Swiss Unconventional Monetary Policy: Lessons for the Transmission of QE

Jens H.E. Christensen & Signe Krogstrup

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Motivation

- At the ZLB, a number of central banks have resorted to unconventional monetary policies, including quantitative easing (QE).
- QE aims to steer long interest rates, and is implemented through large-scale asset purchases, and unprecedented creation of reserves.
- The understanding of transmission of QE to long rates remains at best partial, conceptually and empirically.
- Transmission details matter for how to best design, communicate, and eventually exit QE programs.

Our Contribution

- We argue that QE can be transmitted through reserve expansion *per se*, independently of which assets are purchased.
- Study the SNB reserve expansions of August 2011. These did not involve any long-term security purchases.
- Term structure model to decompose Swiss long-term bond yields into policy expectations and term premiums.
- Event study suggests that term premiums dropped significantly at the time of the SNB's announcements.
- We thereby document a case of reserve expansions *without* purchases of long-term assets leading to declines in long-term yields through a portfolio balance effect.

Outline

1. Introduction
2. Transmission Through Reserves: How?
3. The Case of The SNB's Reserve Expansions in Aug 2011
4. Empirical Analysis
5. Results, Conclusions and Implications

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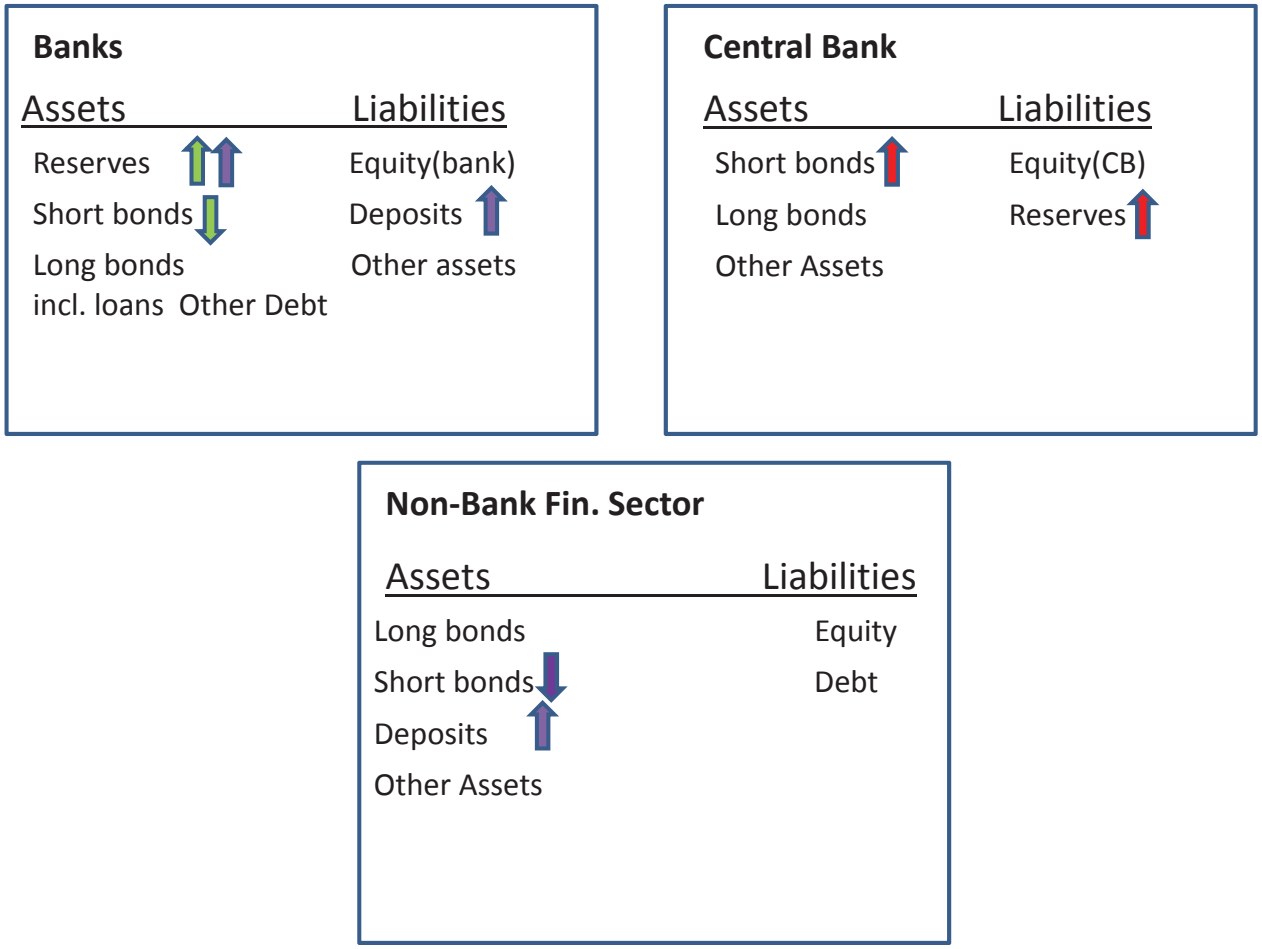
The Existing Literature Focuses on Two Channels

