

The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy

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Objective:

Evaluate the effect of the Federal Reserve's purchase of long-term Treasuries and other long-term bonds ("QE1" in 2008-2009 and "QE2" in 2010-2011) on interest rates.

- What are the effects on a variety of interest rates?
- What are the channels through which QE affects rates?

Understanding channels is important:

- They determine whether it matters what is purchased!
- They determine whether/how much some of the QE effect may have been achievable with commitment statement to keep Fed funds rate low, without balance sheet risk.

Novelty: More interest rates and derivatives data, analysis of both QE1 and QE2, intra-day data, but mainly analysis of channels

QE1 purchase magnitudes and event dates:

1. November 25, 2008: Initial LSAP announcement
Buy up to \$100B of agency debt, up to \$500B of agency MBS
2. December 1, 2008: Bernanke speech
3. December 16, 2008: FOMC statement
4. January 28, 2009: FOMC statement
Fed may expand agency and agency MBS purchases and is evaluating Treasury purchases
5. March 18, 2009: FOMC statement
Increase agency purchases up to \$200B, agency MBS up to \$1.25T, and buy up to \$300B of longer-term Treasuries.

Focus on two-day changes for QE1 (very illiquid period).

Liquid assets (Treasuries, Agencies): One-day changes similar.

Illiquid assets (corporate, MBS): One-day changes smaller.

QE2 purchase magnitudes and event dates:

1. August 10, 2010: FOMC statement

"the Committee will keep constant the Federal Reserve's holdings of securities at their current level by reinvesting principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities."

Prior to this announcement, market expectations were that the Fed would let its MBS portfolio run off.

2. September 21, 2010: FOMC statement

"maintain its existing policy of reinvesting principal payments"

"The Committee will continue to monitor the economic outlook and financial developments and is prepared to provide additional accommodation if needed to support the economic recovery [...]" (emphasis added)

The “additional” was read by many market participants as indicating new stimulus by the Fed, and particularly an expansion of its purchases of long-term Treasuries (e.g. Goldman Sachs commentary on 9/21/2010).

3. November 3, 2010: FOMC statement

"maintain its existing policy of reinvesting principal payments In addition, the Committee intends to purchase a further \$600 billion of longer-term Treasury securities"

This was widely anticipated, so little expected effect of 11/3.
We aggregate across the 8/10 and 9/21 events.

Focus on one-day changes for QE2 (more liquid period).

How large Treasury purchases does reinvesting principal imply?

- About 20% of MBS per year – this is a common pre-payment rate and turns out to be very close to actual principal payments on Fed's MBS:

August 4, 2010 Fed MBS holdings: \$1,118B

June 22, 2011 Fed MBS holdings: \$914B

18.1% decline in a $(1-43/365)=0.88$ of a year, i.e. 20.6% on an annual basis.

- Thus, reinvesting MBS principal in Treasuries implies Treasury purchase of about **\$220B over next year**, and **\$396B over next two years** (from announcement).

Changes in yields using event-study methodology:

QE1, 2-day changes, sum across 5 event dates

Treasury yields					Agency yields				Agency MBS	
30 yr	10 yr	5 yr	3 yr	1 yr	30 yr	10 yr	5 yr	3 yr	30 yr	15
-73	-107	-74	-39	-25	-144	-200	-150	-123	-107	-88
Corporate yields										
		Aaa	Aa	A	Baa	Ba	B			
Long		-77	-83	-93	-81	-60	-43			
Intermediate		-88	-93	-92	-76	-82	-130			

QE2, 1-day changes, sum across 2 event dates

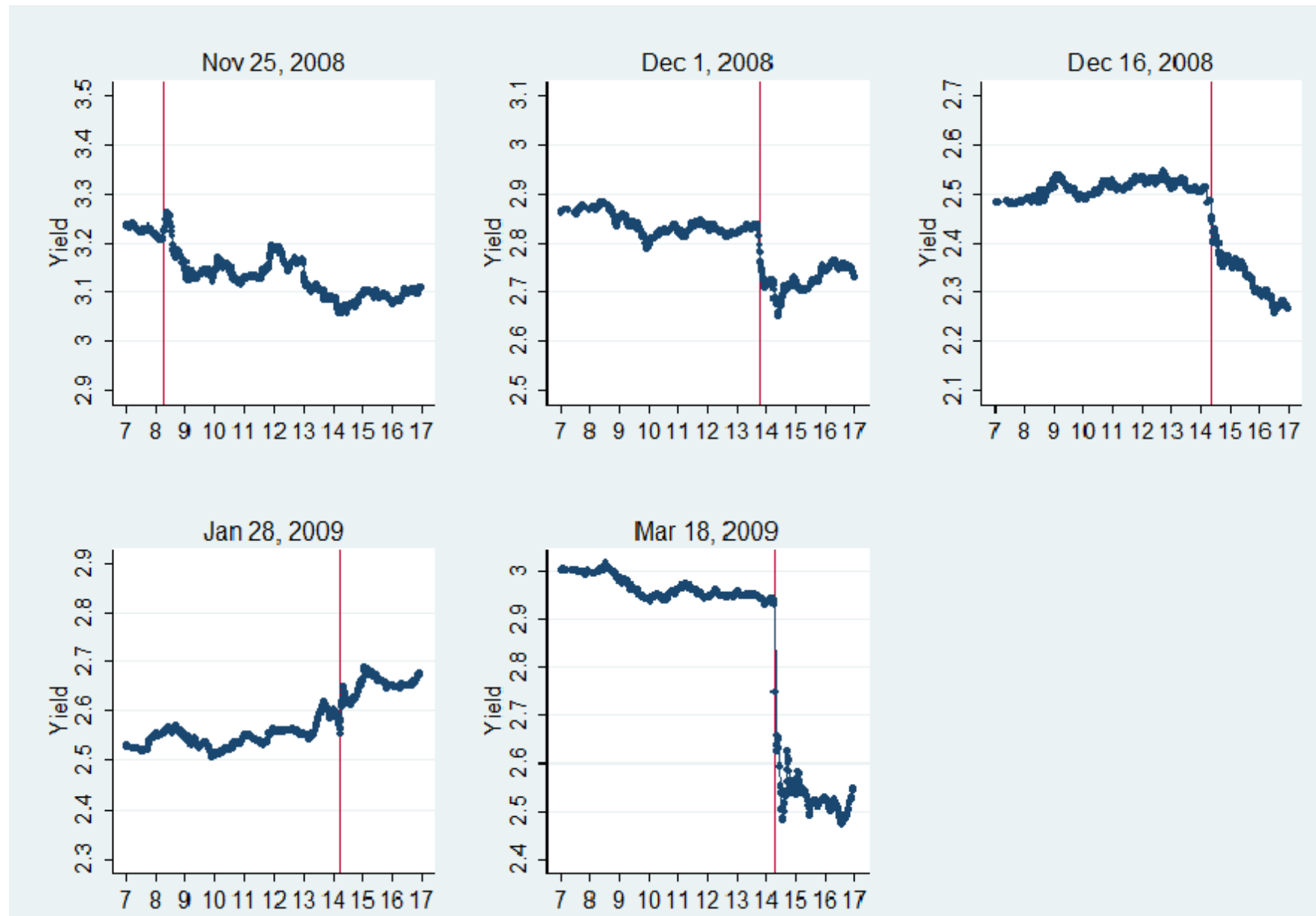
Treasury yields					Agency yields				Agency MBS	
30 yr	10 yr	5 yr	3 yr	1 yr	30 yr	10 yr	5 yr	3 yr	30 yr	15
-9	-18	-17	-8	-1	-9	-17	-17	-10	-9	-12
Corporate yields										
		Aaa	Aa	A	Baa	Ba	B			
Long		-9	-6	-8	-7	-10	-7			
Intermediate		-13	-11	-12	-13	-4	3			

Intra-day changes in on-the-run 10-year Treasury:

To increase confidence that QE announcements were the dominant news on the event dates we study.

- Data from BG Cantor. Yields graphed are averages by the minute and trading volume graphed is total volume by minute.
- Vertical lines indicate the minute of the announcement (minute of the first article covering the announcement in Factiva).
- The trading volume data all suggests that QE was considered important news on each day.
- Intra-day yield move on 1/28/2009 suggests little QE news in announcement.
Intra-day yield move on 11/3/2010 consistent with QE already being priced in.

