Monetary Policy Wedges and the Long-term Liabilities of Households and Firms*

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Abstract

We examine the transmission of monetary policy shocks to the long-duration liabilities of households and firms using high-frequency variation in 10-year swap rates around FOMC announcements. We find that four weeks after the announcement mortgage rates move one-for-one with 10-year swap rates, leaving little explanatory power for mortgage concentration, bank market power, or credit risk. Variation in credit risk does materially affect monetary policy transmission to corporate bonds. Expected future short rates and term premia play a significant role in driving both mortgage rates and corporate bond yields, which explains the Federal Reserve's increased focus on these quantities.

Keywords: Monetary Policy Transmission; Mortgage Lending; Bank Market Power; Cost of Capital

JEL codes: E44, E52, G21.

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1 Introduction

The impact of monetary policy on macroeconomic outcomes hinges on a Central Bank's ability to influence *financial prices that truly matter* to households and firms (Blinder, 1999). Key examples of such prices include mortgage rates for households and rates on long-term corporate debt (Stiglitz and Greenwald, 2003).[1] Consequently, economists are confronted with a critical question: to what extent can monetary policy affect mortgage rates and long-term corporate interest rates? To answer this question, we examine the transmission of monetary policy shocks to the long-duration liabilities of households and firms using changes in 10-year swap rates around Federal Open Market Committee (FOMC) announcements that include not only the narrow window around the statement release but also the press conference window.

We show that making these two changes to the measurement of rate shocks, i.e., a) focusing on changes in convenience-yield-free long-term rates instead of short-term rates and b) extending the window beyond the FOMC statement release alone, substantially alters the empirical inference regarding monetary policy transmission. As in Nakamura and Steinsson (2018) "*our measure of monetary shocks is based not only on surprise changes in the federal funds rate but also changes in the path of future interest rates in response to FOMC announcements. This is important because since over the past 15 years forward guidance has become an increasingly important tool in the conduct of monetary policy* (Gürkaynak, Sack, and Swanson, 2005)." However, because the liabilities we study have durations that are substantially larger than the durations studied in Nakamura

[1] The standard consumption Euler equation relates consumption to expected future nominal rates and change in prices (i.e., real rates):

$$c_t = E_t^{hh} c_{t+1} - \sigma \left(i_t - E_t^{hh} \pi_{t+1} \right) = -\sigma \sum_{j=0}^{\infty} E_t^{hh} i_{t+j} + \sigma \sum_{j=0}^{\infty} E_t^{hh} \pi_{t+j+1},$$

where $E_t^{hh} x_{t+j}$ represents the household's expectation at time t for variable x at time $t+j$, i represents the nominal interest rate, and π represents inflation. Similarly, classical models of firm investment establish a linear relationship between the rate of investment $\frac{I_t}{K_t}$ and Tobin (1969) q, i.e., the value of capital relative to its replacement cost:

$$\frac{I_t}{K_t} = a + bq.$$

When these models imply an equivalence between Tobin's q and the ratio of the market-to-book value of capital $\frac{V}{K}$ (e.g., Hayashi, 1982), it is easy to see that, since V is the present value of all future cash-flows of a firm, long-term real interest rates (and not short-term rates) affect the investment rates of firms.

and Steinsson (2018), we extend their logic by using changes in the 10-year swap rate, a rate that financial institutions advertise as their benchmark rate for many long-duration products. The second change is also key because, since 2011, press conferences that communicate information beyond the announcement of the rate change have become an integral part of how the Fed conducts monetary policy (De Pooter, 2021; Gómez-Cram and Grotteria, 2022; Gorodnichenko, Pham, and Talavera, 2023; Swanson and Jayawickrema, 2023).

Our findings indicate that mortgage rates respond one-for-one to 10-year swap rate changes approximately four weeks after monetary policy announcements. This response implies that other factors such as credit market imperfections, mortgage concentration, or bank market power have little influence on the transmission of monetary policy to mortgage markets. This is important as these factors have been considered to create *wedges* between monetary policy and rates that actually matter for households (e.g., Berger and Udell, 1992; Berlin and Mester, 1999; Crawford, Pavanini, and Schivardi, 2018). Unlike mortgage contracts, which are highly collateralized, unsecured corporate bonds exhibit a greater response to a decrease in 10-year swap rates than to an increase. The differential response in bonds is attributed to the impact of monetary policy on corporate credit spreads. Specifically, in our sample, a drop in rates correlates with a decrease in credit risk, whereas in our sample corporate credit spreads do not rise after a positive rate surprise.

Our work is motivated by the observation that traditional studies of monetary policy transmission predominantly focus on surprises in short-term interest rates. However, several important variables can drive a *wedge* between the so-called short-term policy rate and the interest rates that matter to households and firms. For example, let the fixed rate on a 30-year mortgage for borrower i by lender j be denoted by m_{ij}. We can then decompose this rate as:

$$m_{ijt} = \overbrace{\underbrace{r_t + ER_t + \phi_t}_{\text{Long duration treasury}} + cy_{jt}}^{\text{Swap Rate}} + \underbrace{ed_{it} + dr_{it}}_{\text{Credit spread}} + \underbrace{\theta_{ijt}}_{\text{Market power}} + \varepsilon_{ijt} \quad (1)$$

where r_t is the short-term policy rate, ER_t denotes the duration-adjusted average expected short rate (expectation hypothesis), ϕ_t the term premium, cy_{jt} the relative convenience yield of long-term Treasuries relative to mortgages issued by lender j, ed_{it} the expected default rate of borrower i relative to Treasuries, dr_{it} the default risk premium of borrower i relative to Treasuries, θ_{it} the market power that lender j has with respect to customer i, and ε_{ijt} measures the impact of residual financial market frictions. The equation illustrates that shocks to the short-term rate may not translate into changes in mortgage rates due to offsetting effects from other terms in the equation.

Fully aware of this disconnect, the Fed started using forward guidance as one of its monetary policy tools in early 2000 to at least bridge part of the terms indicated in Equation 1.[2] As stated by Bernanke (2015), "monetary policy is 98% talk and 2% action." This implies that over our sample period, appropriate measurement of rate shocks necessarily includes information on the long end of the curve. In fact, on days of FOMC meetings, as argued by Hanson and Stein (2015), we observe a very large variation in rates in the distant future up to 10 years (Figure A.1). Furthermore, since the financial crisis, the Fed and other Central Banks have added quantitative easing tools to their arsenal, i.e., the purchasing of long-duration treasury securities in exchange for reserves, which also directly affected long-term rates arguably through changes in term premia more so than through changes in the expectations of future rates (Bernanke, 2016).

Indeed, even when one focuses only on FOMC announcement days, changes in long-term rates exhibit, at best, a weak correlation with changes in short-term rates. To illustrate this point, we consider the 160 scheduled FOMC announcements between the year 2000 and 2019, as listed in Table A.1. The correlation between changes in 10-year swap rates and the forecast revisions of the Federal Funds rate by Kuttner (2001) - primarily based on the current-month federal funds futures rate - is a mere 23% on those same days (see Figure 1). When we use the Nakamura and Steinsson (2018) shocks, which include convenience-yield-free rates up to 1 year, this correlation increases to 46.9% (see

[2]See the following link.

Figure A.2).[3,4] More importantly, we observe a counterfactual response of mortgage rates to either the Kuttner (2001) or the Nakamura and Steinsson (2018) shock: on average, mortgage rates go down after positive interest rate surprises in our sample (see Panel A of Figure A.23 and Figure A.24). Thus, if we use surprises in short-term rates as the monetary policy shock measure, we observe an imperfect transmission to the mortgage market unlike the one-for-one response of mortgage rates that we find when using our newly proposed rate shock measure.[5,6]

Therefore, to study the effect of monetary policy news on mortgage and corporate bonds, we construct monetary surprises using changes in long-term (10-year) interest-rate swaps over windows including both FOMC statement releases and press conferences. We follow the discontinuity-based identification approach commonly used in the monetary policy literature that exploits the lumpy way in which monetary news is communicated to investors around FOMC announcements (Cook and Hahn, 1989; Kuttner, 2001; Cochrane and Piazzesi, 2002; Bernanke and Kuttner, 2005; Nakamura and Steinsson, 2018). We combine our measure of monetary surprises with detailed data sets on 1) 30-year mortgages issued in the United States (US) from Corelogic, 2) a survey index produced by Bankrate.com capturing the daily average of 30-year fixed-rate mortgages in the US, 3) interest rates for a range of mortgage products from RateWatch, 4) transactions

[3] Swanson (2021) proposes to separately identify surprise changes in the federal funds rate, forward guidance, and large-scale asset purchases (LSAPs). However, all of his 3-shock components combined explain only 52% of the variation in 10-year swap rates on FOMC days. When using his three components, the first factor (corresponding to changes in the federal funds rate) does not explain any variation in mortgage rates, whereas the second and the third factors (reflecting changes in forward guidance and LSAPs) are both important drivers of mortgage rate changes. However, the residual component, which accounts for 48% of the variation in 10-year swap rates, also appears as a significant driver of mortgage rates.

[4] Figure A.3 shows the rolling-window correlation calculated over 365 days between daily changes in 10-year swap rates (Δs) and daily changes in 1-year government bond yields (Δy^1). Beyond the time variation, one can notice that after 2008, the relation between the daily changes of the two series is less strong, reaching a minimum correlation of 0.24 in May 2014. The plot is almost identical when instead of the 10-year swap rates one uses the series for the 10-year Treasury par yield.

[5] Several recent papers have used the change in the 2-year US Treasury rate on Fed-related announcement days to measure monetary policy surprises (Hanson and Stein, 2015, among others). Therefore, in Figure A.25 Panel A and B we show the response of mortgage rates and corporate bond yields to the daily change in 2-year Treasury rates on FOMC days. Once again, we observe a counterfactual response of mortgage rates to the change in 2-year Treasury rates, similar the resopnse we find when using the monetary policy shocks of Kuttner (2001) and Nakamura and Steinsson (2018).

[6] In online appendix Section B we show evidence in support of the hypothesis that the Federal Reserve manages investors' expectations and affects long-term market interest rates through channels other than changes in the policy rate, which is short term.

of non-financial corporate bonds from TRACE, and 5) CDS spreads for non-financial companies from Markit.

We then estimate the response of long-term interest rates faced by consumers and firms in the four weeks after the monetary announcement. With regard to mortgage rates, we observe, on average, a one-for-one response to monetary policy surprises over a period of four weeks post announcement. More importantly, we do not find any evidence that banks respond to monetary policy surprises differently depending on local mortgage lender concentration. Using four standard concentration measures, we cannot reject the hypothesis that the response is the same in high- and low-concentration areas. Our findings are consistent with the idea that variation in mortgage rates simply reflects variation in banks' funding costs as proxied for by long-duration interest-rate swaps. The difference between loans proposed in different zip codes by a given bank appears to move slowly and not in response to monetary policy announcements.

We then examine whether our estimates are driven by the potential self-selection of borrowers after monetary policy announcements (adverse selection) or changes in the value of mortgage prepayment options. To test for the self-selection of borrowers, we use a survey index produced by Bankrate.com capturing the daily average of 30-year fixed-rate mortgages in the US, as well as rates from RateWatch for fixed-rate mortgages with maturities from 10 year to 30 years. Both the Bankrate.com index and the RateWatch data are intended to represent ideal mortgages to the "best" borrowers, that is, those with exceptional FICO scores, for particular constant loan volumes and with 20% down payment. We confirm that these quoted rates respond to changes in swap rates on FOMC days with a direction and magnitude similar to the transacted rates from Corelogic, which provides evidence against the hypothesis that our estimates reflect changes in the credit risk of the pool of borrowers. Regarding the value of the prepayment option, we include in our estimation the implied volatility for 10-year Treasury futures to proxy for interest rate uncertainty (which in turn drives the variation in the value of the prepayment options) as a control variable and show that the results are nearly identical to our benchmark estimates.

Unlike mortgage rates, corporate bonds exhibit an immediate (non-delayed) response to monetary surprises, and in general, we observe a stronger response following a negative change in 10-year swap rates than a positive change. Splitting the sample by credit rating, yields of speculative-grade bonds respond even more strongly to negative monetary shocks relative to positive shocks than yields of investment-grade bonds. The same is true for CDS spreads: we consistently observe larger magnitudes in the estimated responses when we pass from higher to lower credit ratings.

Next, we use the approach of Adrian, Crump, and Moench (2013) to decompose changes in interest rate swap rates into (a) changes in expected future short rates, (b) term premia, and (c) a residual component that captures treasury convenience relative to swap rates, and study their respective impact on mortgage rates. We observe that 20.5% of the two-day change in the Bankrate.com mortgage rate index around FOMC announcements is explained by changes in expected short interest rates, 15.6% by changes in term premia, while 6.5% by changes in treasury convenience. The results are very different from the ones of corporate bond yields. For both AAA and BAA corporate bond yields, daily changes around FOMC announcements are mostly explained by term premia, whereas almost none of the variation comes from changes in convenience yields. In particular, for AAA bond yields 52% of the daily change in yields around FOMC announcements can be attributed to changes in term premia, whereas for BAA bond yields 65.5% of the daily change in yields around FOMC announcements can be attributed to changes in term premia. Expected short interest rates explain about 15% of the changes in corporate bond yields for both AAA and BAA.

Our findings establish that bank assets (mortgages and corporate loans) are strongly connected to rate shocks affecting long-term rates. This raises the question what the effect is of monetary policy shocks on banks' net worth. Changes in long-term rates can affect banks' equity valuations through two channels: discount rates and cash flows. When rates increase, future cash flows are discounted more heavily, leading to declining market values. However, if assets are re-priced in the near term and funding comes from rather stable and sleepy sources (e.g. deposits), banks can benefit from a larger difference between the rates they charge on their assets and their funding costs.[7]

We regress Fama and French (1997) 49 industry portfolios on the changes in 10-year

[7] See Drechsler, Savov, and Schnabl (2017) for recent work on banks' market power in the deposit market.

swaps on FOMC days, controlling for Kuttner (2001) federal-funds shocks. Aside from two notable QE1 events on 16-Dec-2008 and 18-Mar-2009, where long-term rates fell sharply and bank share prices soared following the Fed's announcement of a trillion-dollar quantitative easing, the banking industry consistently demonstrates the highest exposure to shocks in long-term rates, with a positive and significant coefficient of 7.29. This implies that bank stock prices *increase* by 7.29% for every 1% *positive* shock to the 10-year swap rate. On the other hand, the exposure to short-term rates (fed funds shocks) is negative (-3.53) and not statistically significant, consistent with the estimate of Drechsler, Savov, and Schnabl (2021). We confirm the strong positive relation between changes in 10-year swap rates and bank stock returns using data on individual bank holding companies. When we condition on the fractions of loans that get repriced within one year, we find that this variable is the main determinant of banks' exposure to changes in 10-year swap rates. This confirms the hypothesis that the response of banks' stock returns to long-term rates is explained by a cash-flow channel.[8]

The remainder of this study is organized as follows. Section 2 describes the relation to the previous literature. Section 3 offers a description of the data used. In Section 4 we present our main results on the transmission of monetary policy to interest rates relevant to households and firms. Section 5 discusses the implications of our findings for banks' net worth. The final section summarizes and concludes. The Online Appendix provides evidence that the Federal Reserve *can* affect long-term market rates through channels other than changes in the policy rate, presents a number of empirical tests for robustness, and separately examines monetary policy transmission in the period after 2010.

[8]Our results are important in light of the bank collapses of 2023. For a cash-flow effect to be present, depositors need to be sleepy, which happens when interest rates do not change too much too fast and depositors are guaranteed by the Federal Deposit Insurance Corporation (Jiang, Matvos, Piskorski, and Seru, 2023). In the case of Silicon Valley Bank (SVB), the total withdrawal of $142 billion represented a staggering 81% of SVB's $175 billion in deposits as of year-end 2022. More importantly, SVB revealed that it had more than $150 billion in uninsured deposits at the end of last year, which made it prone to bank runs. In our sample period, from 2000 to 2019, SVB stock returns were also largely positively exposed to changes in 10-year swap rates. Figure A.27 shows the relation between stock returns in percentage and changes in 10-year swaps in bps for the three banks that defaulted. The estimates for SVB imply that for every percentage point increase in swap rates, the bank stock returns are about 10 percentage points (with a t-stat of more than 3 with robust standard errors).

2 Literature Review

In this paper, we evaluate the relative importance of *monetary policy wedges* and their impact on discount rates in the long-term mortgage and corporate bond markets. The presence of these wedges has been recognized before. The Federal Reserve became aware of the disconnect between the federal funds rate and mortgage rates when the latter did not react as expected to the Federal Reserve's tightening measures in mid-2004 (Greenspan, 2009; Backus and Wright, 2007). The main source of this disconnect was thought to be the disconnect between the federal funds rate, i.e., the overnight target interest rate set by the Fed, and long-term interest rates, which are necessary to determine the value of long-lived assets.[9] Recently, Justiniano, Primiceri, and Tambalotti (2022) identified a reinforcing phenomenon, i.e., the disconnect between mortgage rates and long-term Treasury rates due to refinancing activity from mid-2003 to 2006.[10]

The presence of monetary policy wedges could lead some researchers to reach the counterfactual conclusion that the Fed does not control interest rates as argued by Fama (2013). However, the Fed does more than set overnight rates. For instance, in the last two decades, the Fed introduced forward guidance regarding the future path of the federal funds rate, e.g., via press conferences, as well as a number of LSAPs. These instruments are integral parts of monetary policy and must be included when studying monetary policy transmission to rates faced by household and firms (private rates hereafter). Using a variety of methods, Krishnamurthy and Vissing-Jorgensen (2011), Swanson (2011), Hamilton and Wu (2012), Christensen and Rudebusch (2012), Evans and Justiniano (2012), Wright (2012), D'Amico and King (2013), Bauer and Rudebusch (2014), Campbell, Fisher, Justiniano, and Melosi (2017), D'Amico, Kim, and Wei (2018) and van Binsbergen, Diamond, and Grotteria (2022) convincingly demonstrate that unconventional policy measures implemented by the Federal Reserve since the 2007–2008 financial crisis have significantly reduced yields on longer-term Treasury securities.

[9]Quoting Greenspan, *the prices of long-lived assets have always been determined by discounting the flow of income (or imputed services) by interest rates of the same maturities as the life of the asset. No one, to my knowledge, employs overnight interest rates – such as the fed-funds rate – to determine the capitalization rate of real estate, whether it be an office building or a single-family residence.*

[10]They show that this disconnect can be attributed to the attempt of originators to sustain their level of activity following the collapse of their refinancing business.

Our results contribute to an extensive literature that examines the pass-through of monetary policy to private rates or firms' value (Hancock and Passmore, 2011; Scharfstein and Sunderam, 2016; Drechsler, Savov, and Schnabl, 2017; Benetton and Fantino, 2021; Benetton, Gavazza, and Surico, 2021; Wang, Whited, Wu, and Xiao, 2022; Jeenas and Lagos, 2023, among others). Relative to this literature, we a) propose a new shock estimated from long-term rates directly, b) show a complete pass-through of monetary policy surprises on private rates, and c) show that an unexpected decrease (increase) in long-term rates is a negative (positive) surprise to banks' net worth.

The closest paper to ours is Gilchrist, López-Salido, and Zakrajšek (2015) which analyzes monetary policy transmission on 30-year MBS and corporate bond indices. Relative to Gilchrist et al. (2015), we use 10-year swap rates over the whole sample not only to capture shocks to long-term rates, but more importantly because 10-year swap rates are used for pricing and hedging mortgages and corporate bonds. Moreover, compared to Gilchrist et al. (2015), we assess the role of monetary policy wedges, which are key to understanding the transmission of monetary policy. For instance, in the case of mortgages, a variety of factors affect the wedge between the secondary MBS rates studied by Gilchrist et al. (2015) and the primary mortgage rates used in this paper, whereby only the latter are directly relevant to households (Stein, 2012). Our panel approach and the granularity of the data we use allow us to a) account for several potentially important sources of heterogeneity, including local mortgage lender concentration, and b) focus on the high-frequency response of household-relevant transacted rates to monetary policy events.

3 Data description

Swap rates. We utilize high-frequency data on 10-year fixed-to-floating swap rates denominated in U.S. dollars from the Intercontinental Exchange (ICE) and daily data on the same variable from Bloomberg. ICE swap rates are the primary global benchmark for determining swap rates and spreads for interest rate swaps. They are extensively employed as the reference value for cash-settled swaptions, for final payments on the premature termination of interest rate swaps, for floating rate bonds, and most importantly by lenders setting mortgage rates. Minute-level data from ICE are available only for the second half of our sample. So, for our main results, we will use daily changes in interest rate swaps on the days of FOMC announcements. We will show the robustness of our results to intraday changes in interest-rate swaps in the online appendix Section C. In the main text, we use high-frequency intraday variation in 10-year Treasury bond yields, which we can compute from 2000.

The swap rates that we use are set against LIBOR. Conceptually, a credit-sensitive interest rate benchmark such as LIBOR represents the interest paid by one bank to another for unsecured deposits, which for most of our sample period reflects well the marginal cost of funds to large financial institutions. The fixed rate on plain vanilla interest rate swaps where the floating payments are based on LIBOR can therefore be interpreted as the par rate against the LIBOR curve, capturing expectations on future rates and bank credit quality, i.e., the two major components of funding costs of banks. Therefore, the swap rate is designed to capture risks in the banking sector as well and is closely related to bank funding costs (Cooperman, Duffie, Luck, Wang, and Yang, 2023).[11] We annualize swap rates to reflect 365 days.

Ideally, we would base our monetary policy shocks on high-frequency variation around FOMC announcements of *convenience-yield-free* long term interest rates. However, the data to construct this measure is only available to us for a part of our sample. This necessitates the use of high-frequency variation in a close proxy to our 10-year swap rate. Fortunately, such a proxy is readily available. Figure A.4 shows the 10-year swap rate series against the 10-year government-bond par yield computed by Gürkaynak, Sack, and Wright (2007).[12] The two series overlap almost perfectly after 2008. This can be interpreted as a) over this sample period AA-rated banks have a similar credit risk to the US government in the long term (because of the expectations of being bailed out) and b) over this sample period long-term government bonds do not enjoy the convenience

[11]The idea that the 10-year swap rate should match the yield on a 10-year bond issued by a financially sound bank is incorrect. The 10-year swap is written against rolling three-month loans based on LIBOR (i.e., the three-month credit of banks on the polling list over time). Roughly speaking, LIBOR estimates the rate at which an AA-rated bank can obtain an unsecured short-term loan from another bank. Therefore, the swap rates relative to LIBOR take into account updates in the bank poll to include only AA-rated banks.

[12]In Figure A.9 and Figure A.10 we evaluate the response of 10-year Treasury par yields, as well as 10-year TIPS yields, to a daily change in 10-year swap rates around FOMC announcements.

yield documented by van Binsbergen et al. (2022) for securities with maturity lower than 2.5 years. In addition, the correlation between the two series is 99.41% and the correlation between the daily changes in the two series is 92%. Given the high level of correlation between 10-year swap rates and Treasury bonds and, as mentioned, to extend the high-frequency analysis to 2000 we use intraday indicative quotes from GovPX on 10-year Treasury bonds. For all quotes, we use a midpoint of bid and ask.[13] Panel A of Figure A.5 shows the scatterplot of high-frequency intraday changes in 10-year swap rates against high-frequency intraday changes 10-year Treasury yields for the FOMC days after 2010 for which we have intraday data on swap rates. The correlation between the two series is 98%. Panel B of Figure A.5 shows the scatterplot of daily changes in 10-year swap rates against high-frequency intraday changes in 10-year Treasury yields for all scheduled FOMC days from 2000. The correlation between the two series is 79%.

Mortgages. Home mortgage debt constitutes the largest type of debt in the US household portfolio. It represents approximately 70% of the total household debt over the period from 2003 to 2023 compared to auto-loan debt which represents only 9% (see Figure A.6). In this paper, we use both transaction information on mortgages as well as quotes for ideal mortgages, defined as mortgages to households with a FICO score above 740 and a loan-to-value (LTV) ratio of 80%.

Comprehensive transaction information on mortgages is from Corelogic LLMA and Deeds Mortgages. The LLMA data contain information on mortgage and borrower characteristics at origination — the interest rate, LTV ratio, sale price, credit score, whether the mortgage was eligible for purchase by government-sponsored enterprises (GSE-eligible), insured at origination, or whether it was prime or subprime — for a large sample of anonymized borrowers. CoreLogic collects these data from 25 of the largest mortgage servicers in the US. The LLMA data track approximately 5.7 million mortgages each year including on average about 45% of mortgages originated in the US over the sample period. We restrict the sample to 30-year conventional loans (i.e., not originated under a government program) where the borrower's stated purpose was to

[13] For every FOMC day, we select the Treasury bond with a remaining maturity between 9.5 and 10.5 years and with the highest number of observations. However, our results are robust to different methods for selecting Treasury bonds for the computation of the shock.

purchase a single-family residence or residential condominium with no buy-down. Indeed, thirty-year mortgages are the most common choice for households in the US. In 2022 they represented 88.84% of the total number of mortgages originated in the US with the purpose of a home purchase, as reported in HMDA data. We remove mortgage rates in the bottom and top 1% by year-quarter.

From Deeds Mortgages, we only use the mortgage origination date, the original balance, the maturity date, the state, and the zip code of the property. All these variables are also present in the LLMA dataset. We exclude all other variables.[14] The only information we need from the Deeds Mortgages is an accurate origination date, adding the day of origination to the year-month in LLMA. Therefore, we keep only observations in the LLMA data where it is possible to uniquely identify a mortgage origination date. Summary statistics are reported in Table 1. Both the median and the average LTV ratio are about 80%. We have restricted the original term to 30 years, so there is no variation there. Among all mortgages, 92% are GSE-eligible and 92% are prime mortgages. Only 29% of the mortgages are insured at the time of origination.

Figure 2 shows all the mortgage rates in our sample by the date on which the deed of the mortgage was signed by the borrower (blue dots) against the 10-year swap rate series from Bloomberg, USSA10 (red solid line).[15] The relation between the level of swap rates and the level of mortgage rates is clear from the figure. An increase in the swap rate is followed by a rapid rise in mortgage rates, and a decline in the swap rate series is accompanied by a drop in mortgage rates.

We formally test this relation between mortgage rates and swap rates in Table A.2 in the Appendix. The table reports the R^2 for different specifications where we regress all the mortgage rates in our sample against different sets of controls. In column 1, we use the (4-week lagged) 10-year swap rate as our unique regressor. The 4-week lag is motivated by the observation that on average, it takes four to six weeks from the time of application to closing.[16] The swap rate series explains already about 86% of

[14]By doing so, it is impossible for us to (i) determine any individual personally identifiable consumer information or the servicer of any individual loan included in the LLMA Data; or (ii) identify loan or location information more granular than the 5-digit zip code level for any individual loan included in the LLMA Data.

[15]This is the par rate paid annually on the swap fixed leg.

[16]For information on the process click here or here. Quoting from Bankrate.com "The mortgage

the variation in mortgage rates (column 1). Including date fixed effects instead of the swap rate series marginally increases the R^2 value to 88% (column 2), suggesting that the average variation in a day is already quite well-captured by swap rates. Including the characteristics of the borrowers leads to only a small improvement in R^2 to a value of 89.6%. Finally, including lender-by-date (rather than date) fixed effects and both lender-by-date and metropolitan statistical area (MSA)-by-date fixed effects increases the R^2 to approximately 92%. Results are similar in panel B, where we include lender-by-msa-by-date fixed effects. In summary, the results reported in Table A.2 suggest that the majority of the variation in mortgage rates is explained by variation in the 10-year swap rate alone. Understanding the variation in the latter series is therefore key to understanding variation in mortgage rates.

Moreover, our use of swap rates as a benchmark for 30-year mortgage rates is also largely driven by their popularity among institutions that hedge Mortage Backed Securities (MBS), including Fannie Mae and Freddie Mac. These two agencies play a significant role in issuing and guaranteeing credit for a large portion of pass-through MBS. They also hold a substantial amount of mortgage loans and MBS in their portfolios. Managing the interest rate risk of their retained portfolio requires them to engage in interest rate swaps, whereby they exchange fixed-rate interest payments for floating-rate payments that more closely reflect their short-term borrowing costs. It is standard industry practice to average the five- and ten-year swap rates to approximate the relevant swap yield, since these maturities enjoy much greater liquidity than other swaps with different maturities. Hedging strategies typically rely on these widely traded maturities, hence their widespread adoption as a reference point (Hancock and Passmore, 2012; Malkhozov, Mueller, Vedolin, and Venter, 2016).[17]

In Section 4.3, we test to what extent our findings on monetary policy transmission reflect changes in the credit risk of the pool of borrowers. To do so, we use the Bankrate.com

application process can take around 30 to 60 days on average, from having your purchase agreement signed through underwriting to closing on the home. In Nov. 2023, it took an average of 47 days to close on a purchase loan, according to ICE Mortgage Technology."

[17]According to Fannie Mae's 10-K, "in measuring the estimated impact of changes in the level of interest rates, we assume a parallel shift in all maturities of the U.S. LIBOR interest-rate swap curve." It follows that a key metric is the duration of the MBS. As an example, as of March 22, 2023, the duration of the 30-year MBS FN MA4993 issued on March 1, 2023, with a coupon of 4% was 7.09, close to the duration of the 10-year swap (8.185) and above the duration of the 5-year swap (4.264).

