

APPENDICES TO “THE MACROECONOMIC EFFECTS OF GOVERNMENT ASSET PURCHASES: EVIDENCE FROM POSTWAR US HOUSING CREDIT POLICY”

Appendix I: Historical Background

This appendix provides some more historical background to the evolution of agency market shares depicted in Figure I.³² During the Depression, the Home Owners’ Loan Corporation took ownership of nearly 15 percent of mortgage debt. Housing and homeownership reemerged as a priority at the end of WWII, which is reflected in the strong growth of Fannie holdings in the late 1940s until the Korean War again shifted priority away from housing. A struggling Fannie was rechartered as a mixed private-public ownership corporation in 1954. In 1968, Fannie Mae was split into a publicly listed private corporation and a government-owned Ginnie Mae. In the 1970s, Fannie expanded almost without interruption and the agencies mortgage holdings reached close to 10 percent of total mortgage debt. However, Fannie’s large debt-financed balance sheet incurred heavy losses after interest rates rose sharply in 1979. Profitability was only restored through a strategy of aggressive portfolio expansion and by entering the securitization business. At its creation in 1970, ownership of Freddie Mac was restricted to the savings and loans, which had no interest in creating a competitor. As a result, Freddie focused on the securitization of conventional loans, maintaining only a relatively modest mortgage portfolio for warehousing until the late 1980s. In the second half of the 1980s, rising delinquencies and a more hostile attitude of the Reagan administration towards the GSEs led to a reduction in the agencies’ market share.

Various reforms in the aftermath of the 1980s S&L crisis set the stage for a prolonged rise in agency activity in the 1990s and early 2000s, and by 2002, the agencies held close to one quarter of the total outstanding mortgage debt on their portfolios. In 1989, Freddie was turned into a publicly traded company with therefore the same profit incentives for balance sheet growth as Fannie, while the Federal Home Loan Banks were granted permission to invest in MBS. Prudential regulations were tightened for private banks, but remained light for the GSEs despite a 1992 reform. The agencies increasingly retained their own and acquired each other’s MBS, as opposed to selling them to private investors. As part of an ambitious homeownership strategy, the Clinton administration was supportive of the efforts by Fannie and Freddie to develop automated underwriting systems and ramped up affordable housing goals for their purchases.

The rapid rise in agency ownership of mortgage debt increasingly became a cause of concern with public officials, and in the wake of the Enron scandal Fannie and Freddie were required to start filing reports with the Securities and Exchange Commission. Allegations of accounting fraud in 2003 prompted an investigation by regulators, leading to capital surcharges in the fall of 2004 and settlements that included portfolio caps in 2006. This contributed to a sharp fall in the agencies’ market share, which declined 10 percentage points from 2003 to 2007. During the turmoil in mortgage markets in 2007, the portfolio caps and capital surcharges were relaxed, allowing the agencies to step up purchasing activity. In early September 2008, Fannie and Freddie were taken into conservatorship by the Federal Housing Finance Agency and the Treasury Department.

The 2008 conservatorship agreement allowed for continued GSE balance sheet growth in the short run, but also mandated a long-run wind-down of their portfolios at an annual rate of 10 percent, increased to 15 percent in 2012, until they reaching \$250 billion each. The day after the agreement, the Treasury announced its own MBS purchase program, while the Federal Reserve’s MBS program was launched a few weeks later. As a result of the Fed and Treasury programs, the combined agency ownership share regained levels similar to the early 2000s despite a gradual decline in holdership by the traditional housing agencies. In contrast,

³²Table I contains references to various books and articles that contain more comprehensive overviews.

Fannie and Freddie have been allowed to grow their MBS guarantee book essentially without limits. Since the financial crisis, the vast majority of conforming loans originated have been acquired, guaranteed, and sold off in MBS by the agencies.

Appendix II: An Alternative Identification Strategy Using GSE Excess Returns

Although our narrative instrument is a good predictor of agency purchasing activity, it is based on relatively few policy events. To gain confidence that our results are not driven by the small sample size, as well as to address other potential concerns with the narrative identification method, in this appendix we present results based on a complementary identification approach. Under this alternative approach, we instrument measures of agency purchasing activity with innovations in Fannie and Freddie excess stock returns. This strategy is inspired by [Fisher and Peters \(2010\)](#), who use excess return innovations in major US defense stocks as a measure of news shocks to military spending.

The special advantages granted by federal housing credit policy are likely to account for much of Fannie and Freddie's market value and portfolio size. This is supported by [Passmore \(2005\)](#), who estimates that 44 percent to 89 percent of Fannie's and Freddie's stock market value is derived from their special GSE status, and that the GSEs would hold far fewer mortgages in portfolio, and have higher capital ratios, if they were purely private. Based on this, we can expect that idiosyncratic movements in Fannie's and Freddie's stock prices reflect unanticipated changes in the value of the GSE status and expected purchasing activity. More specifically, any news about changes in the policies guiding the GSEs' portfolios business and leverage will affect their market value relative to the private sector. [Fieldhouse and Mertens \(2017\)](#) provide narrative evidence that announcements of housing credit policy changes are generally associated with adjustments in GSE stock prices. Below, we use our narrative indicator of federal housing credit policy changes to confirm that news about policy interventions affecting GSE balance sheets indeed affect Fannie's and Freddie's stock market valuation. After accounting for the usual covariance with real estate and banking sectors and the market as a whole, and after controlling for credit aggregates, interest rates, and other macro variables, we find that residual variation in Fannie and Freddie stock returns predicts agency mortgage purchases. This motivates us to use shocks to GSE excess returns as an alternative instrumental variable for agency mortgage purchasing activity.

Empirical Specification using the GSE Excess Returns Instrument

GSE excess returns shocks er_t^{GSE} are defined as the residual in the following regression:

$$(1) \quad ER_t^{GSE} = \tilde{\alpha} + \tilde{\zeta}W_t + \tilde{\phi}(L)Z_{t-1} + er_t^{GSE}$$

where ER_t^{GSE} is the log ratio of the GSE stock price index over the market index.³³ The vector W_t contains a number of contemporaneous controls, including several excess return measures from the Fama-French data library. In our benchmark specification, we include excess returns for the market index and a real estate portfolio. In appendix IV, we also look at specifications adding excess returns on banking or finance sector portfolios or the [Fama and French \(1993\)](#) size and value factors, with little impact on the results. Besides the return variables, W_t also includes contemporaneous values of the control variables used for the narrative specifications, i.e. the interest rate variables (3-month T-bill, 10-year Treasury, the conventional rate, BAA

³³The GSE stock price index from 1970 through 1988 is based on Fannie stock. Post 1988 it is the geometric average of Fannie and Freddie stock (from Bloomberg). The market and sector return variables are based on value-weighted portfolios and exclude dividends, and were downloaded from the data library on the homepage of Kenneth French at <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french>.

spread), the log of real originations, the log changes in mortgage debt, real house prices, the core PCE price index and personal income, the log of housing starts, and the unemployment rate. For the results below, when we rotate in another variable, we also include it in W_t . Finally, the vector Z_t with lagged controls is the same as in (3), but we also add lags of ER_t^{GSE} as well as (cumulative) Fama-French excess market returns.³⁴ All results involving GSE stock returns are based on monthly data from September 1970 to December 2006. The start of the effective sample is September 1971, reflecting the twelve lags and the fact that Fannie stock was traded for the first time on the NYSE on August 31, 1970.

The left panel in Figure XIV plots the (standardized) estimated innovations $\hat{e}r_t^{GSE}$, together with the non-cyclical narrative indicator for reference. To provide evidence that GSE stock prices reflect policy-induced changes in agency purchasing activity, the right panel in Figure XIV plots the cumulative response of GSE excess returns measures to a one pp. increase in the expected future agency market share, measured by agency commitments as a ratio of trend originations. The response, which is estimated by (3) using the narrative policy indicator as the instrument, reveals a clear and significant rise in the GSE stock prices after accounting for the comovement with the overall market and real estate sector as well as for all other macro and financial factors included as controls.

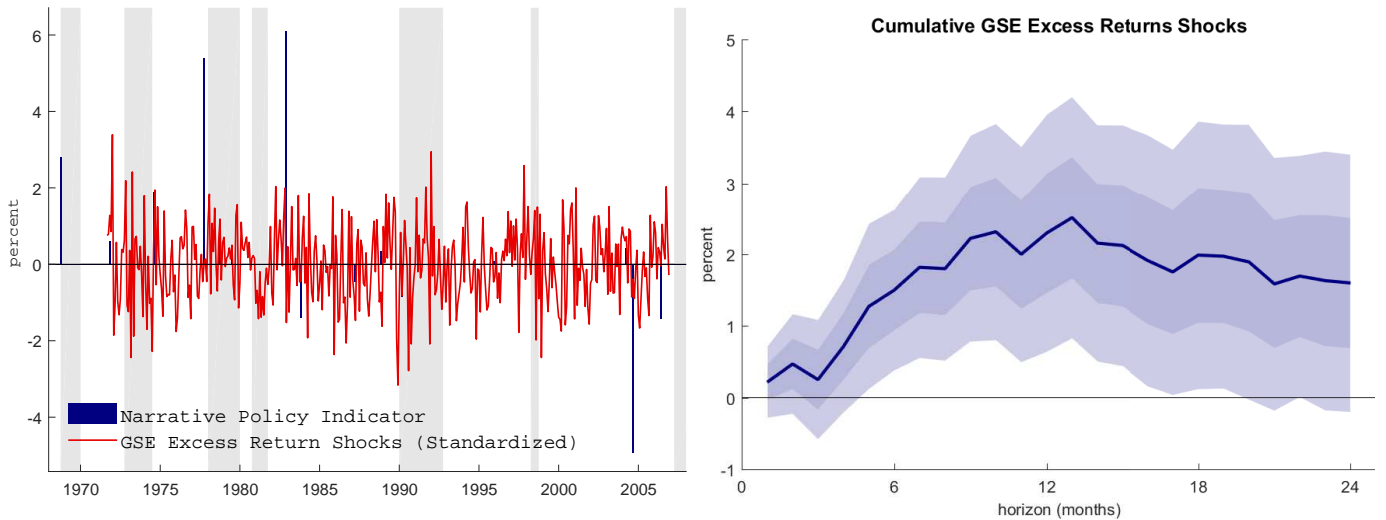


FIGURE XIV GSE Excess Returns Shocks $\hat{e}r_t^{GSE}$ and Response to Anticipated Agency Purchases Shock

The left panel shows the estimated residuals in the GSE excess returns regression in (1), as well as the indicator for non-cyclical policy changes. Shaded areas are credit crunch periods, see the data appendix for the chronology. The right panel shows the cumulative response of $\hat{e}r_t^{GSE}$ to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the non-cyclical narrative policy indicator, see equation (3). Shaded areas are 68% and 95% Newey and West (1987) confidence bands. Sample: Sep 1970 to Dec 2006.

To obtain the effect of a shock to anticipated agency purchases, we estimate the following regressions:

$$(2) \quad y_{t+h} - y_{t-1} = \alpha_h + \delta_h \left(\frac{12}{8} \times \frac{\sum_{j=0}^7 p_{t+j}}{\tilde{X}_t} \right) + \zeta_h W_t + \phi_h(L) Z_{t-1} + u_{t+h}$$

where the right hand side variable of interest measures annualized agency commitments made over an 8 month period, expressed as a ratio of \tilde{X}_t , a long-run trend in annualized originations. The response coefficient δ_h in (2) is estimated using 2SLS using ER_t^{GSE} as the instrumental variable. Because (2) includes

³⁴Further adding real estate sector excess returns to Z_t had no material impact on the results.

the same regressors W_t and (lags of) Z_t as in (1), this is equivalent to using the estimated values of er_t^{GSE} as the instrumental variable. However, including the same controls as in (1) and instrumenting with ER_t^{GSE} makes it straightforward to obtain the correct standard errors. For simplicity, we keep the horizon for cumulating commitments in equation (2) at 8 months, the same as in equation (3). The value of the first-stage robust F-statistic for this horizon is 7.09. The GSE excess returns shocks are therefore followed by statistically significant increases in agency purchasing activity. Figure XV shows the F-statistics associated with both commitments and effective purchases for horizons up to 60 months. The F-statistic for the GSE excess returns instrument is the highest for agency commitments at a horizon of 10 months, and equals 7.96. Changing the horizon for cumulating commitments in specification (2) to 10 months does not lead to any meaningful change in the results.

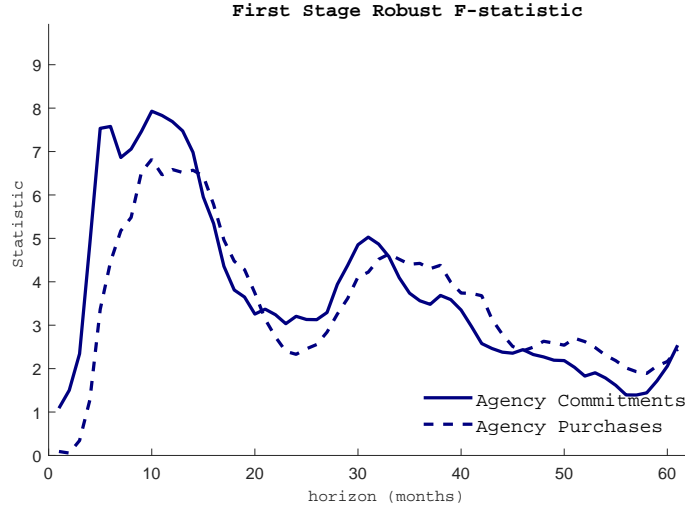


FIGURE XV First-Stage Diagnostics for GSE Excess Returns Instrument

The figure shows Newey and West (1987) robust F-statistics of the first-stage regressions of cumulative agency commitments and purchases, respectively, for the GSE excess returns variable ER_t^{GSE} with the controls W_t and (lags of) Z_t . Sample: Sep 1970 to Dec 2006.

The excess returns identification approach is analogous to Fisher and Peters (2010), who interpret innovations in excess stock returns of major defense contractors as news shocks about future military spending. They obtain these innovations by ordering the excess returns last in a recursively identified structural vector autoregressive system (SVAR). The recursive scheme assumes that none of the endogenous macro aggregates included in the analysis are affected on impact by the news shock, while excess stock returns react contemporaneously to all macroeconomic shocks. Because the monthly innovation er_t^{GSE} is orthogonalized to the innovations to all of the variables included in W_t , the 2SLS regression in (2) similarly imposes that shocks to expected agency purchases have no contemporaneous impact on the variables in W_t . By assumption, this step eliminates other endogenous influences by allowing the GSE excess returns to respond contemporaneously to market or real estate sector returns, in addition to the innovations in mortgage credit, interest rates, prices, and the cyclical indicators. While the assumption of a zero contemporaneous effect on these variables seems ex ante restrictive, it is not rejected by the narrative instrument, see Figures VII, VIII, and X. In appendix IV, we implement the same strategy in a recursive SVAR as in Fisher and Peters (2010), which yields estimates that are very similar those of Figure XVI. In the SVAR, the contribution to the short-run variability of mortgage credit and housing starts is substantial and similar to that of monetary policy shocks.

