Housing Market Activity from 2001-2011: A cross-country look at Monetary Policy and Financial Instability

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Housing Market Activity from 2001-2011: A cross-country look at Monetary Policy and Financial Instability

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May 2013
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1 Introduction

From 1998 to 2006, average home prices in OECD countries increased dramatically by 70%. This paper will examine housing booms and busts on a global scale; looking at home prices in 15 different developed countries. (See Appendix 1) Through empirical analysis and a review of current literature, this paper will attempt to understand the roots of recent housing booms, and an overview of possible policy responses.

In September 2007, Goldman Sachs released a report entitled "Rising Risks to the Global Housing Market." This report pointed to the rising correlation of home prices among most of the OECD countries. According to their housing data, correlation between home prices in OECD countries has increased from 50% in the 1970s to 90% between 1998-2006. This paper was early in detecting that many global housing markets were straying from fundamentals.

There is extensive literature on the housing bubble in the U.S. and the subsequent mortgage crisis. Additionally, Ireland and Spain experienced housing bubbles during the same years as the U.S. Therefore, a cross-country approach might give a better understanding of recent activity in housing markets.

1a Trends in Home Prices

The U.S., Spain, Ireland, and Denmark all experienced similar patterns in their housing markets as seen in Figure 1.1. Between 2000 and 2006, real house prices increased annually by an average of 11% in Spain, 5.4% in the U.S., 8% in Ireland, and 8% in Denmark. From 2007 to 2011, real house prices decreased annually by an average of 4.5% in Spain, 5% in the U.S., 8.7% in Ireland, and 6.3% in Denmark. Most economists have concluded that these countries experienced national housing bubbles.
In comparison, home prices in France, Canada, and Australia rose very quickly in from 2000-2006, and have not fallen. (Figure 1.2) In 2011, The Economist determined that home prices in Australia, Canada, and France looked more overvalued than home prices in the peak of the U.S. housing bubble. The Economist also noted that Australia and Canada both have higher household debt than the U.S. did in 2007.\(^1\) Since interest rates have remained low in response to the Global Financial Crisis, this prolonged period of interest rates may be propping up home prices at a national level.

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Finally, real home prices in Germany and Japan steadily decreased from 2000 to 2011. (Seen in Figure 1.3) In Germany, economists believe that low population growth has led to lower prices. Japan’s recent housing bubble in the 1980s and low economic activity most likely had an effect on home prices.

These graphs clearly show three different patterns in recent housing market activity. Most economic papers cite declining interest rates and financial innovation as the cause of the U.S. housing bubble; however, this idea could be applied to countries around the world.

1b Importance of Home Prices

Rapid booms in home prices have significant effects on economic activity and consumer behavior. Housing wealth effects are defined as increased consumer spending due to a rise in home prices. Households can either use equity from the house to increase spending or reduce savings in other assets. Case et al. (2005) discussed the differences between wealth effects from the stock market and the housing market. At first the paper hypothesized that wealth effects might be smaller from the housing market for several
reasons. First, housing is not an actively traded market; therefore, consumers might be unaware of their true wealth. Second, since wealth in real estate might is usually a long-term investment, consumers might not think it was appropriate for consumption in the present. They studied these effects extensively over the period 1975-1996 by performing a panel regression between U.S. states and then performing a different panel regression on industrialized countries. Surprisingly, they concluded that wealth effects from home prices were much stronger than wealth effects from the stock market.

Between 2000 and 2005, the value of residential real estate increased by $10 trillion in the U.S. In the U.S. and in other countries, which experienced housing booms, the rise in home prices led to a boom in consumer spending and economic activity. Since much of this “wealth” in countries such as the U.S., Spain, and Ireland, was due to speculation, wealth effects led to a painful recession when the housing market bust. Unemployment skyrocketed to 22% in Spain and 14% in Ireland by 2011.

