DETERMINANTS OF THE HOME PRICE- INCOME RELATIONSHIP: 1990-2011

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ABSTRACT

Many studies have attributed the housing bubble or misalignment of home price and income to inefficient markets, irrational behavior, excessive leverage, financial innovations, macroeconomic imbalances, the Fed's easy money policy, and repeal of the Glass-Steagal Act. However, no study has actually looked at data for the past two decades to determine whether these factors do explain the movement in the home price relative to income in the United States. This study uses reduced form models to find the determinants of the income/home price ratio using data over the period 1990 to 2011. We find empirical support that lagged values of household debt and foreign indirect investment are significant predictors of movements in the income/home price ratio. Our results confirm that although the conventional mortgage rate has a stronger negative association with the income/home price ratio, the federal funds rate is a significant determinant as well. This supports the view that keeping the federal funds rate target too low for too long could prolong a misalignment between disposable income and home price. This study also identifies the inception of a housing bubble on a national scale by using the 20-year trend in a home affordability index as a benchmark.

JEL: E50, G18

KEYWORDS: housing bubble, debt, macroeconomic imbalance, monetary policy, financial deregulation

INTRODUCTION

Following a slight decline during the recession of the early 1990s, the average price of homes in the United States remained fairly stable until June 1997, then began its steep climb until its peak in the first quarter of 2006. The Case-Shiller Home Price index almost tripled from 79.91 in June 1997 to 226.38 in March 2006. The National Association of Realtors (NAR) home affordability index, which relates the median price of single-family homes to the median family income, fell below trend beginning in the first quarter of 2004, and reversed its decline when the bubble burst in the second quarter of 2006.

The inventory of foreclosed homes increased first in the states of California, Nevada, Arizona and Florida, but by Spring of 2008 housing prices fell nationwide, and the U.S. economy went into a recession more severe than any other cyclical downturn since the Great Depression. The fiscal stimulus and the loans to, and equity infusions into, large financial institutions necessitated by the financial crisis amounted to about $1.5 trillion. While real GDP has consistently increased since the third quarter of 2009, the housing and job markets have not fully recovered. By now there is a general understanding that the bursting of the housing bubble triggered the financial meltdown of the Fall 2008. Many studies have attributed the housing bubble or misalignment of home price and income to inefficient markets, irrational behavior, excessive leverage, financial innovations (e.g. subprime mortgage-backed security, credit default swap), macroeconomic imbalances, and enactment of the Gramm-Leach-Bliley Act, which repealed the Glass-Steagal Act in November 1999. Moreover, debates continue about whether and how housing bubbles can be identified, whether central banks should prevent asset bubbles from forming, and the role played by the Fed's easy money policy in causing asset bubbles. However, no study has actually

looked at data for the past two decades to determine whether these factors do explain the movement in the average home price relative to the average disposable income in the United States.

In this paper, we will review past studies pertaining to the existence and identification of a housing bubble, views on what brings this about, and the appropriate role for monetary policy. Then we will (a) propose a simple indicator of when a housing bubble has begun to form, and (b) attempt to determine if changes in the federal funds rate, household leverage, foreign capital inflows, and financial deregulation can explain movements in the median household income relative to the median price of single family homes. The remainder of this paper is organized as follows: (a) review of literature; (b) discussion of the data and regression models estimated to test for determinants of the income/home price ratio; (c) analysis of findings; and (d) conclusion and policy implications.

LITERATURE REVIEW

In March 2012, Federal Reserve Board Chairman Ben Bernanke gave a lecture on "The Fed and the Financial Crisis" in which, looking back, he noted that the decline in house prices and the associated mortgage losses were key triggers of the crisis, but that the effects of those triggers were amplified by the following vulnerabilities in the financial system: (a) borrowers and lenders took on too much debt or leverage; (b) banks and other financial institutions failed to adequately monitor and manage their risk exposures to subprime mortgages; (c) financial institutions relied excessively on short-term funding, such as commercial paper; (d) the increased use of exotic financial instruments concentrated risk; (e) gaps in the regulatory structure left important firms without strong supervision; and (f) failures of regulation and supervision, including consumer protection, and insufficient attention paid to the stability of the financial system as a whole (Bernanke 2012). Although not separating triggers from amplifiers, studies made by other government agencies such as the President's Working Group (PWG 2008), the Securities and Exchange Commission (Schapiro 2010), and the Government Accountability Office (GAO 2009), as well as by economists and the financial media mirror this list (see Holstein 2008).

One thing that is missing in the above list is the role of macroeconomic imbalances. In their book, "This Time Is different," Princeton economists Carmen Reinhart and Kenneth Rogoff (2009) contended that the Subprime Crisis was preceded by many alarming macroeconomic imbalances that unfortunately, were not perceived by the Fed nor the International Monetary Fund (IMF) as emerging threats to financial stability in the U.S. and globally. As late as 2006, the previous Fed Chairman, Alan Greenspan, viewed the current account deficit (then over 6.5% of GDP) as a reflection of the broader trend of global financial market deepening but not a primary risk factor, while then Fed governor Ben Bernanke viewed it as the product of a global savings glut (Reinhart and Rogoff 2009). These same authors also mentioned that even the IMF concluded in April 2007 that risks to the global economy had become extremely low, basing this assessment on reduced spreads in all sorts of risky assets due to foreign capital inflows.

These views were echoed by some in academia and the private sector who argued that the gaping current account deficit was just a natural consequence of emerging countries' export-led growth and their need to invest some of the resulting sovereign wealth into safe U.S. assets (Dooley et al. 2004) or into the extraordinarily liquid U.S. financial and housing markets (Cooper 2005). Greenspan also viewed the higher prices for risky mortgage-backed securities as justified by increased liquidity in home finance made possible by securitization (Reinhart and Rogoff 2009). Kaminsky and Reinhart (1999) identified large current account deficits relative to GDP, a surge in capital inflows either due to financial liberalization or financial innovation, sustained debt buildups (private or public sector or both), along with markedly mispriced asset prices as common predictors of financial crises in both developed and emerging market economies since the 13th century. Early warnings that when housing booms are accompanied by a sharp increase in debt, the risk of a banking crisis is significantly elevated were sounded by Bordo and Jeanne (2002) and a study by the Bank for International Settlements (2005).