Because the GSE excess returns instrument has monthly observations, it contains potentially more information about variation in agency purchases than the narrative policy indicator.³⁵ Our narrative indicator contains, for instance, little information for the 1990s because of the scarcity of quantifiable and binding regulatory changes. However, this period witnessed a rapid expansion of GSE balance sheets and may be particularly important for learning the effects of agency purchases. As is well known, however, equity prices are volatile, and the GSE excess return shocks are, on the other hand, also relatively noisy. While the GSE excess returns shocks clearly have predictive power for agency commitment activity, the first-stage F-statistics are somewhat lower than for the narrative instrument. Another caveat is that the GSE excess returns shocks may also pick up unanticipated variation in the scale of the GSEs' securitization business. Nevertheless, we view this identification strategy as a useful alternative to the narrative approach.

Results using GSE Excess Returns Shocks as an Alternative Instrument

Figure XVI summarizes the responses of mortgage credit, interest rates, and other macro variables to news about higher future purchases identified using the GSE excess returns shocks instrument. The impulse responses are directly comparable to those reported in Figures VII and X for the narrative instrument. The GSE excess returns shocks generally yield responses that are less delayed and more transitory for some variables. The main finding, however, is that they are overall remarkably similar in size and direction across both identification strategies.

The first row in Figure XVI shows statistically significant increases in mortgage originations following a shock to agency purchases. The rise in total originations occurs slightly more rapidly, and is more transitory than with the narrative instrument. The peak increase in originations is, on the other hand, very similar in size to that in Figure VII, and occurs between 10 and 14 months at around 4 percent. As with the narrative instrument, both home purchase and refinancing originations rise, but the rise in refinancing activity is particularly pronounced. The leftmost panel in the second row shows that the rise in the stock of mortgage debt is also very similar to that in Figure VII. As in our benchmark results, agency purchases lead to a statistically significant rise in housing starts, which are around 2 percent higher between 4 and 12 months after the shock. There is also a significant and persistent rise in homeownership. The third row in Figure XVI shows that the conventional mortgage rate is lower by 10 to 15 basis points after 6 to 18 months. The declines in the 10-year and 3-month Treasury rates are also similar to our benchmark results.

The bottom row in Figure XVI reveals some differences with our benchmark narrative instrument. The left panel shows a more pronounced increase in consumer spending following the GSE excess returns shock, as well as a clear decline in the unemployment rate. The responses of consumption, unemployment, and personal income (not displayed) are even marginally statistically significant. In contrast to Figure X, there is, on the other hand, no indication that house price are affected significantly by agency purchases.

The results produced by this alternative identification strategy are also similar for other variables not shown in Figure XVI. The GSE excess returns instrument, for instance, also yields a temporary decline in the federal funds rate, although it is smaller in size and not statistically significant. We note, on the other hand, that the GSE excess returns instrument does not yield a similar significant decline in the Romer and Romer (2004) residual, and also leads to different conclusions regarding the role of traditional interest rate policies. Figure XVII compares the estimated responses to those under the counterfactual with constant short-term interest rates, as in Figure XIII. In contrast to the findings based on the narrative instrument, the drop in long-term interest rates remains clearly present after holding short-term interest rates fixed when we use

³⁵ Assuming the GSE excess returns shocks contain all of the information about agency purchase shocks, it becomes possible to estimate the variance contribution of these shocks to any endogenous variables of interest. In appendix IV, we do this in the context of an SVAR model.

GSE excess returns shocks for identification. The same is true for the positive effect on housing starts and, to a lesser extent, for the rise in mortgage debt. As in Figure XIII, purchases of mortgage assets continue to have statistically significant effects on mortgage lending, and short-term interest rates appear irrelevant for the effect on homeownership.

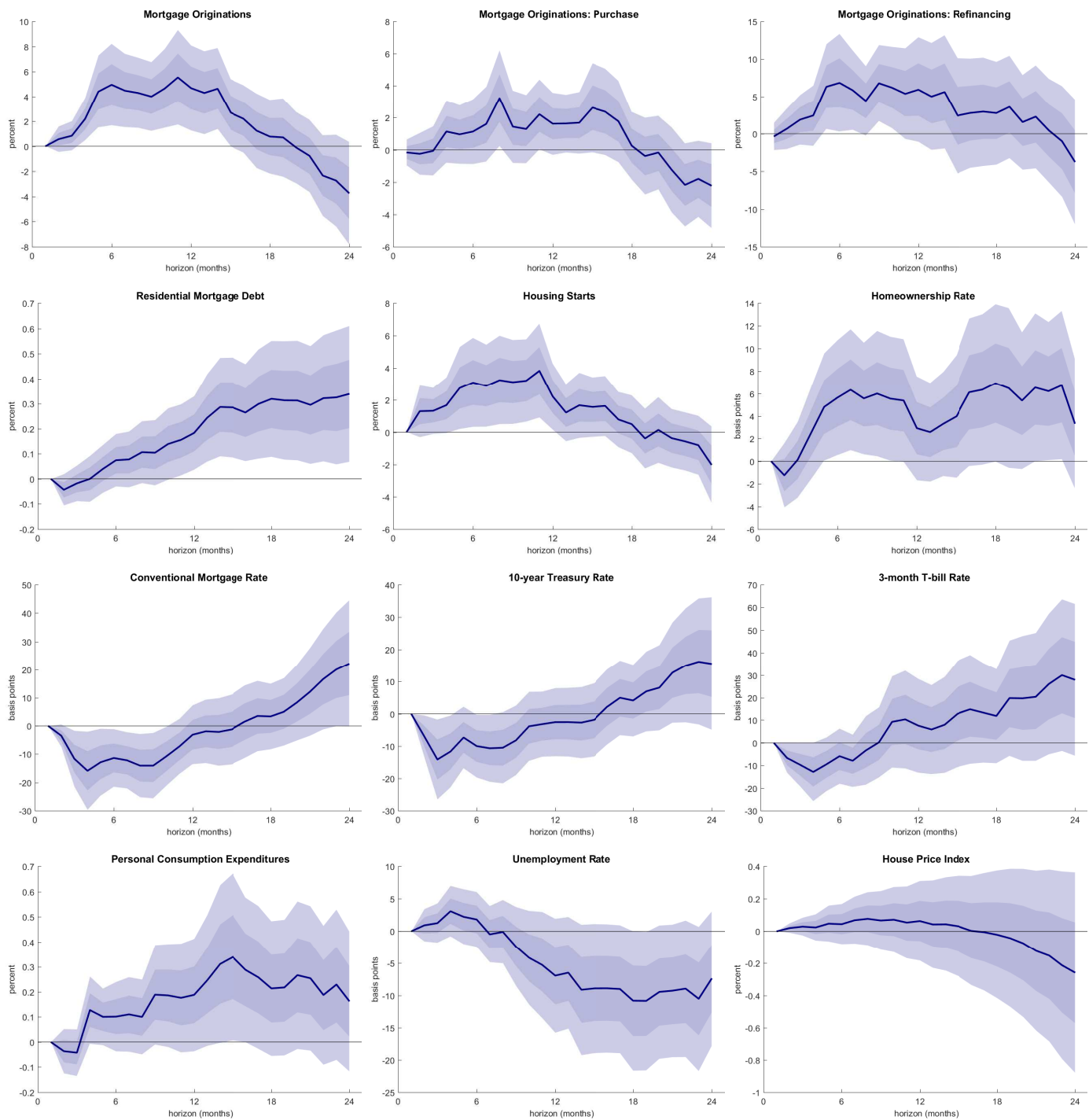


FIGURE XVI Shock to Anticipated Agency Purchases: Responses Using GSE Excess Returns Instrument

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the GSE excess stock returns innovations, see equation (2). Shaded areas are 68% and 95% Newey and West (1987) confidence bands. Sample: Sep 1970 to Dec 2006.

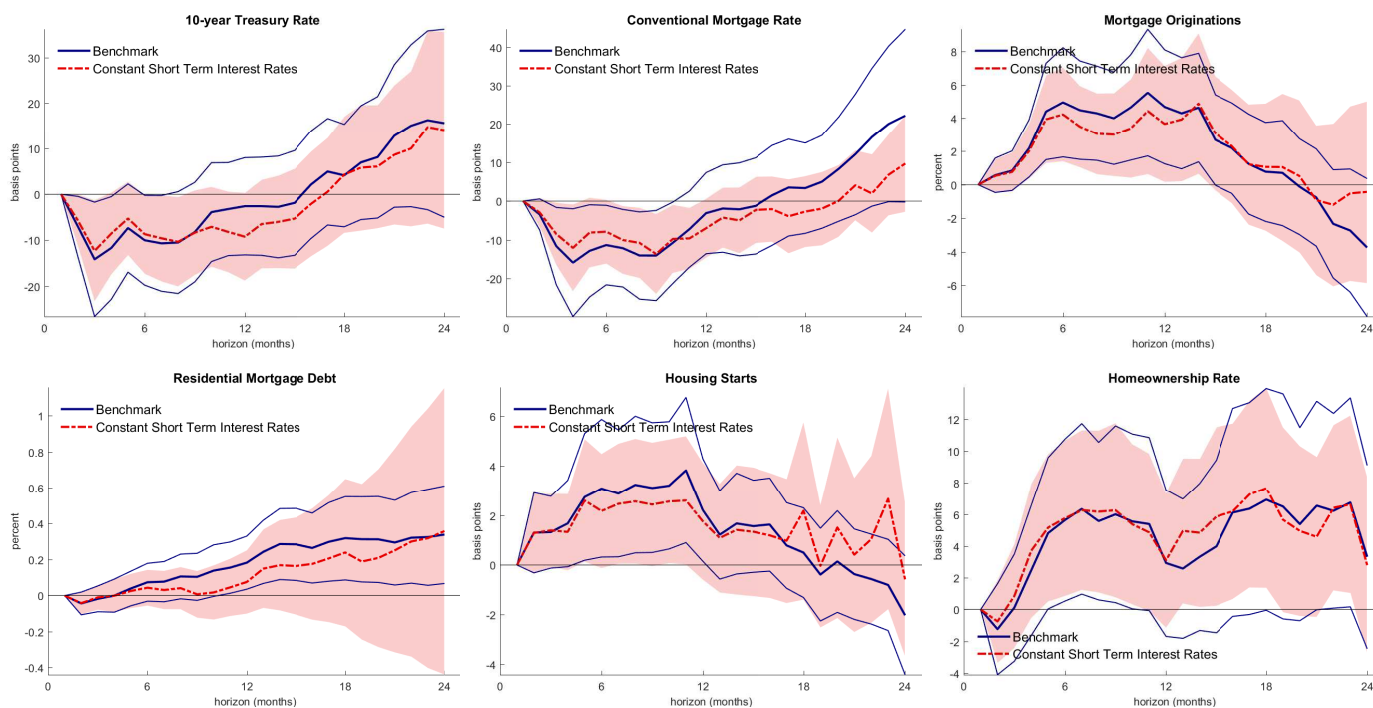


FIGURE XVII Counterfactual with Constant Short-Term Rate Using GSE Excess Returns Instrument

The figure shows responses to a one pp. increase in the expected future agency market share and a sequence of monetary shocks such that the 3-month T-bill rate remains constant. Estimates are from local projections-IV regressions instrumenting agency commitments with the GSE excess stock returns shocks and the 3-month T-bill rate with the [Romer and Romer \(2004\)](#) monetary policy shock measure. Finer lines and shaded areas are 95% [Newey and West \(1987\)](#) confidence bands. Sample: Sep 1970 to Dec 2006.

Appendix III: Data Sources and Construction

Data underlying Figure I: *Residential Mortgage Debt* post-1945 is the sum of home mortgages and multifamily residential mortgages from the Federal Reserve’s Financial Accounts of the United States. Pre-1945 data is spliced using Series N-151 (Nonfarm Residential Mortgage Debt) from the Historical Statistics of the United States (1960 edition). *Nominal GDP* post-1929 is from the National Income and Product Accounts, spliced using series Ca-10 from the Historical Statistics of the United States (Table Ca9-19, Millennial Edition). The data for *Housing Wealth* post-1930 is from [Davis and Heathcoate \(2007\)](#) available at and updated by the Lincoln Institute of Land Policy, <http://www.lincolninst.edu/research-data/data>. Pre-1930 data is spliced using Series N-129 (Total Nonfarm Residential Wealth) from the Historical Statistics of the United States (1960 edition).

Agency Mortgage Holdings is the sum of the retained mortgage portfolios of Fannie Mae, Freddie Mac, Ginnie Mae, the FHLBanks, the Treasury Department, the Federal Reserve, and a number of other government agencies. Both holdings of whole loans and mortgage pools are included.

Fannie Mae: Monthly data on Fannie’s retained mortgage portfolio from 1950 to 2003 is from various issues of the Federal Reserve Bulletin, which stopped reporting GSE portfolio statistics in 2003. From then onwards, the data is from Fannie’s monthly volume summary cross-checked with the annual reports from OFHEO/FHFA for consistency. Prior to 1950, the data is based on fiscal year data from a Fannie publication titled “*FNMA Background and History*” (1969 and 1973 editions), as well as Series N-159 from the Historical Statistics of the United States (1960 edition).

Freddie Mac: Monthly data on Freddie’s retained mortgage portfolio from 1970 to 2003 is from various issues of the Federal Reserve Bulletin, and after 2003 from Freddie’s monthly volume summary cross-checked with the annual reports from OFHEO/FHFA for consistency.

Ginnie Mae: Quarterly data on Ginnie’s home and multifamily mortgage from the Financial Accounts of the United States. Monthly data is available from 1968 to 1974 from various issues of the Federal Reserve Bulletin.

FHLBanks: Data on FHLB mortgage holdings is from various issues of FHFA annual reports (annual from 1992 to 2007 and quarterly since 2008). Pre-1992 annual data is from a 1993 CBO study titled “*The Federal Home Loan Banks in the Housing Finance System*” (p. 15).

Treasury: Data from the Treasury Department <https://www.treasury.gov/resource-center/data-chart-center/Pages/mbs-purchase-program.aspx>

Federal Reserve: Data from the Federal Reserve’s Financial Accounts of the United States.

Other Agencies: The home and multifamily holdings of the Veterans Administration, the Federal Housing Administration, the Federal Farmers Home Administration, the Resolution Trust Corporation, the Federal Deposit Insurance Corporation, and Public Housing Administration are all obtained from the Financial Accounts of the United States. Data from the Home Owners’ Loan Corporation (which in the Financial Accounts is included with Fannie Mae) is series N-158 from the Historical Statistics of the United States (1960 edition).

The upper left panel of Figure I shows annual data up to 1952 and quarterly data afterwards. Missing quarterly data on FHLB holdings is obtained by linear interpolation of annual data.

Residential mortgage originations shown in the lower left panel of Figure I is the quarterly aggregate of the monthly series described below.