Housing bubbles also produce income effects. According to Tobin’s “q” theory, the ratio between home prices and construction costs predict the amount of residential investment. If home prices are much higher than the cost of building a home, residential investment will continue to rise. According to the OECD, this relationship between residential investment and home prices was statistically significant over 1995-2004. (figure 1.4) As noted in the figure below, Spain and Ireland had a much higher change in residential investment and change in Q ratio in comparison to Japan and Germany.
Because home prices have an effect on residential investment, volatility in the housing market affects employment in industries related to real estate and construction. The Bureau of Labor Statistics estimated U.S. employment effects of the recent housing bubble. The BLS created two economic models, depending on whether the bubble began in either 1996 or 2002. According to these studies, the bubble contributed 1.2 million to 1.7 million jobs in 2005, which accounted for .8 to 1.2 percent of total U.S. employment. And in 2008 there were 1.7 to 2.2 million fewer residential-construction related jobs than there would have been if there had not been a bubble.\textsuperscript{2} In Spain, employment in the construction sector was 50\% higher in 2007, at the peak of the housing bubble, than in 2000. Additionally, construction employment in Spain declined by 61\% from 2007 to 2012.\textsuperscript{3} In Ireland, employment in the construction sector was 60\% lower in 2012 than in 2006, whereas employment in the Irish industrial sector was 20\% lower.\textsuperscript{4}

\textsuperscript{3} Instituto Nacional de Estadística de España
\textsuperscript{4} Ireland Bureau of Statistics
Finally, the collapse of home prices had severe effects on the financial sector. After home prices in the U.S. began to decline, it became clear that investment banks were extremely leveraged in the market for mortgage-backed securities. Most economists cite the housing bubble in the U.S. as the direct catalyst of the Global Financial Crisis. Additionally, housing bubbles in Spain and Ireland were two causes of the debt crisis in the Eurozone. The IMF estimated the total cost of the crisis to central banks at $10.9 trillion, which includes support in the form of liquidity, buying toxic assets, and guaranteeing future debt and liquidity support.

1c The Debate over Monetary Policy

In a 2009 working paper entitled “The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong,” John Taylor concludes that the U.S. housing bubble was caused by monetary policy, specifically setting the interest rates too low. The Taylor Rule is a policy rule of thumb that Taylor introduced in 1993. (See explanation below) According to the Taylor Rule, the Federal Reserve should target the real interest rate by using the deviation of actual inflation from its target and the deviation of the “output gap.”

<table>
<thead>
<tr>
<th>Evaluating the Tightness or Ease of Monetary Policy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Form of the Taylor rule:</td>
</tr>
<tr>
<td>[ i_t = r_t^* + \pi_t + a(\pi_t - \pi^<em>) + b(y_t - y_t^</em>) ]</td>
</tr>
<tr>
<td>where:</td>
</tr>
<tr>
<td>• ( i_t ) is the prescribed value of the policy interest rate in a given period ( t ).</td>
</tr>
<tr>
<td>• ( \pi_t - \pi^* ) is the deviation of the actual inflation rate ( \pi_t ) from its target ( \pi^* ) in period ( t ); and</td>
</tr>
<tr>
<td>• ( a ) and ( b ) are positive numbers</td>
</tr>
<tr>
<td>• ( r^* ) is the assumed equilibrium real interest rate</td>
</tr>
<tr>
<td>• ( y_t ) and ( y_t^* ) are the logs of actual/potential GDP</td>
</tr>
</tbody>
</table>

Figure 1.5
(Source Federal Reserve)
The Taylor rule is forward looking; however, Taylor's paper (2009) applies this rule to the past decisions of central banks around the world. According to this analysis, housing booms were the largest in countries where monetary policy deviates furthest from the Taylor rule. Even though the European Central Bank provides a uniform monetary policy, Taylor applied his rule to each individual country in the euro-zone and used different measures of output and inflation. For example, Taylor found that the nation with the largest deviation from the rule was Spain, which had the largest housing boom.

Ben Bernanke strongly argues against this point of view, and concludes that monetary policy was not responsible for the U.S. housing bubble. In his 2010 speech entitled "Monetary Policy and the Housing Bubble," he states "the magnitude of house price gains seems too large to be readily explainable by the stance of monetary policy alone." He also points out that monetary policy is forward looking; therefore, it is much easier to point out better policies when looking at the past. For example, the Federal Reserve was concerned about deflation in 2003 after the recession. Without being able to accurately predict the future, the Federal Reserve must apply whichever policies they think are most important, and so they applied policies in order to avoid deflation.

