

**Another Housing Bubble? A Review of Historical Indicators  
and Analysis of the Current State of the U.S. Residential Real Estate Market**

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### **Abstract**

The purpose of this paper is to investigate the current state of the United States residential real estate market along with its historical indicators. This study will address questions including: why the housing market is important, what housing bubbles are, and how today's asset-price inflation is a cause for concern. Moreover, subsequent sections will attempt to address these questions by analyzing the history of gathering market data, discovering the "fundamental values" that influence home prices, and identifying which of those variables were responsible for the past housing bubble. Once these variables were identified, numerous multiple linear regression models were calculated between the periods 1994—2004, 1994—2007, 2008—2018, and 2008—2021 to determine if the run-up period to a potential bubble causes these fundamental values to become less influential in determining home prices. The results of the model indicate that these values were able to explain slightly less of the total variance in home prices during the buildup of a housing bubble. Although further research will need to be conducted, the results divulge parallels between the last housing crisis and today. With the deviations between home prices and their fundamental values greater today relative to a decade prior, this development could signify the possibility of another housing bubble.

*Keywords:* Finance, housing bubble, asset-price inflation, historical market analyses, fundamental values, multiple linear regression

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### **1. Another Housing Bubble?**

When it comes to the world of finance, both institutional and private investors seek to disperse their risk via proper diversification of their investment portfolios. Within the last few decades, market liberalization, technological innovations and institutional reforms in conjuncture have served to magnify access to risk and credit sharing opportunities. In spite of this, while the greater access to capital has allowed for more growth in the global economy, it is imperative that today's investors acknowledge that portfolio risk can never be fully eliminated (Rajan, 2005). The conventional wisdom in the world of investing has been to focus on the growth of equities, the global value of which was estimated at a market capitalization of \$85.3 trillion in 2017, an increase in over 21.7% from the previous year (Brandon et al., 2018; The World Bank, 2019). In contrast to the global equity market, diversification in the effort to mitigate risk can also be sought from the global bond market with its outstanding value dwarfing equities at a whopping \$100.1 trillion, an increase of 8.9% from the previous year (Brandon et al., 2018).

On the other hand, one of the most overlooked markets in finance has undoubtedly been residential housing. In decades prior, the overall housing market has seldom been included in investment portfolios outside of small niches of real estate investment trusts (REIT's) despite the total value of real estate in the United States being valued at approximately \$8.8 trillion in 1990 because of the difficulty in scaling these investments (DiPasquale & Wheaton, 1992). In recent years, however, the importance of real estate as an asset class has amplified with the total value of real estate in the United States at the close of 2011 increasing to nearly \$25 trillion, of which in excess of \$16 trillion was allocated within residential properties. Moreover, contemporary studies suggest that volatility in real estate prices, occurring in either peaks or troughs of a

cyclical economy, has the ability to either lift up or decimate the financial sector and economy as a whole (Ghysels et al., 2012).

In contrast to other liquid assets, real estate is characterized by extreme heterogeneity due to the locational and physical attributes of property. Accordingly, participants in this market will often confront barriers to scale such as: exorbitant carrying costs, illiquidity, transaction costs and tax considerations (Ghysels et al., 2012). Apart from these negative expenses, Hudson-Wilson et al. (2005) listed out the primary considerations for the inclusion of real estate assets in one's investment portfolio including: reduced overall portfolio risk, potential for absolute competitive return, to hedge against future inflation, diversification using tangible assets, and to deliver strong and reliable cash flows.

Today, with the total value of the U.S. single family housing market being valued at \$32.8 trillion, the question of why economists need to study real estate economics has grown in popularity despite the market's heterogeneous and tangible nature (Goodman et al., 2020). Land and buildings are scarce resources which continues to highlight the reoccurring economic problem of limited resources but unlimited wants. An understanding of real estate markets is vital in order to make sensible decisions in terms of one's own property and wealth. Likewise, the vast majority of real estate has both a utilitarian use and asset value thus making it both a consumer good and investment asset.

Since real estate assets differ from other commodities, conventional microeconomics alone cannot suffice and thus requires the use of complex market analyses (Jowsey, 2011). With the average business holding one quarter of its assets in real estate, and with many retail chains having upward of 85% allocated to this class, the economy has necessitated market analysis to

investigate and document the copious factors influencing the demand and supply of the housing market (Thrall, 2002).

The introduction of this market analysis has proved to be consequential as Case et al. (2001) illustrated that deviations in real estate prices have a significant effect on aggregate consumption in the United States and concluded that the housing market appeared to be more prominent than the stock market in affecting consumption in developed countries. Therefore, it can be concluded that understanding the factors that drive real estate prices is no less important than understanding the complex price intricacies of equity, fixed income, commodities and currencies (Ghysels et al., 2012). As a result of the imperative nature of the housing market from an economic perspective, the purpose of this paper will explore if a nation-wide housing bubble is currently forming within the market. Before one can answer this question, however, the exact definition of a “housing bubble” must be defined.

## **2. Literature Review**

### **2.1 Defining a Housing Bubble**

In the modern era, the popular press has often utilized the word “bubble” to illustrate a time period in when an asset’s price has risen quickly enough as to suggest that the current price is prone to an equally quick and sudden collapse (Contessi & Kerdnunvong, 2015). For instance, the prices of many traded assets within the market—most notably stock prices—have historically displayed the predisposition to grow significantly over a period time only to then unexpectedly and hastily decline (Brooks & Katsaris, 2004). While equity price busts have historically occurred about once every thirteen years and lasted for roughly two and half years, housing price busts have historically occurred about once every twenty years and lasted for roughly four years. Moreover, while only about one quarter of equity price booms would be followed by busts,

nearly forty percent of housing price booms would be followed by busts with the magnitude of the asset price fall depending on the size of the increase in prices prior to them (International Monetary Fund, 2002). With the importance of understanding bubbles becoming more prevalent in recent years, the question of defining this “bust” period has become imperative.

In spite of this simplification, there is often very little agreement when it comes to a consensus on housing bubbles. As a matter of fact, the prevalent use of the phrase “housing bubble” is actually quite new relative to the history of housing. Case and Shiller (2003) observed that the term “housing bubble” had virtually no presence in popular literature until early 2002 when tabulating the aggregate use of the phrase from the Lexis-Nexus English literature database. The term “housing boom,” in contrast, appeared much more frequently since its inception in the early 20<sup>th</sup> century. For example, using Google Book’s Ngram Viewer with the two terms between the years 1900 and 2019, the term “housing boom” was heavily prevalent throughout the 1900’s, whereas the phrase “housing bubble” gained traction in early 2002 (See Appendix A). The authors further suggest that the term “boom” is much more neutral relative to the term “bubble” since the former phrase often carried a positive connotation that suggested rapidly rising prices were an opportunity for investor. In contrast, the latter often carried a negative connotation that often implied that current prices simply cannot be contained. As a result, many economists have contemplated if its continual use drastically influences the thinking of homebuyers.

As a potential financial crisis in the late 2000’s appeared more likely—and as a result of the introduction of the term “housing bubble” in early 2002—many economists have sought to expand this early definition of asset bubbles to cover the residential housing market, resulting in researches proposing a myriad of characteristics and metrics to identify this unique—and

generally uncommon—phenomenon. (Contessi & Kerdnunvong, 2015). For instance, when Case and Shiller (2003) argued that the defining characteristic of a housing bubble is when there is a tendency to view it as an investment, Smith and Smith (2006) rebutted this claim by positing that housing should always be viewed as an investment. Moreover, the authors claim that the best way to define a bubble is a scenario in which market prices for real estate assets surge far above the present value of the anticipated cash flows from those assets. As a result, Smith and Smith's (2006) description of housing bubbles would attempt to enhance the conventional definition of asset bubbles by expanding the phenomenon to four main characteristics: rapidly rising prices, a speculative focus of future price increases, a deviation of prices from the fundamental values that drive them, and an eventual and sudden drop in prices following the burst of a bubble.

In order to derive this definition, Smith and Smith (2006) would combine the research and opinions of many prominent economists. Beginning with the observation of rising prices, the most simplistic of metrics, Baker (2002) would observe rising home purchase prices increasing roughly 30% more than the rate of inflation between the years 1995 and 2002. As a result of this increase, housing wealth across the country rose by more than \$2.6 trillion when compared to home prices' solely keeping pace with inflation (Baker, 2002). Despite the short-term benefits appearing relatively beneficial, Baker (2002) would note that the long-term prospects of a bubble almost always predict an eventual collapse in prices, resulting in millions of families seeing their newly-gained equity rapidly disappear. Although this rapid rise in prices can be indicative of an asset-bubble, it is not definitive. In fact, detecting an asset-bubble—whether it be equity, real estate or debt—can cause much difficulty due to the fact than one must wait a sufficient period of time to analyze future events before coming to any conclusions. Siegel (2003) argues that after a collapse in prices has occurred, if the realized asset return is greater than two standard

deviations from the expected return, then the presence of a bubble can be definitively confirmed. As a result, Siegel's (2003) definition has indicated that it is difficult to tell in real-time if a bubble is occurring. To account for this problem, many studies have looked into the impact of deviations between home prices and the fundamental values that influence them to identify current bubbles prior to their bust period (Smith & Smith 2006; Garber, 2001; Brooks & Katsaris, 2004; Muellbauer & Murphy, 2008; Ikromov & Yavas, 2012).

Fundamentals are an assortment of variables that should, in theory, drive the prices of assets; however, when the prices of these assets tend to deviate from the fundamental values that drive them, it is said that a speculative bubble is occurring (Garber, 2001). When prices tend to persistently and increasingly deviate from their fundamental values, the boom-and-bust periods of these bubbles tend to be significantly longer and much more damaging to the overall economy (Ikromov & Yavas, 2012). As a result, defining some of the most prominent determinants of house prices will be a key issue of this study and play a pivotal role during its empirical analysis.

