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Abstract

Two recent empirical papers have presented results indicating that the U.S. Federal Reserve deserved much blame as a cause of the latest boom and bust in house prices and activity. Both papers are important contributions, but neither study allows for the impact of long-term interest rates, which are more affected by global factors than the Fed-controlled federal funds rate. In this paper, we include both the thirty-year mortgage rate as well as the fed funds rate as determinants of housing variables. Our results indicate that the long-term rate has independent predictive power for housing when included in equations along with the short-term funds rate. Indeed in some cases, the long-term rate is highly significant while the funds rate is not. We also show that in more recent years, the impact of the funds rate on housing has fallen relative to that of the mortgage rate; indeed in the case of house prices, the mortgage rate is highly significant while the funds rate exhibits barely any effect. Finally, we demonstrate through structural change tests that the mortgage rate does not simply proxy for monetary policy, and that the impact of the funds rate on long-term borrowing costs has also fallen through time. This latter finding is in accord with research showing the increased impotence of individual central banks with respect to long term interest rates.
Introduction

The recent run-up and subsequent crash in housing prices and construction constituted one of the most dramatic such episodes in the history of the U.S. housing industry. The episode entailed a large decrease in credit standards, and the increased use of subprime lending, lots of house equity extraction and consequent consumption spending. In addition, the post-crash financial distress harmed lender balance sheets, and the high level of foreclosures appear to have a negative effect even on the value of neighboring homes whose mortgages were not in arrears. While the boom and bust has been devastating for much of the housing industry, the last several years have provided much insight and improved research into the aforementioned topics. In addition, the boom and bust appear to have consequences far beyond the housing sector, as the drop in home values and building was associated with an economy-wide recession which was by some measures the most severe since the Great Depression.

Accordingly, many researchers have attempted to sort out the causes of the run-up and crash in housing. There have been numerous factors proposed as being the cause of the crisis, from lax regulation to tax code changes to government-sponsored enterprises (GSEs). One potential culprit has been identified by a number of commentators—the Federal Reserve, which ran a very loose monetary policy over the years 2001-2004. By running such loose policy, and keeping the short-term federal funds rate (FFR) very low, it is thought by some that the Fed made borrowing to purchase homes very cheap, thus fueling construction and leading home prices into bubble territory, from which they of course later fell.

There have been two very interesting empirical papers which have presented evidence bolstering the case for the Fed’s culpability in the housing bubble. Taylor (2007) estimates housing starts as a function of the FFR, and shows results which suggest that had monetary policy been tighter, the rise and fall in starts would have been much less dramatic. McDonald and Stokes (2011) examine the impact of the FFR on home prices. The authors find, first, a clear overall effect of the FFR on house values, and secondly, that the impact of the FFR on prices has risen in the 2000s decade, relative to its effect in the late 1980s and 1990s.

Both papers are important contributions to the research on the roots of this financial crisis. There is a question of interpretation regarding their inference, however. Both studies solely rely on the FFR as the only
regressor. This could be problematic. Another strand of the literature has developed which points to global, rather than domestic factors as culprits (Economist, 2009). Proponents of this view note that long-term interest rates—those which are the price of mortgage credit—were held down by strong global demand for U.S. assets. Indeed, the Fed did raise the FFR over 2004-2006, but, rather than rise in response, long-term interest rates continued to fall, further providing cheap credit for housing. The then-Fed chief Alan Greenspan famously referred to this failure of long-term rates to rise in response to the FFR as a “conundrum”.

We will thus perform some estimations on house prices, as well as residential investment, and include both the FFR as a measure of monetary policy and the thirty-year mortgage rate. Our goal will be threefold. First, we will determine how well the FFR and thirty-year mortgage rate predict housing variables when both are included in the model. Secondly, we examine how the relationship between housing variables and the two interest rates have evolved over the last several decades. Finally, because the thirty-year rate may be picking up monetary policy, we will estimate how well the FFR predicts the long-term rate, and how this relationship has evolved over time.

Like the Taylor and McDonald and Stokes papers, our estimates are reduced forms. We will be regressing the cyclical components of the housing variables on the lagged cyclical components of the interest rates. We will then follow the methodology of Friedman and Kuttner (1992) to see how these relationships have evolved over time, and estimate the models over different sample periods. Of course, while this technique has been used in the past (by McDonald and Stokes among others) there is the possibility that the results of splitting the sample are a form of data mining. To get further evidence on the nature of the changing relationships, we will perform formal Andrews-Quandt endogenous structural break tests on the models.

Our results from this study are as follows. First, the long-term mortgage rate, when included in equations with the FFR, has independent predictive power for housing measures. Moreover, in some cases, the mortgage rate is significant while the FFR is not. Secondly, the impact of the thirty year rate has grown over time relative to the impact of the FFR (indeed over the last three decades the FFR exhibits virtually no significance for home prices). Finally, we demonstrate through regressions and structural change tests that the mortgage rate does not simply proxy for monetary policy. This last finding is in accord with intuition and the speculation of observers such as Rogoff (2006) who note the declining influence that any single central bank has over long term interest rates.
Taken as a whole, while our findings may not fully acquit the Fed, they show, at a minimum, that the Fed had a major accomplice in the global factors that kept interest rates low as the housing bubble grew. The paper proceeds as follows. The next section describes the previous literature. The third section details our data and methodology. The fourth section describes the results, and the fifth section concludes.

