Expectation-Driven Cycles in the Housing Market: Evidence from Survey Data

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Abstract

Using a vector-autoregression (VAR) model and data from the University of Michigan Survey of Consumers, we provide evidence on the importance of news and consumers' beliefs for housing-market dynamics and aggregate fluctuations. We document that innovations to News on Business Conditions generate hump-shaped responses in house prices and other macroeconomic variables. We also show that innovations to Expectations of Rising House Prices are particularly important in explaining the path of macroeconomic variables during housing booms. To disentangle the effects of News on Business Conditions from other sources of expectation-driven cycles, we estimate a VAR where the News variable is ordered first. Innovations to News on Business Conditions generate Expectations of Rising House Prices. However, during housing booms, innovations to Expectations of Rising House Prices unrelated to News on Business Conditions account for a larger part of macroeconomic fluctuations. Shocks to News and Expectations account together for more than half of the forecast error variance of house prices, and other macroeconomic variables during periods of booms in house prices. Our results are consistent with the transmission of news shocks in Iacoviello and Neri's (2010) model of the housing market.

JEL classification: E32, E44, E52

Keywords: boom-bust cycles, credit frictions, housing market.

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1. Introduction

Boom-bust cycles in asset prices and economic activity are a source of concern for policymakers. The recent boom in U.S. housing prices, followed by the burst in 2007, has brought the topic back onto the agenda for researchers. An often-heard explanation of housing booms is households' optimism about future house-price appreciation. Case and Shiller (2003) document that expectations of future house-price increases played a role in past periods of rising house prices in the U.S. Using data from the Michigan Survey of Consumers, Piazzesi and Schneider (2009) document that during the most recent boom, the share of respondents who believed in rising prices reached its maximum exactly when prices rose to their historical highs. Moreover, expectations of future house prices appreciation are related to optimism about economic conditions.

The aim of this paper is to investigate the importance of news and changes in households' beliefs for house prices and other macroeconomic variables. For this purpose we use data from the Michigan Survey of Consumers and vector-autoregression (VAR) analysis. We focus on two forward-looking questions reported by the survey. The first survey variable we use is News Heard of Recent Changes in Business Conditions ("News on Business Conditions" henceforth), which we choose precisely because it reports news heard, which we interpret as a proxy of news revealed about future economic activity. Indeed, News on Business Conditions leads real GDP growth with high correlation. The VAR model is estimated using U.S. quarterly data over the sample period 1965Q1-2009Q4. Our VAR analysis shows that unexplained changes in News on Business Conditions have statistically significant implications for the future path of private consumption, inflation, house prices and the federal funds rate. The instantaneous impact on macroeconomic variables is relatively small, but, for most of the endogenous variables, it increases and peaks after about four quarters. In particular, a positive shock to News on Business Conditions generates hump-shaped responses in both consumption and house prices. Unexpected News on Business Conditions contributes by a significant fraction to the forecast error variance of all endogenous variables except, inflation. The relationship between News on Business Conditions and house prices is robust to the addition in the VAR model of residential investment and household mortgages. Mortgage loans may be important in the transmission and amplification of shocks due to the credit-channel effects implied by changes in house prices and leverage, while residential investment also captures the supply side of the housing market. A positive innovation to News on Business Conditions also generates hump-shaped responses in mortgage credit and residential investment. In both models, the housing boom is coupled with a tightening of monetary policy.

The Michigan Survey of Consumers also includes a survey of buying conditions for houses, asking consumers whether it is a good time to buy a house and their reasons for holding that particular view. We focus on the index reporting the fraction of consumers that believe it is a good time to buy because house prices will increase ("Expectations of Rising House Prices" henceforth). Previous papers have looked at this index as a measure of consumer optimism about house prices - see Piazzesi and Schneider (2009). Like an innovation in News on Business Conditions, unexpected changes in Expectations of Rising House Prices generate a hump-shaped response in house price with a peak occurring after about four quarters. However, the quantitative effect is smaller. Changes in Expectations of Rising House Prices contribute by a smaller fraction to the four-quarter-ahead error variance of both house prices and other macroeconomic variables. Innovations to Expectations of Rising House Prices are, however, particularly important in accounting for fluctuations in house prices, residential investment and mortgage credit during periods of housing booms. The contribution of changes in Expectations of Rising House Prices to the forecast error variance of housing-market variables, as well as private consumption, is between forty and fifty per-cent during periods of housing booms.

Our VAR analysis shows that News on Business Conditions and Expectations of Rising House Prices contain information about future house prices and other macroeconomic variables. These findings raise the question of whether the two surveys capture the same information. Thus, we attempt to disentangle the effects of News on Business Conditions from other exogenous sources of fluctuation in Expectations of Rising House Prices. In a VAR with the News variable ordered first, innovations in News on Business Conditions explain about twenty per-cent of changes in Expectations of Rising House Prices. On the other hand, innovations in Expectations do not affect News on Business Conditions, except negatively and with a very long delay. The transmission of shocks to News on Business Conditions is not affected by the inclusion of Expectations of Rising House Prices in the analysis, and maintains the same importance over the entire sample. Changes in Expectations of Rising House Prices that are not driven by News on Business Conditions explain little of macroeconomic fluctuations over the sample. However, during housing booms, exogenous changes in Expectations of Rising House Prices explain a larger part of variations in house prices, residential investment and interest rates than do innovations in News on Business Conditions. We find that, during housing booms, both shocks together account for about fifty-five and seventy per-cent of variations in house prices and housing investment, respectively. Our results suggest that expectation-driven cycles are significant sources of business-cycle fluctuations and are particularly important in explaining booms in the housing market.

The importance of shocks to News on Business Conditions and Expectations of Rising House Prices is supported by several extensions of the VAR analysis. Specifically, our results are robust to different identification assumptions regarding the ordering of financial variables in the VAR model, to the use of alternative measures of economic activity, such as real GDP and business investment, to the use of alternative house-price indexes that include existing homes, and to the addition of the thirty-year mortgage rate, which is used to finance a large part of U.S. home purchases.

The second part of the paper offers a model-based interpretation of the effects of news shocks on house prices and other macroeconomic variables. More precisely, we rely on the New Keynesian model of the housing market built by Iacoviello and Neri (2010). We take news on productivity shocks as a proxy for News on Business Conditions, while news on monetary policy shocks are used as proxy for other sources of Expectations of Rising House Prices, independent of business conditions. We find both news shocks to be potential sources of expectations of future house-price appreciation and to generate hump-shaped co-movement in housing and other macroeconomic variables. An anticipated improvement in technology in the nondurable sector leads to an increase in consumption of both nondurable goods and housing, which is made possible by an increase in mortgage borrowing. Hence, future technological improvements generate optimism in house prices. A similar mechanism is at work for an anticipated reduction in the policy rate: mortgages will become less onerous to service, so that credit-constrained households raise their demand for loans and houses. A necessary condition for a house-price boom to emerge is that agents expect rising house prices; these expectations in turn fuel current housing demand and lift house prices.

Recent papers by Leduc and Sill (2012) and Barsky and Sims (2012) use survey data to investigate the importance of shocks to expectations for macroeconomic fluctuations. Using a structural VAR model and survey-data of unemployment-rate expectations, Leduc and Sill (2012) show that changes in expected future economic activity are a quantitatively important driver of economic fluctuations. In the context of a three-variable VAR, Barsky and Sims (2012) show that unexplained shifts in responses to questions from the Michigan Survey of Consumers about the respondent's expectations have powerful predictive implications for the future paths of macroeconomic variables. Our paper follows the approach suggested by these previous papers. We contribute to their findings by documenting the importance of shocks to news and expectations for housing-market dynamics.

The rest of the paper is organized as follows: Section 2 explores the effects of shocks to News on Business Conditions for house prices and macroeconomic developments. Section 3 studies the effects of unexplained

changes in Expectations of Rising House Prices and section 4 disentangles the effects of News on Business Conditions from those of exogenous shocks to Expectations of Rising House Prices. Section 5 conducts robustness analyses. Section 6 discusses the transmission of news shocks in Iacoviello and Neri's (2010) model of the housing market, and section 7 concludes.

2. Baseline VAR with News on Business Conditions

In the following sections we document the importance of shocks to news and expectations for housing-market dynamics over the business cycle. The analyses follows Leduc and Sill (2012) and Barsky and Sims (2012) in the use of survey and expectation data into an otherwise standard vector auto-regression (VAR) model.[1] We estimate an housing VAR model as in Iacoviello (2005) augmented by time-series survey data to measure the importance of shocks to news and expectations. Similar to previous papers, we obtain that shocks to news and expectations account for a sizable fraction of variation in economic activity. We contribute to previous findings by documenting that shocks to survey variables have also relevant effects for housing-market dynamics.

We use the index of News Heard of Recent Changes in Business Conditions ("News on Business Conditions" henceforth) from the University of Michigan Survey of Consumers as a proxy for news revealed about future economic activity as in Barsky and Sims (2012). The Survey, started in 1965, asks questions related to the assessment of the economy and expectations for economic variables and is conducted on about 500 households. The index reports the fraction of respondents who heard favorable news minus the fraction of respondents who heard negative news of recent changes in business conditions. News on Business Conditions predicts changes in economic activity fairly well. Figure 1 plots the survey data and real GDP growth for the United States. News on Business Conditions leads economic activity by one quarter and it does not display any systematic bias.[2] Appendix A.2 reports the exact wording of the relevant survey question.

We estimate a standard VAR model

$$A_0 Y_t = c + A(L) Y_{t-1} + \varepsilon_t \tag{1}$$

[1] Leduc and Sill (2012) investigate the effect of shocks to survey-based measures of future U.S. economic activity. They use alternative measures of unemployment expectations as compiled by the Livingston Survey, the Survey of Professional Forecasters and the Michigan Survey of Consumers. They estimate a structural VAR model with the unemployment rate, the inflation rate, the 3-month treasury bill and survey-data of unemployment-rate expectations. Barsky and Sims (2012) estimate a three-variable VAR model with real GDP, real consumption and survey data from the Michigan Survey of Consumers. They study the effects of unexplained shifts in responses to questions that measure either Consumers' Confidence or News on Business Conditions.

[2] The cross-correlation between the current survey and the one-quarter-ahead real GDP growth is 0.8 and that between the current survey and the two-quarter-ahead real GDP growth is 0.78.

where Y_t is the vector of endogenous variables, A_0 is the matrix of contemporaneous interaction, $A(L)$ is a matrix polynomial in the lag operator L and ε_t is the vector of structural shocks with covariance matrix Σ. In addition to the survey variable, the baseline VAR model includes four endogenous variables: private consumption, the inflation rate, real house prices and the nominal interest rate.[3] The model is estimated on quarterly data over the sample period 1965Q1-2009Q4. We use filtered data obtained through the Baxt-King band-pass filter with standard cut-off frequencies. Relying on the Schwartz Information Criterion we include up to two lags of each of the endogenous variables.[4]

As in Leduc and Sill (2012), we use a recursive (i.e. Cholesky) identification scheme that orders the survey variable first. Thus, we assume no contemporaneous response of News on Business Conditions to shocks to the other variables in the system.[5] Since Christiano et al. (1997), the implementation of short-term restrictions through the Cholesky decomposition of the innovation-covariance matrix has been widely used to study the transmission of monetary policy shocks. The ordering of economic activity, inflation, investment and the interest rate is standard from the monetary transmission literature, whereas the ordering of house prices is somewhat arbitrary. In the baseline model we assume that the information set of monetary policy includes current and lagged values not only of inflation and economic activity, but also of house prices (see among others Musso et al. (2011)). Sensitivity to the identification scheme is evaluated in the next section.

In addition to the macroeconomic variables, we also introduce controls for oil and fiscal shocks. As in Leduc and Sill (2012), we use the dummy variable built by Hamilton (2003) to control for increases in oil prices, while we rely on Ramey and Shapiro (1998) and Ramey (2011) to identify fiscal shocks.[6] Further, we also control for changes in the conduct of monetary policy using a shift dummy from 1979Q4. A last dummy is included to capture issues related to the zero lower bound and the use of unconventional monetary policy measures starting from the fall of 2007.[7]

Figure 2 (first row) shows the impulse-responses to a positive innovation to News on Business Conditions. We interpret a shock to News on Business Conditions as news received by agents about future favorable changes

[3] As a benchmark, we measure Real house prices using the Census Bureau House Price Index (new one-family houses sold including value of lot) deflated with the implicit price deflator for the nonfarm business sector. See Appendix A.1 for a description of the macroeconomic variables. Section 5.3 conducts sensitivity analysis to alternative measures of house prices.

[4] Our results are robust to the use of non-detrended series. Further, the results are also similar when estimating the VAR model in the levels of all variables and thus, using the price level rather than the inflation rate. See Appendix 1.4.2.

[5] One implements this assumption by defining the matrix A_o^{-1} to be the lower Cholesky decomposition of Σ.

[6] See Appendix 1.3 for the definition of the fiscal and oil dummies.

[7] Our results are not significantly different when excluding the dummies. See Appendix 1.4.1.

in business conditions. On impact, favorable News on Business Conditions leads to a hump-shaped response in private consumption and house prices, the latter peaking after about two years. These responses are significantly different from zero at the ninety per-cent confidence level. Inflation also rises, but its response is significant only after about one year, and it peaks several quarters after the peak in house prices. The policy interest rate increases and also follows a hump-shaped pattern. Thus, as in Leduc and Sill (2012), an expectation shock generates a macroeconomic boom coupled with a monetary policy tightening. Further, unexpected favorable News on Business Conditions also leads to a boom in house prices.

Survey data provide evidence on the importance of news on future economic activity for business-cycle fluctuations and house-price dynamics. Since Beaudry and Portier (2006) showed that business cycles in the data are driven primarily by changes in agents' expectations about future technological growth, several authors have highlighted the importance of news shocks as a source of business-cycle fluctuation. According to Schmitt-Grohe and Uribe (2012), in the presence of forward-looking agents, news shocks explain about one half of the variances in output, hours, consumption, and investment. Fujiwara et al. (2011) show that total-factor-productivity news shocks are quantitatively important in an estimated model with nominal rigidities. Milani and Treadwell (2012), estimating a prototypical three-equation New Keynesian model, document that monetary-policy news shocks play a larger role in the business cycle than unanticipated policy shocks.[8] Khan and Tsoukalas (2012) show that, in the presence of wage and price rigidities and a variety of news shocks, non-technology sources of news dominate technology news; in particular, wage-markup news shocks account for about sixty per-cent of the variance share of both hours and inflation.