Investment banks loaded up on debt to increase returns on equity when asset prices were rising. Obstfeld and Rogoff (2001) warned that eventually, the U.S. borrowing binge would have to unwind precipitously and result in sharp asset price declines that could severely stress the complex global derivatives system. Likewise, Roubini and Setser (2004) projected that the U.S. debt would reach 10% of GDP before a dramatic collapse of the economy. When confronted with the possibility of a housing bubble, Greenspan minimized its implication on the broader economy by arguing that these were 'froths' limited to a few markets (PBS 2009). His view may have been based on an internal study conducted by economists at the Federal Reserve Bank of New York to determine if there was a "bubble" in home prices as of the second quarter of 2005. In their study, McCarthy and Peach (2005) found that, if one accounts for quality improvements (such as size, amenities and improvements) and low interest rates due to low inflation, aggregate home prices are "relatively high but not yet out of line".

They acknowledged the possibility of "froth" in certain markets as of 2005, but attributed this to inelastic supply of land, which has caused home prices in these markets to be more volatile. The higher volatility, notwithstanding, they concluded that judging from previous large home value declines in these areas, a sizable negative effect on the aggregate economy was unlikely. Thus, they went against concerns expressed by many analysts that that there has been a large deviation of home prices from the growth trend, and a precipitous correction, whether from the bursting of a bubble or from rising interest rates, will erase a significant portion of household wealth (Baker 2002; Shiller 2005).

The financial crisis raised a red flag for theoretical economists and policymakers. How did many rational financial market participants not perceive the housing bubble as it was happening and price in the risk appropriately in bonds backed by subprime mortgage loans? Regulation of the U.S. securities industry has leaned more towards ensuring disclosure of information so that investors can effectively exercise market discipline should they perceive mispricing: selling securities that are overpriced and buying securities that are underpriced. This is predicated on the efficient markets hypothesis (EMH), which implies that prices are always and everywhere correct because actors are all rational and able to process information instantaneously (Fama 1970). Although proponents of EMH maintain that asset bubbles cannot exist, evidence such as the run-up in the value of the dollar in the mid-1980s, the stock market crash in 1987, compression of spread due to convergence of trades in the run-up to the failure of Long-term Capital Management in 1998, the dotcom bubble of the late 1990s, and the recent housing and credit bubbles, make the existence of bubbles hard to deny. Krugman (2009) attributed the failure of academic financial economists, and those employed by banks and Wall Street firms to predict the subprime mortgage crisis of 2008 on the reliance of their models on the EMH.

He lamented that neoclassical theorists willingly looked past the limitations of human rationality in their use of mathematical models to explain economic phenomena. However, there have been economists and mathematicians who have cast doubt on how accurately the EMH captures the realities of financial markets. In his empirical studies of stock price series, Mandelbrot and Hudson (2004) argued that the randomness permitted by EMH is 'mildly random' but real markets are 'wildly random' in that future market price movements have a higher probability of repeating recent price movements. What they called a clustering effect causes large price movements to occur in short periods of time. Moreover, the EMH implies that a bubble would not occur because market participants would short the asset. The current President of the New York Fed, William Dudley, argues that this may not hold in practice because of constraints on the ability to short the asset, such as (a) the market is not sufficient y developed; (b) compensation schemes reward short-term performance and skew incentives toward trading with the market; and (c) in the case of real estate investments, high transaction costs and illiquidity (Dudley 2010). The applicability of one particular assumption of the EMH to arbitrage was questioned by Shleifer and Vishny (1997) who argued that arbitrageurs are a relatively small number of individuals compared to the large number of traders required to make the EMH valid.

The literature on herding and information cascades adds more to our understanding of the irrationality of market actors. Golec (1997) showed that, in the short run, savvy investors trade based on information implied by the behavior of a "herd" of traders instead of their own evaluation of the fundamentals of the investment. Calvo and Mendoza (1997) explained herding behavior through the increased cost of verifying information in globalized markets. Bikhchandani et al. (1992) proposed that as investors in securities continue to make purchases at rising prices, more and more people will conclude that these investors' information about the market outweigh their own. More recently, behavioral economics has advanced into the mainstream. New theories in behavioral economics and behavioral finance show that individuals do not always behave as expected. They improperly discount the future, they fail to understand the difference between averages and aggregates, they make decisions that lead to lower payoffs, and they overvalue fairness (Avery and Zemsky 1998). In the real world settings of behavioral experiments, the actors who are part of the macroeconomists' models do not play the roles necessary for those models to work (Villatoro 2009, Zhou and Lai 2009).

Interestingly, even the most adroit financial minds fall into this trap. Fedenia and Hirschey (2009) found a paradox: class A preferred stock of Chipotle sells at a significant and persistent premium to class B preferred stock even if the latter has superior voting rights. They concluded that even the savviest stock investors can find themselves acting irrationally and cause the pricing of assets to be incorrect for a long period of time. In relation to overvaluation in the housing market, in particular, Shiller (2005) shares the view that lack of information and uncertainty about risk because rational investors to rely on the judgment of other market participants. Imperfect information or lack of transparency did play a big role in the subprime crisis. The structuring of mortgage-backed securities (MBS) and other collateralized debt obligations (CDOs) became so opaque, and the valuation of these products became too complex for many investors to exercise due diligence, and for directors and stockholders of financial institutions to exercise market discipline. Investors relied on credit rating agencies in assessing the investment risk of the MBS they were buying. According to a government report (PWG 2008), credit rating companies: (a) gave certain mortgage-related securities higher ratings than they should have -- and were too slow in issuing downgrades once the credit markets slumped, (b) did not adequately differentiate the risk of MBS from a corporate bond of similar rating, (c) engaged conflict of interest when investment banks hired them as consultants in structuring the MBS that they subsequently rated, and (d) did not make their track record and the methodologies they used in arriving at credit ratings publicly available.