Figure 2. Intra-day Yields and Trading Volume on QE1 Event Days
Panel A. Yields



Panel B. Trading Volume

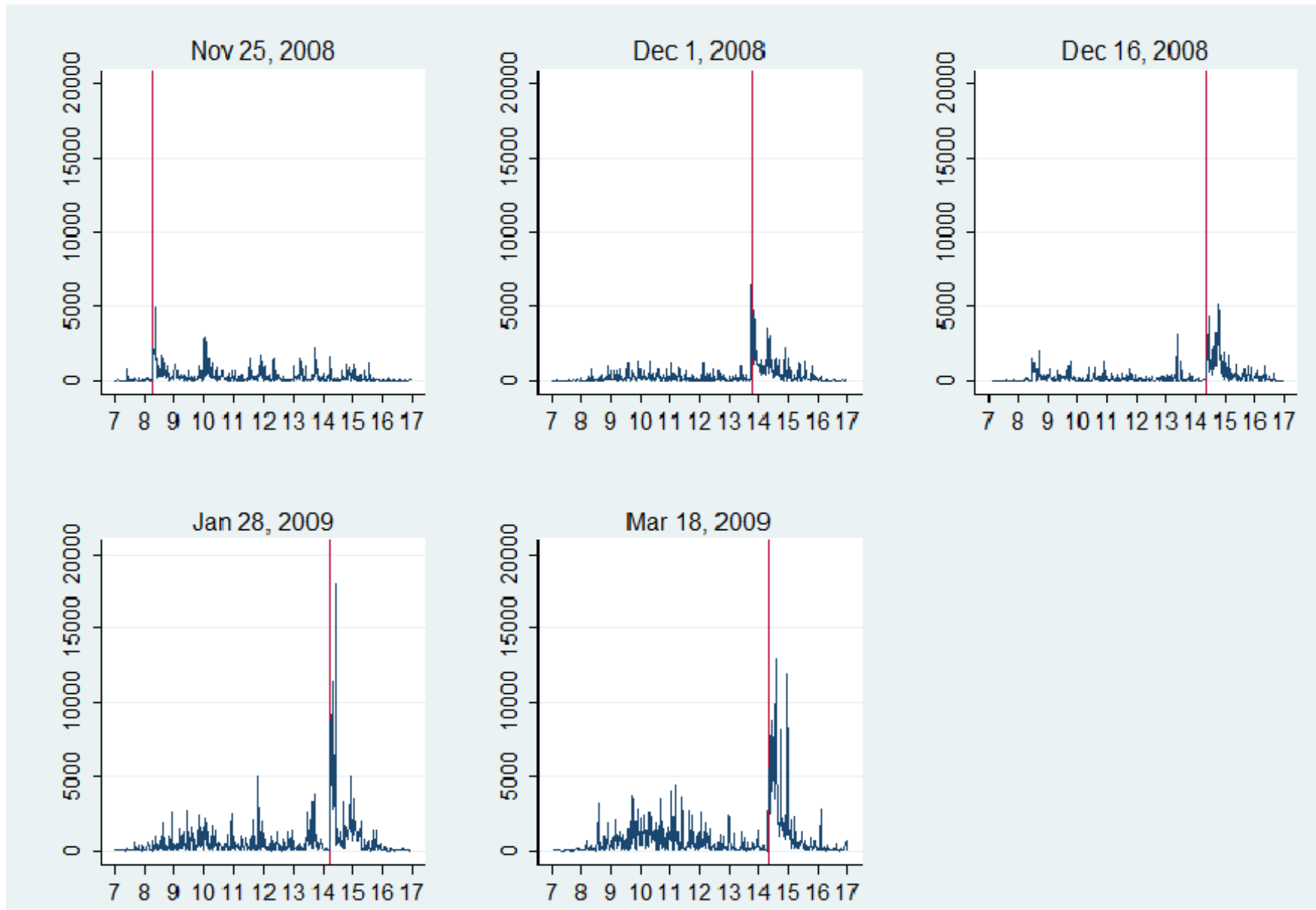
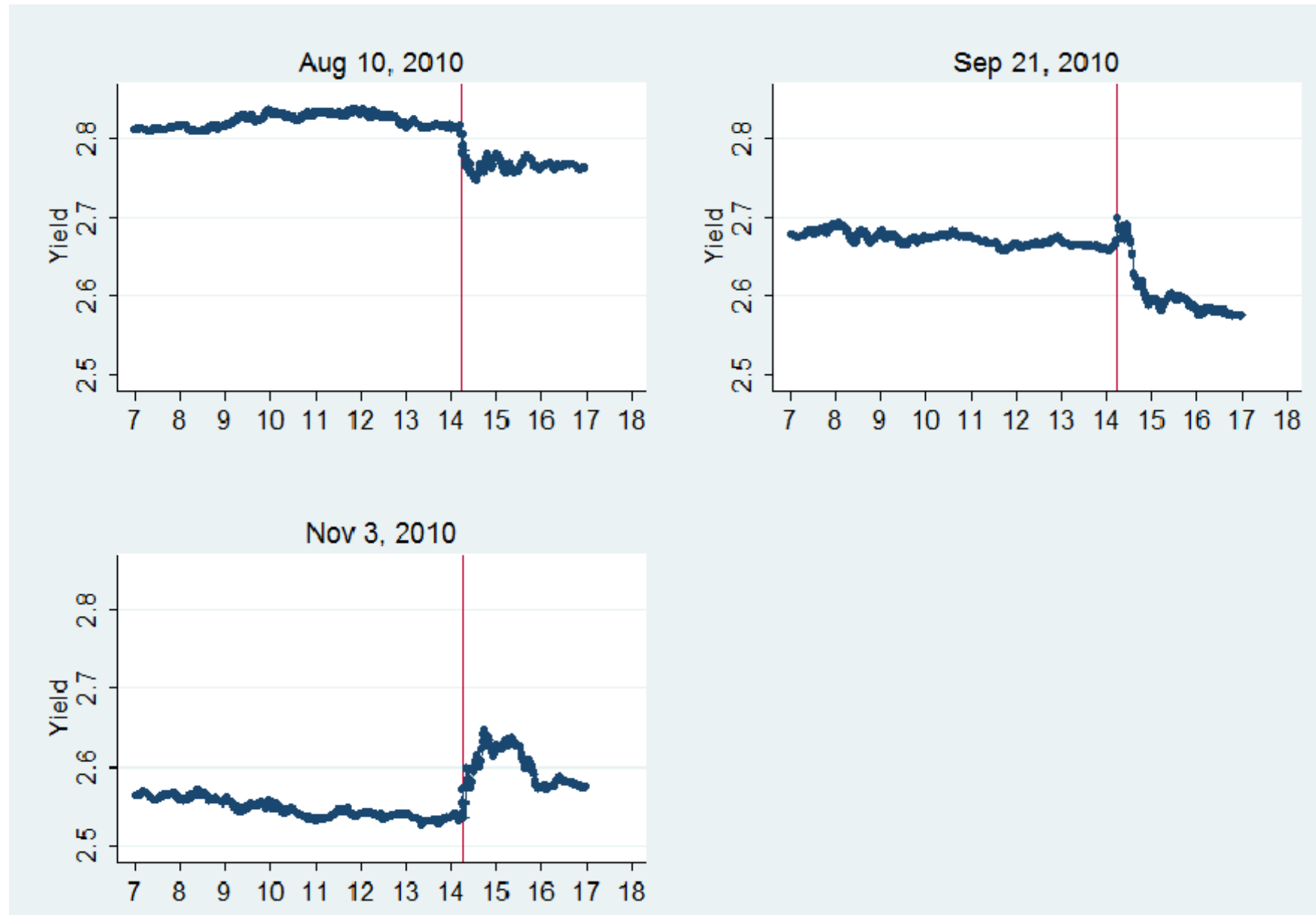
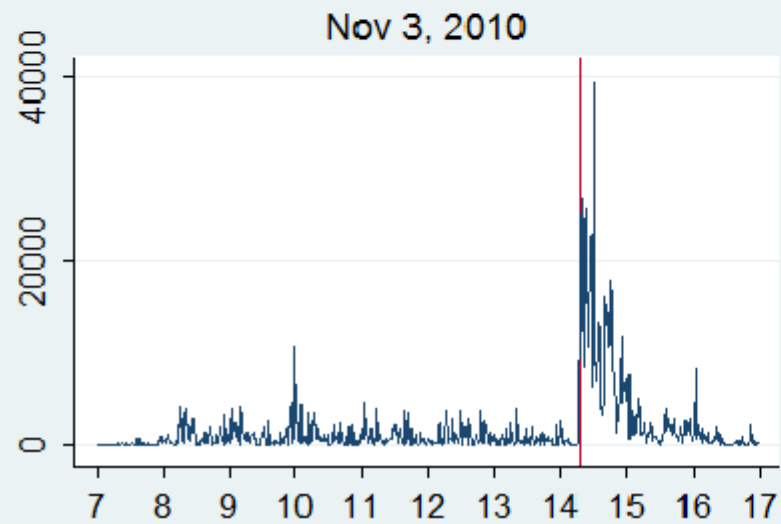
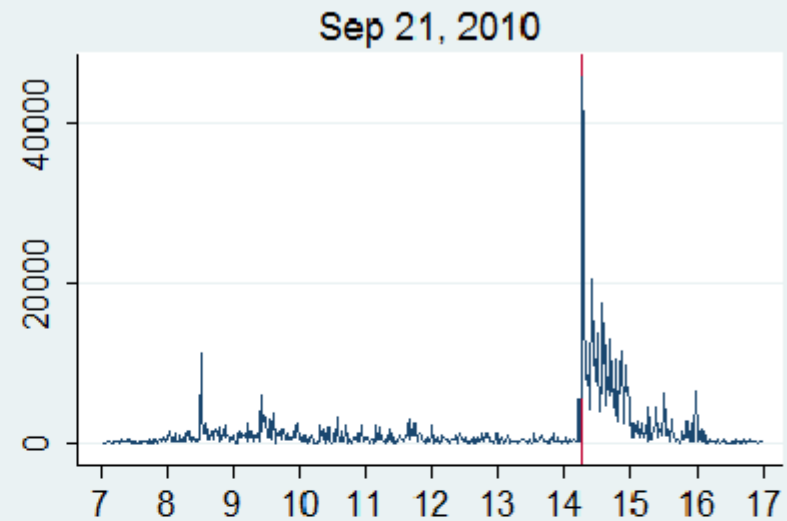
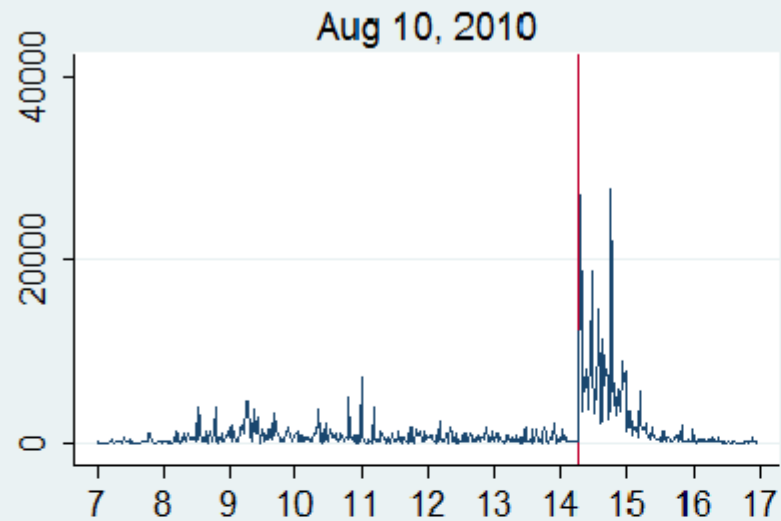