Regarding housing-market dynamics, Kahn (2009) argues that perceived changes in trend productivity growth explained a substantial portion of the behavior of housing prices since the 1960s. In particular, a regime-switching behavior of productivity growth coupled with imperfect information and learning about such regimes can generate bubble-like house-price dynamics. Tomura (2010) documents that boom-bust cycles in house prices can be generated by uncertainty about the duration of a temporary period of high income growth only if the economy is open to international capital flows. Burnside, Eichenbaum and Rebelo (2012) generate booms and busts in the housing market by relying on heterogeneous expectations about long-run fundamentals that drive house prices, as summarized by the flow of utility of holding a house. More recently, Gomes and

[8] Verona, Martins and Drumond (2012) show that anticipated periods of too low for too long interest rates generate a larger and quicker boom in real activity and asset price than similar policies that are unanticipate.

Mendicino (2011) estimate Iacoviello and Neri's (2010) model of the housing market, augmented by news on a variety of shocks, and show that news shocks explain around forty per-cent of variation in house prices and a sizable fraction of variation in consumption and residential and non-residential investment. Non-technology news shocks turn out to be particularly important. Further, news shocks also contain statistically significant information for survey-based inflation and interest-rate expectations.

Section 6. illustrates the transmission mechanism of news shocks in the model of the housing market developed by Iacoviello and Neri (2010).

2.1 Extending the Baseline VAR

In this section, we address concerns related to omitted variables by extending the baseline VAR to include residential investment and household mortgages. Residential investment is introduced to capture the supply side of the housing market. Mortgage loans are particularly relevant for the transmission of News since changes in leverage can amplify the effect of changes in house prices on consumption and investment through the credit channel. Over the entire sample, mortgage credit co-moves with house prices with a contemporaneous correlation of 0.69, whereas residential investment leads house prices by three quarters with a maximum correlation of 0.7.[9] See Appendix A.

We order the variables as: News on Business Conditions, private consumption, the inflation rate, residential investment, real house prices, the nominal interest rate and households' mortgages. Following a conservative approach to the endogeneity of money and credit growth, we order mortgage credit last. In this way we allow mortgage credit to react contemporaneously to shocks in all other variables. Further, this ordering implies that the time t information set of the monetary authority consists of current and lagged values of inflation, consumption, investment and house prices, and only past values of households' mortgages.

Figure 2 (second row) reports the impulse-responses to a positive innovation to News on Business Conditions in the extended model. Both residential investment and mortgages display hump-shaped responses to the News shock. Residential investment peaks several quarters before house prices and consumption. This finding is consistent with previous evidence of residential investment systematically leading the U.S. business cycle, as shown by Leamer (2007) and Kydland, Rupert and Šustek (2011). The addition of residential investment and household mortgages does not affect the response of the other endogenous variables.

[9] During periods of house-price booms, the correlation with house prices increases to 0.85 for residential investment and 0.91 for mortgage credit. See Table A.1.

Table 1: Variance Decomposition

step-ahead	Consumption	Inflation	House Prices	Interest Rate	Residential Inv	Mortgage Credit
forecast error			Baseline VAR			
4 Q	31.15	0.78	10.66	11.61		
8 Q	36.81	5.43	20.26	22.18		
20 Q	40.93	11.28	21.58	27.01		
			Extended VAR			
4 Q	24.48	1.39	10.58	11.10	17.44	9.70
8 Q	25.59	6.22	13.49	18.02	15.01	11.07
20 Q	24.19	9.04	14.26	17.94	17.90	12.61

Shocks to News on Business Conditions are also quantitatively important for macroeconomic fluctuations. Table 1 reports the percentage of unconditional variance of the k-step-ahead forecast error in all endogenous variables due to this shock, for k= 4,8, and 20. Unexpected News on Business Conditions accounts for a non-trivial fraction of the four-quarter-ahead forecast error variance of all endogenous variables except inflation, in both in the five-and seven-variable VAR models.[10] Specifically, shocks to News on Business Conditions account for about twenty-five to thirty per-cent of the four-quarter-ahead forecast error variance of private consumption, and more than ten per-cent of variation in house prices at a one-year horizon. Over a longer horizon, the contribution to house prices increases to about twenty and fifteen per-cent in the baseline and extended models, respectively. Innovations to News on Business Conditions also account for about ten per-cent of the step-ahead forecast error variance of mortgage credit and slightly less than twenty per-cent of the step-ahead forecast error variance of residential investment.

3. Consumers' Expectations and House Prices

In the previous section, we documented that shocks to News on Business Conditions significantly affect house prices and residential investment. These findings suggest a potential role for expectation-driven cycles in the housing market.

To measure expectations on future house-price appreciation we use data from the Michigan Survey of Consumers. The survey reports the consumers' opinion as to whether it is a good time or a bad time to buy a house

[10]Notice that the inclusion of two extra variables in the VAR comes along with the addition of two shocks: a credit shock and a shock to residential investment. Both shocks contribute to the forecast error variance of the model's endogenous variables.

Table 2: Correlations of Expectations of Rising House Prices with House Prices

	Contemporaneous Correlation	Lead/Lag Relationship	Maximum Correlation
Overall Sample	0.26	4	0.54
Booms	0.47	1	0.67
No Booms	0.10	3	0.30

and their reasons for holding a particular view.[11] As in Piazzesi and Schneider (2009), we focus on Expectations of Rising House Prices, i.e. the index reporting the fraction of respondents that expect house prices to remain at their current level or to rise. Appendix A reports the exact wording of the relevant question. Over the entire sample, Expectations of Rising House Prices lead house prices by four quarters with a maximum correlation coefficient of 0.54. See Table 2.

We estimate both the five- and the seven-variable VAR models, ordering Expectations of Rising House Prices first. We interpret a shock to Expectations of Rising House Prices as an exogenous change in household expectations about future house prices. Figure 3 shows the impulse responses of our VAR model to a shock to Expectations of Rising House Prices. Like a shock to News on Business Conditions, a shock to Expectations of Rising House Prices generates hump-shaped responses in house prices, residential investment, interest rate and private consumption. The responses are significant at the ninety per-cent confidence level. However, shocks to Expectations of Rising House Prices account for somewhat less of the forecast-error variance of house prices and other macroeconomic variables than shocks to News on Business Conditions. The interest rate and inflation are exceptions. See Table 3.

Table 3: Shock to Consumers' Expectations of Rising House Prices: Forecast-Error Variance

step-ahead forecast error	Consumption	Inflation	House Prices	Interest Rate	Residential Inv	Mortgage Credit
4 Q	12.11	1.77	4.80	17.56	24.01	13.44
8 Q	12.12	11.18	10.70	31.25	19.50	14.92
20 Q	17.41	15.32	14.70	30.38	24.32	19.05

[11] According to the documentation of the Michigan Survey of Consumers, Consumers appear to assess home buying conditions quite well. In fact, changes in home buying attitudes precede changes in unit sales of new and existing single family homes on average by two quarters with a correlation of 0.77. See pag. 7 of the "Survey Description".

3.1 House-Price Booms

An often-heard explanation of housing booms is households' optimism about future house-price appreciation. In particular, Piazzesi and Schneider (2009) argue that beliefs of rising prices increased during the last housing boom exactly when prices reached their historical highs and that expectations of future house-price appreciation are related to optimism about economic conditions. Nofsinger (2011) argues that the emotions and psychological biases of households play an important role in the boom-bust cycle, with increased speculative behavior late in an economic expansion and restricted economic behavior in a contraction.

Over the period 1965Q1 to 2009Q4, real house prices in the United States display a number of boom-bust episodes, namely periods of persistent deviations of real house prices from a smooth trend, followed by sharp reversals. We use an approach similar to that of Borio and Lowe (2004), Adalid and Detken (2007) and Goodhart and Hofmann (2008). Using the band-pass-filtered series of house prices, we identify four boom episodes that peaked in 1973Q3, 1979Q4, 1989Q2, and 2007Q1. There is an increase in maximum correlation of consumers' expectations of rising prices with house prices, from 0.54 over the entire sample (leading house prices by four quarters) to 0.67 during periods of house-price booms (leading house prices by one quarter). See Table 2.

In order to test whether the repercussions of consumers' expectations of future house-price appreciations are stronger during booms in house prices, we estimate a dummy augmented VAR model

$$A_0 Y_t = c + A_{NB}(L) Y_{t-1} * D^{NB} + A_B(L) Y_{t-1} * D^B + \varepsilon_t \tag{2}$$

where D^B is a dummy variable that is set equal to one when there is a boom in house prices in period t and equal to zero otherwise, whereas D^{NB} is a dummy variable that is set equal to one when there is no boom in house prices in period t and equal to zero otherwise. The dummy variables in (2) are specified according to the identified boom episodes.[12]

Table 4 reports the fraction of the four-quarter-ahead forecast-error variance of the real variables explained by a shock to Expectations of Rising House Prices in the seven-variable VAR model. The variance decomposition reveals that Expectations of Rising House Prices contain useful information about emerging house-price booms. In fact, the expectation shocks explain about fifty per-cent of the four-quarter-ahead forecast-error variance of house prices, consumption and housing investment, and about forty per-cent of mortgage credit.

[12]The booms periods considered exclude few initial quarters of positive house-price growth that do not coincide with above-trend dynamics. Thus, we exclude between two and six initial quarters depending on the boom. According to this definition, the time periods classified as booms include: 1972:Q4-1973:Q3; 1978:Q1-1979:Q4; 1987:Q1-1989:Q2; 2003:Q4-2007:Q1. Regarding the

Table 4: Shock to Expectations of Rising House Prices

	four-quarters-ahead forecast-error variance	
	House Price Boom	No House Price Boom
House Prices	47.35	4.4
Residential Investment	55.66	19.59
Mortgage Credit	39.92	4.71
Private Consumption	49.24	5.49

4. Expectation-Driven Cycles and News Shocks

Previous sections show that both News on Business Conditions and Expectations of Rising House Prices contain information about future house prices and other macroeconomic variables. These findings raise the question of whether the two survey questions capture the same information. In this section we present an attempt to disentangle the effect of News on Business Conditions from other sources of changes in Expectations of Rising House Prices. To this purpose, we estimate a VAR including both News on Business Conditions and Expectations of Rising House Prices. We assume that News on Business Conditions does not react to Expectations of Rising House Prices in the same quarter. The VAR also includes (in this order) private consumption, the inflation rate, residential investment, real house prices, the nominal interest rate and mortgage credit. We maintain the assumption that there is no contemporaneous response of the survey variables to other shocks. Figure 4 reports the impulse responses to a positive shock to News on Business Conditions (top panel) and Expectations of Rising House Prices (bottom panel).

News on Business Conditions maps into higher Expectations of Rising House Prices. Table 5 (first row) reports that News on Business Conditions accounts for about twenty per-cent of changes in Expectations of Rising House Prices. In contrast, a shock to Expectations of Rising House Prices has no significant effect on News on Business Conditions for more than four quarters. The responses of the macroeconomic variables to these two shocks are similar to what is presented in Sections 2 and 3. Table 5 also reports the fraction of the four-quarter-ahead forecast-error variance of the macroeconomic variables accounted for by innovations to News on Business Conditions (left panel) and Expectations of Rising House Prices (right panel), respectively. The results are based on the estimation of both models (1) and (2). Thus, we report the results over the entire sample, during booms

non-boom periods, to be consistent with the two-lag criteria, we exclude the first two quarters after each house-price peak.

in house prices and during non-boom periods. Over the entire sample, the importance of shocks to News on Business Conditions for the other macroeconomic variables is similar to what is reported in Section 2. Thus, the inclusion of shocks to Expectations of Rising House Prices does not alter the quantitative importance of shocks to News on Business Conditions for housing-market and macroeconomic fluctuations. Over the entire sample, changes in Expectations of Rising House Prices that are unrelated to News on Business Conditions explain little of the macroeconomic fluctuations. During booms in house prices, changes in Expectations of Rising House Prices that are unrelated to News on Business Conditions turn out to be very important, accounting for about forty per-cent of variation in house prices and housing investment and thirty per-cent of variation in private consumption and mortgage credit. In contrast, the importance of News on Business Conditions is not different across booms or non-boom periods in house prices. Our results suggest that expectation-driven cycles are very important to explaining housing-market booms. In fact, during booms in house prices, shocks to News on Business Conditions and Expectations of Rising House Prices together account for about fifty-five and seventy per-cent of the four-quarter-ahead forecast-error variance of house prices and housing investment, respectively.

Table 5: News and Expectations: four-quarter ahead forecast-error variance

	News on Business Conditions			Expectations of Rising House Prices		
	Overall Sample	Boom	No Boom	Overall Sample	Boom	No Boom
Expectations of Rising Prices	19.33	23.50	22.45			
House Prices	11.54	16.28	13.16	3.88	36.79	1.77
Residential Investment	19.36	28.76	22.47	9.47	39.16	7.82
Mortgage Credit	11.82	21.01	10.60	4.41	29.17	0.51
Private Consumption	29.17	28.24	27.72	2.65	32.96	0.06
Interest Rate	14.18	8.26	20.08	6.78	37.87	1.04

It is important to highlight that changes in Expectations of Rising House Prices that are not related to News on Business Conditions could be related not only to exogenous shifts in beliefs, but also to news on other factors, such as inflationary pressures, anticipated fiscal-policy shocks and the conduct of monetary policy.

5. Robustness Checks

In the following, we investigate the robustness of the results to alternative recursive schemes. In addition, we test sensitivity to alternative measures of economic activity and house prices, and to the inclusion of the

thirty-year mortgage rate, which is used to finance a large proportion of U.S. home purchases.

5.1 Identification

We present sensitivity to the ordering of the endogenous variables. First, we adopt an alternative recursive scheme that places the two financial variables lower in the ordering. Thus, we allow both of them to respond contemporaneously to shocks in all endogenous variables. We thus assume that the monetary authority cannot react to current changes in house prices and credit when setting the interest rate. As in Goodhart and Hoffmann (2008), Assenmacher-Wesche and Gerlach (2010), Adalid and Detkler (2007) and Musso et al. (2011), we place the credit variable last.[13] The third rows of Figures 2 and 3 show that changes in the ordering of the financial variables has no substantial effect on the results.

Some authors order inflation before both private consumption and investment (see e.g. Musso et al. (2011)). Changes in the ordering of consumption and inflation do not affect the transmission of shocks to news or expectations. See the last rows of Figures 2 and 3. More generally, the order of the endogenous variables does not significantly affect the results.

