Inflation-Adjusted U.S. Home Price Trends

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Abstract

Understanding whether buying a home can be considered an investment is a question of interest within personal finance. Answering it requires a comparison of US home price growth over time to returns from other investments to see if they are comparable. This was done by taking US home prices, specifically Zillow's ZHVI, for an ~25 year time period (January 1996 through October 2020), adjusting them for inflation, and comparing annual growth rates in home prices vs. benchmark investments, both for the US overall and at the metropolitan statistical area level. While home prices generally showed a positive inflation adjusted growth rate of 1.5% annually for the US, this lagged even conservative US treasuries (2.2% annual return) and massively lagged US Stocks (6.9% annual return). At the MSA level, there was variance, but only the top handful were comparable to conservative corporate bonds (3.4% annual return). Based on general lower returns than investments and costs of owning a home, it was concluded that buying a home as a personal residence should not be considered an investment.

Motivation

Whether or not owning a personal residence can be considered an investment (or a good one) is a matter of much discussion on the Internet*, but there's frustratingly little robust analysis on the topic (often just a single soundbite that home prices keep up with inflation, on average). My goal with this analysis was to compare trends in home prices for the US and its largest cities (including nearby suburbs) with the returns an investor would get from investing in US equities (specifically, the S&P 500, US Treasury 10-year bonds, and AAA-rated US corporate bonds). There are additional considerations when evaluating the investment return from buying a home that don't apply to stock or bond investments, those are discussed in the "Limitations" and "Conclusions" sections.

*For example, a google search on 12/07/2020 for "is owning a home a good investment" yielded ~148 million results and the top 5 results disagreed on whether the answer was "yes," "no," or "it depends"

Dataset(s)

1) U.S. Home Values: Zillow's Zillow Home Value Index (ZHVI), all homes, smoothed, and seasonally adjusted, from January 1996 through October 2020 (monthly entries); chose a dataset of US overall and MSA level (MSA = metropolitan statistical area, a US Census bureau way of grouping a city and its nearby suburbs together); in brief, this dataset attempts to show only the home value changes from market factors by controlling for "forced appreciation" (i.e. an owner making a major renovation and that change's effect on the home price), more info on methodology available at https://www.zillow.com/research/zhvi-methodology-2019-deep-26226/; data accessed 11/29/2020

2) Inflation: CPI-U (Consumer Price Index, all Urban Wage Earners) from the U.S. Bureau of Labor Statistics (more info at: https://www.bls.gov/cpi/); data accessed 11/29/2020; entries for each month in the same time period as ZHVI for home values; CPI is a common way to adjust for inflation in US economics

3) S&P 500, U.S. Treasury Returns, and Corporate AAA Bond Returns: from the personal finance website Don't Quit Your Day Job (dqydj.net), calculators accessed 12/07/2020 (not datasets per se, but used to calculate comparisons to data and one outputs a time series); these calculators were chosen since they accounted for reinvesting dividends (from stocks) or coupon payments (from bonds) over the length of an investment rather than simply comparing inflation-adjusted prices at two points in time (i.e. they produce a more accurate estimate of what an investor would actually see from holding an investment); more info at: https://dqydj.com/calculators/

Data Preparation and Cleaning

At a high level, the following steps were needed for data preparation and cleaning:

1. Import the inflation and home price data; melt both datasets (pandas melt function) to get tables with a single row per time period (and MSA for housing data); some small removal of missing values was needed here (especially for smaller MSA's)

2. Create a date variable to merge inflation data onto home prices (required wrestling with pandas datetime functions, including learning the Monthend function), merge the datasets, and calculate an inflation-adjusted home price in 2020 US $* for each data point

*The choice to convert to 2020 US $ is arbitrary and doesn't affect the results, I chose it because it's easier for me to think of old prices in terms of current values than think of current prices in terms of old dollar values

Research Question(s)

1) What is the approximate inflation-adjusted, long-term growth rate of US home prices? Does it appear to be statistically distinguishable from 0%?

