Post-FOMC Announcement Drift in U.S. Bond Markets.

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Forecasting Short Rates

- after FOMC announcement, bond investors face forecasting problem:

$$y_t^N = \frac{1}{N}\mathbb{E}_t^* \left[\sum_{j=1}^{N} r_{t+j}^{N-j+1}. \right]$$

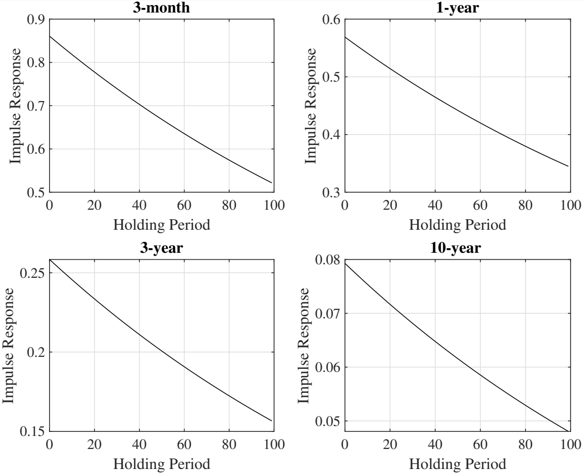
where r_t^N denotes the log return on an N-period bond.

- (rational) expectations hypothesis: investors forecast short rates

$$y_t^N = \frac{1}{N}\mathbb{E}_t \left[\sum_{j=1}^{N} r_{t+j-1}^{\$}. \right]$$

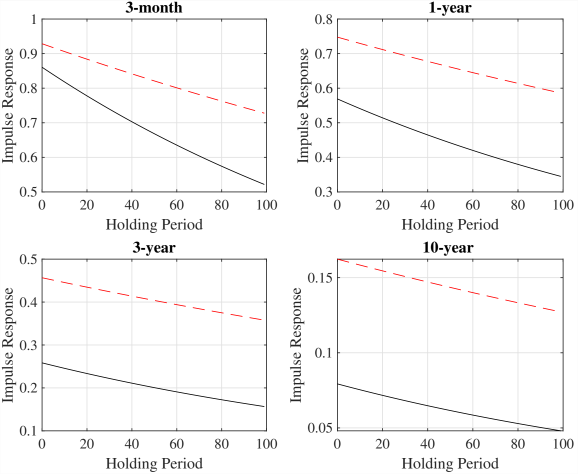
  - DGP for short rates: $r_{t+1}^{\$} = (1-\phi)\theta + \phi r_t^{\$} + u_{t+1}$
  - yield on N-period bond: $(y_t^{N,RE} - \theta) = \frac{1}{N}\frac{1-\phi^N}{1-\phi}(r_t^{\$} - \theta)$.

Benchmark: Expectations Hypothesis



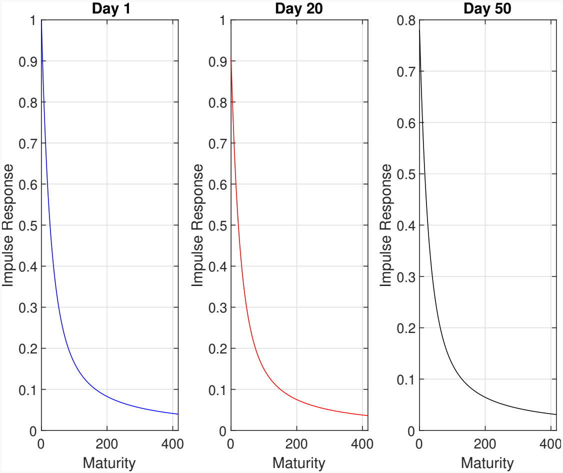
Response to 1 bps. shock to short rate. Holding period in months. Response for ϕ=0.9: $\frac{\Delta y^{N,RE}_{t+k}}{\Delta r^{\$}_t} = \frac{1}{N}\frac{1-\phi^N}{1-\phi}\phi^k$.

