Market Reactions to the Fed’s Balance Sheet Normalization Plans

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Talk based on joint work Francesco Bianchi and Sai Ma
Stock Market Reactions to “QT” Announcements

Discussion Outline

1. High-frequency event study of major Fed communications pertaining to its balance sheet normalization plans: “QT events”
   - 14 QT events: includes both tapering news and tightening news
   - News events span May 22, 2013 to March 20, 2019
   - Taken from: FOMC press releases, Fed Chair press conferences, Fed Chair congressional testimony
   - HF event windows: 10 min before beginning of QT event to close of stock market
   - Focus on stock market

2. Use structural model to make inferences on why the market reacted.
   - Methodology: from work with Francesco Bianchi and Sai Ma (BLM hereafter).
   - BLM approach: integrate a high-frequency monetary event study into a mixed-frequency macro-finance model and structural estimation.
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2. **Use structural model** to make inferences on *why* the market reacted.
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Jumps in Market Variables Around QT Events

The figure displays, for each Fed QT announcement, the log change in the observed variables from 10 min. before the announcement to the end of the stock market trading day, except for Bloomberg forecasts which are measured on day before and day after. Labeled dates are the 5 most quantitatively important announcements based on changes in the SP500. The full sample has 14 balance sheet normalization events spanning 5/22/2013-3/30/2019. For the following dates, the 12-qtr. (36-mon.) Eurodollar rate is used in place of missing 35-month FFF data: 05/22/2013, 12/18/2013, 09/17/2014, 06/14/2017, 12/19/2018, and 03/20/2019.
Jumps in Market Variables Around QT Events

- Large jumps in the **stock market** (top 5 dates labeled)

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- Distant FF futures too

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Jumps in Market Variables Around QT Events

- **QT events do nothing** to change expectations of inflation, GDP growth. Differs from other FOMC news events studied by BLM, mostly not about QE/QT.

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So **big jumps** in financial **markets**; little **impact** on expectations about **broader economy**.

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Brookings Panel: “Shrinking the Federal Reserve Balance Sheet”
First Statement outlining time and pace of tapering

Bernanke: tapering "data-dependent"

Q&A 2:42 PM: "But again, I want to emphasize that we are going to be data-dependent. We could stop the reductions in the pace of purchases if the economy disappoints. We could reduce the pace of purchases somewhat more quickly if the economy is stronger."

Q&A 3:04 PM: "...we’re not doing less... But while we are slowing asset purchases a bit, again, we expect the total balance sheet to be quite large and maintained for a long time. And we expect to keep rates low for a very long time."

Note: The gray shaded areas represent the event window used for the high-frequency structural event study.
First Statement outlining *time and pace* of *tapering*

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Powell: runoff on “automatic pilot”

2:00 PM: “In view of realized and expected labor market conditions and inflation, the Committee decided to raise the target range for the federal funds rate to 2-1/4 to 2-1/2 percent”

- no balance sheet news

Q&A 2:41 PM: “So we...came to the view that we would effectively have the balance sheet runoff on automatic pilot...And I think that has been a good decision... And I don’t see us changing that.”

Q&A 2:52 PM: “And if you just run the quantitative easing models in reverse, you would get a pretty small adjustment in economic growth and real outcomes...we don’t see...the balance sheet runoff as creating significant problems.”

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**Taper tantrum:** hints of possible tapering

- 10:31 AM: "...we could in the next few meetings, take a step down in our pace of purchases."
- 2:00 PM: A "number" of officials in the FOMC backed tapering as early as June.

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Why Did the Market React? BLM Approach

- Integrate high-frequency monetary event study into a mixed-frequency macro-finance model and structural estimation

Two-agent model with NK macro dynamics and heterogeneous beliefs:

- Investors: forward looking and adjust expectations quickly; own all equity and bond
- Workers/HHs: adaptive expectations with lots of inertia, as per our estimates; key for aggregate inflation

MP rule subject to infrequent "structural breaks" → MP regime

- 2 Assets: stock market and nominal bond
- 6 primitive Gaussian shocks:
  1. Aggregate demand shock in HH Euler equation
  2. Monetary policy shock in MP rule
  3. Trend growth shock – moves supply side
  4. Markup shock in Phillips curve
  5. Earnings share shock (purely redistributive between workers and investors)
  6. "Liquidity premium" shock: time-varying preference for risk-free nominal debt over equity

Estimate jumps in investor beliefs about economic state, perceived sources of economic risk, and future regime change in MP rule in response to Fed announcements.

Numerous forward-looking series at mixed frequencies to map theoretical implications for beliefs, markets, and economy into data, estimating all parameters and latent states.