30-year fixed mortgage rate, that is, the overnight national average (computed after the close of the business day) of rates for ideal mortgages to the "best" borrowers, i.e., those with FICO scores of 740 and with 20% down-payment. By construction, the index keeps the riskiness of borrowers fixed. Moreover, it includes only mortgages made to purchase an existing single-family detached home as a primary residence. Also in this case, the relation between the mortgage series and 10-year swap rates is clear. The correlation between the two series is 94.92%. The correlation between monthly *changes* in the Bankrate.com series and the 10-year swap rate is 80.82%.

Corporate bonds. The Enhanced TRACE data consists of transaction-level information from dealers trading corporate bonds. This information includes the identity of the bonds traded, the date and time of execution, the price, and the volume.[18] We keep regular secondary market trades. We combine these data with Mergent/FISD (*issues* and *issuers* files). From Mergent/FISD we obtain information including the bonds' initial terms for offering, the offering date, maturity, and outstanding principal amount (Seltzer, Starks, and Zhu, 2022). We restrict the sample to US corporate debentures, corporate medium-term notes, and US Corporate Bank Notes. We keep senior unsecured bonds with a fixed coupon rate and drop the observations in which the interest on the issue may be paid in more of the same security or other securities (pay-in-kind). We drop observations for which the issuer was a foreign agent, keeping observations only if the country of domicile was the US and the bond was not issued in a foreign currency. We drop bonds that were privately placed or fell under rule 144a, as well as defaulted bonds and preferred, perpetual, exchangeable, or putable securities. We keep bonds where the remaining time to maturity is between 9 and 11 years, matching the tenor of the swaps. To study the monetary policy response of bonds with issuers in the non-banking sector, we drop instances in which the issuer was in the banking sector, as per the definition of sector 44 in the 48 Fama and French (1997) industry portfolio and where the SIC code of the issuer is missing. We remove the top and bottom 1% of observations by year-quarter.

Figure 2 shows as blue dots all bond yields aggregated at the bond issue-day level,

[18]Trace enhanced has been cleaned using the code by Qingyi (Freda) Song Drechsler available on WRDS. The code follows the suggestions by Dick-Nielsen (2009) and Dick-Nielsen (2014)

with the aggregation of intraday transactions weighted by transaction size. The red solid line is the 10-year swap rate series from Bloomberg, USSA10. The relation between the level of swap rates and the level of bond yields is clear from the figure. An increase in the swap rate appears to be followed by a rapid rise in corporate bond yields, and a decline in the swap rate series is accompanied by a drop in corporate bond yields. However, there are instances, such as during the financial crisis of 2008-2009, where the swap rate series declined, whereas bond yields (especially at the top of the distribution) rose.

We test this relation formally in Table A.3 in the appendix. The table reports the R^2 for different specifications where we regress all our corporate bond yields in our sample against different sets of controls. In column 1, we use the 10-year swap rate as our unique regressor. The swap rate series explains about 43% of the variation in corporate bond yields (column 1). Including date fixed effects rather than the swap rate series increases the R^2 to 55% (column 2), suggesting that the average variation in a day is already quite well-captured by swap rates. However, unlike for mortgages, including time-varying borrowers' characteristics leads to large improvements: adding borrower-by-year-month fixed effects leads to an R^2 of almost 99%. These results suggest that credit risk plays a much larger role in explaining corporate bond yields compared to mortgage rates. Indeed, mortgages are collateralized loans, whereas here we are focusing on unsecured bonds. To provide supporting evidence for the larger role of credit risk and credit risk premia, in Panel B of Table A.3 we consider only AA-rated firms. In this sub-sample, the R^2 computed using swap rates as the only regressor is already 86%, which indeed shows that when credit risk is minimal, the 10-year swap rates capture very well the variation of corporate bond yields.

Credit default swaps. Credit default swaps (CDS) can be viewed as agreements for credit protection, involving periodic payments of the "insurance premium" until a default or credit event. We obtain the CDS data from Markit Group Limited, a company founded in 2001 that collects daily CDS spread quotes from a network of partner banks. Our dataset covers the period from January 2001 to December 2019. We restrict our sample to observations in which the underlying currency is USD, the underlying company is a non-financial company, and where the country of the issuing organization is the US.

The number of underlying companies with available data increased from nearly 204 in 2001 to approximately 912 in 2011 before stabilizing at that level and then decreasing to 710 in 2019. We focus on 10-year contracts, which are the more relevant ones for the pricing of the long-term bonds described above.

4 Response of Private Rates

4.1 Identification and methodology

In studies that focus on identifying monetary policy news using high-frequency data, it is typical to examine variation in interest rates in a time frame of one or two days before and after FOMC announcements. This approach, adopted, among others, by Cook and Hahn (1989), Kuttner (2001), Cochrane and Piazzesi (2002), Bernanke and Kuttner (2005) and Hanson and Stein (2015), assumes that no other factor affects the policy indicator during this period. For all scheduled FOMC days from 2000, we use the days when monetary policy decisions after scheduled meetings became known to the public as reported in Table A.1, and compute daily changes in 10-year swap rates.

Gürkaynak et al. (2005) and Nakamura and Steinsson (2018) propose to use shorter time windows surrounding Federal Reserve policy announcements. Given that between 2011 and 2018 in about half of the FOMC dates the statement release has been followed by a press conference, and that from 2019 all FOMC statement releases have been followed by a press conference, we adopt the following rule. Our high-frequency monetary policy surprise is the change in the 10-year Treasury bond yield (or in online Appendix B in the 10-year swap rate) from 10 minutes before the statement release to 30 minutes after if there was no press conference. On the other hand, if there was a press conference, we compute the change in rates from 10 minutes before the statement release to the end of the press conference.[19] This method is consistent with a recent literature highlighting the importance of the press conference as a channel to communicate monetary policy news, to provide forward guidance to investors, and to affect long-term rates through

[19] We follow Nakamura and Steinsson (2018) and take the difference between the last price observed more than 10 minutes before the FOMC announcement and the first price observed at the end of our window.

term premia (Bundick, Herriford, and Smith, 2017; Swanson and Jayawickrema, 2023).[20]

After having computed our proposed monetary policy shocks, we investigate how they transmit into the mortgage markets. We estimate the response of mortgage rates to high-frequency policy news in the four weeks following an FOMC announcement using panel local projections á la Jordà (2005). Unlike other asset classes, where it is possible to compute price changes over short-time windows and then regress those changes onto the monetary policy news, each mortgage is issued only once. So, we run the following regression:

$$
\begin{aligned}
m_{ijcf,h} = \alpha_{jcf} + \delta X_i + \sum_{k=-5}^{-2} \gamma_{Nk} \mathbb{1}_{h=k} \\
+ \sum_{k=0}^{28} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \gamma_{Pk} \mathbb{D}\ \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Pk} \mathbb{D} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f \\
+ \sum_{k=0}^{28} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f + \sum_{k=-5}^{-2} \beta_{Pk} \Delta s_f\ \mathbb{1}_{h=k}\ \mathbb{D}\ + \sum_{k=0}^{28} \beta_{Pk} \Delta s_f\ \mathbb{1}_{h=k}\ \mathbb{D} + \epsilon_{ijcf,h}
\end{aligned}
\tag{2}
$$

where $m_{ijcf,h}$ is the the mortgage rate for borrower i for a 30-year mortgage issued by lender j in metropolitan area code c on date h around FOMC event f. We vary h from -5 to 28 days after the FOMC event f. In the summations k equal to -1 is excluded, because we take mortgage rates on day -1 relative to the event as the base level. X_i is a set of borrower characteristics, including the level and the square of both the FICO score as well as the loan-to-value (LTV) ratio at origination, whether the mortgage was GSE-eligible, whether it was insured at origination, and whether it was prime or subprime. Δs_f is the absolute value of the FOMC shock around the FOMC announcement f, $\mathbb{1}_{h=k}$ is a dummy variable taking a value 1 if h is equal to k and zero otherwise, $\mathbb{D}$ is a dummy variable taking a value of 1 if the FOMC shock was positive and zero otherwise, allowing us to separately study the response of mortgage rates to

[20] To further support the choice of a slightly longer time window as well as the choice of using changes in 10-year swap rates as a measure of the effects of monetary policy on long-term rates, Figure A.7 shows, as an example, the intraday evolution of the implied rate from the 12-month Eurodollar futures, the 5-year Eurodollar futures, and the 10-year swap rate on July 31, 2019. The black dashed vertical line highlights when the FOMC statement was released (14:00). The shaded area denotes the FOMC press conference. The conference started at 14:30 and lasted for about 45 minutes. From the significant variation observable in asset prices during press conferences we can conclude that press conferences are important events where substantial monetary policy information gets communicated to investors (Swanson and Jayawickrema, 2023).

positive and negative FOMC shocks. The variable ϵ is the error term. We control for lender-by-metropolitan-area-by-FOMC-event fixed effects (α_{jcf}). Standard errors are clustered at the MSA origination year-month level.

To investigate how monetary policy surprises instead transmit into the corporate debt market (corporate bond yields and credit spreads), we can again use panel local projections á la Jordà (2005). However, we can now exploit the fact that we observe the price of the same asset before and after an FOMC event. Therefore, we modify the specification to include security-by-FOMC-event fixed effects:

$$\begin{aligned} y_{if,h} = \alpha_{if} &+ \sum_{k=-5}^{-2} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \gamma_{Pk} \mathbb{D} \; \mathbb{1}_{h=k} \\ &+ \sum_{k=0}^{28} \gamma_{Pk} \mathbb{D} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f + \sum_{k=0}^{28} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f \\ &+ \sum_{k=-5}^{-2} \beta_{Pk} \Delta s_f \; \mathbb{1}_{h=k} \; \mathbb{D} + \sum_{k=0}^{28} \beta_{Pk} \Delta s_f \; \mathbb{1}_{h=k} \; \mathbb{D} + \epsilon_{if,h} \end{aligned} \tag{3}$$

where, depending on the analysis, $y_{if,h}$ is the yield on bond i or the par spread on the CDS i on date h around FOMC event f. We vary h from -5 to 28 days after the FOMC event f. In the summations k equal to -1 is excluded, because we take prices on day -1 relative to the event as the base level. As before, Δs_f is the absolute value of the FOMC shock around the FOMC announcement f, $\mathbb{1}_{h=k}$ is a dummy variable taking value 1 if h is equal to k and zero otherwise, and $\mathbb{D}$ is a dummy variable taking a value of 1 if the FOMC shock was positive and zero otherwise, allowing us to separately study the response of corporate bond yields and CDS spreads to positive and negative FOMC shocks. The variable ϵ is the error term. We control for cusip-by-FOMC-event fixed effects (α_{if}). Standard errors are clustered at the year-month level.

4.2 The impact of monetary policy on mortgage rates

Results using daily changes in 10-year swap rates on FOMC days as a measure of interest rate shocks are reported in Figure 3 panel A. The average response to monetary policy shocks is one-for-one and symmetrical: we are unable to reject the hypothesis that the response to a positive shock is indistinguishable from the response to a negative shock.[21] Our second measure of interest rate shocks comes from intraday changes in 10-year Treasury bond yields around the announcement and the post-announcement press conference. Again, we estimate the response of mortgage rates to monetary policy news in the four weeks following an FOMC announcement and report the results in Figure 3 panel B. The results are very similar to those in panel A. Although the response to negative high-frequency shocks is on average 25 basis points lower in magnitude than the response to positive high-frequency shocks, this difference is statistically insignificant.[22]

We then assess the role of local mortgage lender concentration in our estimates of the response of mortgage rates to monetary policy news. This is important because a large literature argues for the presence of market power in banks' lending markets. This literature suggests that adverse selection and imperfect competition are important drivers of the response of bank lending rates to monetary policy news.[23] To analyze the role of imperfect competition in the transmission of monetary policy, we compute four proxies of local-level mortgage lender concentration or market power: a) Herfindahl-Hirschman index based on all loans approved in a FIPS county; b) the market share of the top 4 lenders in a county; c) a county-level measure of excess demand for mortgages whose relation with markups is predicted by several canonical models of implicit collusion (Rotemberg and Saloner, 1986; Rotemberg and Woodford, 1992); d) the component of the mortgage interest rate above and beyond what can be explained by borrower's and loan's characteristics aggregated at the zip3 level.

For each of the four measures, we classify geographical areas into quintiles by year and quarter creating a matrix Q with the five dummy variables stacked together. We expand (2) by interacting each of the dummy variables with the quintile matrix Q. This allows us to compute and compare the monetary policy pass-through in areas of low market power against the pass-through in areas of high market power.

[21]In Figure A.8 we repeat the analysis for the entire sample starting from 2000 excluding FOMC days coinciding with macroeconomic announcement days: we show the robustness of our results. From Bloomberg, we downloaded the economic calendar for the US focusing on news about GDP, consumption, PCE, and CPI, and excluded those FOMC days coinciding with any day in which news on any of those 4 macro variables was released.

[22]Figure A.23 shows the results with respect to the Nakamura and Steinsson (2018) shocks. Surprises in rates up until 1 year do not necessarily transmit to the mortgage market.

[23]For recent examples see Scharfstein and Sunderam 2016; Crawford et al. 2018; Wang et al. 2022).

1. Herfindahl-Hirschman index. The Home Mortgage Disclosure Act (HMDA) mandates that the vast majority of mortgage lenders in the United States furnish information to regulatory bodies regarding the loan, property, and borrower attributes of every mortgage application: the HMDA data are the most comprehensive publicly available information on mortgage market activity. Among the data that must be reported are the specifics of the loan, including loan size, type, and action taken, as well as property characteristics including property type, occupancy status, state, county, and census tract.

We focus on all loans originated and link them to the parent company using the HMDA panel files by year. We sum all loans by parent company and county FIPS and compute the HHI at the county level for each year. Panel A of Figure A.11 reports the histogram of county-level HHI in our sample, whereas panel B shows the spatial variation of average HHI over time. Each year, we sort all counties by their HHI, creating the matrix of quintile dummies Q, and then estimate the expanded version of (2). Figure A.12 shows the results. We do not observe a significantly different response to monetary policy news in high-HHI areas relative to low-HHI areas (5th vs 1st quintile) regardless of whether we focus on the response to a positive or negative rate surprise.

2. Share of the top 4 lenders by county. We follow Scharfstein and Sunderam (2016) and compute from the HMDA data the market share of the top 4 lenders in a county as a measure of concentration. For each county-year, we sort all lenders based on the values of loans originated and compute the ratio between the total amount of mortgages originated by the top four lenders and the total amount of mortgages originated by all lenders in that geographical area. Each year, we sort all counties according to this concentration measure, creating the quintile dummy matrix Q. We then estimate the expanded version of (2). Figure A.13 shows the results. We do not observe a different response to monetary policy news in high-concentration areas relative to low-concentration areas (5th vs 1st quintile).

3. Excess demand. From HMDA data, we define *loans approved* as the sum of all loans originated and applications approved but not eventually accepted by the borrower (*action taken* equal to 1 and 2). We then define *loans denied* as the sum of applications denied by financial institutions and files closed for incompleteness (*action taken* equal to 3 and 5). In a given FIPS county and year, *excess demand* is compute as (loans approved+loans denied)/loans approved. Each year, we sort all counties by their excess demand, creating the matrix of quintile dummies Q, and then estimate the expanded version of (2). Results are shown in Figure A.14. We do not observe a different response to monetary policy news in high-excess-demand areas relative to low-excess-demand areas (5th vs 1st quintile).

4. Interest rate residual by zip3. We want to compute a measure of how expensive is the average loan in an area after adjusting for borrowers' characteristics, loans' characteristics, and the time of origination. To eliminate the influence of borrower and loan characteristics on mortgage rates, we follow Hurst, Keys, Seru, and Vavra (2016) and use loan-level microdata from the Federal Home Loan Mortgage Corporation (Freddie Mac) to estimate the following equation:

$$r_{ikt} = \alpha_0 + \alpha_1 X_{it} + \alpha_2 D_t + \alpha_3 D_t \cdot X_{it} + \eta_{ikt}, \tag{4}$$

where r_{ikt} is the mortgage rate for borrower i in MSA k in year-quarter t. X_{it} is a set of control variables for borrower i in period t including the level and square of the FICO score and LTV ratio. D_t is a vector of time dummies representing the quarter of origination. The residuals obtained from these equations represent the spatially adjusted mortgage rates for a borrower in an MSA for a given quarter. Using the residuals from the previous regression η_{ikt}, we compute

$$R_{kt} = \frac{1}{N_{kt}} \sum_{i=1}^{N_{kt}} \eta_{ikt}, \tag{5}$$

for an MSA k and year-quarter t.

R_{kt} represents the average difference between the observed mortgage rate for loans made in that MSA and the mortgage rate predicted by the borrower and loan characteristics and time fixed effects. N_{kt} is the number of loans originated in MSA k at time t. Figure A.15 shows the spatial variation of R_{kt} averaged over time. Each quarter we then sort MSAs into 5 quintiles based on the value of R_{kt}, and create the matrix of dummy variables Q so as to estimate the expanded version of (2). Results are in Figure A.16. Again, we do not observe a different response to monetary policy news in high-interest-rate-residual areas relative to low-interest-rate-residual areas (5th vs 1st quintile).

4.3 Self-selection of borrowers and prepayment option value

One may wonder to what extent the self-selection of borrowers or changes in the mortgage prepayment options after monetary policy announcements influence our results. For instance, adverse selection suggests that riskier borrowers borrow more after an increase in rates, so the response in actual transacted rates we observe in Figure 3 may reflect changes in the credit risk of the pool of borrowers. Therefore, we first examine the role of endogenous self-selection of borrowers for our results, and then the role of mortgage prepayment options.

To examine whether our results are driven by a potential self-selection mechanism, we estimate a version of (2) using the Bankrate.com 30-year fixed mortgage rate. In particular, let m_h be the Bankrate.com mortgage rate on a given date h around the FOMC event f and the other variables be defined as in (2). The mortgage series now only has a subscript h for the day because it is the daily national average of 30-year mortgage rates across all lenders and borrowers of fixed (ideal) characteristics. We estimate

$$\begin{aligned} m_h = \alpha_f &+ \sum_{k=-5}^{-2} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \gamma_{Pk} \mathbb{D}\ \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Pk} \mathbb{D} \mathbb{1}_{h=k} \\ &+ \sum_{k=-5}^{-2} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f + \sum_{k=0}^{28} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f + \sum_{k=-5}^{-2} \beta_{Pk} \Delta s_f\ \mathbb{1}_{h=k}\ \mathbb{D} \\ &+ \sum_{k=0}^{28} \beta_{Pk} \Delta s_f\ \mathbb{1}_{h=k}\ \mathbb{D} + \epsilon_h. \end{aligned} \tag{6}$$

Figure 4 shows the result and provides evidence against the hypothesis that the self-selection of borrowers after monetary policy announcements drive our findings. Indeed, we observe that the Bankrate.com mortgage interest rates, i.e., survey data, respond immediately to changes in swap rates on FOMC days. The magnitude is very similar to our benchmark specification reported in Figure 3. However, the speed of adjustment here is faster because Bankrate.com rates are quoted rates whereas in Figure 3 we use transacted mortgage rates on the date the mortgage deed is signed.

To confirm our findings, in the appendix, we also use RateWatch data. RateWatch surveys bank branches throughout the US to collect data on a broad range of consumer loan products. Their data go back to 2001 and contain details such as the date the survey was conducted, the particulars of various loan agreements (including interest rates), and the branch responsible for determining the interest rate. Rates refer to ideal mortgages to the "best" borrowers, i.e., those with exceptional FICO scores, for a particular constant loan volume of $175K with 20% down-payment.[24] However, each bank is surveyed only once a month regarding the price of their mortgages so the analysis is coarser than the one using data from Bankrate.com.

We group rates by product category and consider only fixed-rate mortgages. We estimate (2) while modifying the fixed effects in all specifications to account-number-by-MSA-by-FOMC-event fixed effects. However, rather than doing the analysis at a daily frequency, because the survey is conducted monthly for each branch level, we group observations in 3 separate windows. The first window includes dates between the day of the FOMC announcement and 14 days after the announcement. The second window includes dates between 15 and 23 days after the FOMC announcement. Finally, the third window is the pre-period from 10 days before the FOMC announcement to 1 day before. Table A.4 reports our estimates. In all cases, we find that quoted rates respond to changes in swap rates on FOMC days. Our findings provide evidence against the hypothesis that endogenous self-selection of borrowers after monetary policy announcements drives our findings.

Regarding the impact of changes in prepayment option values, our analysis shows a symmetrical, one-for-one response of mortgage rates to shifts in interest rates. This pattern already suggests a limited role of prepayment option value fluctuations on our findings. Specifically, if changes in prepayment option values were large, we would expect to observe a differential response to positive and negative interest rate shocks.

[24]The credit score cutoff is for most banks 740 or higher, e.g., Bank of America.

However, to directly test for the hypothesis that variation in prepayment option values could influence our observations regarding monetary policy news, we include the 10-year Treasury implied volatility series as computed by Choi, Mueller, and Vedolin (2017) as a control variable in our benchmark estimation (2). The implied volatility computed by Choi et al. (2017) is the one-month implied volatility from the 10-year Treasury future options, but given that the first principal component of implied volatility explains a very large fraction of implied volatility across the term structure, this measure is a good proxy for longer maturities as well. The results are reported in Figure A.17 showing an almost identical response of mortgage rates to the one reported in Figure 3. This result provides evidence against the hypothesis that changes in prepayment option values in response to monetary policy shocks lie behind the magnitude of our estimates.

4.4 *The impact of monetary policy on corporate funding costs*

In this section, we study the role of financial frictions and firm heterogeneity in the transmission of monetary policy surprises to the cost of firms' external financing as proxied for by corporate bond yields. Evaluating the response of corporate bonds separately from bank loans is important because the two assets are not perfect substitutes. Among others, the main differences are: a) corporate bonds are less flexible, and their terms are harder to renegotiate than bank loans; b) bank loans are extended by highly-leveraged intermediaries with significant liquidity mismatches; and c) more generally, bonds and loans have different contractual features. It's therefore unclear from the previous results how bond pricing contributes to transmitting aggregate shocks such as monetary policy. We use secondary market prices on corporate bonds and CDS to shed light on this question.

We first estimate (3) using corporate bond yields from TRACE. The equation includes bond-cusip-by-FOMC fixed effects to control for all unobserved characteristics of the bond in the 1-month window surrounding an FOMC announcement. Panel A of Figure 5 shows the results. Unlike mortgages, secondary market yields respond immediately to rate shocks. More importantly, we observe an asymmetry, with a larger response of corporate bond yields to negative rate surprises. The response to positive shocks is 1-to-1 and stabilizes after 4 days. However, the response to negative shocks is 1-to-1 only in the first week after the announcement and then slowly converges to a 2-to-1 response. Yet, the difference between the absolute magnitude of positive and negative responses is statistically insignificant with a t-statistic of -1.14.[25] Panel B of Figure 5 shows the results when using the high-frequency change in 10-year Treasury bond yields. The results are qualitatively similar, although the confidence interval for the estimates of the monetary policy response to a positive change in rates is larger, which makes the estimates statistically insignificant 5 days from the announcement.

We then test whether the response depends on the bond's credit ratings. Using the complete cusip, (issue and issuer cusip), issue name, issuer id, maturity, and offering date, we merge the universe of bonds in Mergent/FISD with the rating file that Mergent provides. We separate all bonds for which we have a rating into investment-grade and speculative-grade bonds using the most recent credit rating issued before the transaction date. Figure 6 shows the results. Speculative grade bonds appear to respond more strongly to negative news in long-term rates, with their yields dropping by a larger amount. On the other hand, the response to positive shocks is weaker for speculative-grade bonds with yields increasing only in the few days after the FOMC announcements and then becoming statistically indistinguishable from 0.

Finally, we test the response of Credit Default Swaps (CDS) to monetary policy surprises. Krishnamurthy and Vissing-Jorgensen (2011) have shown an effect of quantitative easing in reducing the default risk of companies as measured by CDS spreads. We find that a drop in rates has been accompanied by a drop in credit risk, while we do not observe an increase in CDS spreads after a positive monetary policy surprise (Figure 7). Panel B Figure 7 shows that the negative response is more pronounced for the Credit Default Swaps of B-rated non-financial firms. More generally, we consistently observe a stronger response when we pass from a higher to a lower credit rating grade.

Overall, we show that the corporate bonds of companies with low ratings were the most sensitive to monetary shocks and that most of the effect went through a change in the credit risk of these companies. These results are complementary to Ottonello and

[25] Figure A.23 shows the results with respect to the Nakamura and Steinsson (2018) shock. Surprises in rates up until 1 year do not necessarily transmit to long-term bond yields.

Winberry (2020), who document that firms with low default risk invest more in response to monetary shocks. They highlight that highly rated firms invest more in response to monetary policy surprises because they face a flatter marginal cost curve for financing investment, which is indeed consistent with what we observe.

4.5 Decomposing long-term monetary policy news in expected future rates and term premia

Our analysis proceeds in two steps. First, we decompose swap rates into expected future interest rates, term premia, and a residual component that reflects characteristics specific to swap rates compared to Treasuries. We then evaluate how each of these components influences long-term mortgage rates and corporate bond yields. Second, we conduct a variance decomposition to understand how mortgage rates and bond yields respond to FOMC announcements.

Let i_t be the 1-year zero rate between year t and $t+1$ and i_t^m the zero rate at time t for m years, we can decompose i_t^m as

$$i_t^m = \underbrace{E_t \frac{1}{m} \left\{ \sum_{j=0}^{m-1} i_{t+j} \right\}}_{EI} + \phi_t^m, \tag{7}$$

where EI stands for expected future interest rates, and ϕ_t^m is the term premium, which compensates investors in long-term bonds for risks such as interest rate and inflation risk. Our measures of expected future short interest rates and term premia from Treasury yields come from Adrian et al. (2013).

As mentioned, we first regress the daily change in the 10-year swap rate on FOMC days onto the daily change in expected future interest rates, term premia:

$$\Delta s_t = \alpha + \beta_{\text{EI}} \Delta \text{EI}_t + \beta_\phi \Delta \phi_t^{10} + \eta_t, \tag{8}$$

where t is the FOMC event and η is the regression residual. Residuals, which are orthogonal to the two regressors by construction, represent all other factors affecting swaps but not captured by EI or ϕ. The residual term can capture the fact that 10-year swap rates are par yields whereas the two factors are constructed from zero-coupon yields, i.e., small differences in duration, but it can also capture frictions specific to the banking sector or treasury convenience yields relative to swap rates. Table 2 reports the estimates from (8). The two factors explain about 84% of the variation in 10-year swaps on FOMC days.[26] The decomposition of the time series of changes in 10-year swap rates in expected short-term rates and term premia is plotted in Figure A.18.

We then extend (2) and (3) to include together ΔEI, $\Delta\phi$ and η, separating between positive and negative swap rate changes on FOMC days. The results are in Figure A.21 and Figure A.22. Mortgage rates appear to respond consistently to all three components. These results are in contrast to the statements made by the president of the Federal Reserve Bank of New York, John Williams, that the Large-Scale Asset Purchase and Maturity Extension Program "term premium effect is idiosyncratic to Treasury markets and does not fully pass through to private rates."[27] With respect to corporate bond yields, we find that they also respond to all three components. The difference comes from the persistence of the effect. In fact, after a positive shock in 10-year swap rates, only the response of corporate bond yields to the expected short rate component lasts for a few weeks, whereas the response to term premia and the residual component dies out quickly.[28]

We also provide a variance decomposition of the changes in mortgage rates and bond yields around FOMC announcements. For mortgages, we focus on the changes in the Bankrate.com interest rate series from 1 day before the announcement to 1 day after. For corporate bond yields, we compute the daily change of Moody's seasoned Aaa and Baa corporate bond yields on FOMC days. Let the change in our variable of interest v be given by:

$$\Delta v = \beta_{v,r}\Delta r + \beta_{v,ER}\Delta ER + \beta_{v,\phi}\Delta\phi + \beta_{v,cy}\Delta cy + \varepsilon. \quad (9)$$

[26]For comparison, the two factors explain 69% of the variation in our high-frequency shock, i.e., the intraday change in the 10-year Treasury bond yields.

[27]FOMC transcript.

[28]In Figure A.19 and Figure A.20 we repeat the same exercise for the response of mortgage rates and corporate bond yields, but we decompose swap rates into the sum of two terms: government bond 10-year par yields and the difference between 10-year swap rates and the 10-year government par yields. In particular, the difference between 10-year swap rates and 10-year government par yields is a direct proxy of treasury convenience for the 10-year tenor. Both components are significant both in statistical and economical terms. This adds to the evidence that each component that is important enough to drive variation in swap rates will indeed capture a response similar to the one estimated for swap rates directly.

We apply the following variance decomposition

$$
\begin{aligned}
1 = & \frac{Cov(\Delta v, \beta_{v,r}\Delta r)}{Var(\Delta v)} + \frac{Cov(\Delta v, \beta_{v,ER}\Delta ER)}{Var(\Delta v)} \\
& + \frac{Cov(\Delta v, \beta_{v,\phi}\Delta \phi)}{Var(\Delta v)} + \frac{Cov(\Delta v, \beta_{v,cy}\Delta cy)}{Var(\Delta v)} + \frac{Cov(\Delta v, \varepsilon)}{Var(\Delta v)}.
\end{aligned} \tag{10}
$$

Table 3 reports our estimates together with the percentiles from a non-parametric bootstrap. We randomly sample the periods with replacement, and to capture the sampling uncertainty of the original sample, the size of the resampled data is the same as the size of the original data. In each bootstrapped sample, we estimate the relative contribution of expected short-term interest rates, term premia, convenience yields, and short-term rates and retain the distribution of the estimates.

