

Measuring the Effect of the Zero Lower Bound on Monetary Policy¹

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May, 2017

¹The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of San Francisco, the Federal Reserve System, or the Central Bank of Brazil.

Zero lower bound constraint

- ZLB regarded as an important constraint on monetary policy.
 - Absent “unconventional policies,” ZLB not just any constraint – it would completely hamper CB’s ability to provide stimulus.
 - However, if unconventional policies perfect substitute for interest rate policy, ZLB no constraint on policy at all.
- How much of a constraint does ZLB pose for monetary policy?
 - Swanson and Williams (2014): short-term rates lost sensitivity to [macroeconomic surprises](#) but long-term rates continued to respond.

What we do, what we find

- This paper provides direct evidence on whether ZLB poses a constraint:
 - Compares sensitivity of yields to Fed communication surprises before and during ZLB.
 - Only policy tool employed before and during ZLB.
- Fed communication surprises measured as in Lucca and Trebbi (2011):
 - Semantic-orientation measure to quantify “hawkish/dovish” content of Fed communication, as revealed in newspaper and magazine articles.
- Estimates sensitivity of yields of various maturities to communication surprises for pre-ZLB and ZLB periods.
- We find that sensitivity of short-term rates declined but sensitivity of long-term rates remained nearly unchanged.

Fed communication measure – FSO

- Collect from *Factiva* all news articles (in English) with headlines that contain: {Fed, Federal Reserve, or FOMC}.
- Keep only “relevant sentences” which contain: {rate, policy, statement, Fed, FOMC, Federal Reserve, or announcement}.
- Count number of times the words “hawkish” and “dovish” appear in relevant sentences (with some exclusions).
- Calculate the Factiva Semantic Orientation (FSO) measure of communication for a period t :

$$FSO_t = \ln \left(\frac{1 + H_t}{1 + D_t} \right),$$

where H_t (D_t) is the number of times the word “hawkish” (“dovish”) appears in relevant sentences in articles published during period t .

Fed communication surprises

- Fed communication surprises for FOMC meeting at date d :

$$\Delta FSO_d \equiv \ln \left(\frac{1 + H_d^{Post}}{1 + D_d^{Post}} \right) - \ln \left(\frac{1 + H_d^{Pre}}{1 + D_d^{Pre}} \right),$$

where:

- H_d^{Pre} and D_d^{Pre} measured from day before up to Fed announcement on communication date d .
- H_d^{Post} and D_d^{Post} measured from announcement on date d to day after.

Empirical strategy

- OLS regressions of changes in yields on communication and interest rate surprises:

$$\Delta y_d^m = \alpha^m + \beta^m \Delta FSO_d + \gamma^m MS_d + \varepsilon_d^m,$$

where, at “communication date” (d):

- Δy_d^m is the daily change in Treasury yields for maturity (m).
 - $\Delta FSO_d \equiv \ln \left(\frac{1+H_d^{Post}}{1+D_d^{Post}} \right) - \ln \left(\frac{1+H_d^{Pre}}{1+D_d^{Pre}} \right)$.
 - MS_d are “Kuttner surprises”.
- Separate estimations for pre-ZLB and ZLB periods

Communication dates and data

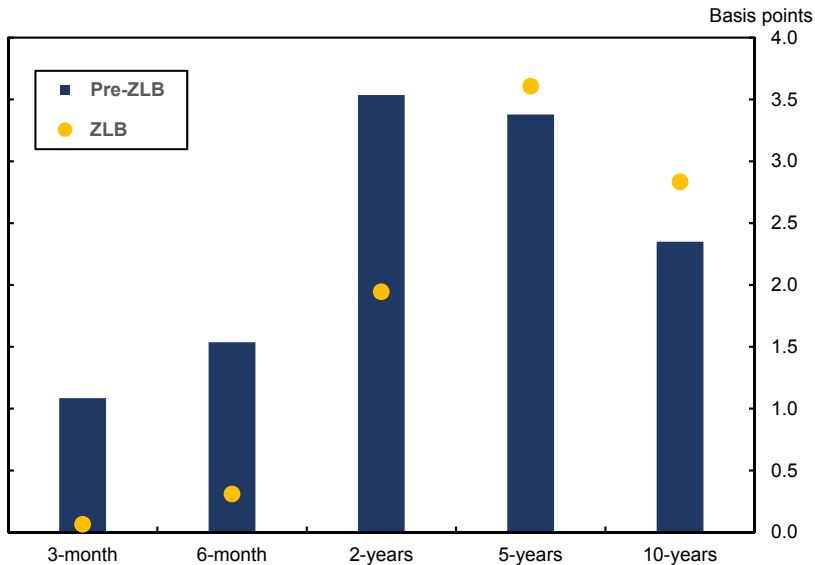
- Communication dates in baseline sample:
 - Dates of FOMC statement releases.
 - Congressional testimonies by the Chair of the Federal Reserve Board.
- Pre-ZLB sample: From May 18, 1999 to December 15, 2008.
- ZLB period: From December 16, 2008 to December 17, 2014.
- Total of 133 FOMC statements and 107 testimonies, of which 49 statements and 40 speeches are in the ZLB period.
- Data:
 - Focus on daily changes in Treasury yields of 3-month, 6-month, 2-year, 5-year, and 10-year maturities.
 - Intraday data for the more limited sample (2-, 5- and 10-year maturities, dates of FOMC statement release only).