5.2 Measures of Economic Activity

In the analysis above, we use private consumption and residential investment as measures of economic activity. Now, we provide further evidence of the real effects of innovations to News on Business Conditions. In particular, we investigate the robustness of the results to the use of GDP and business investment.

First, we estimate the baseline and extended models including GDP instead of private consumption. Figure 5 reports the response to a shock to News on Business Conditions. In all VARs, GDP rises on impact, responds in a hump-shaped fashion and remains above zero for several quarters. The use of GDP as a measure of economic activity has no effect on the responses of the other variables. The last row reports the response to the shock to News on Business Conditions for the VAR model that includes business investment instead of residential investment. The response of business investment is of roughly the same magnitude as the response of residential investment, and the effect of the shock on the other variables is less long-lasting. Similar results hold for the responses to a shock to Expectations of Rising House Prices. See Figure 6.

[13] According to Goodhart and Hoffman (2008), the rationale for ordering house prices before credit variables is given by the fact that house prices are probably stickier than monetary aggregates.

5.3 Alternative Measures of House Prices

The analysis above is conducted using the new house-price index built by the U.S. Census. Some authors argue that this hedonic index is affected by the fact that new homes are typically constructed in the outlying parts of U.S. metro areas and land typically comprises about ten per-cent of the computed costs. In contrast, for existing homes, which account for far more of the turnover in U.S. real estate transactions, land costs contribute about forty per-cent of costs, and it is the land component of house prices that is behind many of the swings in U.S. house prices. Thus, a new-house-price index shows much more muted swings than existing-house-price indexes. We use the repeat-sales index on existing-house prices built by Freddie Mac, a series of repeat-sale prices for home purchases that starts in 1970 but ends in 2010. Figure 7 reports the responses to a shock to News on Business Conditions. No significant differences with the use of the Census index are found. This also holds in the case of a shock to Expectations of Rising House Prices.

For completeness, we also consider other alternative measures of house prices: the Ofheo index and the Case-Shiller index. The top row of Figure 8 reports the impulse response of the alternative measures of house prices to a positive innovation to News on Business Conditions; the bottom row reports the impulse response to a shock to Expectations of Rising House Prices. All house-price measures respond positively to the shocks, and in a hump-shaped pattern. The magnitude of the peak response is similar by the Ofheo, Census, and Freddy Mac indexes. For both shocks, the Case-Shiller index displays a larger peak response.

5.4 Mortgage Lending Rate

There is a long history of housing analysis that emphasizes the importance of carefully measuring the after-tax user cost of capital. Some authors argue that the 3-month Treasury bill rate does not line up well with the typical fixed rate, long-term mortgage interest rate used to finance the bulk of U.S. home purchases. Empirical analysis based on a structural demand and supply housing models showed that considering the real, after-tax mortgage rate can deliver substantially different results.[14] For completeness, we test sensitivity to the inclusion of the real after-tax mortgage lending rate in the VAR model. The real after-tax mortage rate is calculated by assuming a marginal tax rate of 33 per-cent.[15] First, we estimate the model by substituting the Effective

[14] In a very controversial paper, Mankiw and Weil (1989) used a real 3 month Treasury bill for the real cost of mortgage credit and mistakenly concluded that slower population growth reduced real house prices by about 50% in the 1990s. Hendershott (1991) showed that replacing the real 3-month T-bill rate with a real, after-tax mortgage rate gave far different results, with population growth having one-tenth of the estimated impact after making this substitution.

[15] The mortgage rate is measured by the 30-year conventional mortgage rate starting in 1971:1. See Appendix A.1.

Federal Fund Rate with the real after-tax mortgage rate. Then, following Musso et al. (2011) we order the mortgage lending rate after the Effective Federal Fund Rate. Thus, the monetary policy interest rate reacts to mortgage market variables only with a lag. See Figure 9. Notice that the Effective Federal Fund Rate is introduced in the VAR model to account for the contribution of monetary policy shocks to housing market dynamics. Introducing the real after-tax mortgage lending rate has no substantial effect on the transmission of shocks to News on Business Conditions to house prices and other macroeconomic variables. Similar results hold for a shock to Expectations of Rising House Prices.[16]

5.5 Supply Factors

Next, we test sensitivity to the inclusion of variables commonly used as supply-side determinants, such as housing starts and housing permits, either changes in supply or supply adjustments. Some studies use a price-to-rent ratio which implicitly brings in the supply side by including rents. As proxy for the supply side determinants for house prices, we consider the following three variables: housing permits, housing starts and the rent-price ratio.[17] We estimate the extended model by including each of the three variables, separately. Figure 10 reports the responses to a shock to News on Business Conditions. Introducing supply side determinants has no substantial effect on the transmission of shocks to News on Business Conditions to house prices and other macroeconomic variables. Further, unexpected changes in News on Business Conditions have a significant effect on these other housing variables. Table 6 reports the percentage of unconditional variance of the k-step-ahead forecast error in the housing market variables due to News on Business Conditions for k= 4,8, and 20. Shocks to News on Business Conditions accounts for about 10 per-cent of the forecast error variance of both house prices and either housing starts or housing permit. Further, News on Business Conditions accounts for about 20 percent of the four-quarter-ahead forecast error variance of house prices and of the rent-to-price variable.

5.6 House Prices and LTV

To address the question of how house prices behave under different fixed levels of Loan-to-Value ratios, we estimate an alternative model. To capture the effects of the mortgage market deregulation of the beginning of

[16]The results are also robust to the introduction of an "external finance premium" in the housing market measured by the spread between the mortgage lending rate and the short-term interest rate as in Musso et. al (2011). The rise in the spread between the mortgage rate and the short-term interest rate could capture the increase in the external finance premium associated with a housing credit channel. Results are available upon request.

[17]We use the rent-price ratio measured as in Davis, Morris A., Lehnert, Andreas, and Robert F. Martin, (2008). Appendix A.1 for a description of the variables.

Table 6: Variance Decomposition

step-ahead forecast error	House Prices	House Stars	House Prices	Housing Permits	House Prices	Rent-Price
4 Q	10.79	8.66	10.42	7.58	19.64	18.61
8 Q	12.9	8.08	11.43	7.23	26.77	17.29
20 Q	13.41	10.92	11.94	9.19	26.07	10.87

the 1980s, we consider a dummy variable that takes value 0 until the Garn-St. German Act (1982 Q4) and 1 afterwards. In Table 7 we report the fraction of 4-quarter forecast ahead accounted by a shock to News on business conditions for both the benchmark and extended model.

The estimation results show that in unexpected News on Business Conditions accounts for a non-trivial fraction of the four-quarter-ahead forecast error variance of all endogenous variables. Compared with the results of our benchmark VAR (See Table 1, Section 2.2), no significant differences are found in the percentage of unconditional variance of the 4-step-ahead forecast error explained by the innovation to News on business condition in the three VARs. However, we acknowledge that a deposit deregulation dummy does not track the severity or non-severity of disintermediation.

Table 7: Variance Decomposition

step-ahead forecast error	Consumption	Inflation	House Prices	Interest Rate	Residential Inv	Mortgage Credit
			Baseline VAR			
4 Q	31.04	0.79	12.1	14.5		
			Extended VAR			
4 Q	24.35	1.43	10.76	12.16	17.40	9.93

6. News Shocks: Investigating the Transmission Mechanism in a Model of the Housing Market

In previous sections, we documented that innovations to News on Business Conditions and changes in Expectations of Rising House Prices affect house-price dynamics, as well as mortgage credit and housing investment. Thus, a natural framework to interpret these findings is the housing-market model developed by Iacoviello and

Neri (2010).[18]

In this section, we show that our results are indeed consistent with the predictions of their model. As reported in Section 1, a growing strand of the business-cycle literature argues that news on productivity shocks can generate expectation-driven cycles and macroeconomic booms. Thus, we investigate the transmission of news on productivity shocks as a proxy for News on Business Conditions. As an illustrative example, we also consider news on monetary policy shocks, one of the other potential sources of Expectations of Rising House Prices.

We document that in Iacoviello and Neri's (2010) model of the housing market, the transmission of news shocks has two important features. First, news shocks are plausible sources of optimism about future house-price appreciation, and generate macroeconomic booms characterized by hump-shaped dynamics. Further, news shocks generate the co-movement observed in the data during periods of housing booms, i.e. hump-shaped co-movement among house prices, consumption, and both residential- and non-residential investment. In contrast, unanticipated shocks generate responses that are strongest in the short run and eventually die away, thereby failing to generate co-movement among GDP, non-residential investment and hours worked. To generate a boom in house prices and credit, it is necessary that agents expect a future increase in housing prices. Expectations about the future occurrence of shocks that lead to house-price appreciation fuel current housing demand and lift house prices immediately. Thus, the value of housing as collateral increases, and the rise in house prices is coupled with an expansion in household credit. Both news on future productivity and monetary policy shocks generate hump-shaped co-movement in house prices, residential investment, credit, and other macroeconomic variables in accordance with our empirical findings. For completeness, we next report the main features of the model and a description of the impulse-responses of the two shocks.

6.1 Model

Households. The economy is populated by two types of households: the Saver and the Borrower. They both work in the production of consumption goods, $n_{c,t}^{'}$, and housing, $n_{h,t}^{'}$, consume, $c_t^{'}$, and accumulate housing, $h_t^{'}$.

[18]Several papers carry out a quantitative analysis of housing-market dynamics. However, only a few aim at explaining business-cycle fluctuations in both house prices and investment. Among these, Davis and Heathcote (2005) use a calibrated multi-sector model that relies on technology shocks to match the co-movement between consumption, non-residential investment, residential investment and GDP; Iacoviello and Neri (2010), allowing for financing frictions, a role for monetary policy and a larger set of shocks, also find a positive correlation between housing prices and investment and the wealth effect of housing prices; Int'Veld, Raciborski, Ratto and Roeger (2011) build an open-economy model of the housing market, also featuring an analysis of the banking sector to explore the international repercussions of housing-market dynamics.

They differ in their discount factor, (β and $\beta^{'}$). Borrowers (denoted by $\prime$) feature a relatively lower subjective discount factor that in equilibrium generates an incentive to anticipate future consumption in the current period through borrowing. Hence, the ex-ante heterogeneity induces credit flows between the two types of agents. This modeling feature has been introduced in macro models by Kiyotaki and Moore (1997) and extended by Iacoviello (2005) to a business cycle framework with housing investment.

The Borrowers. The Borrowers maximize the utility function[19]:

$$U_t = E_t \sum_{t=0}^{\infty} \beta^{'t} G_C^t \left[ln\ (c_t^{'} - \varepsilon^{'} c_{t-1}^{'}) + j\ ln\ h_t^{'} - \frac{\tau}{1+\eta^{'}} ((n_{c,t}^{'})^{1+\xi^{'}} + (n_{h,t}^{'})^{1+\xi^{'}})^{\frac{1+\eta^{'}}{1+\xi^{'}}} \right]$$

subject to the budget constraint:

$$c_t^{'} + q_t \left[h_t^{'} - (1-\delta_h) h_{t-1}^{'} \right] - b_t^{'}$$

$$\leq \frac{w_{c,t}^{'} n_{c,t}^{'}}{X_{wc,t}^{'}} + \frac{w_{h,t}^{'} n_{h,t}^{'}}{X_{wh,t}^{'}} - \frac{R_{t-1} b_{t-1}^{'}}{\pi_t}$$

We allow Borrowers to collateralize the value of their homes.

$$b_t^{'} \leq m E_t \frac{q_{t+1} \pi_{t+1} h_t^{\prime}}{R_t}\ . \tag{1}$$

Except for the gross nominal interest rate, R, all the variables are expressed in real terms; π_t is gross inflation (P_t/P_{t-1}), $w_{c,t}^{'}$ and $w_{h,t}^{'}$ are the wages paid in the two sectors of production, and q_t is the price of housing in real terms. Houses depreciate at rate δ_h and j determines the relative weight, in utility, of housing services. Limits on borrowing are introduced through the assumption that households cannot borrow more than a fraction of the next-period value of the housing stock. See eq. 1. The fraction m, referred to as the equity requirement or loan-to-value ratio, is treated as exogenous to the model. It can be interpreted as the creditor's overall judicial costs in the case of debtor default and represents the economy's degree of access to the credit market. The borrowing constraint is consistent with standard lending criteria used in the mortgage and consumer loan markets.

The Savers. The Savers face a similar problem to that of the Borrowers in choosing how much to consume, how much to work, and how much to invest in housing. However, they also invest in capital and receive the

[19]Since consumption grows at the rate G_C every quarter, the marginal utility of consumption falls at the same rate. For this reason, the model is transformed so that consumption is scaled by its growth rate G_C^t and the marginal utility of consumption is multiplied by the same rate. As a result, transformed consumption and scaled marginal utility of consumption are both constant in the steady state.

profits of the firms.[20]

Firms. Final good producing firms produce non-durable goods (Y) and new houses (IH). Both sectors face Cobb-Douglas production functions. The non-housing sector produces consumption goods using capital, k_c, and labor supplied by the Savers, n, and the Borrowers, $n^{'}$,

$$Y_t = \left(A_{c,t} \left(n_{c,t}^{\alpha} n_{c,t}^{'1-\alpha} \right) \right)^{1-\mu_c} (z_{c,t} k_{c,t-1})^{\mu_c}.$$

The housing sector also uses an intermediate input, k_b, and land, l, as inputs of production

$$IH_t = \left(A_{h,t} \left(n_{h,t}^{\alpha} + n_{h,t}^{'1-\alpha} \right) \right)^{1-\mu_{h-\mu_b-\mu_l}} (z_{h,t} k_{h,t-1})^{\mu_h} k_b^{\mu_b} l_{t-1}^{\mu_l}.$$

The investment-specific technology as follows:

$$IK_t = \frac{1}{A_{k,t}} \left(k_{c,t} - (1 - \delta_{k_c}) k_{c,t-1} \right).$$

The model assumes heterogeneous deterministic trends in productivity in the consumption ($A_{c,t}$), investment ($A_{k,t}$), and housing sectors ($A_{h,t}$). Firms pay the wages to households and repay the rented capital to the Savers. Retailers, owned by the Savers, differentiate final goods and act in a competitive monopolistic market. Prices can be adjusted with probability $1 - \theta_\pi$ every period, by following a Calvo-setting. Monopolistic competition occurs at the retail level, leading to the following forward-looking Philips curve:

$$ln\pi_t - \iota_\pi ln\pi_{t-1} = \beta \left(E_t ln\pi_{t+1} - \iota_\pi ln\pi_t \right) - \epsilon_\pi ln(X_t/X)$$

where $\epsilon_\pi = \frac{(1-\theta_\pi)(1-\beta\theta_\pi)}{\theta_\pi}$,and X_t represents the price markup.[21]

Households set wages in a monopolistic way. Wages can be adjusted subject to a Calvo scheme with a given probability in every period. Housing prices are assumed to be flexible.

