The Effectiveness of Alternative Monetary Policy Tools in a Zero Lower Bound Environment

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What more can monetary policy do when:

- the fed funds rate is 0.18%
- reserves are over a trillion dollars?

One possible answer:

change in maturity structure of outstanding Treasury debt

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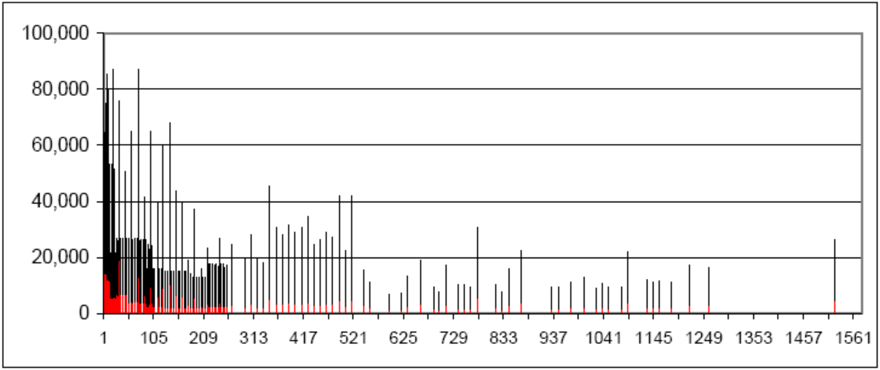
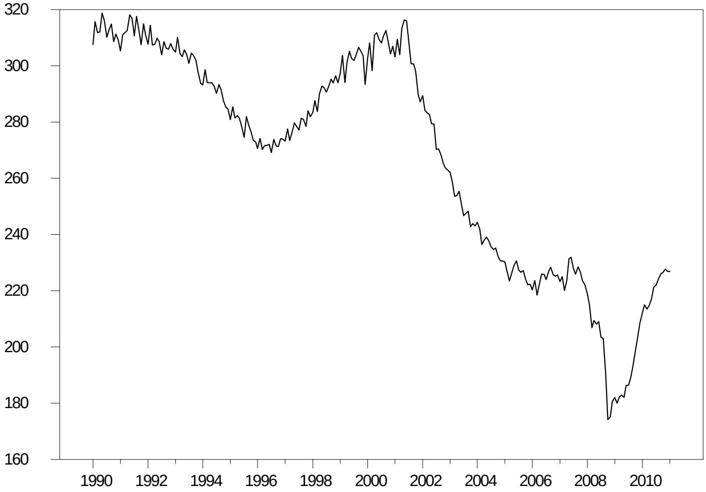
2) Is there reason to think it could work at the ZLB?

Maturity structure: December 31, 2006



Average maturity in weeks



Yield data

Use affine-term-structure model to summarize weekly bond yields in terms of 3 observable factors:

$$f_t = \begin{bmatrix} \text{level} \\ \text{slope} \\ \text{curvature} \end{bmatrix}$$

Estimate 1990-2007.

p_{nt} = log price of n-period pure discount bond
$p_{nt} = \bar{a}_n + \bar{b}_n' f_t$
z_{nt} = fraction of my portolio in bond of maturity n
$z_{nt} \bar{b}_{n-1}' \varepsilon_{t+1}$ = risk exposure

Setup

Suppose a single mean-variance investor held all the publicly-held Treasury debt

$\gamma =$ weight on variance in preferences

$E(\varepsilon_t \varepsilon_t') = \Sigma\Sigma'$

$q_t =$ equilibrium price of risk:

$$\underset{(3\times 1)}{q_t} = \gamma \Sigma\Sigma' \sum_{n=2}^{N} z_{nt} \overline{b}_{n-1}$$

Excess holding returns

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  e.g. hold 5 year bond over 1 year

$$h_{5,1,t} = \log \frac{P_{4,t+1}}{P_{5,t}} - y_{1,t}$$

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- Regression

$$h_{nkt} = c_{nk} + \beta'_{nk} f_t + \gamma'_{nk} x_t + u_{nkt}.$$

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- Expectation hypothesis: excess holding returns are unpredictable
- ATSM: f_t contains all the information at t