Figure 4. Intra-day Yields and Trading Volume on QE2 Event Days
Panel A. Yields



Panel B. Trading Volume



Channels:

- Previous work has emphasized two channels:
 - (1) QE signals lower future fed funds rate
 - (2) A “portfolio rebalancing” channel.Fed officials have focused on a version of (2): A reduction in the duration risk premium.
- We consider signaling in more detail, several portfolio rebalancing channels, and effects of policy on expected default/default risk premia and expected inflation.
- Our basic approach is to think of a given interest rate as driven by a host of components and then compare different interest rates and derivatives prices to isolate each component.

$$\begin{aligned}
& r_{\text{risky, long-term}} \\
&= E[i_{\text{safe, liq, short-term}}] \\
&\quad + \text{Duration} \times P_{\text{DurationRisk}} \\
&\quad + \text{DefaultRisk} \times P_{\text{DefaultRisk}} \\
&\quad + \text{PrepaymentRisk} \times P_{\text{PrepaymentRisk}} \\
&\quad - \text{Liquidity} \times P_{\text{Liquidity}} \\
&\quad - \text{Degree of extreme safety} \times P_{\text{safety}} \\
&\quad - \pi^e
\end{aligned}$$

(r=real, i=nominal)

(1) Signaling channel:

- QE announcements may have changed market expectations about future short rates (and 12/16/2008, 3/18/2009 statements mention keeping Fed funds rate low).
- Possible mechanism: If the central bank raises rates, it takes a loss on the assets purchased. Or perhaps the signal would have been credible even without purchases.
- **Prediction:** QE signals lower future short rates. This affects all securities of similar duration the same.
- Approach 1 (upper bound): Look at changes in longest Fed funds futures, assume they apply to all medium and long rates.
- Approach 2: Use schedule of Fed funds futures to work out how much the Fed funds rate cycle shifted forward in time. Calculate implied effect on each maturity bond.

Table 4. Federal Funds Futures Yield Changes

QE1, 2-day changes, sum across 5 event dates

Fed Funds Futures, Contract Maturity

3rd month	6th month	12th month	24th month
-28	-27	-33	-40

QE2, 1-day changes, sum across 2 event dates

Fed Funds Futures, Contract Maturity

3rd month	6th month	12th month	24th month
0	-1	-4	-11

- Approach 1:

QE1, 2-day: **40 bps** of decline at mat \geq 2 years due to signaling.

QE2, 1-day: **11 bps** of decline at mat \geq 2 years due to signaling.