Moreover, banks and securities firms experienced difficulties in assessing counterparty risk, aggregating exposures across business lines, valuing instruments when markets became illiquid, pricing contingent liquidity facilities, and managing liquidity risk (PWG 2008). These weaknesses were particularly evident with respect to holding asset-backed commercial paper (ABCP) to fund off-balance sheet structured investment vehicles (SIV), and with syndicating leveraged loans. We now turn to the subject of whether monetary policy has a role to play in the formation of asset bubbles, and therefore, in preempting such formation. Many people have proposed that the housing bubble was caused by the Fed keeping interest rates too low for too long even after the recession of 2001 ended (Rajan 2009). In an interview, Greenspan explained that the Fed kept interest rates low because of the jobless recovery that followed the 2001 recession (PBS 2009). Some have speculated that the Fed needed to accommodate the rising federal government borrowing to finance the war on terrorism. Cooper (2005) drew an analogy with the Fed's monetizing of the debt incurred during the Vietnam War. Bernanke (2012) argued against the view that easy money policy caused the housing bubble. He noted that changes in mortgage rates during the boom years seemed far too small to account for the magnitude of house price increases. He cited Dokko et al. (2011) who provide contrary evidence from the United Kingdom where there was a housing boom during the 2000s despite tighter monetary policy than the U.S. He also argued that house prices began to pick up in the late 1990s before monetary policy began easing and continued to rise sharply even after interest rates started to rise from their mid-2003 lows.

There is also disagreement on whether central banks should use monetary policy to prevent asset bubbles or should only clean up after asset bubbles burst, by providing the needed liquidity to the financial system. Morris (2008) faulted the Fed's "resolute insistence on focusing only on consumer price inflation, while ignoring signs of inflation in the prices of assets, especially houses and bonds of all kinds". The Fed under the leaderships of Alan Greenspan and Ben Bernanke has taken the view that central banks cannot identify or prevent an asset bubble from forming, but can only clean up after it burst. Bernanke (2010) maintains that it is the job of regulatory policy, not monetary policy, to deal with housing price bubbles fueled by weak lending standards. However, William Dudley, the current President of the New York Fed, argued that this view must be critically reevaluated and stressed the importance of an earlier response because the cost of waiting to clean up asset bubbles after they burst can be very high as the most recent financial crisis demonstrated (Dudley 2010). He proposed that central banks and other financial regulators should develop additional policy instruments, such as establishing system-wide leverage limits or collateral and collateral haircut requirements. In the next section, we will propose a measure and process for identifying the inception of a housing bubble and discuss the methodology and data sources used to find the determinants of the variance in an index that tracks the median home price relative to the median household income.

DATA AND METHODOLOGY

This study has two objectives: (1) propose a measure and process for identifying the inception of a housing bubble, and (2) attempt to determine if the variance in an index tracking the income/home price relationship for the years leading to the peak of the housing bubble can be explained by the variance in the federal funds rate, household leverage, foreign capital inflows, and financial deregulation. Moody's Analytics uses a structural model to forecast the long-run equilibrium home price by metropolitan area, then uses this value to determine which areas have overvaluation or undervaluation (Chen et al. 2012). Back testing this model, Moody's Analytics found overvaluation of at least 10% in 165 of 384 metro areas. Identifying a housing bubble on a national scale, however, is not an easy task.

First, one must decide which of alternative home price indices to use. Then one must recognize that a rapid rise in home prices by itself is not an indication of a bubble. Whether it is in the stock or housing market, a bubble is said to exist if, as Stiglitz (1990) put it "the reason the price is high today is *only* because investors believe that the selling price will be high tomorrow---when 'fundamental' factors do not seem to justify such a price." Economists have therefore evaluated home prices relative to a measure of its fundamental value, such as the implicit rent of owner-occupied homes or household income.

To chart the movement of the average price of homes, McCarthy and Peach (2005) argues that the Census Bureau's home price index is better than the repeat sales index of the Office of Federal Housing Enterprise Oversight (OFHEO), because the former adjusts for changes in quality measured by home size and amenities. By adjusting for quality changes, along with changes in interest rates, they found a flattening of the curves depicting the growth of home price relative to rent and to income during the housing boom. One problem with the McCarthy and Peach analysis is that they interpreted the concentration of rising price-income ratios at higher-end homes as evidence of a shift in consumer preference causing households to allocate more income toward the purchase of larger homes with greater amenities. We now know, of course, that lower underwriting standards and the use of home equity loan contracts on top of creative adjustable rate mortgages enabled many subprime borrowers to buy more house than they could afford under a conventional mortgage. Thus, their approach masked the effects of factors that may enable many homebuyers to afford larger homes. This approach also masked macroeconomic imbalances that may have kept interest rates low during that period. As a result, they failed to identify the housing bubble as late as mid-2005.

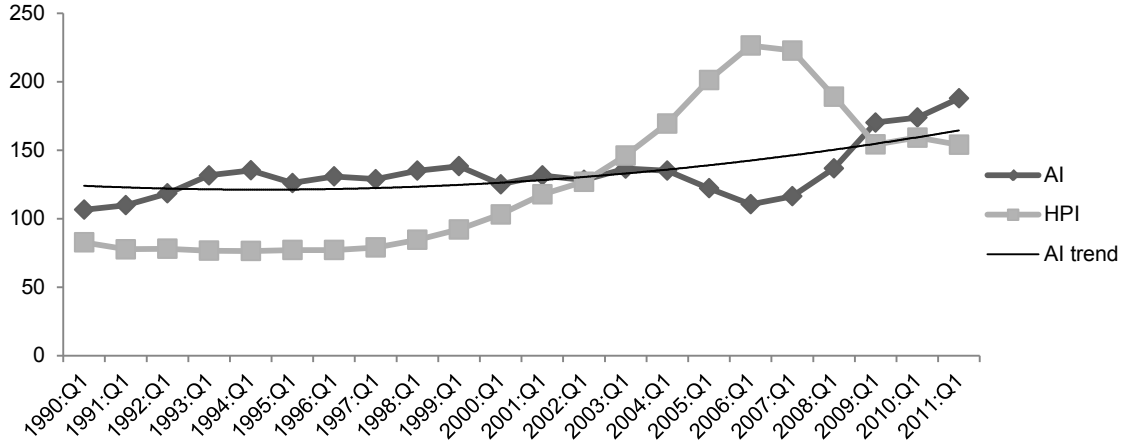
With the benefit of hindsight, we propose using the National Association of Realtors' affordability index (AI), which measures the household income needed to qualify for a conventional mortgage on a median-priced single family home. This mortgage involves a 20% down payment, and a 25% qualifying ratio, that is, a monthly loan amortization below 25% of income using the effective rate on conventional mortgage loans from the Federal Housing Finance Board. An AI value of 100 means that a household earning the median income in the country has exactly the amount of income needed to qualify for a conventional mortgage on a median-priced single family home. An AI value above 100, say 125, means that households earning the median income have 25% more income than is needed to qualify for such a mortgage. Thus, for a given conventional mortgage rate, an increase in the median home price would pull AI down or make homes less affordable. We propose that a housing bubble may be identified through the following process:

1) determine the trend line, using a polynomial equation, for AI values in the most recent 20 years;

2) identify the month when the AI index falls below trend; this marks the probable start of a housing bubble that could be confirmed when AI remains below trend for at least three months.

As Figure 1 shows, the affordability index (AI) fell below trend beginning in the first quarter of 2004 as the increase in the average price of homes in the 10 largest metropolitan began to accelerate. Note that in the 1990-2011 period, the Case-Shiller composite index (HPI) of the average home price in the largest 10 metropolitan areas rose above trend sooner than when the AI fell below trend. This is possible because the AI is a nationwide index or includes parts of the country where home price appreciation is lower. Also, the median family income nationwide could still be rising faster than the nationwide median price of homes.

Figure 1: The Case-Shiller Home Price Index and NAR's Affordability Index: 1990-2011



This figure shows that the affordability index (AI) fell below its trend line beginning in the first quarter of 2004 as the increase in the home price index began to accelerate. The bursting of the housing bubble in the first quarter of 2006 caused the affordability index to reverse its downtrend.

We estimated six reduced form regression models to find the determinants of movements in the median home price index (HPI), and another six reduced form regression models to find the determinants of movements in the Affordability Index, hereafter referred to as the income/home price ratio (IHPR). The explanatory variables in Equations 1~3 and 7~11 consist of a combination of one of two alternative interest rate variables and one of two alternative household indebtedness ratios that is not highly correlated with it. The alternative interest rate variables are the federal funds rate (FFR), which represents the lender's cost of funds, and the 30-year conventional mortgage rate (CMR), which represents the

homebuyer's cost of borrowing. We used the annual average of the interbank lending rate or effective federal funds rate (FFR) instead of the federal funds rate target, which would have discrete values. The explanatory variables in Equations 4~6 and 12 consist of variables of interest that are highly correlated with either the FFR or CMR. As a proxy for these two variables, we used the difference or SPREAD (CMR – FFR).

$$HPI = \beta_0 + \beta_1 FFR + \beta_2 \text{lagged ADSR} + \varepsilon \quad \text{Eq. 1}$$
$$HPI = \beta_0 + \beta_1 FFR + \beta_2 \text{lagged HDSR} + \varepsilon \quad \text{Eq. 2}$$
$$HPI = \beta_0 + \beta_1 CMR + \beta_2 \text{lagged ADSR} + \varepsilon \quad \text{Eq. 3}$$
$$HPI = \beta_0 + \beta_1 SPREAD + \beta_2 \text{lagged FIIR} + \varepsilon \quad \text{Eq. 4}$$
$$HPI = \beta_0 + \beta_1 SPREAD + \beta_2 \text{lagged CADR} + \varepsilon \quad \text{Eq. 5}$$
$$HPI = \beta_0 + \beta_1 SPREAD + \beta_2 GLBA + \varepsilon \quad \text{Eq. 6}$$
$$IHPR = \beta_0 + \beta_1 FFR + \beta_2 \text{lagged ADSR} + \varepsilon \quad \text{Eq. 7}$$
$$IHPR = \beta_0 + \beta_1 FFR + \beta_2 \text{lagged HDSR} + \varepsilon \quad \text{Eq. 8}$$
$$IHPR = \beta_0 + \beta_1 FFR + \beta_2 \text{lagged FIIR} + \varepsilon \quad \text{Eq. 9}$$
$$IHPR = \beta_0 + \beta_1 FFR + \beta_2 \text{lagged CADR} + \varepsilon \quad \text{Eq. 10}$$
$$IHPR = \beta_0 + \beta_1 CMR + \beta_2 \text{lagged ADSR} + \varepsilon \quad \text{Eq. 11}$$
$$IHPR = \beta_0 + \beta_1 SPREAD + \beta_2 GLBA + \varepsilon \quad \text{Eq. 12}$$

Table 1 summarizes the description of variables and sources of data. Many of the explanatory variables are highly correlated with each other (see Table 2). Using a cut-off of 0.50 for the correlation coefficient of explanatory variables, we could, in effect, only use two regressors at a time. Whenever the effective

Table 1: Description of Variables and Data Sources

Variable	Description/Unit of Measure	Period	Number of Observations	Source
IHPR	Income/home price ratio measured by the Affordability Index (100: a household earning the national median income has exactly the median income needed to qualify for a conventional loan for the median-priced single-family home)	First quarter 1990 ~First quarter 2011	22	National Association of Realtors
HPI	Home Price Index for the 10 largest metropolitan areas in in the U.S. (January 2000 = 100).	March 1990 ~ March 2011	22	Case-Shiller Composite-10 Index
FFR	Effective Federal funds rate (quarterly average in %)	First quarter 1990 ~First quarter 2011	22	Federal Reserve Flow of Funds
CMR	Conventional mortgage rate (quarterly average in %)	First quarter 1990 ~First quarter 2011	22	Federal Reserve Flow of Funds
Spread	Difference between CMR and FFR (%)	First quarter 1990 ~First quarter 2011	22	Federal Reserve Flow of Funds
lagged ADSR	Ratio of all household debt to disposable income (lagged 3 months; in %)	Dec. 31, 1989 ~Dec. 31, 2010	22	Federal Reserve Flow of Funds
lagged HDSR	Ratio of household mortgage and consumer debt payments to disposable income (lagged 3 months; in %)	Dec. 31, 1989 ~Dec. 31, 2010	22	Federal Reserve Flow of Funds
lagged CADR	Ratio of the absolute value of the U.S. current account deficit to gross private domestic investments (lagged 3 months; in %)	Dec. 31, 1989 ~Dec. 31, 2010	22	Bureau of Economic Analysis International Accounts
lagged FIIR	Ratio of foreign indirect investment to GDP (lagged 3 months; in %)	Dec. 31, 1989 ~Dec. 31, 2010	22	Bureau of Economic Analysis International Accounts
GLBA	Dummy variable for the implementation of the Gramm-Leach-Bliley Act enacted in November 1999	1: if first quarter of 2000 or later; 0 otherwise	22	U. S. Senate Public Law 106-102

This table describes the dependent and independent variables used in our regression model, their units of measure, time period covered, number of observations, and sources of data.