## **2.2 Asset-Price Inflation**

One of the bluntest warning signs of an impending bubble—whether it be equity, real estate or debt—undoubtedly revolves around the rapid rise of prices. For that reason, it is important to look at the current state of the economy to see if the value of assets is appreciating at an abnormal rate. If this is found to be the case, an investigation to determine whether or not a bubble exists is warranted. Therefore, one must pose the question: are assets appreciating in value abnormally and, if so, is that appreciation contributing to the formation of a bubble?

To answer this question, one doesn't have to look back further than 2020 to discover the meaning of asset-price inflation and its impact on the economy. Upon the commencement of the Coronavirus pandemic in March of 2020, the world's economy has been severely strained. In

spite of this event, nearly every investment soared during this year despite the closing of businesses, a net decline in GDP, and unemployment peaking at nearly 14.7%. During the year of 2020, the consumer price index (CPI) rose a mere 1.1%, almost half of the Federal Reserve's target rate of 2%. Moreover, with markets such as the NASDAQ, Russell 2000 and S&P 500 gaining 43.6%, 18.4%, and 16.3% respectively during 2020 and—with ever-growing liquidity in the market from COVID-related stimulus—many economists have expressed concerns over these rapid rises in asset-valuations (Navellier, 2021).

In general, most economists track real economic growth by measuring the growth of real gross domestic product (GDP) that accounts for inflation of ordinary goods and services. In contrast, asset-price inflation covers the nominal rise in the prices of stocks, bonds, commodities, and real estate where ordinary goods and services are excluded from the definition of “assets” (U.S. Bureau of Labor Statistics, 2020). For instance, over the last two decades, home prices have appreciated significantly faster than nominal inflation—in the leadup to the previous bubble—and has depreciated significantly faster than nominal inflation—following the bust of the previous bubble (See Appendix B). As a result, it can be determined that consumer prices that are included in CPI calculations are among the stickiest in the economy and absorb shocks gradually while asset prices are generally the most flexible and absorb the same shocks far more quickly. Since most standard measurements of inflation—most notably CPI—do not factor in the effect of growing asset prices, Andersson (2011) argues that central banks have the tendency to misjudge the underlying monetary inflation pressure in the short-run which may result in the pursuit of incorrect monetary policy, which many argue was a primary cause of the previous housing bubble (See Section 2.6).

For most investors and the economists at the Federal Reserve, the weakening of the negative correlation between inflation and unemployment as described by the Phillips Curve has promoted a new focus on maximizing employment until macroeconomic pressure from these prices begin to manifest in an attempt to keep the economy stimulated for as long as possible (Sargen, 2020). Although nominal inflation has been appreciating below the Federal Reserve's target rate, efforts to stimulate the economy through growth of the money supply has concerned some economists as this focus on maximizing employment could lead to higher levels of inflation—for both generic goods and investment assets—in the near future.

Since the broad M2 measurement of money supply includes cash, checking deposits, savings deposits and money market securities, investors have the tendency to observe changes to M2 as a leading indicator of the total money supply and future inflation (Franck, 2020). Although M2 supply has ordinarily been described by slow, steady growth, the year-over-year percentage change has surged 20% from \$15.33 trillion in early 2020 to \$18.3 trillion at the end of July 2020, indicating that nearly one out of five U.S. dollars in existence were printed in 2020 alone (Franck, 2020; See Appendix C). Between the ever-growing supply of money and the aggressive acts of monetary policy currently being enacted by the Federal Reserve, it is no surprise that the value of assets has rapidly appreciated despite the high level of unemployment. Consequently, many have now urged authorities to regard asset-price inflation with the same level of necessity as it can ultimately be seen as a predictor of true core inflation (Schwartz, 2002). Although the presence of asset-price inflation has had a profound effect on the value of equities and commodities, the effect of this trend on the housing market has been more or less neglected during this period.

### 2.3 Current Observations of the Housing Market

Before delving further into the theory of housing bubbles and identifying the various fundamental values that influence home prices, it is important to first investigate the current state of the market to determine if such analysis is necessary. As stated previously, the occurrence of abnormally rising prices in a market can provide one of the bluntest warning signs of a potential bubble. If the presence asset-price inflation is found to be significant within a particular market, then an investigation to determine whether or not a bubble exists is warranted. To answer this question, this section will observe the recent trends between both supply and demand of the residential real estate market and the asset-price implications derived from those trends.

Around the globe, a simultaneous boom in residential real estate prices has escalated fears of housing bubbles, a concern that has alarmed policy makers due to years of low interest rates artificially sustaining demand. In China's city of Shenzhen, property prices are up nearly 16% over the past year while both New Zealand's and South Korea's median home prices jumped roughly 23% and 15%, respectively. In Europe, the Danish central bank would issue a warning that cheap financing for ever-growing prices could entice individuals to take on more debt to purchase over-valued homes thus causing the prices to spiral even further in an upwards direction (Cherney & Kowsmann, 2021).

In the United States, home prices have been increasing at the quickest pace in nearly 15 years, rising nearly 11.2% over the past year, the greatest annual rate of price growth since February 2006 (Friedman, 2021a). Moreover, in early 2020, median existing home prices nationwide peaked at over \$300,000, an even higher amount than the previous record in 2006 when adjusted for inflation (Friedman, 2021b). These rapid increases in prices—relative to nominal inflation—parallels the environment during the previous bubble when national home

prices appreciated in value by nearly 10 points at its peak, similar to what can be observed since the onset of 2020.

As a result of these rapid increases in prices, new and existing home sales have increased despite a decrease in overall supply (See Appendix E). Many real-estate analysts argue that the Coronavirus pandemic facilitated the current spike in demand for housing as many residents from urban areas sought to seek cheaper housing upon jobs shifting to a remote-based environment. When nation-wide lockdowns began to ease during the summer of 2020, monthly home sales in June and July spiked 21% and 25%, respectively (Friedman, 2021b).

Normally, 55% to 70% of American home buyers are repeat buyers, meaning that they would sell one home in order to purchase another. Starting in the spring of 2020, however, the portion of first-time buyers in the housing market has increased drastically to about 34%. In contrast to repeat buyers, who balance supply and demand within the market, first-time buyers influence only demand (Romem, 2020). This recent trend has served to deviate the two forces away from their equilibrium, destabilizing the balance as the demand for housing continues to increase with an insufficient supply to supplement it.

In spite of the recent growth of first-time homebuyers in the market, economists argue that the barriers to entry for new buyers have significantly increased in the last few years (Friedman, 2021b). According to a 2020 online survey of 675 nonhomeowners reported by the *New York Times*, 38% of respondents stated that not having enough for a down payment was the biggest barrier in hindering their ability to pursue homeownership (Kolomatsky, 2021). When aggregating the responses relating purely to fiscal concerns, low income, lack of affordable housing and housing market competitiveness all rank among the most popular responses (See Appendix D). These responses are not unexpected given the current and rapid appreciation of

housing prices across the world. Hypothetically, if a home in 2015 costed \$100,000 and doubled in price today, a typical down payment of 20% would increase from \$20,000 to \$40,000; although not seen as a dealbreaker for middle-class families, many low-income households, however, would experience difficulty in affording the initial payment.

While the demand-side of the current housing boom helps explain today's observations, the supply-side has also influenced home prices significantly. The last decade has been characterized by a period of relatively low interest rates which have incentivized homeowners to remain in their current homes for longer than usual. In addition, these low rates incentivized many homeowners who purchased new property not to sell off their current one but to instead handle it as an investment property (See Appendix E). Furthermore, over the same time period, the number of single-family homes in the U.S. rental market increased by nearly seven million units (Badger & Bui, 2021). For instance, the United States Government Accountability Office found that in 2017, nearly seven million more households rented their homes compared to 2001, bringing the share of households that rent from 34% to 36% (Garcia-Diaz, 2020).

Though a majority of these single-family rentals are owned by individual investors, the number of pension funds owning these properties has risen exponentially since the previous crisis through their accumulation of undervalued properties to rent out. The introduction of financiers owning a sizeable amount of previously foreclosed homes allowed them to dominate the market and decrease the amount of supply available which drove up prices as they competed with ordinary American families (Dezember, 2021).

Typically, economists and investors would anticipate that rents and home prices would move collectively as they are based on the same fundamental values that derive them. In spite of this, many metro areas have experienced a divergence between home prices and rents with some

areas having the two variables shifting in opposite directions. The consequences of this shift have directly affected renters with the overall level of affordability declining heavily during this time. In 2017, 48% of renters paid over 30% of their income for rent, 6% higher than in 2001 (Garcia-Diaz, 2020). Moreover, when home prices and rents begin to diverge, it is often a sign of instability in the market and that a potential housing bubble may be inflating (Badger & Bui, 2021).

The rise in the amount of debt outstanding has also raised concerns. Although mortgage foreclosures decreased by 67% from 2019, today 2.15 million American homeowners are three months past due on their mortgages—a figure that increased by 1.7 million during 2020—with lenders unable to take back properties due to state and federal regulations (Ostrowski, 2021). Contributing to the lack of supply, the Housing Finance Policy Center (2020) reported that the inventory of homes for sale was a mere 1.4 million and estimated that at the current demand—assuming if no new homes were constructed—the nationwide inventory of single-family homes would be depleted in less than three months if no further actions were taken.

The ever-shrinking inventory of homes has contributed significantly to the rise of prices across the country. Since May of 2020, this can be observed as while existing inventory fell by 5%, sales prices have risen by 1.3%. Moreover, as inventory has dwindled since 2012, the portion of home-buyers paying above the asking price increased from 18.3% in 2012 to 32.8% in 2020, thus making the housing market heavily tilted towards the seller (Goodman et al., 2020).

Although home builders have attempted to increase construction to meet the ever-growing demand for housing, new construction has been hindered by exorbitant lumber costs, material bottlenecks, opportunity costs and a dearth of available land and labor (Friedman, 2021c). This national lack of supply has severely affected rents along with overall home prices.