1. Signaling channel: Announcements of QE provides information about current or future economic conditions or monetary policy intentions.
2. Portfolio balance channel: CB purchases of long-term bonds reduce the supply of these bonds available in the market, and thereby increase (reduce) their price (yield).
   - Underlying assumption: bonds of different maturities are imperfect substitutes for some investors (preferred habitat) and markets are segmented.

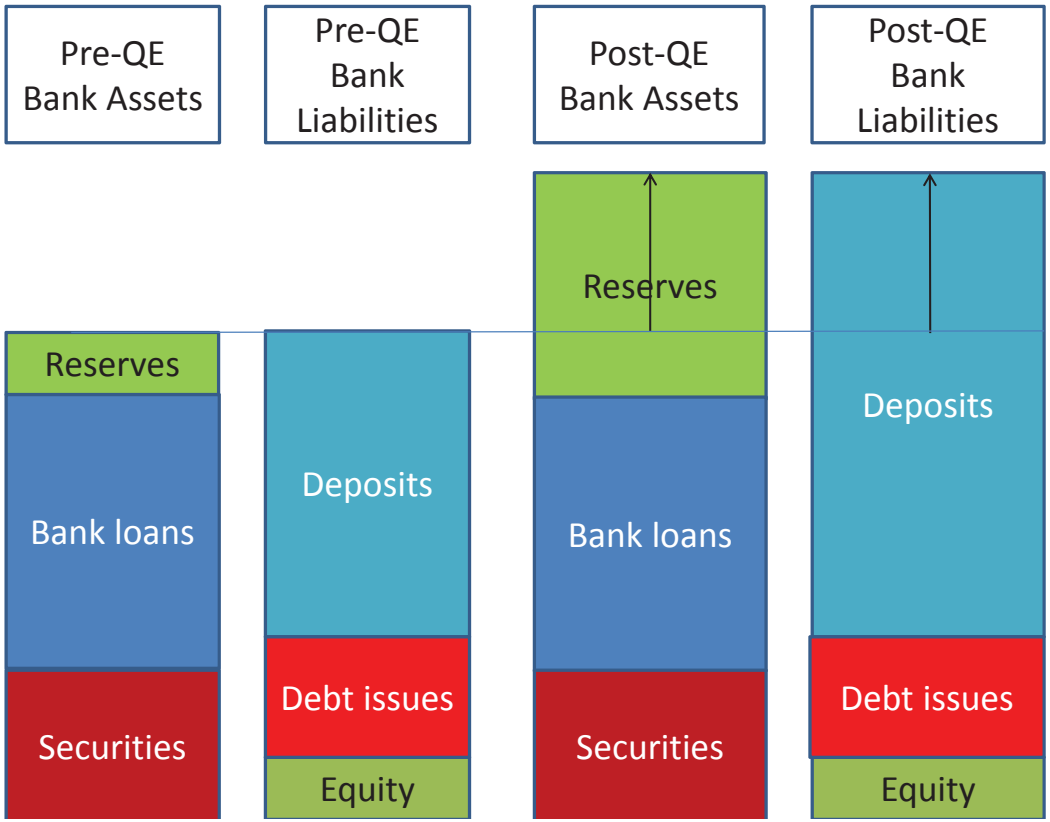
However, as Bernanke and Reinhart (2004) emphasize, an expansion of reserves by itself can potentially lead to portfolio balance effects. See also Tobin (1969), and Brunner and Metzler (1973).