Bernanke also used the residuals from the Taylor rule to study the relationship between monetary policy and house prices, and concluded that the relationship was not statistically significant. (Seen in Figure 1.6) Additionally, Bernanke points out an error with this model; it could potentially overstate the causal relationship within the Eurozone, because this analysis assumes that the Eurozone countries had control over their own monetary policy.
According to Bernanke, the large current account deficits in developing countries are a better explanation for housing booms. Bernanke proposed his “Global Savings Glut” hypothesis in 2005, where he explained the situation of global imbalances. In his 2010 speech, he argues that current account deficits in developed countries and surpluses in developing countries have a stronger relationship with changes in home prices. (Shown in Figure 1.7) Bernanke ran a regression of current account levels and changes in real house prices, and he found that this relationship was more statistically significant than monetary policy. According to Bernanke “about 31% of the variability in house price appreciation across countries is explained.”
1d Hyman Minsky's Financial Instability Hypothesis

This paper will examine these hypotheses, and Hyman P. Minsky’s (1919-1996) Financial Instability Hypothesis and the idea of “Irrational Exuberance.” His hypothesis states that in periods of good times, money managers tend to overestimate returns and underestimate risk. This long period of prosperity essentially destabilizes the Financial System because investors lose their memories of tough times, and the availability of credit becomes more rampant.
2 Understanding Booms and Bubbles in Home Prices

After the rapid deterioration of home prices in the U.S., Spain, and Ireland, it was very clear that these countries experienced bubbles in their housing markets. Other countries, such as Sweden and Australia experienced a boom in their home prices, but it is still unclear if these markets are in the midst of a housing bubble. Fundamental factors such as population growth and increased competition in mortgage markets can increase the price of homes. This section will focus on irrational causes of recent activity in housing markets, such as speculation and looser credit conditions.

2a Speculation

An asset price bubble is an unsustainable rise in prices due to speculation. Bubbles usually begin with an exogenous shock, such as financial innovation, and are fueled by speculation and credit expansion. Sometimes investors believe that “this time is different” and there are certain fundamental factors, which have caused the asset price to skyrocket. In the late 1990s, Alan Greenspan justified the stock market bubble by the development of information technology and his belief in the “New American Economy.” The dot-com bubble began because investors saw productivity and corporate profits rise at an unprecedented level. However, speculation drove the prices too high and the dot-com bubble led to unsustainable price levels.

There are several exogenous shocks that might have driven up home prices in the period of 2000-2007. The entry into the Eurozone was a powerful shock to the financial systems in many European countries and increased optimism that Eurozone GDP would expand with increased European trade. In the U.S., some economists believe that the dot-com bubble was the catalyst for the subsequent housing bubble. After the dot-com bubble, the Federal Reserve kept interest rates low in order to prevent a deep recession, which led to an initial rise in home prices. Also, after the dot.com bubble, consumers believed that
homes were a much more stable investment than the stock market. Both of these responses to the dot-com bubble led to an initial rise in home prices, which took off from 2000-2007. “It could be that the home price boom, which began in the United States and other countries before the peak of the market, started in 1998 in response to the stock market boom and just fed on itself through its own internal feedback after the stock market fizzled.”

The initial rise in prices from an exogenous shock leads to a bubble when investors start to speculate on future capital gains. According to the theory of adaptive expectations, investors use the assumption that past price movements will continue in the future. This assumption is fueled by several positive feedback loops. First, initial price movements lead to “herd behavior.” After certain investors get rich, everyone wants the same returns. This leads to a high demand for a certain asset and even higher prices. Second, as asset prices climb, consumer spending and national income rise, which leads to a false sense of optimism. Research has shown that when markets are overvalued, individuals are more optimistic about market conditions.

2b Financial Innovation

Policy makers and economists often cite financial innovation in mortgage markets as the cause of the U.S. subprime mortgage crisis and housing bubble. According to a paper by Diamond and Rajan (2009), the securitization of mortgages misallocated too much capital to the housing sector. They note that the crisis was caused by a combination of excess capital from developing countries and easy monetary policy. They also stated that the crisis first manifested in the U.S. because the U.S. had the most advanced securitization of mortgages, and created more sub-prime loans.

In 2007, the IMF released a report entitled “Housing and the Business Cycle.” They studied the differences between mortgage markets in the period before 1980, when

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regulations were much tighter, and mortgage markets after 1980. Although regulation varied between countries, securitization and deregulation led to a higher number of banks and financial institutions involved in mortgage markets after 1980. According to the IMF, deregulation was rapid in the United States, the United Kingdom, Canada, Australia, and the Nordic countries. However, some countries, such as Japan, Germany, France, and Italy experienced a slower shift in mortgage market development. With increased competition amongst mortgage lenders and new financial products, more borrowers were able to secure mortgage loans. Since financial regulation and innovation changed in the 1980s, it cannot fully explain why global home prices skyrocketed from 2000 to 2007. However, changes in the mortgage market structure could have helped fuel a housing bubble. For example, option adjustable rate mortgages were developed in the 1990s but they became much more common during the housing expansion. It is estimated that 15% of mortgages written in 2006 in the U.S. were option adjustable rate mortgages in comparison to only 1% of mortgages in 2001.