Sydney C. Ludvigson, NYU Brookings Panel: “Shrinking the Federal Reserve Balance Sheet”
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- **Estimate jumps in investor beliefs** about *economic state*, perceived *sources of economic risk*, and future *regime change in MP rule* in response to *Fed announcements.*
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- **Numerous forward looking series at mixed frequencies** to map theoretical implications for beliefs, markets, & economy into data, estimating all parameters and latent states
Channels of QE/QT Transmission in Model & Estimates

\[ i_t - (r_{ss} + \pi^T_{\xi_t}) = (1 - \rho_i \xi_t) \left[ \psi_{\pi_i} (\pi_t - \pi^T_{\xi_t}) + \psi_{\Delta \pi_i} (y_t - y_{t-1}) \right] + \rho_i \xi_t \left[ i_{t-1} - \left( r_{ss} + \pi^T_{\xi_{t-1}} \right) \right] + \sigma_i \varepsilon_i, \varepsilon_i \sim N(0,1) \]

\[ \text{Perceived Equity Premium} \]

**MP rule w/ regime changes**

\[ \text{subj. equity premium} = -(\Delta \pi^b_{t+1} - \text{COV}_t \left[ m_{t+1}, r^b_{t+1} \right] + 5 \text{COV}_t \left[ \pi_{t+1}, \pi^b_{t+1} \right]) \]

**Risk premium channel**: jumps in beliefs about MP regime \( \Delta \)

**Liquidity premium channel**: exog catchall for all other sources variation in subj EP, e.g., a perceived \( \Delta \) in liquidity/safety attrib of bonds, \( \Delta \) in risk aversion, flight to quality, jump in sentiment

**Information effect channel**: jumps in investor nowcasts of broader economic activity (“Fed info effect”)

**Distributional info channel**: jumps in investor nowcasts of share of rewards to equityholders

**MP summarized by rule** (no explicit Fed buying of LT Treasuries, agency debt, or agency MBS)
Channels of QE/QT Transmission in Model & Estimates

\[ i_t - (r_{ss} + \pi_T^{T_t}) = (1 - \rho_i \xi_t) \left[ \psi_{\pi_{i_t}} (\pi_t - \pi_{i_t}^T) + \psi_{\pi_{i_t}} (y_t - y_{t-1}) \right] + \rho_i \xi_t \left[ i_{t-1} - (r_{ss} + \pi_{i_t}^T) \right] + \sigma_i \varepsilon_{i,t}, \varepsilon_i \sim N(0,1) \]

\[ \mathbb{E}_t^b [r_D^{t+1}] - (i_t - \mathbb{E}_t^b [\pi_{t+1}]) = \left[ \begin{array}{c} -.5 V_{i_t}^b [r_{i_t+1}] - \text{COV}_{i_t}^b [m_{i_t+1}, r_{i_t+1}] + .5 V_{i_t}^b [\pi_{i_t+1}] - \text{COV}_{i_t}^b [m_{i_t+1}, \pi_{i_t+1}] \\ \end{array} \right] + \text{lp}_t \]

- **Perceived Equity Premium**

- **subj. equity premium**
- **subj. risk premium**
- **liquidity premium**

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- **Inflation Expect channel**: QE (QT) manifest via higher (lower) \( \pi_T^{T_t} \), a parameter that may **not equal the stated long-term inflation target** of the central bank; implicit time \( t \) target

- Even if IE channel is muted, QE/QT news can affect financial markets via other channels:
  1. **Risk premium channel**: jumps in beliefs about MP regime \( \Delta \pi_e \) affect the perceived quantity of risk
  2. **Liquidity premium channel**: exog catchall for all other sources variation in subj EP, e.g. a perceived \( \Delta \) in liquidity/safety attrib of bonds, \( \Delta \) in risk aversion, flight to quality, jump in sentiment
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- Unless QE/QT \( \rightarrow \Delta RIR \), above just \( > \) volatility in financial markets, with broader economy unaffected.