Additional Transmission Channel: Reserve Effects (1)



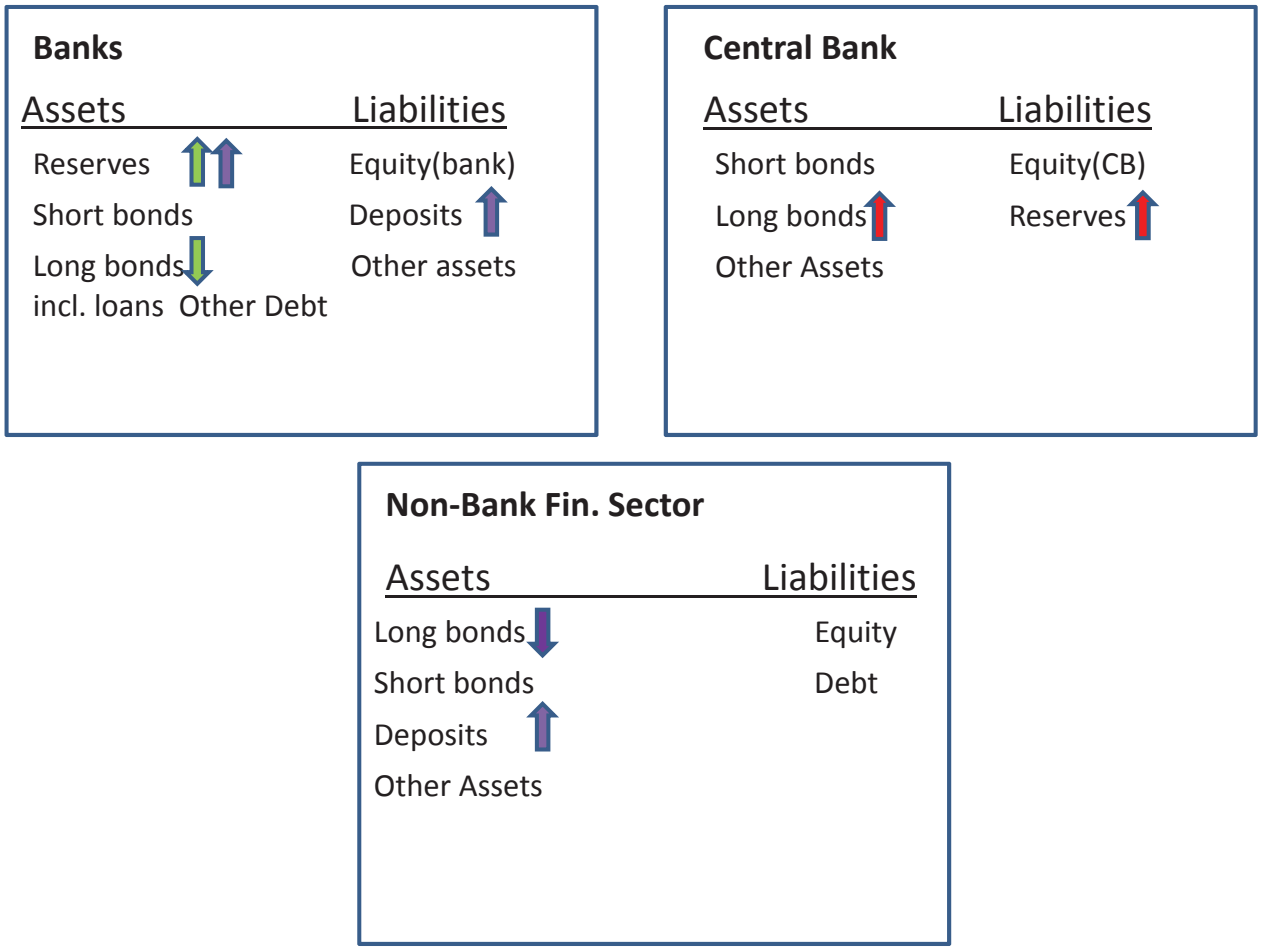
- Example where reserves and short bonds are near-perfect substitutes at the zero lower bound.
- But not perfect: Only banks can hold reserves.