Agency Net Portfolio Purchases and Pool Issues is the sum of net portfolios purchases of both whole loans as well as mortgage pools, and of issues of mortgage pools respectively, by Fannie Mae, Freddie Mac, Ginnie Mae, the FHLBanks, the Treasury Department, the Federal Reserve, and a number of other government agencies:

Fannie Mae: Monthly data on Fannie’s net portfolio purchases from 1953 to 1998 is from various issues of the Federal Reserve Bulletin (portfolio purchases less sales). More recent data is from Fannie’s monthly volume summary cross-checked with the annual reports from OFHEO/FHFA for consistency. While data on purchases is available over the entire sample, data on portfolio sales is missing for 1986 and 1988-1997. We impute the missing observations using data on Fannie’s commitments to purchase and sell, actual purchases, and the net change in the retained portfolio. The imputation is done by Kalman smoothing in a state space model estimated by maximum likelihood as in [Shumway and Stoffer \(1982\)](#) using monthly data from 1980 to 2014. The model used is a vector autoregressive process for the net portfolio purchase rate, retained mortgage portfolio growth, and the ratio of purchases and net commitments to the retained portfolio. Data on Fannie pool issues from 1993 is from [Lehnert, Passmore, and Sherlund \(2008\)](#), extended to 2014 using Fannie’s monthly volume summaries. Pre-1993 monthly data is obtained by subtracting Freddie and Ginnie pool issues from total net purchases by agency mortgage pools from monthly releases by the Department of Housing and Urban Development from the Survey of Mortgage Lending Activity (obtained through the National Archives and Records Administration).

Freddie Mac: Monthly data on Freddie’s net portfolio purchases from 1993 onwards is from [Lehnert, Passmore, and Sherlund \(2008\)](#) and Freddie’s monthly volume summaries. Data before 1984 is obtained by subtracting Freddie pool issues from total wholesale loan purchases available from the Federal Reserve Bulletin. Data between 1984 and 1993 is imputed using data on Freddie holdings and repayment rates in Fannie’s portfolio. The imputation is done by Kalman smoothing in a state space model estimated by maximum likelihood as in [Shumway and Stoffer \(1982\)](#) using monthly data from 1980 to 2014. The model used is a vector autoregressive process for Freddie’s net portfolio purchase rate, retained mortgage portfolio growth, and repayment rates in Fannie’s retained portfolio. Monthly data on Freddie pool issuance is from the journal of the Federal Home Loan Bank Board (various issues, 1971-1980), the Federal Reserve Bulletin (1980-1998), and the monthly volume summaries (1998 onwards).

Ginnie Mae: Monthly data on Ginnie’s net portfolio purchases from 1968 to 1971 is from various issues of the Federal Reserve Bulletin. Subsequent data is imputed by assuming that repayment rates for mortgages packaged in pools backed by Ginnie are the same as for mortgages held in portfolio. Monthly data on Ginnie pool issues since 1968 was provided to us directly by the Department of Housing and Urban Development.

FHLBanks: Data on net purchases by the FHLBanks is imputed using net changes in holdings and assuming that the combined repayment rate on mortgage debt in Fannie, Freddie and Ginnie pools is identical to the repayment rate on mortgages in mortgage-backed securities held by the FHLBanks.

Treasury: Data on MBS purchases is from the Treasury Department <https://www.treasury.gov/resource-center/data-chart-center/Pages/mbs-purchase-program.aspx>.

Federal Reserve: Data on MBS purchases using the date of settlement is available from the Board of Governors https://www.federalreserve.gov/newsevents/reform_mbs.htm and the Federal Reserve Bank of New York https://www.newyorkfed.org/markets/amb/amb_schedule.html.

Other Agencies: Data on combined net purchases by the other agencies is imputed using net changes in holdings and by assuming that the combined repayment rate on mortgages debt in Ginnie pools is identical to the repayment rate on mortgages in mortgage-backed securities held in portfolio.

The lower right panel of Figure I shows quarterly data from 1952 onwards.

Data underlying Figure II: *Agency mortgage holdings* is the quarterly series from Figure I. *Private mortgage holdings* is total residential mortgage debt from Figure I less agency holdings. Both series are deflated by the price index for personal consumption expenditures excluding food and energy from NIPA (series PCEPILFE from the FRED database at the Federal Reserve Bank of St. Louis). The chronology for pre-1986 credit crunches is from [Eckstein and Sinai \(1986\)](#). The dating of post-1986 crunches is based on [Owens and Schreft \(1993\)](#) for the 1990 commercial real estate crunch, [Lehnert, Passmore, and Sherlund \(2008\)](#) for the 1998 Russian default/LTCM crisis, and [Bordo and Haubrich \(2010\)](#) for the 2007 financial crisis.

Monthly agency data: The monthly series for *consolidated agency mortgage holdings* and *net portfolio purchases* sums the monthly series for Fannie, Freddie, Ginnie, the Federal Reserve, and the Treasury described above (see data underlying Figure I). All series are seasonally adjusted using the X-13 program from the Census Bureau.

Agency purchase commitments are the sum of the following series:

Fannie Mae: Monthly data on the stock of total outstanding unfulfilled commitments from 1953 to 1990 is available from various issues of the Federal Reserve Bulletin. To obtain net purchase commitments made during the month, we add net purchases to the net change in commitments outstanding. From 1990 onwards we use net commitments (issued less to sell) from the Federal Reserve Bulletin (up to 2003) and Fannie's monthly volume summaries (2003 onwards).

Freddie Mac: Monthly data on Freddie's net portfolio commitments (issued less to sell) is from Freddie's monthly volume summaries from 1998 onwards. For observations before 1998, we use Freddie net portfolio purchases.

Federal Reserve: Data on MBS purchases using the trade date is available from the Board of Governors https://www.federalreserve.gov/newsevents/reform_mbs.html and the Federal Reserve Bank of New York.

No data for net commitments is available for Ginnie Mae and the Treasury, and we simply use the series for net portfolio purchases.

Monthly mortgage market data: The *conventional mortgage rate* is the 30-year fixed-rate conventional conforming mortgage rate. From 1971 onwards, the conventional rate is the monthly average commitment rate from the Freddie Mac primary mortgage market survey. Pre-1971 data is from the Federal Housing Administration (FHA)/Department of Housing and Urban Development (HUD) series for the primary conventional market rate, available from the Federal Reserve Bulletin (various issues). The *FHA mortgage rate* is the 30-year fixed-rate FHA-guaranteed mortgage rate. Rate data for FHA-mortgages offered in the secondary market from 1963 is provided by FHA/HUD and is available from various issues of the Federal

Reserve Bulletin. Earlier data is from the NBER’s macrohistory database (series m13045). The series has a handful of missing observations and was discontinued in 2000. We impute data by Kalman smoothing in a VAR/state space model estimated by maximum likelihood as in [Shumway and Stoffer \(1982\)](#) using several closely related interest rate series over the 1976-2014 period: the conventional 30-year rate (FHA/HUD as well as the Freddie Mac series), the 3-month and 10-year Treasury rates, and yields on Ginnie Mae securities (from the Federal Reserve Bulletin as well as the MTGEGNSF Index from Bloomberg). A couple of missing observations prior to 1976 were imputed in a similar fashion using data on the 3-month and 10-year Treasury rates, on interest rate data provided by Saul B. Klamman’s 1961 NBER publication “The Postwar Residential Mortgage Market”, and on interest rate ceilings on FHA loans applicable at the time. The 10-year and 3-month Treasury rates are from the FRED database (GS10 and TB3MS).

The primary source of monthly data on *residential mortgage originations* are monthly news releases from the Survey of Mortgage Lending Activity (SMLA) conducted by HUD from 1970 to 1997, accessed through the National Archives and Records Administration (Tables 2 and 3: total originations of long-term mortgage loans for 1-to-4 nonfarm homes and multifamily residential properties). The monthly series is interpolated after 1997 using quarterly data on originations (series USMORTORA in Datastream) and weekly data on mortgage applications (series MBAVBASC on Bloomberg), both from the Mortgage Bankers’ Association (MBA). The interpolation is done through Kalman smoothing of an estimated VAR/state space model as in [Shumway and Stoffer \(1982\)](#). Observations before 1965 are based on data of total new non-farm mortgages of \$20,000 or less recorded from the Federal Home Loan Bank Board and available from the NBER’s macrohistory database (series m02173). To obtain an estimate of total originations, we assume that the share of originations of \$20,000 or less in all originations is the same as the share in originations by Savings & Loans associations. Data on S&L originations (total and \$20,000 or less) is available from various issues of the Savings and Home Financing Sourcebooks, a publication by the Federal Home Loan Bank Board up prior to 1990. Data between 1965 and 1970 is imputed using total originations by S&L associations based on Kalman smoothing in a VAR/state space model estimated as in [Shumway and Stoffer \(1982\)](#) using monthly data from 1954 to 1985. The series is seasonally adjusted using the X-13 program from the Census Bureau. Unfortunately, the monthly SMLA releases do not contain information on the purpose of the mortgage loans. However, the Savings and Home Financing Sourcebooks published prior to 1990 contain monthly data on refinancing originations by S&L banks (although observations from May 1985 to December 1986 are missing). After 1990, quarterly totals of refinancing originations are available from the MBA (series USMORRVLA in Datastream). As an estimate of the share of refinancing loans, we use the monthly shares at S&L banks before 1990, and the quarterly shares from the MBA afterwards. Our monthly series on *refinance* and *purchase originations* are obtained by applying the estimated share of refinancing to our series for total residential mortgage originations.

The monthly series for *mortgage debt* is based on interpolation of the quarterly mortgage debt series from the Financial Accounts of the United States (see Figure I) using the series on monthly originations. The series is constructed by linear interpolation of the implied quarterly repayment rates. The final series is seasonally adjusted using the X-13 program from the Census Bureau.

Other monthly variables The series on (seasonally adjusted) *housing starts* is from the Census Bureau and obtained through the FRED database at the Federal Reserve Bank of St. Louis (series HOUST). *House prices* post-1975 are measured by the Freddie Mac house price index (FMHPI) available at http://www.freddie.mac.com/finance/house_price_index.html. The data are extended before 1975 by splicing with the home purchase component of the BLS Consumer Price Index (PHCPI from FRED), obtained from [Shiller \(2015\)](#), and seasonally adjusted using the X-13 program from the Census Bureau. The series is deflated by the *nominal price level*, measured by the core PCE price index to obtain a real house price index

(series PCEPILFE from FRED). To the best of our knowledge, no monthly data on the *homeownership rate* is available. We therefore simply use quarterly values of series RHORUSQ156N from FRED. Monthly *personal consumption expenditures* is from NIPA (series PCE from FRED). Monthly *personal income* is from NIPA (series PI from FRED). The *unemployment rate* is series UNR from FRED. The *short- and long-term nominal interest rates* 3-month and 10-year Treasury rates are series TB3MS and GS10 from FRED. The *BAA and AAA corporate bond rates* are the Moody's seasoned BAA and AAA yields (series BAA and AAA from FRED).

Appendix IV: Additional Results and Robustness Checks

Cumulative Credit Multipliers

This section discusses a number of robustness checks of the results presented in Section V. regarding the cumulative effects of agency purchases.

1. *Scaling by Trend Originations.* The baseline specification in (2) uses a trend in personal income as the scaling variable. Figure XVIII reports the results when we instead use a long-run trend in annualized mortgage originations. The latter is obtained by fitting a third degree polynomial of time to the log of real mortgage originations obtained using the core PCE price index as the deflator. This is potentially consequential for the results because of trend growth of the mortgage market relative to the economy. However, the figure shows that the results remain generally similar to the baseline in Figure V. Cumulative originations do not increase in the short run, but are higher by 4 dollars after 3 to 4 years, while mortgage debt rises in the long run by almost one dollar. The bulk of the new originations are for refinance purposes, while originations for home purchases are higher by 1 to 1.5 dollars after 3 to 4 years.

2. *Agency Pool Issuance.* Figure XIX reports the cumulative dollar change in agency issuance of mortgage pools, i.e. MBS. In contrast to originations or total mortgage debt, the choice of scaling variable is important for the cumulative impact on agency MBS issuance. Scaling by trend income implicitly assigns a larger relative weight to policy changes that occur later in the sample. The left panel of Figure XIX shows that at relatively short horizons, agency MBS issuance rises by roughly the same dollar amount as the increase in agency mortgage holdings, see Figure V. The fact that private mortgage holdings also decrease by roughly the same amount implies that the agency portfolio purchases are predominantly of MBS, while there are no additional MBS sales to private investors. As the horizon increases, cumulative MBS issuance rises to close to 2 dollars after three to four years. The increase in MBS issuance coincides closely with the rise in originations. Cumulative MBS issuance converges to around 40% to 50% of the cumulative rise in originations, which is about the typical agency securitization share since the mid-1980s. The right panel of Figure XIX shows in contrast no short-run impact on MBS issuance when the scaling variable is a trend in originations, implying that the agency portfolio purchases are instead of whole loans. MBS issuance gradually rises, but the total cumulative increase is a smaller share of the total increase in originations. This pattern is more similar to agency behavior before the growth of mortgage securitization in the mid-1980s.