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Channels of QE/QT Transmission in Model & Estimates

\[ i_t - (r_{ss} + \pi^T_{ε_t}) = (1 - ρ_iε_t) \left[ ψ_i (\pi_t - \pi^T_{ε_t}) + ψ_∆y_i (y_t - y_{t-1}) \right] \]

\[ + ρ_iε_t \left[ \pi_t - \pi^T_{ε_t} \right] \]

\[ + σ_iε_i, ε_i \sim N(0, 1) \]

\[ \text{E}^b_t [r^D_{t+1}] - (i_t - \text{E}^b_t [π_{t+1}]) = \left[ -0.5V_t^b [r^D_{t+1}] - \text{COV}_t^b [m_{t+1}, r^D_{t+1}] \right] + \left[ 0.5V_t^b [π_{t+1}] - \text{COV}_t^b [m_{t+1}, π_{t+1}] \right] + \text{lp}_t \]

- **subj. equity premium**
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**Inflation Expect channel**: QE/QT/FwG can \( Δ π^T_{ε_t} \) b/c these interventions can *in theory* change \( π^e \) and thus *real* rates even if \( i_t \) unchanged. *In practice* HH \( π^e \) adjusts very slowly to \( Δ \) in \( π^T_{ε_t} \)

**Perceived Equity Premium**

**mp rule w/ regime changes**

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\[ i_t - (r_{ss} + \pi_T^{\xi_t}) = (1 - \rho_{i\xi_t}) \left[ \psi_{\pi\xi_t} \left( \pi_t - \pi_T^{\xi_t} \right) + \psi_{\Delta y\xi_t} (y_t - y_{t-1}) \right] + \rho_{i\xi_t} \left[ i_{t-1} - (r_{ss} + \pi_T^{\xi_{t-1}}) \right] + \sigma_i \epsilon_i, \epsilon_i \sim N(0, 1) \]

MP Rule w/ regime changes

\[ \mathbb{E}_t^b [r_{t+1}^D] - \left( i_t - \mathbb{E}_t^b [\pi_{t+1}] \right) = \left[ -0.5 \psi_v^b \left[ r_{t+1}^D \right] - \text{COV}_v^b \left[ m_{t+1}, r_{t+1}^D \right] + 0.5 \psi_v^b \left[ \pi_{t+1} \right] - \text{COV}_v^b \left[ m_{t+1}, \pi_{t+1} \right] \right] + \text{lp}_t \]

Perceived Equity Premium

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- **Even if IE channel is muted**, QE/QT news can affect financial markets via other channels:

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Channels of QE/QT Transmission in Model & Estimates

\[ i_t - (r_{ss} + \pi_T^{T \xi_t}) = (1 - \rho_{i \xi_t}) \left[ \psi_{i \xi_t} (\pi_t - \pi_T^{T \xi_t}) + \psi_{\Delta y \xi_t} (y_t - y_{t-1}) \right] \]
\[ + \rho_{i \xi_t} \left[ i_{t-1} - (r_{ss} + \pi_T^{T \xi_{t-1}}) \right] + \sigma_i \varepsilon_{i,t}, \varepsilon_i \sim N(0,1) \]

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\[ \text{subj. equity premium} = \left[ -0.5 V^b_i \left[ r_{t+1}^D \right] - \text{COV}^b_i \left[ m_{t+1}, r_{t+1}^D \right] + 0.5 V^b_i \left[ \pi_{t+1} \right] - \text{COV}^b_i \left[ m_{t+1}, \pi_{t+1} \right] \right] + \text{lp}_{t} \]

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\[ \mathbb{E}^b [r_{t+1}^{D}] - \mathbb{E}^b [\pi_{t+1}] = \left[ \begin{array}{c} -0.5 \Psi^b_i \left[ r_{t+1}^{D} \right] - \text{COV}^b_i \left[ m_{t+1}, r_{t+1}^{D} \right] \\ +0.5 \Psi^b_i \left[ \pi_{t+1} \right] - \text{COV}^b_i \left[ m_{t+1}, \pi_{t+1} \right] \end{array} \right] + \text{lp}_t \]

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+ 0.5 \psi^b_i [\pi_{t+1}] + \text{COV}^b_i [m_{t+1}, \pi_{t+1}] \right] + \text{lp}_t, \]

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- **MP Rule w/ regime changes**
- **Perceived Equity Premium**

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Brookings Panel: “Shrinking the Federal Reserve Balance Sheet”
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**Perceived Equity Premium**

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4. **Dist. info channel**: jumps in investor nowcasts of share of rewards to equityholders

Unless QE/QT \( \rightarrow \Delta RIR \), above just = volatility in financial markets, with broader economy unaffected.