Figure 3. Yield Curves from Fed Funds Futures, pre- and post QE1 Event Days

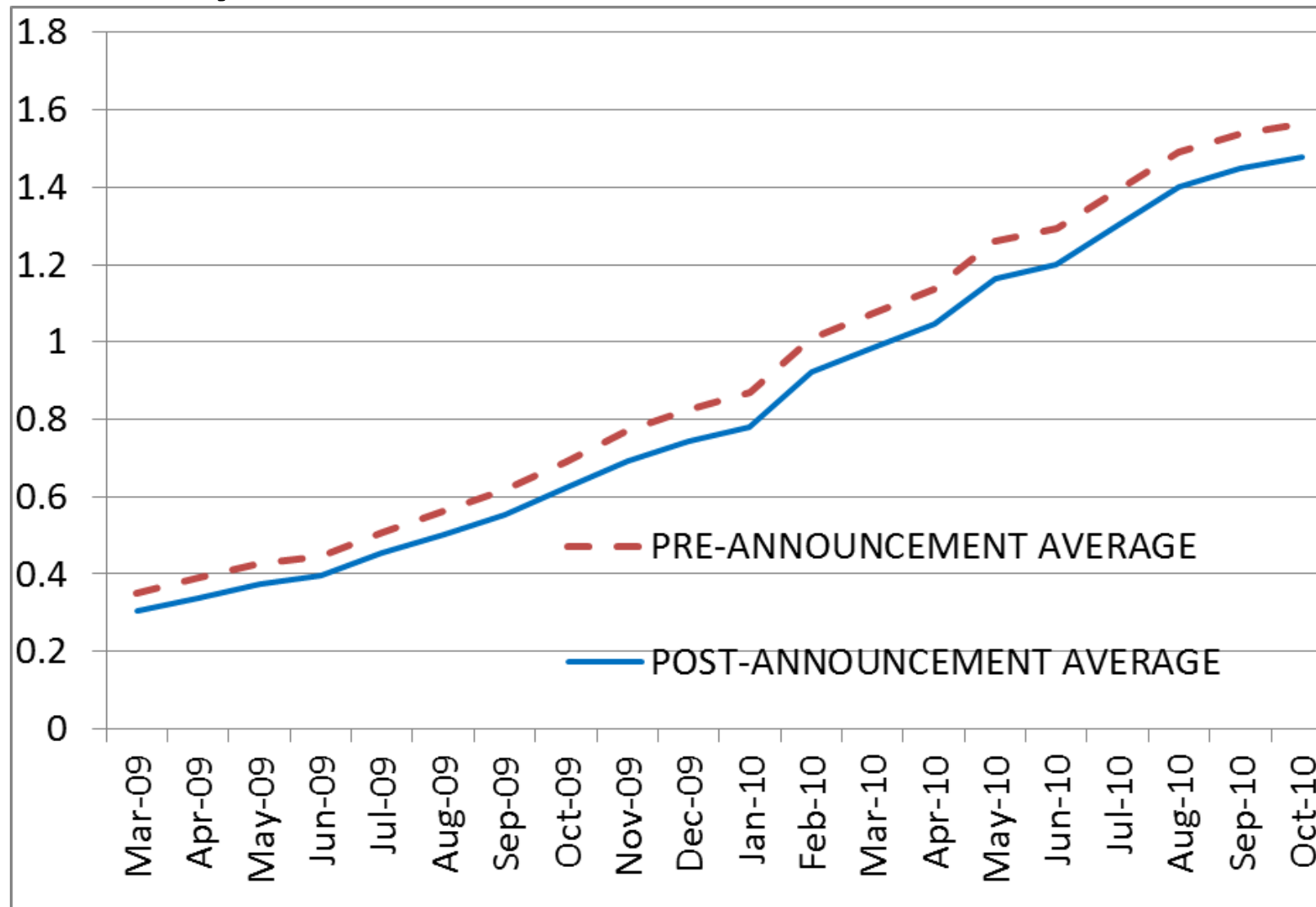
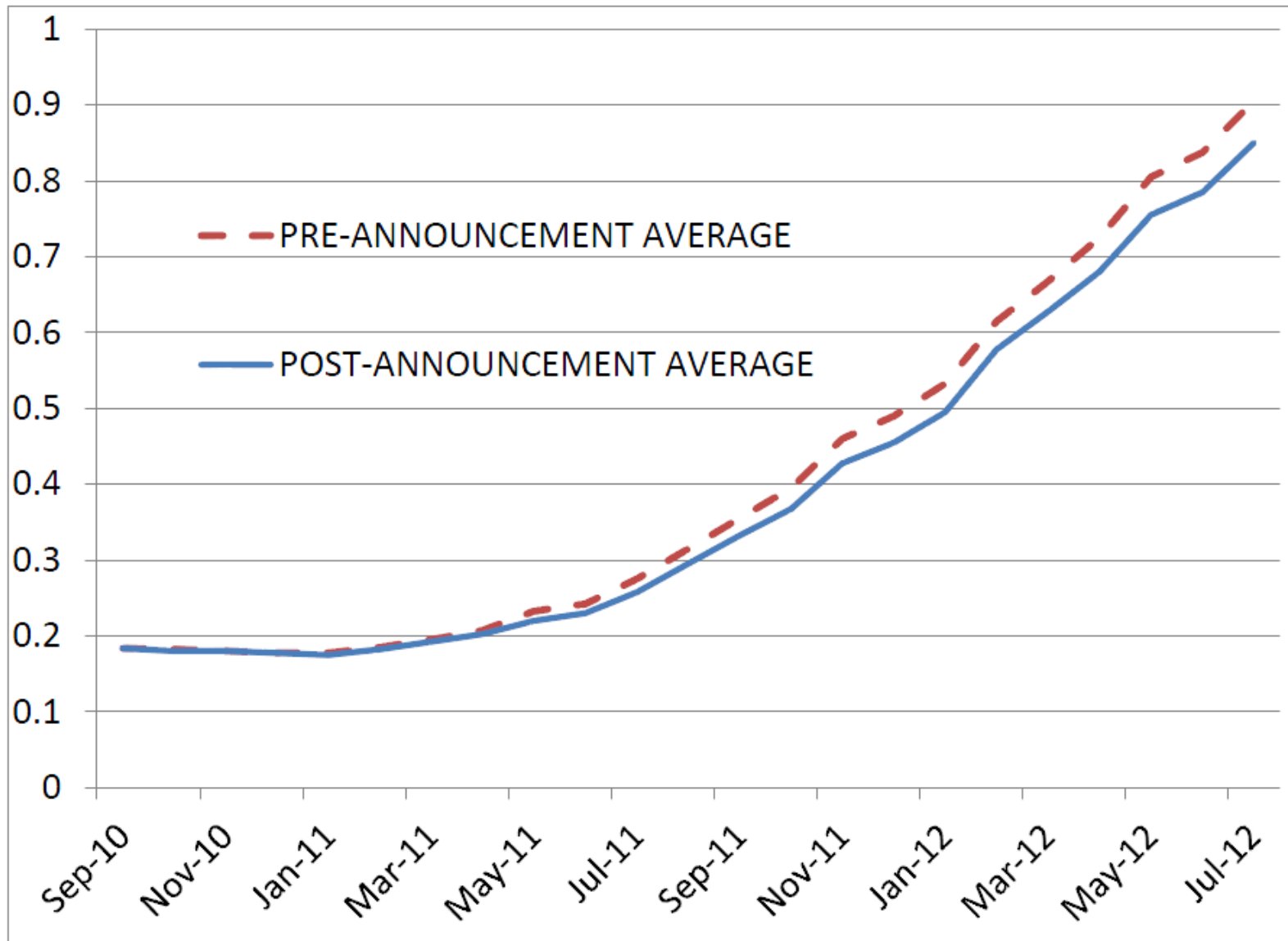


Figure 5. Yield Curves from Fed Funds Futures, pre- and post QE2 Event Days



- Approach 2: Forward shift in rate cycle=[(Vertical shift in avg yield curve)/Slope of initial average yield curve]*[# event dates]

QE1: 6.3 months (evaluated from March 2010 point)

QE2: 2.1 months (evaluated from July 2011 point)

3.2 months (evaluated from July 2012 point)

Implied change in rates:

Expectations term for a T-year bond:

$$E[i_{safe, liq, short-term}] = \frac{1}{T} \int_{t=0}^T i_t^{ff} dt,$$

Suppose that QE policy signals: Rate is going to be held at $i_{0,prior}^{ff}$ for the next X months, and thereafter follow the path indicated by $i_{t,prior}^{ff}$ (i.e. shift rate hike cycle later by X months).

$$\Delta E[i_{safe, liq, short-term}] = \frac{1}{T} \int_{t=T-X/12}^T (i_{0,prior}^{ff} - i_{t,prior}^{ff}) dt.$$

Use $i_{t,prior}^{ff}$ = 4% for 10- and 30-year bonds

Use $i_{t,prior}^{ff}$ = 3.5% for 5-year bonds

QE1 signaling effects:

35 bps for 5-yr bond, **20 bps** for 10-yr bond, **7 bps** for 30-yr bond

QE2 signaling effects using 2.1 months:

12 bps for 5-yr bond, **8 bps** for 10-yr bond, **2 bps** for 30-yr bond.

QE2 signaling effects using 3.2 months:

18 bps for 5-yr bond, **12 bps** for 10-yr bond, **4 bps** for 30-yr bond

- In sum, signaling accounts for:
QE1: 20-40 bps at the 10 year horizon, 35-40 bps at 5 year horizon
QE2: 8-12 bps at the 10 year horizon, 11-18 bps at 5 year horizon
- Qualifier: These numbers may be a little too high.

Effect of Fed funds futures changes on predicted future realized Fed fund rates is a bit less than 1-for-1 because Fed funds futures rates contain a risk premium (Piazzesi and Swanson, 2008) which varies with the level of short rates and the business cycle.

(2) Duration risk premium channel:

- In QE, government is buying long-duration assets from private sector → Reduction in market price of duration risk.
- Likely requires duration risk to be borne by subset of investors to get substantial effects, as in Vayanos and Vila (2010).
- **Predictions:**
 - i. QE decreases yields on all long-term nominal assets, including Treasuries, corporate bonds, and mortgages.
 - ii. The effects are larger effects for longer duration assets.
- Safety-channel affects long Treasuries and agencies more than short ones. Pre-payment risk premium reduction affects long MBS more (not for QE2). So use corporate bonds to isolate duration risk channel. **Lower grade bonds particularly informative (no safety or liquidity effects)**. Adjust yield changes for CDS changes+signaling.

QE1, 2-day changes

Corporate yields

	Aaa	Aa	A	Baa	Ba	B
Long	-77	-83	-93	-81	-60	-43
Intermediate	-88	-93	-92	-76	-82	-130

Credit default swaps

	Aaa	Aa	A	Baa	Ba	B
10 yr	-7	-14	-32	-40	-78	-1354
5 yr	-6	-17	-33	-51	-98	-991

Corporate yields, minus effect of CDS

	Aaa	Aa	A	Baa	Ba	B
Long	-70	-69	-61	-41	18	1311
Intermediate	-82	-76	-59	-25	16	861

QE2, 1-day changes

Corporate yields

	Aaa	Aa	A	Baa	Ba	B
Long	-9	-6	-8	-7	-10	-7
Intermediate	-13	-11	-12	-13	-4	3

Credit default swaps

	Aaa	Aa	A	Baa	Ba	B
10 yr	2	2	2	2	6	8
5 yr	0	4	3	4	9	13

Corporate yields, minus effect of CDS

	Aaa	Aa	A	Baa	Ba	B
Long	-11	-8	-10	-9	-16	-15
Intermediate	-13	-15	-15	-17	-13	-10

QE1: No evidence of duration risk premium effect

- Essentially no change in CDS-adj. yields of Baa and lower bonds. Signaling enough to explain reduction for Baa, and nothing left to explain for lower than Ba and B.

- And no apparent pattern across long and intermediate maturities in the changes in CDS-adjusted corporate bond yields.
- (Also, if this was a strong effect, we'd expect the 30-year Treasury to move a lot more than the 10-year Treasury)

QE2: **No clear evidence of duration risk premium effect**

- CDS-adj. yields of Baa and lower bonds down and MBS down by about the amount of the signaling effect

(Exception: Ba, B long CDS adjusted are down more, but it's possible that our CDS adjustments are too large – in daily changes, yields generally respond less than 1 for 1 to CDS changes.)