2c Credit Conditions and Minsky’s Hypothesis

“The impact of easy monetary conditions on the housing cycle presumably was magnified by the loosening of lending standards and excessive risk-taking by lenders.”

According to Bernanke, monetary policy cannot completely explain the recent bubble in the U.S. housing market. However, Bernanke did not consider risk appetite and loosening of credit standards due to a long period of low rates. According to the IMF’s report, deregulation in the mortgage market over the past 30 years impacted the monetary policy transmission to home prices. Before 1980, when traditional mortgage lenders dominated mortgage markets, monetary policy had a very quick and direct impact on home prices. During the years after 1980 changes in monetary policy had a smaller effect on

home prices, but these effects lasted for a longer period of time. These differences might be attributed to secondary mortgage markets. Instead of one local lender holding on to mortgages for a long period of times, these local banks sold their mortgage holdings to secondary markets, packaged as mortgage backed securities. Since this secondary market was distanced from the original borrower, some investors underestimated the riskiness of these new products. This new development allowed for more competition in the mortgage market but it also led to a higher risk appetite of banks.

Minsky was known as an economic expert on credit crunches, and he examined certain features of financial crises including speculation, euphoria, and the expansion of credit. He noted that the supply of credit was cyclical; in good times credit was easily available. After a bubble, banks panic and the supply of credit tightens, which is referred to as a “Minsky moment.” He believed the cyclical behavior of the credit supply destabilizes the financial system. According to the second theorem of his Financial Instability Hypothesis, “Over periods of prolonged prosperity, the economy transits from financial relations that make for a stable system to financial relations that make for an unstable system.” In summary, a prolonged period of prosperity can lead to a credit expansion and financial instability.

Many papers argue that keeping interest rates low for a very long period of time can impact bank's optimism and lower credit standards. Harvard professor Chris Foote points out that mortgage loans are secured assets, which means if a homeowner defaults on their mortgage, the bank can seize their asset. As home prices continue to rise, the cost of default becomes smaller and mortgage loans are less risky. This feedback loop could influence the

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availability of mortgage loans, which would further increase home prices. If banks see a long period of monetary expansion, they might base their decisions on this trend. As GDP continues to rise at a constant rate, investors will expect the central bank to maintain the same policies. According to Federal Reserve Governor Jeremy Stein, “a prolonged period of low interest rates, of the sort we are experiencing today, can create incentives or agents to take on greater duration or credit risks, or to employ additional financial leverage, in an effort to ‘reach for yield.’”

In the paper Hazardous times for Monetary Policy, a working paper from the Banco de España (2008), Jiménez et al. studied the effects of monetary policy on credit availability. Their data set, from the Credit Register of the Banco de Espana, included 23 million bank loans. This study is ideal for understanding the effects of monetary policy on credit standards, because interest rates in Spain have been “set by Frankfurt” since the late 1980s, when Spain adopted a fixed exchange rate system to the Deutsche mark. According to their study, they found robust evidence that during a long period of lower short-term rates, banks and financial institutions in Spain lowered standards for the credit history of current and potential borrowers.

Low interest rates also spur economic activity and can lead to a higher growth rate of GDP. This causes the net worth of borrowers to rise, which allows banks to take on more subprime borrowers. The study by Jiménez et al. found that GDP growth reduces credit risk for new and outstanding loans. These results are specific to Spain’s financial system; however, further studies might find that these effects are similar across countries.

According to a study by the European Central Bank (2010), the level of GDP growth across countries in the Eurozone led to a softening of credit standards. They also found that low

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short-term rates have a stronger impact on bank’s risk appetite than long-term interest rates. Finally, they determined that weak bank supervision and high levels of securitization amplified the effects of interest rates.

