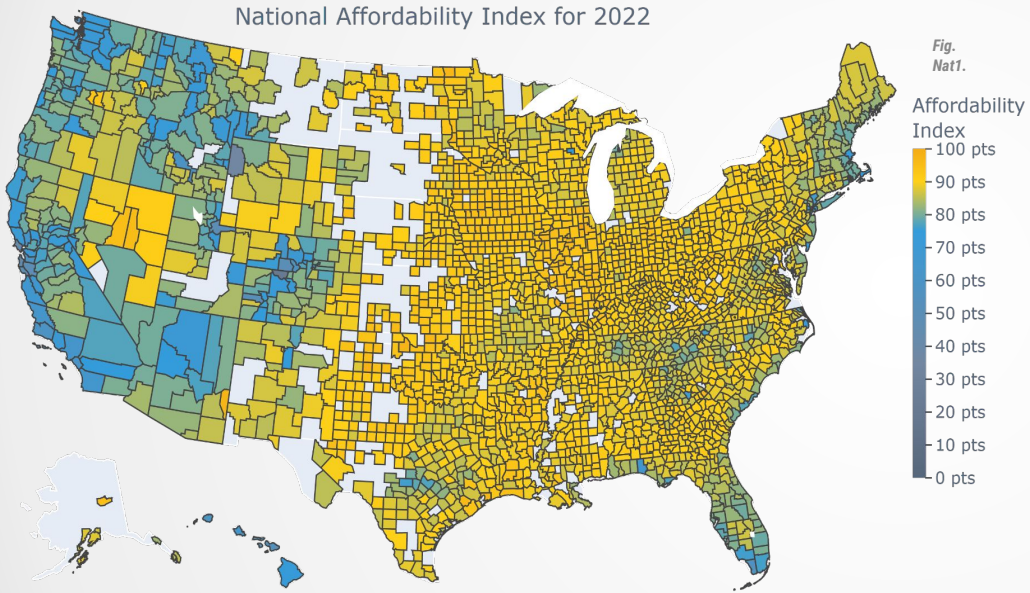


Fig. Nat1.

Data Sources: ACS 5 Yr from Census.gov, Equifax Utilities from Gale Business DemographicsNow, and Zillow Home Index Value from Zillow.com | Data Collected in Jan 2023 | Visualizations via Plotly 5.10.0 in Feb 2023

Snapshot of Nationwide Affordability Index in 2022:

Based on Fig Nat1. we can see that for 2022, much of the areas surrounding large metro areas, the coastlines, and the West appear to be less affordable as indicated by the blue/green shade compared to the more rural middle, where affordability is high (more yellow).

California, for instance saw **9 counties gain more than 250K in median home value between 2020 and 2022**. As a comparison, these same 9 counties saw at a **maximum a $167K bump in median home value between 2017 and 2019**.

These counties fall into two main categories: **the suburban/exurban communities of large metro areas** such as Marin County (around San Francisco) or **retirement/vacation locales** such as Maui, Hawaii or Teton, Wyoming.

We can posit that outward movement from large metro areas had a strong influence on national real estate trends based on the spike in median home values between 2020 and 2022.