It is clear that the increase of prices, lack of affordable housing and undersupply of homes presents a concerning depiction of the current state of the housing economy. Moving forward, it is unclear on how this appreciation of home prices will affect the economy as many government officials, economists and investors are in disagreement about the future. For instance, William Poole, the former president of the Federal Reserve Bank of St. Louis, cautioned of another subprime crisis in March 2017 based off the statistic that nearly 36% of Fannie Mae's loans needed mortgage insurance, similar to the level observed in 2006 prior to the previous housing bust (Poole, 2017). In spite of this, research by firms such as JPMorgan have insisted that in the short-term, the ever-increasing surge in demand will keep the housing market stable and will lessen the degree of risk in the long-run as the economy readjusts (JPMorgan, 2020).

Although a controversial dilemma still persists regarding the short-, medium-, and long-term effects of today's observations, it is clear the asset-price inflation that the nation is currently experiencing warrants further investigation into the state of the economy. This paper will attempt to determine if the presence of these trends—both now and those that occurred in the mid-2000's—diminished the influence of the fundamentals values that should, in theory determine home prices. Therefore, in order to successfully perform this analysis and determine the possibility of another bubble existing, additional criteria must be explained. As a result, in the subsequent sections, the evolution of market analyses will be evaluated, fundamental variables will be identified, and the circumstances surrounding the previous housing bubble will be reviewed.

## 2.4 Brief Overview of Historical Housing Market Analyses

The vast majority of urban and housing market economists today focus on the recent past, the present, and the near-future. While it is imperative to analyze the underlying conditions affecting the housing market today, it is also important that the history of conducting housing market analyses not be overlooked as the methods for appraisal has remained relatively consistent throughout centuries, despite slight variations introduced by theoretical and technological innovations. As a result of the paucity of knowledge regarding the history of housing market analyses, Baer (2017) offered to fill this gap with an exemplary in-depth overview of the housing market from a historical perspective. The remainder of this section will focus on key points from Baer's (2017) findings along with additional information for cohesion and clarity.

The history of housing market analyses can be dated back to the early Roman techniques of development and appraisal. In early Rome, private building construction was a major enterprise as nearly 90% of citizens lived in large apartment complexes, housing roughly thirty to fifty individuals with the ground floor often allocated to commercial use. These properties required significant capital before investors would see any cash-flow; therefore, developers required appraisals to evaluate the risk of such large and risky ventures. For instance, when building farmhouses, construction was evaluated at the average cost of a building using the cost of each marginal roof tile as a unit of measurement (Baer, 2017). These rudimentary concepts would continue far after the fall of Rome and be expanded upon by London developers in the late 16<sup>th</sup> and 17<sup>th</sup> centuries. By the middle of the 1500's, the city of London had experienced a building boom as its population surged from a mere 120,000 residents in 1580 to roughly 540,000 residents in about 100 years (Baer, 2007). Upon the turn of the 17<sup>th</sup> century, London's

building developers engaged in a collective effort to reshape London's housing market, most of which was conducted through trial and error.

By the 1670's, each residential neighborhood would have a different "rule-of-thumb" approach for determining a property's value (Baer, 2002). Although attempts were made to publish guidelines that would help establish a sense of standardization, only 40% of individuals had the ability to read and decipher the material, and those who were able often complained about the varying quality of these proposed standards (Baer, 2002). This amateurish pattern of inexperienced dealings would be repeated for years by underfinanced developers. With primitive book-keeping methods and imprecise market analysis techniques being employed, developers would continually run into cash flow problems using these techniques (Meen et al., 2016).

In spite of this, a more standardized system of market analysis would eventually emerge in the late 17<sup>th</sup> century by Dr. Nicholas Barbon in England. Born in London in 1640, his activities as both a physician and builder would make revolutionary contributions to the economic thought of his time, such as being the first to introduce fire insurance policies and land banks within England (James, 1954). While these achievements were notable, his true contributions came from his techniques in evaluating housing. In contrast to prior methods that estimated housing production based on population growth, Barbon argued that the household formation rate would be a superior metric for analyses (Baer, 2017). Moreover, Barbon was first to discover the correlation between buyers' wealth and the demand for new construction. In addition, Barbon was the first to recognize housing market segmentation and the how the profitability of rents between poor and wealthy owners should influence a developer's capital ventures. Although his discoveries were theoretically correct, Baer (2017) posited that the lack of

data and technology during this time period resulted in society being unable to properly implement Barbon's ideas.

Fast-forwarding to the 1800's, Charles-Maurice Talleyrand, the French foreign minister to Napoleon Bonaparte, would write the first market analysis for the sale of the Louisiana Territory to the United States (Onion et al., 2009). Talleyrand based his analysis on the anticipated population growth of the territory, using Benjamin Franklin's 5% yearly growth as a base (Franklin, 1751). Of this, Talleyrand estimated that 95% of new property owners would venture into agriculture and assumed that each new farm would average 150 acres of land. Using these metrics, he would then calculate levels of demand for uncultivated land. To assist in the calculation, Talleyrand would compare similar land in the USA to current prices of land in Europe and estimated that it would take roughly 85 years before a similar level of development would be reached in America (Baer, 2017).

Following Talleyrand's analysis, little innovation in advancing techniques for market analysis occurred until market data on housing started to be collected by the United States Government in the early 1930's, along with its analytical use by the Federal Housing Administration in 1935. With many still operating under a "rule-of-thumb" system, the federal government would begin collecting housing data through its Real Property Inventories (RPI) and Survey of Finance systems in the early 1930's (Green, 1940). From this research, economists were able to investigate residential investment patterns to reveal the relationships between various factors that affect value stability and the probability of mortgage delinquency (Baer, 2017). Moreover, the introduction and availability of this data to economists most likely contributed to the rise of the phrase "Housing Boom" in the 1930's due to the fact that market statistics could now be measured and general outlooks could be made (See Appendix A). From

there, technological innovations would continue to make conducting market analyses even easier; in recent decades, a plethora of indices have been released to analyze data, the most notable being the S&P CoreLogic Case–Shiller Home Price index on national home prices that originated in in the late 1980's.

Although times 200 years ago were significantly slower and hindered by the lack of modern-day technology, it is evident that the theories that drive market analyses for housing has remained consistent its core. Consequently, while analysts of that past were forced to focus on the long-term of the economy, the introduction of technology and data in the 20<sup>th</sup> century allowed economists to pursue meaningful analyses on the both the short- and medium-term.

## **2.5 Modern Determinates of House Prices**

Upon gaining a comprehensive understanding of how home prices have been documented and researched throughout history, the question of how contemporary home prices are determined must be answered. According to economic theory, the price of an asset is derived from the fundamental variables that influence them. Muellbauer & Murphy (2008) stated that home prices are defined by the relationship between supply and demand where supply is given in the short-run and prices are given by the inverted demand curve. DiPasquale & Wheaton (1992) stated that the annual payments that a household can afford are determined primarily by its level of income when purchasing a home. The authors continue by saying that the circumstances within the capital market would, however, regulate how a household adapts these payments into a definitive purchase price.

Case & Shiller (2003) regressed the influence of income on average home prices between the years of 1985 and 2002 and concluded that income alone explained patterns of home price changes in all but eight states since 1985. Sutton (2002) used a vector autoregressive (VAR)

model—an econometric test to describe interdependencies between time-series data of different unique variables—to compute a typical response of house prices over time to unforecastable changes in determinants of house prices, most notably national income. In the case of Gross National Income (GNP), Sutton (2002) found that increases in the growth rate of this variable would lead to higher home prices over time. Moreover, the author's study illustrated that a 1% increase in the growth of GNP would correlate to the rise of home prices in the range of 1% to 4% in a time span of 3 years.

Abelson et al. (2005) attempted to analyze the Australian home market through the use of a long-run equilibrium model. Upon conducting their analysis, the authors concluded that not only are long-run home prices significantly influenced by changes in real disposable income, but also by unemployment, real interest rates, equity prices, CPI and the supply of housing. Furthermore, Hort (1998) drafted a restricted error-correction model of real house price changes based on Swedish data and found that in the long-run, movements in income, user costs, and construction costs had a significant impact on real house prices in Sweden. Manning (1988) also ran an equilibrium model seeking to explain inter-urban variations in home prices. Upon completion of the study, the author concluded that greater after-tax household income contributed significantly to increases in home prices in a particular city. Moreover, of the six measures used to describe nonmonetary income, half were found to be statistically significant. As a result, it is clear that an individual's level of income is extremely influential in determining home prices.

In addition to income, user costs in the form of rent/mortgage payments have also been shown to act as fundamental values to national home prices. These costs become prevalent during the phase of construction as developers often use these variables to compute an estimated

rate of return when evaluating new capital projects. Muellbauer & Murphy (2008) stated that in order for a project to be suitable, its capital gains would have to be greater than its construction and upkeep costs. Moreover, the authors posited that capital gains would be an important factor in influencing residential construction demand which, in turn, would affect overall home prices. McCarthy & Peach (2004) found that while home prices were positively correlated with increases in family income, they were inversely related to declines in nominal mortgage rates. Hendershott et al. (1980) found that despite the real mortgage payments on a particular house doubling, the prices of homes between 1977 to 1979 were ten percent higher than it would have been in the absence of the inflation-induced decline in rental prices and the overall rise in mortgage rates that occurred during this time period.

Kivedal (2012) analyzes the price-rent ratio prior to the 2007 subprime mortgage financial crisis. Within the study, the author concludes that the ratio is a significant measurement of potential divergence between housing prices and their fundamental values. In addition, his econometric model suggested that interest rates are also an important factor in influencing demand for housing mortgages which, in turn, affect overall housing prices. Furthermore, Caspi (2015) created a model to evaluate the rapid appreciation of home prices in Israel between 2008 and 2013 by testing for explosive behavior from fundamentals such as price to rent ratio, interest rates, income and the leverage ratio. Upon completion, Caspi (2015) could not reject his null hypothesis of a no-bubble scenario existing in Israel during this time period. Based on this assumption, the author concludes that the recent appreciation of home prices was the outcome of changes to fundamental values, specifically rent and interest rates.