It is interesting to compare the mild recession after the dot.com bubble to the global financial crisis. There are several factors, which differed between the two bubbles. First, investors were more aware of the bubble in the stock market. According to a survey in April 1999, 72% of professional money managers believed that the stock market was in a bubble. In a 2004 survey of U.S. homeowners only 1% used the term “bubble” to describe the housing market. Bordo and Jeanne (2002) studied the same OECD countries as this study from the period 1970-2002. According to their historical data, the probability of a boom in property prices ending in a bust was 52%, whereas the probability of a boom in stock prices ending in a bust was around 12%. This shows that irrational exuberance is even stronger in housing markets.

Minsky believed that investor optimism plays an important part in volatility of the financial system. After a recession, investors are more prudent with their money. As time goes one, investors lose their “memory” of tough times. If the economy keeps growing for a long period of time, money managers tend to overvalue new financial products and undervalue their risks. There have been many instances of euphoria affecting the judgment of banks and economists. Irving Fisher famously said shortly before the crash of 1929 "Stock prices have reached what looks like a permanently high plateau." In September 2006 a poll of 69 economists stated that there was only a 25% chance of the U.S. economy falling into a recession in 2007. According to Goldman Sachs Economist Bill Dudley in January 2006, the yield curve was not signaling a recession. Instead, Dudley believed that the flattening of the yield curve was a signal of investors’ confidence in the Federal Reserve to reduce volatility in core inflation.
Finally, Minsky believed that excessive debt was the cause of financial crises. He developed a theory, which described three levels of debt financing: hedge finance, speculative finance, and Ponzi finance:

“A firm is in the hedge finance group if its anticipated operating income is more than sufficient to pay both the interest and scheduled reduction in its indebtedness. A firm is in the speculative finance group if its anticipated operating income is sufficient so it can pay the interest on its indebtedness; however the firm must use cash from new loans to repay part or all of the amounts due on maturing loans. A firm is in the Ponzi group if its anticipated operating income is not likely to be sufficiently large to pay all of the interest on its indebtedness on the scheduled due dates; to get the cash the firm must either increase its indebtedness or sell some assets. Minsky's hypothesis is that when the economy slows, some of the firms that had been involved in hedge finance are shunted to the group involved in speculative finance and that some of the firms that had been involved in the speculative finance group now find that they are in the Ponzi finance group.”

According to this theory, bubbles lead to financial crises if investors and firms are heavily indebted. Once the price of the asset starts to decline, certain firms fail and panic begins.

A "Minsky moment" can turn into a crisis if investors are heavily indebted. In 2005 U.S. private debt was 15% higher than in 1999, as shown in the figure below. This statistic might signal that firms and households used more debt to invest in real estate during the housing bubble than stocks during the dot.com bubble. Afterwards, the financial system went into panic, as Minsky predicted. In the Eurozone, low short-term rates drove up debt in the financial sector in countries like Ireland and Spain.

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Although Minsky’s beliefs are very applicable to the recent global financial crisis, the tools used by the Federal Reserve generally ignore the fluctuations in the financial sector. Financial crises can have major effects on output and inflation, which are typically mandates of central banks. Therefore, some economists argue that central bankers should change their responses to asset price booms and bubbles in order to stabilize output.

3 Empirical Analysis

3a Fixed Effect Model

In order to understand recent activity in housing markets, a fixed effects panel regression will be used over the years 2001-2011. The dependent variable is percentage change of real home prices year over year. The panel regression will attempt to determine the magnitude and significance of several independent variables. In order to pick up external variables, which differ across countries, the fixed effects model includes a dummy variable for each country. Therefore the model follows the form:
\[ Y_{ij} = \beta_i X_{ij} + \alpha_i + u_i \]

where \( i \) represents each country and \( j \) represents each year.

### 3b Independent Variables

The percentage change of home prices is measured in real terms; therefore, it was important to include real interest rates. Usually real interest rates are measured as the difference between interest rates and expected inflation. Since data on historical inflation is available, I assumed that the actual inflation rate was close enough to the expected inflation. This also helped control for differences in interest rates among Eurozone countries, by subtracting different inflation rates from each country. Long-term rates and short-term rates are highly correlated; therefore, I decided to use the difference between the long-term rate and the short-term rate as an independent variable. This spread variable is used in other working papers, and it is a good variable to measure the effect of monetary policy. Long-term rates and short-term rates are correlated but they do not always move exactly together. If investors believe that the Central Bank set the interbank rate too low, long-term interest rates increase in response. Therefore this variable is a good measure of the effect of monetary policy on investor's decisions.