[20]The model we rely on does not allow for a convex adjustment cost of housing demand. Iacoviello and Neri (2010) report that in preliminary estimation attempts, they found that the parameter measuring this cost was driven to its lower bound of zero. As argued by Iacoviello and Neri (2010), 25 percent of residential investment in the National Income and Product Accounts (that is the variable used in the data analysis) consists of home improvements, where transaction costs are less likely to apply. However, we acknowledge that the existence of substantial transactions costs (both pecuniary and search) creates a nontrivial possibility for serial correlation in excess return that can affect the formation of house price expectations and the shapes of the responses of house prices to shocks.

[21]The model allows for price rigidities in the consumption sector and for wage rigidities in both the consumption and housing sectors. There are several reasons why housing might have flexible prices. For instance, Barsky, House, and Kimball (2007) argue that housing is relatively expensive on a per-unit basis. Therefore, if menu costs have important fixed components, there is a large incentive to negotiate on the price of this good. Moreover, most homes are priced for the first time when they are sold.

Monetary Authority. We assume that the central bank follows a Taylor-type rule as estimated by Iacoviello and Neri (2009)

$$R_t = R_{t-1}^{r_R} \pi_t^{(1-r_R)r_\pi} \left(\frac{GDP_t}{GDP_{t-1}} \right)^{(1-r_R)r_Y} rr^{(1-r_R)} \frac{u_{R,t}}{s_t} \tag{2}$$

where rr is the steady state real interest rate and $u_{R,t}$ is an i.i.d. monetary policy shock. The central bank's target is assumed to be time varying and subject to an AR(1) shock, s_t

$$s_t = (1 - \rho_s) s_{t-1} + u_{s,t}. \tag{3}$$

GDP is defined as the sum of consumption and investment at constant prices. Thus

$$GDP_t = C_t + IK_t + qIH_t,$$

where q is real housing prices at the steady state.

6.2 News Shocks and House-Price Booms

To introduce expectations of future monetary-policy and productivity developments, we follow Christiano et al. (2008) in assuming that the error term of each shock consists of an unanticipated component, $\varepsilon_{z,t}$, and an anticipated change n quarters in advance, $\varepsilon_{z,t-n}$,

$$u_{z,t} = \varepsilon_{z,t} + \varepsilon_{z,t-n},$$

where $\varepsilon_{z,t}$ is i.i.d. and $z = \{A_c, R\}$. Thus, at time t agents receive a signal about future macroeconomic conditions at time $t + n$. If the expected movement does not occur, then $\varepsilon_{z,t} = -\varepsilon_{z,t-n}$ and $u_{z,t} = 0$. The model's parameters are set equal to the mean of the posterior distribution estimated by Iacoviello and Neri (2010) for the U.S. economy. See Table A.2.

News on Productivity. Figure 11 reports the effect of an anticipated increase in productivity, namely a four-period-ahead expected shock to $A_{c,t}$ (starred line). It also illustrates the case in which news of a future shock to $A_{c,t}$ turns out to be wrong, and there is no change in productivity at time $t = 4$ (solid line). The anticipation of higher future productivity leads households to increase their current consumption expenditure. Demand pressures raise current inflation. Expected higher future productivity also creates endogenous expectations of rising house prices that further induce Borrowers to increase their current demand for housing and thus

credit. Due to limits on credit, Borrowers increase their labor supply in order to raise internal funds for housing investments. Savers' position in the housing market depends only on housing prices: when housing prices are above steady state, Savers' housing demand declines.

Given the adjustment costs of capital, firms in the consumption sector already start adjusting the stock of capital at the time in which news spreads about a future increase in productivity. This way, when the increase in productivity occurs, capital is already in place. For the increase in investment to be coupled with an increase in hours, wages rise in both sectors. The increase in business and housing investment makes GDP rise. In the case of an anticipated shock that is realized, aggregate variables boom and then slowly decline (starred line). The peak response in output corresponds to the time at which expectations realize.[22]

News on Monetary Policy. In the following, we study the role of expectations of a future reduction in the policy rate in driving business-cycle fluctuations in the housing market. Figure 12 reports the effect of an expected four-period-ahead one-period reduction in the policy rate of 0.1 percentage points, namely an expected shock to $u_{R,t}$ (starred line). It also illustrates the case in which news of a future negative shock to u_R turn out to be wrong and at time $t = 4$ there is no change in the policy rate (solid line). Signals of lower policy rates generate expectations of a decline in the future real interest rate. Borrowers anticipate this effect and increase their current consumption, as servicing loans will be less expensive. Demand pressure raises current inflation. The current ex-post real rate declines, reducing the debt service. The anticipation of expansionary monetary policy also creates expectations of higher future housing prices that further induce Borrowers to increase their current demand for housing and thus indebtedness. Due to limits on credit, impatient households increase their labor supply in order to raise internal funds for housing investments. Savers face a reduction in their current and expected interest income. Thus, for this group of agents, consumption increases by less, current housing investment declines and their labor supply increases significantly. As in the previous case, due to capital adjustment costs, firms already begin adjusting the stock of capital when news about a future reduction in the policy rate spreads. For the increase in investment to be coupled with an increase in hours, wages rise in both sectors. The increase in business and housing investment makes GDP increase at the time of the signal.

As a consequence of the current increase in inflation and GDP, the policy rate increases at the time of the signal, to decline only at the time of the occurrence of the shock. In the case of an anticipated shock that is

[22] Notice that, news on productivity shocks in the housing sector are also sources of optimism about future house-price appreciation and generate macroeconomic dynamics characterized by hump-shaped co-movement between house prices and other macroeconomic variables as documented in the VAR analysis presented above.

realized (starred line), aggregate variables boom and then slowly decline. In contrast, if expectations are not realized, there is a dramatic drop in both quantities and prices (solid line). Aggregate variables fall below their initial level. It takes about ten quarters for GDP return to its initial level. Thus, unrealized expectations of looser monetary policy generate a macroeconomic boom-bust cycle followed by a recession (solid line).[23]

7. Conclusion

We use a VAR model to estimate how unexplained changes in responses to questions about expectations from the Michigan Survey of Consumers affect house prices and other macroeconomic variables. We argue that shocks to News on Business Conditions generate hump-shaped responses in most macroeconomic variables, and explain a sizable fraction of the fluctuation in house prices and other macroeconomic variables. Further, changes in Expectations of Rising House Prices unrelated to News on Business Condition explain little of the macroeconomic fluctuation over the entire sample, but turn out to be very important during housing booms. Overall, News and Expectations account for more than half of the forecast-error variance of most macroeconomic variables during booms in house prices.

Last, we study the transmission mechanism of news shocks in a DSGE model with housing. News on future productivity and monetary policy shocks generate hump-shaped co-movement in house prices, residential investment, credit, and other macroeconomic variables in accordance with our empirical findings.

[23] News on a variety of shocks could potentially be sources of optimism about future house price appreciation. Indeed, expectations about the future occurrence of shocks that lead to house-price appreciation generate a boom in house prices and credit. However, not all news shocks are in line with the evidence presented in Figures 1-9 of the paper. For instance, expectations of future housing demand shocks cannot be considered as potential sources of news-shock-driven housing booms. In fact, news on housing preference shocks do not generate the right co-movement between business investment and house prices as documented in Figure 5 of the current version of the paper.

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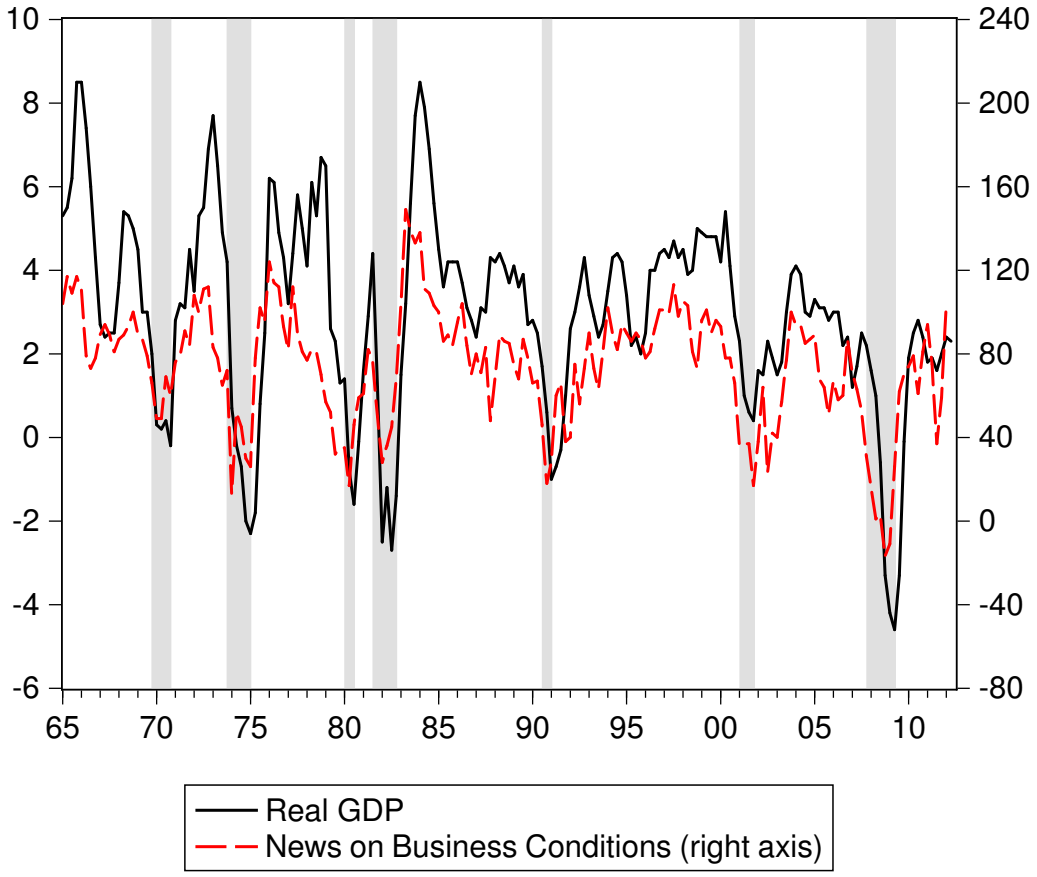

Figure 1: Survey data on News on Business Conditions and real GDP growth; United States 1965Q1 to 2012Q1