Excess holding return regressions

Regressors	6m over 3m	1yr over 6m	2y over 1y	5y over 1y	10y over 1y
c, f_t^*	**0.357**	**0.356**	**0.331**	**0.295**	**0.331**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
c, f_t, z_t^{A*}	**0.410**	0.420	0.373	0.300	0.336
	(0.020)	(0.119)	(0.311)	(0.728)	(0.665)
c, f_t, z_t^{L*}	**0.428**	**0.501**	**0.524**	**0.398**	0.357
	(0.003)	(0.008)	(0.006)	(0.035)	(0.196)
c, f_t, z_t^{pc*}	**0.368**	**0.361**	0.333	0.297	0.334
	(0.001)	(0.007)	(0.062)	(0.098)	(0.051)
c, f_t, v_t^*	**0.385**	**0.409**	**0.388**	**0.339**	0.338
	(0.016)	(0.001)	(0.006)	(0.008)	(0.227)
c, f_t, q_t^*	**0.444**	**0.568**	**0.714**	**0.617**	**0.549**
	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)
c, f_t, z_t^{pc}, q_t^*	**0.452**	**0.571**	**0.717**	**0.618**	**0.550**
	(0.002)	(0.000)	(0.000)	(0.000)	(0.002)
c, f_t, v_t, q_t^*	**0.458**	**0.595**	**0.737**	**0.640**	**0.552**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)
$c, f_t, z_t^A, z_t^L, q_t^*$	**0.476**	**0.597**	**0.741**	**0.670**	0.634
	(0.000)	(0.001)	(0.000)	(0.002)	(0.054)

z_t^A: average maturity; z_t^L: fraction 10 years; z_t^{PC}: 3 principal components

v_t: Cochrane-Piazzesi; q_t: Treasury factors

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- Spurious regression

Yield factor forecasting regressions

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$$f_{t+1} = c + \rho f_t + \phi q_t + \varepsilon_{t+1}$$

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- nonzero ϕ does not reflect response of q_t to f_t
- estimate incremental forecasting contribution of q_t beyond that in f_t

Significance of Treasury factors

F test that $\phi = 0$

$$f_{t+1} = c + \rho f_t + \phi q_t + \varepsilon_{t+1}$$

	F test
level	**3.256**
	(0.023)
slope	**4.415**
	(0.005)
curvature	**2.672**
	(0.049)

Quantitative illustration

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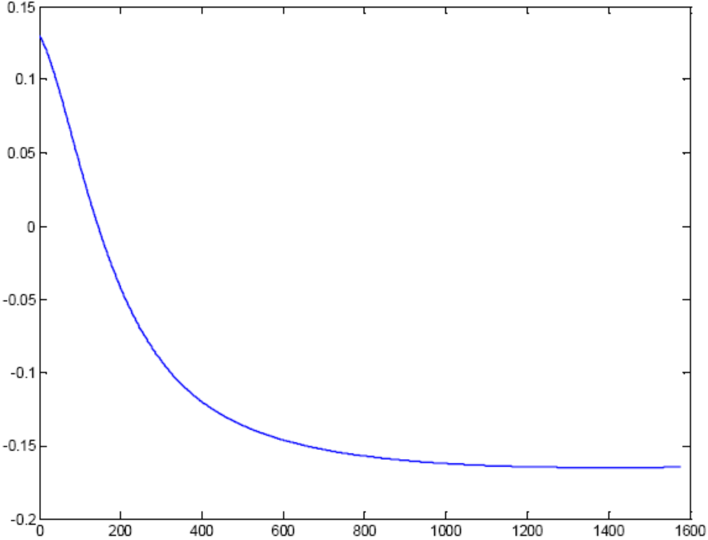
	$\phi_i' \Delta$
level	0.005
	(0.112)
slope	**−0.250**
	(0.116)
curvature	−0.073
	(0.116)

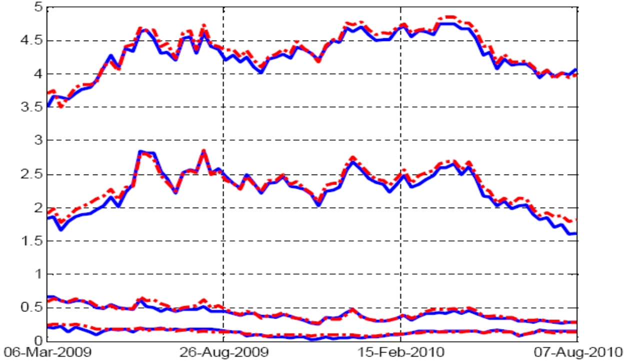
- Δ: average change in q_t

Impact on yield curve 1-month ahead



Financial Crisis and Zero Lower Bound

Zero Lower Bond



- Short term yields near zero
- Longer term yields considerable fluctuation.
- Explanation: when escape from ZLB (with a probability), interest rates will respond to f_t as before

Parsimonious Model of ZLB

- Same underlying factors f_t

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same (c, ρ, Σ)

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- Once escape from ZLB

$$\tilde{y}_{1t} = a_1 + b_1' f_t$$

$$\tilde{p}_{nt} = \bar{a}_n + \bar{b}_n' f_t$$

$\bar{a}_n$ and $\bar{b}_n$ calculated from the same difference equations

Parsimonious Model of ZLB

- At ZLB

$$y^*_{1t} = a^*_1$$
$$p^*_{nt} = \overline{a}^*_n + \overline{b}^{*\prime}_n f_t.$$

π^Q: probability still at ZLB next period
No-arbitrage:
Can calculate $\overline{b}^*_n$ (how bond prices load on factors at ZLB) as functions of $\overline{b}_n$ (how they'd load away from the ZLB) along with π^Q (probability of remaining at ZLB), ρ (factor dynamics), and Λ (risk parameters).