Sydney C. Ludvigson NYU | Brookings Panel: “Shrinking the Federal Reserve Balance Sheet”
Channels of QE/QT Transmission in Model & Estimates

\[ i_t - \left( r_{ss} + \pi_{T_{\xi_t}}^{T} \right) = \left( 1 - \rho_{i_{\xi_t}} \right) \left[ \psi_{\pi_{\xi_t}} \left( \pi_t - \pi_{T_{\xi_t}}^{T} \right) + \psi_{\Delta y_{\xi_t}} \left( y_t - y_{t-1} \right) \right] + \rho_{i_{\xi_t}} \left[ i_{t-1} - \left( r_{ss} + \pi_{T_{\xi_{t-1}}}^{T} \right) \right] + \sigma_i \varepsilon_{i,t}, \varepsilon_i \sim N(0,1) \]

MP Rule w/ regime changes

\[ E_b^{b} \left[ r_{t+1}^{D} \right] - \left( i_t - E_t^{b} \left[ \pi_{t+1} \right] \right) = \left[ -0.5 \psi_v^b \left[ r_{t+1}^{D} \right] - \text{COV}^b \left[ m_{t+1, \pi_{t+1}} \right] + 0.5 \psi_v^b \left[ \pi_{t+1} \right] - \text{COV}^b \left[ m_{t+1, \pi_{t+1}} \right] \right] + \text{lp}_t \]

Perceived Equity Premium

**MP summarized by rule** (no explicit Fed buying of LT Treasuries, agency debt, or agency MBS)

**Inflation Expect channel**: QE/QT/FwG can \( \Delta \pi_{\xi_t}^{T} \) b/c these interventions can in theory change \( \pi^e \) and thus real rates even if \( i_t \) unchanged. In practice HH \( \pi^e \) adjusts very slowly to \( \Delta \) in \( \pi_{\xi_t}^{T} \)

**Even if IE channel is muted, QE/QT news** can affect financial markets via other channels:

1. **Risk premium channel**: jumps in beliefs about MP regime \( \Delta \) affect the perceived quantity of risk
2. **Liquidity premium channel**: exog catchall for all other sources variation in subj EP, e.g. a perceived \( \Delta \) in liquidity/safety attr of bonds, \( \Delta \) in risk aversion, flight to quality, jump in sentiment
3. **Information effect channel**: jumps in investor nowcasts of broader economic activity (“Fed info effect”)
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**Unless QE/QT \( \rightarrow \Delta \) RIR**, above just \( \Rightarrow \) volatility in financial markets, with broader economy unaffected.
Why Did the Market React?

Up next: our estimate of contribution of revisions in investors’ perceptions about economic state and beliefs about future policy to jumps in the SM in tight windows around QT events.

Novelty of mixed-frequency structural approach: granular detail on why markets respond to Fed news (or any news), with a decomposition of responses into the primitive economic sources of risk responsible for observed revisions in numerous forward-looking series.

Filtering algorithm + structural estimation allows us to infer investor updating not only of economic state, but also which shocks they perceive are hitting the economy.
The figure reports a decomposition of movements in the S&P 500-lagged GDP ratio in tight windows around QT news events into sources attributable to revisions in the perceived shocks hitting the economy and to jumps in beliefs about near-term MP regime change for the 3 most quantitatively important Fed QT events. The red triangles denote both the observed jump in the stock market and the model-implied jump in response to the QT news.
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Top Three Fed QT Events for the SP500

- **Dec/19/18 subjective EP** ($\uparrow$ \(lp\) but also beliefs about MP regime change) & lower nowcast for earnings share

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Jumps in Risk Perceptions, Short Rates, and Earnings

Top events for revisions in investor beliefs about MP regime change

Panel (a) shows the pre-/post-QT event change in the perceived probability that financial markets assign to a switch in the monetary policy rule occurring within one year. Panel (b) shows a decomposition of the fluctuations in the log price-payout ratio \( pd = pdv_t(\Delta d) - pdv_t(r^X) - pdv_t(rir) \) in tight windows around these events driven by variation in \( pdv_t(r^X) \) (yellow bar), \( pdv_t(rir) \) (blue bar), and \( pdv_t(\Delta d) \) (red bar).
Jumps in Risk Perceptions, Short Rates, and Earnings

- Dec/19/18 big \( \downarrow \) perceived prob of MP regime change within next year.

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Jumps in Risk Perceptions, Short Rates, and Earnings

- \( pd \downarrow \) b/c subj return premia \( \uparrow \) in part b/c beliefs about future MP changed: decline in perceived probability of switching to a more active MP regime

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Jumps in Risk Perceptions, Short Rates, and Earnings

- Less activism in stabilizing output growth lifting expected volatility and the perceived quantity of risk

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Jumps in Risk Perceptions, Short Rates, and Earnings

- This is the **structural interpretation** of Powell’s “autopilot runoff”, seen through **lens of this model**.

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Takeaways

▶ Whether it’s tapering or tightening, stock market dislikes perceived inflexibility.

▶ Financial markets are clearly attuned to news about the Fed’s balance sheet.

▶ Subjective equity return premia are big drivers of SM jumps around QT events, with perceptions about earnings share playing important secondary role.