**Previous Literature**

The housing bubble in the United States over the 2000s has attracted much attention. Wheaton and Nechayev (2009), for example, provide an excellent study on the bubble, and examine the role of second home and speculative buying and the impact of subprime lending. Ding, Quercia, Li and Ratcliffe (2011) also perform an interesting analysis on the topic of subprime lending, and show that subprime loans play a causal role in default, independent of the risk characteristics of the borrower (see also Ding, Quercia and Ratcliffe (2010) for a further analysis of subprime lending’s effects).

The bubble and bust also attracted attention in no small part due to the severe recession that followed the crash. In contrast to housing, while many (even noted efficient markets advocate Burton Malkiel) concede that equity valuations in the late 1990s had reached bubble levels, the subsequent recession following the stock market crash in 2000 was quite mild by historic standards. The leveraged nature of housing may make the resolution of turmoil in the housing sector much more costly to the economy. Hatzius (2008) identifies four channels through which a housing downturn can affect the macroeconomy. First, a downturn in housing directly lowers output, as residential investment is a component of output. Second, there are “knock-on” effects, as laid-off construction and real estate workers reduce spending on other goods and services. Third, there may be a wealth effect on consumption from changes in home values (LaCour-Little, Rosenblatt and Yao (2010) for instance examine house prices and how they affect refinancings and consumer spending). Finally, losses on mortgage credit eat into the capital of lenders causing a reduction in credit to borrowers. Igan and Pinheiro (2010) study the vulnerability of bank balance sheets to real estate losses. And of course foreclosures can also lower the prices of neighboring homes setting off a vicious circle (Rogers and Winter (2009) exploit a unique data set and find a clear negative effect of foreclosures on the sale prices of neighboring homes).
Given these channels, it is unsurprising that Leamer (2007) finds that housing, which comprises only a small fraction of total GDP, has a large effect on cyclical fluctuations. Indeed the author titles his paper “Housing IS the Business Cycle” to emphasize the unique ability of housing, as opposed to other categories of output, to serve as a leading indicator of economic activity. His study employed post-war data prior to the current crisis. In addition, Miles (2009) finds that the impact of housing on the economy has grown in recent years as financial innovation and the development of secondary mortgage markets have proceeded.

As the latest housing bubble episode seemed to have such a large impact on the economy, much research has been devoted to determining the underlying causes of the boom and crash. McDonald and Stokes (2011) provide an excellent synopsis of much of the hypothesized causes of the boom and bust. The authors cite Shiller (2009), who believes that the rise in home values began in 1997. This “9-year upward trend” is inconsistent, according to Shiller, with Fed interest rate cuts as the main explanation of the episode, since prices continued rising even as the Fed was raising interest rates in 1999. In addition, Shiller is quoted as believing that some of the other purported drivers of the housing boom such as lowered credit standards, lax regulation and malfeasance on the part of rating agencies were more a result of rising valuations than vice-versa. Moreover, McDonald and Stokes point out that dating the beginning of the boom in 1997 is consistent with an observation by Thornton (2009), who noted that the capital gains tax on owner-occupied homes was greatly reduced that year.

McDonald and Stokes cite Hendershott, Hendershott and Shilling (2010), who put much of the blame on the Government Sponsored Enterprises (GSEs) Fannie Mae and Freddie Mac for lending to questionable borrowers and the securitization of such risky loans by both the GSEs and the private sector.

The authors also quote Zandi (2009), who mentions financial innovation and the ratings agencies. Zandi also, though, believes the Federal Reserve deserves blame for “lighting the fuse” of the bubble through excessively low interest rates. And indeed there were numerous other commentators who argued that Fed policy was a major factor in the housing crisis (McDonald and Stokes cite Barth (2009), Roubini and Mihm (2010) and Schwartz (2009), among others).

Taylor (2007) was among the early studies which brought empirical evidence to bear on the question of the Fed’s culpability. The author studied housing starts, or output, rather than housing prices, but the results are
interesting. Taylor gathers data on starts and the FFR running from 1959 into 2007. The author regresses starts on
the FFR, and finds a strong effect of the monetary policy variable on housing activity. The author also states that
over the years 2002 through 2006, Fed policy was uncharacteristically loose as measured by the Taylor Rule.
Running a counter-factual exercise, Taylor finds that had the Fed followed a more predictable, tighter policy,
according to his specification, there would have been a smaller rise and a much smaller subsequent drop in housing
starts, than the boom-bust scenario that actually unfolded under actual Fed policy.