2) How does this inflation-adjusted growth compare to other types of investments – specifically: the S&P 500 index (an index of the 500 largest US-listed companies), US Treasury 10-year notes (US Treasury notes are debt issued by the US government), and AAA-rated US corporate bonds (AAA is the highest bond rating, indicating the lowest risk of non-payment)?

Methods

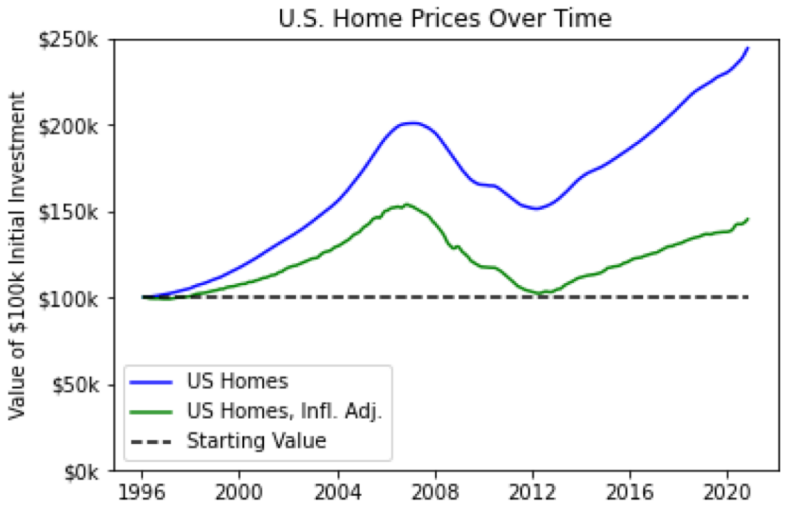
1) To inflation adjust home prices, I used the ratio of the CPI-U index between different time periods (the CPI is used to adjust benefits paid by the US government for inflation).

2) To calculate long-term average annual home price growth for the US and each MSA, I took the beginning (01/1996) and ending (10/2020) inflation-adjusted home price for each and calculated the geometric average annual growth rate.

3) To calculate the likelihood that these growth rates were non-zero, I first calculated the annual growth rate observed in each one month period for the US and each MSA. I then calculated the p-value for a two-tailed t test against a null hypothesis that growth rate=0 for the US and each MSA.

4) For S&P 500, US Treasury, and AAA corporate bond returns, I leveraged calculators from DQYDJ.net; the S&P 500 calculator produced a time series which I also inflation adjusted. All these return calculations calculate approximate return for a “buy and hold” investor (i.e. they account for dividend reinvestment and management fees to the extent possible).

Findings 1: Inflation Adjusting is Important

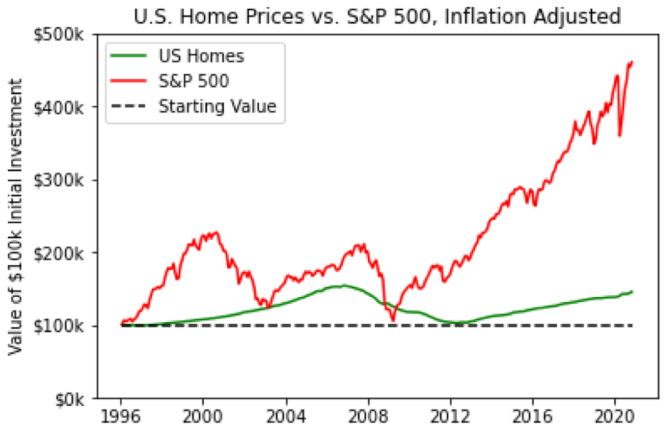


Without adjusting for inflation, the price of a typical US home (indexed to $100k) increased by ~150% from January 1996 to October 2020.

By contrast, once we account for inflation, the increase is down to ~50%, for a geometric average annual growth rate of 1.51% after inflation (p value <<0.1 that it is non-zero). All annual growth rates in the remainder of these slides are inflation adjusted.