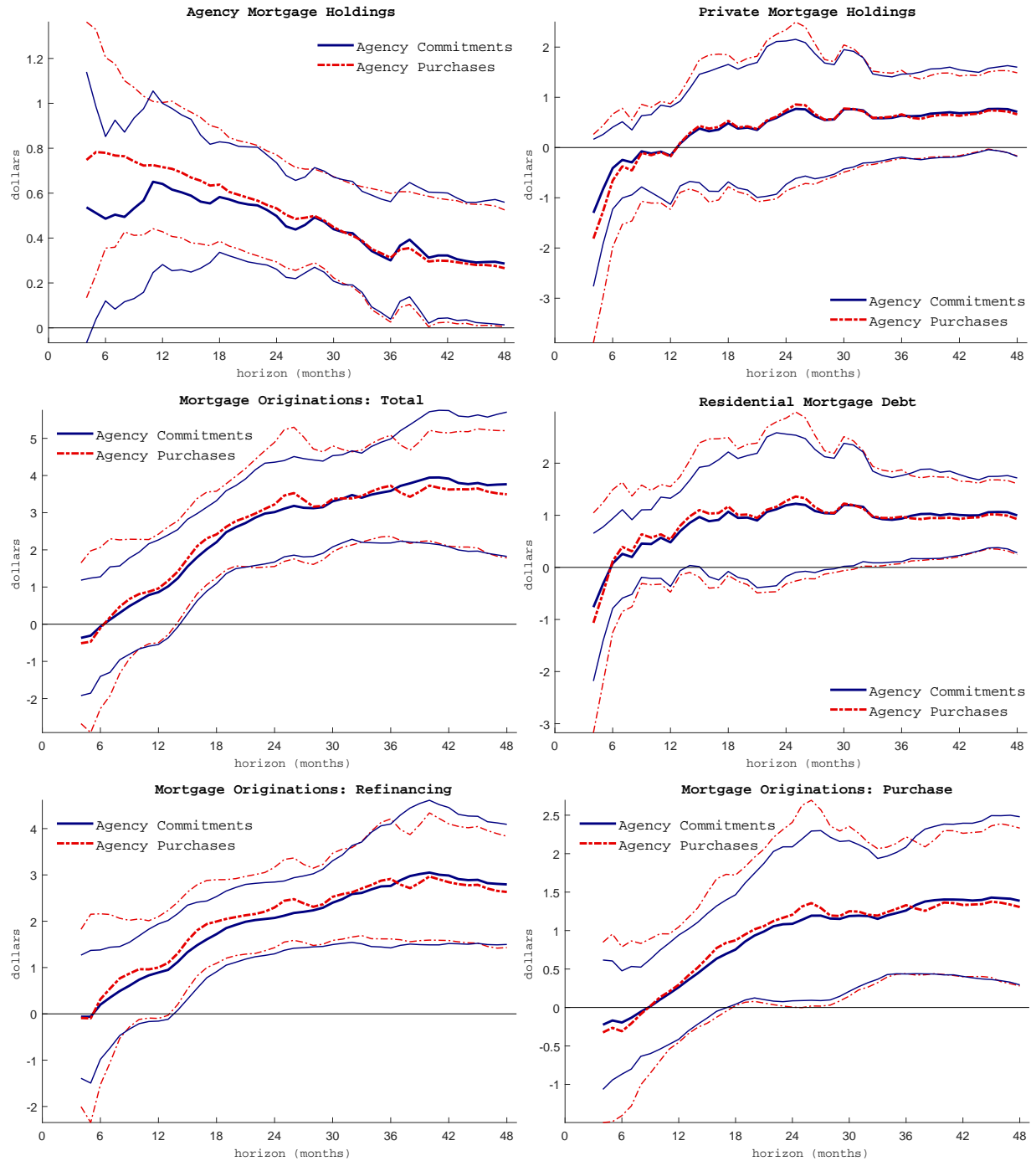


FIGURE XVIII Cumulative Estimates Using Trend Originations as the Scaling Variable

The figure shows dollar changes per dollar increase in agency net portfolio purchases or commitments to purchase cumulated over the reported horizon in months. Estimates are from local projections-IV regressions, see equation (2). Finer lines are 95% Newey and West (1987) confidence bands. Sample: Jan 1967 to Dec 2006. In the bottom row panels, the sample excludes May 1985 to Dec 1986 because of missing data on refinance shares.

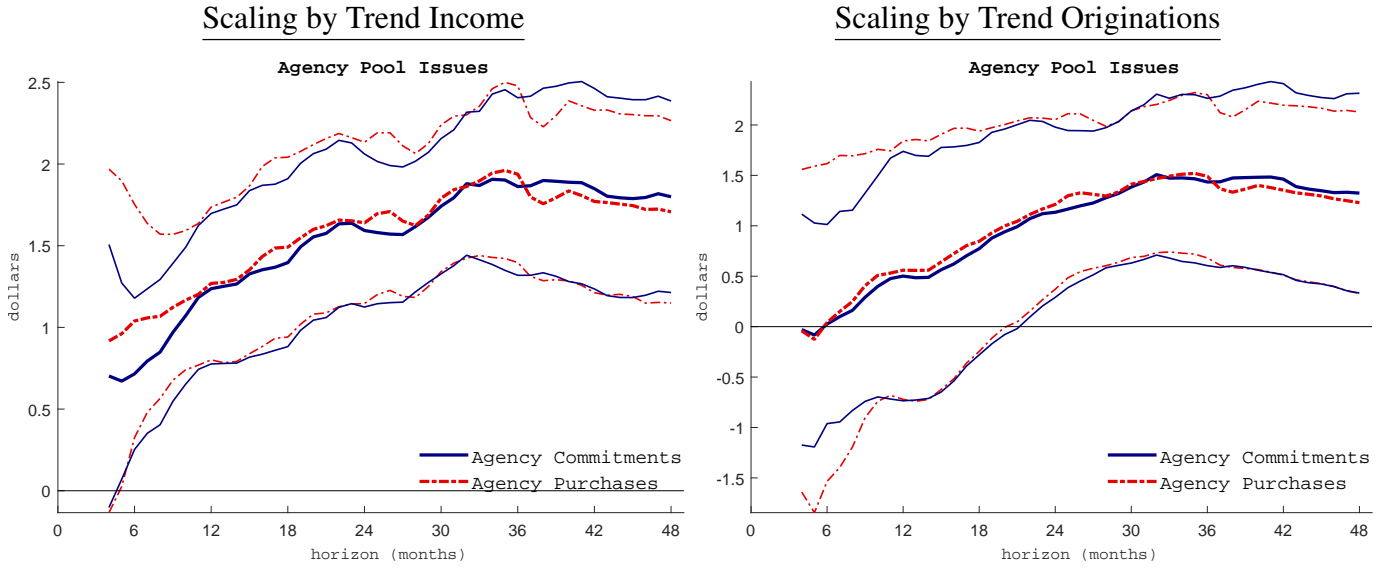


FIGURE XIX Total Mortgage Pool Issuance Associated with Agency Mortgage Purchases

The figure shows dollar changes per dollar increase in agency net portfolio purchases or commitments to purchase cumulated over the reported horizon in months. Estimates are from local projections-IV regressions, see equation (2), using non-cyclical policy events as the instrument. Finer lines are 95% Newey and West (1987) confidence bands. Sample: Jan 1967 to Dec 2006.

3. *Other Robustness Checks.* Table III clarifies how the results depend on instrumentation and the choice of controls. Estimates from the benchmark specifications of Section V, using net commitments and purchases are reported in columns [6] and [7], respectively. Given the similarity of the results, the other columns all report multipliers associated with commitments only. To assess the role of instrumentation, column [5] reports the OLS estimates for the benchmark specification. Columns [3] to [4] display the OLS and IV estimates when the cyclical indicators (unemployment and income growth) are omitted. Columns [1] and [2] further omit the interest rate controls. Finally, column [8] shows the IV estimates when we use all policy events, both cyclical and non-cyclical, to construct the instrument. To better visualize the role of instrumentation by the narrative instrument, Figure XX displays the cumulative effects on agency holdings and mortgage originations estimated by OLS and 2SLS for all horizons.

We highlight the following patterns from the results in Table III. First, the point estimates across the IV regressions are all quite similar. Controlling for interest rates is the most consequential. When leaving out interest rates in [2], we find somewhat smaller increases in mortgage originations and debt. The results are essentially unchanged by including the cyclical controls (unemployment and income growth). Interestingly, and conditional on including the richest control set as in our benchmark specification, the results remain similar when we also include the cyclically motivated policy events in the instrument, see column [8]. This suggests that any bias arising because the cyclical policy events are correlated with other economic shocks is probably relatively small compared to the other sources of endogeneity bias discussed in Section IV.A.. Another factor that may mitigate the impact of the cyclical policy events are the lagged controls. Based on our reading of the various historical policy actions, see Fieldhouse and Mertens (2017), recognition and decision lags likely exceed one month in practice. With a sufficiently rich set of lagged controls, including the cyclical actions may therefore not lead to any meaningful violation of the requirement that the policy events are contemporaneously uncorrelated with economic shocks.

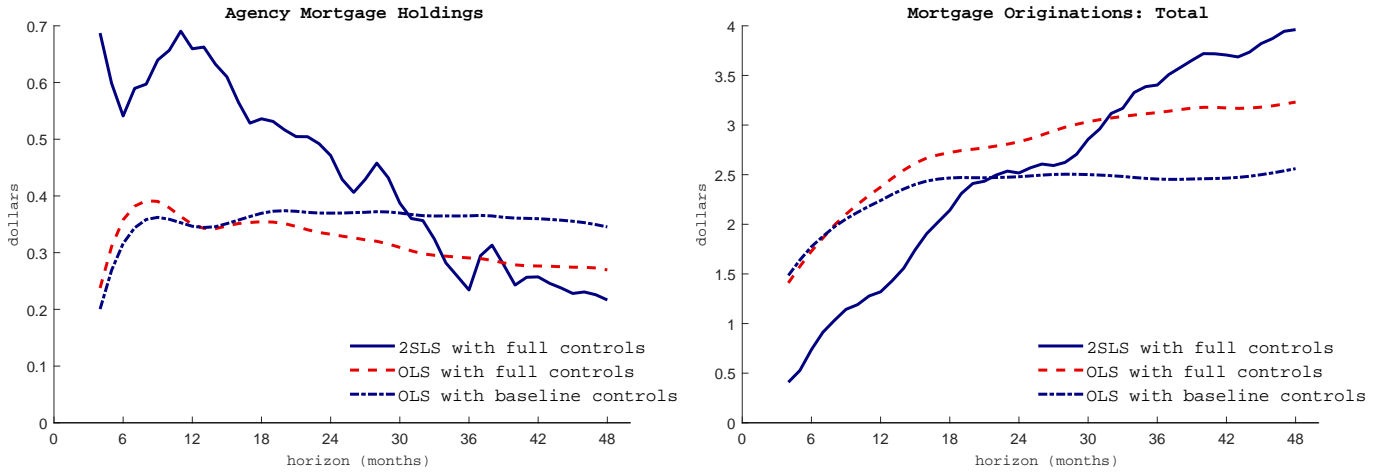
Instrumentation with policy events, however, is important for the results. The OLS estimates in columns [1], [3], and [5] differ substantially in size and display very different time patterns from the IV counterparts in columns [2], [4], and [6]: Agency holdings rise immediately and more or less independently of the

horizon, private holdings do not fall significantly over shorter horizons, and originations are higher by an amount that is much less dependent on the horizon. The OLS estimates are likely contaminated by reverse causality, as this pattern is more consistent with private lenders simply passing on newly originated loans to the agencies rather than selling existing loans off their balance sheets. Figure XX further illustrates this by depicting the full set of OLS and 2SLS estimates for agency holdings and mortgage originations. Regardless of whether the baseline or full set of controls are included, the bulk of the increase in mortgage originations per dollar change in commitments occurs within the first 12 months (panel A), and within even a much shorter window when the regressor is agency purchases (panel B). Such a pattern indicates a much stronger contemporaneous relation between originations and agency purchases. Given decision lags as well as the time delays associated with the making of new mortgage loans, the delayed and gradual rise in originations that appears after instrumentation is more consistent with a causal interpretation. Figure XX also reveals that the total agency mortgage holdings increase by a substantially smaller amount than the dollar purchased or committed, even at relative short horizons. This indicates that agency purchases tend to coincide with higher sales of mortgage assets to private investors and/or with higher repayment rates, both of which are likely to reflect other influences on the private demand for mortgage credit in the primary or secondary market.

Table IV verifies the robustness of the results to variations in the sample and to the inclusion of additional indicators of agency activity. For comparison, column [1] repeats the benchmark estimates based on net commitments. For brevity, all other columns are based on using commitments as the measure of agency purchasing activity. Column [2] extends the end point of the sample from December 2006 to December 2014. Note that in this case the h -th regression in (2) drops the last h observations. Column [3] restricts the sample by setting September 1982 as the starting point, marking the end of the period of non-borrowed reserves targeting by the Federal Reserve. This shorter sample selects a period of more stable monetary policy. Because of the smaller sample, we omit in this case the cyclical controls to reduce the number parameters to be estimated. Columns [4], [5], and [6] show results when we omit in turn each of the three largest policy interventions from the non-cyclical narrative instrument: the October 1977 conforming loan limit increase and expansion of the Brooke-Cranston Tandem program, the December 1982 increase in Fannie Mae's debt-to-capital limit, and the September 2004 tightening of capital requirements. In each case we add the omitted event as a separate dummy variable, including both the contemporaneous value and twelve lags to the control variables. The final two columns include lagged values of two indicators of agency activity as additional controls: the volume of mortgage pool issues (in ratio of X_t) and log ratio of GSE stock prices to the S&P 500 index. In the latter case, the sample starts in September 1971 instead of December 1967, reflecting the fact that Fannie Mae stock started trading on August 31, 1970.

All variations of the baseline specification reported in Table IV yield cumulative origination multipliers in the range of 2.5 to 4.5 after 3 to 4 years. Moreover, the impact on originations is consistently highly statistically significant. The estimated cumulative change in mortgage debt also remains in the range of the benchmark specification. The credit multipliers are the lowest when we extend the sample to include the recent financial crisis (column [2]) and when we add the GSE to S&P 500 stock price ratio to the control set (column [8]). In these cases, the impact on mortgage debt is no longer significant at conventional levels. We also highlight that the inclusion of the September 2004 policy event is important for the precision of the estimates. The instrument that omits the 2004 event is generally weaker and produces wider confidence bands. On the other hand, omitting the 1977 and 1982 events (columns [5] and [6]) does not have a large influence on the results.

A. Per Dollar in Agency Commitments



B. Per Dollar in Agency Purchases

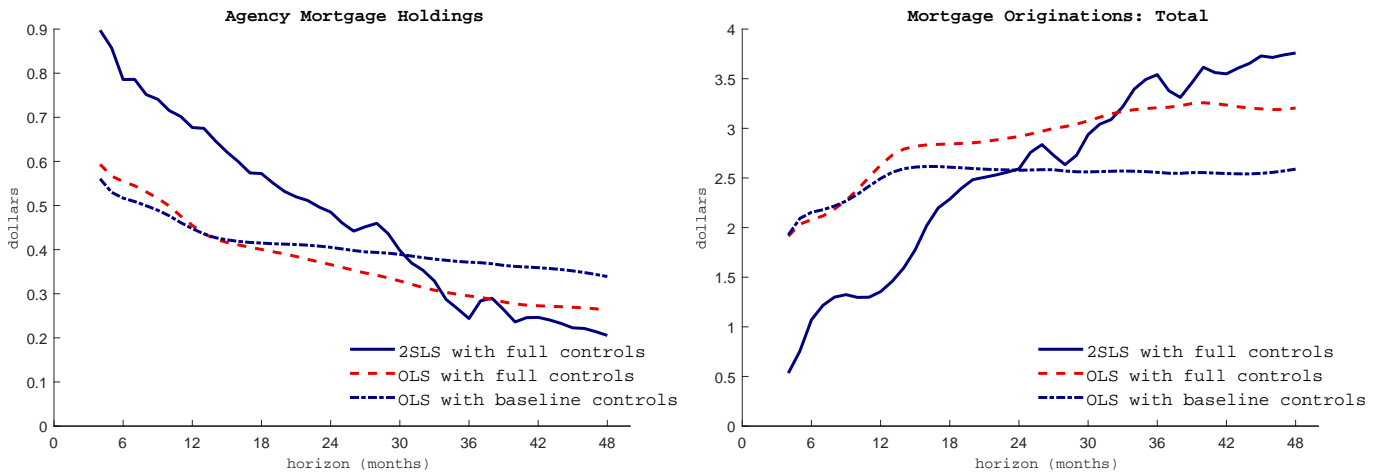


FIGURE XX Comparing OLS and 2SLS Estimates of Mortgage Credit Multipliers

The figure shows dollar changes per dollar increase in agency net portfolio purchases or commitments to purchase cumulated over the reported horizon in months. The specification with baseline controls excludes the interest rate and cyclical controls.