Additional Transmission Channel: Reserve Effects (2)



- Initial impact of QE: Bank asset duration is shortened.
- The extra reserves must stay in banks: Hot potato effect....
- ... until longer-duration yields decline (prices increase) enough to make banks content to hold the extra reserves.

Additional Transmission Channel: Reserve Effects (3)



- Reserve effects are independent of the assets purchased.
- Reserve effects can arise when assets are purchased from non-banks.
- Long bond QE can have both reserve and supply effects.

Additional Transmission Channel: Reserve Effects (4)

Has this channel been empirically relevant in QE programs?

Event studies of US and UK QE cannot identify, but circumstances make reserve effects more likely:

US:

- Carpenter et al. (2013) provide evidence for the U.S. that QE counterparties have tended to be non-banks.
- Ennis (2014) shows that reserves now make up 50% of total securities and reserves portfolio of US banks.

UK:

- Joyce et al. (2011) describe UK QE as designed for non-bank counterparties, with the aim of increasing broader money.
- In effect, UK bank holdings of the purchased long-term Gilts increased, non-bank private sector holdings declined, in connection with the initial QE in 2009.

Additional Transmission Channel: Reserve Effects (5)

For outright identification in event studies, we need a case of QE-style central bank reserve expansions, but in the absence of long-term bond purchases.

The Swiss reserve expansion program of August 2011 represents exactly such a case.

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Unconventional Swiss Monetary Policy

Swiss policy interest rates reached ZLB in early 2009.

The Swiss franc strongly appreciated starting in late 2008, compounding the negative shocks from the global financial and European debt crises at ZLB.

Some monetary policy reactions to the appreciation and deflationary concerns:

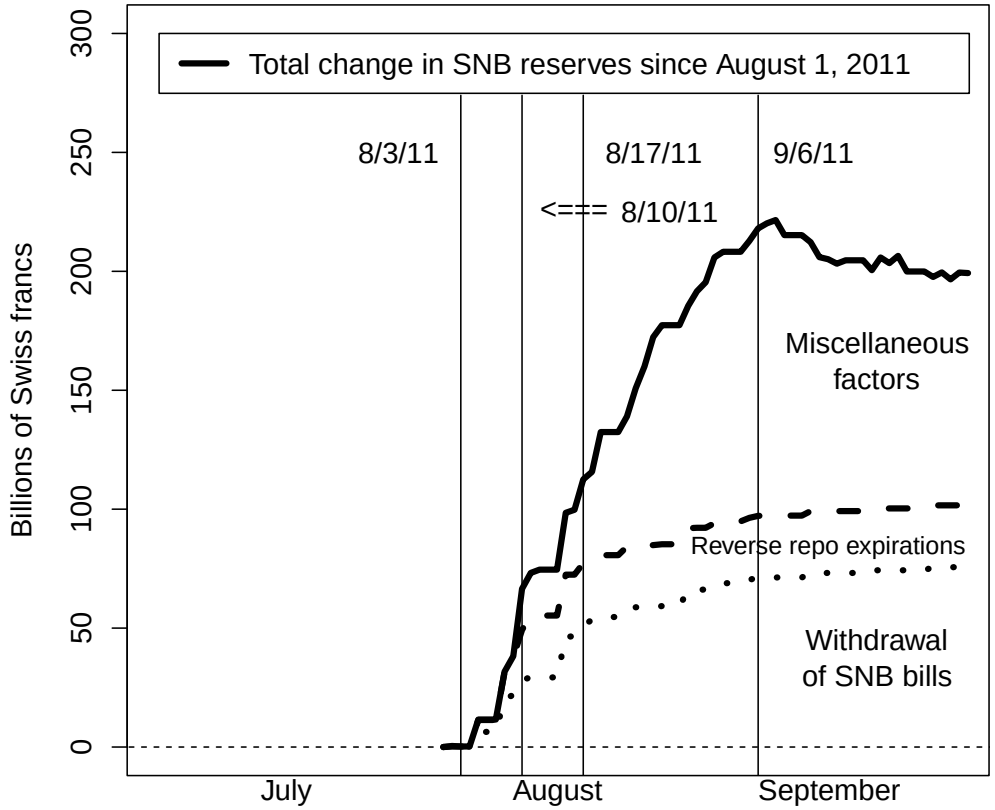
- FX interventions in 2009-2010.
- Announcement and implementation of **three rounds of reserve expansions in Aug 2011.**
- Floor of 1.20 Swiss francs per euro in Sep. 2011.