Benchmark: Expectations Hypothesis



Response to 1 bps. shock to short rate. Response for ϕ=0.9 (full line) and ϕ=0.95 (dotted line). $\frac{\Delta y_{t+k}^{N,RE}}{\Delta r_t^{\$}} = \frac{1}{N}\frac{1-\phi^N}{1-\phi}\phi^k$.

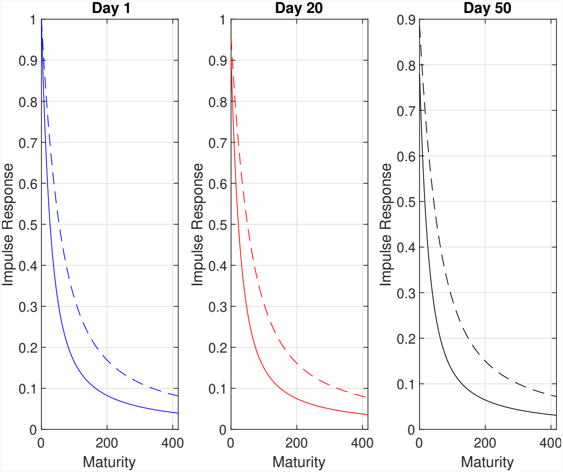
Benchmark: Expectations Hypothesis



Term Structure of Yield Responses. ϕ=0.9. Maturity on horizontal axis in months.

$$\frac{\Delta y_{t+k}^{N,RE}}{\Delta r_t^{\$}} = \frac{1}{N}\frac{1-\phi^N}{1-\phi}\phi^k.$$

Benchmark: Expectations Hypothesis



Term Structure of Yield Responses. ϕ=0.9 (bottom line) and ϕ=0.95 (top line).

Maturity on horizontal axis in months. $\frac{\Delta y_{t+k}^{N,RE}}{\Delta r_t^{\$}} = \frac{1}{N}\frac{1-\phi^N}{1-\phi}\phi^k$.

Computing Impulse Responses of Yields to Mon. Surprises

- y_t^k: the par bond yield on Treasury bond with maturity k.
- regression of cumulative yield changes between $t-1$ and $t+j-1$ on the monetary policy surprise at t:

$$y^k_{\tau_i+j-1} - y_{\tau_i-1} = a_{k,j} + b_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots .$$

  where $\tau_i \in \tau$ is the date of one of the regularly scheduled FOMC meetings.

  - news about FFR: innovation in FF futures (nearest contract) on announcement days

$$\Delta r^u_t = \left(f^0_t - f^0_{t-1}\right)\frac{m}{m-t}.$$

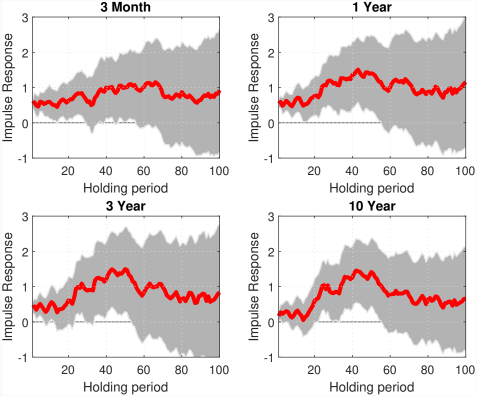
Surprises on Scheduled FOMC Meeting Days: Lumpy FFR News

$$\Delta r_t^u = \left(f_t^0 - f_{t-1}^0\right) \frac{m}{m-t}.$$

	All	FOMC
		Scheduled
Obs	6760	157
Mean(abs)	0.164	3.906
Std	1.849	**6.786**
		Target Changes
Obs	6760	59
Mean(abs)	0.164	6.456
Std	1.849	**9.587**
		No Target Changes
Obs	6760	98
Mean(abs)	0.164	2.371
Std	1.849	**4.302**

Full sample contains 157 regularly scheduled FOMC meetings between 2-Nov-1988 and 29-Oct-2008.