TABLE III OLS AND IV ESTIMATES OF BALANCE SHEET ADJUSTMENTS AND MORTGAGE CREDIT MULTIPLIERS

	Months	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Agency Holdings	12	0.35*** (0.19, 0.50)	0.61*** (0.35, 0.88)	0.33*** (0.18, 0.48)	0.68*** (0.43, 0.93)	0.35*** (0.21, 0.49)	0.66*** (0.40, 0.92)	0.68*** (0.44, 0.91)	0.56*** (0.25, 0.87)
	18	0.37*** (0.25, 0.49)	0.55*** (0.33, 0.78)	0.33*** (0.22, 0.44)	0.58*** (0.35, 0.81)	0.35*** (0.26, 0.45)	0.54*** (0.30, 0.77)	0.57*** (0.34, 0.80)	0.42*** (0.15, 0.70)
	24	0.37*** (0.26, 0.48)	0.50*** (0.29, 0.71)	0.31*** (0.20, 0.42)	0.51*** (0.29, 0.73)	0.33*** (0.23, 0.43)	0.47*** (0.26, 0.69)	0.49*** (0.27, 0.70)	0.37*** (0.12, 0.63)
	36	0.36*** (0.27, 0.46)	0.26** (0.01, 0.51)	0.28*** (0.18, 0.38)	0.26** (0.01, 0.50)	0.29*** (0.20, 0.38)	0.23* (-0.00, 0.47)	0.24* (-0.01, 0.50)	0.15 (-0.15, 0.44)
	48	0.35*** (0.25, 0.44)	0.25** (0.00, 0.49)	0.26*** (0.16, 0.36)	0.23* (-0.03, 0.49)	0.27*** (0.18, 0.36)	0.22* (-0.04, 0.47)	0.21* (-0.03, 0.45)	0.19 (-0.08, 0.46)
Private Holdings	12	-0.16 (-0.47, 0.15)	-0.76** (-1.36, -0.15)	-0.12 (-0.40, 0.15)	-0.81** (-1.43, -0.19)	-0.11 (-0.38, 0.17)	-0.75** (-1.40, -0.11)	-0.77** (-1.39, -0.15)	-0.68* (-1.49, 0.13)
	18	-0.17 (-0.41, 0.06)	-0.43 (-1.01, 0.15)	-0.07 (-0.29, 0.14)	-0.31 (-0.94, 0.31)	-0.07 (-0.28, 0.14)	-0.23 (-0.81, 0.34)	-0.25 (-0.86, 0.36)	0.01 (-0.70, 0.73)
	24	-0.12 (-0.35, 0.10)	-0.26 (-0.85, 0.34)	0.06 (-0.15, 0.26)	-0.11 (-0.73, 0.50)	0.06 (-0.14, 0.25)	-0.07 (-0.63, 0.48)	-0.07 (-0.64, 0.49)	0.20 (-0.52, 0.93)
	36	-0.03 (-0.29, 0.22)	0.14 (-0.73, 1.01)	0.27*** (0.09, 0.45)	0.34 (-0.32, 0.99)	0.30*** (0.11, 0.49)	0.30 (-0.27, 0.88)	0.31 (-0.28, 0.91)	0.55 (-0.17, 1.27)
	48	0.19 (-0.12, 0.51)	0.67 (-0.63, 1.97)	0.55*** (0.32, 0.78)	0.90* (-0.14, 1.94)	0.57*** (0.33, 0.81)	0.82* (-0.13, 1.76)	0.78* (-0.13, 1.68)	0.84 (-0.18, 1.87)
Mortgage Debt	12	0.18** (0.02, 0.35)	-0.14 (-0.54, 0.26)	0.21*** (0.06, 0.36)	-0.14 (-0.56, 0.29)	0.24*** (0.09, 0.40)	-0.09 (-0.53, 0.34)	-0.10 (-0.54, 0.34)	-0.12 (-0.70, 0.46)
	18	0.20*** (0.06, 0.34)	0.12 (-0.31, 0.56)	0.26*** (0.12, 0.40)	0.27 (-0.21, 0.74)	0.29*** (0.14, 0.43)	0.30 (-0.11, 0.72)	0.32 (-0.13, 0.77)	0.44 (-0.10, 0.97)
	24	0.25*** (0.10, 0.39)	0.24 (-0.23, 0.71)	0.37*** (0.23, 0.50)	0.40* (-0.08, 0.88)	0.39*** (0.25, 0.53)	0.40* (-0.01, 0.81)	0.41* (-0.02, 0.84)	0.58** (0.02, 1.13)
	36	0.33*** (0.15, 0.51)	0.40 (-0.27, 1.08)	0.55*** (0.43, 0.68)	0.59** (0.12, 1.07)	0.59*** (0.46, 0.73)	0.54** (0.13, 0.95)	0.56*** (0.14, 0.98)	0.70*** (0.18, 1.21)
	48	0.54*** (0.30, 0.78)	0.92* (-0.16, 1.99)	0.81*** (0.65, 0.98)	1.13*** (0.31, 1.95)	0.84*** (0.67, 1.01)	1.03*** (0.31, 1.76)	0.98*** (0.29, 1.68)	1.03** (0.24, 1.83)
Originations	12	2.24*** (1.69, 2.79)	1.33*** (0.42, 2.24)	2.43*** (1.99, 2.86)	1.22*** (0.37, 2.07)	2.37*** (1.94, 2.80)	1.32*** (0.44, 2.20)	1.35*** (0.40, 2.31)	1.45*** (0.41, 2.50)
	18	2.47*** (1.99, 2.94)	1.87*** (0.99, 2.74)	2.80*** (2.47, 3.14)	2.00*** (1.14, 2.85)	2.72*** (2.38, 3.06)	2.14*** (1.32, 2.96)	2.29*** (1.37, 3.20)	2.50*** (1.55, 3.45)
	24	2.48*** (2.06, 2.90)	2.03*** (1.17, 2.89)	2.93*** (2.58, 3.27)	2.37*** (1.49, 3.26)	2.83*** (2.49, 3.18)	2.52*** (1.68, 3.35)	2.59*** (1.67, 3.51)	2.94*** (1.92, 3.97)
	36	2.46*** (1.98, 2.94)	2.83*** (1.39, 4.28)	3.14*** (2.68, 3.61)	3.38*** (2.00, 4.77)	3.13*** (2.63, 3.62)	3.40*** (2.10, 4.71)	3.54*** (2.25, 4.83)	3.62*** (2.15, 5.10)
	48	2.56*** (2.05, 3.07)	3.38*** (1.34, 5.41)	3.25*** (2.65, 3.84)	4.02*** (2.13, 5.90)	3.23*** (2.64, 3.83)	3.96*** (2.20, 5.72)	3.76*** (2.09, 5.43)	3.92*** (2.02, 5.82)
Dollar increase in:		Comm.	Comm.	Comm.	Comm.	Comm.	Comm.	Purch.	Comm.
Method:		OLS	2SLS-NC	OLS	2SLS-NC	OLS	2SLS-NC	2SLS-NC	2SLS-ALL
Interest rate controls:		No	No	Yes	Yes	Yes	Yes	Yes	Yes
Cyclical controls:		No	No	No	No	Yes	Yes	Yes	Yes

Notes: Numbers are dollar amounts. Estimates are from local projections-IV regressions, see equation (2). OLS: no instrument used; 2SLS-NC, instrument based on non-cyclical policy events; 2SLS-ALL: instrument based on all policy events. 95% Newey and West (1987) confidence bands in parentheses. Asterisks denote 10%, 5%, or 1% significance. Sample: Jan 1967 to Dec 2006.

TABLE IV CREDIT MULTIPLIERS, SAMPLE AND ROBUSTNESS CHECKS

	Months	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Agency Holdings	12	0.66*** (0.40, 0.92)	0.76*** (0.31, 1.22)	0.42*** (0.23, 0.61)	0.88 (-0.35, 2.11)	0.64*** (0.38, 0.90)	0.67*** (0.38, 0.96)	0.72*** (0.40, 1.04)	0.63*** (0.32, 0.94)
	18	0.54*** (0.30, 0.77)	0.62*** (0.27, 0.96)	0.31*** (0.16, 0.45)	0.78 (-0.18, 1.75)	0.52*** (0.29, 0.75)	0.53*** (0.27, 0.78)	0.60*** (0.29, 0.90)	0.48*** (0.12, 0.85)
	24	0.47*** (0.26, 0.69)	0.55*** (0.28, 0.82)	0.26*** (0.12, 0.41)	0.59 (-0.16, 1.35)	0.45*** (0.23, 0.67)	0.47*** (0.24, 0.69)	0.53*** (0.25, 0.82)	0.43*** (0.04, 0.81)
	36	0.23* (-0.00, 0.47)	0.32*** (0.11, 0.53)	0.08 (-0.10, 0.25)	0.32 (-0.19, 0.83)	0.21 (-0.04, 0.45)	0.16 (-0.11, 0.43)	0.21 (-0.09, 0.52)	0.27 (-0.13, 0.66)
	48	0.22* (-0.04, 0.47)	0.19 (-0.10, 0.47)	0.09 (-0.12, 0.30)	0.17 (-0.82, 1.16)	0.20 (-0.07, 0.46)	0.15 (-0.15, 0.44)	0.20 (-0.14, 0.54)	0.30 (-0.08, 0.68)
Private Holdings	12	-0.75** (-1.40, -0.11)	-1.23** (-2.20, -0.27)	-0.44* (-0.93, 0.04)	-0.83 (-3.34, 1.68)	-0.72** (-1.36, -0.07)	-0.83** (-1.58, -0.08)	-0.94** (-1.70, -0.18)	-0.95*** (-1.67, -0.23)
	18	-0.23 (-0.81, 0.34)	-0.68* (-1.40, 0.04)	0.01 (-0.28, 0.31)	0.31 (-2.22, 2.83)	-0.21 (-0.81, 0.39)	-0.32 (-0.94, 0.29)	-0.31 (-1.03, 0.41)	-0.30 (-1.28, 0.67)
	24	-0.07 (-0.63, 0.48)	-0.53* (-1.15, 0.09)	0.19 (-0.10, 0.47)	0.65 (-1.76, 3.07)	-0.04 (-0.62, 0.54)	-0.17 (-0.73, 0.38)	-0.11 (-0.82, 0.60)	-0.25 (-1.30, 0.80)
	36	0.30 (-0.27, 0.88)	-0.24 (-0.94, 0.47)	0.56*** (0.25, 0.86)	0.73 (-0.47, 1.93)	0.36 (-0.24, 0.97)	0.42 (-0.27, 1.11)	0.33 (-0.40, 1.05)	-0.24 (-1.05, 0.57)
	48	0.82* (-0.13, 1.76)	0.41 (-0.79, 1.61)	1.12*** (0.45, 1.79)	1.62 (-2.92, 6.17)	0.87* (-0.12, 1.87)	1.09* (-0.07, 2.26)	0.89 (-0.45, 2.23)	0.15 (-0.87, 1.18)
Mortgage Debt	12	-0.09 (-0.53, 0.34)	-0.47 (-1.10, 0.16)	-0.02 (-0.37, 0.32)	0.05 (-1.64, 1.74)	-0.07 (-0.51, 0.36)	-0.16 (-0.66, 0.35)	-0.22 (-0.73, 0.28)	-0.32 (-0.81, 0.17)
	18	0.30 (-0.11, 0.72)	-0.06 (-0.57, 0.44)	0.32*** (0.08, 0.56)	1.09 (-1.30, 3.48)	0.31 (-0.13, 0.75)	0.20 (-0.21, 0.62)	0.29 (-0.23, 0.81)	0.18 (-0.55, 0.91)
	24	0.40* (-0.01, 0.81)	0.02 (-0.46, 0.49)	0.45*** (0.23, 0.68)	1.25 (-1.01, 3.50)	0.41* (-0.02, 0.84)	0.29 (-0.09, 0.67)	0.42 (-0.12, 0.96)	0.18 (-0.59, 0.94)
	36	0.54** (0.13, 0.95)	0.08 (-0.54, 0.70)	0.63*** (0.42, 0.85)	1.05** (0.06, 2.03)	0.57*** (0.14, 1.00)	0.58** (0.09, 1.06)	0.54** (0.01, 1.07)	0.03 (-0.57, 0.63)
	48	1.03*** (0.31, 1.76)	0.60 (-0.45, 1.65)	1.21*** (0.69, 1.73)	1.79 (-1.87, 5.46)	1.07*** (0.31, 1.84)	1.24*** (0.33, 2.15)	1.09** (0.03, 2.14)	0.45 (-0.30, 1.20)
Originations	12	1.32*** (0.44, 2.20)	0.41 (-1.47, 2.28)	2.09*** (1.39, 2.78)	-0.23 (-5.14, 4.69)	1.39*** (0.51, 2.26)	1.32*** (0.40, 2.23)	1.14* (-0.01, 2.28)	1.47*** (0.48, 2.46)
	18	2.14*** (1.32, 2.96)	1.40* (-0.02, 2.83)	2.93*** (2.39, 3.47)	1.56 (-1.86, 4.98)	2.20*** (1.38, 3.03)	2.00*** (1.13, 2.88)	2.04*** (0.88, 3.20)	2.38*** (1.19, 3.57)
	24	2.52*** (1.68, 3.35)	1.74*** (0.61, 2.88)	3.22*** (2.66, 3.77)	2.79* (-0.21, 5.79)	2.59*** (1.73, 3.45)	2.35*** (1.48, 3.22)	2.55*** (1.40, 3.70)	2.63*** (1.05, 4.20)
	36	3.40*** (2.10, 4.71)	2.51*** (1.27, 3.75)	3.79*** (2.97, 4.61)	4.43*** (1.29, 7.57)	3.53*** (2.17, 4.89)	3.56*** (2.00, 5.12)	3.70*** (1.97, 5.44)	2.69*** (0.92, 4.46)
	48	3.96*** (2.20, 5.72)	3.39*** (1.47, 5.30)	4.30*** (2.98, 5.63)	5.59 (-2.41, 13.60)	4.07*** (2.22, 5.93)	4.29*** (2.13, 6.45)	4.35*** (1.81, 6.90)	3.06*** (1.23, 4.89)
Sample:		67M1-06M12	67M1-14M12	82M10-06M12	67M1-06M12	67M1-06M12	67M1-06M12	67M1-06M12	71M09-06M12
Modification:		Benchmark	Full Sample	Post-1982 Sample	Omitting Sept 2004	Omitting Dec 1982	Omitting Oct 1977	Controls incl. Pool Issues	Controls incl. GSE stock price

Notes: Numbers are dollar amounts. Estimates are from local projections-IV regressions, see equation (2), using non-cyclical policy events as the instrument. 95% Newey and West (1987) confidence bands in parentheses. Asterisks denote 10%, 5%, or 1% significance.