Expected short rates explain 20.5% of the 2-day change in mortgage rates, whereas term premia account for 15.6%, and treasury convenience yields for 6.5%. The Nakamura and Steinsson (2018) shock does not explain any of the variation in mortgage rates once the other factors are controlled for. The results for corporate bond yields are very different as far as expected short rates, term premia, and convenience yields are concerned. For both AAA and BAA corporate bond yields, changes around FOMC announcements are mostly explained by term premia, whereas almost none of the variation comes from changes in convenience yields. In particular, for AAA bond yields 52% of the change in yields around FOMC announcements can be attributed to changes in term premia, whereas for BAA bond yields, 66% of the change in yields around FOMC announcements can be attributed to changes in term premia. This finding is consistent with Hanson and Stein (2015) and Leombroni, Vedolin, Venter, and Whelan (2021). Expected short interest rates explain about 15% of the changes in corporate bond yields for both AAA and BAA. Neither changes in Treasury convenience yields nor the Nakamura and Steinsson (2018) shock can explain the variation in the daily change in corporate bond yields around FOMC announcements.[29]

[29] Table A.6 presents the variance decomposition of monthly changes in mortgage rates and corporate bond yields. There are some significant differences from the variance decomposition results around FOMC announcements shown in Table 3. First, 70% of the monthly changes in mortgage rates can be explained by variation in expected short rates, term premia, and convenience yields against 42% of the two-day changes in mortgage rates around FOMC announcements. Second, about 50% of the variation in Moody's Baa corporate bond yields can be explained by expected short rates, term premia,

5 Implications for bank net worth

A central idea in modern banking theory is that banks provide *maturity transformation* services, i.e., banks borrow funds on a short-term basis and lend them to borrowers on a longer-term basis (Diamond and Dybvig, 1983; Diamond, 1984; Gorton and Pennacchi, 1990; Diamond and Rajan, 2001; Kashyap, Rajan, and Stein, 2002). This implies that banks' profits are influenced by movements in both short- and long-term rates, invalidating the sole reliance on a single market interest rate to evaluate a bank's exposure to monetary policy news (Hancock, 1985). While previous studies have used a single short-term interest rate to estimate banks' sensitivity to interest rates (Samuelson, 1945; Drechsler et al., 2021), we recommend distinguishing between short- and long-term rates and considering both sets of rates when evaluating how a bank's wealth responds to monetary surprises.

Both short-term and long-term monetary policy surprises can affect banks' equity valuations through two channels: discount rates and cash flows. When interest rates increase, future cash flows are discounted more heavily, leading to declining market values. However, if banks reprice their assets in the near future and secure funding from relatively stable and sleepy sources, they can reap benefits from the widening gap between the long-term rates they charge on their assets and the short-term rates associated with their funding costs (the *term premium* effect on cashflows suggested by Paul, 2023).[30]

Figure 9 shows the results of regressing Fama and French (1997) 49 industry portfolios on the changes in 10-year swaps on FOMC days controlling for Kuttner (2001) federal-funds shocks, which captures movements in the short-term rates:

$$R_{jt} = \alpha + \beta_j \Delta s_t + \gamma_j \Delta \mathrm{FF}_t + \epsilon_{jt}, \tag{11}$$

and convenience yields against 80% of the daily variation in Moody's Baa corporate bond yields around FOMC announcements. This second result is consistent with the findings of Section 3 showing that changes in credit spreads are key to understanding the variation in corporate bond yields. Third, the monthly variation in the term premia explains most of the monthly variation in both the mortgage rates and the yields of corporate bonds.

[30]Interestingly, Paul (2023) notices that an increase in the term premium leads to higher net interest margins for banks, while non-financial firms are unlikely to experience such an effect: most firms face increased interest expenses due to higher term premia, causing a decline in cash flows. As a result, bank stock returns tend to respond more positively than those of non-financial companies following an increase in the term premium via the cash-flow channel.

where R_{jt} us the daily return for industry j on FOMC day t, Δs is the change in 10-year swap rates in FOMC days, and ΔFF is the Kuttner (2001) shock. Considering all the dates in our analysis, we find that banks are positively exposed to an increase in long-term rates, although the coefficient is small in magnitude and statistically insignificant. However, the results are remarkably large in magnitude and significance when we exclude the three scheduled Quantitative Easing 1 (QE1) FOMC announcements from the sample: these three particular dates stand out as they coincide with the two most significant declines in 10-year swaps, but they also indicate substantial support for the financial sector during periods of banking turmoil, undeniably representing positive news for banks.[31] Once we remove the three observations of QE1, the banking industry shows the highest exposure to shocks in long-term rates, with a positive and significant coefficient of 7.29. This implies that bank stocks increase by 7.29% for every 1% positive shock to the 10-year swap rate. On the other hand, the exposure to short-term rates (fed funds shocks) is negative (-3.527), consistent with the estimate of Drechsler et al. (2021).

To better understand the mechanism, we now calculate the exposure of publicly traded commercial banks to monetary policy news using individual bank-level data. For all FOMC days, excluding QE1 events, we regress individual bank daily stock returns onto the change in swap rates and the Kuttner (2001) fed fund futures shock (ΔFF). We model the individual bank's exposure to swap changes as a linear function of the bank's characteristics (X_{it}). In all specifications, we include bank-level fixed effects. Standard errors are clustered at the FOMC level. Table 4 reports the estimates for the following equation

$$R_{it} = \beta_{0i} + \beta_{FFi} \times \Delta FF + \beta_x \times X_{it} + \beta_s \times \Delta s + \beta_{sx} \times X_{it} \times \Delta s + \epsilon_{it}, \qquad (12)$$

both in the case of no weight (columns 1, 3, and 5) and for a WLS using the natural logarithm of the bank's assets as weight (columns 2, 4, and 6). We confirm the positive relationship between changes in swap rates and bank stock returns. Once we include the fraction of loans repricing in the next year as a determinant of the bank's exposure

[31] Figure A.26 shows the scatterplot of the bank's daily returns on FOMC days against the daily change of 10-year swap rates for all dates, including QE1 events. The two top-left points refer both to QE1 scheduled FOMC announcements.

to rates, we see that banks with a larger fraction of loans repricing in the short term benefit the most from increased rates. Using the fraction of government securities with a remaining maturity or next repricing date of 1 year or less provides qualitatively similar, but statistically insignificant results. When we also control for the bank's equity ratio we see that banks with a higher equity ratio benefit more from increases in long-term interest rates.

Our findings have significant implications in the context of existing research that highlights how monetary policy surprises can impact the real economy through their effects on banks' net worth (Gertler and Kiyotaki, 2010; He and Krishnamurthy, 2013; Brunnermeier and Sannikov, 2014; Ottonello and Song, 2022). Specifically, our results shed light on the positive impact of news about long-term rates on the banking sector and banks' shareholders. In contrast to changes in short-term rates that do not always translate into equivalent changes in banks' funding costs, particularly when banks have significant market power in deposits markets (Hannan and Berger, 1991; Neumark and Sharpe, 1992; Drechsler et al., 2017), we have documented rate shocks affecting the long end of the term structure and banks' assets. Our findings confirm the hypothesis of a cash-flow-driven positive response of banks' stock returns to long-term rates.

6 Conclusion

Much of the academic and practitioner literature in economics studies the impact of the Federal Reserve's monetary policy by focusing on innovations in the Fed's short-term policy rate. In this paper we argue that this approach of using changes in expected (very) short-term interest rates computed in a narrow time window surrounding FOMC rate announcements fails to capture the effect that announcements and press conferences have on long-term interest rates. Given that these long-term interest rates are what ultimately drive the private rates that matter to households and firms, this approach has inadvertently underestimated the impact of monetary policy on the wider economy.

Instead, in this paper, we examine the impact of monetary policy transmission on the long-term liabilities of households and firms, using high-frequency changes in 10-year swap rates surrounding FOMC announcements. We find that this alternative approach leads to substantially different inferences and conclusions regarding the effect of monetary policy. First, we find that mortgage rates respond one-to-one to monetary policy announcements in the four weeks after an announcement. More importantly, we find no evidence for the hypothesized distortionary role of local mortgage market concentration, bank market power, or variation in credit spreads on monetary policy transmission.

Second, regarding corporate bond yields, we do find an important role for credit spreads in the transmission of monetary policy to the debt funding cost of corporations, particularly for rate cuts.

Third, when we decompose our newly defined monetary policy shock into the innovations in expected short-term rates, term premia, and convenience yields, we find that while the majority of the response of mortgage rates to monetary policy news is due to changes in expected future rates, it is the term premium that plays the largest role in the context of corporate bond yields.

Finally, we study the implications of our findings for banks' net worth. Outside of unconventional monetary policy interventions, the banking industry is positively exposed to shocks in long-term rates, with bank stocks increasing by 7.29% for every 1% positive surprise to the 10-year swap rate. Our findings are explained by a cash-flow channel: if banks reprice their assets in the near future and secure funding from relatively stable and sleepy sources (an important reason can be the market power in the deposit market, Drechsler et al., 2017), they can reap benefits from the widening gap between the long-term rates they charge on their assets and the short-term rates associated with their funding costs.

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Table 1. Summary statistics mortgage sample

Panel A

	N	average	st.dev.	p10	p25	p50	p75	p90
Initial interest rate	6,602,283	5.40	1.173887	3.875	4.375	5.5	6.375	6.875
FICO score at origination	5,746,342	743.08	51.65227	670	710	754	784	800
original loan-to-value ratio	6,587,350	80.38042	14.012	62.8	77.07	80	90	95
original term	6,602,283	360	0	360	360	360	360	360

Panel B

GSE-eligible	Non-conforming (5.14%)	Conforming (92.14%)	Jumbo conforming (2.73%)
Inferred Collateral type	Prime (92.17%)	Subprime (3.97%)	No info (3.85%)
Mortgage insurance	No (64.30%)	Yes (29.23%)	No info (6.47%)

Notes: The table reports the summary statistics for the sample of mortgages from Corelogic. Data span January 2000 to December 2019.

Table 2. Estimates from regressing changes in 10-year swap rates on Adrian et al. (2013) measures of expected short-term interest rates and term premium

	Δs
Term premium	0.789***
	(0.083)
Expected short-term interest rates	1.195***
	(0.074)
Constant	-0.005*
	(0.002)
Observations	160
Adjusted R^2	0.841

Notes: This table presents the regression coefficient estimates from (8). Standard errors are in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively. The sample is from January 2000 to December 2019 and includes 160 scheduled FOMC announcements.

Table 3. The impact of expected short-term interest rates, term premia, and convenience yields on mortgage and corporate bond rate responses to monetary policy

Decomposition of the response of Bankrate.com mortgage interest rate to monetary policy

Percentiles	5	10	25	50	75	90	95
Expected short rates	8.04	10.38	14.99	20.52	27.31	32.53	35.38
Term premia	6.12	8.07	11.40	15.57	20.32	24.95	27.55
Convenience yield	0.14	0.82	3.10	6.45	10.76	14.78	17.60
Nakamura-Steinsson	-4.62	-3.61	-2.21	-0.05	2.63	5.22	6.96

Decomposition of the response of Moody's Aaa corporate bond yields to monetary policy

Percentiles	5	10	25	50	75	90	95
Expected short rates	8.89	10.32	12.75	15.65	19.08	22.06	24.22
Term premia	37.29	40.36	46.28	51.95	56.90	62.28	65.63
Convenience yield	-2.59	-1.76	-0.83	-0.12	0.38	1.29	1.97
Nakamura-Steinsson	-0.92	-0.65	-0.17	0.54	1.79	3.16	4.20

Decomposition of the response of Moody's Baa corporate bond yields to monetary policy

Percentiles	5	10	25	50	75	90	95
Expected short rates	7.16	8.71	11.51	14.99	18.74	23.05	24.74
Term premia	53.91	56.10	60.52	65.52	69.74	73.11	75.28
Convenience yield	-3.91	-2.80	-0.93	0.73	2.40	4.23	5.16
Nakamura-Steinsson	-2.06	-1.70	-1.00	-0.34	0.22	1.04	1.53

Notes: This table presents the contribution of expected short-term interest rates, term premia, convenience yields and the Nakamura and Steinsson (2018) shock to the response of mortgage rates and corporate bond yields to monetary policy. The sample is from January 2000 to December 2019. The percentiles are computed using non-parametric bootstrap.

Table 4. The relation between individual bank holding company stock returns and the 10-year interest rate swap changes on FOMC days

Dependent variable:	Stock returns					
	(1)	(2)	(3)	(4)	(5)	(6)
Δs	4.749***	5.191***	1.427	1.612	0.070	0.089
	(1.790)	(1.838)	(1.302)	(1.318)	(1.302)	(1.252)
ΔFF	-3.127	-3.289	-3.329	-3.487	-3.315	-3.468
	(3.487)	(3.676)	(3.094)	(3.399)	(3.097)	(3.405)
Loans repricing in 1 year × Δs			5.980**	6.417**	5.751**	6.196**
			(2.904)	(2.910)	(2.846)	(2.865)
Gov. sec repricing in 1 year × Δs			1.879	2.149*	1.614	1.907
			(1.241)	(1.232)	(1.157)	(1.160)
Equity-ratio × Δs					14.468*	16.068*
					(7.545)	(9.073)
Control	No	No	Yes	Yes	Yes	Yes
Permno fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Weighted by log(Assets)	No	Yes	No	Yes	No	Yes
R^2	0.03	0.03	0.03	0.03	0.03	0.03
Observations	95,720	95,720	88,818	88,818	88,818	88,818

Notes: This table presents the sensitivity of individual bank stock returns to changes in 10-year swap rates on FOMC days excluding the 3 scheduled QE1 dates listed by Krishnamurthy and Vissing-Jorgensen (2011) and van Binsbergen et al. (2022):

$$R_{it} = \beta_{0i} + \beta_{FFi} \times \Delta FF + \beta_x \times X_{it} + \beta_s \times \Delta s + \beta_{sx} \times X_{it} \times \Delta s + \epsilon_{it}.$$

We control for the Kuttner (2001) shocks. For each column we also control for the same variables interacted with Δs. Columns (2), (4), (6) show the results for WLS using market capitalization as weight. All bank characteristics refer to 1 quarter before the FOMC announcement. Standard errors are clustered at the FOMC-day-level and are robust to heteroscedasticity. ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

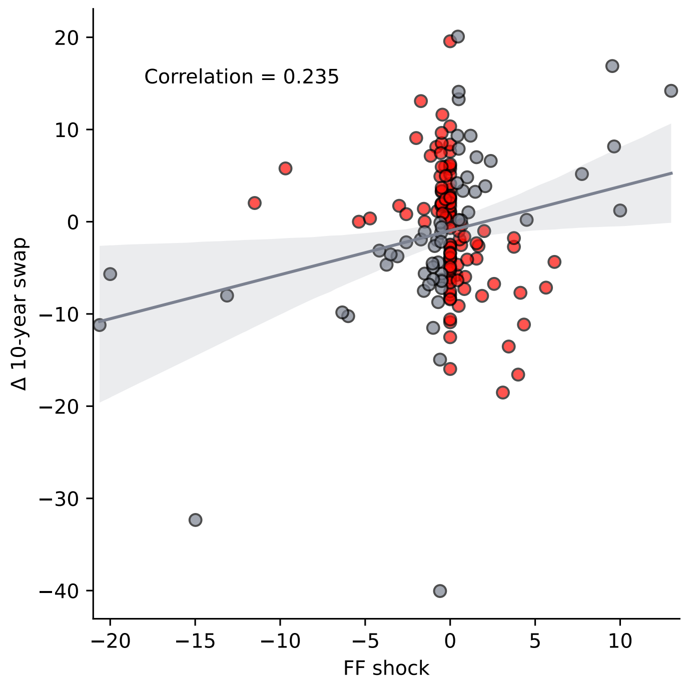
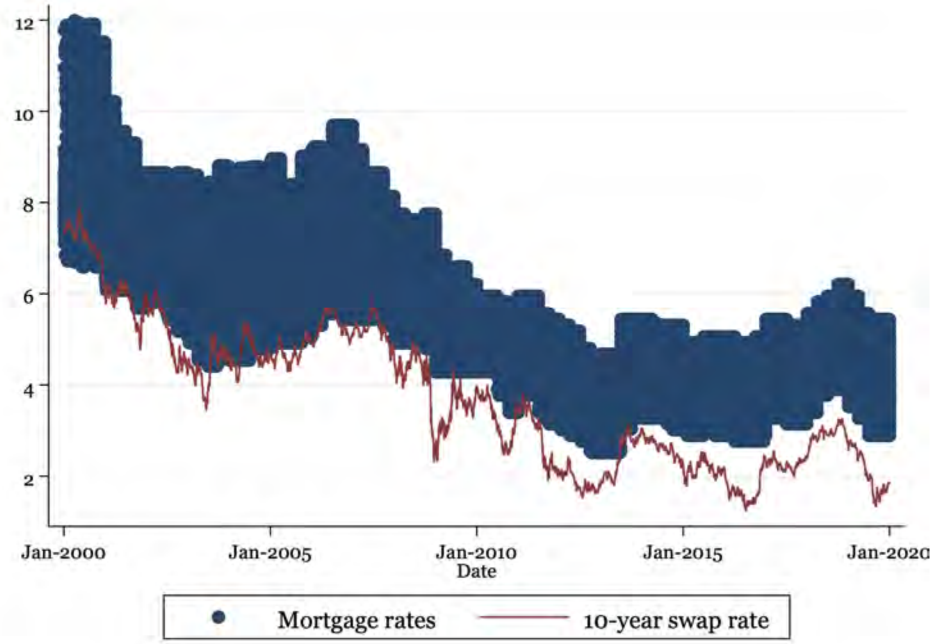


Fig. 1. *Notes*: The figure shows the scatterplot of the changes in 10-year swap rates on FOMC days against changes the Kuttner (2001) Federal funds rate shock computed by Acosta (2022). Values are expressed in basis points. The grey dots represent FOMC events for which the changes in 10-year swap rates on FOMC days and Kuttner (2001) shocks shared the same sign. The red dots are events in which the two shocks had opposite signs. The sample includes all scheduled FOMC meetings from February 2, 2000 to December 11, 2019.

Panel A: Mortgages



Panel B: Non-financial corporate bonds

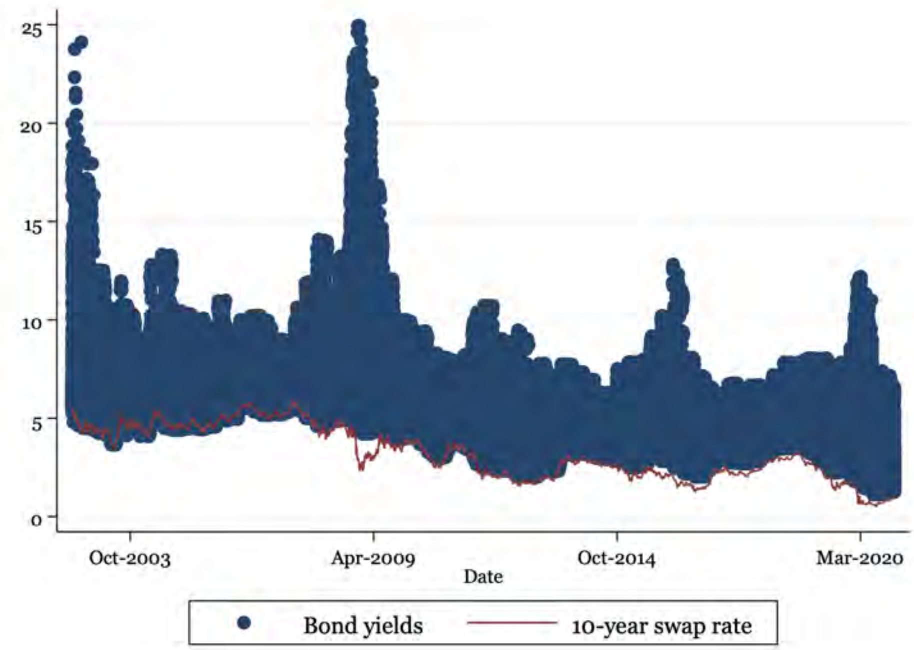
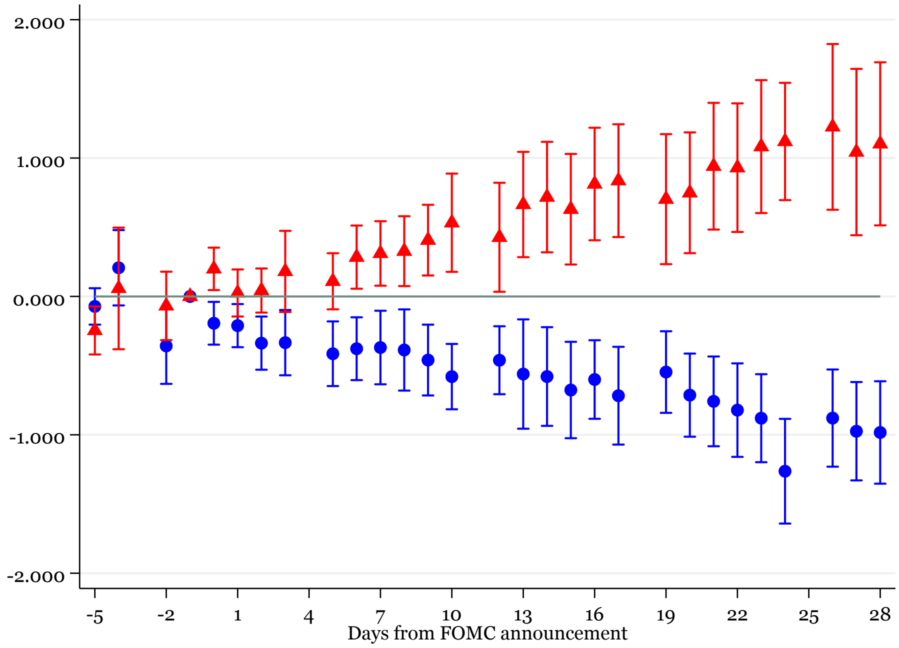


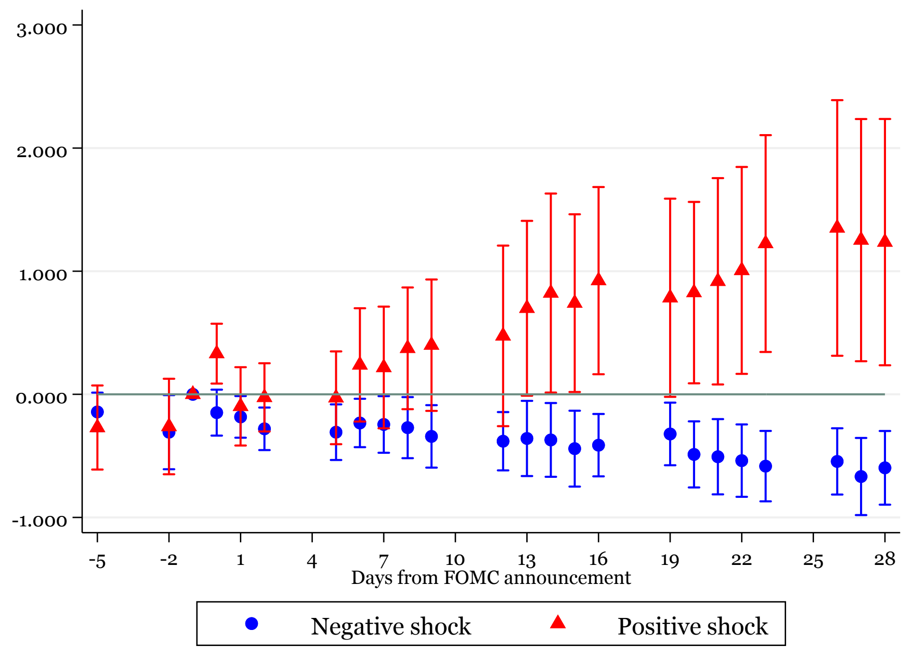
Fig. 2. *Notes*: The figure shows individual 30-year fixed mortgage rates (dated by borrower's signature) in Panel A, and daily corporate bond yields (dated at transaction) in Panel B, both compared against the daily 10-year swap rate.

Fig. 3. **Response of mortgage interest rates to daily and intradaily FOMC shocks**

Panel A: daily changes in 10-year swap rates

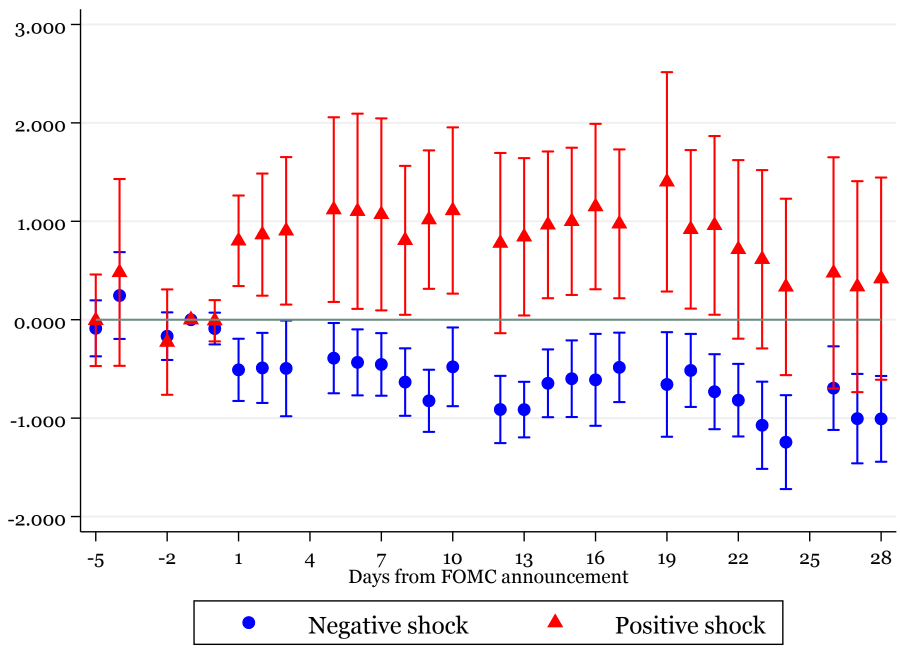


Panel B: intradaily changes in 10-year Treasury bond yields



Notes: The figure reports the slope coefficient β and 95%-confidence interval from (2). The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at MSA $\times$ origination year-month level. The sample consists of all the conventional loans (not originated under a government program) where the borrower's stated purpose is to purchase a property and the property type is either a condominium or single-family residence. Data span from January 2000 to December 2019.