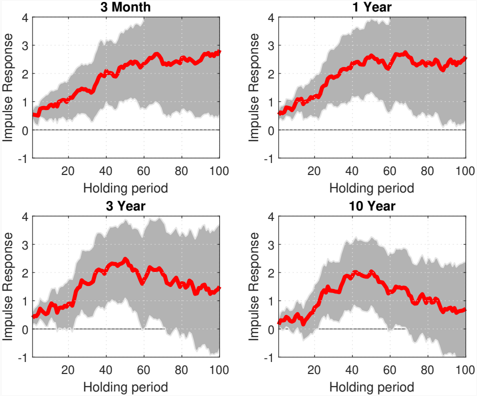
Impulse Response of U.S. Treasuries



Response in bps. of U.S. Treasuries with Constant Maturity to 1 basis points (Kuttner) surprise in FFR after k days. Sample consists of all 157 regularly scheduled FOMC meetings between 2-Nov-1988 and 29-Oct-2008. We plot 2-standard-error bands around the IR.

$$y^k_{\tau_i+j-1} - y_{\tau_i-1} = a_{k,j} + b_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots .$$

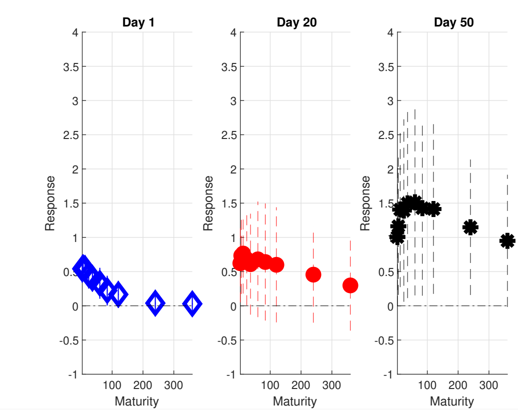
Impulse Response of U.S. Treasuries: Target Changes



Response in bps. of U.S. Treasuries with Constant Maturity to 1 basis points (Kuttner) surprise in FFR after k days. Sample consists of all 59 target changes on regularly scheduled FOMC meetings between 2-Nov-1988 and 29-Oct-2008. We plot 2-standard-error bands around the IR.

$$y^k_{\tau_i+j-1} - y_{\tau_i-1} = a_{k,j} + b_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots .$$

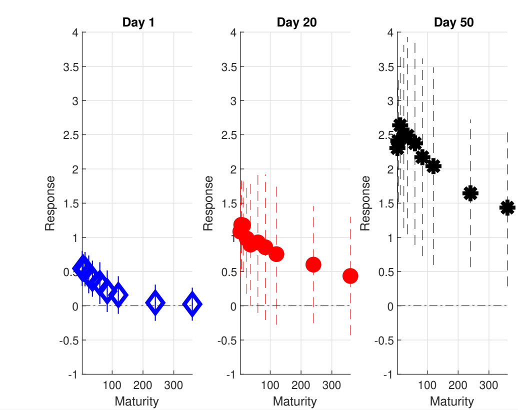
Term Structure of U.S. Treasury Responses



Response of U.S. Treasuries with Constant Maturity to 1 basis points (Kuttner) surprise in FFR after k days. Sample consists of all 157 regularly scheduled FOMC meetings between 2-Nov-1988 and and 29-Oct-2008.

$$y^{k}_{\tau_i+j-1} - y_{\tau_i-1} = a_{k,j} + b_{k,j}\left(-\Delta r^{u}_{\tau_i}\right) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots.$$