That's still >0%, but how does it compare to returns from other investments?

Findings 2: Homes under-perform as investments



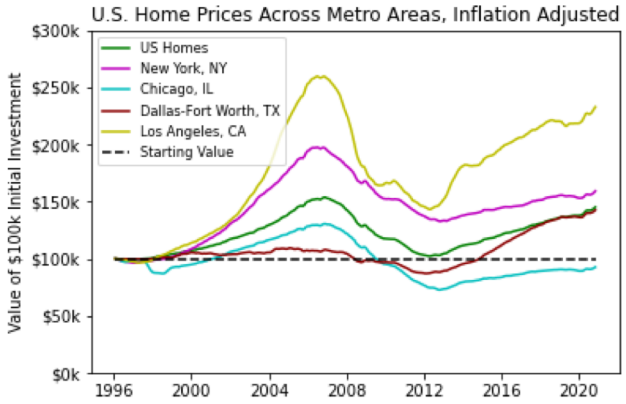
Investment	Annual Growth
S&P 500 Index	6.88%
U.S. Corporate AAA bonds	3.44%
U.S. Treasuries, 10-year	2.16%
U.S. Homes	1.51%

Over the same time period, the S&P 500 index delivered substantially higher growth (6.88% annually, accounting for inflation) and US Corporate and Government bonds also outperformed home prices (by smaller amounts, as expected for more conservative bond investments).

For comparison, $100k (in 2020 USD) used to buy a home or buy stocks in 1996 would be worth ~$150k today if used to buy a home, vs. ~$450k if used to buy stocks.

However, home price trends are likely to be highly local – how did different MSA's perform?

Findings 3: Home prices show regional variances



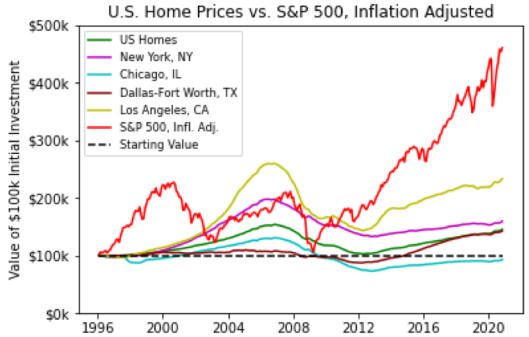
MSA	Annual Growth
Los Angeles, CA	3.46%*
New York, NY	1.89%*
U.S. Overall	1.51%*
Dallas-Fort Worth, TX	1.44%*
Chicago, IL	-0.31%

*Statistically significant vs. null hypothesis of zero annual growth, $p<0.05$

Home price trends showed local variation – among the 4 largest MSA's, annual growth rates ranged from 3.46% to -0.31%, with all but one statistically significant vs. 0% growth (table to left).

For all MSA's nationwide, the trend was similar, with only 5 MSA's outperforming LA and 18 underperforming Chicago (out of 429 nationwide). Additionally, 6 of the 10 highest growth rates were in California (the other 4 plus 3 of 6 CA MSA's have <300k total population, possibly outliers due to small size).

Findings 4: Bonds and Stocks generally beat Homes



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Even the highest performing MSA among the 4 largest in the US had substantially lower annual growth than a stock investment, comparable to a conservative (AAA rated) corporate bond investment (table to left).

Given that homes only kept pace with conservative bonds in the highest-performing MSA's within the US and lagged very conservative US treasuries in most MSA's, I assert that it is incorrect to think of owning a home as an investment based on price trend data. A risk-weighted returns discussion is outside the scope of this analysis, but likely would not favor a single home vs. broad market indices, either.

Limitations and Possible Future Analyses

First, since this analysis focused exclusively on US data, the findings may not generalize to other countries. Additionally, since the time period for this data included the “Great Recession” of ~2007-2010 which was caused in part by a subprime mortgage bubble (affecting home prices significantly), using data over an even longer time period would be ideal to get a better sense for how home prices have trended over the long term (this would require finding a new data source for home prices, as Zillow’s ZHVI starts in January 1996 based on the data available on their website).