Parsimonious Model of ZLB

Assume: $(c^Q, \rho^Q, a_1, b_1, \Sigma)$ as estimated pre-crisis
$\Rightarrow (\bar{a}_n, \bar{b}_n)$ same as before
Estimate two new parameters $\left(a_1^*, \pi^Q\right)$ to describe 2009:M3-2010:M7 data from

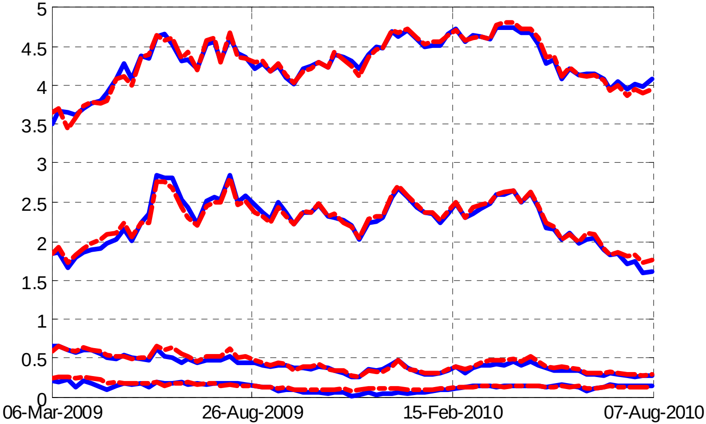
$$Y_{2t} = A_2^\dagger + B_2^\dagger Y_{1t} + \varepsilon_t^e$$

- Y_{1t} = 6-month, 2-year, 10-year
- Y_{2t} = 3-month, 1-year, 5-year, 30-year
- $A_2^\dagger, B_2^\dagger$ functions of $(c^Q, \rho^Q, a_1, b_1, \Sigma)$ and $\left(a_1^*, \pi^Q\right)$
- Estimation method: minimum chi square (Hamilton and Wu, 2010)

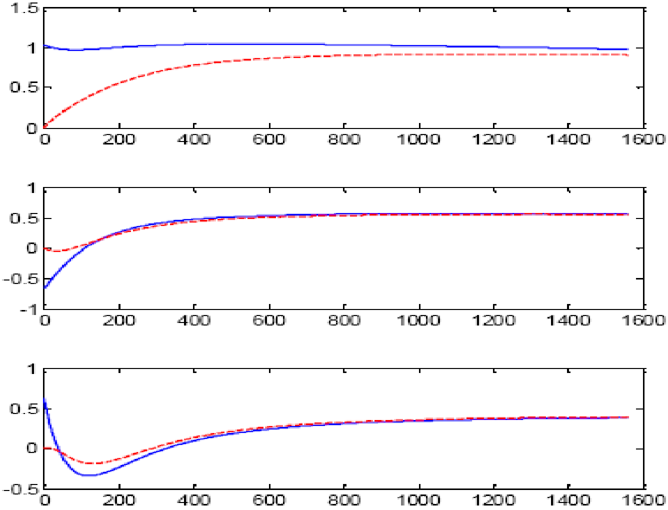
Parameter estimates for ZLB

Slightly better fit if allow new value for a_1 after escape from ZLB
$5200a_1^* = 0.068$ (ZLB = 0.07% interest rate)
$\pi^Q = 0.9907$ (ZLB may last 108 weeks)
$5200a_1 = 2.19$ (compares with $5200a_1 = 4.12$ pre-crisis–
market expects lower post-ZLB rates than seen pre-crisis)