Impulse Responses of Mortgage Originations by Type

This section discusses additional results regarding the effects of news shocks to agency purchases on mortgage originations by type. The available data allows us to distinguish between refinancing and purchase originations (see data appendix). The average share of refinancing originations in the 1967-2006 sample is 25% (and 28% in the 1967-2014 sample). The refinancing share is volatile and ranges from values of 10%

during the high nominal interest rates of the late 1970s and early 1980s, to up to 75% during refinancing booms.

Figure XXI shows point estimates for the first 24 months after an increase in anticipated purchases by one percentage point of trend originations, together with 95% Newey and West (1987) confidence bands. For reference, the left panel repeats the responses of total mortgage originations shown in Figure VII. The middle panel shows the estimated response of refinancing originations, while the right panel shows the estimated response of originations financing the purchase of a home. We note that for the estimates in these two panels, the sample excludes May 1985 to December 1986 because of missing data on refinance shares, see data appendix.

The results in Figure XXI are consistent with those for the dollar credit multipliers reported in Section V.. Refinancing originations show a gradual increase following the agency purchase shock. Purchase originations also rise, but with a longer delay relative to refinance originations. Purchase originations are initially lower for the first six months or so, before rising between 12 and 24 months. Using the average share of refinancing originations of 25% over the benchmark sample, the estimates in Figure XXI imply that refinancing originations account for the larger share of the increase in total originations.

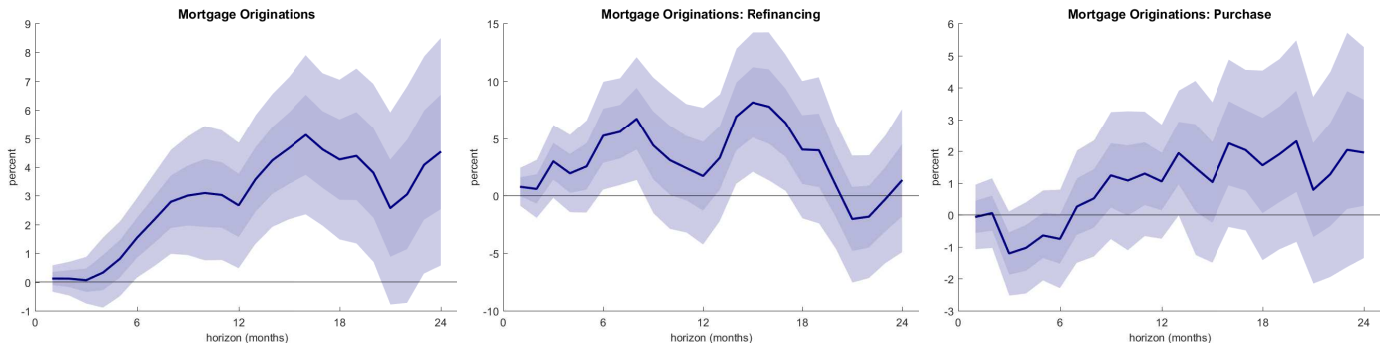


FIGURE XXI Impulse Responses to a Shock to Anticipated Agency Purchases

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the narrative policy indicator, see equation (3). Shaded areas are 68% and 95% Newey and West (1987) confidence bands. Sample: Jan 1967 to Dec 2006. In the middle and right panels, the sample excludes May 1985 to Dec 1986 because of missing data on refinance shares, see data appendix.

Figure XXII compares the response of originations to a traditional monetary policy shock (in red) with the response to the agency purchase shock identified using the narrative instrument (in blue). Responses to monetary shocks are identified using the Romer and Romer (2004) monetary policy shock measure as an instrument, as explained in Section VII.. As in Figure XII, the impact of the interest rate shock is scaled such that the maximum decline in the 3-month T-bill rate is identical as for the agency purchase shock identified with the narrative instrument. The left panel repeats the responses of total mortgage originations shown in Figure XII and shows that the agency purchase shock generates a larger increase in total originations. The middle panel shows the responses of refinancing originations, while the right panel shows the estimated responses of originations financing the purchase of a home. The results in Figure XXII indicate that the differential impact on total originations is due to the different impact on refinancing activity. The response of purchase originations (right panel) is very similar in timing and size across both shocks. The response of refinancing originations to monetary policy shock, on the other hand, is much more muted than the response to the agency purchase shocks.

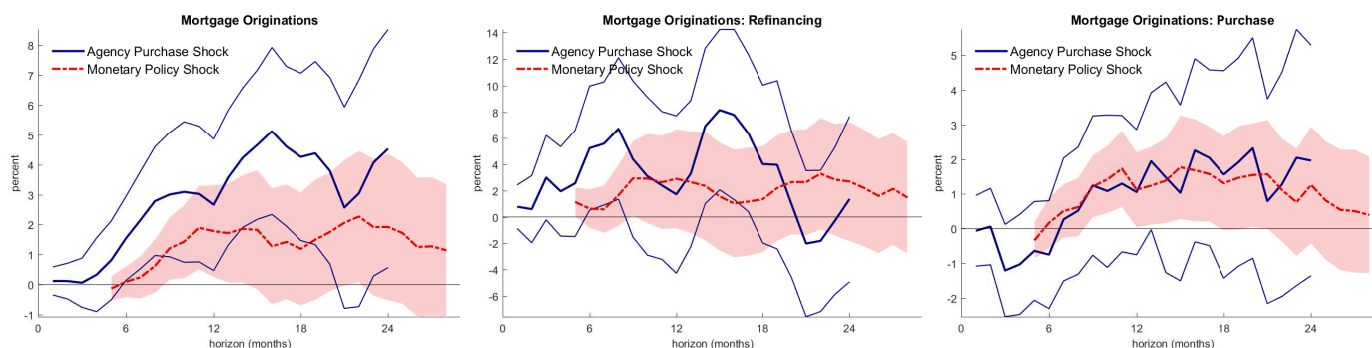


FIGURE XXII Responses to a Shock to Anticipated Agency Purchases Versus a Monetary Policy Shock

The figure shows responses to a one pp. increase in the expected future agency market share as well as the response to a monetary policy shock. Estimates are from local projections-IV regressions instrumenting agency commitments with the narrative policy indicator, see equation (3), and instrumenting the 3 month T-Bill rate with the [Romer and Romer \(2004\)](#) monetary policy shock measure. Finer lines and shaded areas are 95% [Newey and West \(1987\)](#) confidence bands. Sample: Jan 1967 to Dec 2006. In the middle and right panels, the sample excludes May 1985 to Dec 1986 because of missing data on refinance shares, see data appendix.

Impulse Response Analysis: Sensitivity Checks

1. *Omitting the 1977-1982 and NBR-targeting Periods.* Figure [XXIII](#) shows the response to a shock to anticipated agency purchases by one percentage point of trend originations, together with 95% [Newey and West \(1987\)](#) confidence bands. Each figure shows results based on the narrative instrument for two different subsamples. The first subsample omits the period of non-borrowed reserves targeting under the Volcker chairmanship of the Federal Reserve from October 1979 to August 1982. The second subsample omits the 6 years between 1977 and 1982, which are more broadly characterized by relatively high interest rate volatility. Each of the excluded periods contain several sizable credit policy changes as well as a greater incidence of large monetary policy shocks in the [Romer and Romer \(2004\)](#) measure. Their exclusion allow us to verify the role of these parts of the sample for our results regarding the interactions between the two types of policies. The results in Figure [XXIII](#) are qualitatively very similar to those of the full sample, and in both cases include both a significant rise in originations as well as declines in short- and long-term interest rates. Compared to the full sample, the rise in the stock of mortgage debt is, however, no longer evident when we omit the 6 years between 1977 and 1982.

2. *Post-1982 Sample.* Figure [XXIV](#) shows the response to a shock to anticipated agency purchases based on a shorter sample that starts in October 1982 instead of December 1967. The Figure reports results for agency purchases instrumented with the narrative instrument, as in Figure [VII](#). The October 1982 starting period marks the end of the period of non-borrowed reserves targeting by the Federal Reserve and selects a period of more stable and inflation averse monetary policy. Because of the smaller sample, we omit in this case the cyclical controls (personal income and unemployment) to reduce the number parameters to be estimated. The results remain qualitatively very similar to those of the full sample, indicating a rise in originations and declines in short- and long-term interest rates. Compared to the full sample, the rise in the of stock mortgage debt is slightly smaller.

3. *Including [Romer and Romer \(2004\)](#) Shocks as Controls.* Figure [XXV](#) compares the benchmark narrative impulse response estimates of Figure [VII](#) with those from a specification that includes both the contemporaneous value as well as 12 lags of the [Romer and Romer \(2004\)](#) monetary shock measure as additional controls. Figure [XXV](#) shows that controlling for the [Romer and Romer \(2004\)](#) shocks has little effect on the estimation results.

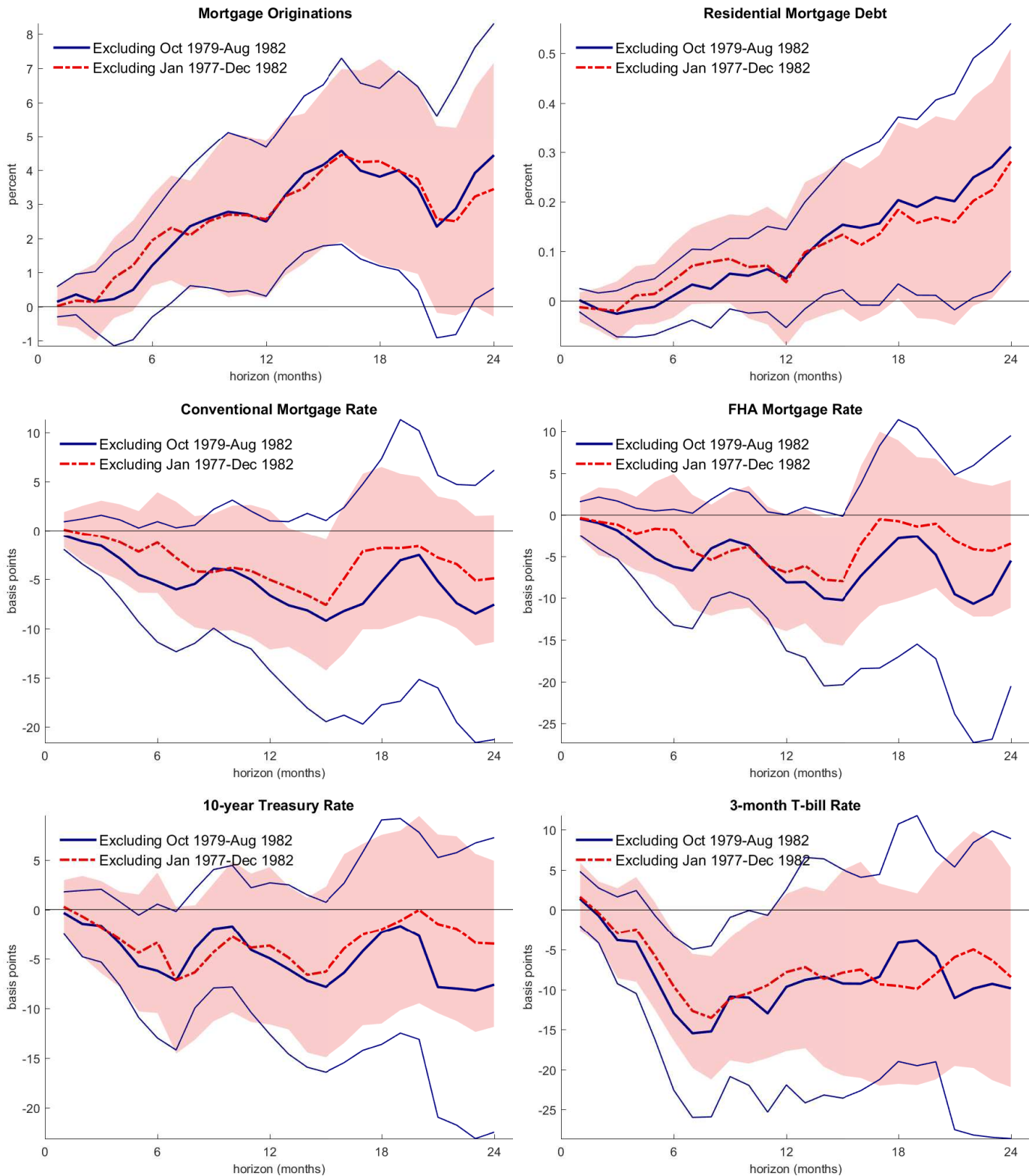


FIGURE XXIII Impulse Responses Excluding 1977-1982 and NBR Targeting Periods

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the narrative policy indicator, see equation (3). Finer lines and shaded areas are 95% [Newey and West \(1987\)](#) confidence bands. Sample: Jan 1967 to Dec 2006, excluding the period indicated.

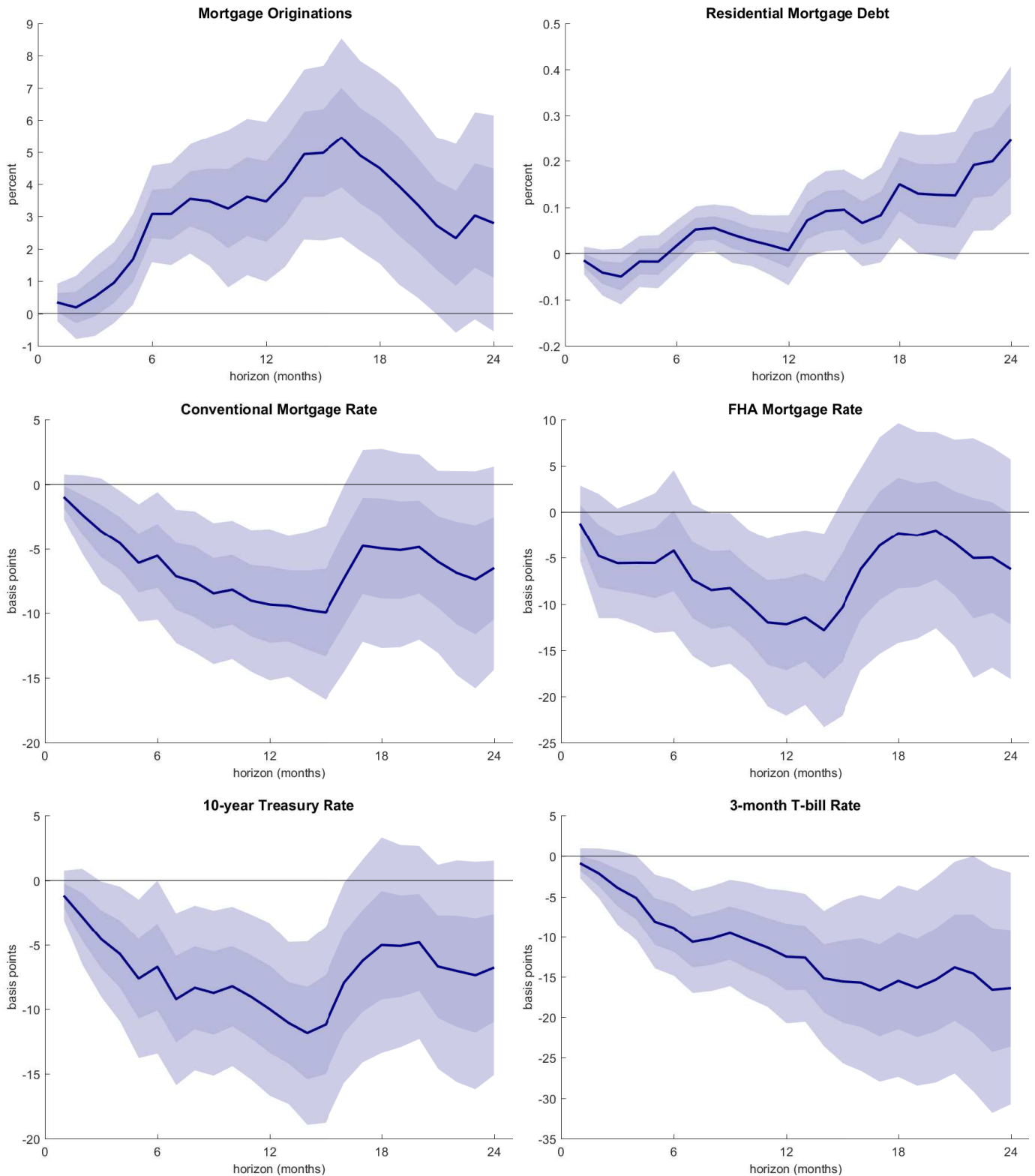


FIGURE XXIV Impulses Responses in the Post-1982 Sample

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the narrative policy indicator, see equation (3). Shaded areas are 68% and 95% [Newey and West \(1987\)](#) confidence bands. Sample: Oct 1982 to Dec 2006.