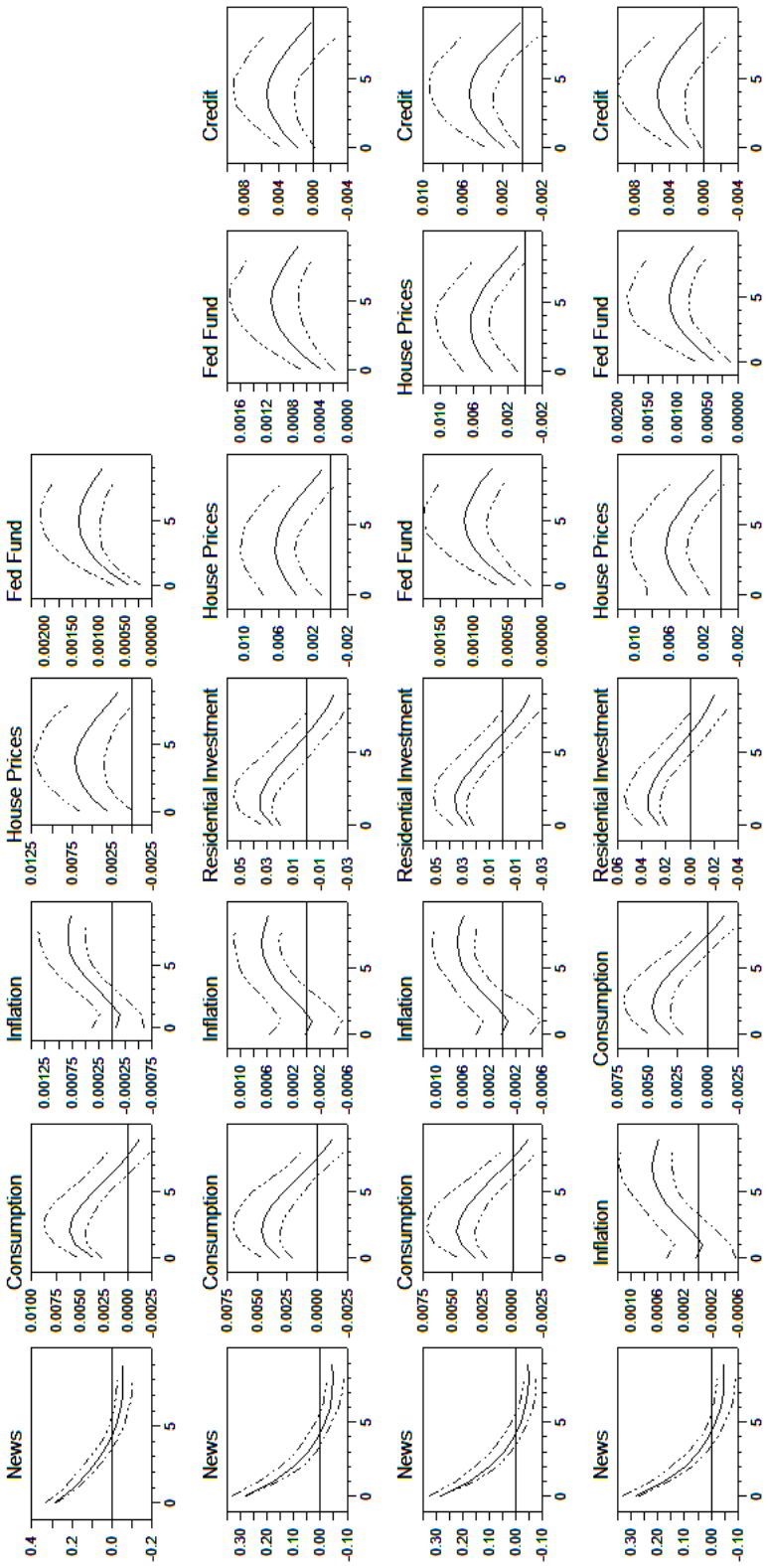

Figure 2: Response to a Shock to News on Business Conditions

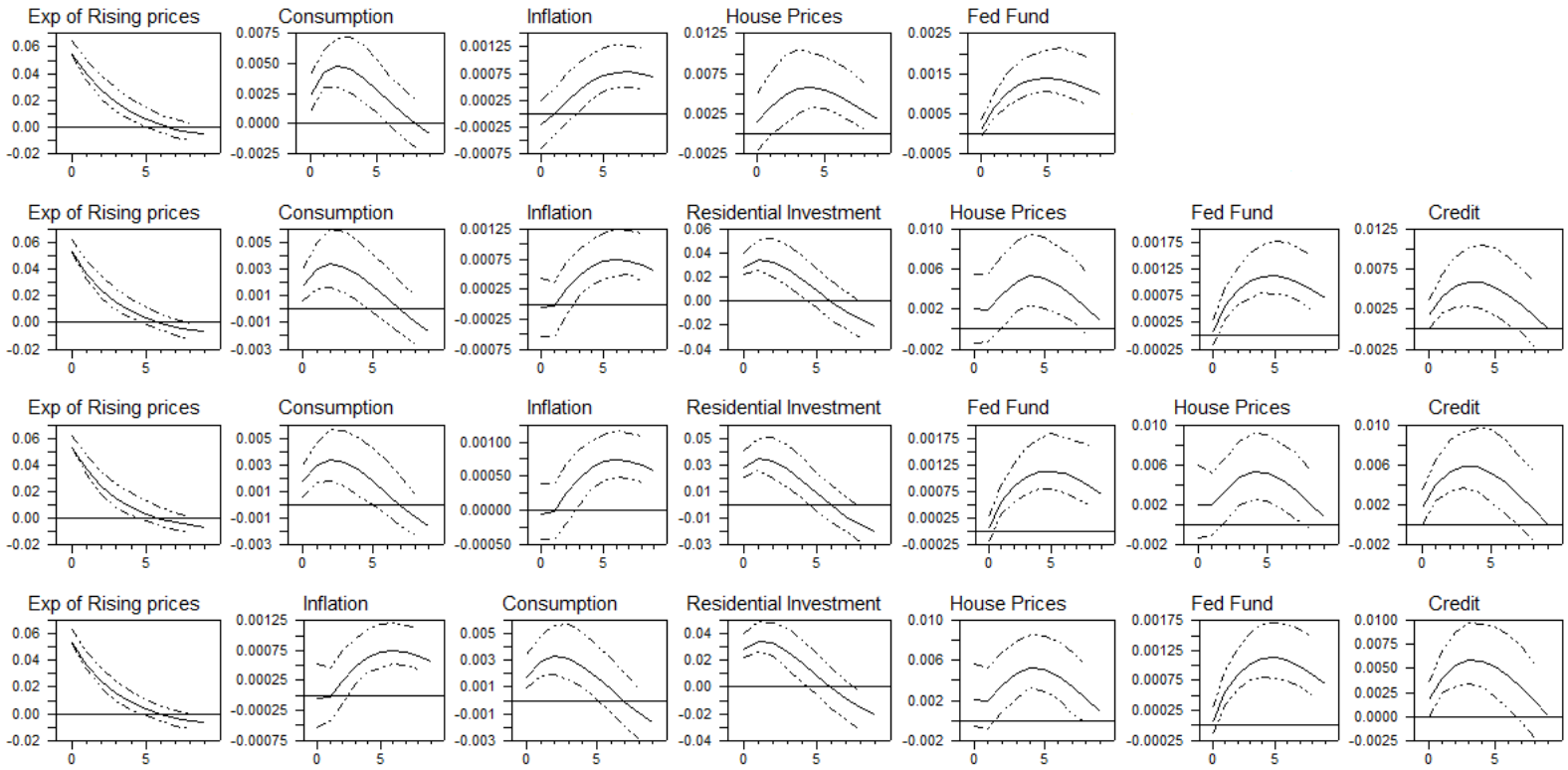

Figure 3: Response to a Shock to Consumers' Expectations of Rising House Prices

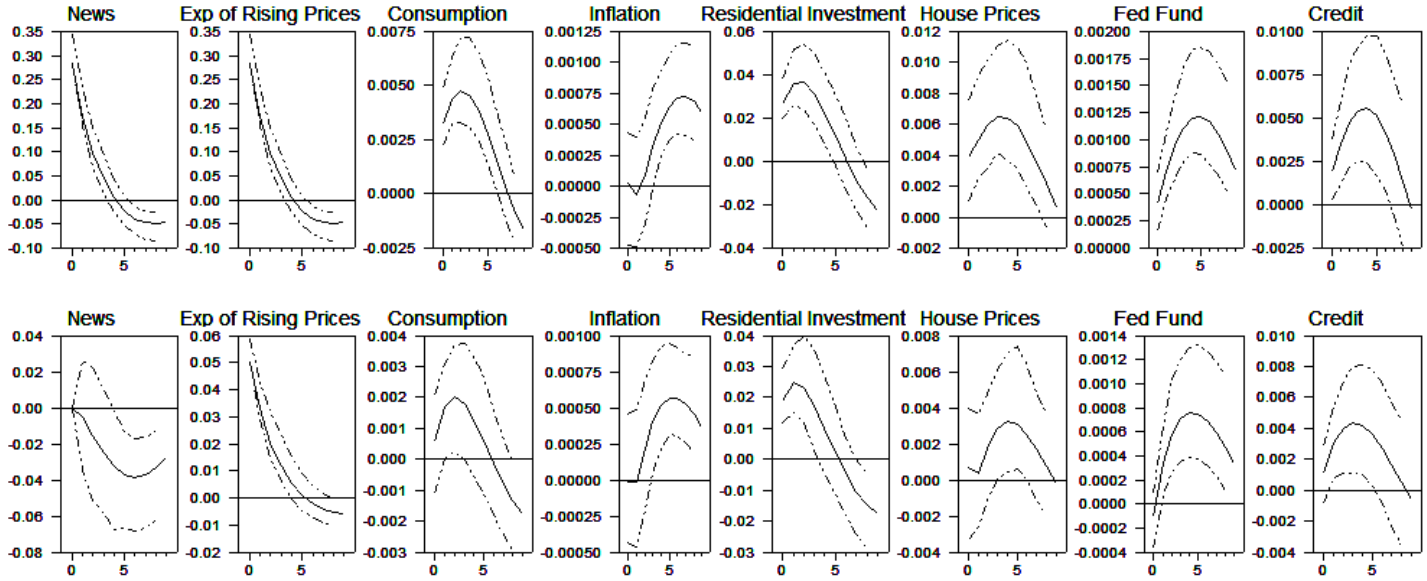

Figure 4: Response to a Stock to News of Business Conditions (Top Row) and to a Shock to Expectations of Rising House Prices (Bottom Row)

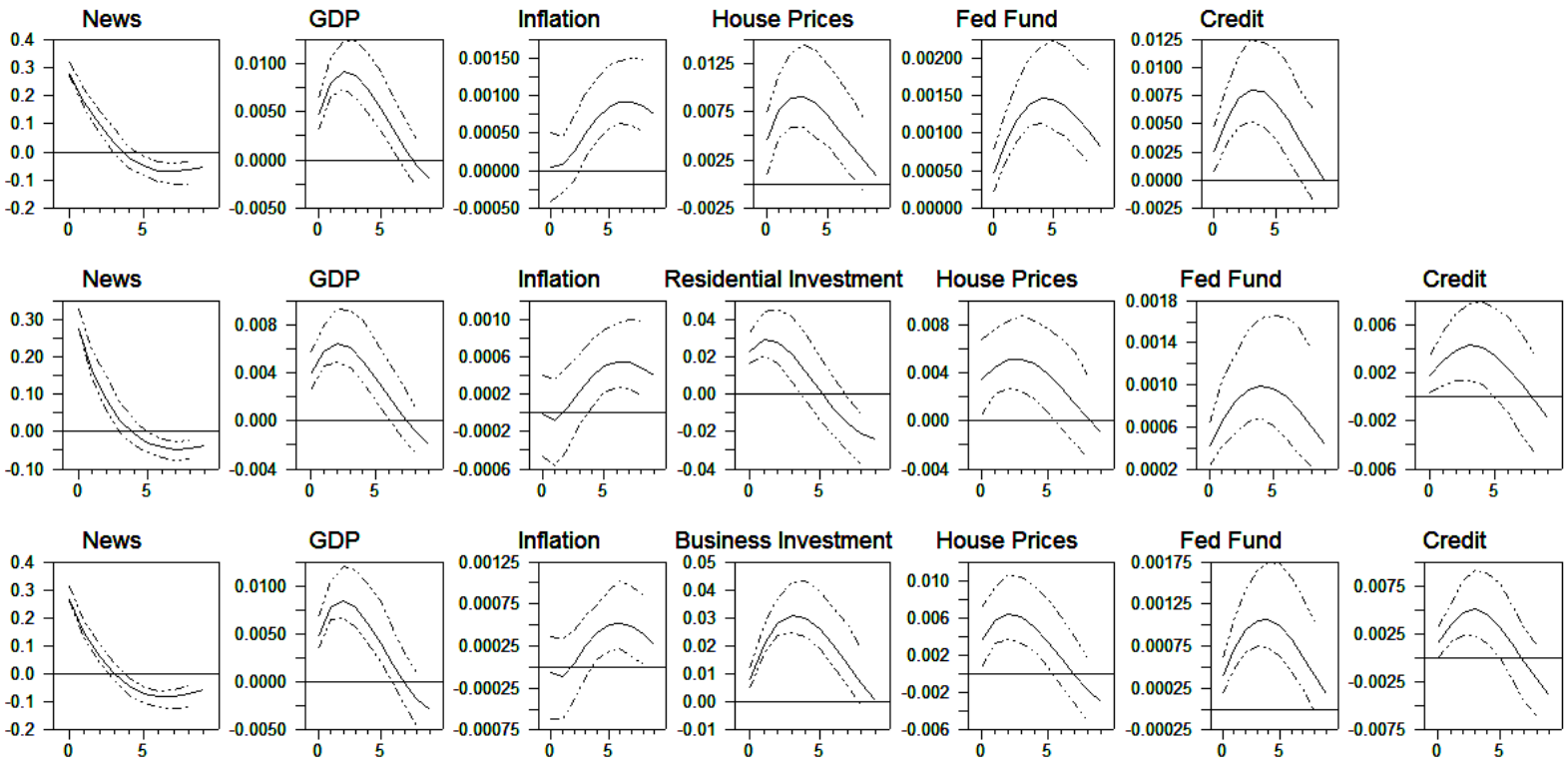

Figure 5: Alternative Measures of Activity: Shock to News on Business Conditions

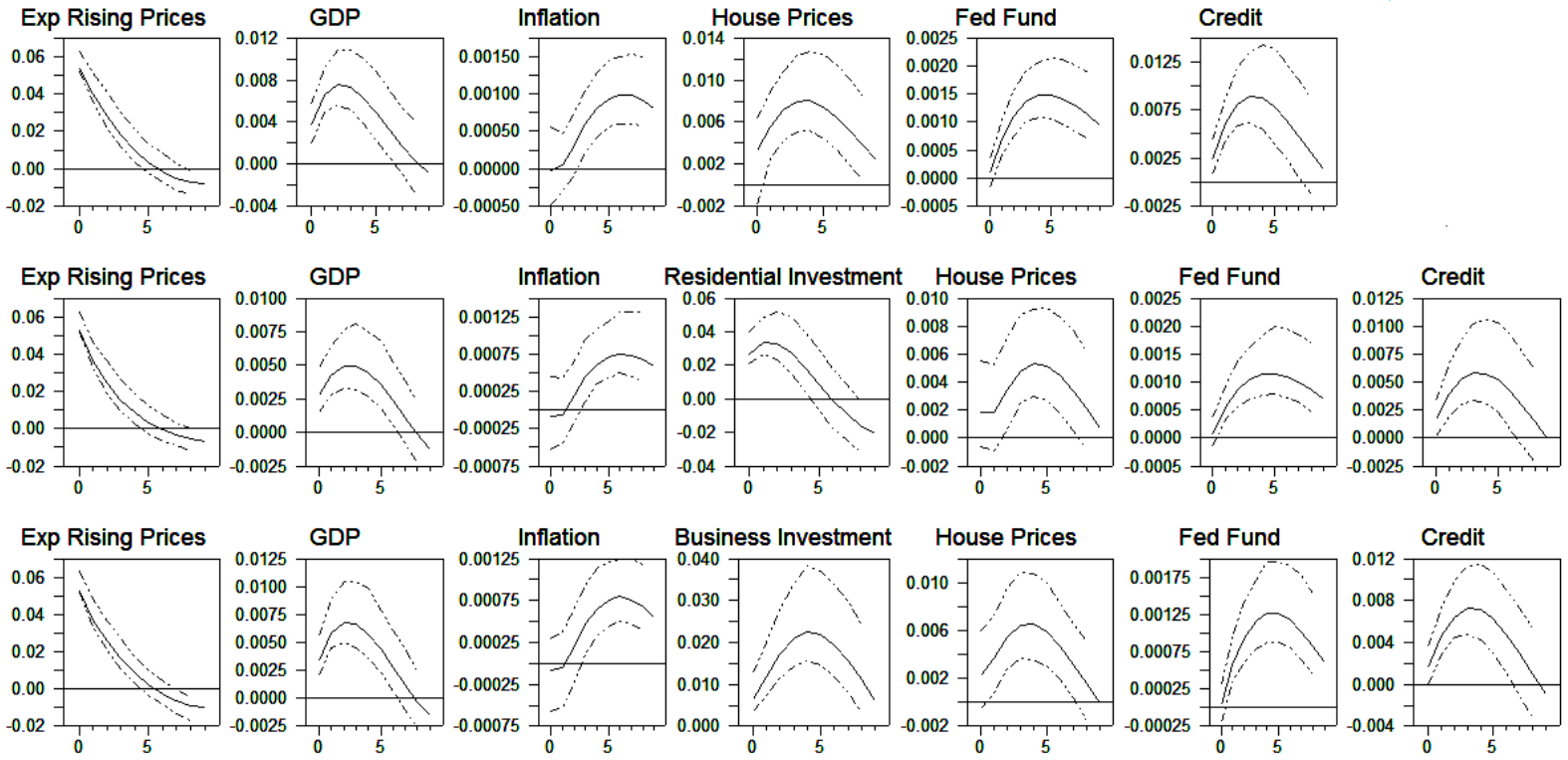

Figure 6: Alternative Measures of Activity: Shock to to Expectations of Rising House Prices