In addition, Sutton (2002) posited that decreases in real interest rates lead to increases in home prices over time. For instance, Sutton's (2002) model illustrated that a 100-basis point

decrease in the real short-term interest rate leads to an increase in home prices over a year in the range of 0.5% to 1.5%. Furthermore, McQuinn & O'Reilly (2008) proposed a theoretical model of home prices where demand for housing is driven in part by how much individuals can borrow from financial institutions and empirically tested the model by applying it to the Irish property market. The authors discovered that a larger amount of credit received by households would lead to greater home prices where the level of borrowing hinges on current interest rates and levels of disposable income.

Since houses eventually depreciate over time, depreciation of houses inevitably leads to higher user costs as a result of increased maintenance. Apart of these maintenance expenses are construction costs which have the potential to lower housing demand if it is too high. This is evident when DiPasquale and Wheaton (1996) stated that a rise in construction costs leads to a reduction in the construction and supply of new homes, thus increasing both rent prices and home prices.

Demographic factors are also influential in determining home prices. Between 1980 and 2000, home ownership with those aged 25 to 44 fell significantly, despite a period of time where homeownership seemingly should have been easier to obtain (Fisher & Gervais, 2011). This decline in homeownership rates was documented by Mankiw and Weil (1989) where a significant relationship between population demographics and home prices were discovered. Moreover, the authors conclude in their research that the number of births over time have led to robust and predictable changes in housing demand. Similarly, Levin et al. (2009) examined the impact of demographic change, specifically the effect of population size, age and income, in Scotland and England/Wales. From these fundamental variables, the researchers found a statistically significant relationship between home prices and demographic factors. Moreover,

they found that the growth rate in the age-groups associated with first-time buyers is also significantly related to changes in overall home prices.

Although this list is not all-inclusive, it is conclusive that predictors of real estate price changes can come in various forms. Ghysels et al. (2012) listed a plethora of the most successful forecasting variables including: rent-to-price and income-to-price ratios; local economic variables, such as employment rates, income, and construction costs; demographic trends; housing starts; vacancy rates; measures of leverage and monetary policy action. As a result, it can be concluded that a myriad of fundamental variables has influenced the change of home prices in select markets. Since previous sections have illustrated that home prices have grown at an abnormally high rate, and this section has provided a comprehensive summary of the variables that should derive the prices of housing, an analysis of the current state of the housing market is warranted through the use of these variables, of which will be explained in section three of this study.

## **2.6 Causes of the Previous Housing Bubble**

After obtaining a comprehensive understanding of the fundamental values that determine home prices, it is important to briefly review which of these variables contributed to the previous housing bubble crash. This housing bust period began shortly after housing prices peaked in 2006 where, over the course of five years, home prices would drop by 32.7% in 2011, the largest margin in their history (Christie, 2011). Although the general consensus is that the burst of the housing bubble in the United States served as a prerequisite to the financial crisis of 2007 to 2009, it is not surprising that economists have different opinions regarding the primary causes of this event. For instance, views regarding the cause of this phenomenon often range from an

emphasis on the aggressive monetary policy enacted by the Federal Reserve to a plethora of external factors that disregard the Fed's impact entirely.

Starting with the effects of monetary policy, many accredited economists cite the abnormally low federal funds rate, or interest rate, as a primary factor that influenced this event. For example, economist John Taylor argued that the Federal Reserve kept the federal funds rate too low during the critical period between 2002 and 2005 and argues that if the Fed had followed his "Taylor Rule"—a general guideline for central banks based on rates of asset-price inflation, GDP, and levels of income—and increased the federal funds rate by three percent to match his calculated rate, Taylor argues that the bubble could have been avoided (Taylor, 2009, as cited in McDonald & Stokes, 2011). This is evident as the Financial Crisis Inquiry Commission (2011) observed that in 2003 a 90-day commercial paper could be borrowed by the strongest U.S. companies at an average of 1.1%, far below Taylor's rate, in comparison to 6.3% only three years prior. In addition, the commission also states that rates on three-month Treasury bills dropped below 1% in mid-2003 from 6% from three years ago as well, drastically cutting the cost of homeownership while also sparking demand.

Schwartz (2009) agrees with Taylor (2009) in that expansive monetary policy was a leading cause of the housing bubble, stating that the asset boom was propagated by lower interest rates that enticed borrowing beyond normal pragmatic limits. Moreover, Schwartz (2009) argues that Fed was slow to tighten its monetary policy, thus giving the government a pivotal role in stimulating demand for homes by indirectly proselytizing the advantages of home ownership. McDonald & Stokes (2011) would seek to investigate these claims of low interest rates having a profound effect on the run-up in home prices. Within their study, the authors conduct Granger causality analyses and VAR modeling between the S&P/Case-Shiller housing price index and

federal funds rate data. Following their tests, McDonald & Stokes (2011) concluded that the relationship between home prices and interest rates were consistent with the hypothesis that the Fed's use of expansive monetary policy was at least one important cause of the housing bubble. In addition, the results from their analysis divulge that positive shocks in interest rates have a negative effect on home prices while positive shocks in home prices have a positive impact on interest rates, a finding consistent with the existence of a housing bubble (See Appendix F).

On the other hand, Shiller (2009, as cited in McDonald & Stokes, 2011) takes a different position on the issue stating that very loose monetary policy should not be seen as an exogenous cause of the bubble since monetary policy was dictated by the current economic climate following the stock market bubble of the late 1990's. Moreover, Shiller (2009) argued that many of the widely cited causes of the housing bubble—such as loose lending standards that led to a surplus of subprime mortgages—were caused by rising home prices, not vice versa. Krugman (2009, as cited in McDonald & Stokes, 2011) would add to Shiller's theory by positing that the rise of home prices led many to abandon the traditional principles surrounding mortgage lending practices which caused these ever-growing home prices to encourage even more loose credit standards, creating a virtuous cycle. Zandi (2009) would also provide a myriad of other causes of the housing bubble, including but not limited to the ever-growing U.S. trade deficit, low interest rates from other central banks, rating agencies, and financial innovations.

Roubini and Mihm (2010) discuss the impact of financial innovation and how it may have been a catalyst for the impending housing bubble as companies began slicing and dicing “junk” mortgages and selling them as if they were of AAA quality. In terms of subprime loans, lenders during this time often extended credit to borrowers previously unable to qualify for loans in the desire for higher returns. From 2003 to 2005, the percent of subprime mortgage

originations rose from 8% to 20%, respectively (Alexander et al., 2008). Moreover, over 75% of the subprime loans that originated during this period were referred to as “short-term hybrids” in which the rate of interest was fixed for the first few years—often called a “teaser” rate to entice new borrowers—until it eventually became a floating rate tied to the market (Mayer et al., 2008).

As a result of these “favorable” rates, a wave of optimistic beliefs would ensue during this period that enticed lenders to endogenously expand cheaper credit to risky borrowers. Kaplan et al. (2017) argued that because of these beliefs, the housing boom and bust of the 2000’s was triggered by shifts in expectations regarding the growth of future home prices. For example, societal influences would play a significant role in the growth of home prices as promotion of homeownership by the media skyrocketed during this time, with the overall U.S. homeownership rate increasing from 64% in 1994 to an all-time high of 69.2% in 2004 (United States Census Bureau, 2021). In late 2005, television programs promoting real estate investing and flipping became abundant with new shows such as *House Hunters* and *What You Get for the Money* on HGTV (Wiltz, 2005). In addition, this mania for homeownership created a boom for the real estate profession with the number of real estate licensees in California in 2005 soaring to 476,000, a 14% increase from the previous year and a 57% percent increase from five years prior (Davi, 2006).

It is clear that the media and the rise of the internet played a prominent role in spiking demand for homeownership, similarly to how newspapers played a decisive role in the early history of “speculative bubbles” and how telephones played a role in the stock market of the late 1920’s (Askitas, 2016). Even today it is evident that the advent of the internet and social media has played a pivotal role in influencing today’s market with these mediums offering modern-day economists’ new ways to analyze and interpret the wealth of data that is available. For instance,

Askatas (2016) created a time series of weekly ratios of Google searches in the United States between the terms “buy” and “sell” in the real estate category of Google Trends and named it the BUSE (buyers-sellers) index. Within the study, it is found that the BUSE index had a significant correlation with the S&P/Case-Shiller National Home Price Index with the author concluding that the index can be used to better understand the dynamics of supply and demand in the U.S. housing market. Recreating the BUSE index with updated data from Google Trends, it can be observed that the frequency of “buy” and “sell” searches were quite close in volume in the lead up to the bubble; from 2009, however, a clear divergence can be seen between the two search terms (See Appendix G).

Although economists continue to cite their reservations in regards to what the primary cause of the housing bubble was, it is clear that a wide array of factors were responsible for the housing boom of the early- to mid-2000’s. In addition, this section illustrates how housing bubbles can be so unique fundamentally, with the lead up to the housing bubble during this time mainly caused by an oversupply of homes in contrast today’s general lack of supply (Haughwout et al., 2012). Consequently, understanding the nuances that make up and contribute to housing booms and busts is imperative to understanding how housing bubbles emerge.

### **3. Empirical Analysis**

#### **3.1 Methodology**

As stated by Siegel (2003), it is extremely difficult, and in some cases nearly impossible, to know in real time whether a market is currently in a bubble, due to the extremely heterogenous and illiquid nature of real-estate assets. While past studies have focused on what particular variables influence home prices, few have run assessments between two periods to see if a run-up period to a potential bubble diminishes these variables’ influence. To provide an answer to

this dilemma, Arshanapalli & Nelson (2008) sought to discover a way to detect this phenomenon by using past studies that have identified statistically significant variables and incorporating them into an experiment to see if run-up periods to a bubble do in fact diminish a variable's influence.