Table 2: Correlation Matrix of Variables

Variables	IHPR	HPI	FFR	CMR	SPREAD	lagged HDSR	lagged ADSR	lagged CADR	lagged FIIR	GLBA
IHPR	1.00									
HPI	0.14	1.00								
FFR	-0.68	-0.51	1.00							
CMR	-0.65	-0.74	0.86	1.00						
SPREAD	0.49	0.09	-0.82	-0.42	1.00					
lagged HDSR	-0.07	0.87	-0.24	-0.50	-0.13	1.00				
lagged ADSR	-0.05	0.88	-0.23	-0.45	-0.10	0.95	1.00			
lagged CADR	0.16	0.93	-0.46	-0.71	0.04	0.93	0.86	1.00		
lagged FIIR	-0.18	0.70	-0.12	-0.43	-0.26	0.65	0.60	0.66	1.00	
GLBA	0.34	0.83	-0.57	-0.73	0.20	0.78	0.67	0.91	0.51	1.00

This table shows the correlation coefficients of pairs of variable used in the regression models. The explanatory variables included in each regression equation have correlation coefficients below 0.50.

federal funds rate is highly correlated with a control variable of interest, we used the conventional mortgage rate (CMR) or the interest rate spread (CMR - FFR) as alternative explanatory variables. To control for household leverage, we used two alternative measures: (a) household debt service ratio (HDSR), which is the ratio of estimated required payments on outstanding mortgage and consumer debt to disposable personal income, and (b) all debt service ratio (ADSR), which adds to mortgage and consumer debt payments, the rental payments on tenant-occupied property, homeowner's insurance, property tax payments, and automobile lease payments. Values for these two ratios are available on an annual, end-of year basis, so these are in effect lagged by one quarter relative to the home price index, income/home price ratio, and interest rate variables, which are for the first quarter of the following year. To control for macroeconomic imbalances, we used two alternative variables: (1) CADR: the ratio of the current account deficit (converted to absolute value) relative to gross private investments; and (2) FIIR: the ratio of the inflow of foreign indirect investments relative to GDP. Values for these variables are also available on an annual, end-of year basis, and hence, lagged by one quarter. To control for the effect of financial deregulation, particularly the implementation of the Gramm-Leach Bliley Act (GLBA) starting in the year 2000, we use a dummy variable (1990Q1~1999Q1=0; 2000Q1~2011Q1 = 1).

Table 3: Means and Values of Variables for Selected Years

Statistics	HPI	FFR (%)	CMR (%)	lagged ADSR (%)	lagged HDSR (%)	lagged FIIR (%)	lagged CADR (%)
Mean: 1990-1999	80.15	5.57	8.41	14.82	11.56	3.61	6.00
Mean: 2000-2006	164.66	2.92	6.52	16.20	13.25	7.95	24.46
First quarter 2006	226.38	3.22	5.86	17.10	13.72	8.99	29.46
First quarter 2011	153.92	0.18	4.69	14.80	11.51	6.95	18.65

The mean values of the home price index, and the debt, foreign indirect investment, and current account deficit ratios were higher in the 2000-2006 period than in the 1990's. Also shown are the high values of these variables at the peak of the housing bubble (first quarter of 2006), and the most recent values after the bubble burst (first quarter 2011). Note that the federal funds rate and conventional mortgage rate were, on average, lower in the 2000-2006 period than in the 1990s. The lower rates in the first quarter of 2011 compared to the first quarter of 2006 reflect the effect of expansionary monetary policy.

Table 3 presents means of the dependent and independent variables for the periods 1990~1999 and 2000~2006, as well as values for selected years. The mean values of the home price index, and the debt, foreign indirect investment, and current account deficit ratios were higher in the 2000-2006 period than in the 1990's. The values of these variables were above the mean at the peak of the housing bubble (first quarter of 2006), and fell after the bubble burst. The federal funds rate and conventional mortgage rate were, on average, lower in the 2000-2006 period than in the 1990s. The lower rates in the first quarter of

2011 compared to the first quarter of 2006 reflect the effect of expansionary monetary policy prompted by the Great Recession, which began in December 2007. We will now discuss the rationale for our choice of explanatory variables.

Federal Funds Rate: Traditional theory traces the transmission mechanism of monetary policy, particularly changes in the federal funds target, through its effect on long-term interest rates. As Blinder (1998) puts it: "…central banks generally control only the overnight interest rate, an interest rate that is relevant to virtually no economically interesting transactions. Monetary policy has important macroeconomic effects only to the extent that it moves financial market prices that really matter – like long-term interest rates, stock market values, and exchange rates." This is consistent with what Bernanke (2004) called the "expectations channel," i.e. the central bank influences mortgage rates and other interest rates that affect consumption and investing by charting a path for future short rates and communicating this path clearly to the market. However, in the aftermath of the financial crisis, Adrian and Shin (2009) argue that short-term rates are important in their own right because continued low short rates imply a steep yield curve for some time, which increases the risk-taking capacity of banks that participate in capital markets. In their so-called risk-taking channel of monetary policy, Borio and Zhu (2008) explained that because banks borrow short and lend long, a wider term spread increases bank profitability, and hence, their ability to raise funds in equity markets.