SNB QE-type Announcements in August 2011

No.	Date	Announcement description
I	Aug. 3, 2011 9:05 a.m.	Target range for three-month CHF LIBOR lowered to 0 to 25 basis points. In addition, banks' sight deposits at the SNB will be expanded from CHF 30 billion to CHF 80 billion.
II	Aug. 10, 2011 8:55 a.m.	Banks' sight deposits at the SNB will rapidly be expanded from CHF 80 billion to CHF 120 billion.
III	Aug. 17, 2011 9:05 a.m.	Banks' sight deposits at the SNB will immediately be expanded from CHF 120 billion to CHF 200 billion.

- Total expansion of reserves: CHF 170 billion, or 30% of GDP.
- Was achieved within a month.
- Unprecedented in terms of both size and pace.

Implementation of the Reserve Expansions



- Outstanding **SNB bills** were reduced by CHF 66 billion in August, and by CHF 100 billion by the end of 2011.
- CHF 26 billion outstanding **reverse repos** expired in August.
- The remaining August expansion: temporary **FX swaps**.
- No long-lived securities were purchased.

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Data and Event Study Details

Data and sample:

- Zero-coupon equivalent yields generated by SNB staff (Svensson (1995) discount function).
- Daily bond market data collected between 9:00 and 11:00 a.m.
- Sample contains six maturities, $\{1, 2, 3, 5, 7, 10\}$, from January 6, 1998, to December 30, 2011.

Two-day event window:

- SNB made announcements around 09:00 a.m., which may be before or after data collection.
- Ranaldo and Rossi (2010): Swiss bond markets can take up to 30 min. to react to SNB policy announcements.

Were the announcements unexpected?