Within this study, the authors used quarterly data from two time periods—1975 to 2000 and 1975 to 2007—to determine if the latter period, which included the run-up to the past housing bubble, saw significantly less influence from the variables that would normally describe changes in home prices. Moreover, the authors achieved this by using a cointegration test—a technique used to find a possible correlation between time series data in the long term—and concluded that “...the linkage between home prices and the fundamental variables weakened substantially after 2000” and posited that the presence of a growing housing bubble was a main factor for this deviation.

In this study, a similar approach is intended to be utilized. Similar to the model created by Arshanapalli & Nelson (2008), the periods of 1994 to 2004 and 1994 to 2007 will be analyzed. The year 2004 was selected as the start since this is approximately the time when the phrase “Housing Bubble” became heavily prominent in English literature (See Appendix A). In addition, the same method will be conducted using the data from 2008 to 2018 and 2008 to 2021 with the results compared to the deviations observed from the previous bubble, all of which use quarterly compiled data. In order to standardize the data and to eliminate patterns in residuals, the data was converted to percentage change from the previous period. Furthermore, the residuals in this study were checked for normality, thus allowing the data to be used for regression. In addition to these two tests, a control analysis of the entire period from 1994 to 2021 will be conducted as well. To generate these results, multiple linear regression will be utilized with quarterly percentage

change data of one dependent variable regressed against ten independent variables to compare the influence of the fundamental values that should, in theory, derive the value of home prices.

### **3.2 Data**

As discussed in previous sections, there are a myriad of variables that have been statistically proven to drive the value of home prices. The independent variables that will be used in this study are sourced from Section 2.5 and include: Unemployment (Abelson et al., 2005; Ghysels et al., 2012), Consumer Price Index (Abelson et al., 2005; Ghysels et al., 2012), Interest Rates (Sutton, 2002; Caspi, 2015), Housing Starts (Abelson et al., 2005; Ghysels et al., 2012), Rent Costs (Hendershott et al., 1980; Ghysels et al., 2012), Construction Costs (Muellbauer & Murphy, 2008; DiPasquale and Wheaton, 1996), Mortgage Rates (McCarthy & Peach, 2004; Hendershott et al., 1980), Price-Rent Ratio (Kivedal, 2012; Caspi, 2015), Personal Income (Case & Shiller, 2003; Sutton, 2002), and Debt Payments (Caspi, 2015; McQuinn & O'Reilly, 2008). Although many variables have been proven to be statistically significant in the past, these specific variables were chosen to be the independent variables for this study due to their format and availability.

The home price variable was imported from the S&P CoreLogic Case-Shiller U.S. National Home Price Index which measures the value of single-family housing within the United States compiled monthly from the nine U.S. Census divisions. The unemployment rate metric is sourced from the U.S. Bureau of Labor Statistics and represents the number of unemployed individuals as a percentage of the labor force. In addition, the consumer price index (CPI) is also obtained from the U.S. Bureau of Labor Statistics and represents the average monthly change in the price for goods and services paid by urban consumers between any two time periods. The interest rate variable is compiled from the International Monetary Fund (IMF) and represents the

discount rate for the United States which is updated on a monthly basis. The housing starts metric refers to new residential construction of single-family units reported monthly in the United States from both the U.S. Census Bureau and the U.S. Department of Housing and Urban Development. The average cost of rent statistic is reported on a monthly basis and is compiled as a subsection of the consumer price index by the U.S. Bureau of Labor Statistics.

Total construction spending is reported on a monthly basis by the U.S. Census Bureau and represents the average total cost of construction in the United States. The 30-Year Fixed Rate Mortgage is provided by Freddie Mac on a weekly basis and refers to the current mortgage rate of the market for borrows. The Price-Rent ratio is found by dividing the S&P CoreLogic Case-Shiller U.S. National Home Price Index by the average monthly rental cost. The real disposable personal income per capita statistic is released on a monthly basis by the U.S. Bureau of Economic Analysis. Finally, debt payments refer to the quarterly household debt service payments that are paid as a percent of disposable personal income and is provided by Board of Governors of the Federal Reserve System. For each initial test period, each variable will consist of 40 observations (since these periods consist of 10 years compiled quarterly); each variable in subsequent tests that include the run-up to a housing bubble will consist of 52 observations (since these periods consist of 13 years compiled quarterly).

### 3.3 Empirical Results

The results of each regression are listed in tables 1-5 with each test period (consisting of the bubble and non-bubble period) on its own dedicated page. Table 1 is listed first and provides the results of the control test of the entire period. Tables 2&3 provide the results of the run-up to the previous bubble (1994 – 2007) and tables 4&5 provide the results of the run-up to the today's potential bubble (2008 – 2021). The regression formula used for this analysis is listed below:

$$\hat{y}_t = \beta_0 + \beta_1 U_t + \beta_2 CPI_t + \beta_3 I_t + \beta_4 S_t + \beta_5 R_t + \beta_6 C_t + \beta_7 M_t + \beta_8 PR_t + \beta_9 PI_t + \beta_{10} D_t + \varepsilon_t$$

Where:

$\hat{y}$	= Mean $\Delta$ of Home Prices
U	= $\Delta$ Unemployment
CPI	= $\Delta$ Consumer Price Index
I	= $\Delta$ Interest Rates
S	= $\Delta$ Housing Starts
R	= $\Delta$ Rent Costs
C	= $\Delta$ Construction Costs
M	= $\Delta$ Mortgage Rates
PR	= $\Delta$ Price-Rent Ratio
PI	= $\Delta$ Personal Income
D	= $\Delta$ Debt Payments
$\varepsilon$	= Error Term

**Table 1***Coefficients (1994 — 2021)*

	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
<b>(Intercept)</b>	0.882	0.392	2.248	0.027
<b>Δ Unemployment</b>	0.019	0.007	2.739	0.007
<b>Δ Consumer Price Index</b>	-0.176	0.246	-0.713	0.477
<b>Δ Interest Rates</b>	0.016	0.006	2.578	0.011
<b>Δ Housing Starts</b>	0.069	0.016	4.178	6.44E-05
<b>Δ Rent Costs</b>	-0.227	0.480	-0.473	0.637
<b>Δ Construction Costs</b>	0.224	0.060	3.711	3.44E-04
<b>Δ Mortgage Rates</b>	0.019	0.020	0.947	0.346
<b>Δ Price-Rent Ratio</b>	0.012	0.007	1.689	0.094
<b>Δ Personal Income</b>	0.381	0.170	2.244	0.027
<b>Δ Debt Payments</b>	0.487	0.145	3.347	0.001
<b>Multiple R-squared</b>	0.543	<b>F-statistic (10 &amp; 97 DF)</b>	11.53	
<b>Adjusted R-squared</b>	0.4959	<b>F-statistic (p-value)</b>	8.37E-13	

When analyzing the output of Table 1, the multiple  $R^2$  value is 0.543, meaning that the model explains 54.3% of the total variance in home prices, an expected score since the period includes the housing bust. The adjusted  $R^2$  value is also given as 0.4959, or 49.59%. Although it is typical to use the adjusted  $R^2$  score, this study focuses on the  $R^2$  score since the goal is to see which periods become weaker when all the independent variables are weighted equally. In addition, each test period will show varying levels of significance between variables; as a result, the  $R^2$  values will be used for comparison to ensure all tests are similar and weighted equally.

In terms of the validity of the model, the f-statistic illustrates the statistical significance for the model as a whole while the t-statistic illustrates the statistical significance for each individual variable along with its corresponding p-value. Since  $F(10,97) = 11.53$  and the p-value is less than 0.01, it can be confirmed with 99% certainty that at least one of the betas of the model is not equal to 0.

Table 2

*Coefficients (1994 — 2004)*

	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
<b>(Intercept)</b>	-1.131	0.414	2.736	0.011
<b>Δ Unemployment</b>	-0.033	0.023	-1.471	0.152
<b>Δ Consumer Price Index</b>	0.218	0.300	0.726	0.474
<b>Δ Interest Rates</b>	0.001	0.003	0.401	0.691
<b>Δ Housing Starts</b>	0.009	0.019	0.475	0.638
<b>Δ Rent Costs</b>	2.402	0.442	5.428	7.73E-06
<b>Δ Construction Costs</b>	-0.029	0.059	-0.496	0.624
<b>Δ Mortgage Rates</b>	-0.013	0.016	-0.813	0.423
<b>Δ Price-Rent Ratio</b>	0.383	0.050	7.632	2.05E-08
<b>Δ Personal Income</b>	-0.130	0.155	-0.840	0.408
<b>Δ Debt Payments</b>	-0.188	0.120	-1.563	0.129
<b>Multiple R-squared</b>	0.7438	<b>F-statistic (10 &amp; 29 DF)</b>	8.418	
<b>Adjusted R-squared</b>	0.6554	<b>F-statistic (p-value)</b>	3.08E-06	

Table 3

*Coefficients (1994 — 2007)*

	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
<b>(Intercept)</b>	-1.073	0.517	-2.073	0.044
<b>Δ Unemployment</b>	-0.011	0.027	-0.391	0.698
<b>Δ Consumer Price Index</b>	0.219	0.292	0.749	0.458
<b>Δ Interest Rates</b>	0.003	0.004	0.753	0.456
<b>Δ Housing Starts</b>	0.017	0.022	0.779	0.440
<b>Δ Rent Costs</b>	1.797	0.505	3.559	9.57E-04
<b>Δ Construction Costs</b>	0.143	0.069	2.077	0.044
<b>Δ Mortgage Rates</b>	-0.035	0.018	-1.923	0.061
<b>Δ Price-Rent Ratio</b>	0.439	0.055	8.048	5.70E-10
<b>Δ Personal Income</b>	-0.040	0.181	-0.223	0.824
<b>Δ Debt Payments</b>	-0.093	0.144	-0.649	0.520
<b>Multiple R-squared</b>	0.7269	<b>F-statistic (10 &amp; 41 DF)</b>	10.91	
<b>Adjusted R-squared</b>	0.6603	<b>F-statistic (p-value)</b>	9.67E-09	