McDonald and Stokes (2011), having surveyed the literature on the causes of the housing boom, perform
their own empirical analysis. These authors examine the impact of monetary policy on US house prices. Data was
gathered on the FFR and the Case-Shiller home price indices (both the ten and twenty-city versions), running from
1987 to 2010. The authors investigate whether the FFR Granger-Causes home prices, as well as whether the
impact of monetary policy on home prices has changed through time. For the entire sample, running from 1987 into
2010, the FFR clearly Granger-causes home prices, with the p-value on the test being very low. Moreover, when the
sample is restricted to exclude the years of the last decade, ending in either 1999 or 2000, the p-value on the
Granger-causality test is much lower. The authors interpret this finding as evidence in favor of the hypothesis that
the relationship between monetary policy and house prices was stronger in the latest decade. The authors also
perform impulse-response analysis, and find that at the national level, there is a significant negative impulse
response of home prices to the FFR.

Thus both Taylor, as well as McDonald and Stokes, have presented evidence that, taken in and of itself,
would appear to convict the Fed as guilty of playing a major role (if not the major role) in creating the housing
bubble. And, as noted in the synopsis in McDonald and Stokes, this evidence is consistent with much speculation
by other economists and housing commentators.

However, taking into consideration some other factors, it is not entirely clear that Fed policy was the
driving force behind the housing bubble (not least of these factors is the fact that many countries besides the United
States also experienced housing booms). And indeed global factors, rather than simply the Fed, have been cited by
others as being a major factor in the crisis (see Obstfeld and Rogoff, 2009, Merrouche and Nier, 2010). And it is
quite plausible that global imbalances-large trade surpluses in Asia, and large trade deficits in the US, UK and other
countries—could well have led to the housing boom. Driven by a desire to avoid currency crises such as those in the
late 1990s, and to keep exports competitive, many Asian countries-China as well as others-engaged in large purchases of US assets, especially Treasury bonds. These purchases kept Asian currencies competitively valued, and allowed for the amassing of large dollar reserves. Of course, these investments in the US also implied current account deficits, and that Treasury yields were kept quite low throughout the past decade, which would make mortgages very affordable and boost housing.

Several theoretical papers have recently shown the link between current account deficits and house prices (See Gete, 2010, Laibson and Mollerstrom, 2010, Adam, Kuang and Marcet, 2011). Gete, for instance, develops a model in which housing booms are larger when countries are able to run trade deficits (and the US has been able to run record trade deficits). Bergin (2011) nicely summarizes much of this research and demonstrates the close link between housing prices and current account deficits in a number of countries. Indeed, Laibson and Mollerstrom show that in a sample of nineteen nations, housing prices explain half of the variation in current account balances. Gete (2010) tests his model and similarly finds a close link between current accounts and housing demand for a sample of OECD countries.

Taylor acknowledges that the behavior of long term rates complicates his analysis. The author concedes that long term rates didn’t rise “as much when the federal funds rate rose as would be expected from past experience during the Great Moderation. A larger increase in long term rates would clearly have mitigated the housing boom even with the actual path of the funds rate” (p. 5) (indeed, Adam, Kuang and Marcet (2011) show theoretically that “the US house price boom could have been largely avoided, if real interest rates had decreased by less after 2000”). Taylor does not include long term rates in his empirical model, however.

One might speculate that the low long term rates were determined by the Fed’s low FFR. However, the ability of central banks such as the Fed to influence long term rates is thought to be much less than in years past (see Rogoff, 2006). Rogoff notes that “Through both goods and asset price arbitrage, globalization is weakening the grip of individual central banks over the trajectory of domestic real interest rates except at relatively short horizons” (Rogoff, p. 2). Rogoff goes on to note that some estimates suggest that long-term rates in the US would have been palpably higher in recent years but for globalization. Indeed, between 2004 and 2006, the Fed raised short-term rates, but longer term yields, to the dismay of the Fed, continued
to fall. Alan Greenspan referred to this episode as a “conundrum”. Wu (2006) notes that low long-term interest rates over this period were not confined to the United States, but seemed to prevail throughout the industrialized world, suggesting a global cause. The author contrasts the Fed tightening of 1994-95, in which a rising Fed funds rate was followed by rising ten-year Treasury yields, with the 2004-05 tightening, in which ten-year yields fell as the funds rate was increased. The author notes that a number of global causes, among them the rising foreign exchange reserves of Asian and Latin American central banks, and more developed global financial markets, may account for the lower long-term rates in the face of tight central bank policy. To anticipate our results, we will investigate the impact of the FFR on the thirty-year mortgage rate, and our results will indicate that the FFR once had a significant impact on longer yields, but now no longer does.