Results – benchmark regressions

Table 1: Effects of the measure of Fed communication ΔFSO on yields

Panel A: Pre-ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.96 (0.63)	1.36*** (0.42)	3.13*** (0.66)	2.99*** (0.74)	2.08*** (0.68)
Mon. Surprise (γ)	0.59*** (0.1)	0.58*** (0.06)	0.38*** (0.09)	0.24* (0.12)	0.12 (0.12)
R^2	0.55	0.58	0.36	0.22	0.12
Observations	151	151	151	151	151
Panel B: ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.05 (0.06)	0.24*** (0.08)	1.51*** (0.43)	2.80*** (0.93)	2.20** (0.88)
Mon. Surprise (γ)	0.16*** (0.02)	-0.13*** (0.03)	0.92*** (0.16)	1.90*** (0.34)	2.31*** (0.27)
R^2	0.1	0.15	0.3	0.28	0.27
Observations	89	89	89	89	89

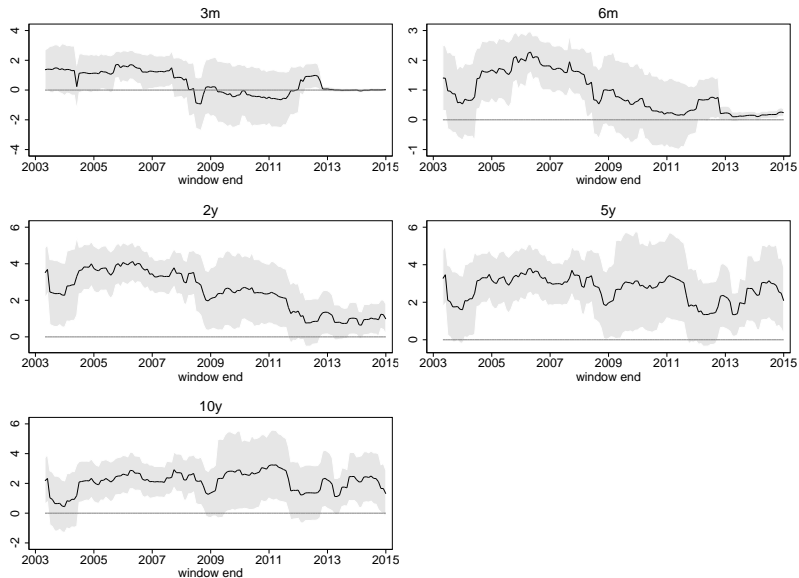
Results – benchmark regressions: comparing β 's



Note: Treasury yield response (in basis points) to a one-standard deviation Fed communication surprise.