(3) MBS pre-payment risk premium channel:

- Gabaix, Krishnamurthy, and Vigneron (2007) present theory and evidence that mortgage prepayment risk carries a positive risk premium.
- Requires pre-payment risk to be borne by subset of investors to get substantial effects (segmented MBS market).
- **Predictions:**
 - i. In QE1 MBS rates fall by more than the signaling effect
 - ii. In QE2, which does not involve MBS purchases, MBS rates fall only by the signaling effect.
- Note: We'll consider other channels below. These either don't affect MBS (default risk channel, long-term safety channel, liquidity channel) or are insignificant channels in general (duration risk premium channel).

QE1, 2-day changes, sum across 5 event dates

Treasury yields					Agency yields				Agency MBS	
30 yr	10 yr	5 yr	3 yr	1 yr	30 yr	10 yr	5 yr	3 yr	30 yr	15
-73	-107	-74	-39	-25	-144	-200	-150	-123	-107	-88
Corporate yields										
		Aaa	Aa	A	Baa	Ba	B			
Long		-77	-83	-93	-81	-60	-43			
Intermediate		-88	-93	-92	-76	-82	-130			

QE2, 1-day changes, sum across 2 event dates

Treasury yields					Agency yields				Agency MBS	
30 yr	10 yr	5 yr	3 yr	1 yr	30 yr	10 yr	5 yr	3 yr	30 yr	15
-9	-18	-17	-8	-1	-9	-17	-17	-10	-9	-12
Corporate yields										
		Aaa	Aa	A	Baa	Ba	B			
Long		-9	-6	-8	-7	-10	-7			
Intermediate		-13	-11	-12	-13	-4	3			

- Suppose 15 yr MBS has duration around 5 years, and 30 yr MBS has duration around 10 years. Then:

QE1: Pre-payment risk premium channel is:

At least $88 \text{ bps} - 40 \text{ bps} = 48 \text{ bps}$ for the 15 yr MBS

At least $107 \text{ bps} - 40 \text{ bps} = 67 \text{ bps}$ for the 30 yr MBS.

Pre-payment risk interpretation is consistent w/30-year MBS down more than 15-year MBS (more pre-payment risk in 30-year MBS than 15-year MBS).

QE2: Pre-payment risk premium channel is zero, as expected.

(4) Default risk channel:

- If QE succeeds in stimulating the economy, we can expect that the *default risk* of corporations will fall.
- Also, investor risk aversion may fall as economy recovers, implying a lower *default risk premium*. Increasing health/capital in the intermediary sector can further lower risk premium on default risk.
- **Prediction:** Credit default swap rates for corporate bonds will fall.
- QE1: A lot of decline in yields for lower grade corporates is due to reduced credit risk!
- QE2: CDS rates went up! QE2 didn't succeed in reducing credit risk. Perhaps market inferred from QE2 decision that economy was in worse shape than previously thought.
- This suggests that the MBS purchases in QE1 were crucial for stimulating the economy!

QE1, 2-day changes**Corporate yields**

	Aaa	Aa	A	Baa	Ba	B
Long	-77	-83	-93	-81	-60	-43
Intermediate	-88	-93	-92	-76	-82	-130

Credit default swaps

	Aaa	Aa	A	Baa	Ba	B
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Corporate yields, minus effect of CDS

	Aaa	Aa	A	Baa	Ba	B
Long	-70	-69	-61	-41	18	1311
Intermediate	-82	-76	-59	-25	16	861

QE2, 1-day changes**Corporate yields**

	Aaa	Aa	A	Baa	Ba	B
Long	-9	-6	-8	-7	-10	-7
Intermediate	-13	-11	-12	-13	-4	3

Credit default swaps

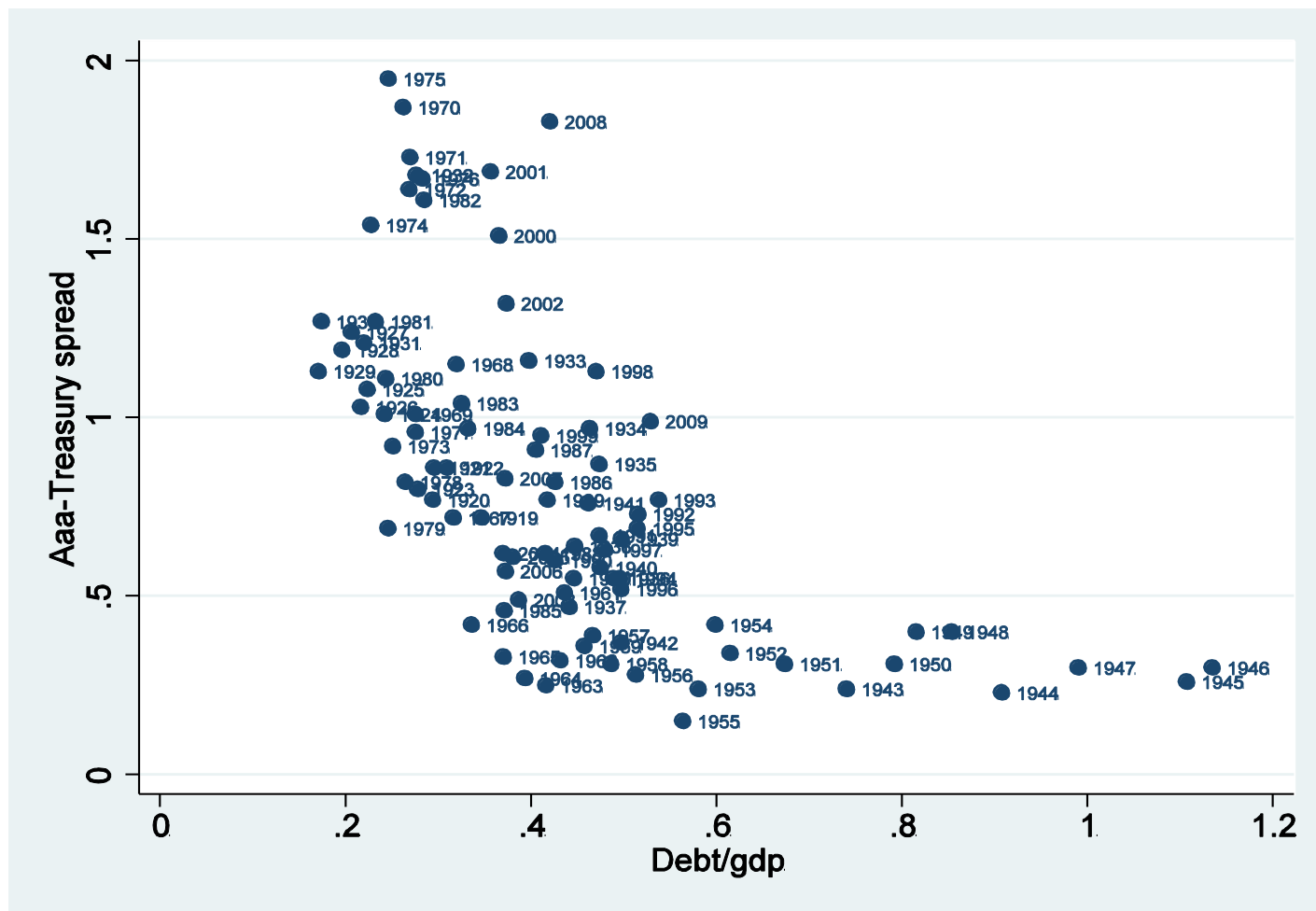
	Aaa	Aa	A	Baa	Ba	B
10 yr	2	2	2	2	6	8
5 yr	0	4	3	4	9	13

Corporate yields, minus effect of CDS

	Aaa	Aa	A	Baa	Ba	B
Long	-11	-8	-10	-9	-16	-15
Intermediate	-13	-15	-15	-17	-13	-10

(5) Long-term safety channel:

- Krishnamurthy and Vissing-Jorgensen (2010): Evidence of a clientele-demand for long-term safe assets (1925-2009) -- investors value absolute certainty of nominal repayment





- Safety premium on bonds with near-zero default risk implies very steep relation between price and expected default rate near zero. Steeper with lower supply of long-term Treasuries.