Additionally, the Zillow data guide notes that foreclosure sales are not included directly as they are typically available at a discount to fair market values, so this analysis does not apply (directly, at least) to a buyer who intends to buy a foreclosed home.

Since the Zillow data was both smoothed and seasonally adjusted, it’s likely that my attempts to hypothesis test vs. a growth rate of 0% overstate the confidence in the statistical test (or put another way, the calculated p-values are likely lower than they should be); more robust analysis would try to find a non-smoothed, non-seasonally adjusted dataset (which would be a fairer comparison to the investment return data). Looking at trends among high-priced vs. mid-tier vs. low-priced homes in the Zillow data would likely be informative as well, as price trends could be very different among different home price points.

Since buying real estate as an individual is by definition very local (a buyer buys a single home), it would be a useful follow-up to leverage Zillow’s zip-code-level data, possibly also selecting a dataset for the same home size to inform an individual buyer’s choice (Zillow offers datasets for single family homes by number of bedrooms, and a separate dataset for condos).

Conclusions

Overall, this analysis found that nationwide home prices generally grew - ~1.5% annually, after adjusting for inflation - over a long time period (25 years). This trend held true with some regional variance - MSA growth rates spanned from -0.85% to 5.2%, with growth rates above ~3.5% being outliers. However, the US aggregate growth rate in home prices was substantially lower than for US stocks (~6.9%), US corporate bonds (~3.4%), or US Treasury bonds (~2.2%), and only a few MSA's outperformed US corporate bonds (none came close to outperforming US stocks). Taken in whole, this leads to a conclusion that a home should not be thought of as an investment (especially given maintenance and tax costs plus the much higher transaction costs of buying or selling a house vs. bonds and stocks). Buying a home for the purposes of renting to tenants requires separate cashflow calculations and is well beyond the scope of this analysis.

That does not, however, mean that buying a home is necessarily a poor financial choice – a person still needs to live somewhere and therefore the tradeoffs between renting and buying need to be weighed. The New York Times has a fairly robust calculator (see "References" slide for link), although any end user would, at minimum, need to adjust the investment returns upwards from the default of 4.0% (not inflation adjusted). Don't Quit Your Day Job (dqydj.net), the source of the S&P 500 return numbers used here, has several calculators for different equity indexes that could be averaged together in someone's chosen portfolio mix (be sure to *not* adjust for inflation when getting a number for the NYT calculator). Tweaking other values to better match an individual's situation would also be advisable (note: all % growth rates in the NYT calculator do *not* adjust for inflation).

Acknowledgements

I'd like to acknowledge the following sources of data:

- For inflation: the US Bureau of Labor Statistics
- For home prices: Zillow's research division for developing their ZHVI – a discussion of the quality of this measure of home prices is beyond the scope of this presentation, but I believe it's a very high-quality economic measure
- For investment returns: Don't Quit Your Day Job (dqydj.net) produces fantastic calculators for investment returns that model an actual investor's experience well (i.e. accounting for reinvesting, management fees, and inflation)

References

Analysis was performed on my own, however, the following blog post by Paula Pant (AffordAnything.com) was invaluable in kicking off my thinking on the tradeoffs between renting and buying as a US resident: https://affordanything.com/is-renting-better-than-buying-should-i-rent-or-buy/ (Title “RENTING IS THROWING MONEY AWAY … RIGHT?”)

Additionally, the New York Times produces an excellent calculator on renting vs. buying a home: https://www.nytimes.com/interactive/2014/upshot/buy-rent-calculator.html

Quick Note re: attached code

My attempts to download my jupyter notebook as a pdf were not successful, so I'm unfortunately not including the code notebook here (but I will post it to github in the next month or two, email me at mmarszowski@gmail.com if you were really dying to get your eyes on the code notebook).