Table 4

*Coefficients (2008 — 2018)*

	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
<b>(Intercept)</b>	1.512	0.649	2.330	0.027
<b>Δ Unemployment</b>	-0.073	0.051	-1.426	0.165
<b>Δ Consumer Price Index</b>	-0.397	0.325	-1.220	0.232
<b>Δ Interest Rates</b>	0.018	0.016	1.158	0.256
<b>Δ Housing Starts</b>	0.049	0.024	2.040	0.051
<b>Δ Rent Costs</b>	-1.013	0.775	-1.307	0.201
<b>Δ Construction Costs</b>	0.131	0.090	1.460	0.155
<b>Δ Mortgage Rates</b>	0.049	0.028	1.740	0.092
<b>Δ Price-Rent Ratio</b>	0.008	0.007	1.265	0.216
<b>Δ Personal Income</b>	0.382	0.405	0.942	0.354
<b>Δ Debt Payments</b>	0.685	0.374	1.831	0.077
<b>Multiple R-squared</b>	0.7699	<b>F-statistic (10 &amp; 29 DF)</b>	9.703	
<b>Adjusted R-squared</b>	0.6906	<b>F-statistic (p-value)</b>	7.33E-07	

Table 5

*Coefficients (2008 — 2021)*

	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr(&gt; t )</b>
<b>(Intercept)</b>	1.845	0.567	3.255	0.002
<b>Δ Unemployment</b>	0.025	0.008	3.030	0.004
<b>Δ Consumer Price Index</b>	-0.253	0.301	-0.840	0.406
<b>Δ Interest Rates</b>	0.023	0.012	1.895	0.065
<b>Δ Housing Starts</b>	0.060	0.019	3.182	0.003
<b>Δ Rent Costs</b>	-1.427	0.700	-2.037	0.048
<b>Δ Construction Costs</b>	0.202	0.072	2.807	0.008
<b>Δ Mortgage Rates</b>	0.052	0.025	2.072	0.045
<b>Δ Price-Rent Ratio</b>	0.009	0.006	1.454	0.154
<b>Δ Personal Income</b>	0.690	0.304	2.266	0.029
<b>Δ Debt Payments</b>	0.916	0.286	3.204	0.003
<b>Multiple R-squared</b>	0.7246	<b>F-statistic (10 &amp; 41 DF)</b>	10.79	
<b>Adjusted R-squared</b>	0.6574	<b>F-statistic (p-value)</b>	1.14E-08	

Upon running the four main tests, it is clear that in each period that included the run-up (or potential run-up) to the housing bubble, the model was able to explain slightly less of the total variance in home prices. For instance, the multiple  $R^2$  values for the periods 1994 to 2004 and 1994 to 2007 decreased ~2% from 74.38% to 72.69%, respectively. Similarly, the multiple  $R^2$  values for the periods 2008 to 2018 and 2008 to 2021 decreased ~4% from 76.99% to 72.46%, respectively. Moreover, while many variables are not found to be statistically significant on their own, the f-statistic for each calculation illustrates the model together is valid and statistically significant. As a result, this is most likely why the adjusted  $R^2$  value actually increased in the first test since less variables were found to be statistically significant in comparison to the second test. To test for this potential problem, each study was re-calculated after eliminating the least statistically significant variable from each model. Upon conducting this experiment, the results were extremely close to the results that were found originally thus confirming that as long as the variables have been proven in some form to influence home prices, similar results can be obtained no matter the variables that are used.

Another important observation is that although each test has varying changes to each variable's coefficients and standard errors, the t-values almost always increase when including the bubble run-up period. Consequently, since higher t-values indicate that a large difference exists between two sample sets, this data provides another indication that home prices are deviating from their fundamental values when the bubble run-up periods are included. Perhaps the most interesting observation is in regards to the 2% increase in the  $R^2$  from the contemporary period relative to the past period. This increase is most likely due to the extraordinary and aggressive monetary and fiscal response to the Coronavirus pandemic throughout 2020.

## 4. Conclusion

### 4.1 Implications

Throughout this paper, information was provided to answer the questions of why the housing market is important, what housing bubbles are, what asset-price inflation is and how its presence today is a cause for concern. Moreover, subsequent sections analyzed the history of gathering market data, discovering what the “fundamental values” that influence home prices are, and identifying which of those variables were responsible for the past housing bubble. From this data, it is clear that housing bubbles are as rare as they are unique and has caused many economists such as Siegel (2003) to argue that is nearly impossible to tell in real-time if a bubble is occurring.

Although the conditions regarding the state of economy is different from the one that occurred nearly a decade ago, analyzing the data that economists have access to in our modern-day economy allow for the study of the short- and medium-terms, rather than the long-term. Upon using this information, economists have discovered a plethora of variables that have impacted changes in home prices in some way, such as Ghysels et al.’s (2012) list of some of the most successful forecasting variables such as: rent-to-price and income-to-price ratios; local economic variables, such as employment rates, income, and construction costs; demographic trends; housing starts; vacancy rates; measures of leverage and monetary policy action. Furthermore, it was able to be determined that expansionary monetary policy, along with high levels of debt and an ever-growing mantra for homeownership, contributed heavily to prior housing bubble.

The rapid growth of home prices in recent years, along with the plummeting supply of homes, should force investors to be cautious regarding the economic outlook in the future. The

parallels between the run-up period to the previous bubble and today provide a wealth of inferences on the current state of the economy. From these multiple linear regression models, the periods that included the run-up periods were able to explain slightly less of the total variance in home prices, thus illustrating these prices did diverge from the fundamental values that are meant to define them. Similar to how investors conduct financial analyses of firms relative to other companies from the same industry, comparing the deviation in  $R^2$  scores between these similar periods provides an economist context. From these results, it is clear that the deviation of home prices from their fundamental values is actually more severe today than nearly two-decades ago. As a result, the rapid rise in home prices in conjunction with the deviation in home prices from their fundamentals should, at the minimum, signify the possibility that another housing bubble may exist. Although its existence cannot be definitively concluded, it is undeniable that another housing bust equal to or greater than the magnitude of the previous one has the potential to severely threaten the stability of the market and the financial security of its participants if gone unchecked.

#### **4.2 Limitations and Further Research**

The general lack of significance between individual variables can most likely be attributed to the data that was used to conduct this study. First, quarterly data had to be used to eliminate patterns in each model's residuals which severely limited the sample size to forty per variable. In addition, the contemporary nature of this study—along with data only going back roughly two decades—also created burdens on the sample size of the study. Other limitations include omitting certain variables due to certain data sets being unable to fit within the study's time frame. In addition, certain variables were left out the calculations for simplicity that could be used in future studies, such as demographic trends, taxation benefits or opportunity costs.

Moreover, using regression might have not been the best statistical tool due to the data being a time series, which can create patterns in the model's residuals and introduce additional issues such as autocorrelation. These particular issues could be corrected in future studies by using statistical analyses that are more responsive to time series data, such as cointegration tests that were used by Arshanapalli & Nelson (2008). Moreover, future tests can apply the same methodology to other types of asset-bubbles that have more data to work with, such as equity boom and bust periods. In addition, this study could be expanded to include variables that were omitted due to simplicity reasons—such as demographic trends and tax benefits—as well as more unorthodox variables such as Google Trend data that was excluded due to the available data not covering the entire span of the study.

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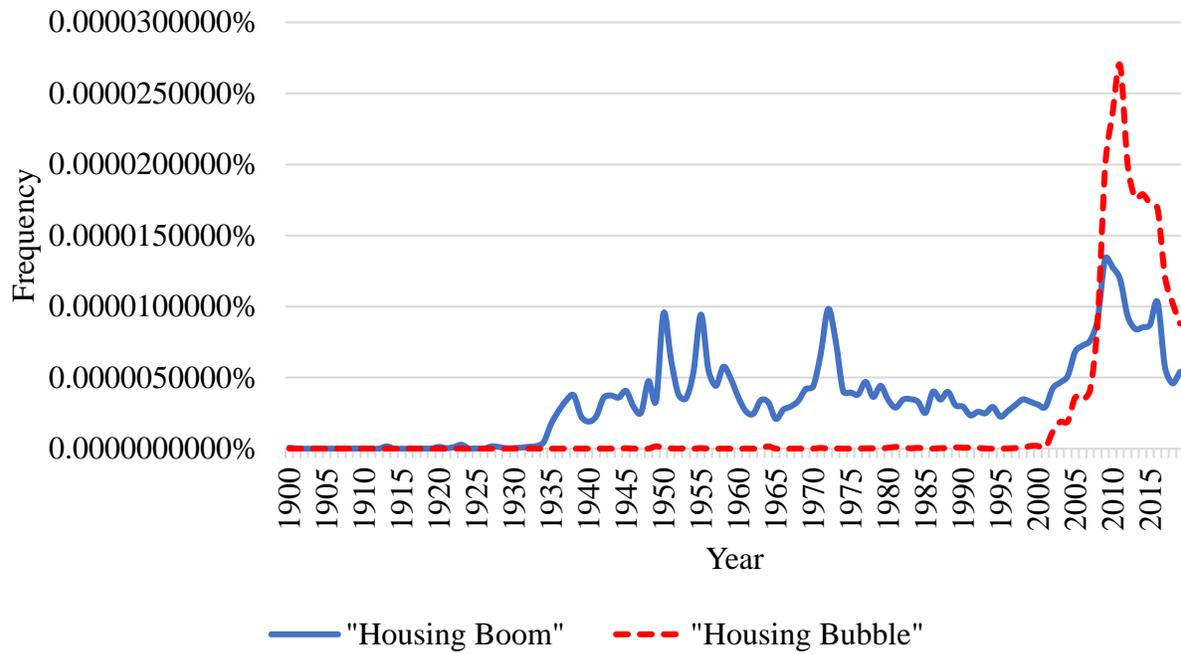
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Appendix A