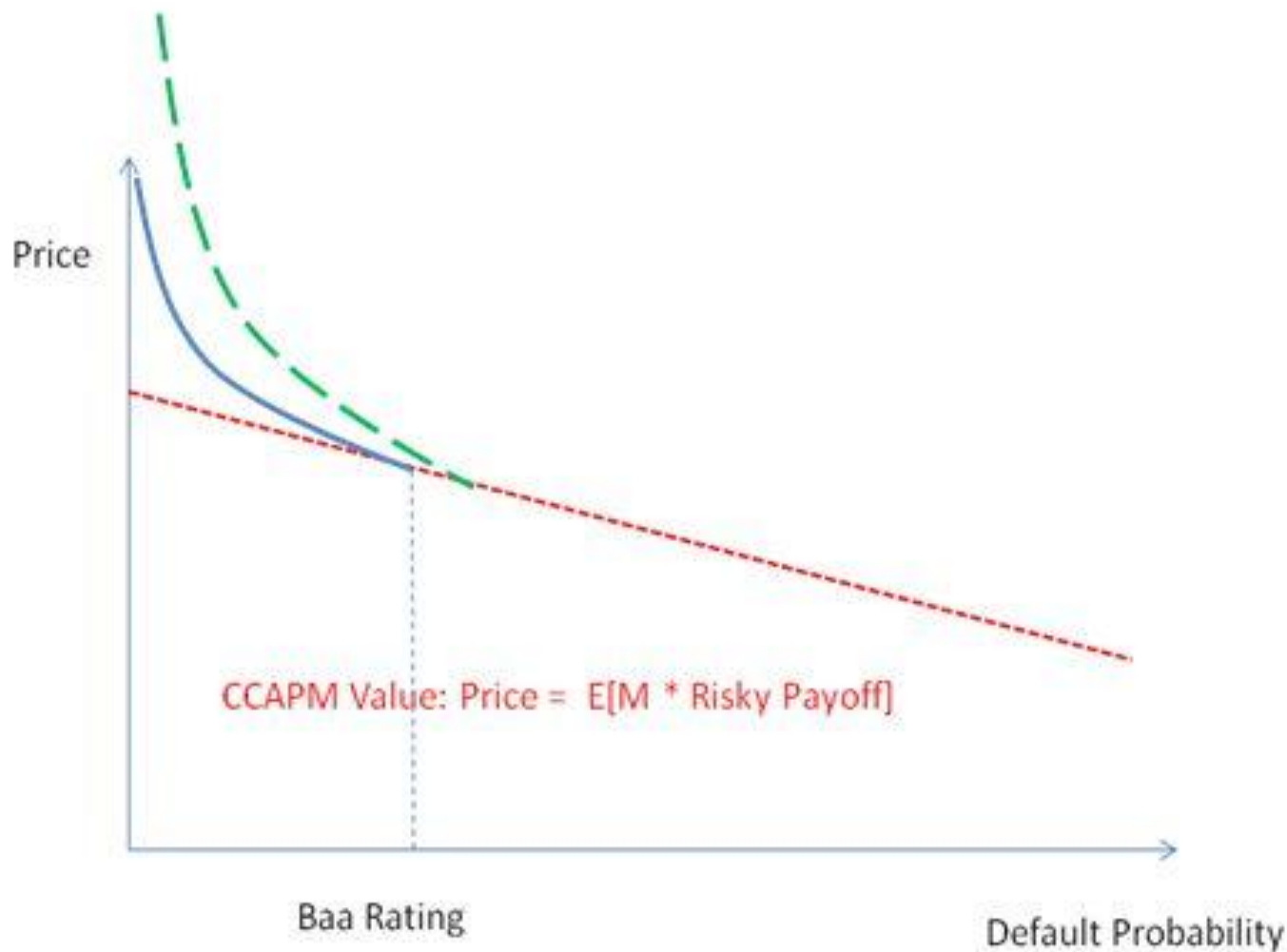


Table III. Impact of Treasury Supply on Price of Safety, Price of Liquidity

	Panel A: Price of Safety			
	Assets with similar liquidity and different safety:			
	$S^{Baa-Aaa}$		S^{P2-P1}	
Period	1926-2008	1926-2008	1974-2007	1974-2007
$\log(Debt/GDP)$	-0.506		-0.879	
	[-3.42]		[-4.47]	
$\log(Debt > 10 \text{ year mat}/GDP)$, instr. by powers of $(Debt/GDP)$		-0.310		
		[-2.40]		
$\log(Debt \leq 1 \text{ year mat}/GDP)$ instr. by powers of $(Debt/GDP)$				-1.453
				[-2.94]
Volatility	5.070	6.311	0.321	0.029
	[6.53]	[6.66]	[0.38]	[0.03]
Slope	0.229	0.209	0.014	0.054
	[4.15]	[3.24]	[0.40]	[1.14]
Constant	0.660	0.241	-0.500	-2.662
	[4.52]	[0.648]	[-2.45]	[-2.56]
N	83	83	34	34
R^2	0.600		0.486	
Estimation method	OLS	IV	OLS	IV
Error term	AR(1)	AR(1)	AR(1)	AR(1)
Impact of -1 σ supply		+41 bps		+26 bps

Table III. Impact of Treasury Supply on Price of Safety, Price of Liquidity

Panel B: Price of Liquidity		
Assets with similar safety and different liquidity: $S_{FDIC\ insured\ CDs-Bills}$ $S_{Time\ \&\ Savings\ Accounts-Bills}$		
Period	1984-2008	1935-1965
$\log(Debt/GDP)$	-1.904 [-1.83]	-0.639 [-2.37]
<i>Slope</i>	0.137 [1.32]	1.013 [8.48]
<i>Constant</i>	-1.500 [-1.63]	-0.070 [-0.41]
<i>N</i>	25	31
R^2	0.271	0.720
Estimation method	OLS	OLS
Error term	i.i.d.	i.i.d.
Impact of -1 σ supply	+115 bps	

- QE decreases supply of long-term safe assets: Treasury and agency bonds (agency MBS has significant prepayment risk which means that it is unlikely to meet clientele safety demands)
- **Predictions:**
 - i. Safety-channel implies that QE involving Treasuries and agencies lowers the yields on very safe assets
 - ii. Safety-channel has no effects on lower-grade debt such as Baa bonds or bonds with prepayment risk such as MBS.

Best place to isolate this effect: Agency bonds - these are affected by signaling, but not pre-payment risk (we tabulate non-callable agency bonds), or default (was taken over by govt. pre-QE1).

QE1, 2-day changes, sum across 5 event dates

Treasury yields					Agency yields				Agency MBS	
30 yr	10 yr	5 yr	3 yr	1 yr	30 yr	10 yr	5 yr	3 yr	30 yr	15
-73	-107	-74	-39	-25	-144	-200	-150	-123	-107	-88
Corporate yields										
		Aaa	Aa	A	Baa	Ba	B			
Long		-77	-83	-93	-81	-60	-43			
Intermediate		-88	-93	-92	-76	-82	-130			

QE2, 1-day changes, sum across 2 event dates

Treasury yields					Agency yields				Agency MBS	
30 yr	10 yr	5 yr	3 yr	1 yr	30 yr	10 yr	5 yr	3 yr	30 yr	15
-9	-18	-17	-8	-1	-9	-17	-17	-10	-9	-12
Corporate yields										
		Aaa	Aa	A	Baa	Ba	B			
Long		-9	-6	-8	-7	-10	-7			
Intermediate		-13	-11	-12	-13	-4	3			

Agency yield reduction due to safety effect (netting out signaling):

QE1:

At least 200 bps-40 bps=**160 bps** for the 10 yr agency

At least 150 bps-40 bps=**110 bps** for the 5 yr agency

QE2:

At least 17 bps-12 bps=**5 bps** for the 10 yr agency

At least 17 bps-18 bps=**-1 bps** for the 5 yr agency

Same safety effect on Treasuries, but these are also affected by liquidity issues (more shortly), so not a good place to look to isolate the safety effect.

QE1 evidence for corporate bonds also consistent with a **safety-effect for higher-grade corporate bonds**. Aaa, Aa and A-rated bonds CDS-adjusted fall by about 75 bps, i.e. more than can be explained by signaling, and more than for lower-grade corporates.

Why couldn't non-investment grade bonds+CDS satisfy safety demand?

- Even with CDS protection these bonds are not close to riskless due to counterparty risk in CDS
- Also, you cannot post a bond+CDS as collateral.

Perspective: The QE1 period is an unusual financial-crisis period. Demand for safe assets was heightened, segmented market effects were apparent across many markets, and intermediaries suffered from serious financing problems. In such an environment, supply changes should be expected to have a large safety effect on interest rates.

(Mention regression results)

(6) Liquidity channel:

- QE involves purchasing long-term securities and paying by increasing reserve balances which are likely more liquid → Reduction in price premium of liquid assets (yield increase).
- **Prediction: The liquidity effect raises yields on liquid assets**

QE1: Strong liquidity effect

- Yields on Treasuries (more liquid) fall less than yields on agencies (less liquid). 10 yr Agency-Treasury spread falls $200-107=93$ bps

QE2: No liquidity effect

- Yields on Treasuries and agencies fall the same.
- Plausible: Liquidity premia were quite low in late 2010 (almost same yields on 1-week and 3-month T-bills and on T-bills and Tier 1 CP). Reserves ↑ about \$750B, T-bills ↑ about \$290B from QE1 to QE2.