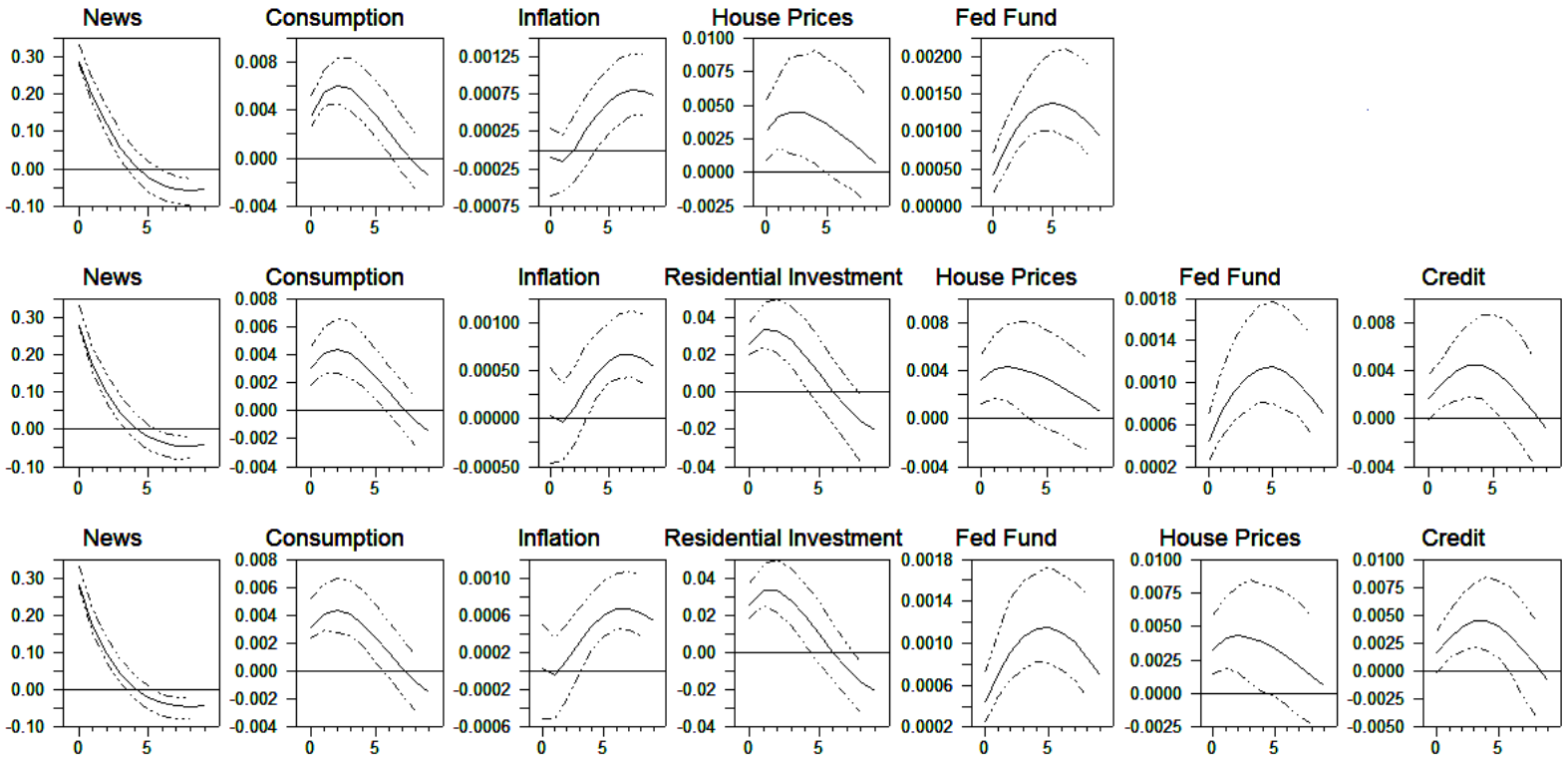

Figure 7: Response to a Shock to News on Business Conditions: Freddy Mac House Price Index

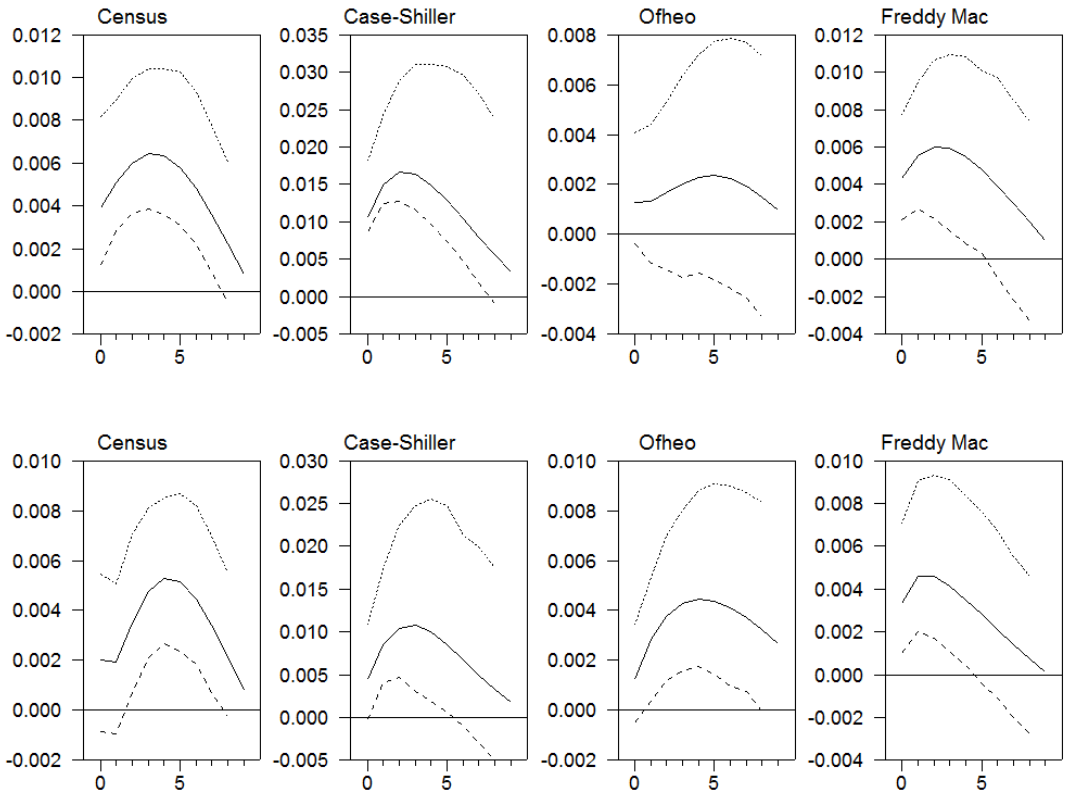

Figure 8: Alternative Measures of House Prices: Shock to News on Business Conditions (Top); Shock to Expectations of Rising House Prices (Bottom)

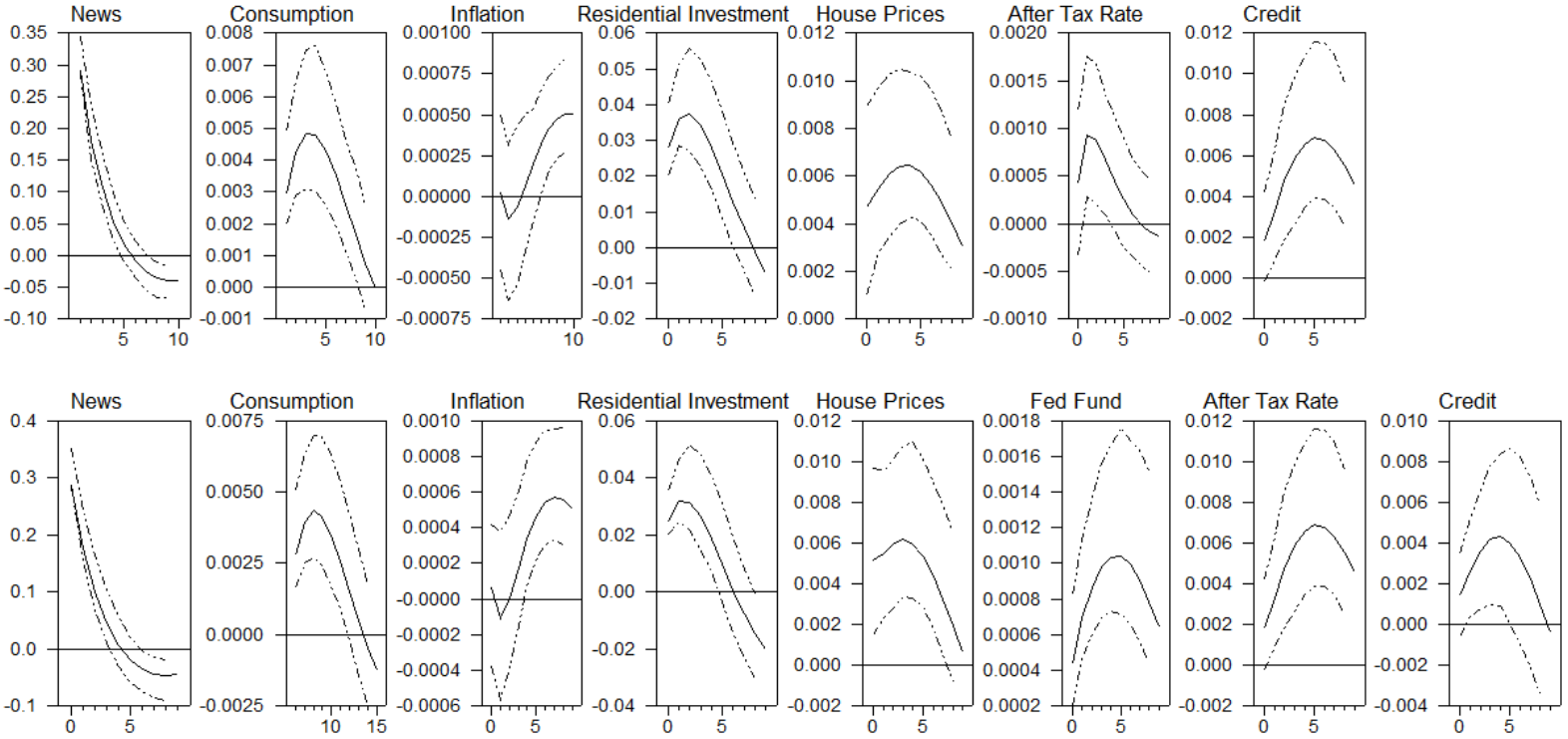

Figure 9: Response to a Shock to News on Business Conditions: Real After-Tax Mortgage Rate

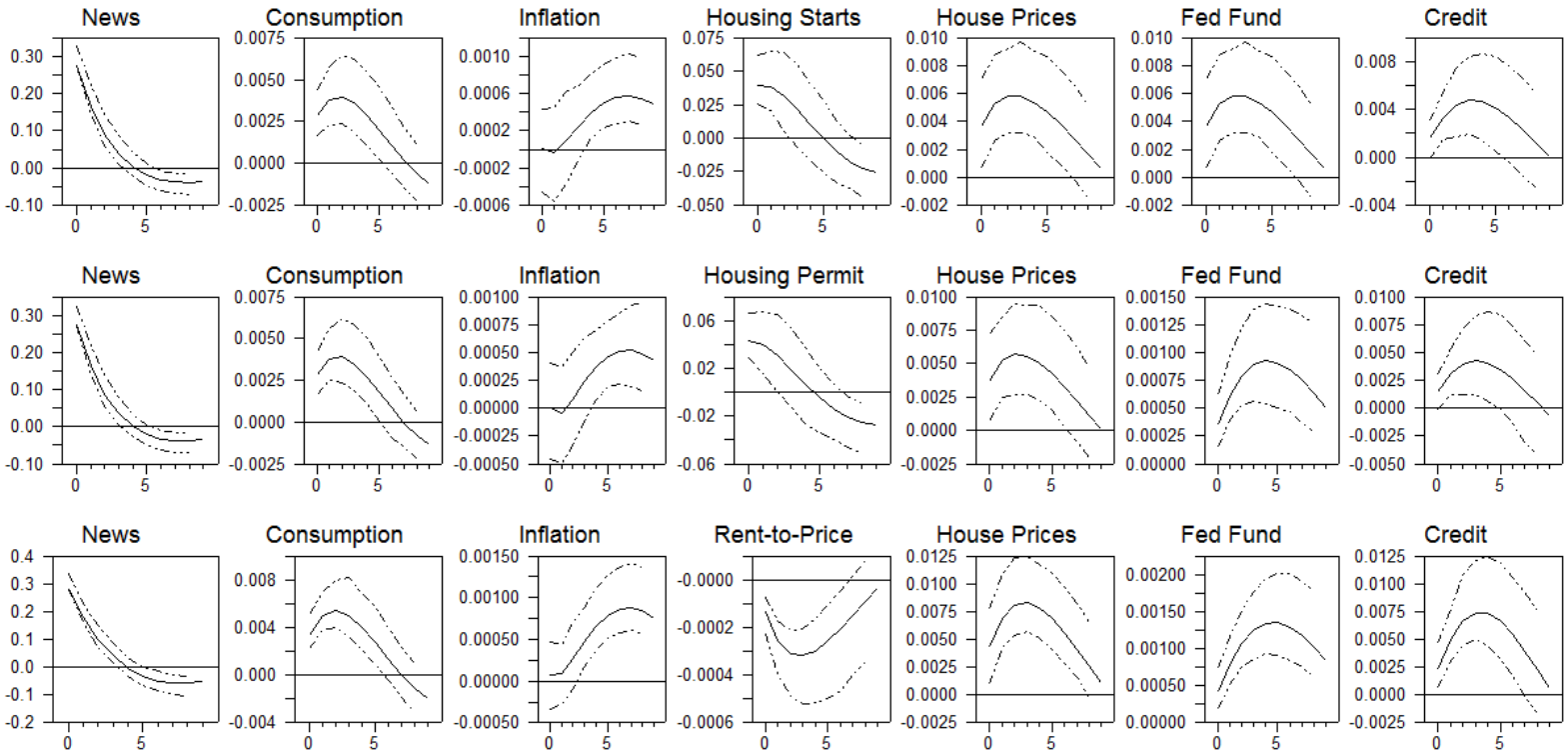

Figure 10: Alternative Measures of Housing Supply: Shock to News on Business Conditions