Additionally, I used bank's capital to assets ratio to study their risk appetite. If banks had a very low capital to asset ratio, they would be taking more risk. In order to test Minsky's hypothesis, a koyck-distributed lag will be used to demonstrate expected GDP growth and expected variance, placing a larger weight on recent experience. During periods of economic optimism, investors expect higher rates of returns with less risk, based on past experience. This causes investors to bid up asset prices and take on more debt.

In order to construct each Koyck distributed lag, assume that the expected value of \( g \) (growth rate of real GDP) for \( t+1 \) is a weighted average of past growth rates with relatively more weight on the recent past. Using Koyck weights, this takes the form of:
\[ E_{g_{t+1}} = g_t^* = w g_t + w(1-w) g_{t-1} + w(1-w)^2 g_{t-2} + \ldots \]
\[ = w \sum_{i=0}^{n} (1-w)^i g_{t-i} \]

If this is an infinite series, with \( w < 1 \), then the expression for \( g_t^* \) collapses to
\[ E_{g_{t+1}} = g_t^* = w g_t + (1-w) g_{t-1}^* \]

Since the data set is not infinite, we approximate this by going back 1960, which is the initial year \( N \), and we set \( g_N^* \) at what we see as a reasonable initial value, \( g_0 \). Thus
\[ E_{g_{t+1}} = g_t^* = w g_t + (1-w) g_{t-1} \]
for \( t > N \)
\[ E_{g_{t+1}} = g_t^* = g_0 \]
for \( t = N \)

In like manner, as a measure of perceived stability of growth rates, assume that the perceived variance of the growth rate for next year is a weighted average of squared deviations of actual \( g \) from expected \( g \) over the past, with more weight on the recent past.

Let us call this measure \( V \) (for perceived, or subjective variance).
\[ V_{t+1} = w(g_t - E_{g_t})^2 + (1-w)V_{t-1} \]
for \( t > N \)
\[ V_{t+1} = V_0 \]
for \( t = N \)

Under Minsky’s model, we would expect asset prices to rise with higher expected growth and to rise with lower variability of growth.\(^{10}\) In order to standardize this variable, I used the square root of the perceived variances. The constructed lag for GDP and the deviations from expectations will be used as independent variables in the panel regression.

\(^{10}\) Petersen, Harold “Notes on using Koyck weights to estimate the mean and variance of growth over the next year.” 7 Dec. 2012.
I used the World Bank and the OECD as my data sources, because their data is internationally comparable. I had hoped to include a variable on the level of mortgage debt in each country; however, this data was not available.

**Figure 3.1: Variables**

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Explanation</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>pch</td>
<td>Percentage Change of Real House Prices over Previous Periods</td>
<td>OECD</td>
</tr>
<tr>
<td>dif</td>
<td>Difference between Long-term Real Interest Rate and Short-term Real Interest Rate</td>
<td>OECD</td>
</tr>
<tr>
<td>stirreal</td>
<td>Short-Term Real Interest rate</td>
<td>OECD</td>
</tr>
<tr>
<td>asset</td>
<td>Bank capital to assets ratio (%)</td>
<td>World Bank</td>
</tr>
<tr>
<td>gdp</td>
<td>Koyck-distributed lag of GDP growth (%) since 1960</td>
<td>World Bank</td>
</tr>
<tr>
<td>sd</td>
<td>Standard Deviation of GDP expectations developed from Lag</td>
<td>World Bank</td>
</tr>
</tbody>
</table>

**3c Results**

I decided to add a one-year lag to short-term rates and the spread of interest rates. This tests the hypothesis that monetary policy affected home prices. Below are results from a panel regression in Stata.

R-sq=.4921

| Variable               | Coefficient | Standard Error | t-value | P>|t| |
|------------------------|-------------|----------------|---------|------|
| diflag                 | 3.018154    | .4971098       | 6.07    | 0.000 |
| stirreallag            | -1.05416    | .3904937       | -2.70   | 0.008 |
| asset                  | .4406892    | .4321608       | 1.02    | 0.310 |
| gdp (20% weight)       | 4.357739    | .7321723       | 5.95    | 0.000 |
| sd (20% weight)        | .194250     | .9691596       | 0.20    | 0.841 |

As seen above, the variables measuring monetary policy were highly significant. The short-term real rate has an inverse relationship with home prices and a larger difference between long-term interest rates and short-term rates has a positive effect on home prices. Therefore, these estimators are consistent with Taylor's Hypothesis that countries with rates that were too low experienced booms in their housing sector. All other things equal, a -1.054 reduction in real short rates leads to a 1% rise in national home
prices. However, since the spread of rates and short-term rates are correlated, this causal relationship is not completely accurate.