(7) Inflation channel:

- To the extent that QE is expansionary or signals central bank willingness to stimulate, it *increases inflation expectations*. This can be expected to have a positive effect on nominal interest rates.
- QE may also either increase or decrease *inflation uncertainty*.
- **Predictions:**
 - i. QE increases the rate on inflation swaps as well inflation expectations as measured by the difference between nominal bond yields and TIPS.
 - ii. QE may increase or decrease interest rate uncertainty as measured by the implied volatility on swaptions.
- Important: If operative, this means that *real* rate declines were larger than *nominal* rate declines.

- What nominal yield be compared to TIPS yields? Something with the same safety-demand, so probably not Treasuries or agencies. We'll show results for Aaa corp and Baa corp (CDS-adjusted)

QE1, 2-day changes

Corporate yields, minus effect of CDS changes						
	Aaa	Aa	A	Baa	Ba	B
Long	-70	-69	-61	-41	18	1311
Intermediate	-82	-76	-59	-25	16	861
Inflation swaps				TIPS real yields		Interest rate volatility
30 yr	10 yr	5 yr	1 yr	20 yr	10 yr	5 yr
35	96	38	41	-135	-187	-160
						-38

QE2, 1-day changes

Corporate yields, minus effect of CDS changes						
	Aaa	Aa	A	Baa	Ba	B
Long	-11	-8	-10	-9	-16	-15
Intermediate	-13	-15	-15	-17	-13	-10
Inflation swaps				TIPS real yields		Interest rate volatility
30 yr	10 yr	5 yr	1 yr	30 yr	10 yr	5 yr
11	5	3	-1	-20	-25	-22
						-3

QE1: Expected inflation up by...

- Using inflation swaps: **35 to 96 bps**.
- Using Aaa (CDS-adj)-TIPS:
10-year: $-70 - (-187) = \mathbf{117 \text{ bps}}$. 5-year: $-82 - (-159) = \mathbf{77 \text{ bps}}$
- Using Baa (CDS-adj)-TIPS:
10-year: $-41 - (-187) = 146 \text{ bps}$. 5-year: $-25 - (-159) = 134 \text{ bps}$.

QE2: Expected inflation up by...

- Using inflation swaps: **-1 to 11 bps**.
- Using Aaa (CDS-adj)-TIPS:
10-year: $-11 - (-25) = \mathbf{14 \text{ bps}}$. 5-year: $-13 - (-22) = \mathbf{9 \text{ bps}}$
- Using Baa (CDS-adj)-TIPS:
10-year: $-9 - (-25) = 16 \text{ bps}$. 5-year: $-17 - (-22) = 5 \text{ bps}$.

Inflation uncertainty: Implied vol from interest rate swaptions falls 38 bps in QE1 (avg. vol. over QE1 time period=104 bps), 3 bps in QE2.

Summary:

Signaling channel: For all bonds

- QE1: 20-40 bps at the 10 yr horizon, 35-40 bps at 5 yr horizon
- QE2: 8-12 bps at the 10 yr horizon, 11-18 bps at 5 yr horizon

Duration risk premium channel: Doesn't seem important

Pre-payment risk premium channel: For MBS

- QE1: At least 48 bps for the 15 yr MBS, 67 bps for the 30 yr MBS.
- QE2: Pre-payment risk premium channel is zero, as expected.

Default risk channel: For corporates

- QE1: 7 bps (Aaa) to 78 bps (Ba)
- QE2: CDS rates go up!

Safety channel: For agencies and Treasuries

- QE1: At least 160 bps for the 10 yrs, 110 bps for the 5 yrs
- QE2: At least 5 bps for the 10 yrs, 0 bps for the 5 yrs

Liquidity channel: For Treasuries

- QE1: 93 bps, pushing yields up
- QE2: No liquidity effect

Inflation channel:

- QE1: 10-year expected inflation up 96-146 bps
- QE2: 10-year expected inflation up 5-16 bps

Operative for both QE1 and QE2: Signaling, safety, inflation channels

Operative only for QE1: Pre-payment risk, default risk, liquidity.

Policy implications:

(1) It matters what you buy!

- MBS purchases in QE1 crucial for lowering MBS rates and likely driver of lower corporate credit risk and thus corporate yields.
- Treasuries-only QE in QE2 has disprop. effect on Treasuries and agencies relative to MBS and corporates. No CDS reduction.

(2) Signaling played a non-negligible role

- So perhaps some of the QE effect may have been achievable with commitment statement, without balance sheet risk.
- FOMC announcement on August 9, 2011 is informative for this:
“... exceptionally low levels for the federal funds rate at least through mid-2013”.
- 1-day changes in Treasuries on August 9:

30-yr	10-yr	5-yr	3-yr
-12 bps	-20 bps	-20 bps	-12 bps
- Fed funds futures on August 9, 2011:

2-yr	1-yr
-22 bps	-4 bps

9/21/2011 FOMC announcement:

“To support a stronger economic recovery and to help ensure that inflation, over time, is at levels consistent with the dual mandate, the Committee decided today to extend the average maturity of its holdings of securities. The Committee intends to purchase, by the end of June 2012, \$400 billion of Treasury securities with remaining maturities of 6 years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of 3 years or less. ...”

“To help support conditions in mortgage markets, the Committee will now reinvest principal payments from its holdings of agency debt and agency mortgage-backed securities in agency mortgage-backed securities.”

- Treasuries:

30-yr	10-yr	5-yr	3-yr	1-yr
-17	-7	+3	+7	+2

- Agencies:

30-yr	10-yr	5-yr	3-yr
-16	-2	+1	+6

- MBS:

30-yr	15-yr
-23	-7

- Fed funds futures:

3 rd month	6 th month	12 th month	24 th month
+2	+2	+2	-1

- Corporate rates, long:

Aaa	Aa	A	Baa	Ba	B
-16	-17	-16	-15	-5	+3

Corporate rates, intermediate:

Aaa	Aa	A	Baa	Ba	B
0	+2	+2	-2	-2	+1

- CDS rates, 10-year:

Investment grade	High yield
+9	+1

- CDS rates, 5-year:

Investment grade	High yield
+8	+34

- Inflation swaps:

30-yr	10-yr	5-yr	1-yr
-8	-4	-1	-7

- TIPS: 30-yr 10-yr 5-yr

-5	-2	+4
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- Interest rate volatility:

0

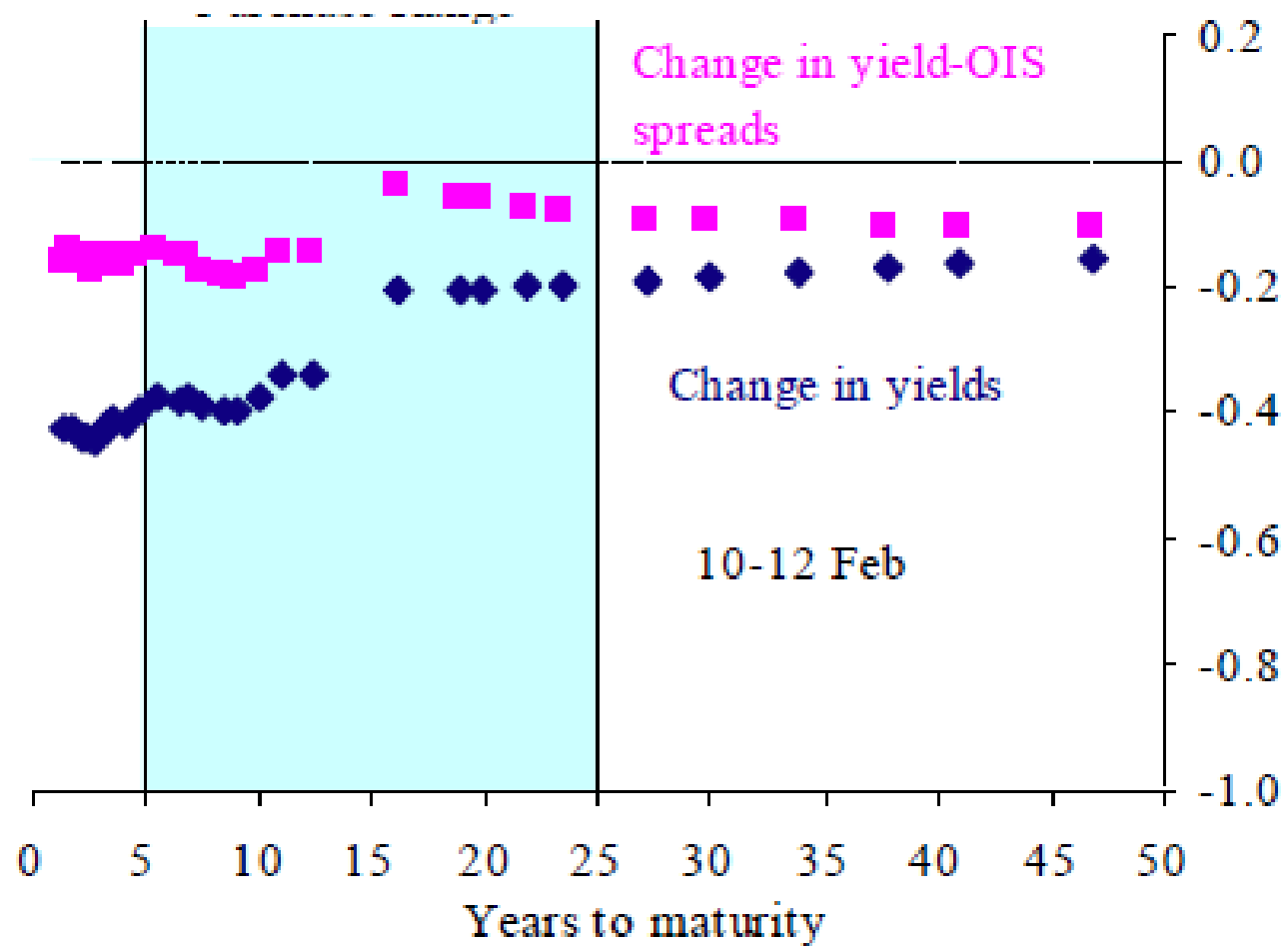
UK QE evidence provide interesting facts about safety demand for specific maturities