Term Structure of U.S. Treasury Responses: Target Changes



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Summary

- expectations hypothesis roughly holds *on FOMC announcement day*
- *puzzling post-announcement drift in yields after FOMC announcements*, especially at long end; contributes to
  - failure of expectations hypothesis
  - excess volatility of long bonds *(CS, 1988)*
  - excess sensitivity of long rates *(GSS, 2005; CP, 2002; HS 2015; GK, 2017)*
  - time-series momentum in fixed income *(MOP, 2012)*

- robust to controlling for
  1. Δ in expectations about future path ✓
     $y^k_{\tau_i+j-1} - y_{\tau_i-1} = a_{k,j} + \beta_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \gamma_{4,j}(f^4_{\tau_i} - f^4_{\tau_i-1}) + \gamma_{8,j}(f^8_{\tau_i} - f^8_{\tau_i-1}) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots.$
  2. Δ in expectations of macro fundamentals ✓
  3. lagged FOMC announcements in window ✓

Summary

- *puzzling post-announcement drift in yields after FOMC announcements*, especially at long end; contributes to
  - failure of expectations hypothesis
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- robust to controlling for
  1. Δ in expectations about future path ✓
  2. Δ in expectations of macro fundamentals ✓
     $y^k_{\tau_i+j-1} - y_{\tau_i-1} =$
     $a_{k,j} + \beta_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \sum_l \gamma^l_{k,j} \Delta \mathbb{F}^l_{\tau_i}(x) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots.$
  3. lagged FOMC announcements in window ✓

- not robust to including unscheduled FF Target changes
  - (bad) news is revealed about macro-fundamentals

Mechanism: Mutual Fund Flows

Mechanism: Mutual Fund Investors help the Fed

- *less sophisticated capital*: pay attention to fixed income performance and sell (buy) only *after FF rate change*
  - persistent, large flows out of fixed income MFs after surprise Fed Funds rate increases; larger rate increases induce larger outflows
    - MF investors subject to *sticky and extrapolative* expectations
  - MF managers forced to sell Treasurys
  - evidence of flow-induced price pressure in Treasury markets
- slow-moving *sophisticated capital* : arbitrage capital is not leaning against the wind
  - rate changes $\sim$ Treasury supply shocks (similar to evidence from index additions/deletions and Treasury auctions)

U.S. Government Bond Mutual Fund Returns

All Scheduled FOMC Meetings

1	5	10	20	50	100
-1.48	-5.09	-5.22	-7.10	-12.86	-10.90
(0.71)	(1.71)	(2.56)	(3.24)	(4.68)	(4.71)
0.06	0.12	0.08	0.07	0.12	0.05

Target Changes

1	5	10	20	50	100
-1.38	-4.91	-5.82	-7.10	-14.45	-11.55
(0.76)	(1.98)	(2.41)	(3.45)	(5.05)	(4.76)
0.08	0.18	0.17	0.11	0.22	0.10

Response of U.S. gov't bond MF returns in bps to 1 bps surprise in FFR (Target Changes) after *k* days:

$$r^k_{\tau_i \to \tau_i+j-1} = a_{k,j} + b_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \varepsilon^{k,j}_{\tau_i+j-1}, j = 1, 2, \ldots.$$

- same-day return response is -1.48 bps per bps of surprise
- 5-year duration for MFs: approx. 0.30 bps response of yields, consistent with the response of 6-year Treasury yield
- 50-day return response is 12.86 bps per bps surprise $>> 7.55 = 5 \times 1.51$ bps response implied by 6-year Treasury yield *(see CS, 2007)*