Results – rolling regressions

Figure 2: Effects of the measure of Fed communication ΔFSO on yields over time: rolling regressions



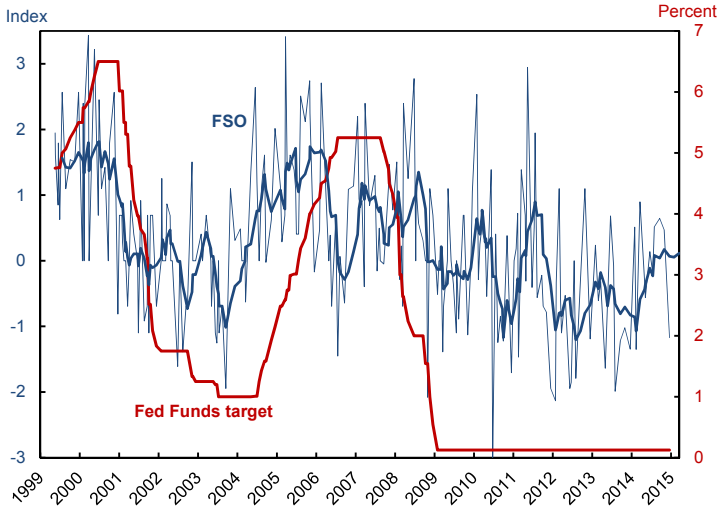
Results – intraday data

Table 2: Effects of the measure of Fed communication ΔFSO on yields using intraday data

Panel A: Pre-ZLB period			
	Treasury yields		
	2-years	5-years	10-years
Communication (β)	1.22** (0.54)	1.40** (0.6)	0.98** (0.46)
Mon. Surprise (γ)	0.18* (0.1)	0.10 (0.08)	0.01 (0.05)
R^2	0.17	0.13	0.09
Observations	81	81	81
Panel B: ZLB period			
	Treasury yields:		
	2-years	5-years	10-years
Communication (β)	0.63 (0.43)	1.43* (0.8)	1.30* (0.66)
Mon. Surprise (γ)	0.76*** (0.03)	0.72*** (0.1)	0.74*** (0.09)
R^2	0.45	0.23	0.19
Observations	48	48	48

Assessing our measure of communication

- *FSO* and the fed funds target rate



Note: The thick line shows moving average calculated over the previous six values of FSO

Assessing our measure of communication

- Use intraday data to evaluate effects of ΔFSO around the announcement times.
- Build alternative ΔFSO that only includes news articles released immediately after the FOMC statement release.
- Rely on a dynamic term-structure model to evaluate how ΔFSO affects yields' components (risk-neutral and term-premium).

Effects around announcement times

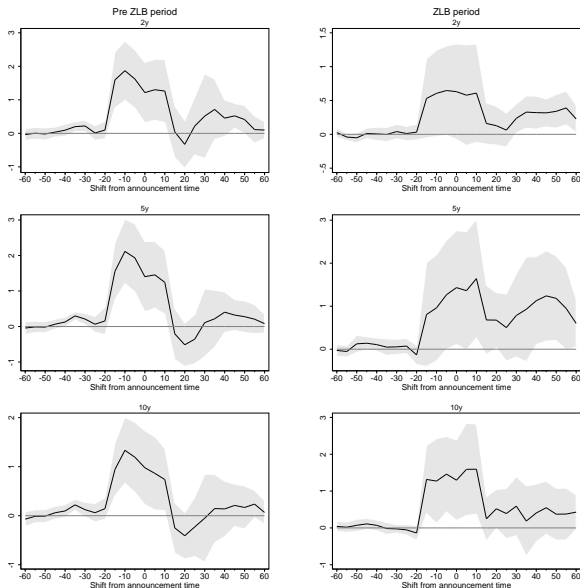
- Reestimate regression varying the 30-minute window change in Treasury yields around the announcement time.

$$\Delta_{30}y_{d,t}^m = \alpha^m + \beta^m \Delta FSO_d + \gamma^m MS_d + \varepsilon_d^m,$$

- For each FOMC statement release date, we set $t = 0$ to be the time of the release.
- 30-minute windows around a time t range from 10 minutes before to 20 minutes after t .
- For all $t < -20 \text{ min}$, the window ends before the statement release, and for all $t > 10 \text{ min}$, the window starts after release.
- If ΔFSO captures Fed communication surprises, β^m should decrease as we increase $|t|$.