The boost in bank capital then increases the capacity of the bank to bear the risk of expanding its balance sheet, including the extension of new loans, which eventually increases real output. Moreover, as the recent financial crisis revealed, shadow banks and broker-dealers financed their purchase of long-term assets, including subprime mortgage securities, with short-term funding sources such as asset-backed commercial paper and repurchase agreements (repos). Through arbitrage in the money market, the Fed Funds target set by the Federal Open Market Committee determines other relevant short term interest rates, such as repo rates and interbank lending rates (what we refer to as effective federal funds rate (FFR). For an off-balance sheet conduit or structured investment vehicle (SIV) that finances holdings of mortgage-backed securities by issuing commercial paper, a difference of a quarter or half percent in the federal funds rate makes all the difference between a profitable, and a loss-making, venture. Indeed, Adrian and Smith (2009) found that the growth in the balance sheets of shadow banks and security broker-dealers explain shifts in future real activity better than bank's balance sheets, mainly because they mark most items in their balance sheets to market.

Conventional Mortgage Rate and Spread: To deal with multicolinearity issues, we used the 30-year conventional mortgage rate (CMR) or its spread from the federal funds rate (FFR) as an alternative measure of borrowing cost, in some of our regressions. The 30-year CMR was on a downtrend since 1990 along with the yields on the one-year and 10-year Treasuries. The federal funds rate moved closely with the one-year Treasury yield, which was the typical benchmark for ARM loans.

Current Account Deficit and Foreign Indirect Investments : Beginning in 1999, the ratio of the absolute value of the current account deficit relative to gross private domestic investments and the inflow of foreign indirect investments relative to GDP both increased above the typical values in the1990s. At about that time, the median home price in the 10 largest metropolitan areas started its steep climb (see Figure 2). Huge capital inflows from abroad resulted from trade surpluses of Japan, Germany, and emerging economies with the U.S. The portion of the national debt owed to external creditors grew along with the housing boom. Reinhart and Rogoff (2009) proposed that foreign capital inflows fueled asset price inflation and lowered the interest rate spread that ultimately masked risks for both regulators and rating agencies. Between 2004 and 2006, the U.S. soaked up more than two of every dollar of savings from China, Japan, Germany, Saudi Arabia, and Russia, net of their own investments. Clearly, the growing current account deficit of the U.S. was unsustainable.

Figure 2: The Home Price Index and Foreign Capital Inflows

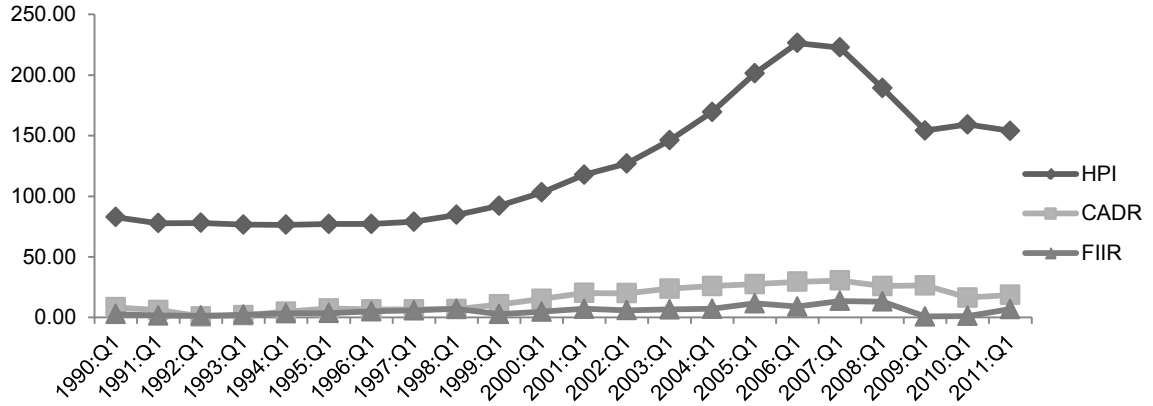


Figure 2 shows that the median price of single family homes in the 10 largest U.S. cities (HPI), the current account deficit ratio (CADR) and the foreign indirect investment ratio (FIIR) were fairly constant for most of the 1990s. The increase in the median home price accelerated since 2000 just as the CADR and FIIR rose above their typical values during the 1990s.

Household Leverage : During the housing boom, household debt grew dramatically as lax underwriting standards of mortgage brokers and fiancé companies enabled subprime borrowers to qualify for adjustable rate mortgage loans with low teaser rates, no proofs of income, or down payments financed by a home equity loan. Rising home equities enabled the purchase of larger homes, and boosted consumer confidence to take on more credit card debt, auto leases, and other consumer debt. Viewed against the growing current account deficit, the booming housing and stock markets may be considered evidence of borrowed prosperity. In this study, we use the household leverage ratios, not as a measure of household debt per se, but as a proxy for lax underwriting standards and financial innovations that enabled banks and broker-dealers to channel funds from the money and capital markets to homebuyers.

Among the financial innovations that enabled the increase in household leverage are complex derivatives, such as collateralized debt obligations backed by subprime mortgage loans, and credit default swaps, which were traded over the counter instead of a central clearinghouse or exchange. As Table 4 shows, the trading volume of over-the counter (OTC) derivatives (measured by notional value) is highly correlated with both household leverage ratios (lagged HDSR and lagged ADSR), the home price index (HPI) in the largest 10 metropolitan areas, and the income/home price ratio (IHPR). We were not able to control for the separate effect of OTC in our regressions because data is only available from 1998 to 2010. Overall, the volume of derivatives traded over the counter outpaced that of exchange-traded derivatives in 2006 and 2007, increasing six-fold from 2002 to a peak of $818.3 trillion in 2007 (FSOC 2011). It declined during the crisis, but remains above exchange-traded derivatives.