Greenspan (2010) acknowledges that many economists blame the Fed (he cites a Wall Street Journal poll in 2010 in which 78 percent of Wall Street and business economists and 48 percent of academic economists thought “Excessively easy Fed policy in the first half of the decade helped cause a bubble in house prices” (see Greenspan, page 237, footnote 49). At the same time, he strongly argues that long term, rather than short term rates were the drivers of the housing bubble. He first notes that long term rates started falling in mid-2000, six months before the Fed started lowering the FFR. Secondly, he states that over the 2002-05 period, long term rates were much more highly correlated with the Case-Shiller house price index than the FFR (there was an $R^2$ of 0.5 in a regression of the house price index on long term rates versus that of 0.205 in a regression where the FFR was employed). Of course, this was a very short span of time, and does not constitute a formal test, which we will perform in our analysis, but the results are suggestive. Third, Greenspan argues that these results “should not come as a surprise-prices of long-lived assets have always been determined by discounting the flow of imputed income (or services) using interest rates on assets of comparable maturity. No one to my knowledge, employs overnight interest rates-such as the federal funds rate-to determine the capitalization rate of real estate.” (Greenspan, p. 236). Finally Greenspan presents results showing that the FFR and long-term rates were highly correlated between 1983 and 2002 (the correlation coefficient being at 0.86), but that this correlation appeared to drop markedly over the 2002-05 period (the estimated coefficient was only 0.1). Again, while not a formal test, these results are at least indicative of a substantial role for longer term rates in affecting housing variables.
At a minimum, a study of the Fed’s potential culpability should include both the short-term FFR that was included in the Taylor and McDonald and Stokes papers, and longer term interest rates, which were not included in either study. Jarocinski and Smets (2008) do employ both the FFR and the long term interest spread (the difference between ten-year Treasury rates and the FFR) in an identified, Bayesian VAR in which the impact of developments in output as well as interest rates are examined. The authors find that both the FFR and the long term spread help explain developments in both house prices and residential investment.

The Jarocinski and Smets study is interesting, as the authors go beyond the reduced form approach of Taylor and McDonald and Stokes. McDonald and Stokes, however, did perform Granger-causality tests over different samples (1987-2000 and 2000-2010) to examine how the relationship between housing and monetary policy evolved. It is possible that monetary policy has become more powerful (as results from McDonald and Stokes seem to indicate) or less powerful (given the conjecture of Rogoff) over the decades. Jarocinski and Smets, in contrast, confine their sample to 1987-2007. Indeed the authors rationalize doing so because they note that “the role of housing investment in the business cycle may have changed since deregulation in the early 1980s” (p. 340). Thus, the authors seem to believe there may have been some structural change in the relationships between housing and the rest of the economy.

Indeed, there have been studies indicating that the relationship between housing and the macroeconomy have changed over time. For instance, before 1980, most housing finance in the United States was provided by thrifts, which were bound by Regulation Q to keep limits on the rates paid on deposits. Thus if the economy started growing, market interest rates would rise, leading to a scarcity of funds for thrifts, and hence less mortgage lending, which would curtail housing investment.

Regulation Q was abolished in 1980. Moreover, a secondary market for mortgages has grown over the decades through securitization. The secondary market grew very rapidly in the early 1980s (Pozdena, 1990). Pozdena believed that this secondary market should make the housing sector less sensitive to developments in the overall business cycle. Empirically, Miles (2009) finds that since the early 1990s, housing is less “crowded out” by non-housing investment, and residential investment has a larger impact on consumption than previously. Gauger and Snyder (2003) also find that residential investment has greater predictive power for GDP since the early 1980s.
And in addition to these changes in the US housing market, there have been the aforementioned changes in global financial markets. Given all of these changes, in order to gauge the role of the Fed in the latest episode, it will be necessary to include both the FFR and long term interest rates in the analysis, as well as to estimate whether and how these relationships have changed going into the 2000s.

Our approach will thus be similar in spirit to the study by Friedman and Kuttner (1992), who examined the evolving relationship between monetary policy and the economy. Among other specifications, the authors tested for the significance of lagged FFR and monetary aggregates in predicting output and inflation. The authors run estimates over different time periods to see how the relationships changed. We will estimate similar models over different time periods for monetary policy and housing. We will also formally test for changes in these relationships with proper structural break tests.

Data and Methodology

The data includes the Federal Funds Rate, Residential Investment, and the Federal Housing Finance Authority’s (FHFA) home price index. All of the variables are seasonally adjusted. As a measure of output, residential investment was deflated with the GDP Deflator. The first three variables were obtained from the St. Louis Federal Reserve Bank’s FREDs website. The home price index was obtained from the FHFA website. We employ the FHFA, as opposed to the Case-Shiller index, as the former goes back to 1975, while the latter starts only in 1987. Employing the Case-Shiller index would thus preclude investigating how relationships among the variables have evolved across important financial and economic changes.