Results – ΔFSO effects around announcement times

Figure 3: Effects of the measure of Fed communication ΔFSO on yields outside announcement times



Accounting for the Fed news embargo

- News articles might be shaped by market reactions to announcements (reverse causality).
- Build alternative ΔFSO that *almost certainly* only includes articles produced during news embargo, and hence, unaffected by markets.
 - ΔFSO_d^{5min} limits “post” articles to only include those published within 5 minutes of the FOMC statement release.

$$\Delta FSO_d^{5min} \equiv \ln \left(\frac{1 + H_d^{5min}}{1 + D_d^{5min}} \right) - \ln \left(\frac{1 + H_d^{Pre}}{1 + D_d^{Pre}} \right),$$

Results – ΔFSO^{5min} effects

Table 4: Effects of the measure of Fed communication ΔFSO^{5min} on yields

Panel A: Pre-ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.03 (0.71)	-0.14 (0.69)	1.02 (0.93)	0.95 (0.95)	0.85 (0.77)
Mon. Surprise (γ)	0.55*** (0.17)	0.62*** (0.11)	0.51*** (0.19)	0.29 (0.21)	0.15 (0.17)
R^2	0.31	0.39	0.18	0.07	0.04
Observations	84	84	84	84	84
Panel B: ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.08 (0.13)	0.22** (0.1)	1.35** (0.62)	3.11** (1.45)	2.47* (1.27)
Mon. Surprise (γ)	0.15*** (0.03)	-0.14*** (0.04)	0.85*** (0.17)	1.76*** (0.47)	2.17*** (0.37)
R^2	0.1	0.11	0.22	0.23	0.25
Observations	49	49	49	49	49

Yield decomposition

- Use the shadow-rate dynamic term-structure model from Christensen and Rudebusch (2016).
 - Model decomposes yields into risk-neutral and term-premium components
- Estimate how risk-neutral and term-premium components respond to ΔFSO during the pre- and the ZLB periods.

Other results

- Alternative set of keywords to build *FSO*.
- News-articles- versus yield-based measures of communication (“horse-race” with Gürkaynak et al. 2005).
- Results excluding LSAP announcement dates.
- Results based on dates of FOMC statement releases only.

Results – alternative set of keywords

- Associate contractionary policies with the set {hawkish, tighten}, and expansionary policies with the set {dovish, ease}.

Table 3: Effects of the alternative measure of Fed communication ΔFSO_{alt} on yields

Panel A: Pre-ZLB period					
Treasury yields:					
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.64 (0.87)	0.51 (1.01)	3.29*** (1.1)	3.37*** (1.19)	2.87*** (1.03)
Mon. Surprise (γ)	0.60*** (0.1)	0.59*** (0.06)	0.40*** (0.1)	0.26* (0.13)	0.13 (0.12)
R^2	0.54	0.55	0.29	0.16	0.11
Observations	151	151	151	151	151
Panel B: ZLB period					
Treasury yields:					
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.10 (0.11)	0.42*** (0.11)	1.57*** (0.58)	2.70** (1.15)	1.91* (1.08)
Mon. Surprise (γ)	0.16*** (0.02)	-0.13*** (0.03)	0.94*** (0.16)	1.94*** (0.36)	2.34*** (0.29)
R^2	0.10	0.19	0.22	0.20	0.21
Observations	89	89	89	89	89

Results – news- versus yield-based communication measure

- Follow Gürkaynak et al. (2005) and Swanson (2015) and to extract “target and path factors” from yields.
 - Exclude LSAP-related dates.
 - Extract two principle components from short-term futures to obtain target and path factors (Z_1 and Z_2).

Correlation between yield- and semantic-based measures

	Pre-ZLB	ZLB
Z_1 & Kuttner	0.9	1
Z_2 & ΔFSO	0.3	0.1

- Estimate regressions including factors and ΔFSO .

Results – news- versus yield-based communication measure

Table 7: Effects of the semantic- and the yield-based measures of Fed communication (ΔFSO and Z_2) on yields: a horse race

Panel A: Pre-ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication ($\beta_{\Delta FSO}$)	0.39 (0.5)	-0.03 (0.29)	0.18 (0.23)	-0.07 (0.32)	-0.23 (0.32)
Communication (β_{Z_2})	0.05** (0.02)	0.11*** (0.02)	0.24*** (0.01)	0.24*** (0.02)	0.19*** (0.02)
Mon. Surprise (γ)	0.48*** (0.13)	0.45*** (0.1)	0.32*** (0.06)	0.20** (0.08)	0.12 (0.07)
R^2	0.39	0.51	0.82	0.7	0.57
Observations	151	151	151	151	151
Panel B: ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication ($\beta_{\Delta FSO}$)	-0.04 (0.08)	-0.02 (0.08)	0.45 (0.3)	0.79* (0.4)	0.93** (0.47)
Communication (β_{Z_2})	0.03** (0.01)	0.02** (0.01)	0.15*** (0.05)	0.21** (0.08)	0.19** (0.08)
Mon. Surprise (γ)	0.37 (0.5)	0.4 (0.37)	0.76 (1.34)	1.32 (2.3)	0.82 (2.07)
R^2	0.13	0.15	0.33	0.25	0.21
Observations	69	69	69	69	69