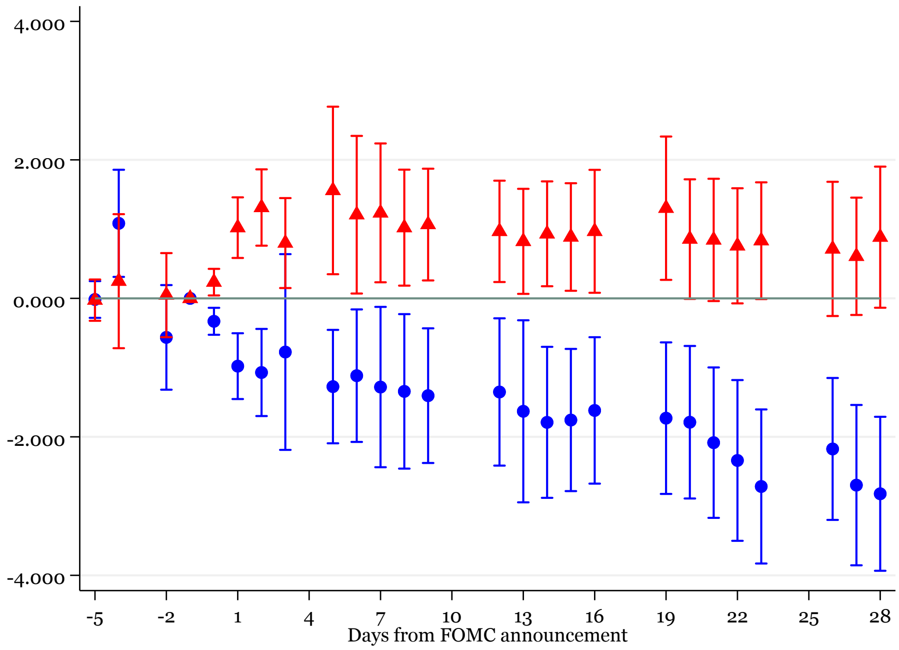
Fig. 4. **Response of Bankrate.com mortgage interest rate to daily FOMC shocks.**



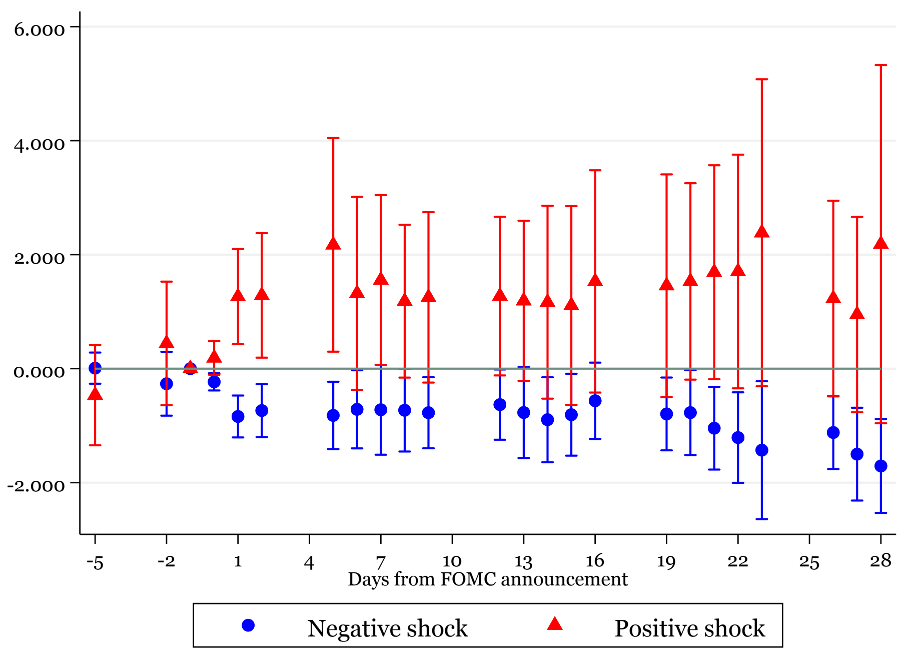
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (6). The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. 5. **Response of corporate bond yields to daily and intradaily FOMC shocks**

Panel A: daily changes in 10-year swap rates



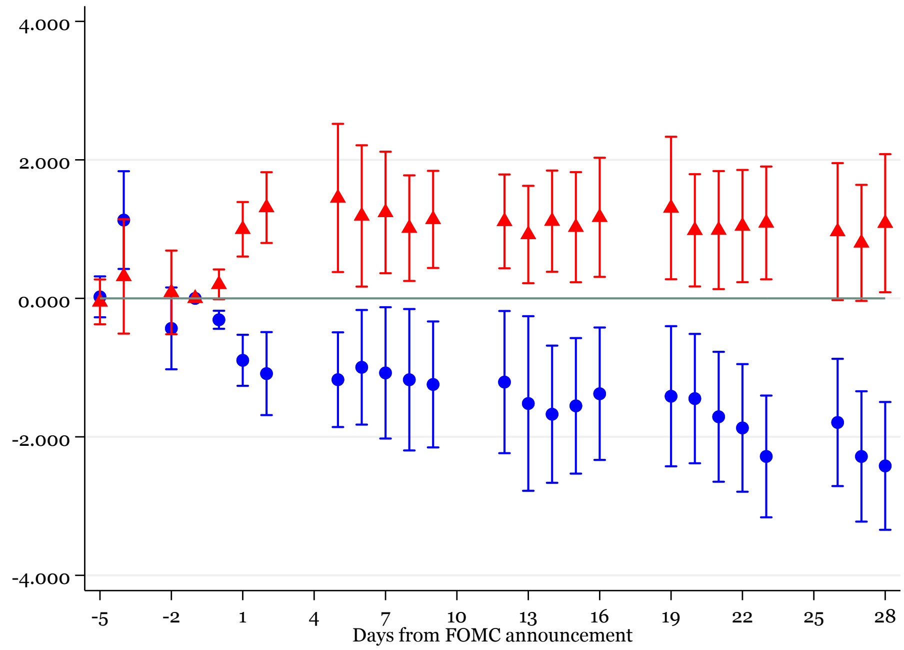
Panel B: intradaily changes in 10-year Treasury bond yields



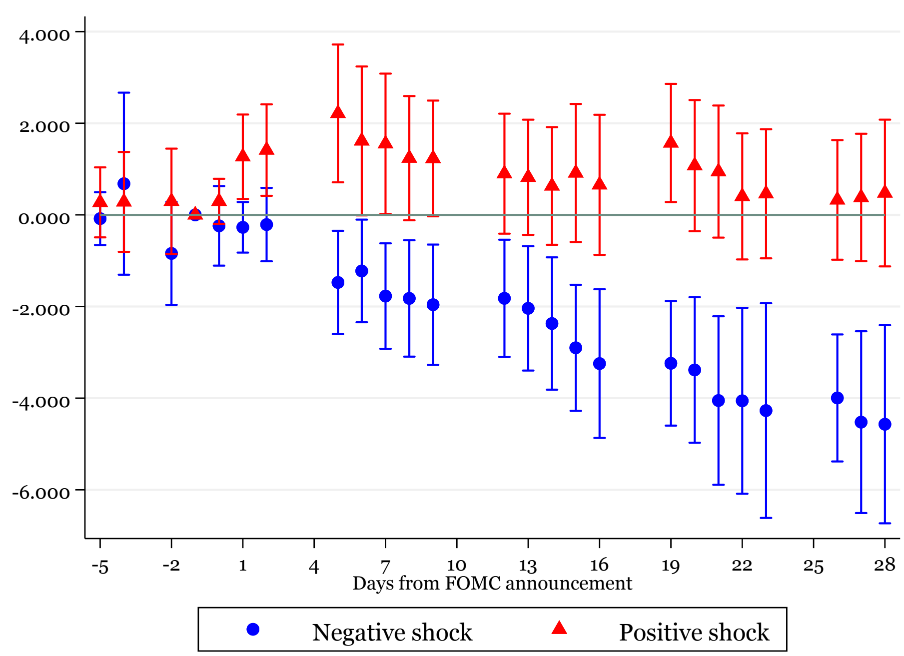
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for corporate bond yields. The regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. 6. **Response of corporate bond yields to daily and intradaily FOMC shocks by ratings**

Panel A: Investment grade



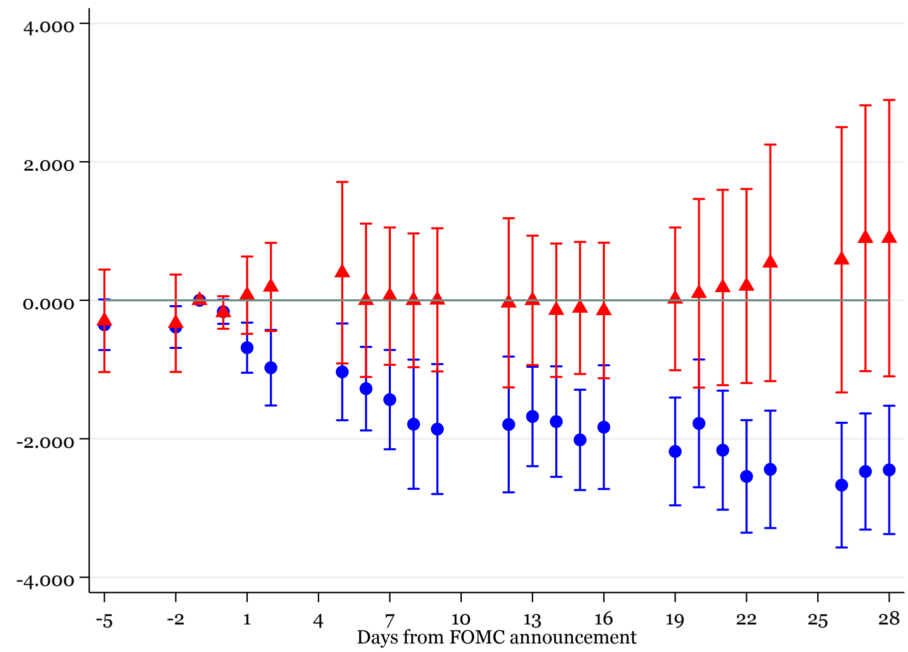
Panel B: Speculative grade



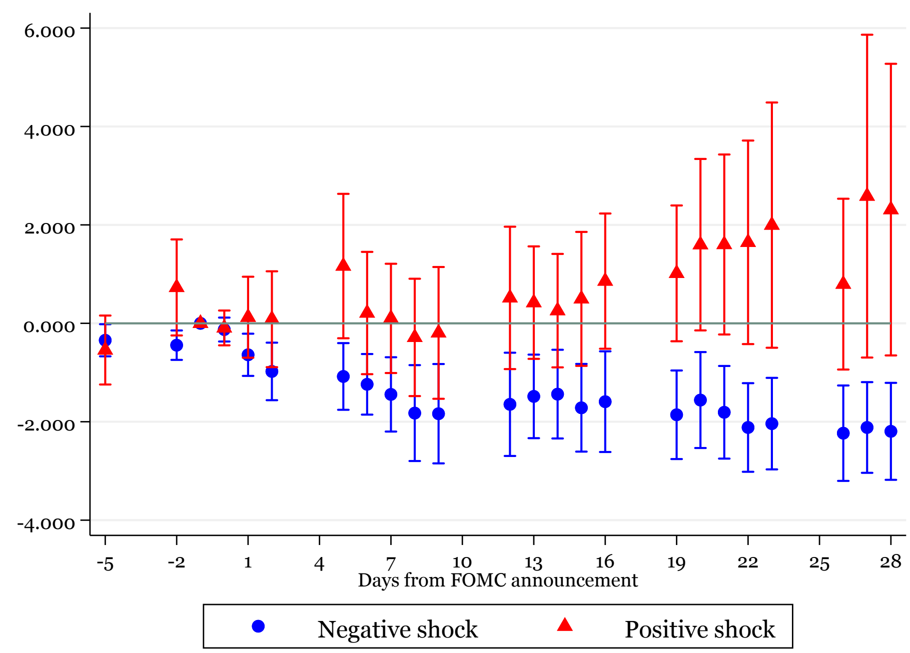
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for corporate bond yields. The regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. 7. **Response of 10-year CDS of non-financial firms to daily and intradaily FOMC shocks**

Panel A: daily changes in 10-year swap rates



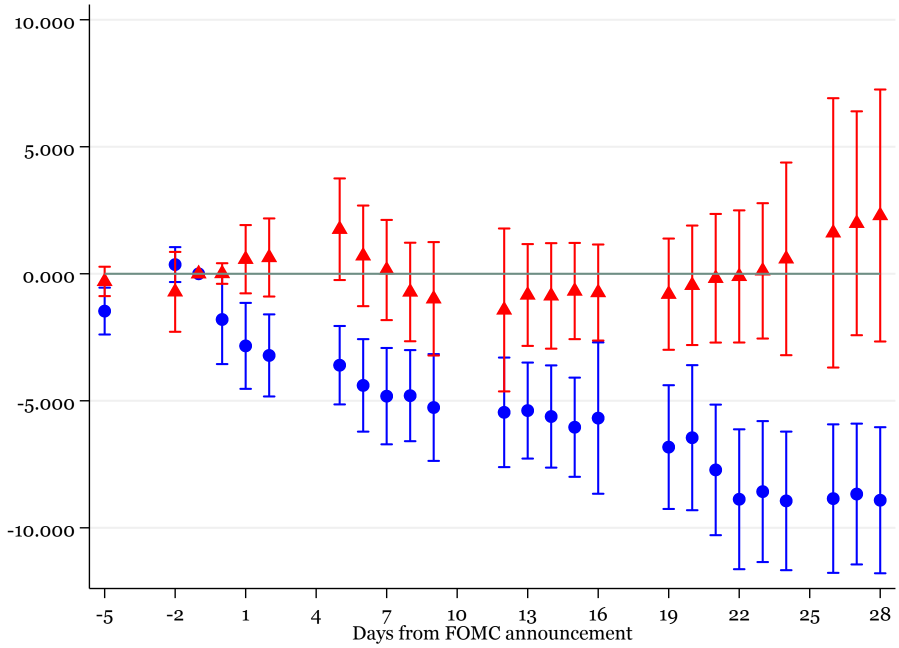
Panel B: intradaily changes in 10-year Treasury bond yields



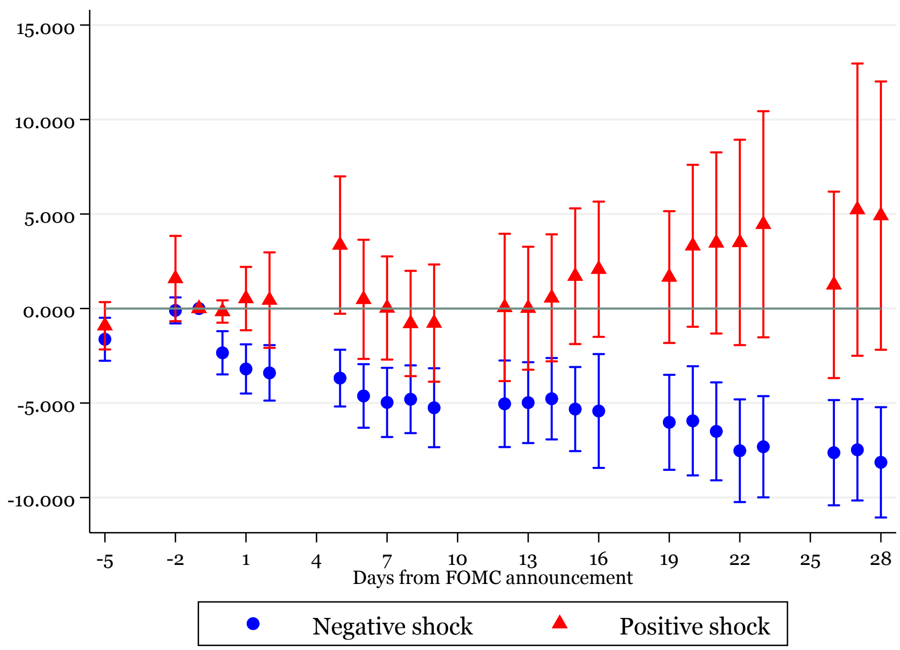
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for CDS spreads. The regression controls for underlying company-by-FOMC-event fixed effects. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. 8. **Response of 10-year B-rated CDS of non-financial firms to daily and intradaily FOMC shocks**

Panel A: B-rated CDS



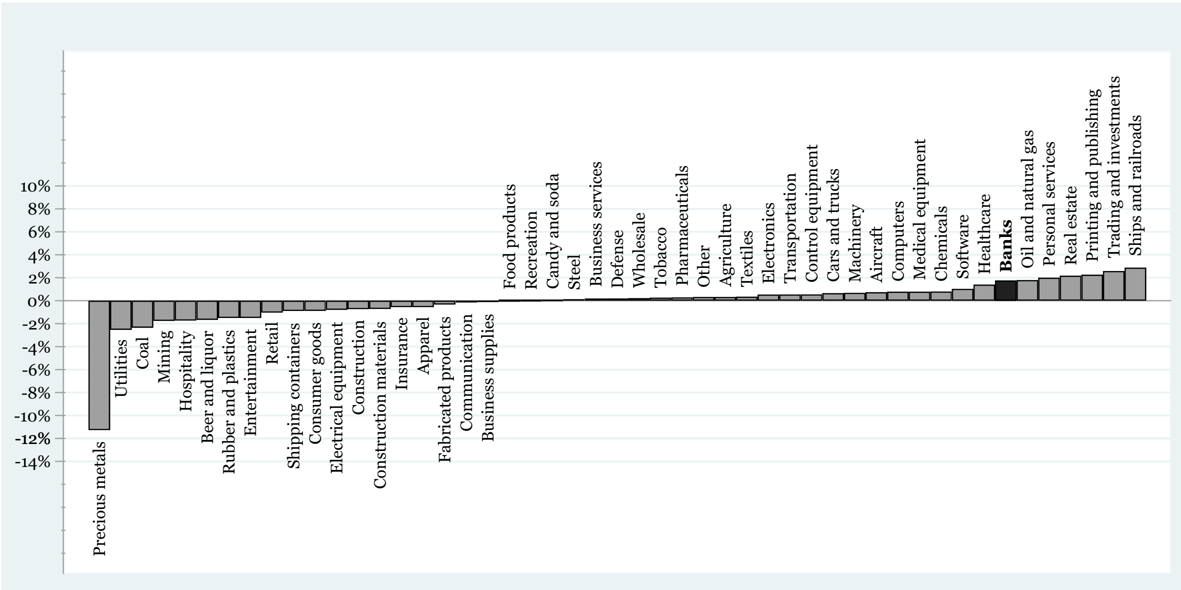
Panel B: intradaily changes in 10-year Treasury bond yields



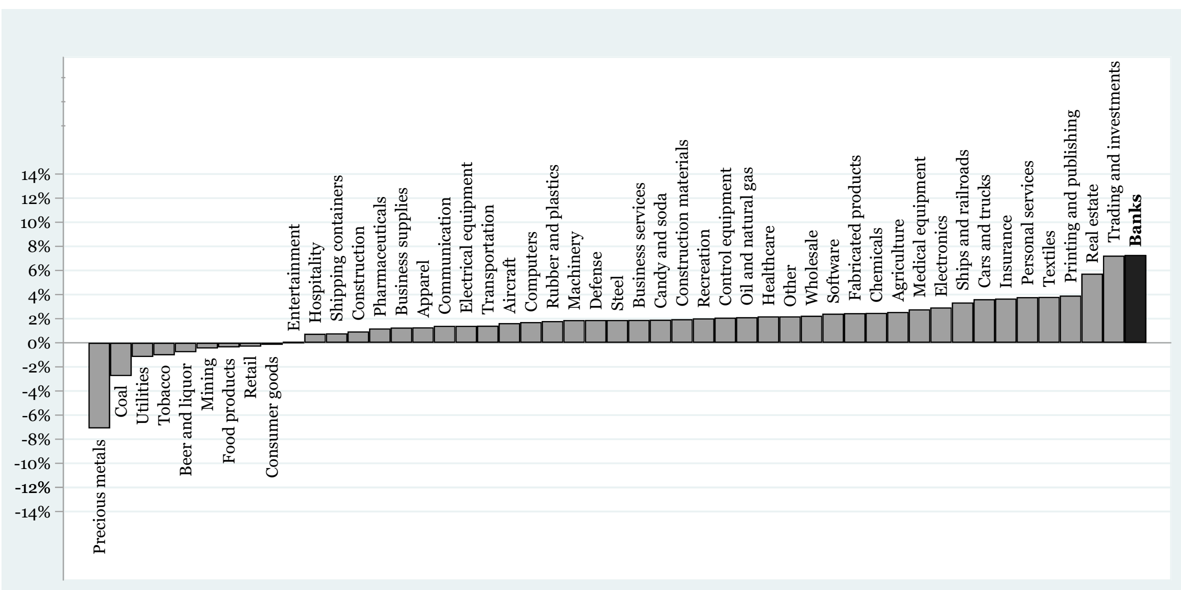
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for CDS spreads. The regression controls for underlying company-by-FOMC-event fixed effects. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. 9. **Banking industry stock returns on the 10-year interest swap rate changes.**

Panel A: β_j estimates from $R_{jt} = \alpha + \beta_j \Delta s_t + \gamma_j \Delta \mathrm{FF}_t + \epsilon_{jt}$ – All dates



Panel B: β_j estimates from $R_{jt} = \alpha + \beta_j \Delta s_t + \gamma_j \Delta \mathrm{FF}_t + \epsilon_{jt}$ – Excluding the 3 QE1 scheduled FOMC dates, i,e., December 16, 2008, January 28, 2009, and March 18, 2009.



Notes: The figure shows the sensitivity of industry stock portfolios to FOMC rate changes. Industry data are the returns of the Fama and French (1997) 49 industry portfolios, downloaded from Ken French's website. The figure plots the coefficients from regressing daily industry returns on FOMC days onto the daily changes in 10-year swap rates and the Kuttner (2001) shocks on the same days. Panel A shows the results for all dates, whereas Panel B excludes the three scheduled FOMC announcements listed as QE1 dates by Krishnamurthy and Vissing-Jorgensen (2011) and van Binsbergen et al. (2022). Values are expressed as the change in the industry portfolio for every 1% unexpected positive increase in 10-year swap rates.

Online Appendix

Table of Contents

A Additional results

Table A.1. Dates of scheduled FOMC meetings since 2000

Year	N	Scheduled FOMC meetings							
		1.	2.	3.	4.	5.	6.	7.	8.
2000	8	02-Feb	21-Mar	16-May	28-Jun	22-Aug	03-Oct	15-Nov	19-Dec
2001	8	31-Jan	20-Mar	15-May	27-Jun	21-Aug	02-Oct	06-Nov	11-Dec
2002	8	30-Jan	19-Mar	07-May	26-Jun	13-Aug	24-Sep	06-Nov	10-Dec
2003	8	29-Jan	18-Mar	06-May	25-Jun	12-Aug	16-Sep	28-Oct	09-Dec
2004	8	28-Jan	16-Mar	04-May	30-Jun	10-Aug	21-Sep	10-Nov	14-Dec
2005	8	02-Feb	22-Mar	03-May	30-Jun	09-Aug	20-Sep	01-Nov	13-Dec
2006	8	31-Jan	28-Mar	10-May	29-Jun	08-Aug	20-Sep	25-Oct	12-Dec
2007	8	31-Jan	21-Mar	09-May	28-Jun	07-Aug	18-Sep	31-Oct	11-Dec
2008	8	30-Jan	18-Mar	30-Apr	25-Jun	05-Aug	16-Sep	29-Oct	16-Dec
2009	8	28-Jan	18-Mar	29-Apr	24-Jun	12-Aug	23-Sep	04-Nov	16-Dec
2010	8	27-Jan	16-Mar	28-Apr	23-Jun	10-Aug	21-Sep	03-Nov	14-Dec
2011	8	26-Jan	15-Mar	27-Apr	22-Jun	09-Aug	21-Sep	02-Nov	13-Dec
2012	8	25-Jan	13-Mar	25-Apr	20-Jun	01-Aug	13-Sep	24-Oct	12-Dec
2013	8	30-Jan	20-Mar	01-May	19-Jun	31-Jul	18-Sep	30-Oct	18-Dec
2014	8	29-Jan	19-Mar	30-Apr	18-Jun	30-Jul	17-Sep	29-Oct	17-Dec
2015	8	28-Jan	18-Mar	29-Apr	17-Jun	29-Jul	17-Sep	28-Oct	16-Dec
2016	8	27-Jan	16-Mar	27-Apr	15-Jun	27-Jul	21-Sep	02-Nov	14-Dec
2017	8	01-Feb	15-Mar	03-May	14-Jun	26-Jul	20-Sep	01-Nov	13-Dec
2018	8	31-Jan	21-Mar	02-May	13-Jun	01-Aug	26-Sep	08-Nov	19-Dec
2019	8	30-Jan	20-Mar	01-May	19-Jun	31-Jul	18-Sep	30-Oct	11-Dec

Table A.2. Variation in mortgage rates

Panel A: Balanced panel – MSA-year-month and Lender-date

Dependent variable:	Mortgage rates				
	(1)	(2)	(3)	(4)	(5)
4-week lagged 10-year swap	Yes	No	No	No	No
Date fixed effects	No	Yes	Yes	No	No
Lender− fixed effects	No	No	No	Yes	No
MSA− fixed effects	No	No	No	No	Yes
R^2	86.30	88.14	89.63	91.90	92.19
Observations	4,613,284	4,613,284	4,613,284	4,613,284	4,613,284

Panel B: Balanced panel – MSA-Lender-date

Dependent variable:	Mortgage rates				
	(1)	(2)	(3)	(4)	(5)
4-week lagged 10-year swap	Yes	No	No	No	No
Date fixed effects	No	Yes	Yes	No	No
Lender− fixed effects	No	No	No	Yes	No
Lender− fixed effects	No	No	No	No	Yes
R^2	86.89	88.73	90.13	91.99	93.63
Observations	3,078,239	3,078,239	3,078,239	3,078,239	3,078,239

Notes: This table presents the coefficient of determination (R^2) for different specifications of mortgage rates. Borrower's characteristics include the level and the square of the FICO score at origination and of the loan-to-value (LTV) ratio at origination, whether the mortgage was GSE-eligible, insured at origination, or whether it was prime or subprime. The sample is from January 2000 to July 2020.

Table A.3. Variation in corporate bond yields

Panel A: Whole sample

Dependent variable:	Corporate bond yields				
	(1)	(2)	(3)	(4)	(5)
10-year swap	Yes	No	Yes	No	No
Date fixed effects	No	Yes	No	Yes	No
Borrower fixed effects	No	No	Yes	Yes	No
Borrower−year−month fixed effects	No	No	No	No	Yes
R^2	42.59	54.71	74.14	86.45	98.59
Observations	770,878	770,878	770,878	770,878	770,878

Panel B: AA-rated companies

Dependent variable:	Corporate bond yields − AA-rated firms				
	(1)	(2)	(3)	(4)	(5)
10-year swap	Yes	No	Yes	No	No
Date fixed effects	No	Yes	No	Yes	No
Borrower fixed effects	No	No	Yes	Yes	No
Borrower−year−month fixed effects	No	No	No	No	Yes
R^2	85.78	95.40	92.13	98.01	99.22
Observations	48,348	48,266	48,348	48,266	48,348

Notes: This table presents the coefficient of determination (R^2) for different specifications of corporate bond yields. Panel B restricts the sample to AA-rated firms. The sample for both panels is from January 2000 to December 2019.

Table A.4. Sensitivity of different loan products to monetary policy

Product name	Negative shock		Positive shock	
	0-14 days	15-23 days	0-14 days	15-23 days
10 Yr Fxd Mtg @ 175K - Rate	-1.79***	-0.985***	2.053***	0.222
	(0.412)	(0.214)	(0.615)	(0.25)
15 Yr Fxd Mtg @ 175K - Rate	-1.105***	-0.958***	0.523***	0.57***
	(0.155)	(0.116)	(0.2)	(0.146)
20 Yr Fxd Mtg @ 175K - Rate	-1.284***	-1.175***	1.886***	1.036***
	(0.316)	(0.161)	(0.528)	(0.341)
30 Yr Fxd Mtg @ 175K - Rate	-1.262***	-1.039***	0.783***	0.776***
	(0.163)	(0.098)	(0.221)	(0.197)

Notes: This table presents the estimated response to monetary policy news of fixed-rate mortgage quotes surveyed by RateWatch data. The sample is from January 2000 to December 2019.

Table A.5. Rolling-window correlation between daily changes in 10-year swap rates and 1-year bond yields against the level of 1-year bond yields

Dependent variable:	Roll.-wind. corr. b/w Δs and Δy^1 from $t-365$ and t				
	(1)	(2)	(3)	(4)	
y_{t-365}	0.050***		0.036***	0.322***	0.272***
	(0.001)		(0.001)	(0.007)	(0.005)
y_t		0.048***	0.020***		0.056***
		(0.001)	(0.001)		(0.006)
y^2_{t-365}				-0.087***	-0.077***
				(0.003)	(0.002)
y^2_t					-0.000
					(0.002)
y^3_{t-365}				0.007***	0.006***
				(0.000)	(0.000)
y^3_t					-0.001***
					(0.000)
R^2	0.36	0.30	0.38	0.60	0.66
N	4,660	4,703	4,660	4,660	4,660

Notes: We first compute the rolling-window correlation between daily changes in 10-year swap rates and 1-year bond yields over 365 days, as shown in Figure A.3. This table presents the estimates from regressing this rolling-window correlation against the level of 1-year bond yields (current or lagged 365 days), and a polinomial of the level of 1-year bond yields. The sample is from January 1997 to January 2023.

Table A.6. The impact of expected short-term interest rates, term premia, and convenience yields on the monthly changes in mortgage rates and corporate bond yields

Decomposition of monthly changes in Bankrate.com mortgage interest rate

Percentiles	5	10	25	50	75	90	95
Expected short rates	14.95	16.88	21.3	26.27	31.10	35.09	38.26
Term premia	33.62	35.89	40.19	45.64	50.56	55.85	58.23
Convenience yield	-1.40	-0.70	0.61	2.45	4.87	7.84	9.73
Change in 1 year rates	-8.11	-6.88	-4.68	-2.46	-0.36	1.71	3.18

Decomposition of monthly changes in Moody's Aaa corporate bond yields

Percentiles	5	10	25	50	75	90	95
Expected short rates	0.50	1.08	2.16	3.90	5.94	8.15	9.53
Term premia	54.90	57.08	61.07	65.40	69.53	73.06	75.15
Convenience yield	-2.08	-1.51	-0.79	-0.24	0.06	0.46	0.82
Change in 1 year rates	2.10	2.99	4.68	7.05	9.57	11.83	13.61

Decomposition of monthly changes in Moody's Baa corporate bond yields

Percentiles	5	10	25	50	75	90	95
Expected short rates	-0.67	-0.34	-0.01	0.47	1.91	3.93	5.70
Term premia	32.89	36.45	41.21	47.02	52.11	56.64	59.01
Convenience yield	-0.24	-0.09	0.23	2.09	5.5	9.45	11.58
Change in 1 year rates	0.32	1.07	2.64	4.82	7.49	10.16	12.22

Notes: This table presents the contribution of expected short-term interest rates, term premia, convenience yields and the Nakamura and Steinsson (2018) shock to monthly changes in mortgage rates and corporate bond yields. The sample is from January 2000 to December 2019. The percentiles are computed using non-parametric bootstrap.