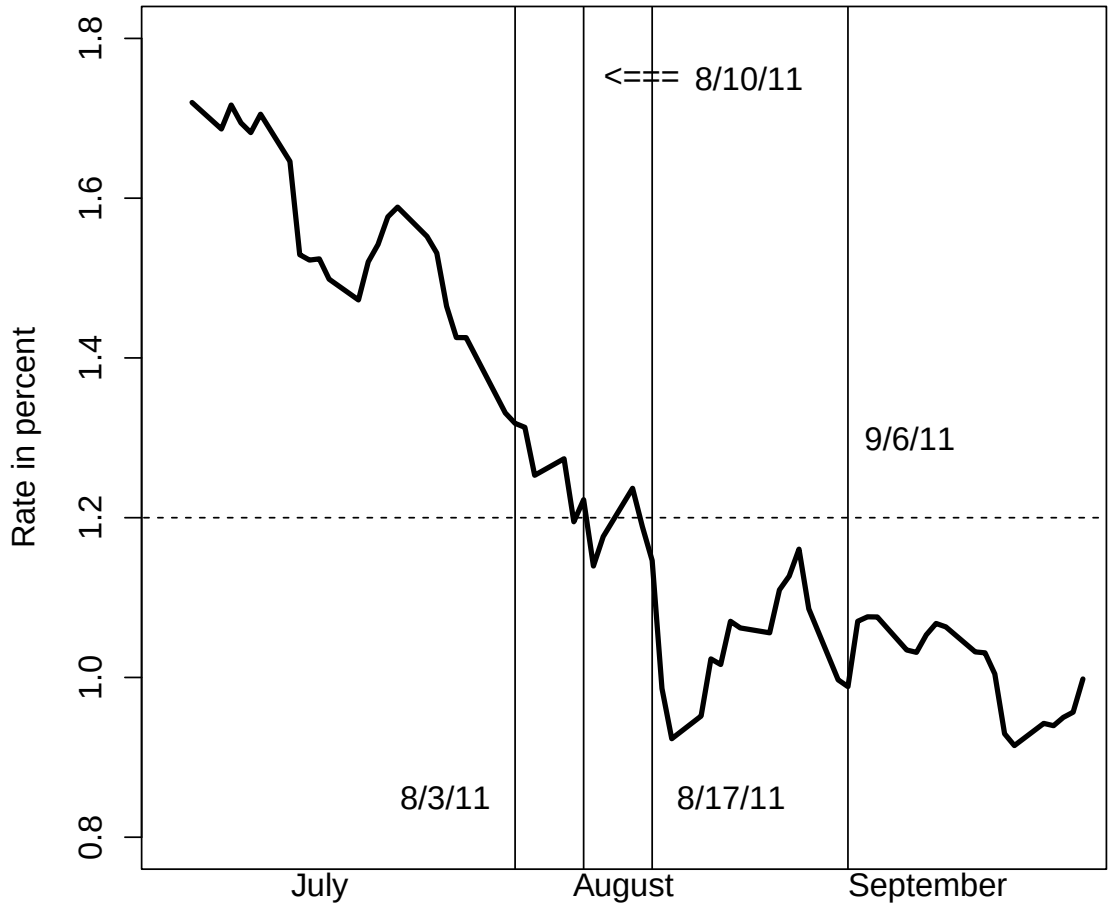
- They were unscheduled, and the nature, size, and pace of measures were at least partly unexpected.

First Look at The Data: Swiss Confederation Yields

Event		Maturity					
		1-year	2-year	3-year	5-year	7-year	10-year
I	Aug. 2, 2011	30	17	24	65	100	133
	Aug. 4, 2011	26	12	20	61	98	131
	Change	**-4**	**-5**	**-5**	**-4**	**-3**	**-2**
II	Aug. 9, 2011	26	13	14	47	83	119
	Aug. 11, 2011	21	8	10	43	79	114
	Change	**-5**	**-5**	**-5**	**-4**	**-4**	**-6**
III	Aug. 16, 2011	19	8	13	49	84	119
	Aug. 18, 2011	18	8	7	32	64	99
	Change	**0**	**0**	**-6**	**-17**	**-21**	**-20**
Total net change		**-9**	**-10**	**-15**	**-25**	**-28**	**-28**

For comparison, the sample standard deviation of two-day changes is 5 bps (or 6-8 bps in the summer of 2011).

First Look at The Data: Swiss Confederation Yields (2)



To what extent did the yield declines reflect policy expectations (signaling) vs. portfolio balance effects?

Yield Decomposition by Term Structure Modeling

Define the term premium:

$$y_t(\tau) = \frac{1}{\tau} \int_t^{t+\tau} E_t^P[r_s]ds + TP_t(\tau)$$

- Changes in policy expectations are associated with signaling effects;
- Changes in term premiums are associated with portfolio balance effects.

We need a measure of policy expectations over all maturities in daily data. For this purpose, we estimate an

Arbitrage-Free Nelson-Siegel (AFNS) model following Christensen, Diebold, and Rudebusch (2011).