National Analysis

How affordability changed from 2020 to 2022

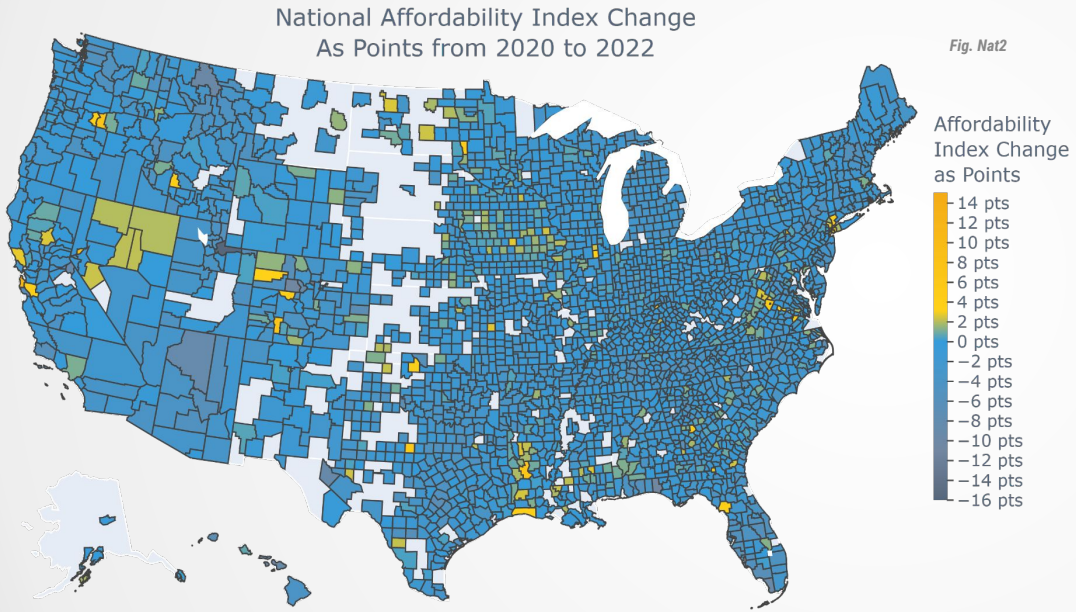


Fig. Nat2

Data Sources: ACS 5 Yr from Census.gov, Equifax Utilities from Gale Business DemographicsNow, and Zillow Home Index Value from Zillow.com | Data Collected in Jan 2023 | Visualizations via Plotly 5.10.0 in Feb 2023

Snapshot of Change in Nationwide Affordability

Based on the 2020 to 2022 change in national affordability index as shown in Fig. Nat2, we can see that the **vast majority of counties did not change all that much and only got marginally expensive** as most of the landscape is blue.

Even with that being said, **only 6 counties decreased in median home value from 2020 to 2022**. The areas in yellow saw large increases in affordability, and these areas surround major metro areas where an exodus of remote workers would move out of. In 2020, Suffolk County, where the Boston metro is, had a median home value of $597K, about **$35,000 more than the next highest surrounding county**.

However, in 2022, the average median home value of the surrounding counties of Suffolk County, **increased by $143K**, well above Suffolk County's **increase in median home value of $88K**. We believe much of that is the donut effect in action.

Next, we'll look at SF and NYC in detail.

New York City Metropolitan Area

A Visualization of Index Changes - The Donut Effect

Identifying the Donut Effect

With the global trends towards urbanization (Ritchie & Roser 2018) , demand for housing historically outstripped supply in urban locations, driving higher home values as a general rule. The traditional advantages for living in cities (entertainment, amenities, career opportunities) were largely nullified during the COVID-19 pandemic in 2020 (Coate 2021), which induced a radical change in modern workplace behaviors, with **57% of all professionals** in the US participating in remote work by May 2020 (Lund et al. 2020), only 4 months after initial shutdowns due to the outbreak.

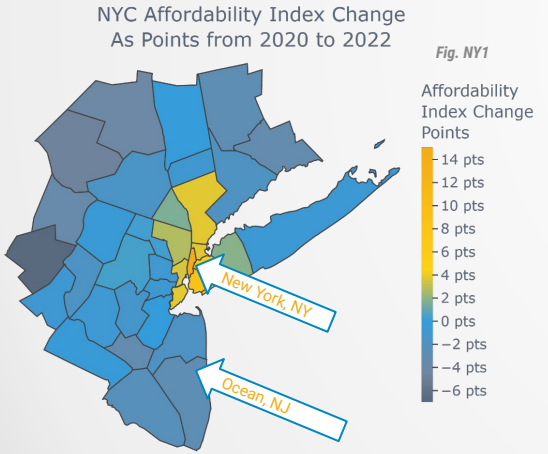


Fig. NY1

Data Sources: Equifax Utilities from Gale Business DemographicsNow, ACS 5 Yr from Census.gov, Zillow Home Index Value from Zillow.com
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The trend of **soaring prices in metro locations**, with suburbs as the reasonably priced alternative began to **invert in 2020**, with well paid professionals **migrating from the city centers** to the more reasonably priced exurbs due to this change in work patterns. This has a dual effect of dramatically driving up costs in the exurbs, as well as seeing prices drop in the city centers.