The financial crisis revealed that all these OTC derivatives needed was a slight deterioration in the value of underlying subprime mortgage loans for losses to escalate rapidly. Securitization of subprime mortgage loans rose dramatically during the housing boom. Subprime mortgage loans were first securitized as private-label MBS by investment banks, and later by government sponsored enterprises (GSEs) like Fannie Mae and Freddie Mac. Issuance of private-label MBS outgrew issuance by GSEs from 2004 to 2006 (FSOC 2011). According to data cited in Goodman et al. (2008), subprime MBS accounted for only 32.7% of the $2.1 trillion market for mortgage-backed securities in 2006, yet the collapse of this market brought down hedge funds and large financial institutions in North America and Europe. What made subprime MBS a very attractive investment globally were the insurance provided by credit default swaps and their AAA credit ratings. The issuer of a credit default swap guaranteed a continuation of income payments in the event that subprime borrowers defaulted on their payments. The notional value of credit

default swaps rose significantly from $6.4 trillion in 2007 to $58.2 trillion in 2007, but has declined by about half since then (FSOC 2011).

Table 4: Correlation of Trading Volume of Over-the-Counter Derivatives with Key Variables

Data for 1998 Q1-2006 Q1	Correlation Coefficient
OTC and lagged HDSR (mortgage and consumer debt to income ratio)	0.88
OTC and lagged ADSR (all household debt to income ratio)	0.96
OTC and HPI (Case-Shiller Composite-10 Home Price Index)	0.99
OTC and IHPR (income/home price ratio)	- 0.75

This table shows that the trading volume of over-the counter (OTC) derivatives is highly correlated with both household debt ratios (HDSR and ADSR), the home price index (HPI), and the income/home price ratio (IHPR).

Financial Deregulation : Banks lobbied for many years for the repeal of the Glass-Steagal Act, which was passed after the Great Depression to separate the business of banking from that of investment banking. Banks argued that they could not compete with large foreign banks, which could engage in securities underwriting, insurance, and in the case of Japan and Germany, also could own equity interest in nonfinancial corporations under so-called "universal banking" system. The Gramm-Leach- Bliley Act (GLBA) in 1999 allowed the creation of financial holding companies under which umbrella, a bank could engage in securities underwriting, insurance and real estate operations. GLBA led to consolidation in the financial industry and large, complex financial institutions emerged without one regulator. Moreover, regulation by function under GLBA led financial institutions to shop for the least restrictive regulators. For example, during the housing boom, banks affiliated with mortgage brokers and finance companies, whose lending practices were not subject to oversight by Federal bank regulators.

These affiliates increased the volume of subprime mortgage loans that banks then securitized. A second example is AIG, the largest insurance company in the world, marketed the credit default swap as a derivative, even though by being obligated to pay investors in mortgage –backed securities (MBS) in the event of default by homeowners, it was really an insurance product. The reason for this is that lax reporting and capital adequacy requirements for derivative products was predicated on the fact that, on average, investors in complex derivatives, including those traded over-the-counter (OTC), were more financially sophisticated or could afford to pay for information or expert advice. Insurance or deposit products, on the other hand, were heavily regulated. A third example is the request made by the five biggest U.S. investment banks in 2004 for exemption from the SEC's net capital rule, which limited their debt –to-equity ratio to 8:1. An investigation by the Government Accountability Office (GAO 2009) found that the SEC Commissioners yielded to this request, giving the Federal Reserve Board of Governors oversight of their capital adequacy based on consolidated assets of the holding company they were affiliated with. The GAO study reported that this resulted in these investment banks' debt to equity ratios to quadruple, averaging about 35:1 by 2008, without any federal regulator being alarmed. The GAO investigation also revealed that the SEC relied on the risk-management models of the holding company without doing its own independent review.

RESULTS AND DISCUSSION

Ordinary least squares estimates of equations 1~12 were obtained. We will first report the regression results on the determinants of home price movements. As discussed in the previous section, we could only enter two variables (with correlation coefficients below 0.50) in each regression to avoid multicolinearity issues. For example, the effective federal funds rate (FFR) or the conventional mortgage rate (CMR) paired with one measure of household leverage (lagged HDSR or lagged ADSR). Also, where FFR is highly correlated with the other variables of interest, we substituted it with the conventional mortgage rate (CMR) or its spread. The results summarized in Table 5, columns 2~3 show that the federal

funds rate is a statistically significant determinant of the average price of homes in the 10 largest urban areas. The same is true of the conventional mortgage rate (column 3) and the spread between CMR and FFR (columns 4~5). The signs of the coefficients are as expected, that is, as the FFR (a bank's cost of obtaining short-term funds), or CMR (a homebuyer's financing cost) fell, the average home price rose.

Table 5: Regression Results using the Home Price Index (HPI) as Dependent Variable

Regression Equation →	1	2	3	4	5	6
FFR	-7.13***	-6.99***				
CMR			-14.85***			
SPREAD				-11.15*	2.02	-3.14
lagged ADSR	40.11***		34.16***			
lagged HDSR		42.00***				
lagged FIIR				10.74***		
lagged CADR					4.92***	
GLBA						85.68***
Constant	-469.1***	-364.7	-298.3	30.41	43.60***	89.06***
F-value	67.32	56.05	110.2	12.50	65.85	21.72
Adjusted R^2	0.86	0.84	0.91	0.52	0.86	0.66

This table shows the coefficient estimates for Equations 1~6, along with the goodness-of -fit statistics. The federal funds rate (FFR), conventional mortgage rate (CMR), lagged ratios of household debt (ADSR and HDSR), foreign indirect investments (FIIR), and current account deficit (CADR), as well as implementation of the Gramm-Leach-Bliley Act (GLBA) are all significant determinants of the median home price.

Both ratios of household debt relative to disposable income (lagged HDSR and lagged ADSR) are significant positive predictors of home price movement in the next quarter. As expected, the narrower ratio of homeownership and consumer debt to disposable income (lagged HDSR) has a larger coefficient value than the ratio that includes car loan payments. The positive signs of the coefficients for both household debt ratios mean that as household indebtedness increased at year-end, the average home price in the 10 largest urban areas rose one quarter later. Theory would suggest that the more indebted the household is, the less likely it will add to its debt by borrowing to buy a bigger or better house.