▶ Open question: Do market jumps in response to QT news have any relevance for broader economy?

▶ Little evidence that forecasts of $\pi_t$ or GDP growth change in response to QT news.

▶ No forecaster tantrums.

▶ A long literature in asset pricing: much variation in SM return premia has negligible correlation with macroeconomy at any horizon.

▶ Earnings share $\Delta'$s here merely redistribute rewards w/o affecting the size of rewards.
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APPENDIX
Fed surprises market by not tapering at this meeting

FOMC: no preset course for asset purchases

Bernanke: tapering not on “fixed calendar-schedule”

2:00 PM: “In judging when to moderate the pace of asset purchases, the Committee will, at its coming meetings [emphasis added], assess...incoming information...”

Q&A 3:03 PM: “…we can’t let market expectations dictate our policy actions.”

Q&A 2:49 PM: “…we don’t have a fixed calendar schedule - but we do have the same basic framework that I described in June.”
Bernanke: purchases could end by first half of next year.

Note: The gray shaded areas represent the event window used for the high-frequency structural event study.
Define: \( mps_t \equiv FFR_t - \text{Expected Inflation}_t - r^*_t \)

The real interest rate is the difference between the nominal federal funds rate (FFR) and expected inflation, where expected inflation is computed as a four quarter moving average of inflation. The monetary policy spread is defined as \( mps_t \equiv FFR_t - \text{Expected Inflation}_t - r^*_t \), where \( r^*_t \) is the natural rate of interest from Laubach and Williams (2003). The sample spans the period 1961:Q1-2020:Q2.
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Real interest rate and Monetary Policy Spread ($mps$)

- RIR in 2003 ≈ its nadir from 2008-2013 despite massive QE post crisis

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Define:
\[
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\]

Deviations of \( mps_t \) from 0 last decades

RIR in 2003 \( \approx \) its nadir from 2008-2013 despite massive QE post crisis

Secular ↘ in \( r^* \) → policy less accommodative after the crisis than in 2003

QE: limited ↗ \( \pi_e \) & thus ↘ real rates relative to e.g., 2003, echoing QT events

Suggests can't replicate accommodative MP at the ZLB with QE

IE channel muted, helping explain why \( mps \) deviations large and persistent

Model accounts for this w/ 2-agent structure & slow, adaptive learning by HHs

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Real interest rate and Monetary Policy Spread (mps)
Definition of Monetary Policy Spread (mps):

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Real interest rate and Monetary Policy Spread (mps)

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Measures of the Real Interest Rate

Notes: The real interest rate is measured as the federal funds rate minus a measure of inflation expectation. In the left panel, the black line measures inflation expectation uses a four quarter moving average of inflation. The blue line uses one-year mean forecast of inflation from the Survey of Consumers. The red line uses one-year mean forecast of inflation from the Survey of Professional Forecasters. The right panel plots the monetary policy spread, i.e., the spread between the real interest rate and the Laubach and Williams (2003) natural rate of interest. The sample spans 1961:Q1-2020:Q1.
Overview of Model and Approach

1. **MP rule** subject to infrequent “structural breaks”.

2. **Two-agent model w/ NK macro dynamics & heterogenous beliefs**
   - “Investors”: e.g., wealthy HH or large institution; small fraction of pop. but own all of SM. Takes macro dynamics as given.
   - “Households”: workers invest in bonds only; beliefs are key drivers of macro expectations
   - **Why 2 agents?** survey data → subst. *inertia* in HH expectations; financial markets *react swiftly* to CB communications

3. **Model investor beliefs about breaks in MP rule**: can estimate *current* rule but must form *beliefs* about how long current rule will last, what will follow. Investors form expectations of next “Alternative” *policy rule* and probability of exiting the current rule.

4. **In resp to Fed news** Investors may revise:
   - “Nowcasts” of *economic state*
   - Beliefs about probability of regime change in MP rule
   - Perceived risk in the stock market.
Notes: The figure reports the decomposition of movements in the 6-month FFF rates, the 10-month FFF rates, the 35-month FFF rates, and the stock market attributable to revisions in the perceived shocks hitting the economy and in the belief regimes for the 5 most relevant Fed QT announcements based on changes in the stock market. The full sample has 14 balance sheet normalization events spanning May 22, 2013 to March 20, 2019.
Notes: The figure reports the decomposition of movements in the 35-month Fed funds futures (FFF) rate attributable to revisions in the perceived shocks hitting the economy and in the belief regimes for the 5 most quantitatively important Fed announcements (as measured by the absolute magnitude of jumps in the stock market) about balance sheet normalization. The difference between the model-implied series and the observed counterpart is attributable to observation error.