Summary Slide on the AFNS Term Structure Model

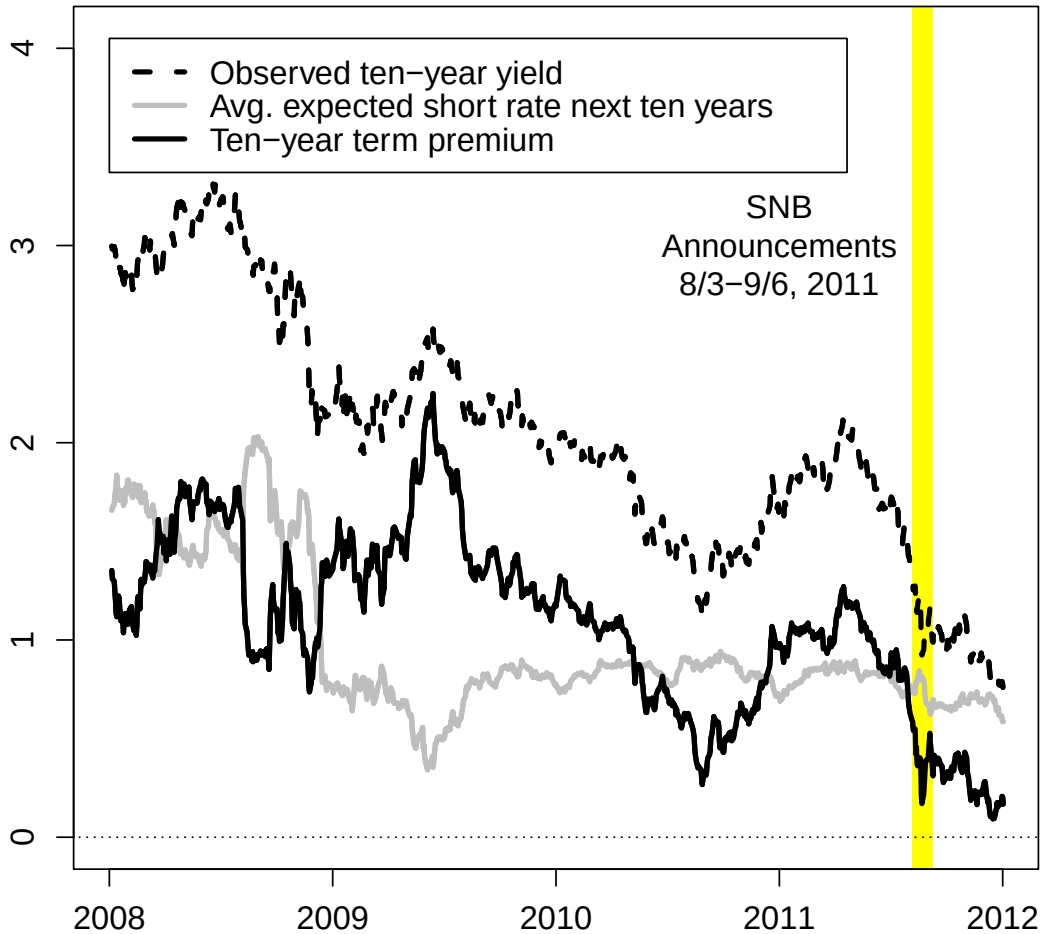
- Why Nelson-Siegel? The three factors of the NS model fit Swiss yield data very well.
- Gaussian model (no shadow-rate model): Swiss bond yields were not constrained by the ZLB during the period we are interested in.
- Since purpose is short-rate forecast, we follow Christensen and Rudebusch (2012) and carry out a **rolling real-time analysis**.
- Model performance: Very good fit, relatively strong forecast performance (reasonable model of policy expectations).