To illustrate the concept of the donut effect, **Figure NY1** depicts the difference in the Affordability Index (AFI) between the years of 2020 and 2022. The darker areas of the diagram represent a decrease in affordability with a negative loss in points, while the lighter color areas indicate a gain in affordability. The **affordability of New York county, NY** had the highest amount of improvement in the NYC metro area with over **14 affordability points gained in those two years**, putting it in the **85th percentile of improvement** nationwide. The counties immediately surrounding New York county also experienced gains in affordability, generally improving by 2 to 10 points, while the exurb counties have decreases in affordability, with even already relatively expensive locations like **Ocean County, NJ** experiencing a **-3 point change** to its index score (Fig. NY1).

This isn't to say that New York is now "inexpensive", only that is it more affordable in 2022 than it was in 2020. To see the dollar figures, we next need to look at the Median Home Values for the area.

New York City Metropolitan Area

Visualizing Home Values and Household Income

Changes to Household Income

The major sources for changes to our Affordability Index are Household Income and Home Value. For the **NYC region**, an analysis of **Income** revealed that it was **mostly flat**, with an **average $2k increase** across all counties. One major outlier of note was **Monroe, PA**, with a **loss of -$6.7k** between 2020 and 2022 (Fig. NY2). This loss, and a Home Value increase of $112k (Fig. NY3), caused its **AFI score** to **decrease by nearly -7 points**.

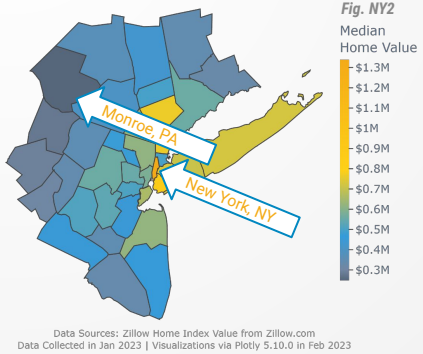
Changes to Home Values

All counties in the NYC analysis experienced **positive Median Home Value (MHV) growth** during the analysis time frame of 2020 to 2022. New York was the **9th most expensive county** in the US at $1.34M (Fig. NY2), but gained only $111k between 2020 and 2022 (Fig. NY3), a mere **9% increase in MHV**. For comparison, **Suffolk county gained $180k** in value to reach a total MHV of $724k, which represents a **33% increase**. This lack of significant growth in the core and explosive growth in the exurbs is a product of high value homes sales in the city core with the equity from those sales being used to buy comparatively reasonably priced homes in the exurbs.

This creates excessive demand in the exurbs, driving up costs, but there was also an issue with the supply of new homes, as well. Per FRED, the **Monthly Supply of New Houses** in the US dropped from a ratio of **6.7 in April 2020** to a record low of **3.3 in August of 2020** since recording began in 1963. The types of houses sold are changing as well, with increased demands for amenities such as home gyms and especially home offices with high speed internet access. The inclusion of **a home office increases the value** of a home **by 3.4%**, and increases sales speed by 9 days (Yale 2021).

NYC Median Home Value in 2022

Fig. NY2



Data Sources: Zillow Home Index Value from Zillow.com
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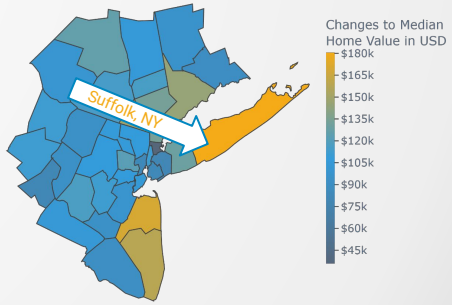
NYC Change in Median Home Value From 2020 to 2022

Fig. NY3



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San Francisco Metropolitan Area