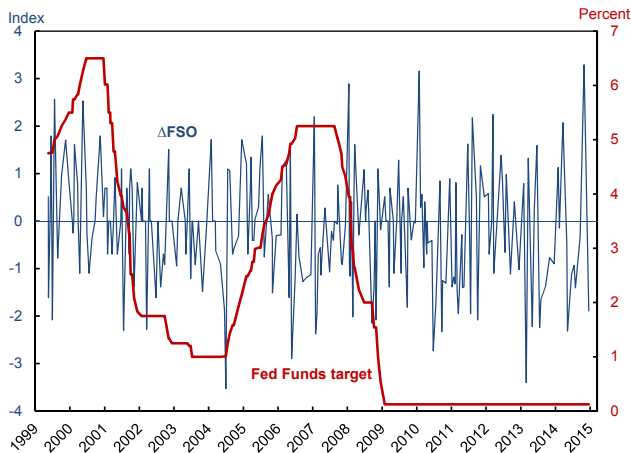
Conclusion

- Assess whether the ZLB has posed a constraint to the monetary authority.
- Construct a news-based measure of communication and compare effects on yields in the pre-ZLB and the ZLB periods.
- We find that:
 - During the pre-ZLB, communication surprises affected yields of both short- and long-term maturities
 - Since 2008, the sensitivity of short-term yields diminishes, but effects on longer-dated yields are basically unchanged.
- Results provide direct evidence that monetary policy was not all constrained by the ZLB.

Results – dates of FOMC statement release only

Panel A: Pre-ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication (β)	1.30*	1.47***	3.34***	3.17***	2.12***
	(0.73)	(0.48)	(0.75)	(0.83)	(0.76)
Mon. Surprise (γ)	0.61***	0.60***	0.39***	0.25*	0.12
	(0.09)	(0.05)	(0.09)	(0.13)	(0.12)
R^2	0.63	0.64	0.4	0.25	0.14
Observations	84	84	84	84	84
Panel B: ZLB period					
	Treasury yields:				
	3-month	6-month	2-years	5-years	10-years
Communication (β)	0.07	0.29***	1.66***	3.15***	2.48**
	(0.07)	(0.1)	(0.5)	(1.1)	(1.05)
Mon. Surprise (γ)	0.16***	-0.13***	0.91***	1.87***	2.28***
	(0.02)	(0.04)	(0.15)	(0.37)	(0.3)
R^2	0.13	0.2	0.34	0.31	0.3
Observations	49	49	49	49	49

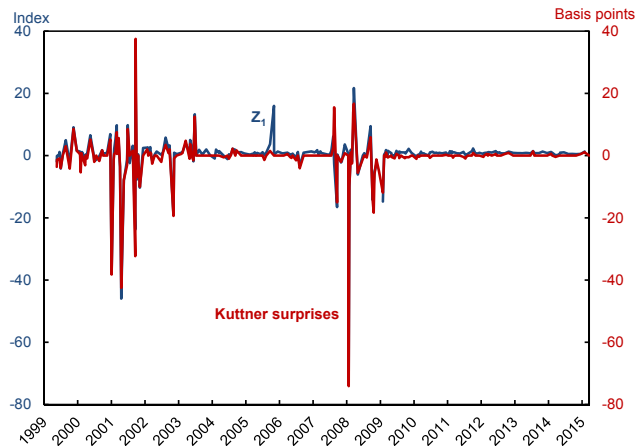
ΔFSO and the fed funds target



Mean and standard deviation of communication surprises

	Pre-ZLB	ZLB
Mean	-0.1	-0.3
Std. deviation	1.1	1.3

Monetary surprises



Mean and standard deviation of Kuttner surprises

	Pre-ZLB	ZLB
Mean	-1.9	-0.2
Std. deviation	9.5	1.3

Results – Z_2 effects around announcement times