GDP growth with 20% weight on the prior year was also highly significant. However, the standard deviation of the expected GDP was not significant. In order to understand why this variable was not significant, I ran regressions with different weights on the past. The GDP variable was always significant at different weights; however, the standard deviation weight remained not significant. Below is a comparison of the GDP variable with different weights on the previous year.

| Weight | Coefficient | t-value | P>|t| |
|--------|-------------|---------|-----|
| 5%     | 7.431371    | 4.90    | 0.000 |
| 10%    | 7.611506    | 6.55    | 0.000 |
| 20%    | 4.357739    | 5.95    | 0.000 |
| 50%    | 2.044959    | 5.05    | 0.000 |
| 70%    | 1.650296    | 5.14    | 0.000 |
| 90%    | 1.355098    | 4.81    | 0.000 |
| 100%   | 1.236507    | 4.63    | 0.000 |

This comparison shows a few points. The coefficient on gdp became much larger with a smaller weight on the previous year. This conclusion does not necessarily oppose the idea of irrational exuberance in the housing market. According to this data, historical GDP growth had a larger effect on home prices. This might be expected because national income typically increases the value of homes. However, GDP growth with 70%, 90%, and 100% weight on the previous year are also highly significant. This is consistent with the idea that investors bid up asset prices in response to GDP in the year before.

3d Robustness of Regression

This table points out the correlation between independent variables, using 20% weight on the previous year’s GDP.
<table>
<thead>
<tr>
<th></th>
<th>diflag</th>
<th>stirreallag</th>
<th>asset</th>
<th>gdp</th>
<th>sd</th>
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<td>diflag</td>
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The high correlation between the spread of interest rates and the short-term rates was expected. However, the correlation between the standard deviation of GDP growth and the interest rate spread was unexpected. This correlation might point to the fact that monetary policy responds to unexpected fluctuations in GDP growth.

3e Conclusions

In conclusion, the results demonstrate that low interest rates increase home prices, which strengthens John Taylor's argument. Also, the difference between long-term and short-term rates has a significant effect on home prices, showing that central banks have kept rates too low. Finally, the results also demonstrate that investors respond to GDP growth in the previous year. Since housing booms and busts have destabilizing effects on the economy, it is important to explore possible policy responses, which might reduce this variance.

4 Policy Implications

It is widely debated whether monetary policy should respond to asset price bubbles. Since booms and busts in housing markets played a major role in the global financial crisis and the Eurozone debt crisis, many economists have re-evaluated whether monetary policy can improve financial stability by "leaning against" bubbles.

In this section, I will identify common arguments for and against using monetary policy in response to asset price bubbles. First, monetary policy is a very blunt tool to deal with rising asset prices. If central banks raise interest rates in response to a potential
bubble, output will drop in all parts of the economy. Therefore, regulation in financial markets is regarded as a better tool because it can have a more specific impact on the bubble. Unfortunately, there are practical problems with this argument. Since the political process drives regulation, it can be much slower in reaction to problems in the financial system. Also, banks have an incentive to exploit weaknesses in regulation. According to Federal Reserve governor Jeremy Stein, monetary policy can be useful because “it gets through all the cracks.”

Second, central bankers worry that they cannot accurately identify an asset price bubble. This argument is not completely valid, because central bankers usually need to identify the existence of a bubble in order to predict future output and inflation. All of monetary policy is based on predictions, which are sometimes inaccurate.

Finally, Ben Bernanke points out that the Federal Reserve tried to burst the bubble in the late 1920s and the Bank of Japan tried to burst the bubble in the late 1980s, and both had disastrous responses. However, most economists who believe that monetary policy should react to asset prices do not believe that tightening monetary policy is always the best response. According to a model by Bordo and Jeanne (2002), optimal monetary policy should respond to asset prices depending on private sector optimism. When private sector optimism is low, there is not a very large probability of a bust. When private sector optimism is very high, raising rates probably won’t be able to control the asset price boom, and the probability of a bust will be smaller. Therefore, raising rates when private sector optimism is in a medium range would be the best response. This best response would be a small rise in rates at the beginning of a bubble.