All of these variables have been found non-stationary in different studies. Thus simply regressing levels on levels could lead to spurious inference. One obvious solution would be to difference the data. Differencing the data can often lead to a loss of information, however. Examining a possible cointegrating relationship among the variables is a possibility, but, this would make examining the changes over sub-samples quite difficult, as tests for cointegration may be sensitive to different sample sizes (see Cheung and Lai, 1993). Thus, like Taylor and McDonald and Stokes, this estimation will be in reduced form—that is, we will not attempt to specify and estimate a structural model, as this could make examining the changes in the relationships prohibitively difficult.
We will employ an alternative technique that has become quite standard in macroeconomic research to analyze relationships among variables such as output, money and prices. Given that many such time series contain a non-stationary component, techniques have been developed to decompose a series into a stochastic trend and a cyclical component. Analysis can then be performed on the cyclical component. Initially, the Hodrick-Prescott (HP) filter had been developed and widely employed. More recently Baxter and King (1999) and Christiano and Fitzgerald (2003) have developed more refined filters. Koopman and Azevedo (2008) note that the Christiano-Fitzgerald technique is “the best performing and most flexible linear filter available” (see also Mink, Jacobs and de Haan, 2012). We will accordingly decompose all of the variables using the Christiano-Fitzgerald filter.

Having de-trended the variables, we will then investigate the relationship between housing (both prices and residential investment) and the FFR and thirty-year mortgage rate. Our specification will be similar to that of McDonald and Stokes, as they regressed house prices on lags of the FFR. McDonald and Stokes used monthly data with twelve lags. As our data is quarterly, we will employ four lags. Taylor employed only one lag of the FFR in his analysis of housing starts. Another key difference (besides our use of properly filtered, rather than differenced data) between the specifications of McDonald and Stokes and Taylor, on the one hand, and the model we will estimate is that we will augment our model with four lags of the thirty-year mortgage rate. We will see whether the thirty year rate adds to the explanatory power of the model. If it does, this suggests that the two just-mentioned studies may be attributing too much credit to Fed policy in determining housing activity and prices.

As a number of researcher have noted, the relationship between housing and monetary policy may have changed over the years. Accordingly, we will follow a method similar to Friedman and Kuttner (1992). These authors believed that the impact of monetary policy and aggregates on output and prices was likely to have changed over the years. They thus estimated output and inflation as functions of lags of the FFR and money supply measures, but they split their samples to conduct the analysis over different time periods. The authors found that over a sample spanning 1960-1979, money had a significant effect on output changes. Over the 1970-1990 sample, however, the significance of money disappeared. We will similarly investigate whether the impact of monetary variables on housing has changed over the years relative to the impact of the more market-determined mortgage rate.

One possible objection to finding significance for the mortgage rate relative to the FFR is that the mortgage rate may be a function of the FFR. Of course, Rogoff (2006) has already conjectured that the influence of central
banks on long term yields has diminished. Moreover, there was the episode of 2004-2006 in which the FFR was raised, and yet long term rates continued to fall, labeled a “conundrum” by Alan Greenspan. At the same time, it would be useful to gather more formal evidence on the relationship between mortgage rates and the FFR. We will thus estimate the mortgage rate as a function of its own lags, as well as lags of the FFR. We will, as with the housing regressions, estimate this model over different time periods to see if the FFR has less of an impact on long-term rates than in earlier decades.

A potential difficulty in making proper inference through estimating over different time periods in this manner is that we may be splitting samples based on “known”, or suspected changes in finance or the global economy. It would be analogous to testing for a structural break in the parameters by choosing a break date based on familiarity with the data. Unfortunately, testing for the effect of parameter change in this manner is problematic. Hansen (1992) explains in detail that since the break point is chosen because it is “known” to have been a date of potentially important change, the choice of that date is the result of a form of data mining, and hence endogenous. Intuitively, the true critical values for such a test would be much larger than standard t, F or Chi-square tables would indicate.

This is not some inconsequential point of statistical theory. For instance, Alogoskoufis and Smith (1991) examine changes in U.S. inflation persistence resulting from the dropping of exchange rate pegs. The authors find that episodes such the U.S. leaving the gold standard and the collapse of the Bretton Woods system did appear to lead to large increases in inflation persistence. However, Burdekin and Siklos (1999) conjecture that events besides changing exchange rate pegs affect inflation as well. Upon testing different events for breaks, Burdekin and Siklos find that other events such as oil price shocks have larger effects than changes in exchange rates.

Intuitively, to avoid the problem of data mining and choosing break points based on prior knowledge, one could test all points (one might first trim the data set by dropping the first and last few observations) for a break, and choose as the breakpoint that date which yields the largest test statistic. This is the approach of Quandt (1960). However, this test statistic will not have a standard distribution, as the break is identified only under the alternative hypothesis. In addition, if one is using a nominal size of five percent, it is almost certain to reject the null hypothesis of no break, even when the null hypothesis is true, for any reasonably large data set. Fortunately, Andrews (1993) and Hansen (1997) have developed test statistics and critical values for this type of test which overcome the
problems of Quandt (1960). The Andrews-Quandt test uses the date of the largest F-test statistic as the break point, and Hansen (1997) has provided critical values for this procedure.

Accordingly, we will test for structural change in the parameters of the models of housing investment, house prices and the thirty year mortgage rate. To anticipate our findings, we do indeed find significant breaks that support the notion that thirty year rates have increased, and monetary policy has decreased, in importance for the housing market. We now discuss our results in detail.