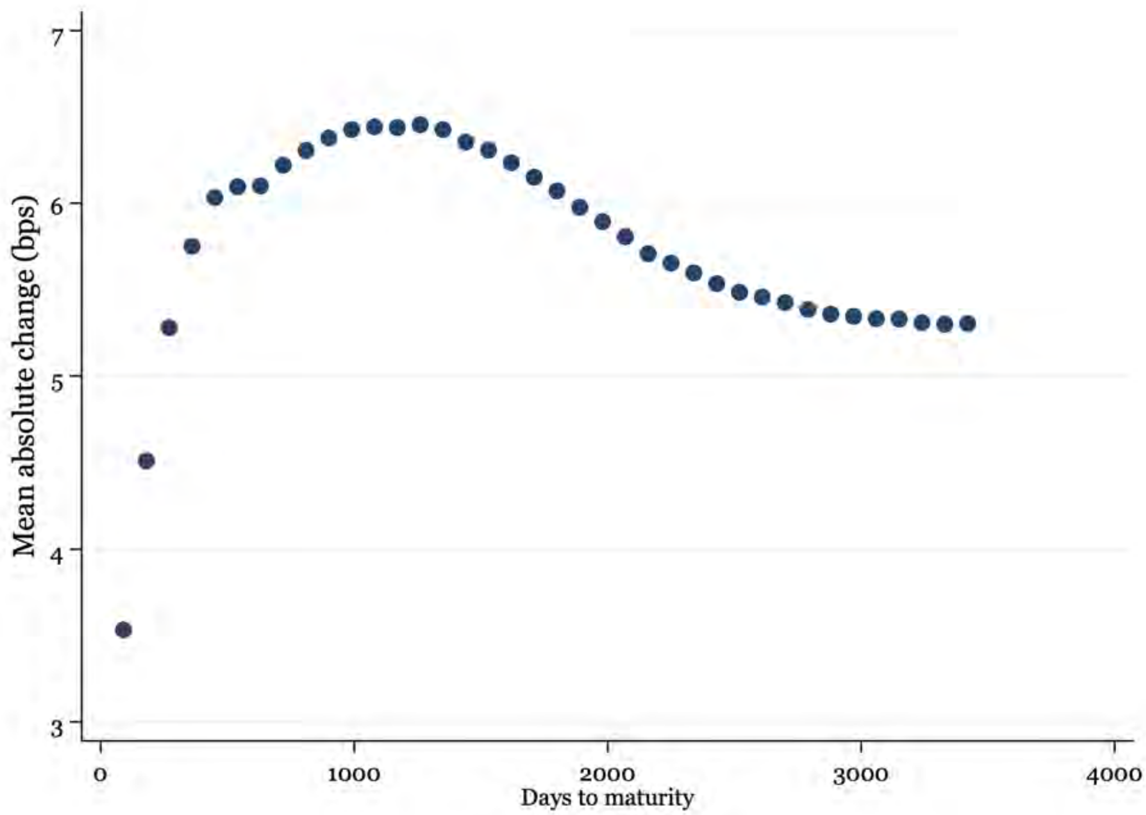


Fig. A.1. *Notes*: The figure shows the average absolute daily change of forward three-month LIBOR interest rates on FOMC days as implied by Eurodollar futures contracts against the days to the expiration of the futures contracts. On each date, the daily changes of implied forward rates is interpolated to evaluate the changes against fixed days to maturity. The sample includes all scheduled FOMC meetings from February 2, 2000 to December 11, 2019.

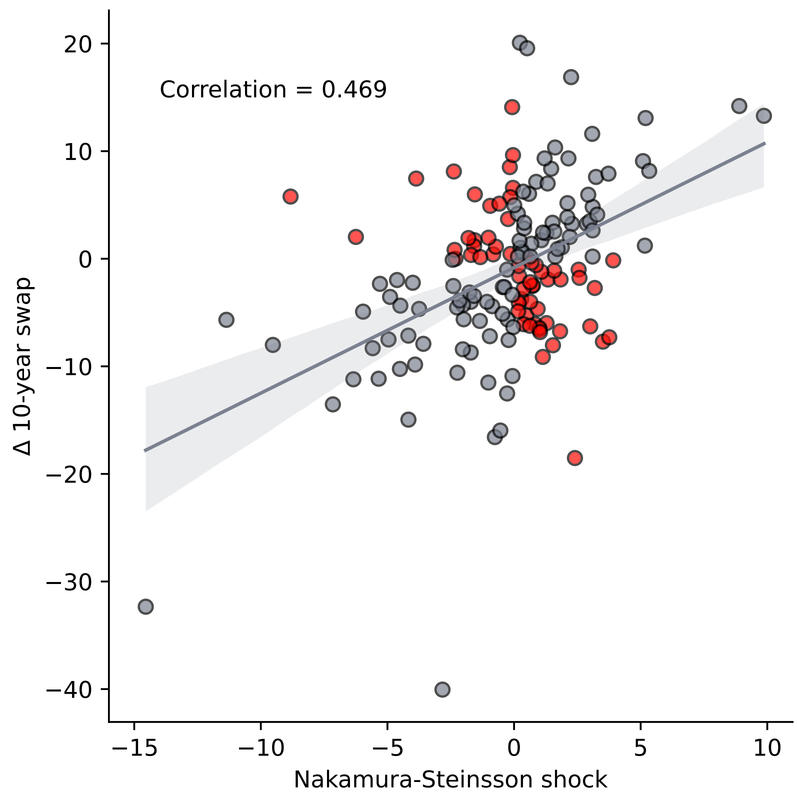


Fig. A.2. *Notes*: The figure shows the scatterplot of the changes in 10-year swap rates on FOMC days against the Nakamura and Steinsson (2018) shock computed by Acosta (2022). Values are expressed in basis points. The grey dots represent FOMC events for which the changes in 10-year swap rates on FOMC days and the Nakamura and Steinsson (2018) shocks shared the same sign. The red dots are events in which the two shocks had opposite signs. The sample includes all scheduled FOMC meetings from February 2, 2000 to December 11, 2019.

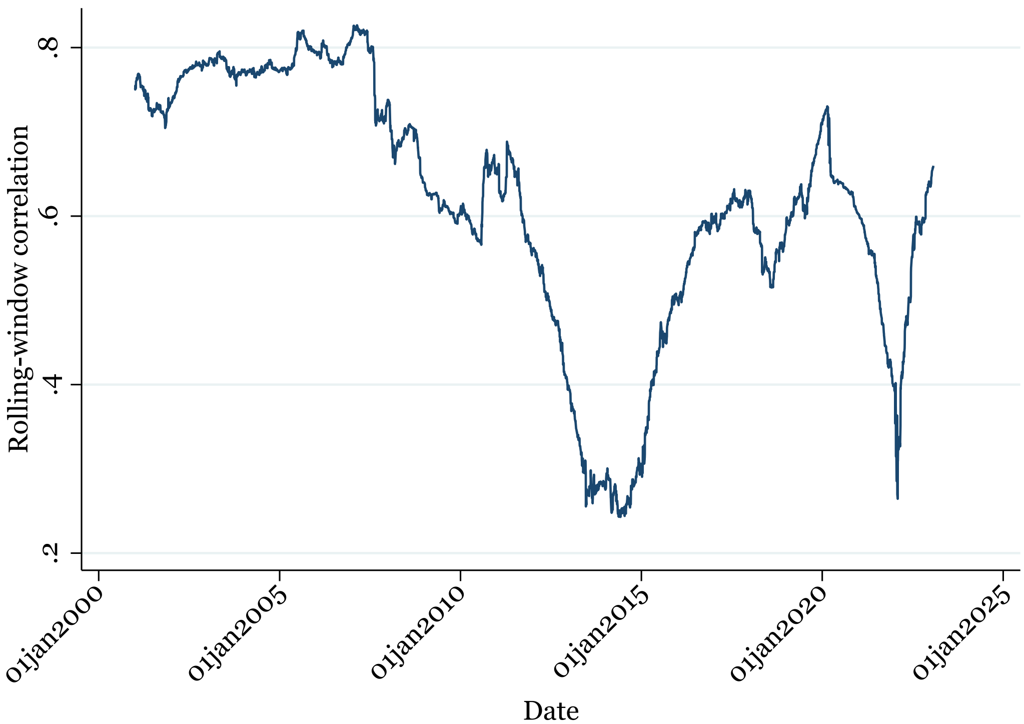


Fig. A.3. *Notes*: The plot shows the rolling-window correlation computed over 365 days between daily changes in 10-year swap rates (Δs) and daily changes in 1-year government bond yields computed by Gürkaynak et al. (2007) (Δy_1).

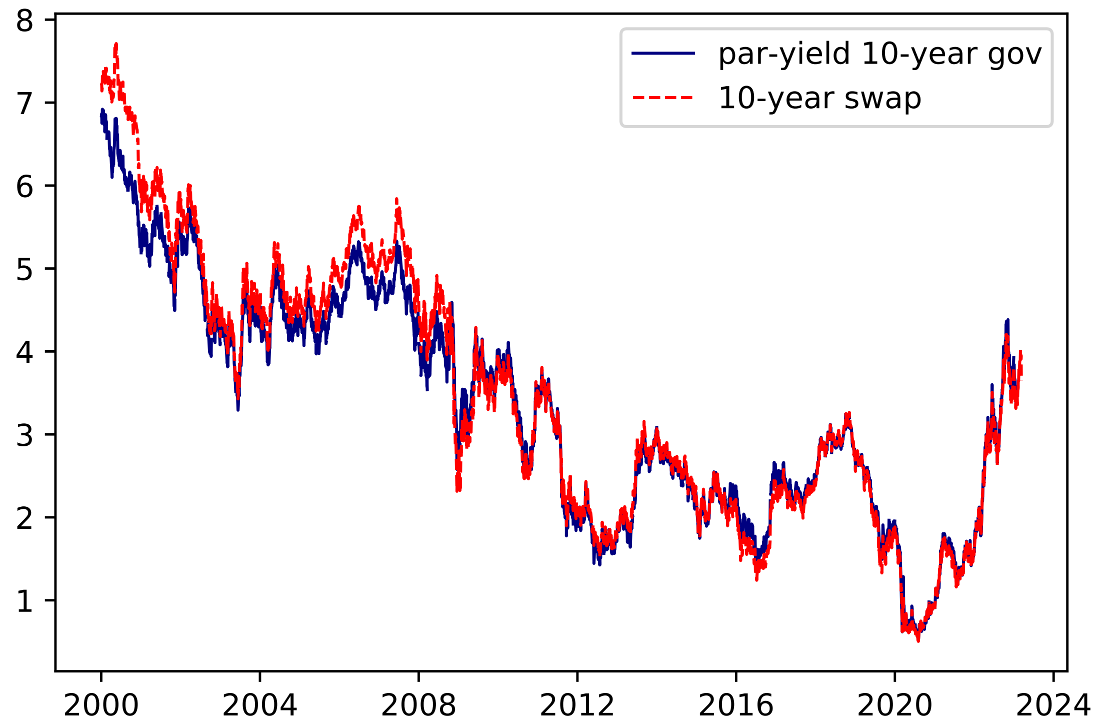
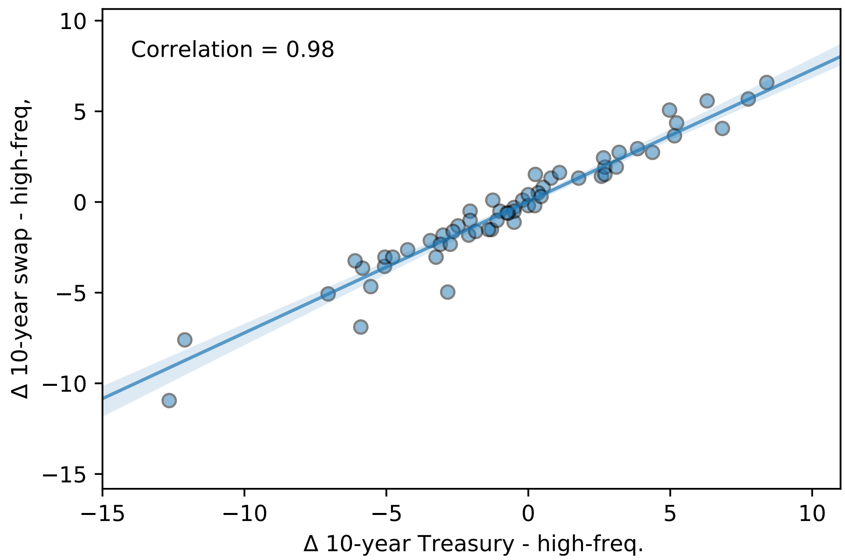


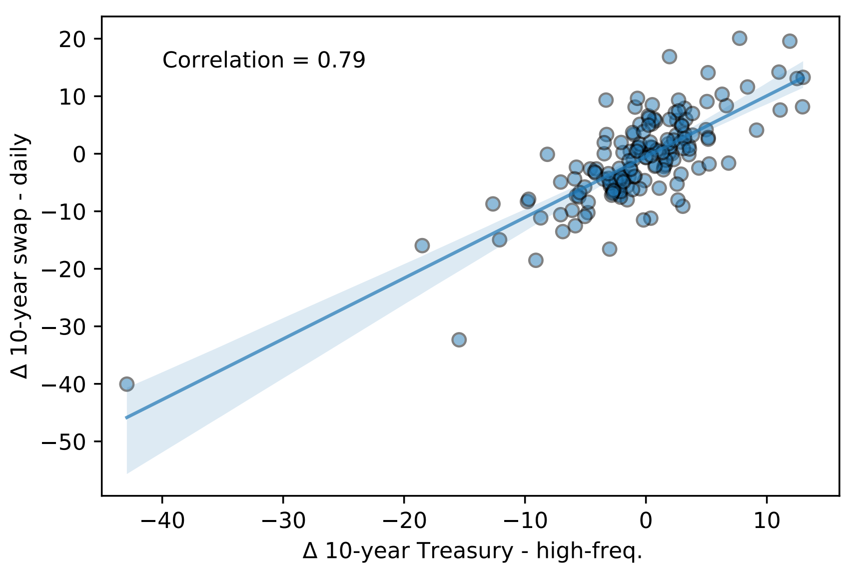
Fig. A.4. *Notes*: The figure shows the 10-year swap rate (annualized to reflect 365 days) against the 10-year government-bond par-yield as computed by Gürkaynak et al. (2007). All rates are continuously compounded.

Fig. A.5. **High-frequency (HF) changes in 10-year Treasury yields against HF or daily changes in 10-year swap rates.**

Panel A: HF changes in 10-year Treasury yields vs HF changes in 10-year swap rates – sample from 2010



Panel B: HF changes in 10-year Treasury yields vs daily changes in 10-year swap rates – sample from 2000



Notes: The figure shows the scatterplot of high frequency changes in 10-year Treasury bond yields on FOMC days against intradaily changes in 10-year swap rates on FOMC days (Panel A) or daily changes in 10-year swap rates on FOMC days (Panel B). Values are expressed in basis points. The sample includes all scheduled FOMC meetings from February 2, 2000.

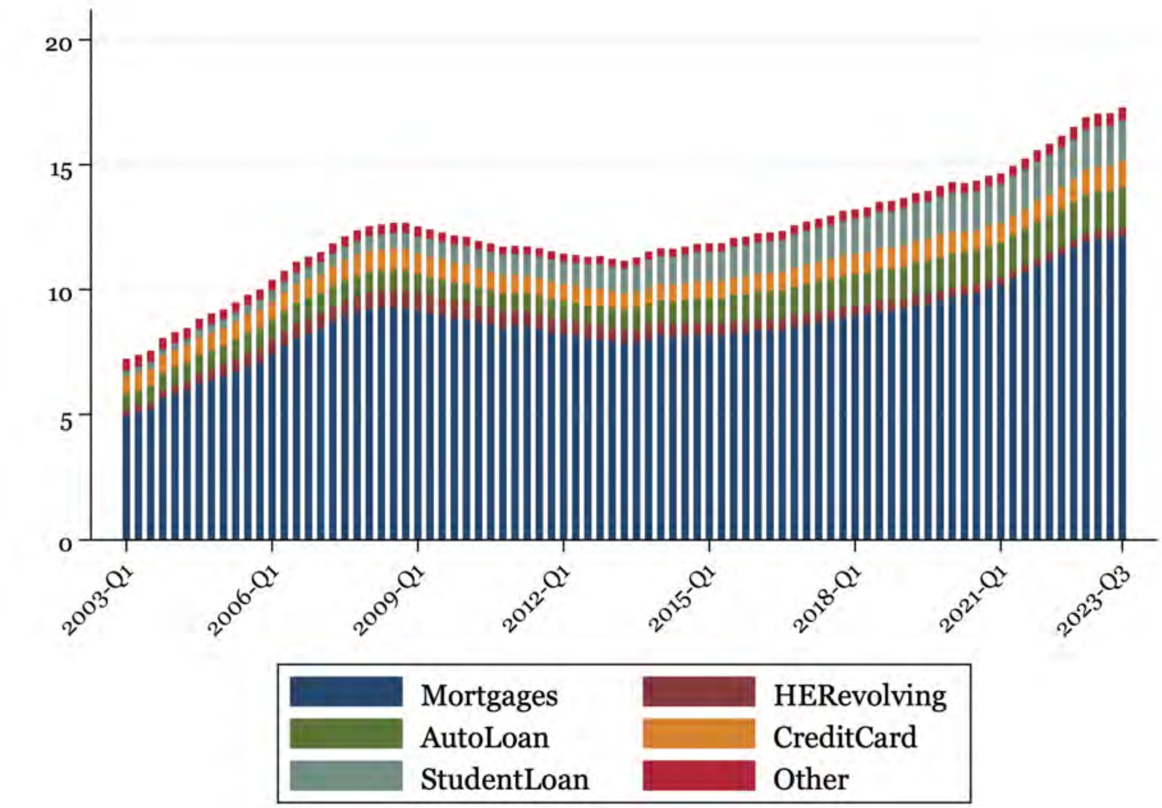


Fig. A.6. *Notes*: The figure shows U.S. household debt composition (in trillions of Dollars) over time. As a reference, in 2023-Q3, mortgages accounted for 70% of the total, home equity revolving (HERevolving) for 2%, auto loans for 9%, credit cards for 6% and student loans for 9%.

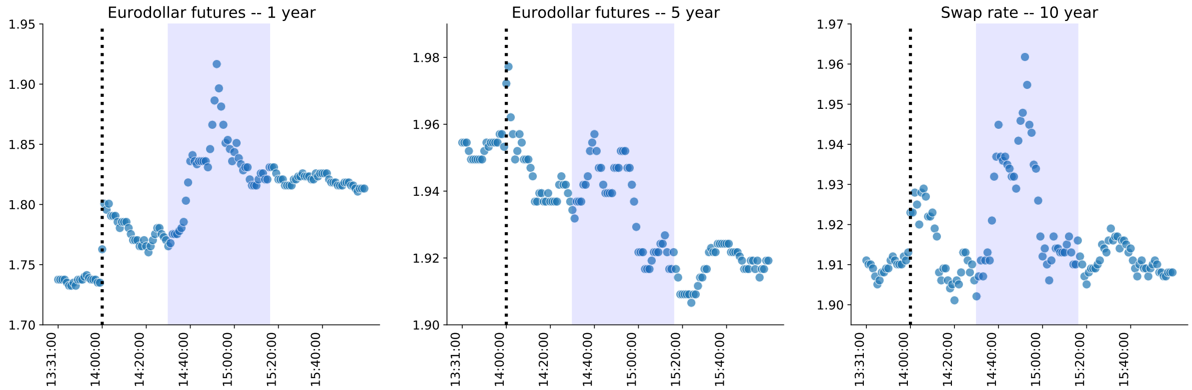
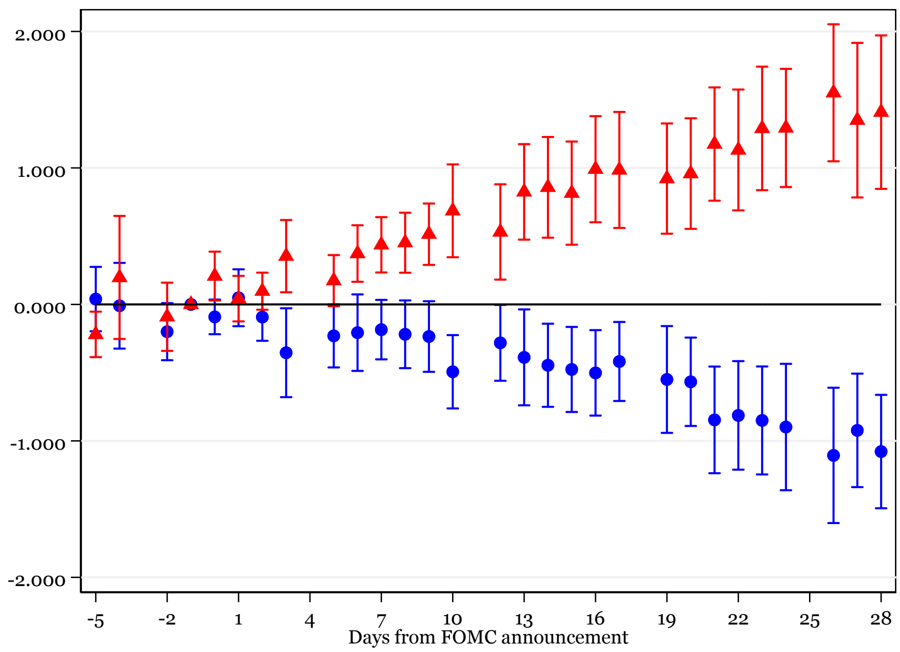


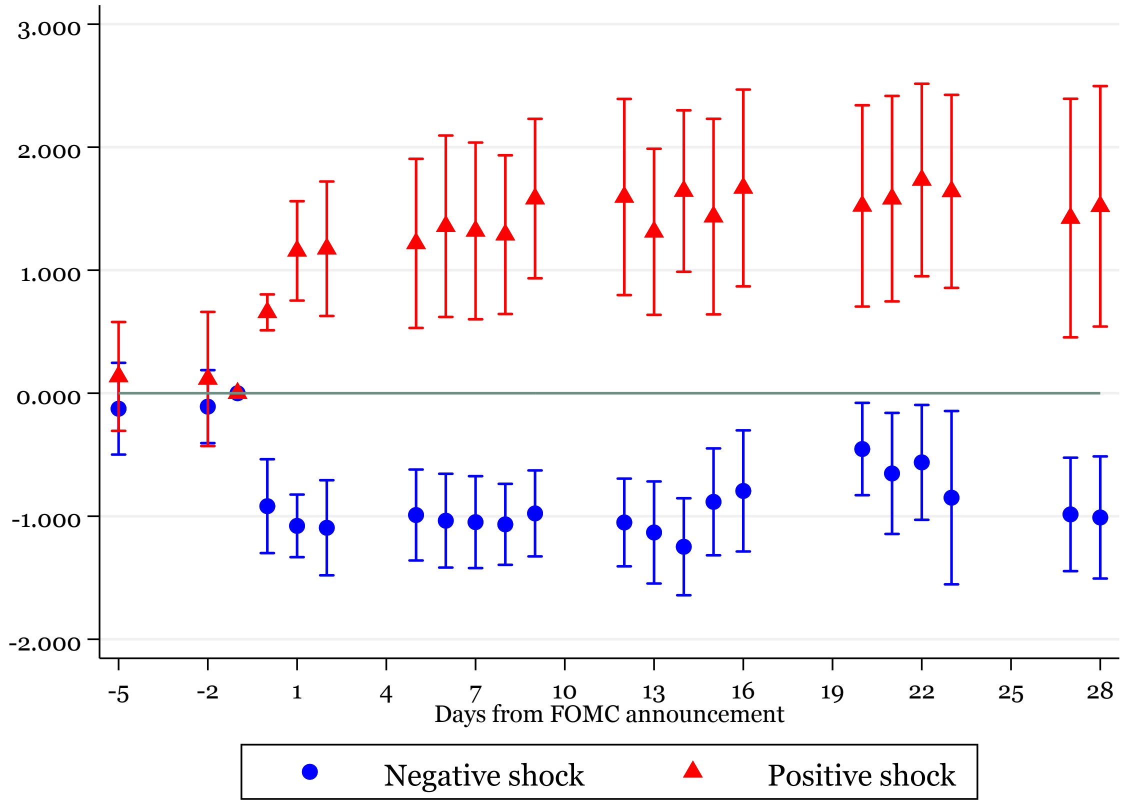
Fig. A.7. *Notes*: The figure shows the intraday evolution of the implied rate from the 12-month Eurodollar futures, the 5-year Eurodollar futures, and the 10-year swap rate on July 31, 2019. The black dashed vertical line on the plot referring to July 31, 2019 highlights the time at which the FOMC statement was released (14:00). The shaded area denotes the FOMC press conference. All rates are continuously compounded.

Fig. A.8. **Response of mortgage interest rates to daily FOMC shocks excluding days of macro announcements**



Notes: The figure reports the slope coefficient β and 95%-confidence interval from (2). The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at MSA $\times$ origination year-month level. The sample consists of all the conventional loans (not originated under a government program) where the borrower's stated purpose is to purchase a property and the property type is either a condominium or single-family residence. Data span from January 2000 to December 2019, but exclude FOMC days coinciding with macroeconomic announcement days. From Bloomberg, we downloaded the economic calendar for the US focusing on news about GDP, consumption, PCE, and CPI, and excluded those FOMC days coinciding with any day in which news on any of those 4 macro variables was released.

Fig. A.9. **Response of 10-year government bond yields to daily FOMC surprises.**

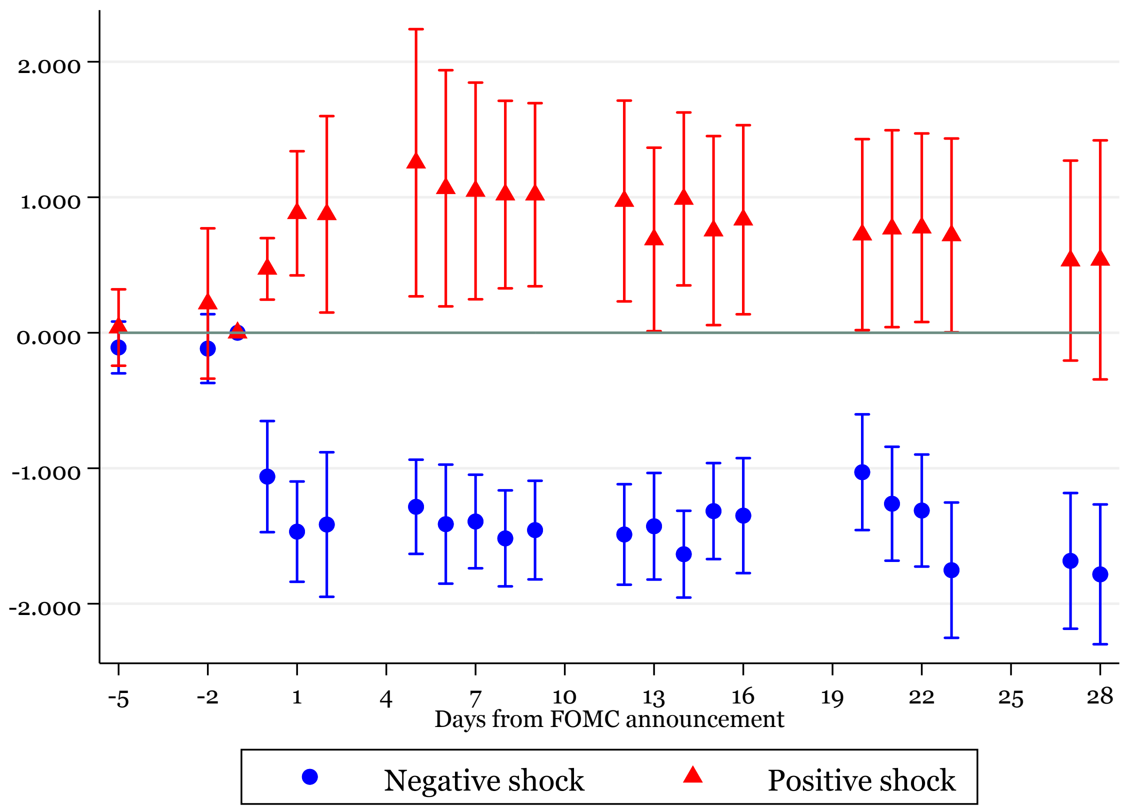


Notes: The figure shows the estimated response of 10-year government bond yields to monetary policy surprises and corresponding 95% confidence interval from the following regression:

$$c_{hf} = a_f + \sum_{k=-5}^{-2} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \gamma_{Pk} \mathbb{D} \ \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Pk} \mathbb{D} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f$$
$$+ \sum_{k=0}^{28} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f + \sum_{k=-5}^{-2} \beta_{Pk} \Delta s_f \ \mathbb{1}_{h=k} \ \mathbb{D} + \sum_{k=0}^{28} \beta_{Pk} \Delta s_f \ \mathbb{1}_{h=k} \ \mathbb{D} + \epsilon_{hf}$$

where h represents the number of days from the FOMC announcement day f, c is the par-yield on 10-year nominal government bonds as computed by Gürkaynak et al. (2007), Δs_f is the absolute value of the change in par swap rate for 10-year tenor around the FOMC announcement f, $\mathbb{1}_{h=k}$ is a dummy variable taking value 1 if h is equal to j and zero otherwise, $\mathbb{D}$ is a dummy variable taking a value of 1 if Δs_f is positive and zero otherwise, and ϵ is the error term. Standard errors are clustered at the year-month level. Data span January 2000 to December 2019.