Thus, everything else constant, this would have a dampening effect on demand, hence, the equilibrium price of homes. The positive sign may, as we proposed earlier, capture the reinforcing effect of the use of over-the-counter derivatives by banks and broker dealers, and lax underwriting standards, which enabled many subprime homebuyers to qualify for mortgage and home equity loans. We also find the enactment of the Gramm-Leach Bliley Act (GLBA) beginning in 2000, and the one-quarter lagged values of the ratio of foreign indirect investment to GDP (lagged FIIR) and the ratio of the absolute value of the current account deficit to gross private domestic investments (CADR), are all significant positive predictors of the movement in home price. Next, we look at the regression results using the income/home price ratio (IHPR) as dependent variable. The lagged value of indirect foreign investments relative to GDP (lagged FIIR) is a significant negative predictor of the income/home price relationship (Table 6, column 4), controlling for the effective federal funds rate. This suggests that the higher the inflow of indirect investments from abroad, the higher is the demand for and price of homes relative to income. The lagged ratio of all household debt to income (ADSR) is a significant negative determinant of the income/home price relationship, controlling for the conventional mortgage rate (column 6).

The negative sign of the coefficient for lagged ADSR means that as household indebtedness increased at year-end, the income/home price ratio fell a quarter later. This means that the median home price increased by more than the median income, making homes less affordable. Again, as explained in the previous paragraph, this suggests that high levels of indebtedness did not have a dampening effect on home price during the period 1990-2011. Instead, the lagged ADSR variable may be reflecting the effect of financial innovations and lax underwriting that enabled highly indebted and/or subprime borrowers to obtain mortgage loans to buy homes. The positive and statistically significant sign of the coefficient for the interest rate spread (column 7) suggests that as CMR rose relative to the FFR, demand for homes fell,

and everything else held constant, home prices fell relative to income, making homes more affordable. Although we find the enactment of GLBA since 2000 and the lagged current account deficit ratio (CADR) are statistically significant predictors of home price movement in the 10 largest urban areas, we do not find empirical evidence that these are significantly associated with the income/home price relationship (columns 5 and 7).

Table 6: Regression Results Using the Income/Home Price Ratio (IHPR) as Dependent Variable

Regression Equation →	**7**	**8**	**9**	**10**	**11**	**12**
FFR	-6.22***	-6.29***	-6.09***	-6.58***		
CMR					-11.53***	
SPREAD						6.68**
lagged ADSR	-4.29				-8.55**	
lagged HDSR		-5.02				
lagged FIIR			-1.47*			
Lagged CADR				-0.41		
GLBA						9.94
Constant	225.80***	221.40***	166.78***	166.82***	349.92***	107.14***
F-value	10.01	10.39	11.14	9.43	13.07	4.08
Adjusted R^2	0.46	0.47	0.49	0.45	0.53	0.23

This table shows the coefficient estimates for Equations 7~12, along with the goodness-of -fit statistics. The federal funds rate(FFR), conventional mortgage rate(CMR), lagged ratios of foreign indirect investment (FIIR) and household debt (ADSR and HDSR) are all significant negative determinants of the home price-income ratio, but the absolute current account deficit ratio(CADR), and implementation of the Gramm-Leach-Bliley Act (GLBA) are not.

The interest rate variables (FFR and CMR) are both significant negative determinants of the income/home price relationship (columns 2~6). This means that the lower is FFR (cost of obtaining short-term funds for banks), or CMR (financing cost for homebuyers), the higher is income relative to home price or the more affordable homes are. The coefficient estimates confirm that although the conventional mortgage rate (CMR) has an expected stronger negative association with home price as well as with the income/home price index, the federal funds rate is, in its own right, a significant determinant of both. This lends credence to those who argue that there is a risk-taking transmission channel of monetary policy. For a given CMR, the lower the federal funds rate is, the higher is the profitability of extending new mortgage loans. This increased profit expectation increases the ability of banks to raise capital. Given its regulatory capital requirement, more capital enables banks to acquire higher risk investments or extend higher risk loans. The federal funds rate also determines other short-term rates like the commercial paper and repo rates. There is a high negative correlation (-0.67) between the effective federal funds rate and the trading volume of over-the-counter derivatives during the period 1998 to 2006. The financial crisis of 2008 revealed that banks and broker-dealers financed their acquisitions of mortgage-backed securities with short-term funding, such as by issuing asset-backed commercial paper. Thus, it may indeed be possible that by keeping the federal funds rate target too low for too long, the Fed could inadvertently prolong the existence of a housing bubble (i.e. misalignment of home price and income), by increasing the risk-taking capacity of financial institutions.

CONCLUDING COMMENTS

In this study, we proposed that the 20-year trend in the National Association of Realtor's home affordability index (AI) provides a simple benchmark for identifying the inception of a housing bubble on a national scale. This index tracks the movement of median household disposable income to the median price of single-family homes. We suggest that when the monthly affordability index value falls below trend for at least three months, a housing bubble probably exists. Using this benchmark during the housing boom that ended in the first quarter of 2006, we dated the start of the housing bubble to about the first quarter of 2004. This study also estimated reduced form models to determine if movements in home price and the income/home price ratio are associated with movements in the effective federal funds rate (or alternatively, the conventional mortgage rate or the spread between this and the effective federal funds

rate). We controlled for changes in household leverage enabled by financial innovation and lax underwriting standards, as well as foreign capital inflows, and deregulation. Our results confirm that although the conventional 30-year mortgage rate, as expected, has a stronger negative association with home price and with the income/home price relationship, the federal funds rate is a significant determinant as well. This supports the view that keeping the federal funds rate target too low for too long could prolong a misalignment between disposable income and home price by increasing the risk-taking capacity of financial institutions. For policy purposes, this implies that gradually increasing the federal funds target as soon as concern about a housing bubble arises can be an effective tool for preventing its persistence or worsening. This study found empirical evidence that one-quarter lagged increases in foreign indirect investments relative to GDP as well as the level of household indebtedness are significantly associated with an increase in home price and a decline in the income/home price relationship. Although the implementation of the Gramm-Leach Bliley Act and the one-quarter lagged value of the current account deficit were significant predictors of changes in home price, these could not significantly explain changes in the income/home price relationship. This result, however does not preclude the possibility that the SEC's relaxation of the leverage limit on the five largest investment banks from 2004 to 2008 played a role. Future research could include a dummy variable for this period.

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