Predicting U.S. Mutual Fund Returns

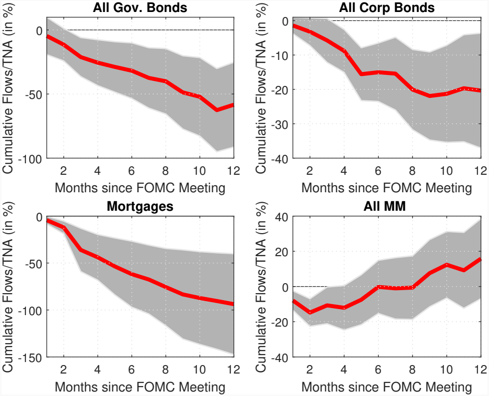
All Government Bonds					
1	**5**	**10**	**20**	**50**	**100**
-0.72	-1.86	-0.83	-2.64	-7.36	-8.10
(0.97)	(1.20)	(1.25)	(1.97)	(3.08)	(3.39)
0.02	0.11	0.01	0.04	0.15	0.12
Intermediate Short Government Bonds $1yr < x < 5yrs$					
1	**5**	**10**	**20**	**50**	**100**
-0.34	-1.32	-0.68	-2.94	-7.94	-7.92
(0.70)	(1.10)	(1.38)	(1.85)	(3.34)	(3.35)
0.01	0.07	0.01	0.06	0.17	0.11
Intermediate Government Bonds $5yrs < x < 10yrs$					
1	**5**	**10**	**20**	**50**	**100**
-0.81	-2.14	-1.16	-6.55	-10.76	-8.13
(1.13)	(1.18)	(1.70)	(3.23)	(4.67)	(3.93)
0.02	0.11	0.01	0.12	0.15	0.07

Target Changes only. Forecasting of k-day ahead cumulative log returns.

$$r^k_{\tau_i+1\to\tau_i+j-1} = a_{k,j} + b_{k,j}\left(-\Delta r^u_{\tau_i}\right) + \varepsilon^{k,j}_{\tau_i+j}, j = 1, 2, \ldots.$$

- 10 bps surprise: investors realize 73.6 bps in incremental return over 50 days by going long or short in these government bond funds or 3.68% per annum.
- the maximum (annualized) SR increases from buy-and-hold SR of 0.408 to 0.98 at the 50-day horizon $0.98 = \frac{\sqrt{SR^2_{bah} + \frac{R^2}{k}}}{\sqrt{1-R^2}}$, where $R^2 = 0.15$.
- 50-day window maximizes predictability, in line with time-series momentum

Impulse Response of U.S. Mutual Fund Flows: Target Changes

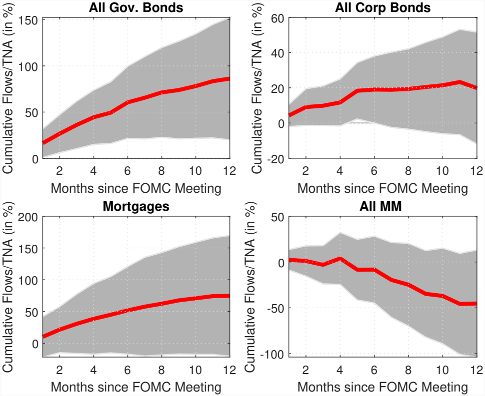


Response of U.S. mutual fund flows to 100 bps (Kuttner) surprise in FFR after k months. Only target changes. Aggregate Fund flows are divided by aggregate TNA.

total outflow after 12 months as % of TNA in response to 1 std surprise (10 bps):

1. 8% of all gov bond MFs (or \$ 128 billion in 2017.Q2)
2. up to 2% of corporate bond MFs (or \$ 48 billion in 2017.Q2)
3. up to 10% of mortgage MFs

Impulse Response of U.S. Mutual Fund Flows: No Target Changes



Response of U.S. mutual fund flows to 100 basis points (Kuttner) surprise in Federal Funds Rate after k months. No target changes. Aggregate Fund flows are divided by aggregate TNA.