Fig. A.10. **Response of 10-year TIPS yields to daily FOMC surprises.**



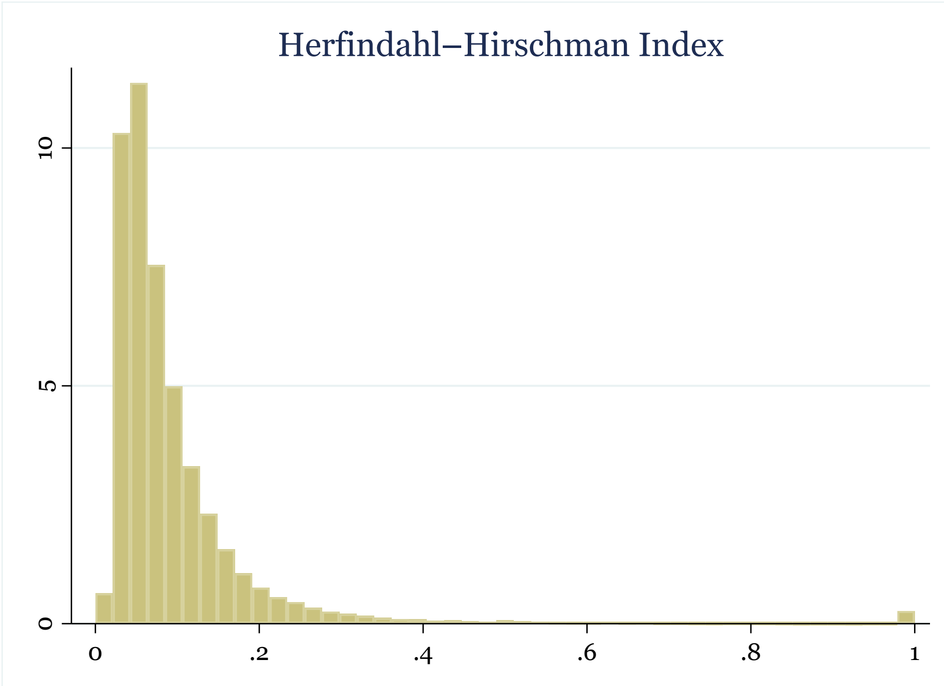
Notes: The figure shows the estimated response of 10-year TIPS yields to monetary policy surprises and corresponding 95% confidence interval from the following regression:

$$c_{hf} = a_f + \sum_{k=-5}^{-2} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Nk} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \gamma_{Pk} \mathbb{D}\ \mathbb{1}_{h=k} + \sum_{k=0}^{28} \gamma_{Pk} \mathbb{D} \mathbb{1}_{h=k} + \sum_{k=-5}^{-2} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f$$
$$+ \sum_{k=0}^{28} \beta_{Nk} \mathbb{1}_{h=k} \Delta s_f + \sum_{k=-5}^{-2} \beta_{Pk} \Delta s_f\ \mathbb{1}_{h=k}\ \mathbb{D} + \sum_{k=0}^{28} \beta_{Pk} \Delta s_f\ \mathbb{1}_{h=k}\ \mathbb{D} + \epsilon_{hf}$$

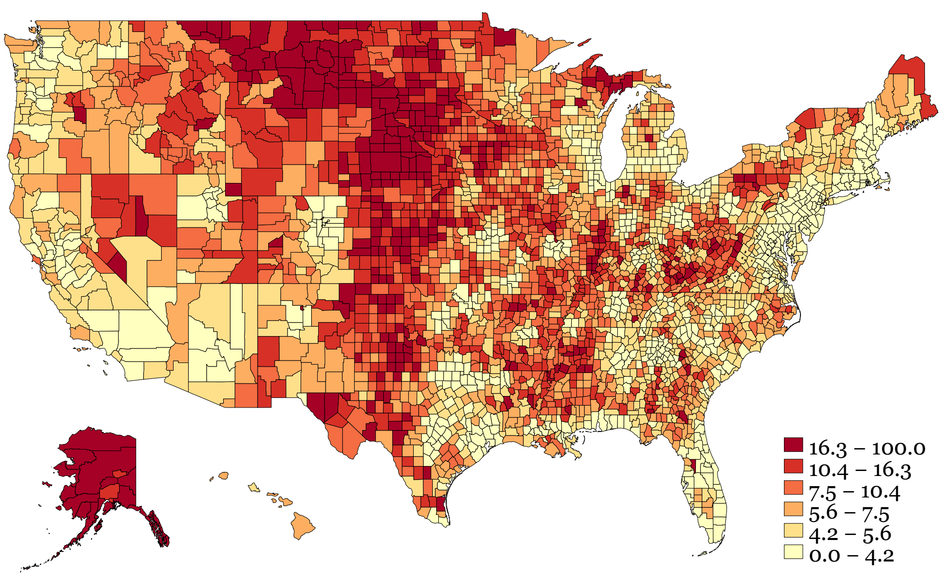
where h represents the number of days from the FOMC announcement day f, c is the par-yield on 10-year TIPS as computed by Gürkaynak, Sack, and Wright (2010), Δs_f is the absolute value of the change in par swap rate for 10-year tenor around the FOMC announcement f, $\mathbb{1}_{h=k}$ is a dummy variable taking value 1 if h is equal to j and zero otherwise, $\mathbb{D}$ is a dummy variable taking a value of 1 if Δs_f is positive and zero otherwise, and ϵ is the error term. Standard errors are clustered at the year-month level. Data span January 2000 to December 2019.

Fig. A.11. **Herfindahl-Hirschman Index distribution.**

Panel A: Histogram of HHI from 2000 to 2017



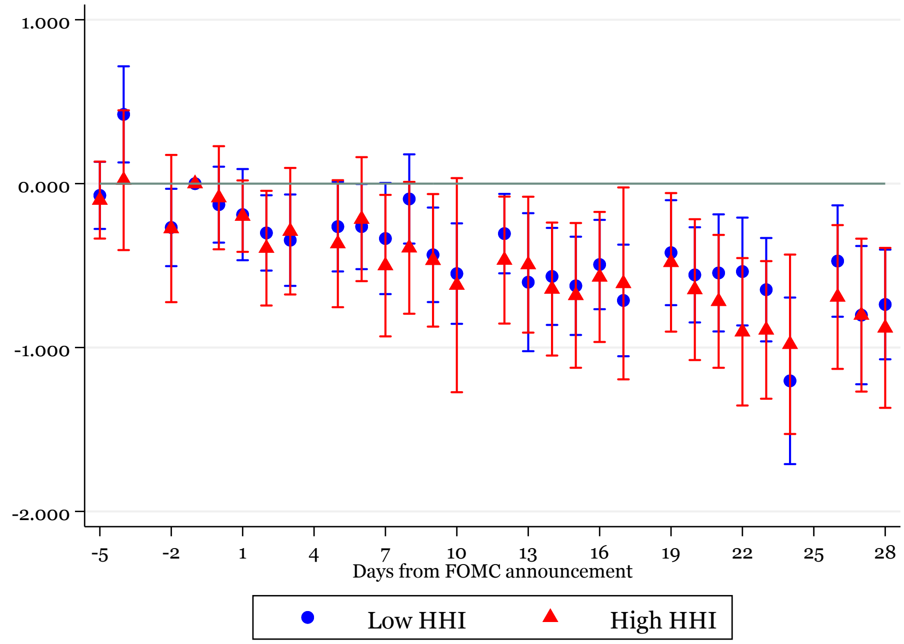
Panel B: Spatial variation HHI



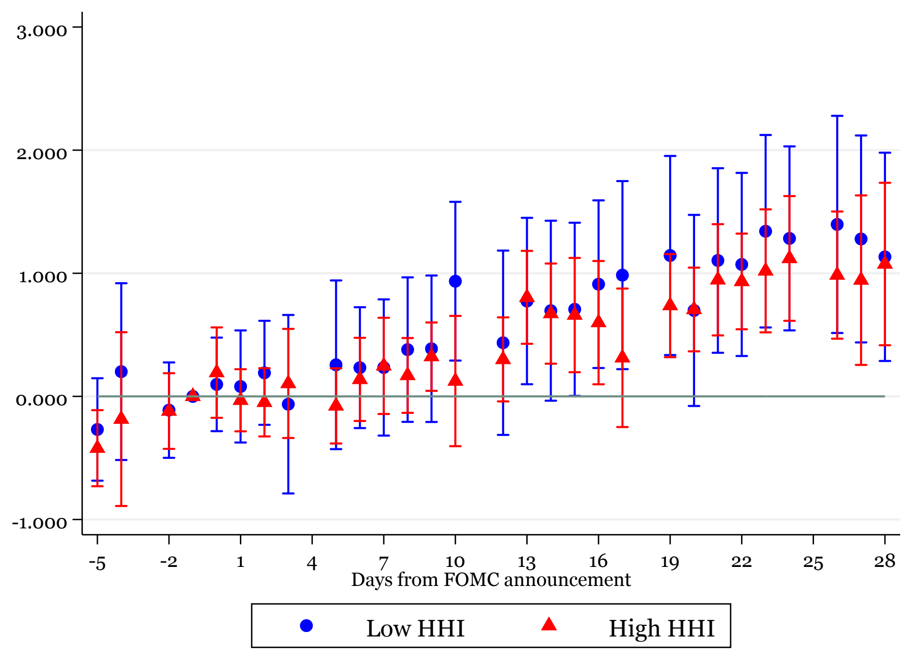
Notes: The figure shows the histogram of the Herfindahl-Hirschman Index in our sample and the spatial distribution of the average Herfindahl-Hirschman Index in our sample.

Fig. A.12. **Response of mortgage interest rates to daily FOMC shocks by Herfindahl-Hirschman index (HHI)**

Panel A: Response to a negative shock



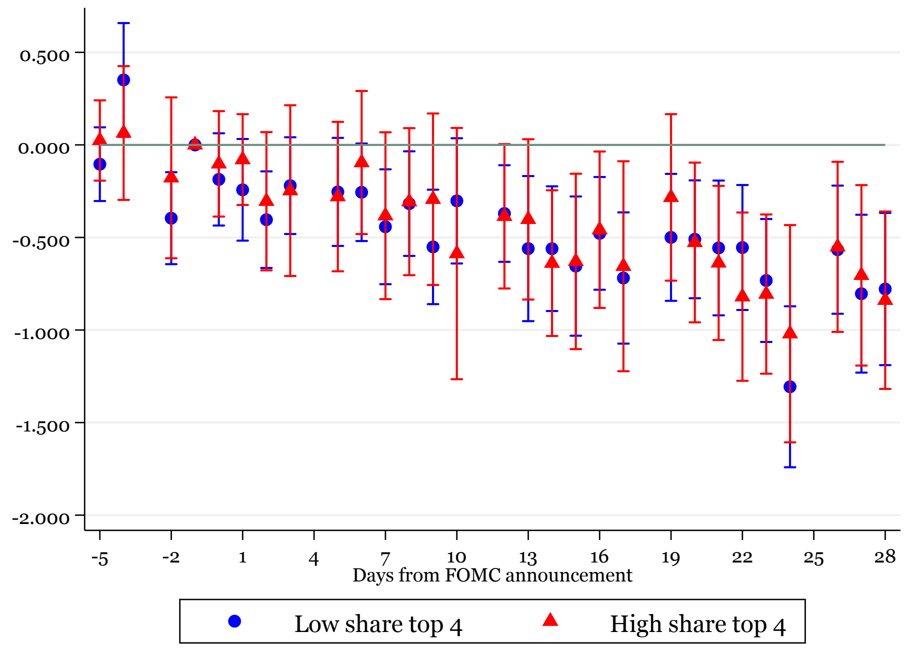
Panel B: Response to a positive shock



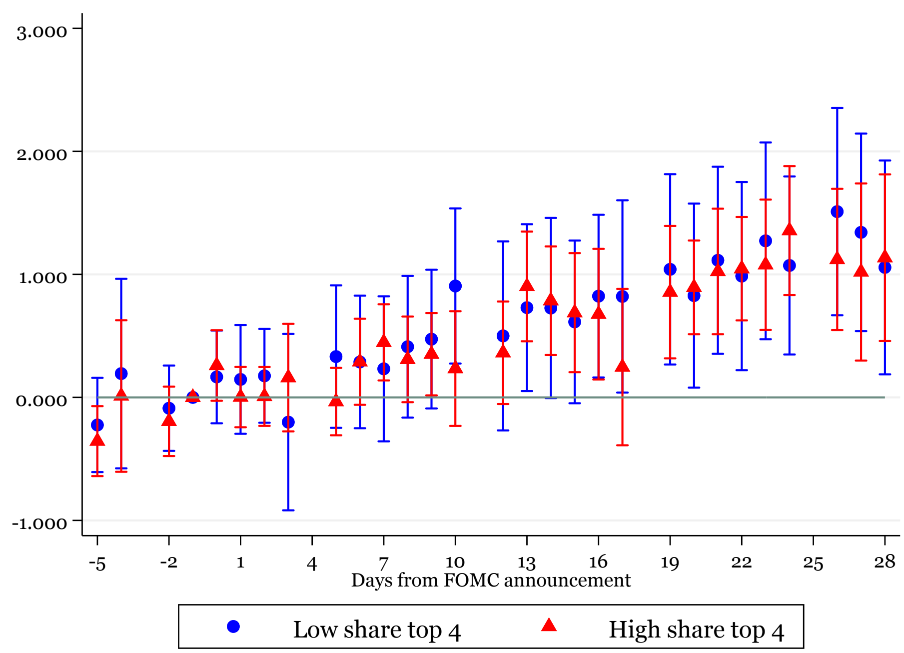
Notes: For each year-quarter we create quintiles based on the HHI computed from HMDA. We interact the response of mortgage rates to swap rates by the quintile. We present the response to a monetary policy shock in a bottom and a top quintile area. Data span from January 2000 to December 2019.

Fig. A.13. **Response of mortgage interest rates to daily FOMC shocks by share of top 4 lenders in a FIPS county**

Panel A: Response to a negative shock



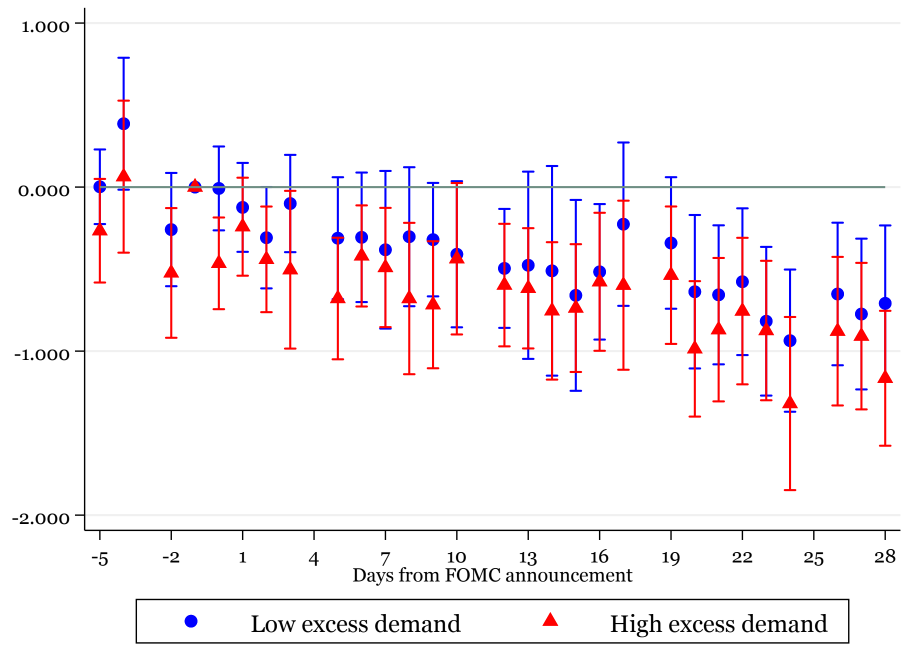
Panel B: Response to a positive shock



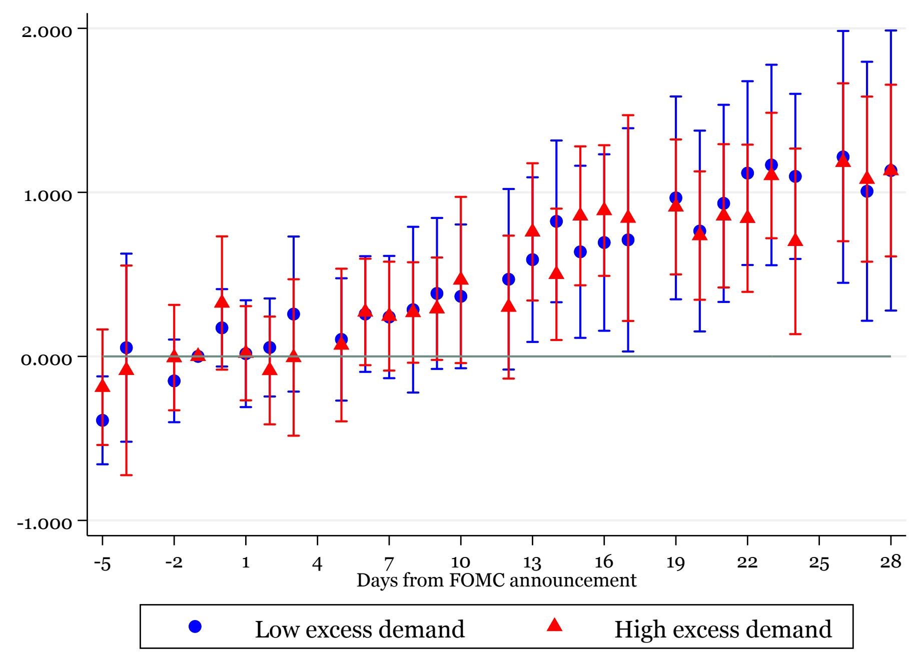
Notes: For each year-quarter we create quintiles based on the share of the top 4 lenders in a FIPS county computed from HMDA. We interact the response of mortgage rates to swap rates by the quintile. We present the response to a monetary policy shock in a bottom and a top quintile area. Data span from January 2000 to December 2019.

Fig. A.14. **Response of mortgage interest rates to daily FOMC shocks by mortgage excess demand**

Panel A: Response to a negative shock

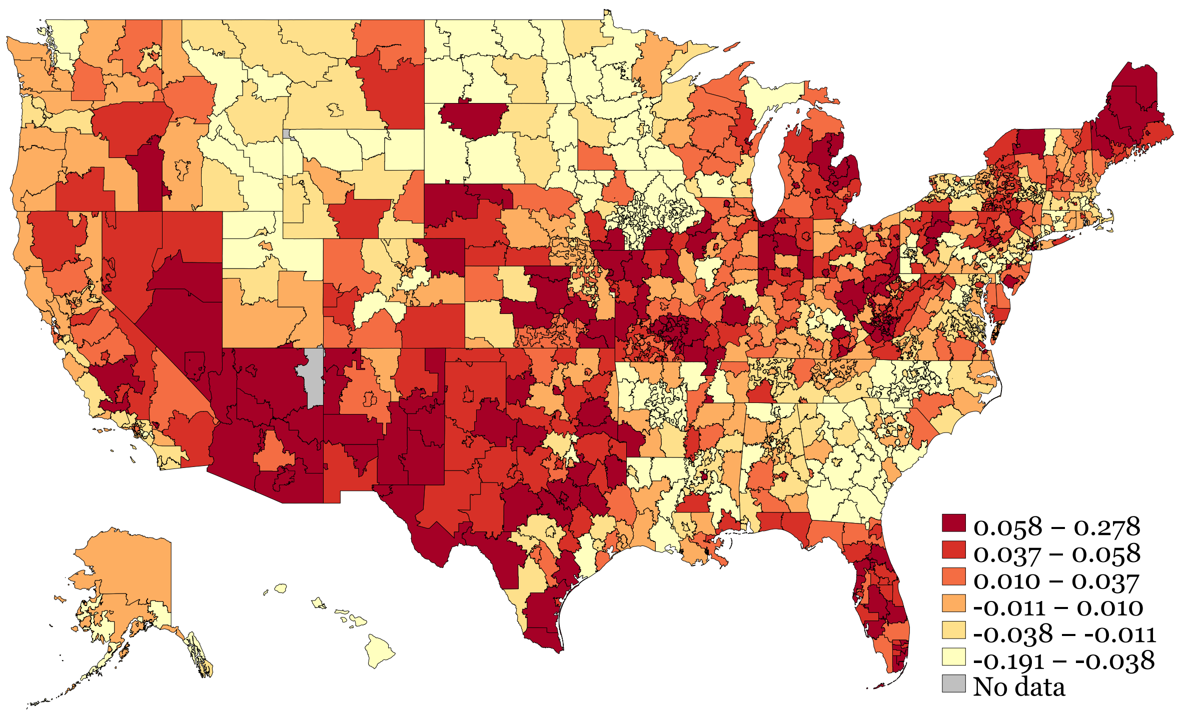


Panel B: Response to a positive shock



Notes: For each year-quarter we create quintiles based on the loan excess demand (the amount of loans approved plus the amount of loans rejected over the amount of loans approved by county FIPS) computed from HMDA. We interact the response of mortgage rates to swap rates by the quintile. We present the response to a monetary policy shock in a bottom and a top quintile area. Data span from January 2000 to December 2019.

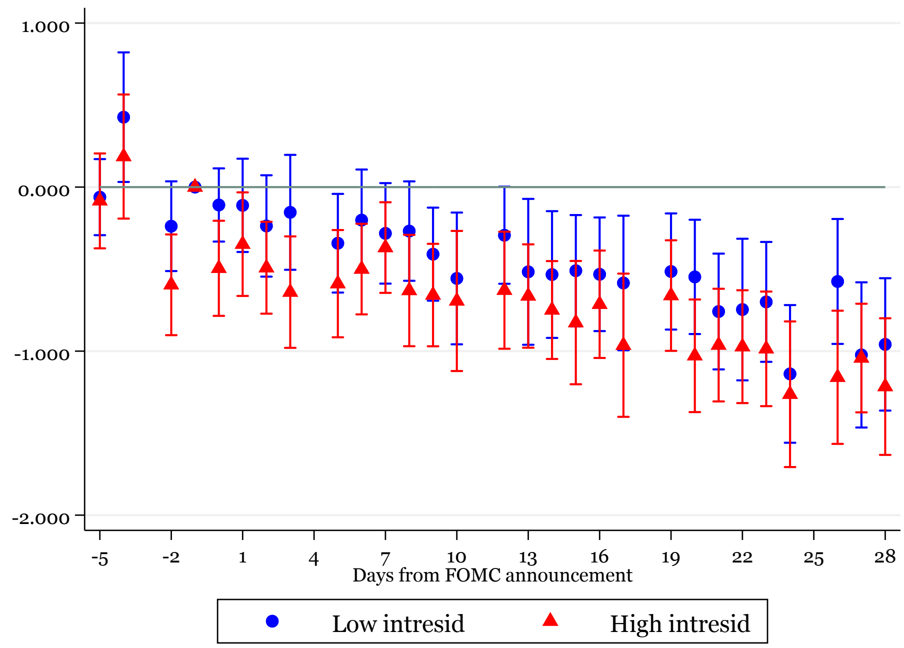
Fig. A.15. **Spatial variation in mortgage rates controlling for borrower and loan characteristics.**



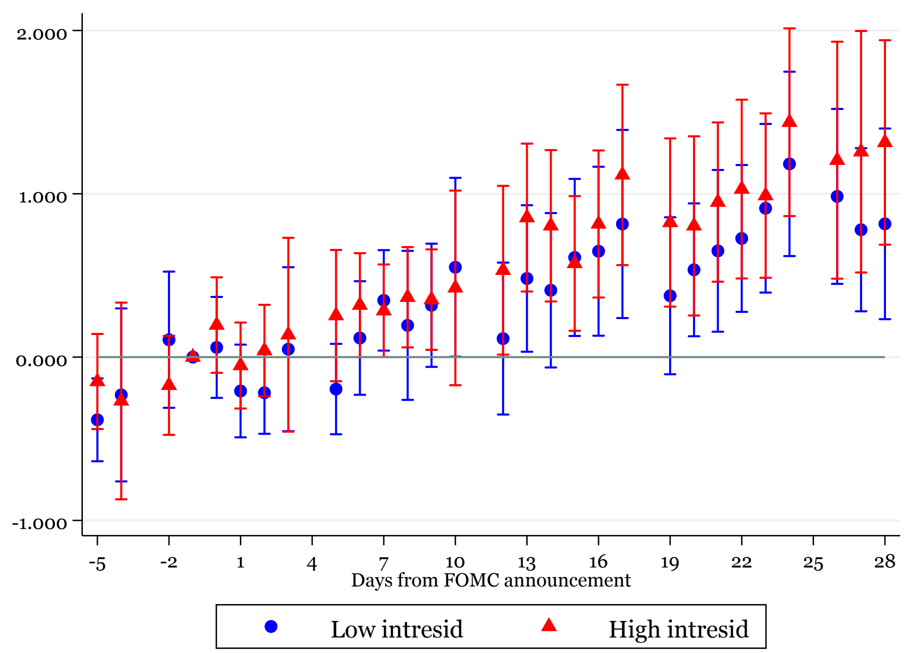
Notes: The figure shows the spatial variation in the residualized mortgage rates from Freddie mac dataset after controlling for borrower and loan characteristics following Hurst et al. (2016).

Fig. A.16. **Response of mortgage interest rates to daily FOMC shocks by residualized mortgage rates (intresid)**

Panel A: Response to a negative shock

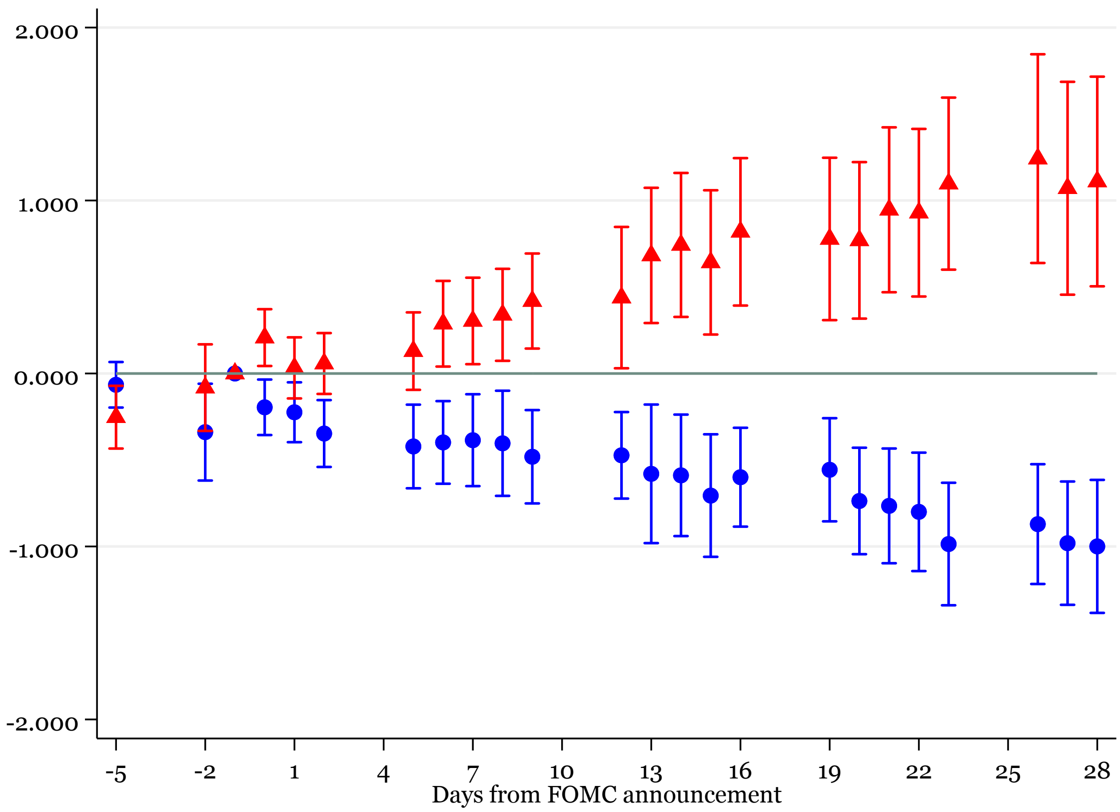


Panel B: Response to a positive shock



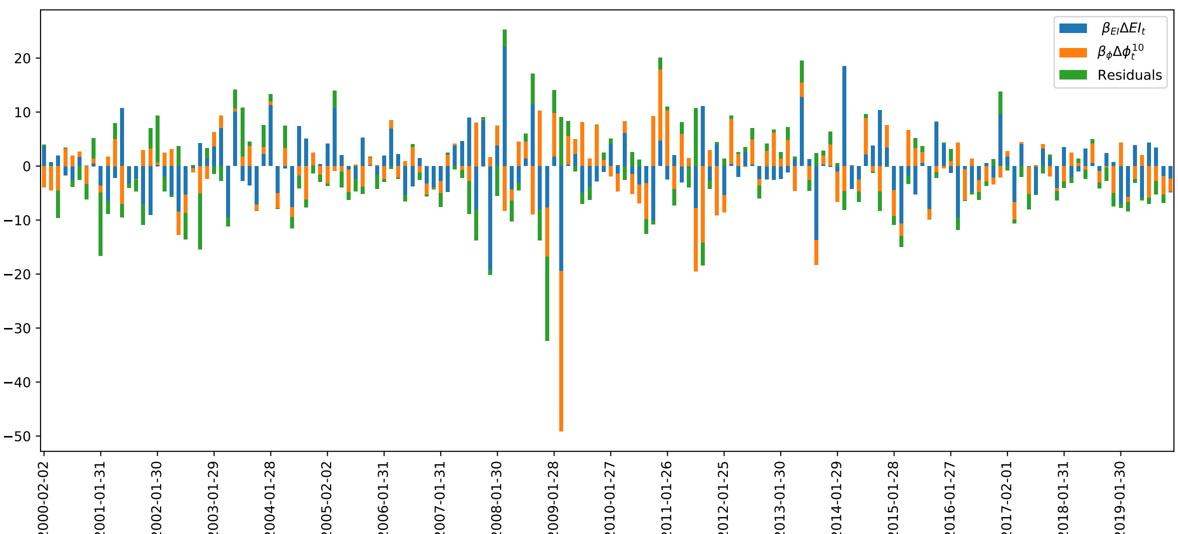
Notes: For each year-quarter we create quintiles based on the residualized mortgage rates from Freddie mac dataset after controlling for borrower and loan characteristics computed following Hurst et al. (2016) (intresid). We interact the response of mortgage rates to swap rates by the quintile. We present the response to a monetary policy shock in a bottom and a top quintile area. Data span from January 2000 to December 2019.