A View on Index Changes - The Donut Effect

Continued Donut Effect

The effects of NYC's Donut Effect are observed in the San Francisco Bay Area as well. Since the beginning of the COVID-19 pandemic in 2020, only 6 counties have increased in affordability where the other 20 counties have decreased. Silicon Valley counties (San Mateo and Santa Clara) saw the greatest increases in affordability while remote locations such as Santa Cruz county decreased the most, as shown below:

San Mateo, CA: +12 pts
Santa Clara, CA: +4 pts
Santa Cruz, CA: -6 pts

This shift in affordability from urban centers to surrounding, less-populated counties indicates a **Donut Effect** occurred. The cause of the affordability change now comes into question.

2020 to 2022 experienced an intense labor market that largely increased wages. The Bureau of Labor Statistics (BLS) estimates 24 percent of establishments increased pay or paid bonuses during this period (Bureau 2022). The combination of stagnating prices from departing remote workers, and rising wages among remaining employees likely drove the Donut Effect shown in Figure SF1.

SF Bay Affordability Index Change
As Points from 2020 to 2022

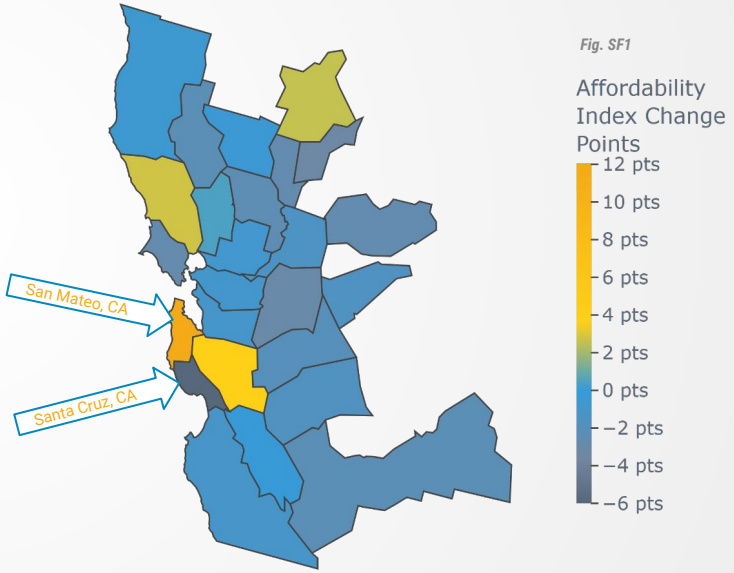

Fig. SF1

Data Sources: Equifax Utilities from Gale Business DemographicsNow, ACS 5 Yr from Census.gov, Zillow Home Index Value from Zillow.com
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San Francisco Metropolitan Area

Home Values and Household Income

Affordability Driven by Income

Confirming the BLS article on increasing incomes, our analysis shows that **salaries across the Bay Area increased 4%**, where Silicon Valley incomes such as San Mateo increased 10%. With incomes rising, a fall in affordability suggests housing and utility costs increased at a rate greater than income. Considering the index weightings described previously, home value is likely the greatest cause.

Affordability Driven by Housing

Home values averaged 32% growth across the Bay from 2020-2022. San Francisco, however, only grew 10% during that time (Figure SF3), with Marin county to the North growing 34%. Surprisingly, Marin county incomes also fell 4% during this same time period. This suggests that remote workers are not the only cohorts driving the donut effect. Lower-paid property owners leaving urban centers such as San Francisco also contributed to the donut effect, driving home prices in some cases to match those of the urban centers themselves (Marin and SF counties in Figure SF2). Whether driven by remote workers or other causes, the Bay Area donut effect observed in the affordability index aligns with changes in home values and incomes across the Bay.