This model is consistent with the idea of "leaning against the wind," an idea which has been widely debated over the past fifteen years. "Leaning against the wind" is the idea that monetary policy can reduce the size of an asset price bubble ex ante by raising interest
rates slightly above the Taylor rule. According to Alan Greenspan, monetary policy should only focus on stabilizing the economy after the bursting of an asset price bubble. Donald Kohn, former Vice Chairman of the Federal Reserve System, has revisited this debate following the bursting of the U.S. housing bubble. Kohn agreed with Greenspan after the bubble in 1999; however, he wrote a paper in 2008 entitled "Monetary Policy and Asset Prices" changing his view on the subject. Due to the enormous cost of “mopping up” the U.S. housing bubble, Kohn now believes that optimal monetary policy would respond to an asset price bubble ex ante.

In addition to “leaning against the wind,” if central banks expand their forecasting, bubbles will seem to have a bigger impact on output and growth. According to the IMF: “This analysis suggests that in economies with more developed mortgage markets, monetary policymakers may need to respond more aggressively, within a risk-management approach that treats house price dynamics as one of the key factors to be considered in assessing the balance of risks to output and inflation.”

Sweden’s central bank, Sveriges Riksbank, has recently incorporated home prices into its monetary policy decision-making process. In 2006, Sveriges Riksbank decided to raise their interest rates by .25% in direct response to rising home prices. According to the Bank governor, Stefan Ingves, there is not enough research on the effect of monetary policy on home prices to create a formal rule of thumb. Instead, Sveriges Riksbank's uses its own judgment to determine risk in the housing sector. Sweden's home prices did not fall after the financial crisis, instead they kept rising. Despite the current economic conditions, Sweden's central bank has not let interest rates drop too low for fear that the market is currently in a bubble.

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Unfortunately, the Eurozone cannot use the policy of “leaning against the wind” if there are asset price bubbles in only a few member countries. Some economists believe that this dilemma led to the excessive public debt in Greece and excessive private debt in Spain and Ireland, which fueled their housing bubbles. After the formation of the Eurozone, short-term interest rates in many of the member states were much lower than the Taylor rule would recommend, based on their output. Since rates are set for the entire region, they cannot respond to risks and problems in each member state. During the Eurozone debt crisis, this structural problem became much more important. Since this “indiscipline” is difficult to constrain, it is possible that the Eurozone will constantly experience debt crises and imbalances in the peripheral countries. Bernard Connolly, an economist who initially predicted the Eurozone debt crisis, provides a very grim view of the currency union. According to Connolly “Either Germany pays something like 10% of German GDP a year, every year, forever” in order to keep funding the bailouts of the rest of the Eurozone or finally Germany might decide to drop the currency. He believes that the euro countries’ inability to control indiscipline through monetary policy is a structural problem that cannot be fixed. However, bank supervision and regulation are two other possibilities that Connolly does not consider.

In addition to monetary policy, supervision and regulation must be the main tools for improving financial stability. Although it is difficult to understand the riskiness of complicated mortgage products, it is possible for the government to reduce leverage of banks and reduce household debt. For example, the loan to value ratio describes the value of the mortgage loan in comparison to the value of the property. This ratio typically determines the mortgage rate; however, governments could set tighter limits of the loan to value ratio.
5 Conclusion

In conclusion, monetary policy across 15 countries had very significant effects on home prices. My results are consistent with John Taylor’s hypothesis that countries with interest rates that were too low experienced booms and busts in their housing markets. Due to the crippling effects of the Global Financial Crisis, central banks should research the possibility of responding to bubbles, especially in the housing market.

According to recent literature, periods of low short-term rates also leads to increased credit availability. This topic is very applicable to the recent Eurozone debt crisis and the subprime mortgage crisis in the U.S. Easy credit conditions make it possible for borrowers to be highly leveraged and bid up asset prices. If monetary policy could respond to asset price bubbles at the beginning of their development, they could reduce the economic effects of the bust.
Appendix 1

Countries Studied:
1. Australia
2. Canada
3. Denmark
4. Finland*
5. France*
6. Germany*
7. Ireland*
8. Italy*
9. Japan
10. The Netherlands*
11. Norway
12. Spain*
13. Sweden
14. United Kingdom
15. United States
*Denotes Eurozone country
References


Petersen, Harold. "Notes on using Koyck weights to estimate the mean and variance of growth over the next year." 7 Dec. 2012.