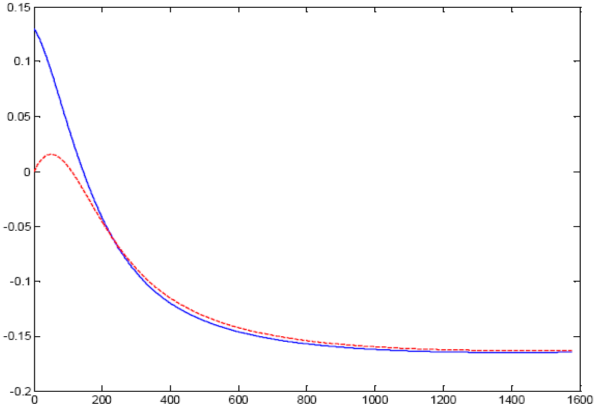
Actual and fitted values



Factor Loadings



One-month-ahead predicted effect of Fed swapping short- for long-term



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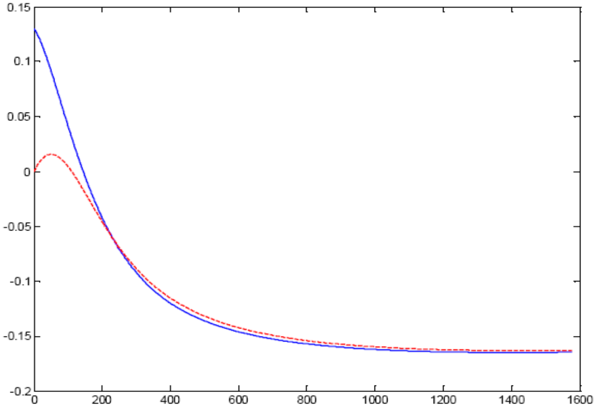


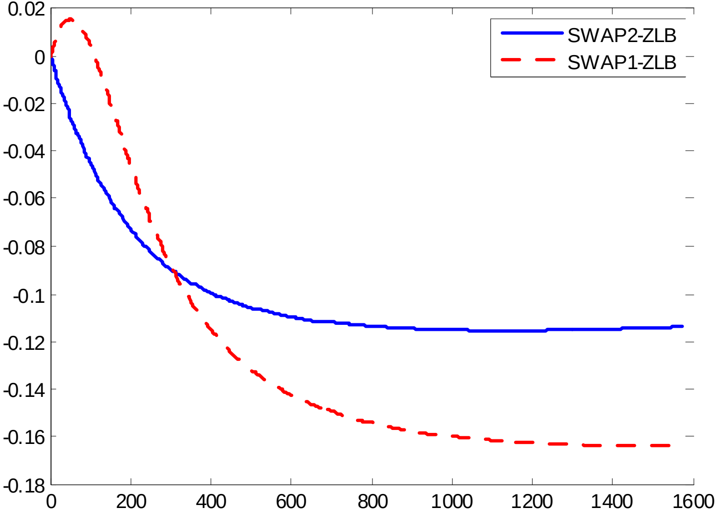
Note: quantitative easing has almost identical effect as swapping maturities at the ZLB

Comparison of alternative estimates

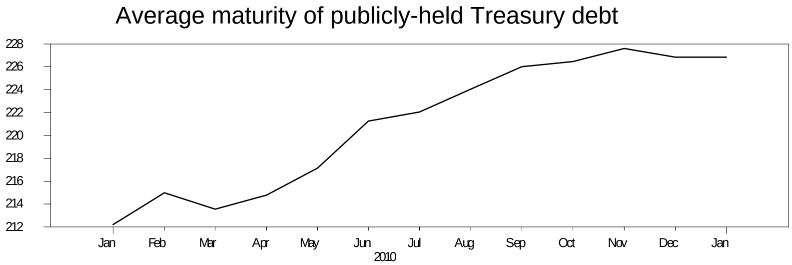
		Original estimates		Hamilton-Wu estimates	
Study	Measure	Pre-crisis	ZLB	Pre-crisis	ZLB
Gagnon, et. al.	10 yr yield	20		14	13
Greenwood-Vayanos	5yr-1yr spread	39		17	9
	20yr-1yr spread	74		25	18
D'Amico-King	10yr yield		67	14	13
Deutsche Bank	10yr yield		20	14	13

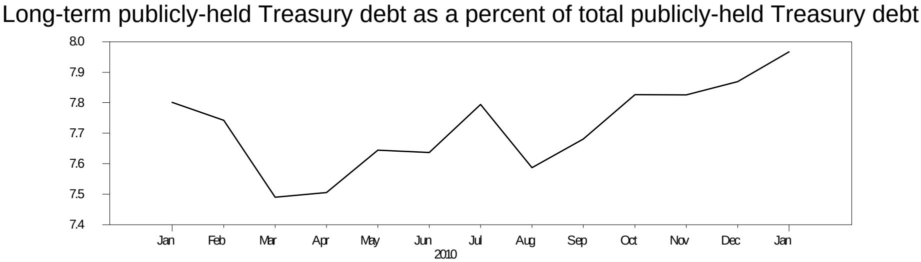
Table 5: Comparison of different estimates of the effect of replacing $400 billion in long-term debt with short-term debt.

Effect of buying intermediate- instead of long-term debt



Combined effect of Fed's QE2 and Treasury operations





Why the Fed and not the Treasury?

- Possible tool for signaling future short rate plans
- Far from ideal instrument in normal times