Inelastic Demand for Treasurys

- Fed engineers 'exogenous shock to net supply'
- 10% outflow reduces cumulative log return between 51.9 and 62.1 bps
  - assume duration of 5 years
- 10% outflow increases Treasury yields by 10.38 to 12.42 bps
- the implied semi-elasticity of Treasury yields is

$$0.089 = 0.001038/0.011$$

1% increase in supply increases yields by 8.9 bps per annum

A Model of Mutual Fund Investors

1. **sticky expectations**: only fraction $1-\lambda$ of MF investors updates

$$y_t^{i,N,mf} = \frac{1}{N}\mathbb{E}^i_{t-l(i)}\left[\sum_{j=1}^{N} r^{\$}_{t+j-1}\right],$$

   $t-l(i)$ denotes last update of her short rate forecasts.
   (Mankiw and Reiss, 2002; Coibion and Gorodnichenko, 2015)

2. **extrapolation**: MF investors put too much weight on current short rate

$$r^{\$}_{t+1} = (1-\phi_{mf})\theta + \phi_{mf} r^{\$}_t + u_{t+1},\ \phi_{mf} > \phi$$

   (Cieslak, 2018; BSV, 1998; FLM, 2010)

Sticky and Extrapolative Expectations Hypothesis

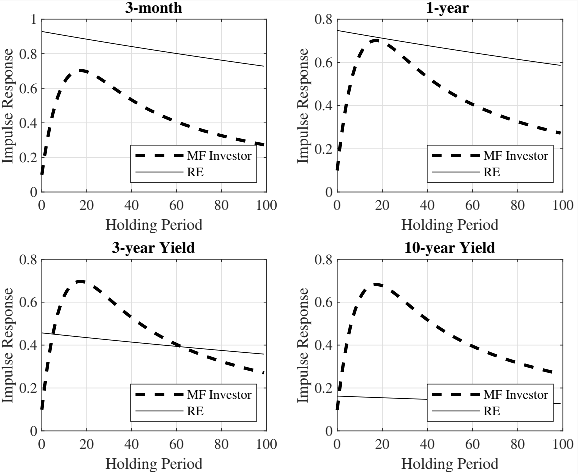
- The average 'target' nominal yield desired by MF investors is given by:

$$y_t^{N,mf} - \theta \quad = \quad \frac{1}{N}\sum_{j=0}^{\infty}\frac{(\lambda)^j(1-\lambda)\left(1-\phi_{mf}^N\right)}{1-\phi_{mf}}\phi_{mf}^j(r_{t-j}^{\$}-\theta).$$

  - when λ=0, $y_t^{N,RE} - \theta = \frac{1}{N}\frac{1-\phi^N}{1-\phi}(r_t^{\$} - \theta)$
- The impulse response of the average 'target' yield to a short rate shock k periods ago is given by:

$$\begin{aligned}\frac{\Delta y_{t+k}^{N,mf}}{\Delta r_t^{\$}} &= \phi^k\frac{1}{N}\frac{(1-\lambda)\left(1-\phi_{mf}^N\right)\left(1-(\lambda(\frac{\phi_{mf}}{\phi}))^{k+1}\right)}{(1-\phi_{mf})(1-\lambda(\frac{\phi_{mf}}{\phi}))} \\ &> \\ \frac{\Delta y_{t+k}^{N,RE}}{\Delta r_t^{\$}} &= \frac{1}{N}\frac{1-\phi^N}{1-\phi}\phi^k.\end{aligned}$$

Impulse Response of Yields– Sticky Expectations Hypothesis



Response in bps. in REH Model (full line) and Sticky EH Model (dotted line) to a 1 bps shock. $\phi = 0.9$ and $\phi_{mf} = 0.995$. λ is equal to 0.90 (daily frequencies).

Conclusion

- target rate changes by FOMC induce failure of expectations hypothesis:
    - expectations hypothesis seems to hold on FOMC announcement days
    - substantial post-FOMC-announcement drift in Treasury markets
    - drift contributes to failure of expectations hypothesis: long rates too sensitive to short rates

- less sophisticated investors pay attention to FF rate changes:
    - sticky expectations
    - extrapolative expectations
- more sophisticated investors do not readily absorb increased supply