Results

The first columns of Table 1 displays the results from our initial exercise, in which we regress the filtered quarterly FHFA index on four lags of the filtered FFR and filtered thirty-year mortgage rate (we used, as noted, the Christiano-Fitzgerald decomposition with cycles constricted to last between six and thirty two quarters, as is standard practice with this de-trending technique). Again, this specification is similar to McDonald and Stokes (they use twelve lags as their data is monthly, we employ four with our quarterly data), although we augment our model with the market mortgage rate. As can be observed from the table, when the mortgage yield is included, the FFR has little predictive power.

We do note that some of the significant lags of both the FFR and the mortgage rate are “wrongly” signed in that they are positive. It is important to keep in mind that this is a “reduced form” exercise, as were the estimates of McDonald and Stokes and well as Taylor. There is no pretense that the obtained coefficients represent an identified estimate of a structural parameter; rather, we are just trying to observe how well the policy and non-policy rates predict housing variables.

Over the whole sample in Table 1, the FFR is significant only at the fourth lag, and only at the ten percent level. In contrast, the first two lags of the mortgage rate are significant, each at the five percent level, and, although this model is in reduced form, the net effect of the first two mortgage rate lags is “more negative” than that of the one marginally significant FFR coefficient. Thus, the thirty year mortgage rate appears to have a greater impact on home prices than the FFR over the whole 1975-2011 sample.

In the next columns of Table 1, we have restricted the sample to 1975:2-1992:1, thus deliberately missing nearly twenty years of increased financial innovation and globalization. Note that over this sample, all lags of both
the FFR and mortgage rate are significant. Thus, it appears that home prices may have become less sensitive to interest rates over the past two decades, although the market mortgage rate seems to have retained more of its impact.

This point is further bolstered when the sample is restricted in the last columns of Table 1 to 1982:3-2011:3. The year 1982 has been found to be a break point in other studies, as Regulation Q had recently ended and securitization was rapidly increasing (see Pozdena, 1990, for details on the development of the secondary market in housing loans). Gauger and Snyder, for instance, estimate housing models over 1959-1979 and then 1982-1999, splitting the sample at this point to account for changes in financial regulation. Bradley, Gabriel and Wohar (1995) find that the impact of deposit flows at thrifts on mortgage rates experienced a structural break in 1982:7, which corresponds to the beginning of our sample in Table 3.

As displayed, no lag of FFR is significant at five percent in this sample while the mortgage rate still retains significance at the first lag. Once, again, the mortgage rate appears to have a greater impact on home values than the policy rate and to have retained more of its effect.

Of course, changing the sample in this manner could lead to accusations, of “cherry picking” different sample dates based on knowledge of the data—the early 1980s have especially been noted previously as a period of structural change. This would lead to inference problems in choosing break points discussed in the Previous Literature section. Accordingly, we perform formal Andrews-Quandt tests on the specification in the first columns of Table 1. Results are displayed in Table 2.

The impact of the FFR did indeed experience parameter change, with two lags exhibiting significant breaks at 1980:2. This of course corresponds to the previous literature (Bradley, Gabriel and Wohar, Gauger and Snyder, Pozdena) on the changes in the housing market over the early 1980s. The fourth lag exhibits a break at 2006:1–this corresponds to the “conundrum” described by Alan Greenspan.

While Table 1 indicates that both the FFR and long term rates have diminishing effects on house prices through the years, the only significant break date for the mortgage rate in Table 2 is at 2006, quarters 1 and 2, and all lags experience a break in this year. These results again bolster the case that the mortgage rate has had a larger overall impact, and specifically retained this impact longer than monetary policy instrument1.
We next turn our attention from house prices to house building—residential fixed investment. We again regress the filtered (using the Christiano-Fitzgerald decomposition) RFI as the dependent variable on the filtered lags of the FFR and thirty-year mortgage rate. The results of Table 3 would appear to support the notion that monetary policy has a strong effect on home construction, as over the whole sample, all lags of the FFR are significant, while the mortgage rate is never significant at any lag.

If these results held over later samples, it might be reasonable to conclude that estimating housing variables as functions of only the FFR was reasonable, as market rates do not appear to exert an influence. However, when we restrict the sample, to 1982:1-2011:3, we observe that while the FFR remains significant, the mortgage rate becomes significant at the third and fourth lags (the fourth lag being significant at the ten percent level). When the sample is further restricted, in the last columns of Table 3, to 1987:1-2011:3, three lags of the mortgage rate are significant, and all at the five percent level.

Again, these changing parameter values over different samples, while highly suggestive of a growing role for non-Fed influences, are not a formal test. In Table 4, we apply the Andrews-Quandt test to the RFI equation. There are significant breaks in the impact of FFR, at 2001:1 and 2000:2, at the first and second lags, respectively. There is a break in the fourth lag of the thirty-year mortgage rate at 2003:4, just as the housing bubble was getting underway, and at the first, second and third lags at 2005:4. Thus the evidence again indicates that the impact of market rates, relative to the policy-controlled FFR has increased in recent years.