Fig. A.17. **Response of mortgage interest rates to daily FOMC shocks controlling for 10-year Treasury implied volatility.**



Notes: The figure reports the slope coefficient β and 95%-confidence interval from (2). The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Relative to Figure 3 we also control for the daily level of 10-year Treasury implied volatility as computed by Choi et al. (2017). Standard errors are clustered at MSA $\times$ origination year-month level. The sample consists of all the conventional loans (not originated under a government program) where the borrower's stated purpose is to purchase a property and the property type is either a condominium or single-family residence. Data span from 2000 to 2018.

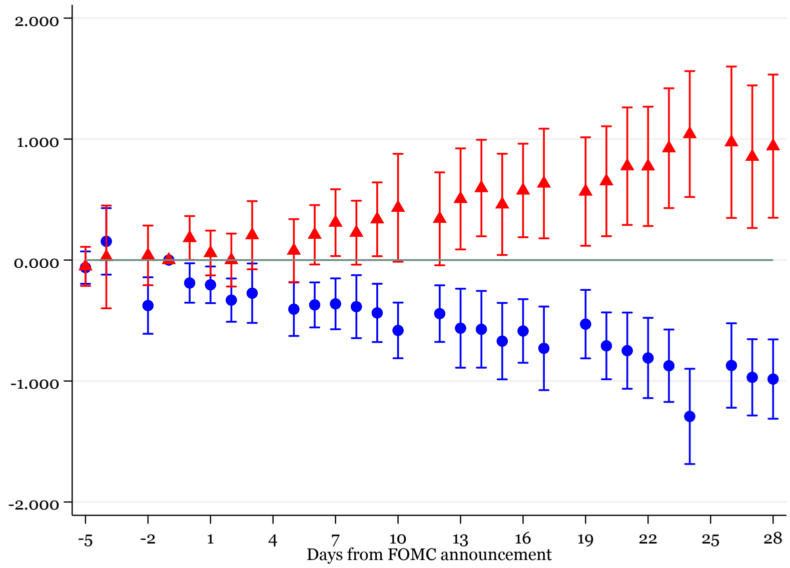
Fig. A.18. **Decomposition of changes in 10-year swap rates in future expected short rates and term premium**



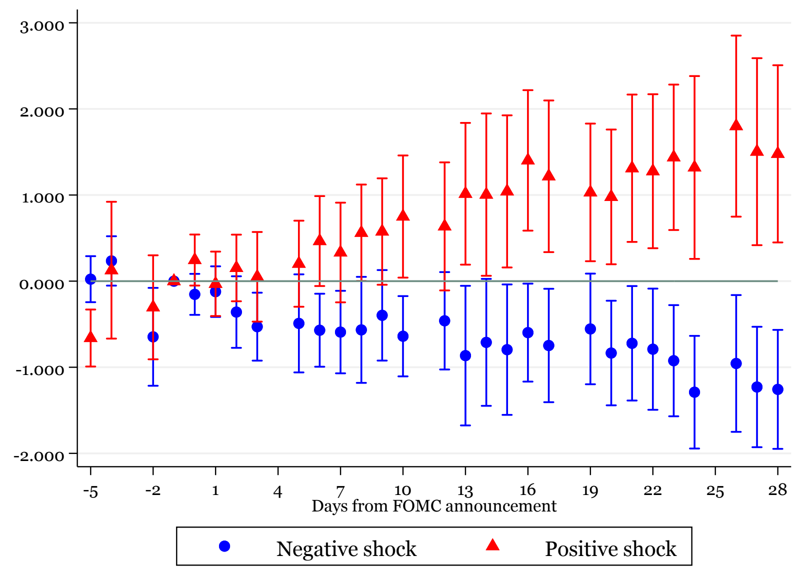
Notes: The figure shows the decomposition of changes in 10-year swap rates into Adrian et al. (2013) future expected short rates and term premium and a residual component.

Fig. A.19. **Response of mortgage interest rates to daily government par-yield shocks and the difference between swap rate and gov. par-yield**

Panel A: Response to svenpy10



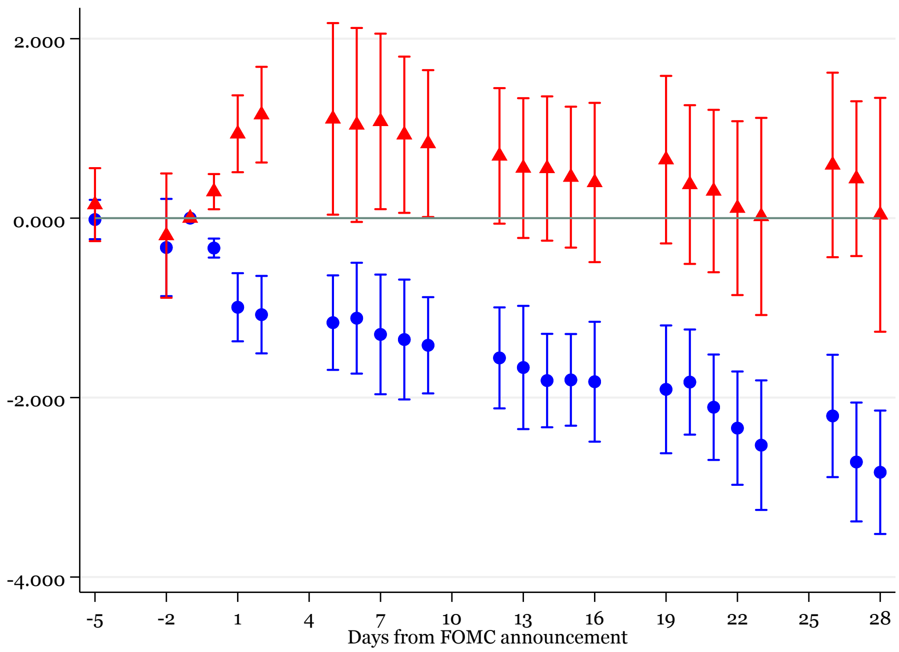
Panel B: Response to the difference between swap rate and svenpy10



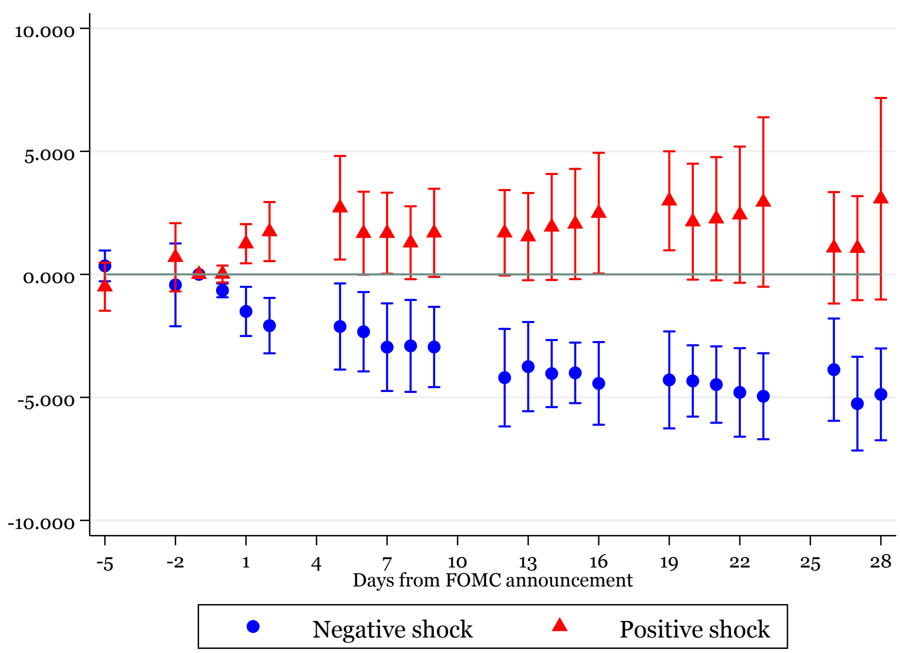
Notes: The figure reports the slope coefficient and 95%-confidence interval from (2) extended to include together the 10-year Treasury par yield and the difference between the 10-year swap rate and the par yield, and still separating between positive and negative swap rate changes on FOMC days. The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at MSA $\times$ origination year-month level. The sample consists of all the conventional loans (not originated under a government program) where the borrower's stated purpose is to purchase a property and the property type is either a condominium or single-family residence. Data span from January 2000 to December 2019.

Fig. A.20. **Response of corporate bond yields to daily government par-yield shocks and the difference between swap rate and gov. par-yield**

Panel A: Response to svenpy10



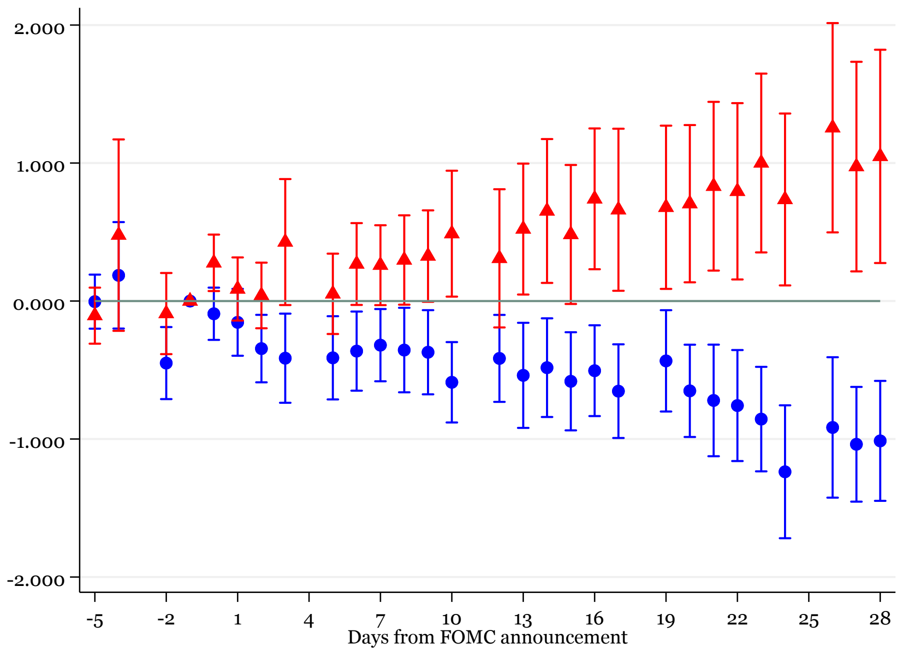
Panel B: Response to the difference between swap rate and svenpy10



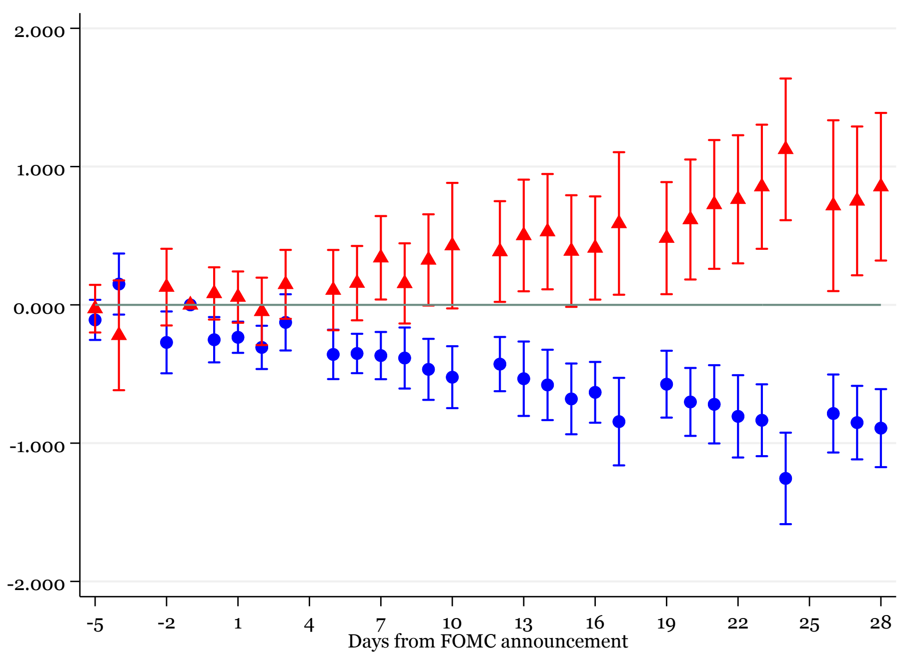
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for corporate bond yields extended to include together the 10-year Treasury par yield and the difference between the 10-year swap rate and the par yield, and still separating between positive and negative swap rate changes on FOMC days. The regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. A.21. **Response of mortgage interest rates to to news about expected future rates and term premia, Adrian et al. (2013)**

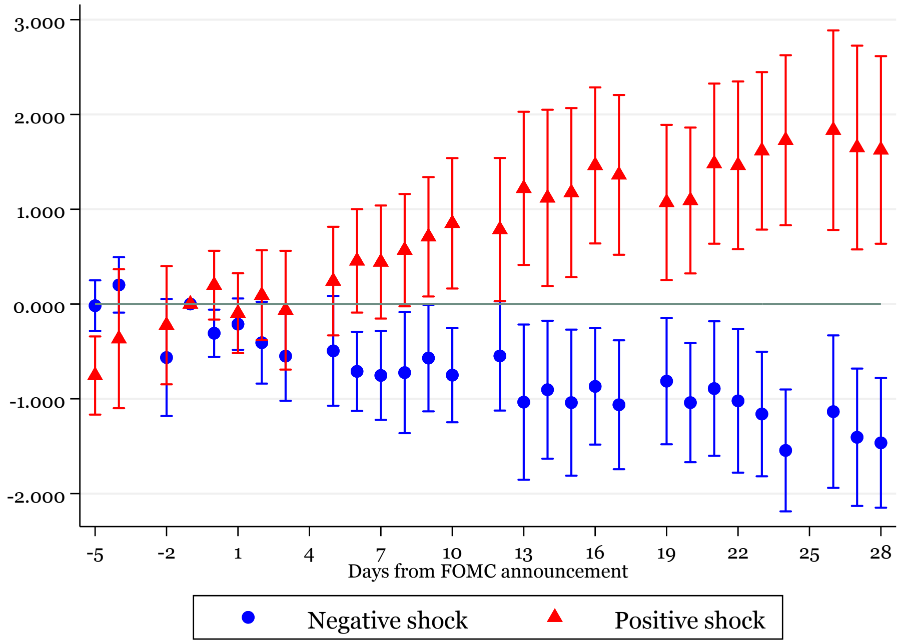
Panel A: Response to future short-term rates



Panel B: Response to term premia



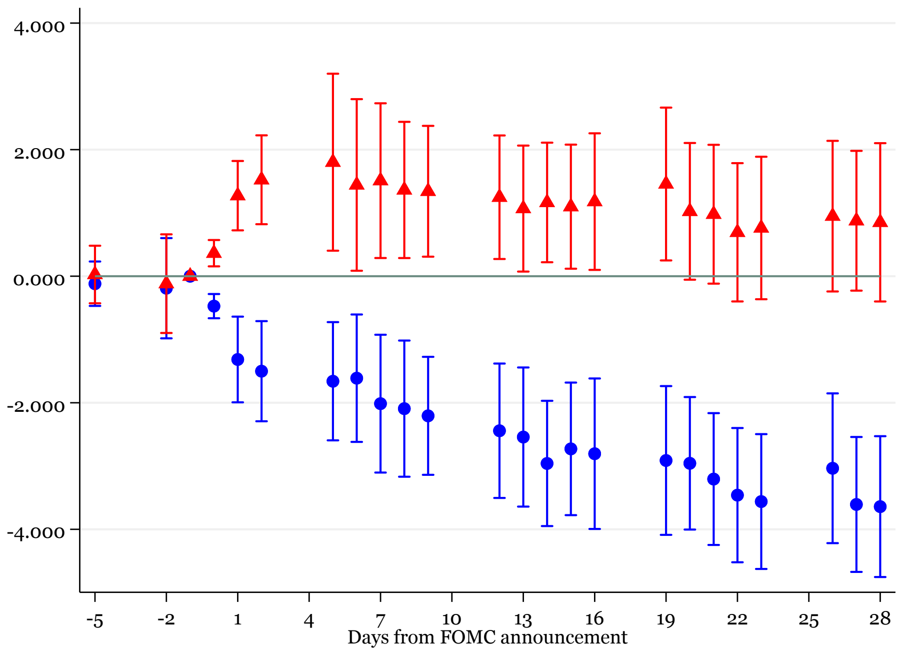
Panel C: Response to swap rate change residualized by future short-term rates and term premia



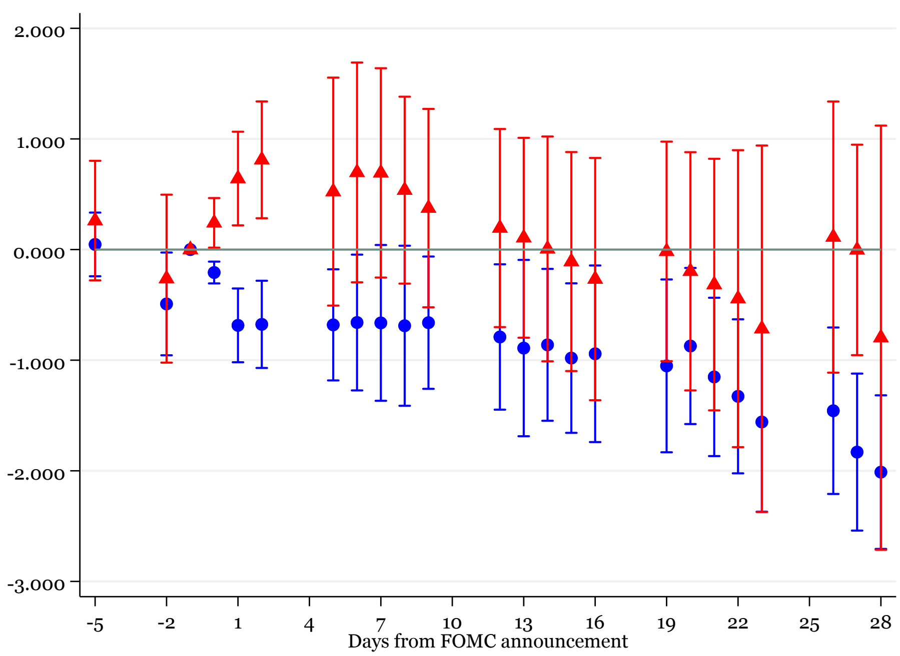
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (2) extended to include together ΔEI, $\Delta\phi$ and η, and still separating between positive and negative swap rate changes on FOMC days. The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at MSA $\times$ origination year-month level. The sample consists of all the conventional loans (not originated under a government program) where the borrower's stated purpose is to purchase a property and the property type is either a condominium or single-family residence. Data span from January 2000 to December 2019.

Fig. A.22. **Response of corporate bond yields to news about expected future rates and term premia, Adrian et al. (2013)**

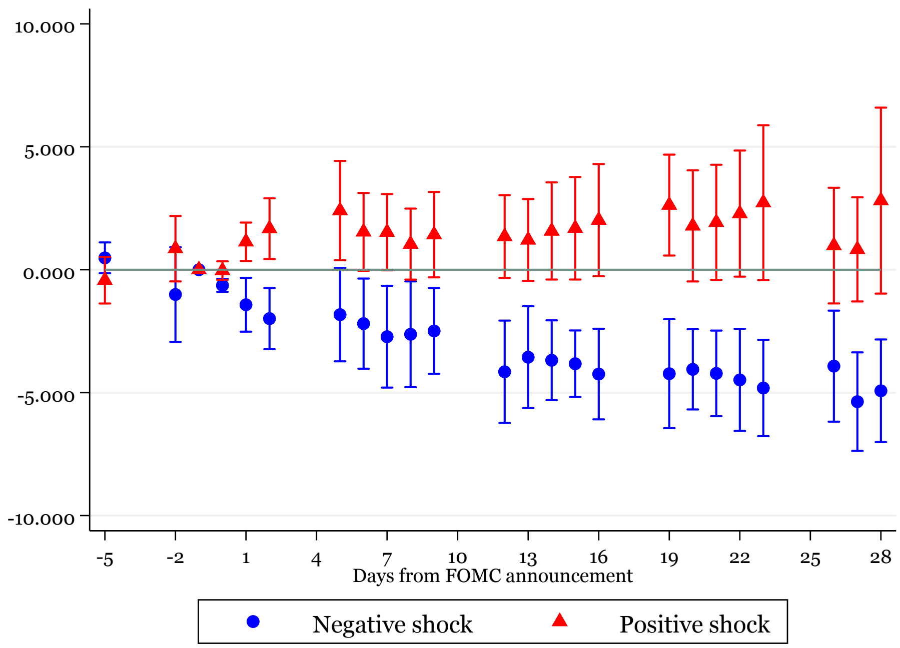
Panel A: Response to future short-term rates



Panel B: Response to term premia



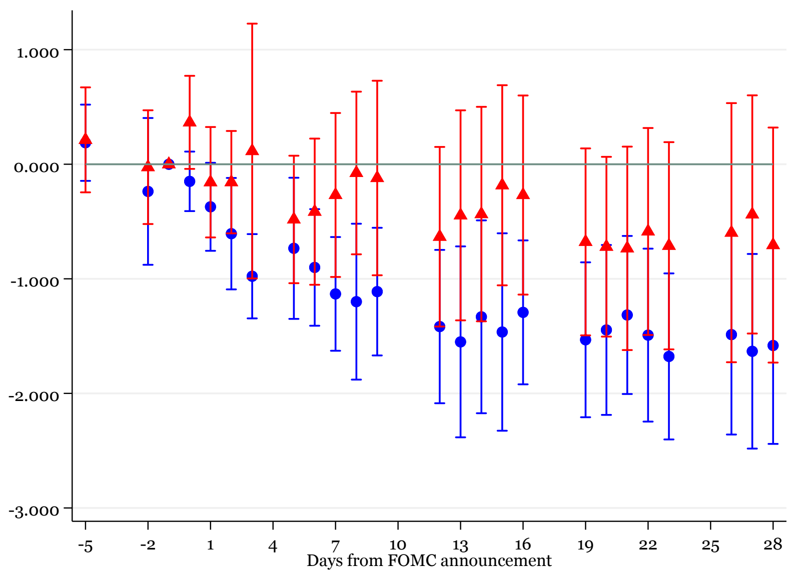
Panel C: Response to swap rate change residualized by future short-term rates and term premia



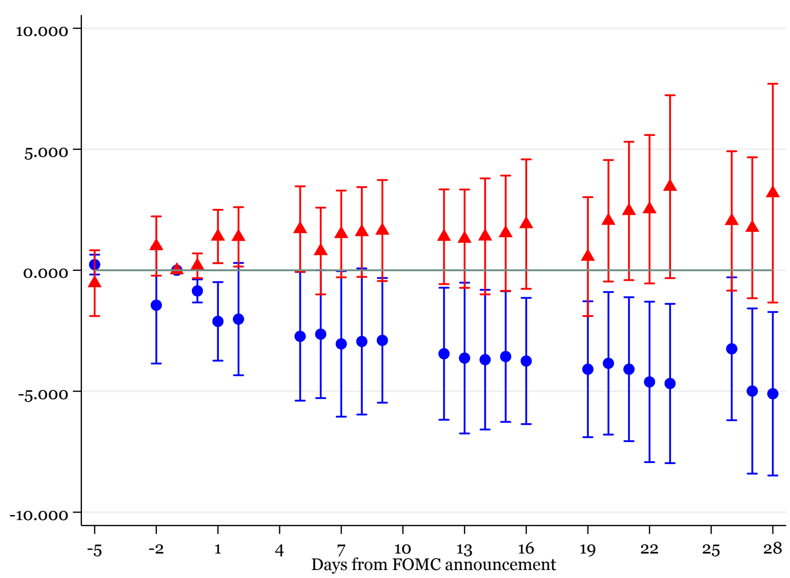
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for corporate bond yields to include together ΔEI, $\Delta\phi$ and η, and still separating between positive and negative swap rate changes on FOMC days. The regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. A.23. **Response of mortgage interest rates and corporate bond yields to Nakamura and Steinsson (2018) shocks**

Panel A: Mortgage interest rates



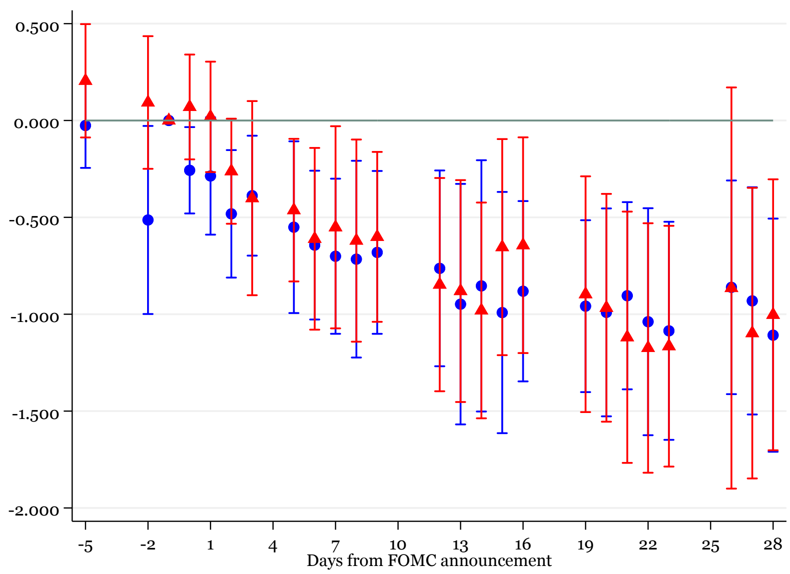
Panel B: Corporate bond yields



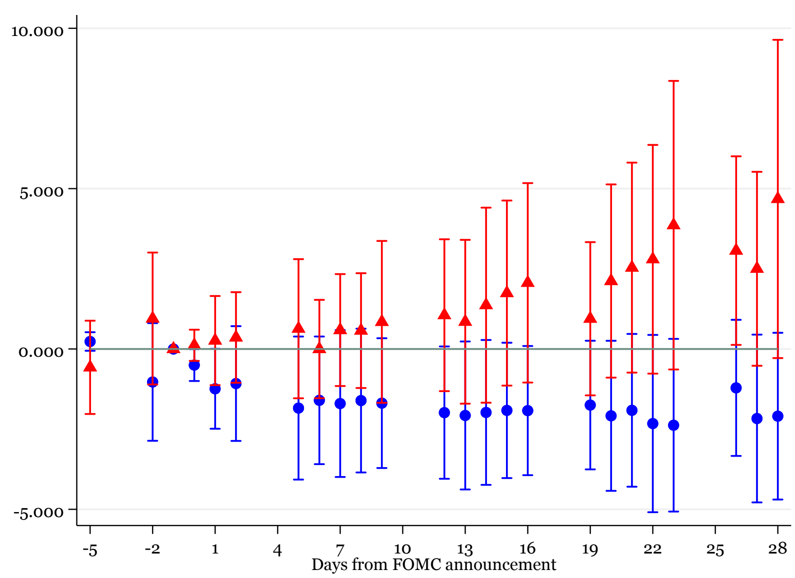
Notes: The figure reports the slope coefficient β on Nakamura and Steinsson (2018) shocks and 95%-confidence interval from (2) and 3. For mortgage rates (Panel A), the regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. For corporate bond yields (Panel B), the regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. For mortgage rates, standard errors are clustered at MSA $\times$ origination year-month level; for corporate bond yields, standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. A.24. **Response of mortgage interest rates and corporate bond yields to Kuttner (2001) shocks**