SF Bay Median Home Value in 2022

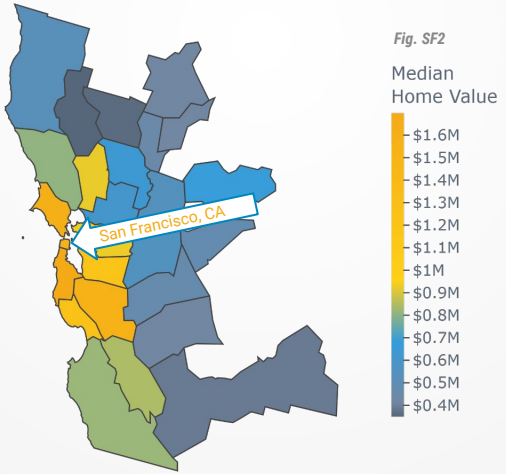

Fig. SF2

Data Sources: Zillow Home Index Value from Zillow.com
Data Collected in Jan 2023 | Visualizations via Plotly 5.10.0 in Feb 2023

SF Bay Change in Median Home Value From 2020 to 2022

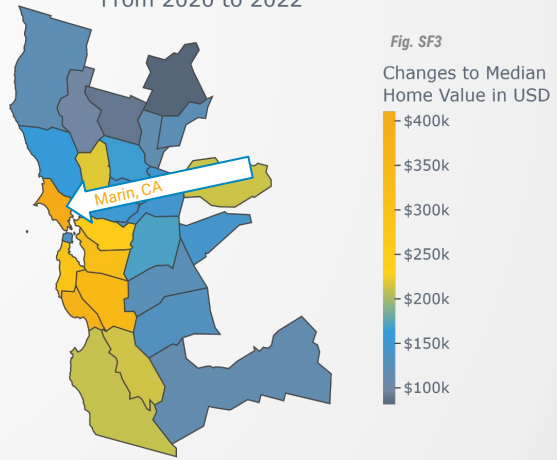

Fig. SF3

Data Sources: Zillow Home Index Value from Zillow.com
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Overall Results and Summary

Trends and Observations

Affordable Regions are Changing

Regional affordability has undergone a significant transformation in the wake of the COVID-19 pandemic. Dramatic increases of remote work opportunities, rising wages, and radically fluctuating home prices are leading to widespread changes to the affordability of both city centers and the exurb counties that surround them.

Analysis shows that urban centers such as the New York and San Francisco metropolitan regions experienced a "**Donut Effect**" between 2020 and 2022 with regards to their observed median home value. This effect is manifested as a shift in **improved affordability for the dense urban centers**, while surrounding suburbs and exurbs became less affordable relative to prior years.

While the full cause of this scenario is not entirely certain, it is likely that a significant portion of the explainability for the shift comes down to **the migration of remote workers leaving expensive areas for more affordable locations** as a result of increased work-from-home policies during COVID.

National Analysis Highlights Unsustainable Affordability

With employees now returning to office in a full-time and hybrid capacity, it will be interesting to see whether rural areas can maintain their elevated home values given the standard income and utility costs in the areas. The National analysis showed historically affordable states such as Idaho and Montana were significantly less affordable in 2022 compared to 2020. This may lead to a retraction of home values in the future, especially when considering the exceptionally high increases to interest rates in 2022 & 2023.

Future Considerations

Although ACS, Zillow, and Equifax data provided robust material for analysis, certain factors should be considered in future iterations to extend the project's reach. These include:

- Account for digital nomads
- Expand housing to rental markets
- Increase granularity to zip codes
- Analyze beyond COVID years
- Incorporate interest rates

Adding these elements will improve the breadth of the analysis and enhance the strength of the affordability index.

Statement of Work and References

Statement of Work

The team met with a minimum frequency of twice weekly to coordinate efforts in-person, with additional collaboration daily via Slack. Both of those communication mechanisms were also used to check in with our advisor on an as-needed basis several times throughout the project. Overall, the team collaborated well. Future collaboration efforts would improve by designating a task coordinator ensuring equal contributions. While all members were involved in each section of the project, the following members were accountable for the following specific deliverables:

- Arun Suresh - Data manipulation, Data Manipulation Notebooks, National Analysis
- James Conner - Data collection, Choropleth graphs, Scatterplot Graphs, Analytic Notebook, NY Regional Analysis
- Nick Wheatley - Indexes creation, National Scatterplot graph, SF Regional Analysis

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