Finally, while the evidence strongly indicates that the mortgage rate has a palpable, and, at least relative to monetary policy, a growing influence on housing, it could be that the thirty year market rate is simply reflecting Fed policy. Of course, there is evidence that the relationship between short and long term rates has dramatically changed. Rogoff (2006) notes that globalization is “weakening the grip of individual central banks over the trajectory of domestic real interest rates except at relatively short horizons” (p.6). And of course, despite raising the FFR over 2004-2006, the Fed witnessed the famous “conundrum” of long-term rates falling, rather than rising in the face of these short-term rate hikes.

More formally, we can test whether the relationship between the FFR and thirty year mortgage rate has changed. In the first columns of Table 5, we regress the filtered thirty year rate on four lags of the FFR, as well as
four own lags, over the sample spanning 1972:2-2011:3. As displayed, the FFR is significant at five percent in the first two lags, at ten percent in the third, and not quite significant at the ten percent level at the fourth lag. The own lags of the mortgage rate are all significant. In the next columns of Table 5, where the sample is restricted to 1985:1-2011:3, all four own lags are significant, but no lag of the FFR exhibits significance. This result gives credence to Rogoff’s claim about the weakened grip of central banks on long term interest rates.

Once, again, the splitting of the sample may be arbitrary, and so we proceed with an Andrews-Quandt test on the initial specification in Table 5. As noted, all lags of the FFR undergo significant breaks. The first lag experiences a significant break in 2000, and the other three all break in 2002. Thus it does appear that, especially over the recent housing bubble, the thirty-year rate, which has been shown to have much independent predictive power over housing variables, even when including the FFR in the models, was not simply a proxy for monetary policy.

Conclusion

The housing bubble has attracted more attention than bubbles in other assets such as equities due to the greater impact of housing on the economy. Housing’s leveraged nature means that the aftermath of a crash can be very devastating to the macroeconomy (note that the stock market crash in 2000 was followed by a mild recession, perhaps owing to the less-leveraged nature of equity investment).

Given the importance of housing to the economy, the search for culprits is understandable, as it would be desirable to lessen the volatility of home prices and activity. While many have blamed Fed policies, our results suggest that long-term interest rates have a larger impact on house prices than the FFR, and that the impact of the FFR has fallen into irrelevance in recent years. Similarly, with residential investment, while FFR still retains some significance, the predictive power of the mortgage rate is much larger in magnitude than in the past.

Our results may not completely exonerate the Fed, nor do they imply no role for some of the other suggested roots of the crisis such as lax regulation, rating agency malfeasance, etc. However, they stand in contrast to some previous research which attributes too much guilt to monetary policy and not enough to global financial markets which have kept the cost of borrowing at very low levels.
Summary

Recent research on the housing bubble suggests a prominent role for the Federal Reserve. According to this line of research, excessively loose monetary policy by the central bank led to low interest rates, and a resulting frenzy of construction and home prices which reached bubble levels. The bubble of course inevitably collapsed.

While these studies have been important contributions, they omit the role of long-term interest rates, which are the true price of mortgage credit, instead focusing solely on the impact of the short-term Federal Funds Rate (FFR). There has been speculation, however, that the FFR in recent years has little impact on long term rates, and that long term interest costs have been held low by global forces outside the control of the Fed.

Accordingly, we estimates models of housing construction and prices which include both the FFR and longer term interest rates. Our findings are two-fold. First, long-term interest rates have independent predictive power for housing variables when employed in models which also include the FFR. In fact, in some cases, the long-term interest rate is highly significant while the FFR is not. We also show that in more recent years, the impact of the funds rate on housing has fallen relative to that of the mortgage rate; indeed in the case of house prices, the mortgage rate is highly significant while the funds rate exhibits barely any effect.

Secondly, we demonstrate that the mortgage rate does not simply proxy for monetary policy, and that the impact of the FFR on mortgage costs has fallen through time. Thus while not “acquitting” the Fed, our results indicate a major role for global forces as culprits in the housing bubble and bust.
References


Gete, P. “Housing Markets and Current Account Dynamics”, unpublished manuscript, Georgetown University.