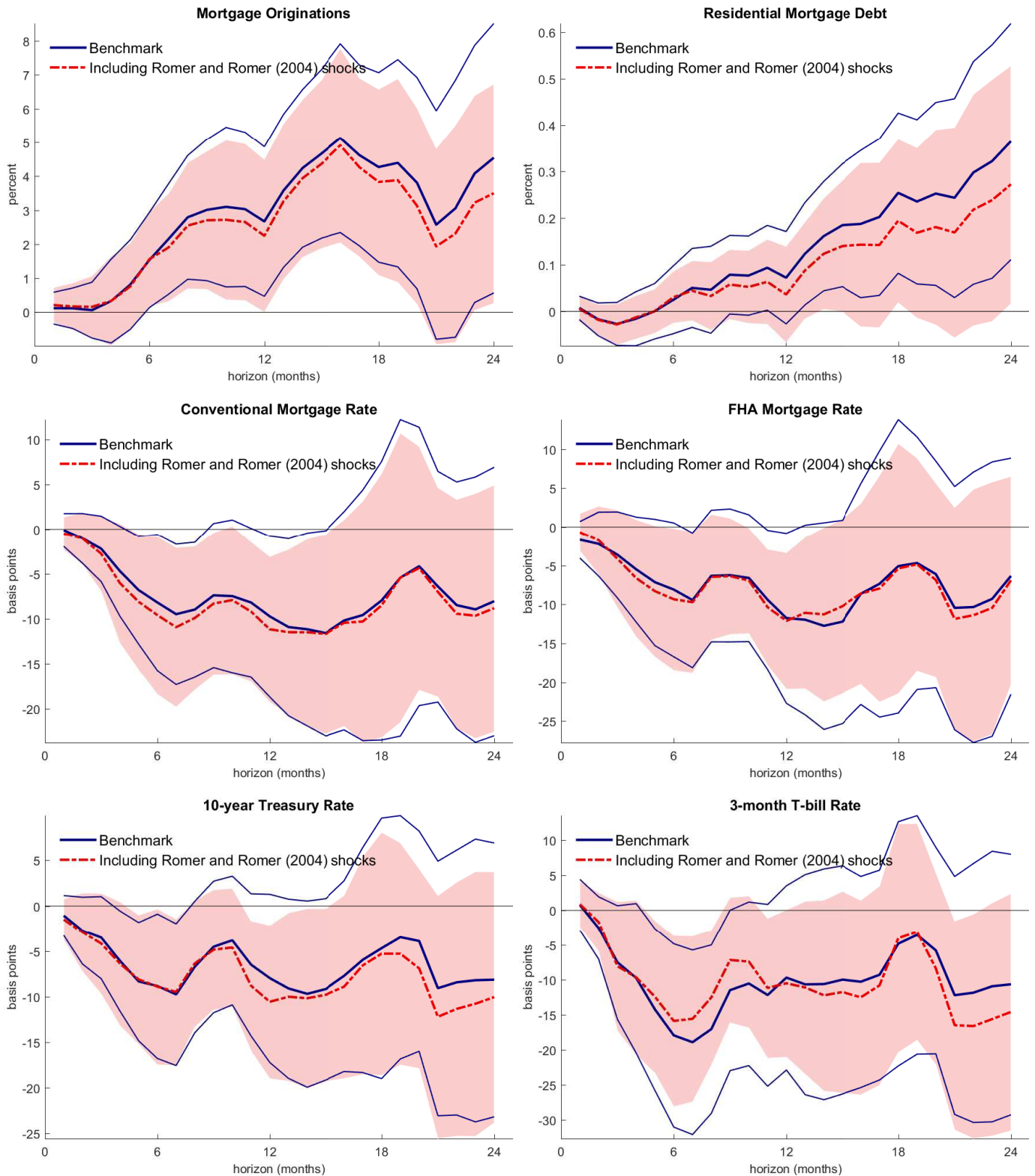


FIGURE XXV Controlling for [Romer and Romer \(2004\)](#) Shocks

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Benchmark estimates are from local projections-IV regressions instrumented with the narrative policy indicator, see equation (3). The new specification includes additionally the contemporaneous value and 12 lags of the [Romer and Romer \(2004\)](#) shocks as controls. Finer lines and shaded areas are 95% [Newey and West \(1987\)](#) confidence bands. Sample: Jan 1967 to Dec 2006.

Alternative Versions of the GSE Excess Returns Instrument

As described in appendix II, the GSE excess returns shocks are defined as the residual in the regression given in (1). Our benchmark specification controls for returns on the market portfolio, as well as on a real estate sector portfolio. This section presents results based on several alternative versions of the excess returns instrument that are obtained by adding additional contemporaneous regressors in the vector W_t relative the benchmark results in the paper. Each of the additional variables are obtained from the data library on the homepage of Kenneth French at <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french>

Figure XXVI shows the results after adding the excess return on a value-weighted banking sector portfolio, and Figure XXVII after adding the excess return on a value-weighted finance sector portfolio. The return variables exclude dividends and are expressed relative to the overall market return. Figure XXVIII shows the results after adding the Fama-French value and size factors. All the additional results are very close to those reported in Figure XVI.

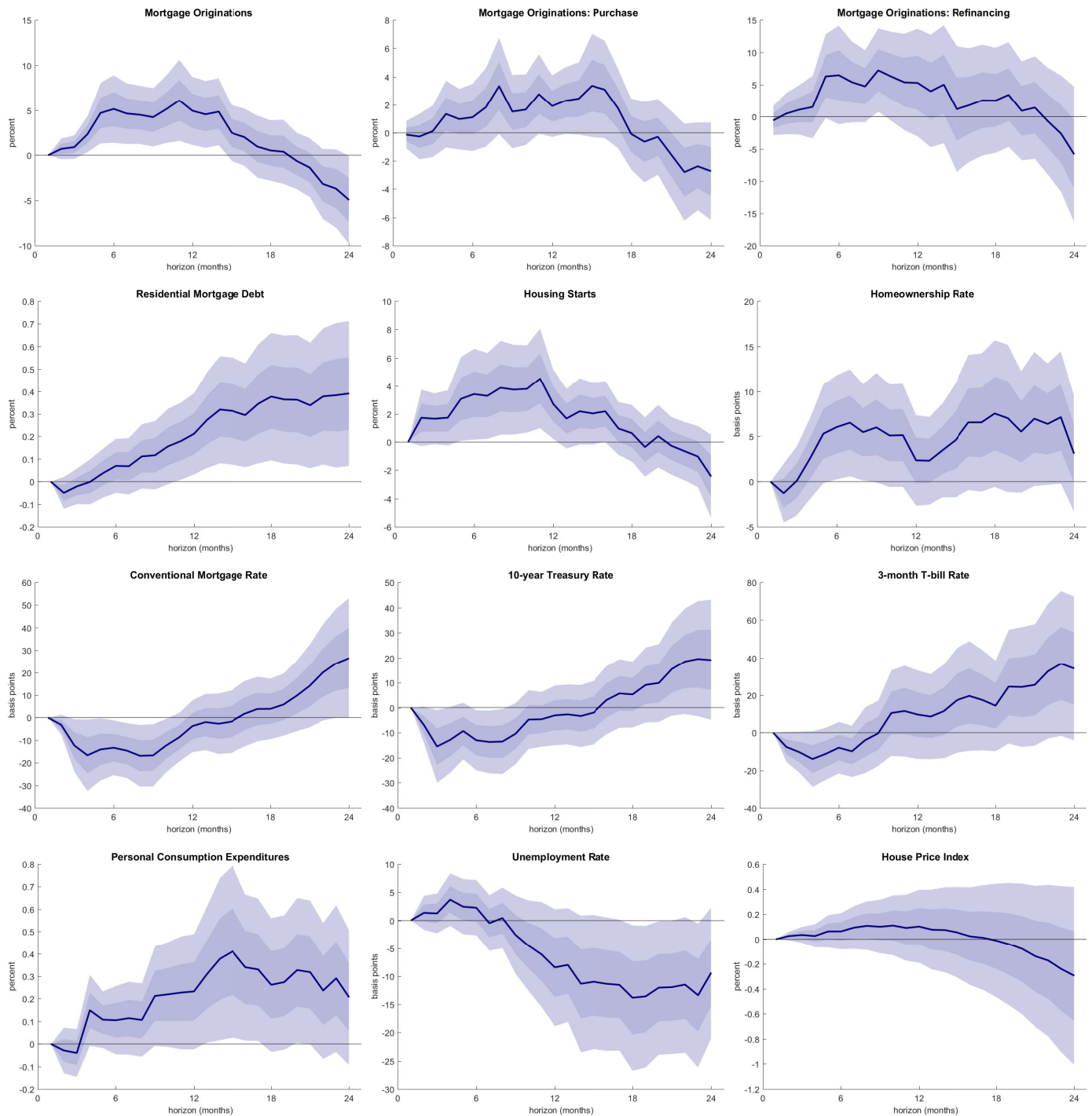


FIGURE XXVI Controlling for Banking Sector Excess Returns

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the GSE excess stock returns innovations, see equation (2). Shaded areas are 68% and 95% Newey and West (1987) confidence bands. Sample: Sep 1970 to Dec 2006.

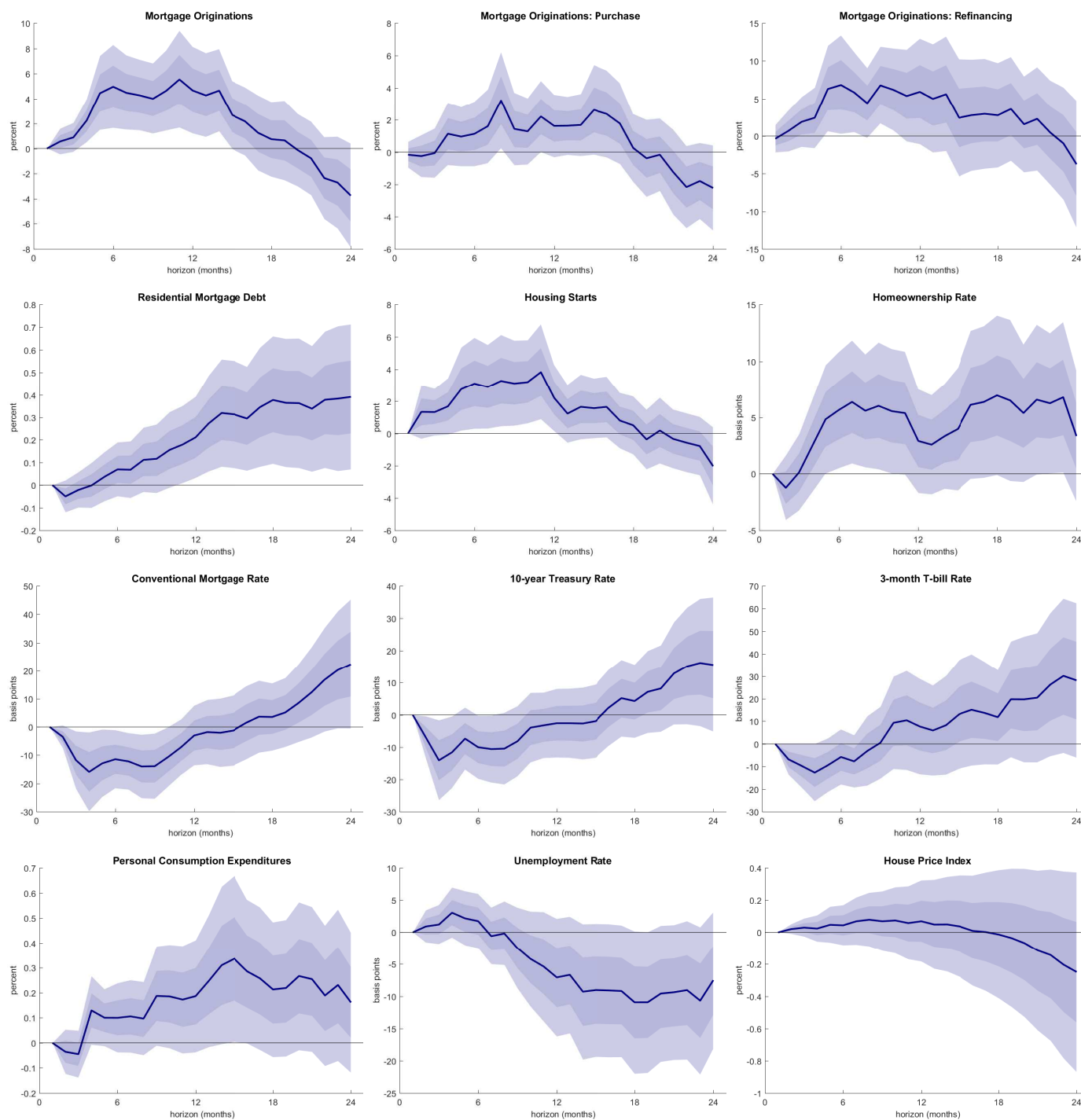


FIGURE XXVII Controlling for Finance Sector Excess Returns

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the GSE excess stock returns shocks, see equation (2). Shaded areas are 68% and 95% Newey and West (1987) confidence bands. Sample: Sep 1970 to Dec 2006.