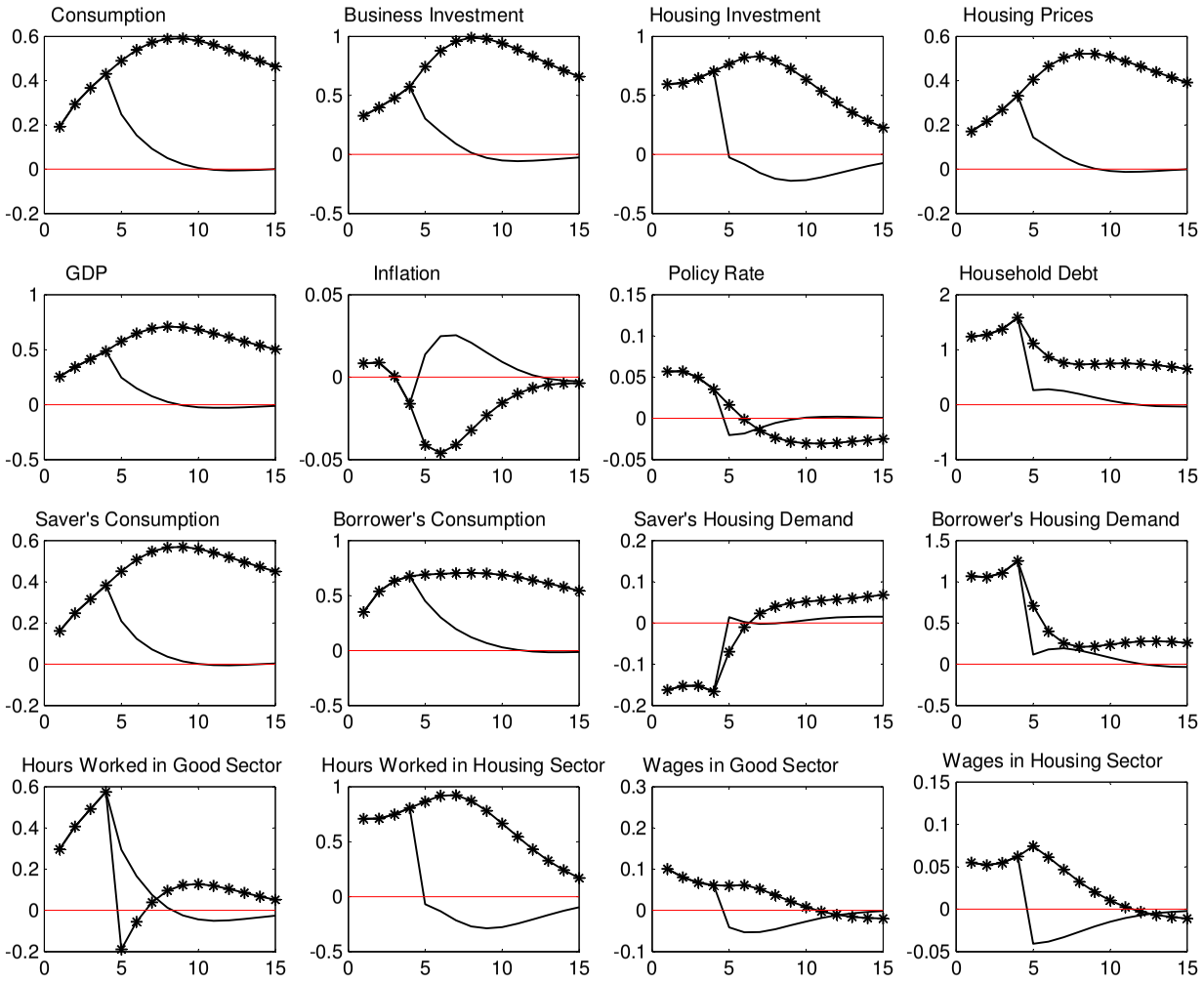

Figure 11: News on Technology Shock: Anticipated Shock (starred line) and Not Realized Shock (solid line)

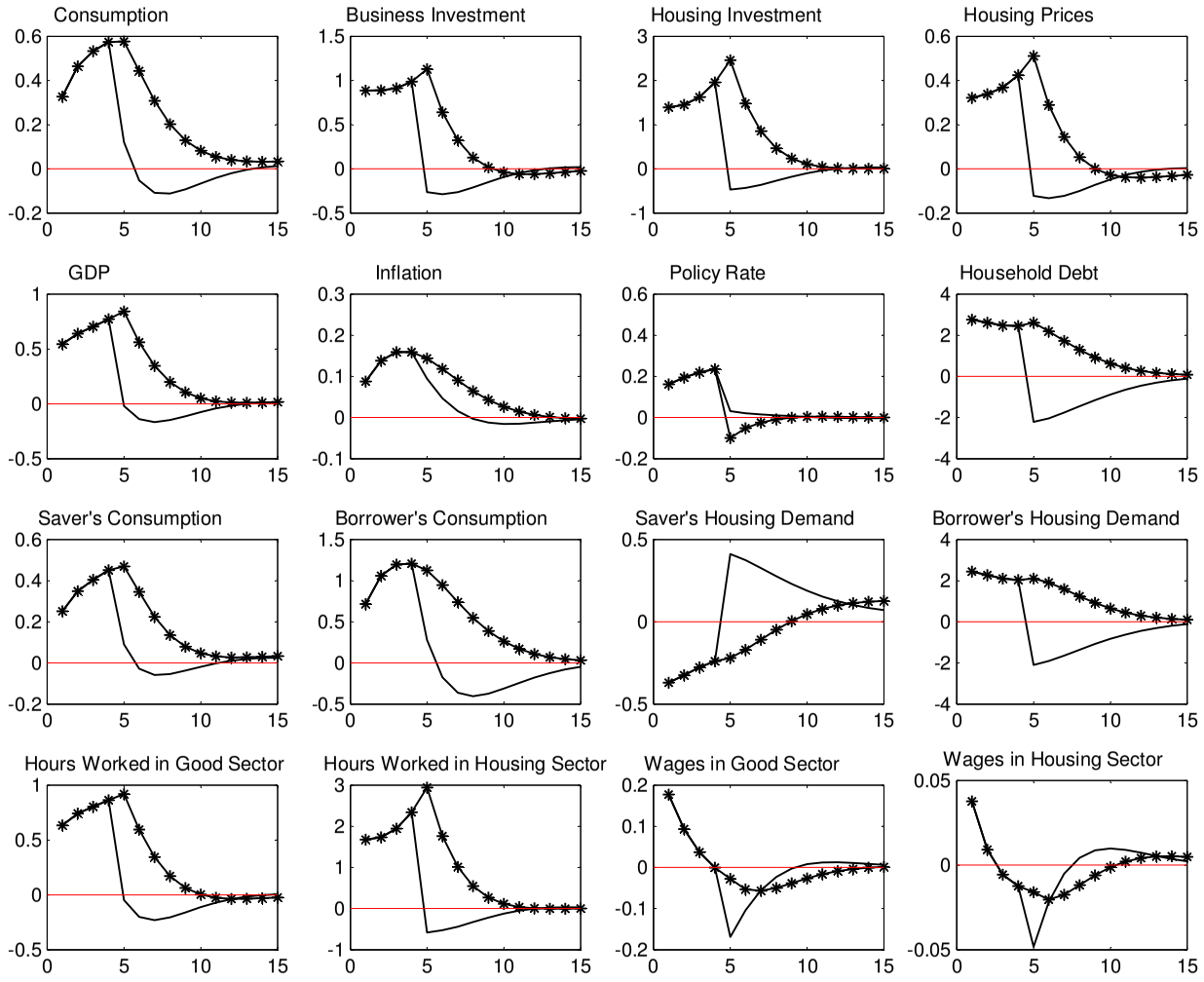

Figure 12: News on Monetary Policy Shock: Anticipated Shock (starred line) and Not Realized Shock (solid line)

APPENDIX

A Data

1.1 Macro Series

Private Consumption : Real Personal Consumption Expenditure (seasonally adjusted, billions of chained 2005 dollars, Table 1.1.6), divided by the Civilian Noninstitutional Population (CNP16OV, source: Bureau of Labor Statistics). Source: Bureau of Economic Analysis (BEA).

GDP : Real Gross Domestic Product (seasonally adjusted, billions of chained 2005 dollars, Table 1.1.6), divided by CNP16OV. Source: BEA.

Business Investment : Business Fixed Investment. Real Private Nonresidential Fixed Investment (seasonally adjusted, billions of chained 2005 dollars, Table 1.1.6), divided by CNP16OV. Source: BEA.

Residential Investment : Real Private Residential Fixed Investment (seasonally adjusted, billions of chained 2005 dollars, Table 1.1.6.), divided by CNP16OV. Source: BEA.

Inflation : Quarter on quarter log differences in the implicit price deflator for the nonfarm business sector, demeaned. Source: Bureau of Labor Statistics (BLS).

Interest Rate : Effective Federal Fund Rate, expressed in quarterly units. Demeaned.

House Prices : Census Bureau House Price Index (new one-family houses sold including value of lot) deflated with the implicit price deflator for the nonfarm business sector.

Source: Census Bureau, http://www.census.gov/const/price_sold_cust.xls.

Mortgage Credit : Households and nonprofit organizations home mortgages liability (seasonally adjusted, millions of current dollars), divided by the implicit price deflator and divided by the Civilian Noninstitutional Population. Source: The Federal Reserve Board (Series ID: Z1/Z1/LA153165105.Q).

Mortgage Lending Rate : 30-Year Conventional Mortgage Rate. Source: Board of Governors of the Federal Reserve System.

Housing Permits : New Private Housing Units Authorized by Building Permits. Source: U.S. Department of Commerce: Census Bureau: New Residential Construction.

Housing Start : New Privately Owned Housing Units Started, Total. Source: U.S. Department of Commerce: Census Bureau: New Residential Construction.

Rent-Price Ratio : Source: Land and Property Values in the U.S., Lincoln Institute of Land Policy.
http://www.lincolninst.edu/subcenters/land-values/rent-price-ratio.asp.

The time series are displayed in Figure A.1. Correlations with House Prices are reported in Table A.1.

Data

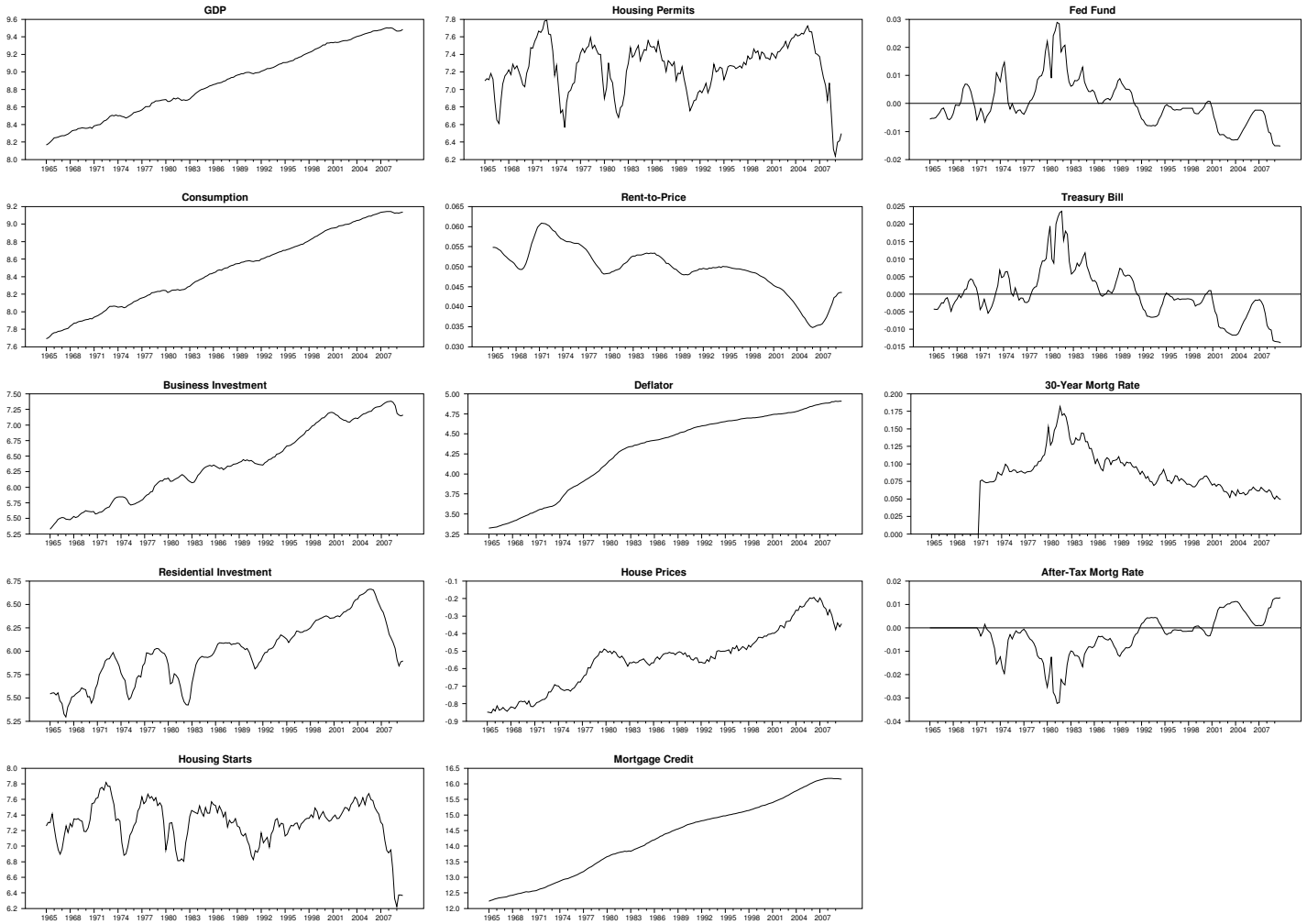

Figure A.1: Time Series

Table A.1: Correlations with House Prices

	Contemporaneaous Correlation	Lead/Lag Relationship	Overall Sample Maximum Correlation
Private Consumption	0.49	2	0.56
Residential Investment	0.48	3	0.70
GDP	0.58	1	0.59
Business Investment	0.50	-1	0.55
Mortage Credit	0.69	0	0.69
FF	0.28	8	-0.43
Inflation	0.25	-3	0.32

	Contemporaneaous Correlation	
	Booms	No Booms
Private Consumption	0.68	0.3578
Residential Investment	0.8523	0.2405
GDP	0.6848	0.3403
Business Investment	0.5813	0.5128
Mortage Credit	0.9161	0.5852
FF	0.1768	0.3611
Inflation	0.4097	0.2113

1.1.1 Alternative Sources of House Price

Freddie Mac House Prices : Repeat-transactions indexes deflated with the implicit price deflator for the nonfarm business sector.