Two first QE event dates for the UK, from Joyce et al 2010:

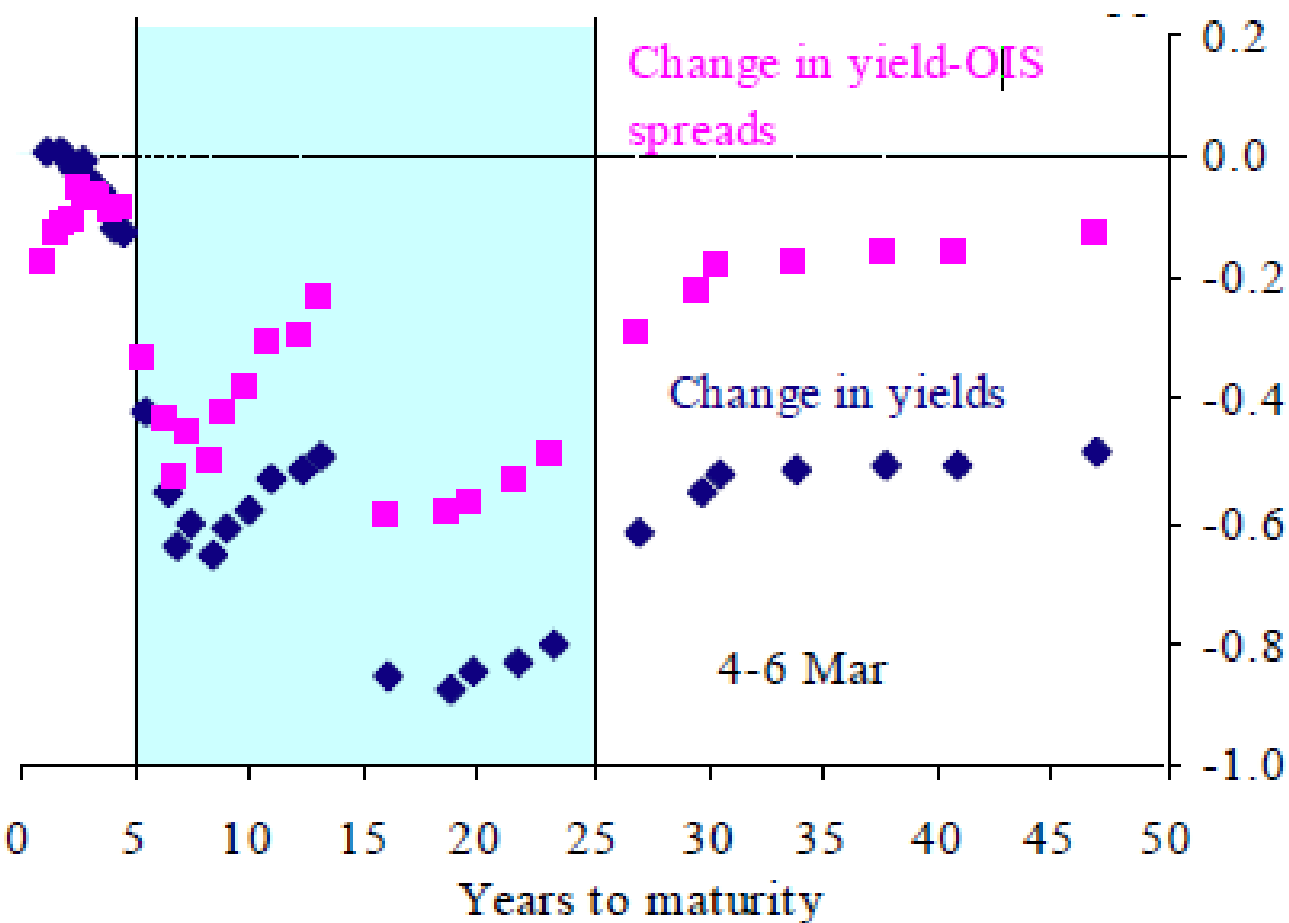
Table A: Key QE announcement dates

<i>Announcement</i>	<i>Decision on QE</i>	<i>Other information</i>
11 February 2009	February <i>Inflation Report</i> and the associated press conference gave strong indication that QE asset purchases were likely.	
5 March 2009	The MPC announced that it would purchase £75 billion of assets over three months funded by central bank reserves, with conventional bonds likely to constitute the majority of purchases. Gilt purchases were to be restricted to bonds with a residual maturity of between 5 and 25 years.	Bank Rate reduced from 1% to 0.5%.

Yield changes by maturity, Feb 10 to Feb 12:



Yield changes by maturity, Mar 4 to Mar 6:



Regression analysis of the safety channel

Possible drawbacks of event-study approach:

- Event dates chosen may not capture all of the effect of expectation changes due to policy.
- Results may be particular to period studied (this is good and bad).

Consider the following regression approach to evaluate the predicted impact of Treasuries-only QE, on average using annual data for 1949-2008. Builds on Krishnamurthy and Vissing-Jorgensen (2010a).

$$\text{Baa} - \text{Treasury yield spread}_t = \text{Default controls}_t + \beta \ln(\text{Long Treasury supply}_t / \text{GDP}_t) + \epsilon_t$$

Evaluate the term $\beta \ln(\text{Long Treasury supply} / \text{GDP})$ at the pre-QE and post-QE values of long Treasury supply.

- Baa-Treasury spread reflects both liquidity premium and safety premium. Consider also Baa-Aaa spread: Captures safety premium only, but not fully.

Estimation:

- Long Treasury supply: 10-year equivalents
Compute market value of each Treasury issue $\times (\text{Duration}/10)$.
Sum across Treasury issues with remaining maturity ≥ 2 years.
- Instrument by (Total Treasury supply)/GDP, and squares and cubes of (Total Treasury supply)/GDP.
- Default controls: Stock market volatility (std. dev. of weekly stock returns over preceding year), slope of yield curve (10 year minus 3-month Treasury yield).
- Estimate by 2SLS. Adjust std. errors assuming AR(1) error term.

Estimates for QE1:

11 bps using Baa-Treasury spread. 4 bps using Baa-Aaa spread.

- Purchases of \$242B of Treasuries and agencies in 10-year equivalents from Gagnon et al (2010).
(Regression evidence suggests that Baa and Agency-MBS moves similar in response to Treasury supply --> Agency-MBS supply does not drive safety premium.)
- Small relative to safety effect estimates from QE1 event study.
- Suggests that changes in Treasury supply have much larger impact on safety premium in times of unusually high safety demand than in average times.

Estimates for QE2:

21 bps using Baa-Treasury spread. 7 bps using Baa-Aaa spread.

- Using purchase of \$600bn of Treasuries and rolling over maturing MBS into long-term Treasuries (about \$220bn over the next year).
- \$820B of Treasuries= \$511B of 10-year equivalents, based on the planned maturity breakdown provided by the Federal Reserve Bank of New York.
- These numbers seem in line with those from the event study.