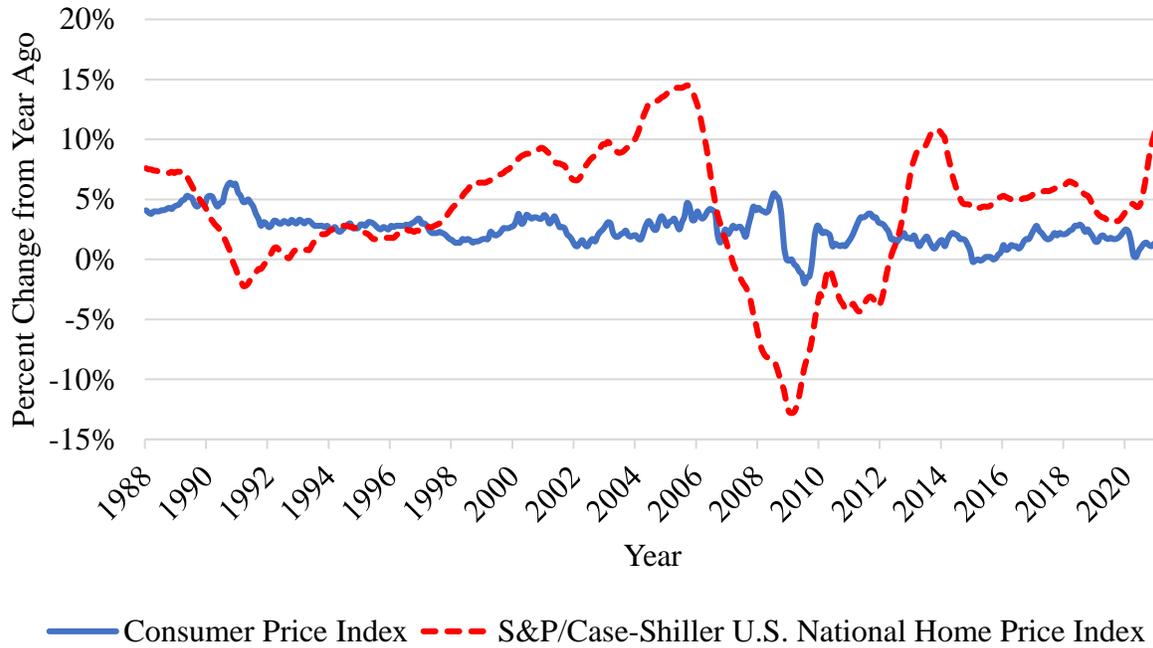
*"Housing Boom" vs "Housing Bubble"*



*Note:* The above graph illustrates the frequency of the terms “Housing Boom” and “Housing Bubble” in English literature since 1900. Retrieved from [https://books.google.com/ngrams/graph?content=housing+boom%2Chousing+bubble&year\\_start=1900&year\\_end=2019&corpus=26&smoothing=3](https://books.google.com/ngrams/graph?content=housing+boom%2Chousing+bubble&year_start=1900&year_end=2019&corpus=26&smoothing=3)

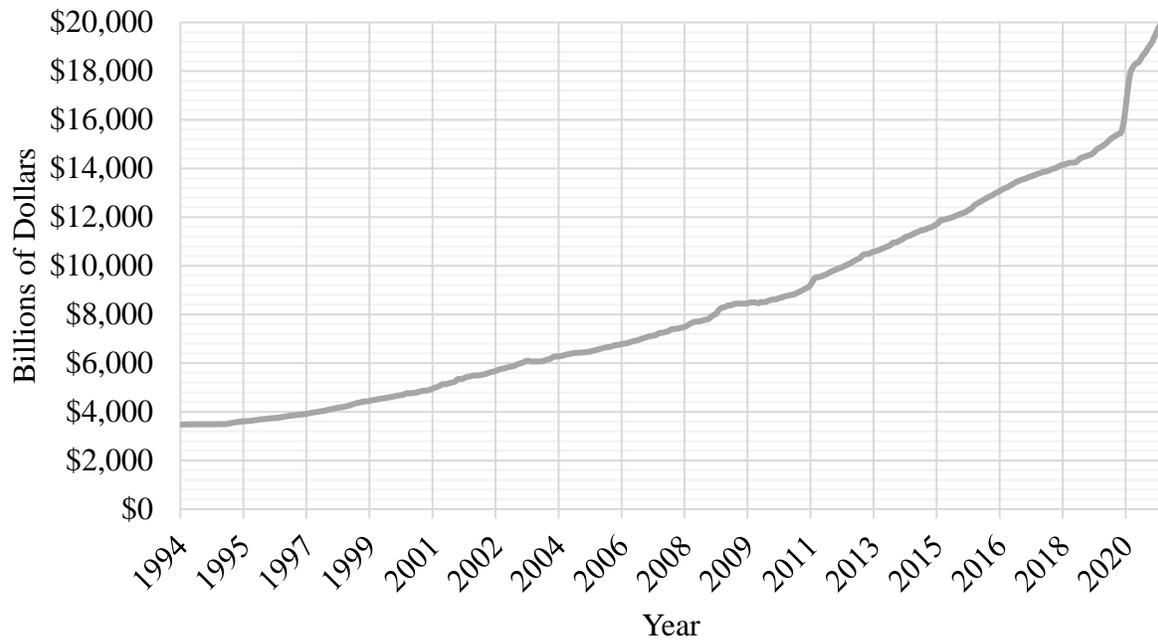
**Appendix B**

*CPI vs Home Prices*



*Note:* The above graph illustrates the percent change from a year ago values between the consumer price index (nominal inflation) and the S&P/Case-Shiller U.S. National Home Price Index (asset-price inflation). Adapted from Federal Reserve Bank of St. Louis. (2021). Retrieved from <https://fred.stlouisfed.org/series/CPIAUCSL> and <https://fred.stlouisfed.org/series/CSUSHPINSA>.

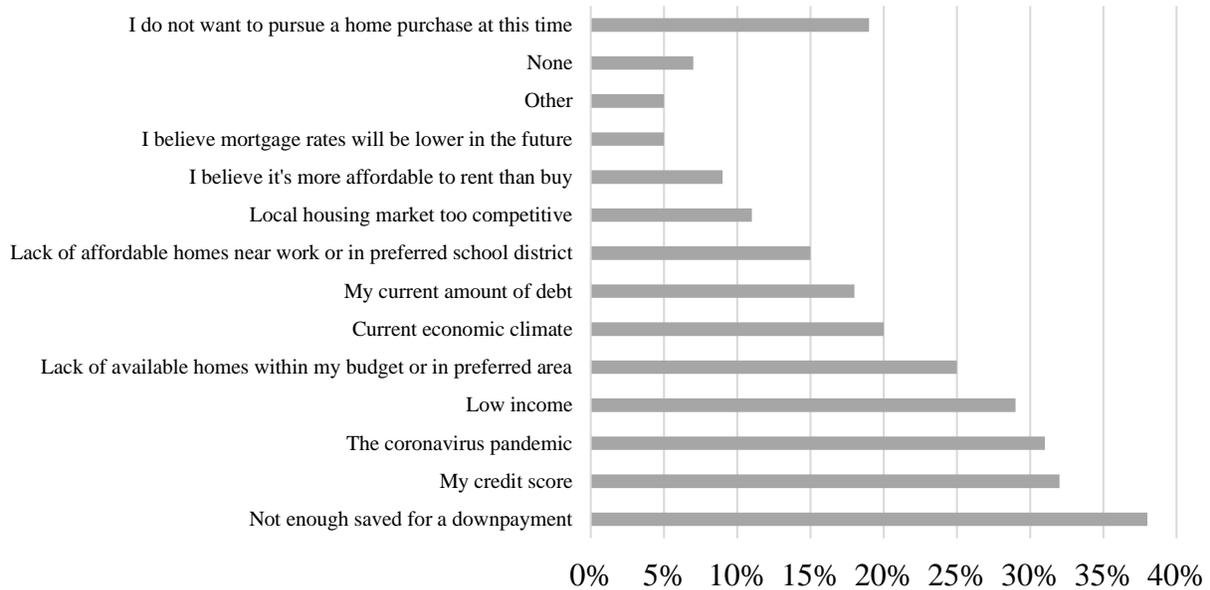
## Appendix C

*M2 Money Stock*

*Note:* The above graph illustrates the growth of M2 Money stock from the year 1994 to mid-2020. Adapted from Federal Reserve Bank of St. Louis. (2021). Retrieved from <https://fred.stlouisfed.org/series/M2SL>.