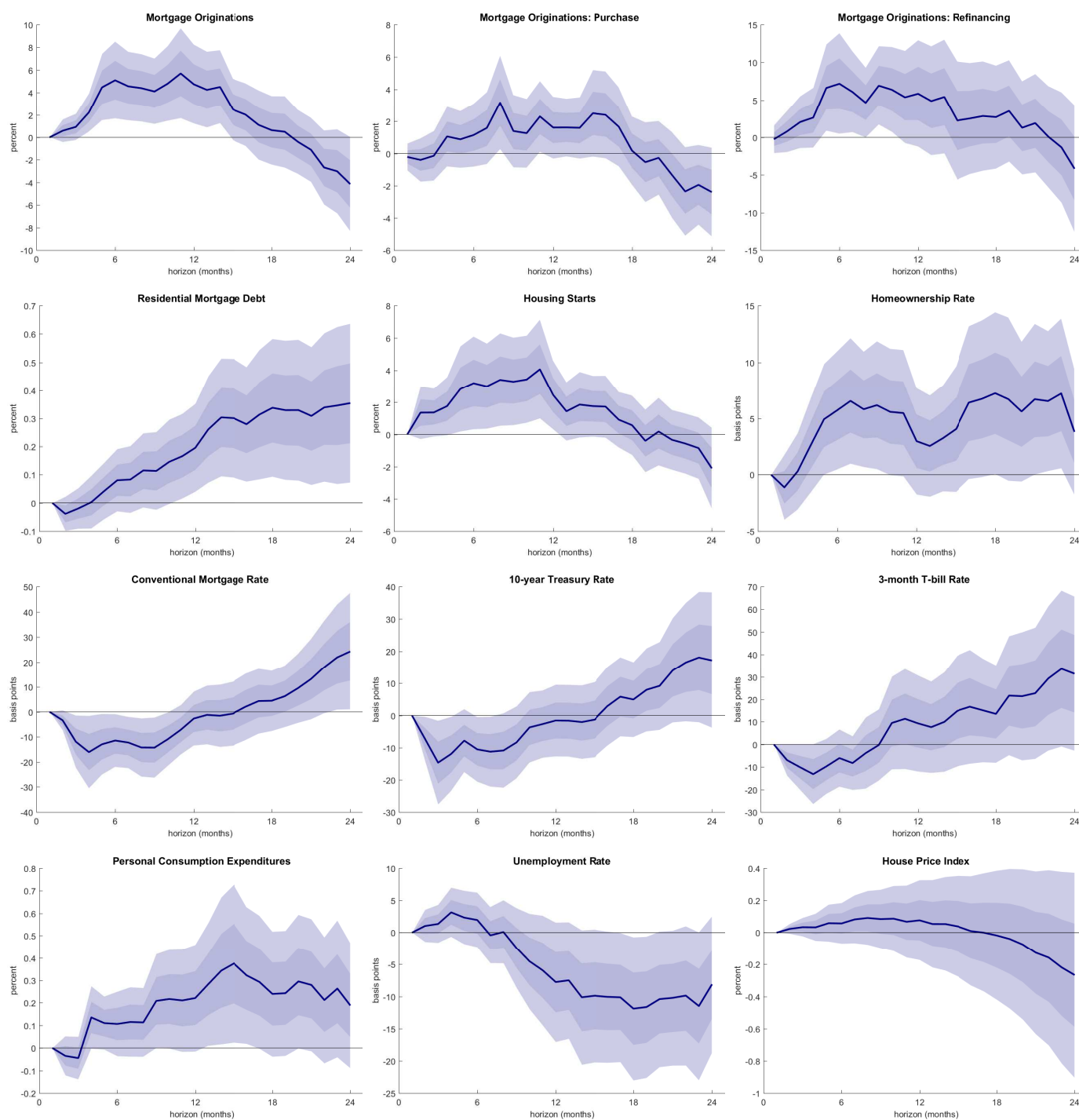


FIGURE XXVIII Controlling for Fama and French (1993) Size and Value Factors

The figure shows responses to a one pp. increase in the expected future agency market share measured by agency commitments as a ratio of trend originations. Estimates are from local projections-IV regressions instrumented with the GSE excess stock returns shocks, see equation (2). Shaded areas are 68% and 95% Newey and West (1987) confidence bands. Sample: Sep 1970 to Dec 2006.

Forecast Error Contributions from an SVAR Model

The local projections-IV specifications do not allow an assessment of the historical role of structural shocks to housing credit policy, which requires knowledge of the variance contribution of these shocks to the cumulative purchase measures in equations (2) or (3). In order to gain some insight into the importance of GSE activity for the dynamics of credit aggregates and interest rates, this section estimates the variance contribution of the GSE excess returns shocks in a structural vector autoregressive (SVAR) model. The main finding is that the contribution of GSE excess returns shocks to the short-run variability of mortgage credit and housing starts is roughly as important as that of monetary policy shocks. In addition, shocks to monetary policy are substantially more important for the forecast error variance of interest rates in the short run. The role of GSE excess returns shocks for long-term interest rates exceeds the one of monetary policy shocks at horizons beyond 18 months.

In order to estimate forecast error variance contribution of shocks to GSE activity, we adopt a VAR model for the joint dynamics of the ratio of agency purchases and commitments to trend originations, as well as all of the variables included as controls in the LPIV regressions: the log levels of core PCE and house price indices, the log difference of total mortgage debt, the log levels of real mortgage originations and housing starts, the 3-month T-bill rate, the 10-year Treasury rate, the conventional mortgage interest rate, the BAA-AAA corporate bond spread, the unemployment rate, and the log of real personal income. In addition, the VAR system also includes the cumulative difference in returns between (1) the Fama-French market portfolio and a risk free portfolio, (2) GSE stock and the market portfolio, and (3) the Fama-French real estate and market portfolios. We estimate the VAR by OLS using 12 lags of all the endogenous variables and using monthly data from September 1970 to December 2006.

The impact of a shock to orthogonalized GSE excess returns is the response to an innovation to the GSE stock index variable, which is obtained by taking the lower triangular Choleski decomposition of the estimated covariance matrix of the VAR residuals, ordering all of the variables except agency purchases/commitments above the GSE stock index variable. This approach imposes the same exclusion restrictions as the LPIV model in (3) within the SVAR context, which amounts to assuming that none of the variables ordered before the GSE stock index variable responds within the same month to orthogonalized GSE excess returns innovations.

Figure XXIX shows the resulting impulse responses, which for ease of comparison are scaled to imply a similar 6-month impact on originations as the LPIV estimates in Figure VII. The GSE excess returns shocks lead to statistically significant increases in agency net commitments and net purchases (not shown). Consistent with our main findings, Figure XXIX shows that originations, mortgage debt, and housing starts all rise significantly following a positive innovations in GSE excess returns, while interest rates decline in the short run. The SVAR estimates are generally very similar to those obtained using LPIV regressions using the GSE excess returns shocks as an instrument for agency mortgage purchases.

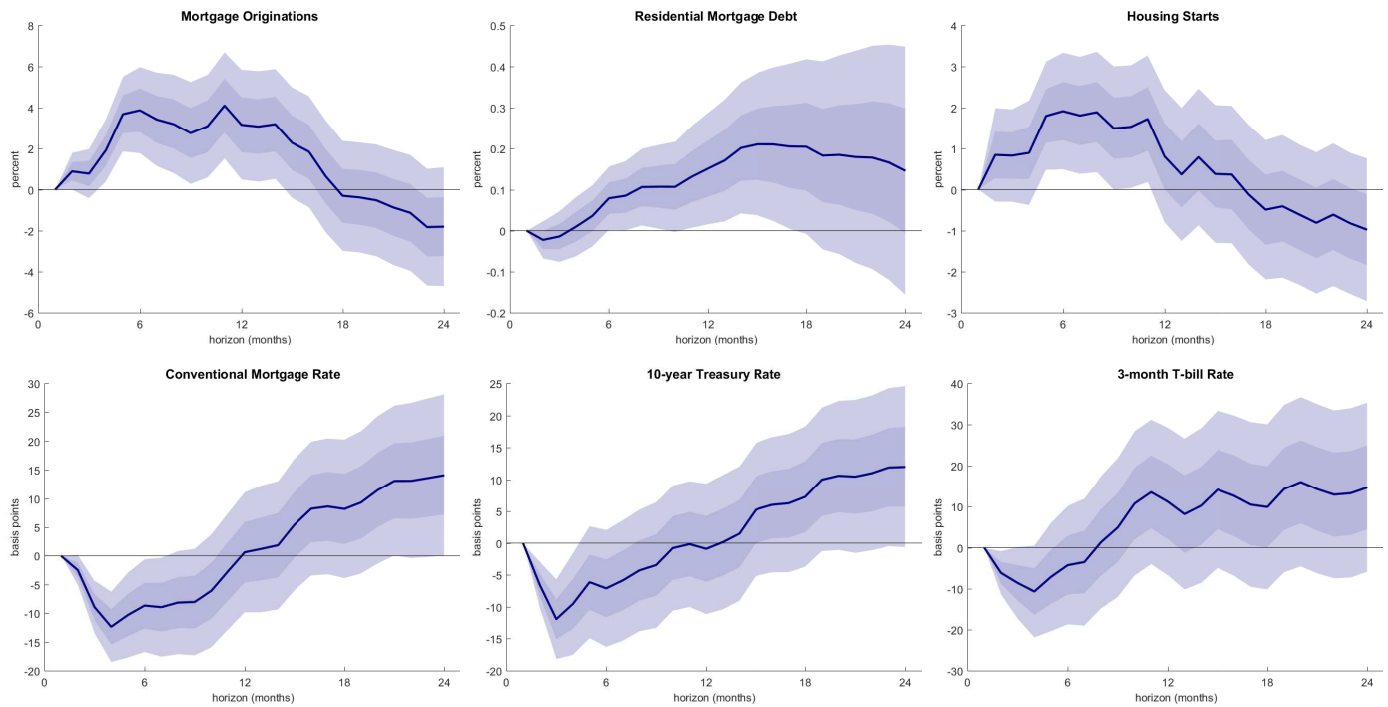


FIGURE XXIX SVAR Impulse Responses to a GSE Excess Returns Shock

The figure shows SVAR impulse responses to an innovation in orthogonalized GSE excess returns. Shaded areas are 68% and 95% confidence bands obtained from a residual wild bootstrap using 10,000 replications. Sample: Sep 1970 to Dec 2006.

An advantage of the SVAR model is that it is straightforward to evaluate the relative importance of shocks in driving fluctuations in the endogenous variables. Figure XXX depicts the share of the forecast error variance at various horizons that is due to the identified GSE excess returns shocks. For comparison, Figure XXX also shows the variance contribution of monetary policy shocks identified using the [Romer and Romer \(2004\)](#) measure as a proxy using the methodology in [Stock and Watson \(2012\)](#) and [Mertens and Ravn \(2013\)](#). We find that the GSE excess returns shocks explain up to 8% of the agency net purchases and commitments forecast variance (not shown). The contribution of monetary policy shocks remains below 2% at all horizons considered. Figure XXX reveals that both shocks account for a substantial fraction of the forecast variance of originations and housing starts at horizons beyond 6 months. GSE excess returns shocks explain up to 12% of the forecast variance of originations at horizons between 12 and 18 months, and around 7% to 8% of housing starts between 8 and 14 months. In comparison, monetary shocks explain between 6% to 8% of originations, and around 11% of housing starts at similar horizons. Neither of the shocks accounts for much of the forecast variance of the stock of mortgage debt at horizons up to 36 months. Monetary shocks account for a substantial share of the short-run forecast variance of the 3-month T-bill rates, and up to 14% and 7%, respectively, of the variance in mortgage and 10-year Treasury rates at horizons shorter than 6 months. GSE excess returns shocks are relatively less important for the variability in interest rates at shorter horizons, but become relatively more important than monetary policy shocks in accounting for the uncertainty in long-term interest rates at horizons exceeding 18 months.

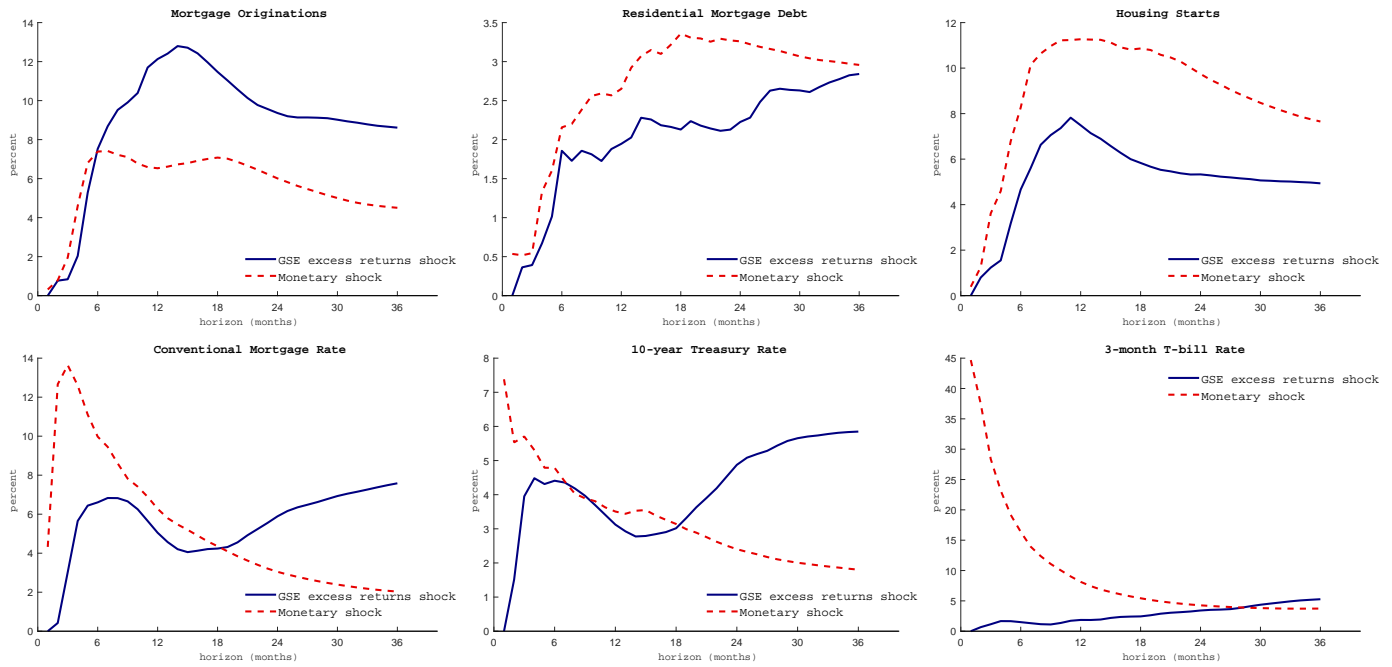


FIGURE XXX Forecast Error Variance Contributions of Monetary and GSE Excess Returns Shocks

The figure shows contributions to the forecast error in the SVAR model. Monetary policy shocks are identified using the [Romer and Romer \(2004\)](#) measure as external instrument. GSE excess returns shocks are identified as described in appendix II. Sample: Sep 1970 to Dec 2006.

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