Panel A: Mortgage interest rates



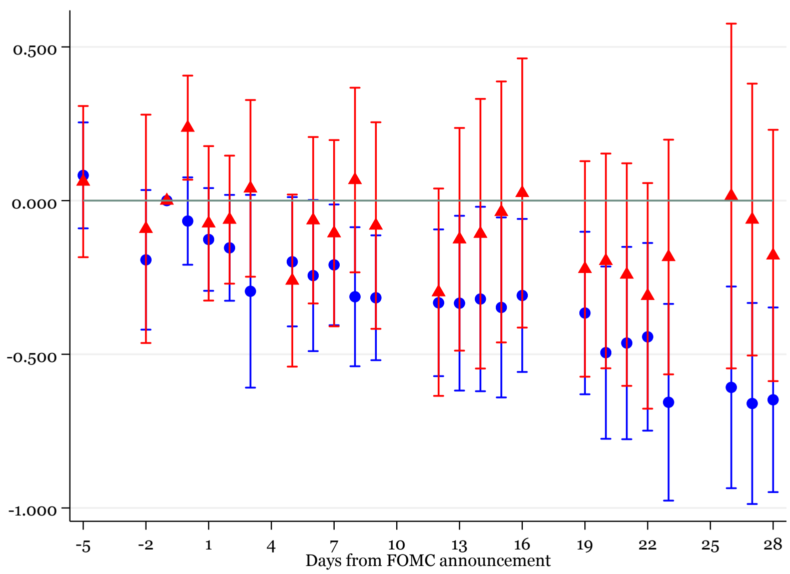
Panel B: Corporate bond yields



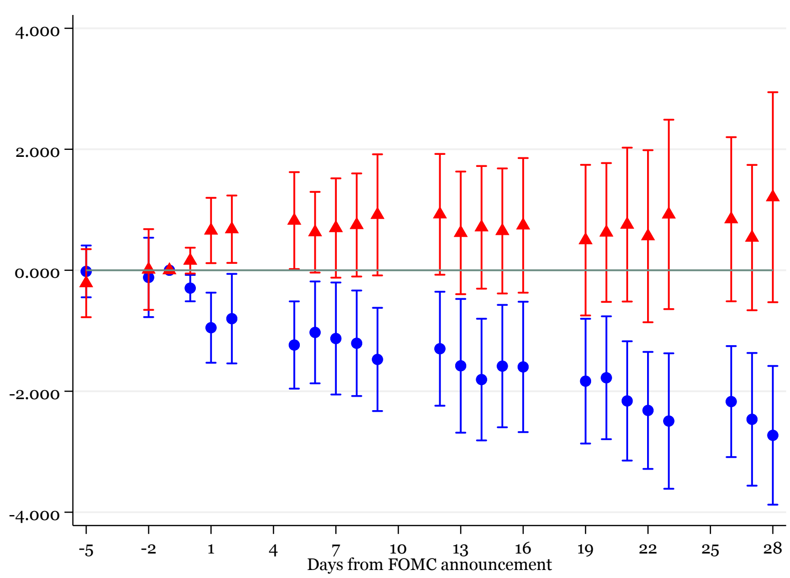
Notes: The figure reports the slope coefficient β on Kuttner (2001) shocks and 95%-confidence interval from (2) and 3. For mortgage rates (Panel A), the regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. For corporate bond yields (Panel B), the regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. For mortgage rates, standard errors are clustered at MSA $\times$ origination year-month level; for corporate bond yields, standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

Fig. A.25. **Response of mortgage interest rates and corporate bond yields to FOMC daily changes in the 2-year Treasury rates**

Panel A: Mortgage interest rates

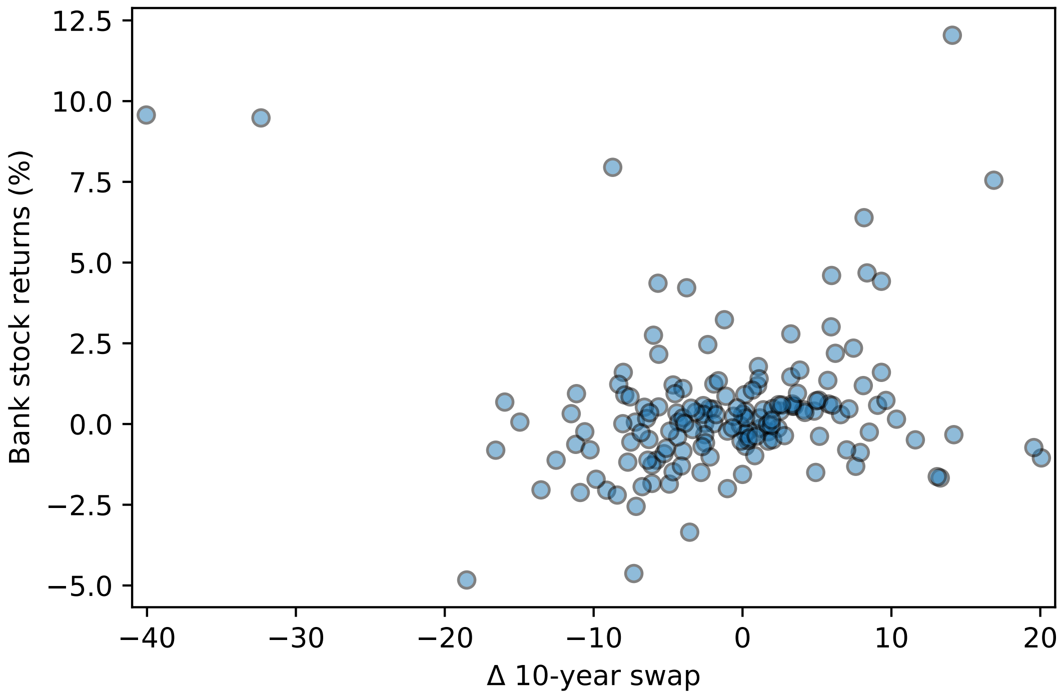


Panel B: Corporate bond yields



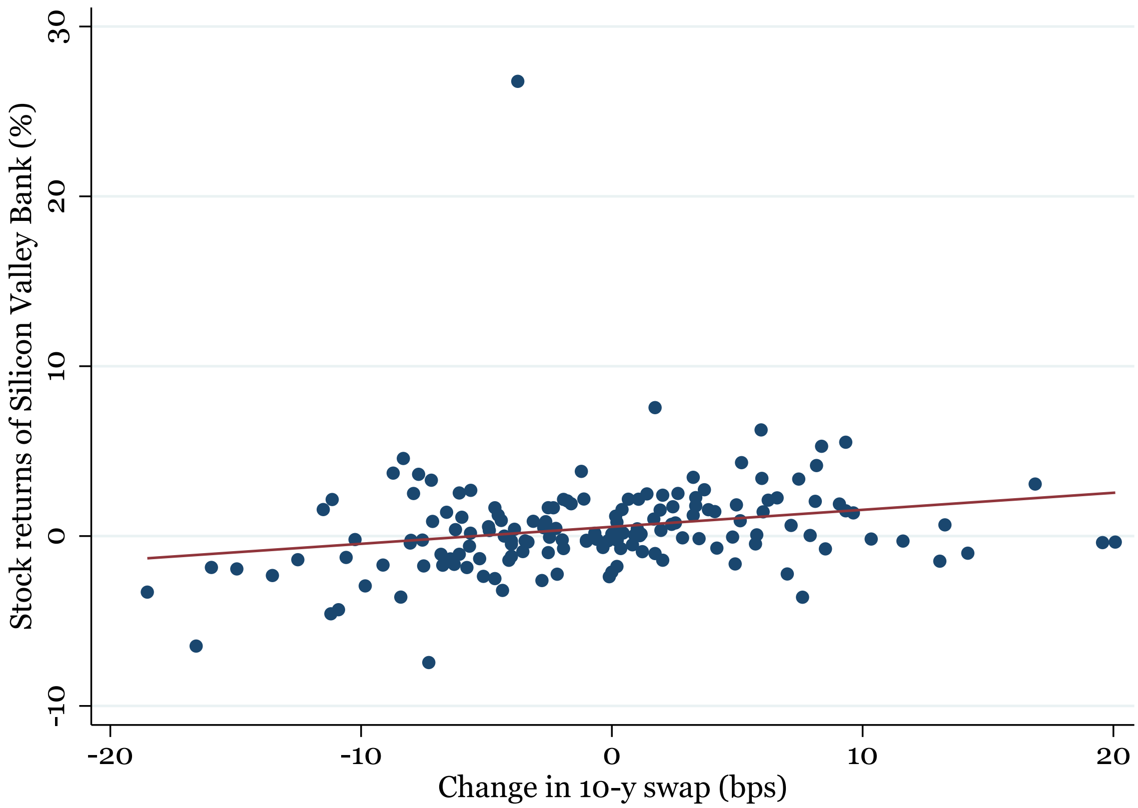
Notes: The figure reports the slope coefficient β on FOMC daily changes in the 2-year Treasury rates and 95%-confidence interval from (2) and 3. For mortgage rates (Panel A), the regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. For corporate bond yields (Panel B), the regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. For mortgage rates, standard errors are clustered at MSA $\times$ origination year-month level; for corporate bond yields, standard errors are clustered at the year-month level. Data span from January 2000 to December 2019.

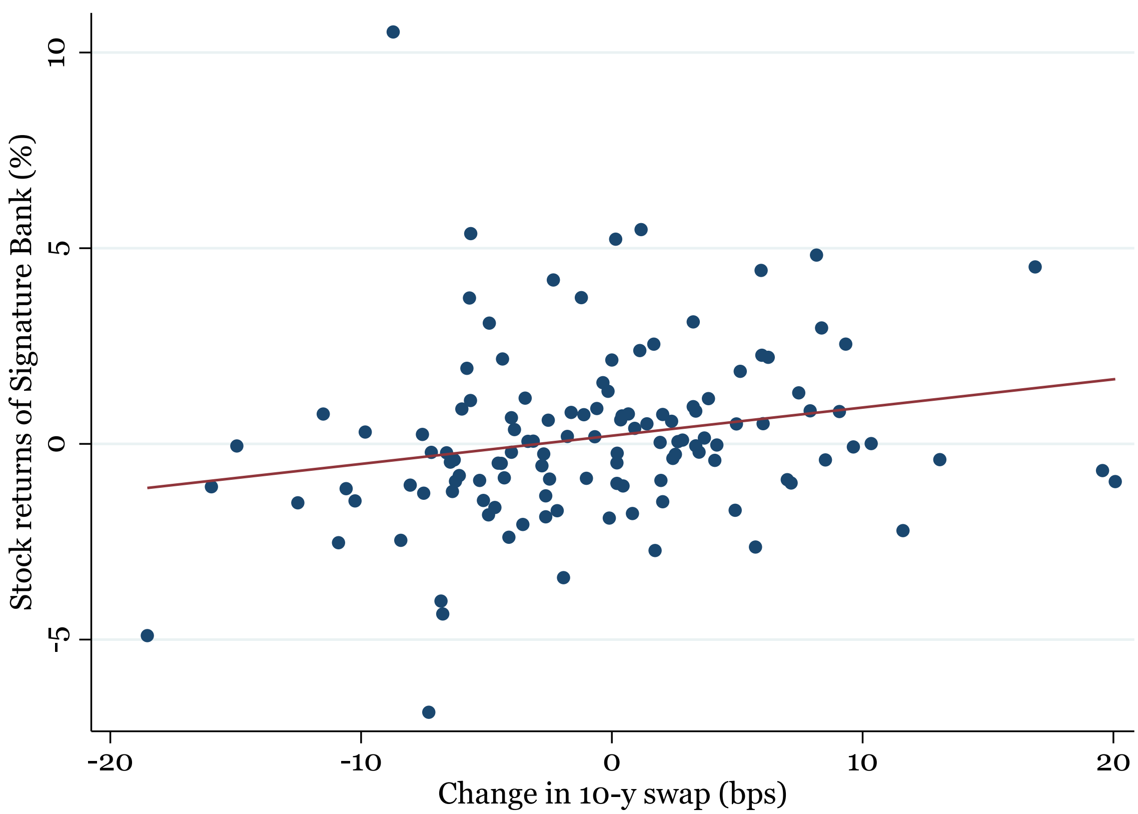
Fig. A.26. **Banking industry stock returns on the 10-year interest swap rate changes.**

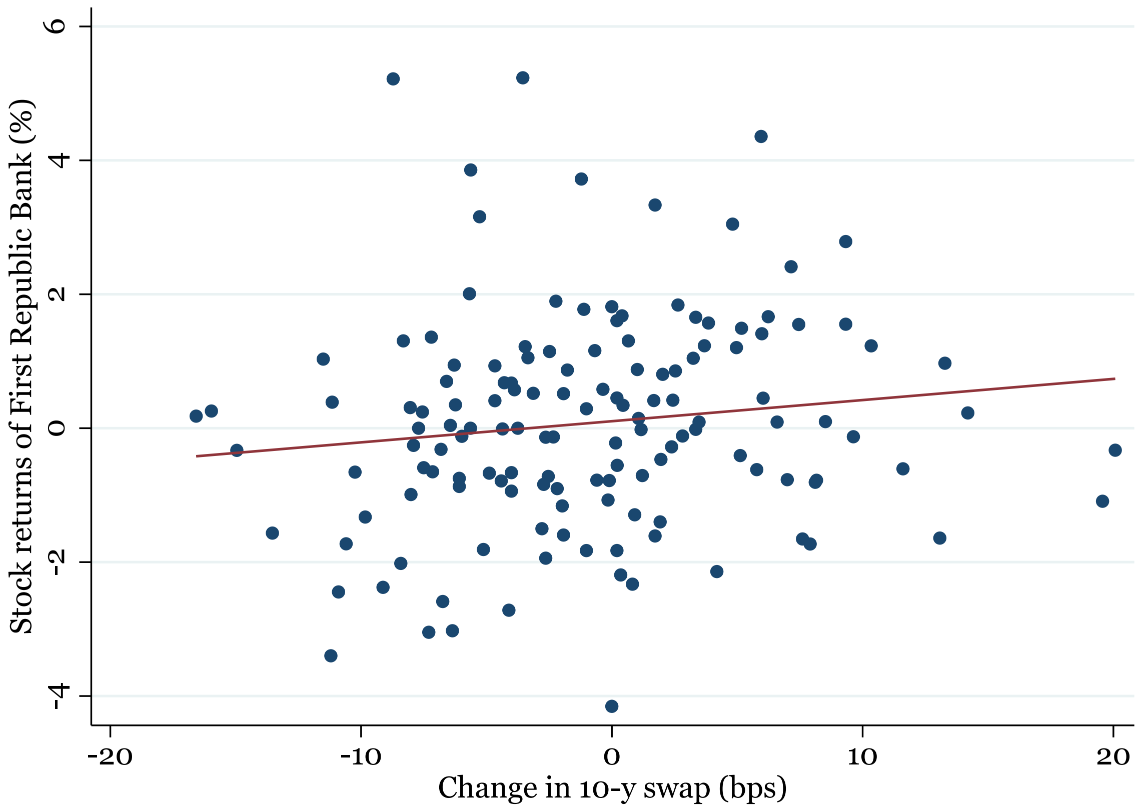


Notes: The figure shows the scatterplot of the banking industry stock returns on FOMC days against changes in the 10-year swap rates for the same dates. Industry data are the returns of the Fama and French (1997) 49 industry portfolios, downloaded from Ken French's website. Values for Δ 10-year swap rates are expressed in basis points, while bank stock returns are in percentage. The sample includes all scheduled FOMC meetings from February 2, 2000 to December 11, 2019.

Fig. A.27. **Scatterplot of stock returns of 3 individual banks – Excluding the 3 QE1 scheduled FOMC dates, i,e., December 16, 2008, January 28, 2009 and March 18, 2009.**







Notes: The figure shows the scatterplot of the stock returns 3 individual banks on FOMC days against changes in the 10-year swap rates for the same dates. Values for Δ 10-year swap rates are expressed in basis points, while bank stock returns are in percentage. The sample includes all scheduled FOMC meetings from February 2, 2000 to December, 2019.

B Evidence on Long-run Fed Guidance

In the paper, we have argued that expectation management through channels other than changes in the policy rate affects changes in market interest rates. To explore this channel, we use the dot plot contained in the Statement of Economic Projection (SEP) every quarter. From January 25, 2012, the Federal Reserve started revealing individual forecasts made by the FOMC meeting participants on the federal funds rate in the short and the long term. The dot plot, which is a chart revealing these individual forecasts for the federal funds rate, is what the market and financial press refer to as the FOMC members' rate forecasts. We are interested in how the "Long-run Fed Guidance," i.e., the disclosure of the Fed participants' expectation about the long-run nominal rate, is related to changes in long-term market rates.

Our sample includes 32 subsequent dot plot observations from January 2012 to December 2019. Following Hillenbrand (2021), we estimate Δs_t, that is, the daily change in swap rates on FOMC days, as a function of $\Delta\mathbb{E}$[Long-term fed funds rate], i.e., the change in the median forecast of the long-term fed funds rate relative to the previous dot plot.Our findings are reported in Table B.1 and indicate that a 100 basis points increase in the Fed's long-run interest rate forecast leads to an over 42 basis points increase in long-term swap rates (Column 1). When we control for the level of disagreement in the revision (the standard deviation of the forecasts weighted by the number of people forecasting the same value) we find that higher disagreement is related to positive changes in 10-year rates (Column 2). Finally, we condition on the level of 1-year government bond yields and split the observations in terciles of 1-year government bond yields. We find that the sensitivity of 10-year swap rates to forecast revision of long-term fed funds rate is higher when 1-year government bond yields are in the lowest tercile (Column 3). The sensitivity goes down monotonically as 1-year government bond yields increase. This evidence supports the hypothesis that expectation management through channels other than changes in the policy rate is important for monetary policy transmission.

Table B.1. The relation between 10-year swap rates and the long-run dots

Dependent variable:	Δs		
	(1)	(2)	(3)
$\Delta\mathbb{E}$[Long-term fed funds rate]	0.424** (0.173)	0.411** (0.183)	2.112*** (0.603)
Uncertainty		0.272* (0.144)	
Tercile(2)			-0.074* (0.039)
Tercile(3)			-0.130*** (0.036)
Tercile(2) $\times$ $\Delta\mathbb{E}$[Long-term fed funds rate]			-1.663** (0.643)
Tercile(2) $\times$ $\Delta\mathbb{E}$[Long-term fed funds rate]			-2.164*** (0.678)
R^2	0.14	0.24	0.45
Observations	32	32	32

Notes: The table shows the estimates from regressing the daily change in 10-year swap rates (Δs) on the FOMC meeting participants' median forecast for the long-term level of the federal funds rate ($\Delta\mathbb{E}$[Long-term fed funds rate]). Uncertainty is the standard deviation of forecasts for the meeting with each value weighted by the number of people forecasting that value. Tercile represents the tercile of the 1-year government bond yield levels on the 32 dates in the sample. Robust standard errors are shown in parentheses. The sample is from January 2012 to December 2019.

C Monetary policy transmission in the sample from 2010

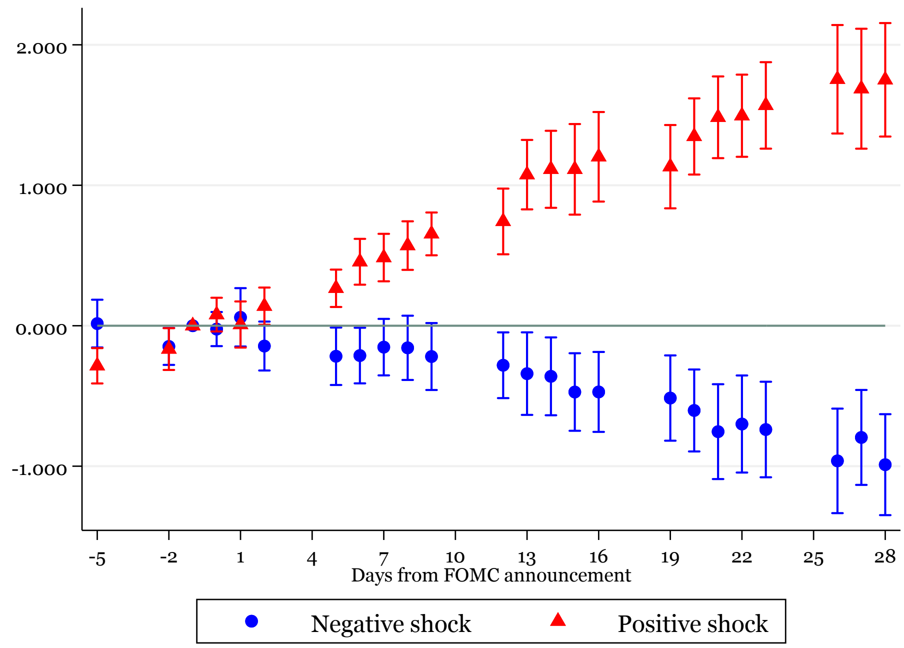
We repeat the analysis focusing on the more recent subsample from 2010. We do so because the more recent sample experienced a) short-term rates close to zero, b) an increase in the usage of forward guidance and LSAPs, and c) the introduction of post-announcement press conferences held by the Federal Reserve President. Again we compute the response of mortgage rates and corporate bond yields to monetary policy using daily and intraday variations in 10-year rates. However, in this case, we can use swap rates for calculating both daily and intraday shocks.[32]

As regards the response of mortgage rates, Figure C.1 shows the response of mortgage rates to daily and higher-frequency FOMC shocks in the sample from 2010. Both using daily and higher-frequency FOMC shocks, we observe an average response to positive rate shocks that is larger than the response to negative shocks. For instance, using daily shock the average response to positive rate shocks is larger than the response to negative shocks by about 54 basis points per 100 basis points of the shock (t-statistics of 3.65). This finding is key to understanding monetary policy transmission to the mortgage markets. Our results suggest that the one-for-one response we describe in the paper can be seen as an average between a two-for-one response in the latter part of the sample and a nearly negligible response of mortgage rates to long-term rate movements in the first part of the sample, a point highlighted by Justiniano et al. (2022). As regards corporate bond yields, results are shown in Figure C.2. Findings are very similar to the ones in the overall sample from 2000. Unlike mortgage rates, corporate bonds exhibit an immediate response to monetary surprises, and in general, we observe a stronger response following a negative change in 10-year swap rates than a positive change.

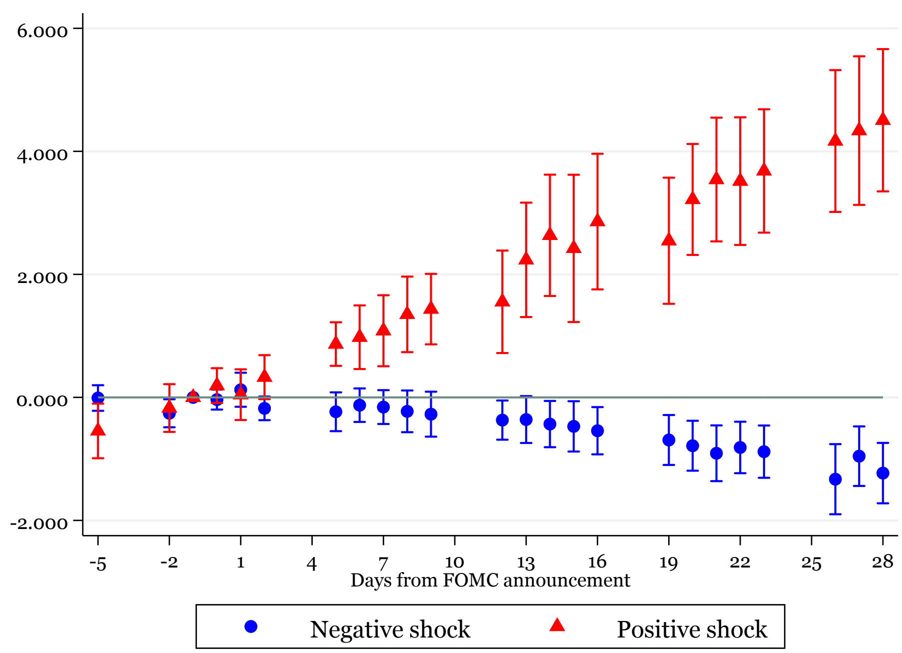
[32] We can compute high-frequency monetary policy surprises for 62 out of the 79 FOMC dates from March 2010 to December 2019. We miss data for 10-Aug-10, 21-Sep-2011, 25-Apr-2012, 20-Mar-13, 01-May-2013, 31-Jul-13, 30-Oct-13, 29-Apr-15, 17-Jun-15, 28-Oct-2015, 27-Apr-2016, 15-Jun-2016, 27-Jul-2016, 02-Nov-16, 01-Nov-17, 19-Dec-2018, 01-May-19.

Fig. C.1. **Response of mortgage interest rates to daily and higher-frequency FOMC shocks – 2010-2019.**

Panel A: January 2010 to December 2019 – daily



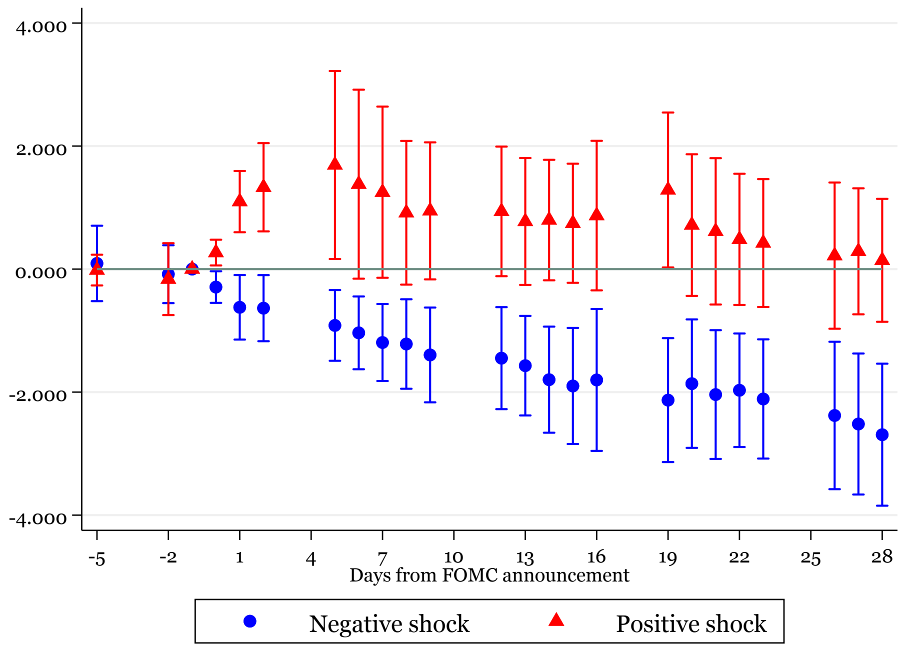
Panel B: January 2010 to December 2019 – intradaily



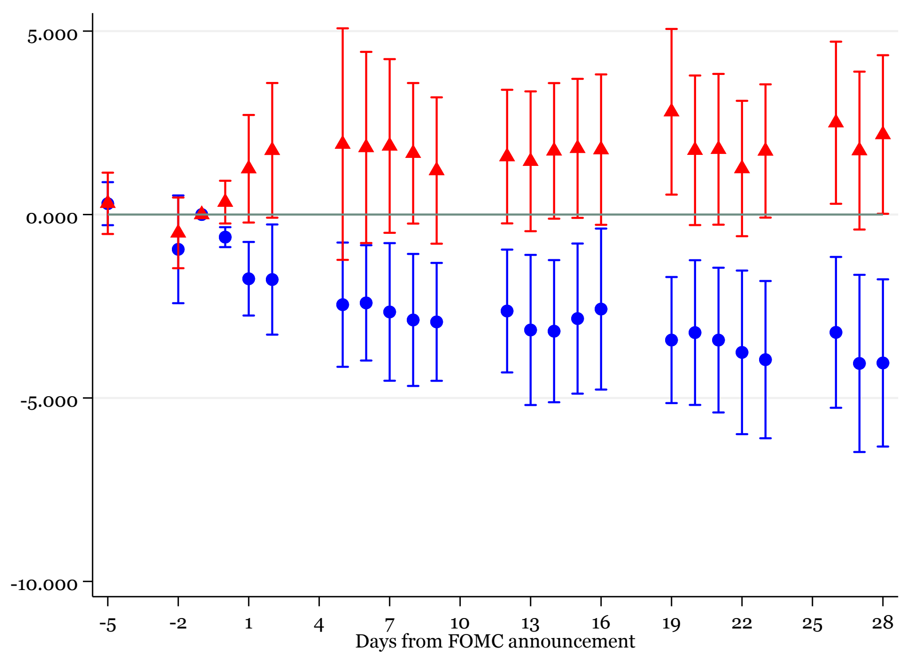
Notes: The figure reports the slope coefficient β and 95%-confidence interval from (2). The regression controls for lender-by-metropolitan-area-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at MSA $\times$ origination year-month level. Data span from January 2010 to December 2019.

Fig. C.2. **Response of corporate bond yields to daily and higher-frequency FOMC shocks – 2010-2019.**

Panel A: January 2010 to December 2019 – daily 10-year swap rates



Panel B: January 2010 to December 2019 – intradaily 10-year swap rates



Notes: The figure reports the slope coefficient β and 95%-confidence interval from (3) for corporate bond yields. The regression controls for issue-cusip-by-FOMC-event fixed effects as well as borrower's characteristics. Standard errors are clustered at the year-month level. Data span from January 2010 to December 2019.