**Appendix D**

***"Which of the following are preventing you from pursuing homeownership at this time?"***

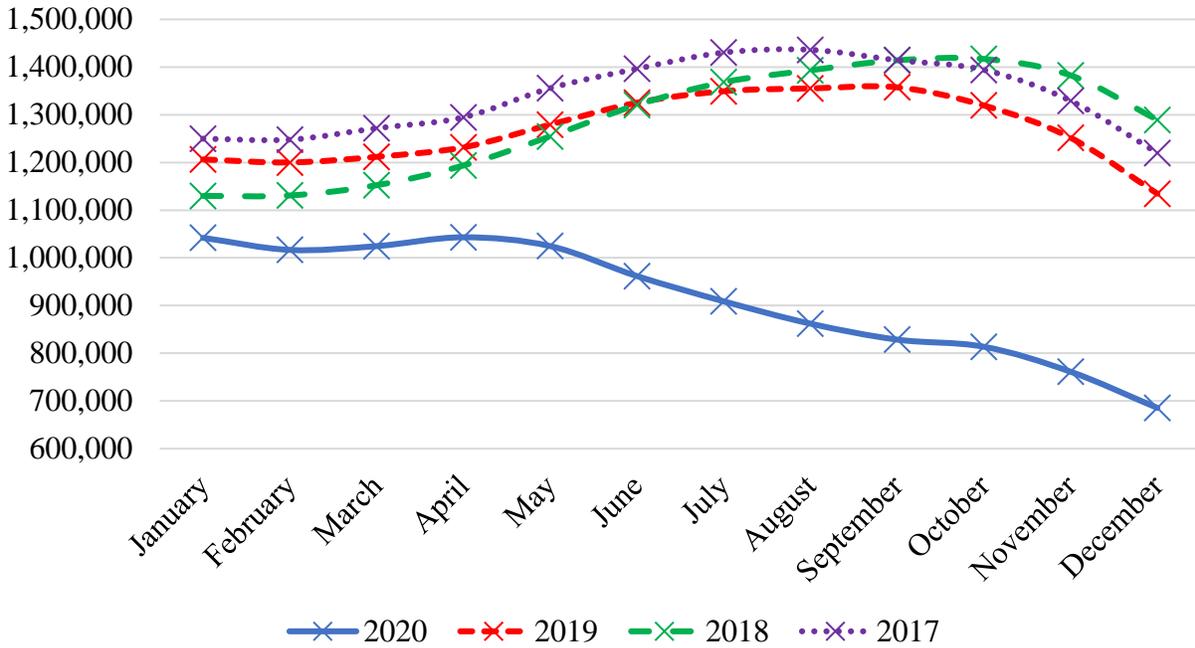


*Note:* The above bar graph lists the frequency of responses that non-homeowners cited that they believe hinder their ability to purchase a home. Respondents could select multiple responses.

Adapted from a *New York Times* survey conducted online by The Harris Poll among 675 nonhomeowners. Retrieved from <https://www.nerdwallet.com/blog/2021-home-buyer-report/>.

Appendix E

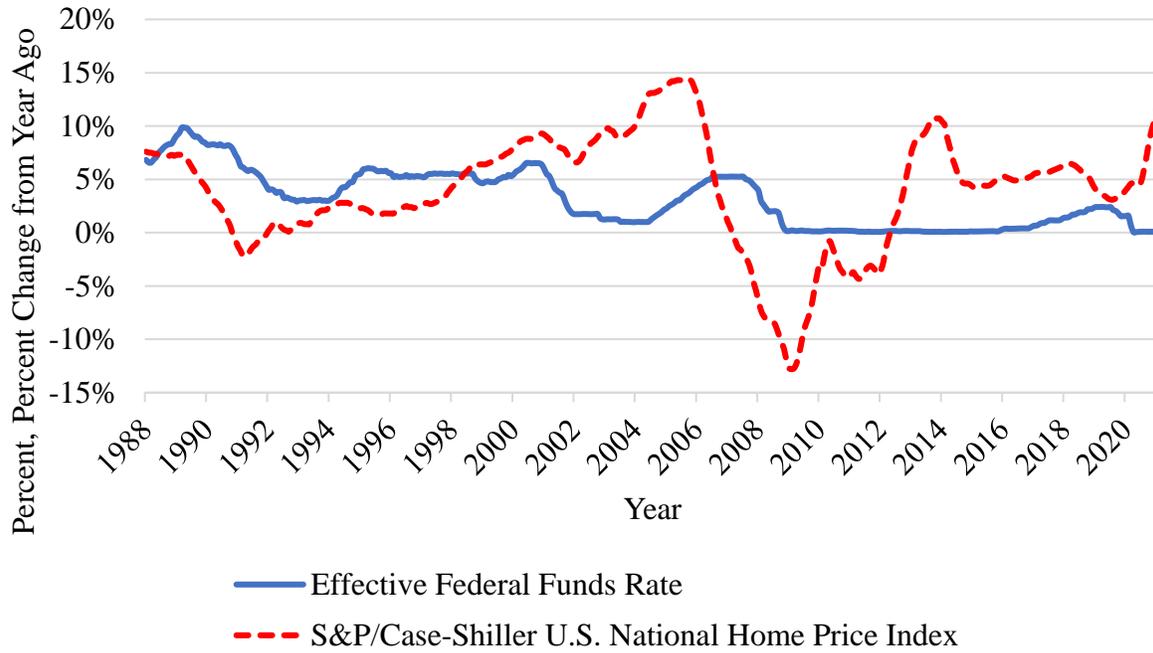
*Active Listings in the United States*



*Note:* The above graph illustrates the number of active listings in the United States for the years 2017, 2018, 2019, and 2020. Adapted from realtor.com. Retrieved from <https://www.nerdwallet.com/blog/2021-home-buyer-report/>.

Appendix F

*Interest Rates vs Home Prices*

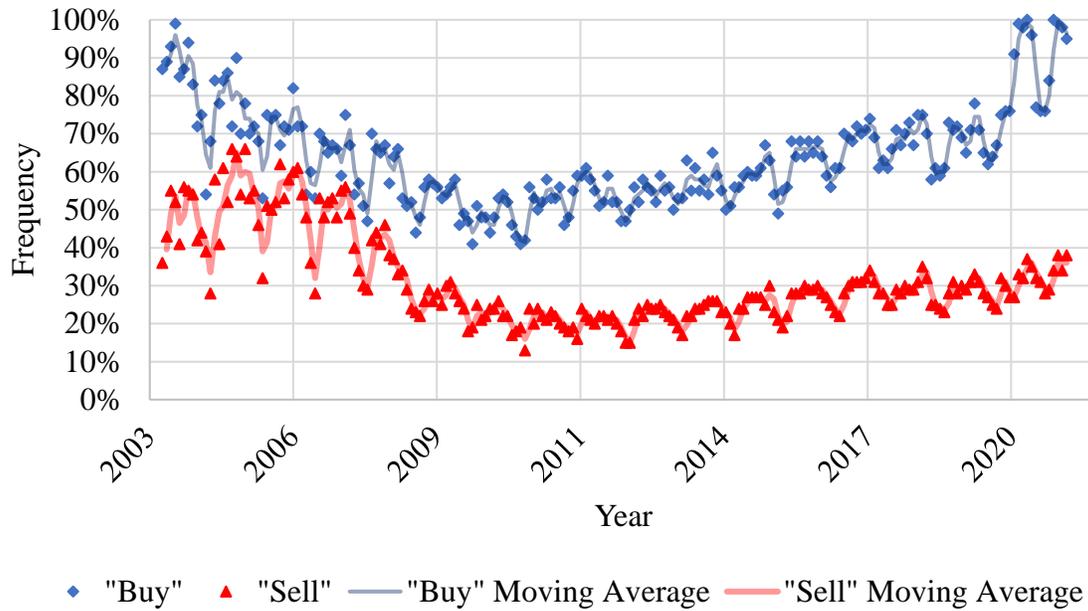


*Note:* The above graph illustrates the impact of the current level of interest rates (%) against changes in the S&P/Case-Shiller U.S. National Home Price Index (% change from a year ago).

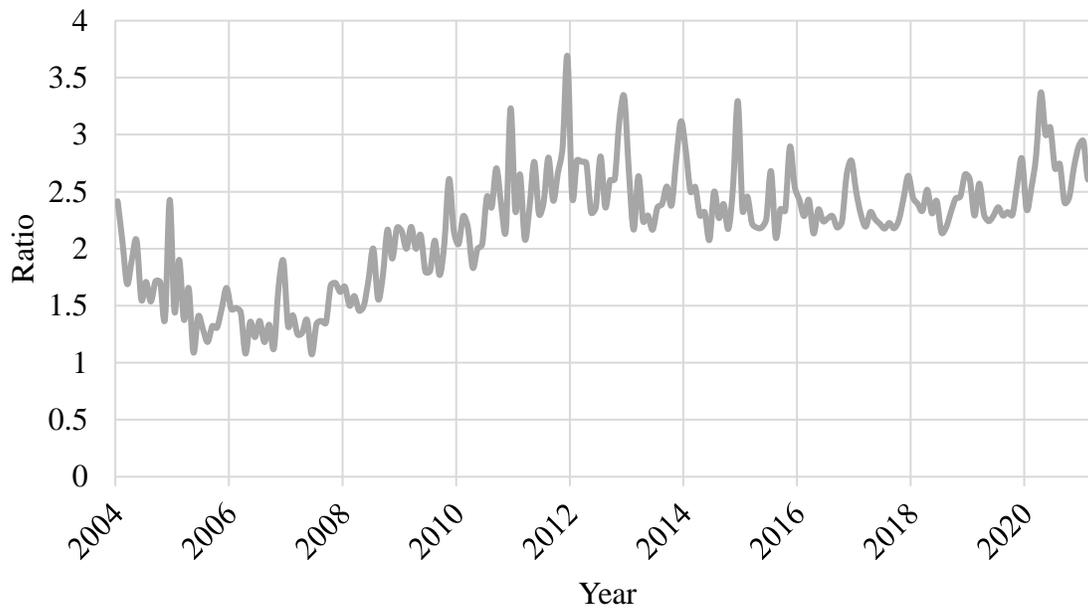
Adapted from Federal Reserve Bank of St. Louis. (2021). Retrieved from <https://fred.stlouisfed.org/series/FEDFUNDS> and <https://fred.stlouisfed.org/series/CSUSHPINSA>.

Appendix G

*Google Trends: "Buy" vs "Sell" Search Frequency*



*Google Trends: "Buy"/"Sell" Ratio*



*Note:* The above graphs show frequency of “buy” and “sell” searches in the real estate category from 2004 to mid-2021. Adapted from Google Trends. Retrieved from <https://trends.google.com/trends/explore?cat=29&date=all&geo=US&q=buy,sell>.