Source: http://www.freddiemac.com/finance/fmhpi/

Ofheo House Prices : Single-family house weighted, repeat-sales index (average price changes in repeat sales or refinancing on the same properties) deflated with the implicit price deflator for the nonfarm business sector.

Source: http://www.fhfa.gov/webfiles/23951/1q12hpi_reg.txt

S&P/Case-Shiller House Prices : Value of single-family housing within the United States. The index is a composite of single-family home price indices for the nine U.S. Census divisions and is calculated quarterly.

Source: http://www.standardandpoors.com/indices/sp-case-shiller-home-price-indices/

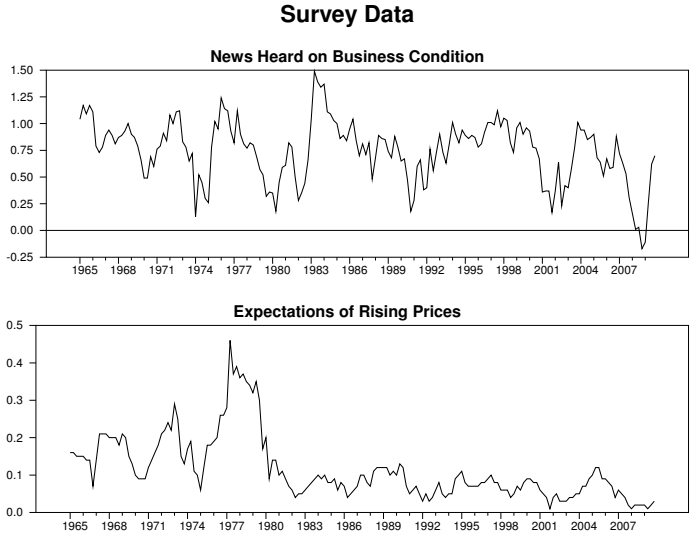

Figure A.2: Time Series

1.2 Survey

News on Business Conditions : News Heard of Recent Changes in Business Conditions (Question 6), University of Michigan Surveys of Consumers. Question wording: "During the last few months, have your heard of any favorable or unfavorable changes in business conditions? What did you hear?"

- Heard Favorable News
- Heard Unfavorable News
- No mentions

Good Time to Buy : Selected Reasons About Buying Conditions for Houses (Table 24), University of Michigan Surveys of Consumers. Question wording: "Generally speaking, do you think now is a good time or a bad time to buy a house? Why do you say so?"

- Good time to buy: Prices are low; good buys available
- Good time to buy: House prices won't come down; are going higher
- Good time to buy: Borrow-in-advance of rising interest rates
- Good time to buy: Interest rates are low; credit is easy
- Bad time to buy: Prices are high
- Bad time to buy: Interest rates are high; credit is tight

The survey series are displayed in Figure A.2.

1.3 Oil and Fiscal Dummy

We associate oil dummy variables with the following dates, which correspond to exogenous declines in world oil supply: 1973Q4, 1978Q4, 1980Q4, 1990Q3. For fiscal shocks we identify dummy variables with the following dates: 1980Q1 (Carter-Reagan military buildup) and 2001Q3 (terrorist attack on September 11).

To control for exogenous, unanticipated increases in oil prices, we employ the quantitative dummy variable developed by Hamilton (2003). The quantitative dummy variable captures the disruptions in the oil market due to political events in the Middle East that are plausibly exogenous to developments in the U.S. economy. Hamilton identifies the following dates as being associated with exogenous declines (in parenthesis) in world oil supply: November 1956 (10.1%), November 1973 (7.8%), December 1978 (8.9%), October 1980 (7.2%), and

August 1990 (8.8%). Four of these episodes fall within the sample period of our baseline model: November 1973, December 1978, October 1980, and August 1990. The quantitative dummy takes a value equal to the drop in world production during the period in which the episodes occur and is otherwise zero. To identify exogenous fiscal shocks, we appeal to the narrative approach of Ramey and Shapiro (1998) and its extension in Ramey (2009). They identify four exogenous fiscal shocks in the postwar U.S. data: 1950Q3, associated with the Korean War; 1965Q1, associated with the Vietnam War; 1980Q1 associated with the Carter-Reagan military buildup; and 2001:Q3, associated with terrorist attack on September 11. Of these shocks, only the 1980Q1 and 2001Q3 episodes fall within our estimation period.

1.4 Estimates

1.4.1 Controls

In the paper, we report the results of the model using controls for oil and fiscal shocks and for changes in the conduct of monetary policy from 1979Q4 and for the use of unconventional monetary policy measures starting from the fall of 2007. For completeness, we estimate the VAR model without fiscal and oil dummies. In addition, since the post-2007 period may appear to be too short to be considered as a separate regime, we exclude it from the sample.

Figure A.3 (first row) shows the Impulse responses to a positive innovation to News on Business Conditions. The exclusion of the dummy variables has no substantial effect on the results. Further, we also find no substantial effect on the transmission of shocks to consumers' Expectations of Rising House Prices to house prices and other macroeconomic variables. See Figure A.3 (second row).

1.4.2 Alternative treatments of the Variables

The results showed in the paper are based on filtered data obtained through the Baxt-King band-pass filter. However, it is not necessary to induce stationarity to estimate VAR models. For completeness, we also estimate the VARs without filtering the data. Figure A.4 shows the impulse responses of our VAR model to a shock to News on Business Conditions. In the first row we report the results of the model estimated using the inflation rate, whereas the second row considers the levels of all the variables. In this latter case, we use the price deflator rather than the inflation rate. Estimating the model has no substantial effect on the transmission of shocks to News on Business Conditions to house prices and other macroeconomic variables. As in the benchmark case, favorable News on Business Conditions leads to a hump-shaped response in private consumption, residential investment and house prices. However, the effect of these shock is more persistent. Contrary to results reported in the paper, the effect on unexpected change on News on Business Conditions on either inflation or the price level is mainly negative and rarely significant. The key properties of the impulse responses of the housing market variables are not particularly sensitive to the use of the price variable in level or in first differences. Similar results hold for a shock to Expectations of Rising House Prices.

Parameter	Description	Value
β	Saver's Discount Factor	0.9925
$\beta^{'}$	Borrower's Discount Factor	0.97
j	Housing Preference Shock	0.12
μ_c	Good Capital Share	0.35
μ_h	Housing Capital Share	0.1
μ_l	Land Share	0.1
μ_b	Intermediate Good Share	0.1
δ_h	Housing Depreciation Rate	0.01
δ_{kc}	Depreciation Rate in Good Sector	0.025
δ_{kh}	Depreciation Rate Housing Sector	0.03
X	Price Markup	1.15
X_{wc}	Wage Markup in Good Sector	1.15
X_{wh}	Wage Markup in Housing Sector	1.15
m	Loan-to-Value	0.85
ε	Saver's Habit Consumption	0.32
$\varepsilon^{'}$	Borrower's Habit Consumption	0.58
η	Saver's Labor Supply Elasticity	0.52
$\eta^{'}$	Borrower's Labor Supply Elasticity	0.51
ξ	Saver's Disutility of Labor across sector	0.66
$\xi^{'}$	Borrower's Disutility of Labor across sector	0.97
$\phi_{k,c}$	Capital Adjustment Cost in Good Sector	14.25
$\phi_{k,h}$	Capital Adjustment Cost in Housing Sector	10.9
α	Share of Credit-Constrained Agents	0.79
r_R	Monetary Policy Inertia	0.59
r_π	Monetary Policy Inflation Feedback	1.44
r_Y	Monetary Policy Output Feedback	0.52
θ_π	Price Stickiness	0.83
ι_π	Price Indexation	0.69
$\theta_{w,c}$	Wage Stickiness in Good Sector	0.79
$\iota_{w,c}$	Wage Indexation in Good Sector	0.08
$\theta_{w,h}$	Wage Stickiness in Housing Sector	0.91
$\iota_{w,h}$	Wage Indexation in Housing Sector	0.4
ζ	Capacity Utilization	0.69
γ_{AC}	Growth Rate in Good Sector	0.0032
γ_{AH}	Growth Rate in Housing Sector	0.0008
γ_{AK}	Growth Rate in Business Investment	0.0027
ρ_{AC}	AR of Technology Shock	0.95
σ_{AC}	STD of Technology Shock	0.01
σ_R	STD of Policy Rate Shock	0.0034

Table A.2: Calibrated Parameters. Source Iacoviello and Neri (2010).

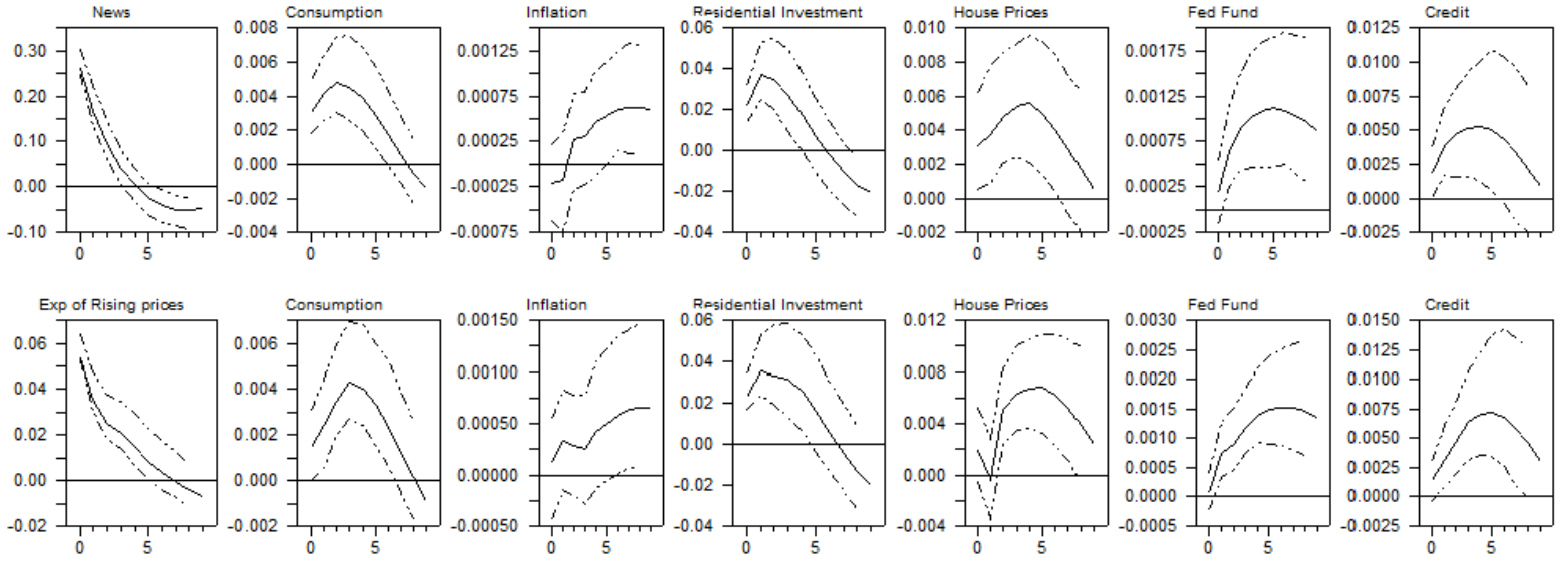

Figure A.3: Response to a Shock to News on Business Conditions: Sample Period from 1965 until 2007

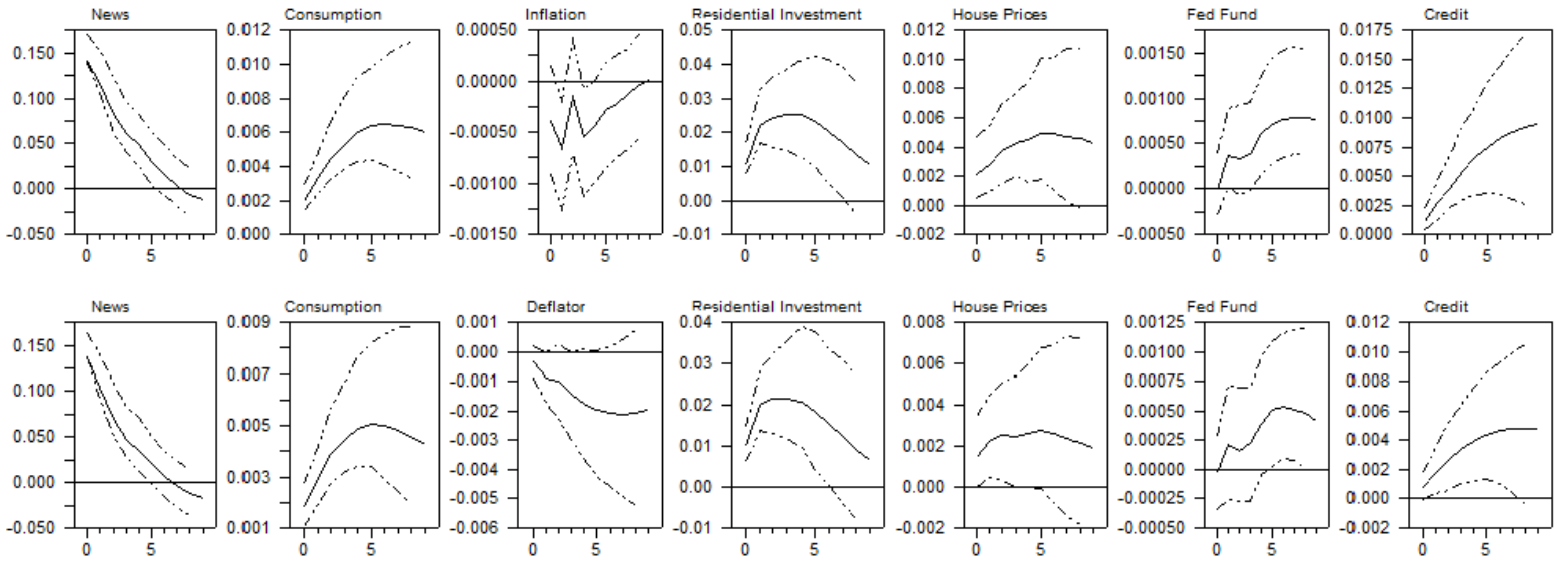

Figure A.4: Response to a Shock to News on Business Conditions: Inflation Rate versus GDP Deflator