Table 1
FHFA Price Index

<table>
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<td>Coeff.</td>
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<td>0.057</td>
<td>0.22</td>
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<td>FFR(-1)</td>
<td>-0.109</td>
<td>0.9922</td>
<td>-7.07</td>
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<td>FFR(-2)</td>
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<td>0.346</td>
<td>16.59</td>
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<tr>
<td>FFR(-3)</td>
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<td>0.188</td>
<td>-17.35</td>
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<td>30Y(-3)</td>
<td>68.24</td>
<td>0.182</td>
<td>45.73</td>
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<td>30Y(-4)</td>
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<td>0.74</td>
<td>-19.99</td>
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<tr>
<td>R²</td>
<td>0.348</td>
<td>0.46</td>
<td>0.53</td>
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The dependent variable is the cyclical component of the FHFA home price index, obtained by de-trending the FHFA index with the Christiano-Fitzgerald filter. The regressors are lagged values of the cyclical component of the de-trended Federal Funds Rate (FFR) and Thirty-year mortgage rate (30Y). The first three columns are the results from the whole 1972:2-2011:3 sample, while the next set of results are those from restricting the sample to 1975:1-1992:1, and the last two columns are results from restricting the sample to 1982:3-2011:3. All data was obtained from the FRED database from the Federal Reserve Bank of Saint Louis website.
Table 2
Break Test Results
FHFA Price Index-FFR and 30Y

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<td>FFR(-3)</td>
<td>1980:2</td>
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</tr>
<tr>
<td>FFR(-4)</td>
<td>2006:1</td>
<td>0.000</td>
</tr>
<tr>
<td>30Y(-1)</td>
<td>2006:1</td>
<td>0.000</td>
</tr>
<tr>
<td>30Y(-2)</td>
<td>2006:2</td>
<td>0.000</td>
</tr>
<tr>
<td>30Y(-3)</td>
<td>2006:2</td>
<td>0.000</td>
</tr>
<tr>
<td>30Y(-4)</td>
<td>2006:2</td>
<td>0.016</td>
</tr>
<tr>
<td>All</td>
<td>2006:2</td>
<td>0.000</td>
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</table>

The p-values are from the Andrews-Quandt structural break tests, in which the null hypothesis is that no break occurred. The entry “All” is a test for a break in all coefficients collectively.
The dependent variable is the cyclical component of residential fixed investment (RFI), obtained by detrending inflation-adjusted RFI with the Christiano-Fitzgerald filter. The regressors are lagged values of the cyclical component of the de-trended Federal Funds Rate (FFR) and Thirty-year mortgage rate (30Y). The first three columns are the results from the whole 1972:2-2011:3 sample, while the next set of results are those from restricting the sample to 1982:1-2011:3, and the last two columns are results from restricting the sample to 1987:1-2011:3. All data was obtained from the FREDS database from the Federal Reserve Bank of Saint Louis website.

<table>
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<td>30Y(-4)</td>
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<td>$R^2$</td>
<td>0.534</td>
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### Table 4
Break Test Results
Residential Fixed Investment
-FFR and 30Y

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<td>0.06</td>
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<td>FFR(-2)</td>
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<tr>
<td>30Y(-4)</td>
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</tr>
<tr>
<td>All</td>
<td>2001:1</td>
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The p-values are from the Andrews-Quandt structural break tests, in which the null hypothesis is that no break occurred. The entry “All” is a test for a break in all coefficients collectively.
### Table 5
30Y and FFR

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<td>P-value</td>
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<td>P-value</td>
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<td>C</td>
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<td>0.9102</td>
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<td>0.7556</td>
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<td>0.0249</td>
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<td>0.5404</td>
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<td>0.021</td>
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<tr>
<td>FFR(-3)</td>
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<td>0.059</td>
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<td>2002:2</td>
<td>0.026</td>
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<td>FFR(-4)</td>
<td>-0.034</td>
<td>0.1126</td>
<td>0.0323</td>
<td>0.3157</td>
<td>2002:3</td>
<td>0.05</td>
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<td>30Y(-1)</td>
<td>3.09</td>
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<td>3.256</td>
<td>0.000</td>
<td>1981:3</td>
<td>0.003</td>
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<td>0.000</td>
<td>-4.54</td>
<td>0.000</td>
<td>1981:4</td>
<td>0.01</td>
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<td>3.15</td>
<td>0.000</td>
<td>2003:3</td>
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<td>2005:4</td>
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<tr>
<td>R²</td>
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<td></td>
<td>0.997</td>
<td>All</td>
<td>1980:4</td>
<td>0.000</td>
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The dependent variable is the cyclical component of Thirty-year mortgage rate (30Y), obtained by de-trending inflation-adjusted Thirty-year mortgage rate (30Y) with the Christiano-Fitzgerald filter. The regressors are lagged values of the cyclical component of the de-trended Federal Funds Rate (FFR) and Thirty-year mortgage rate (30Y). The first three columns are the results from the whole 1972:2-2011:3 sample, while the next set of results are those from restricting the sample to 1985:1-2011:3. The last two columns are the results from the Andrews-Quandt structural break test. The entry “All” is a test for a break in all coefficients collectively. All data was obtained from the FRED database from the Federal Reserve Bank of Saint Louis website.
Note that in some studies of housing, such as Jarocinski and Smets (2008) and Gauger and Snyder (2003), the M2 money supply, as well as the FFR, is employed as an indicator of monetary policy. We also performed the exercises in Tables 1 through 4 replacing the FFR with the de-trended M2 money supply. The results were similar to those utilizing the FFR—the thirty-year rate has an independent effect on both house prices and residential investment later in the sample when included in specifications with M2. We did not include these results, but they are available upon request.