Decomposition of Swiss Ten-Year Yield Response

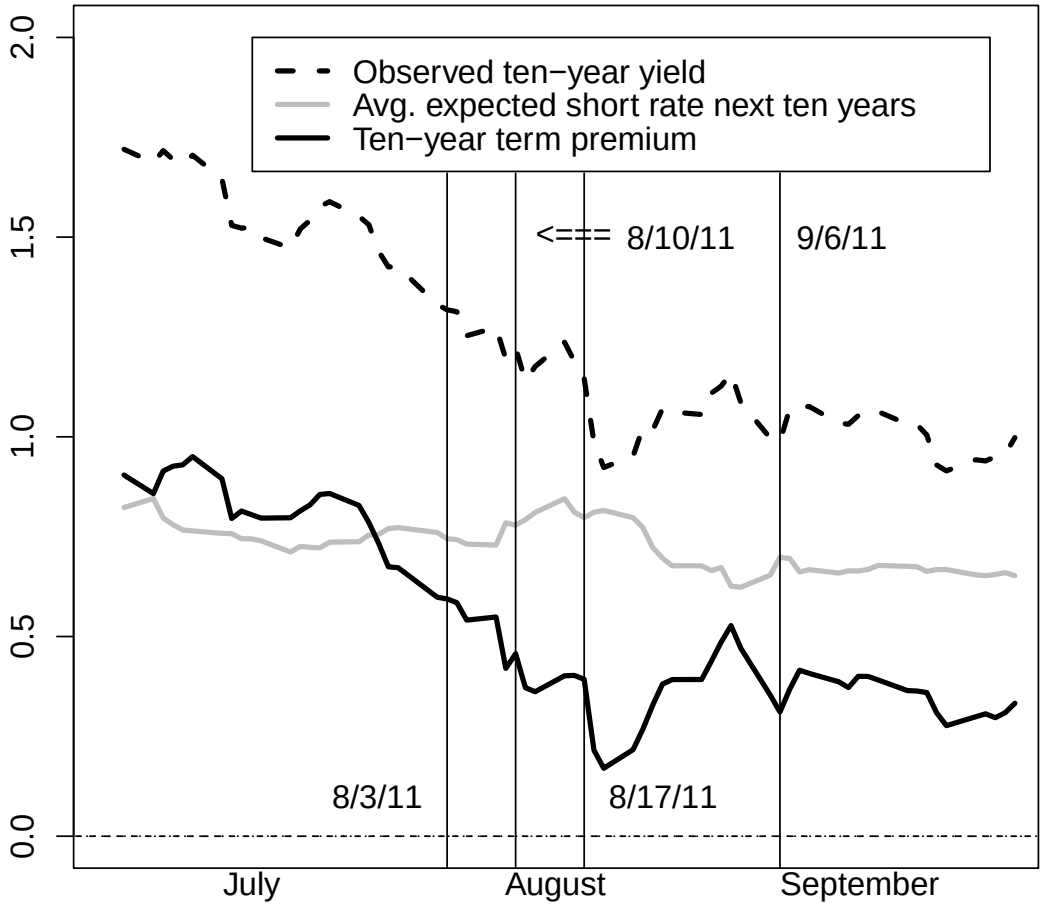
Event	Model	Avg. target rate next 10 years	10-year term premium	Res.	10-year yield
I 8/3/11	Unconstr.	-5	2	1	**-2**
	Unrestrict. K^P	-2	-1	1	
	Indep.-factor	-3	-1	1	
	Preferred	**-2**	**-1**	**1**	
II 8/10/11	Unconstr.	-3	-2	-1	**-6**
	Unrestrict. K^P	0	-4	-1	
	Indep.-factor	1	-5	-1	
	Preferred	**1**	**-5**	**-1**	
III 8/17/11	Unconstr.	0	-20	0	**-20**
	Unrestrict. K^P	4	-23	-2	
	Indep.-factor	-1	-17	-2	
	Preferred	**0**	**-19**	**-2**	
Total	Unconstr.	-8	-19	0	**-28**
	Unrestrict. K^P	2	-28	-2	
	Indep.-factor	-3	-23	-2	
	Preferred	**-1**	**-25**	**-2**	

- Very similar decompositions across model specifications.

Decomposition of 10-year Yield with Preferred Model



Decomposition of 10-year Yield with Preferred Model



Zoom in on the Summer of 2011

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Results and Robustness

Results:

- We find 25 bps accumulated drop in the term premium of Swiss 10-year yields.
- The drop was particularly large after the third "strongest" announcement.
- Only the first announcement related to signaling, as it affected expected future policy rates. Consistent with the message.

Robustness: Could the drops have been driven by other market or foreign developments? We think not:

- No other events likely to explain these drops.
- Results robust to controlling for market uncertainty (VIX); illiquidity (bid-ask spreads) and foreign term premia at announcement dates.

Conclusion

- Real-time estimation of dynamic term structure models and event study suggest SNB QE announcements were associated with declines in the term premiums of long-term Swiss bonds.
- As the SNB bought no long-term bonds, we interpret this as evidence of portfolio balance effects of reserve expansions on long-term yields.
- The transmission channel of QE programs to long-term interest rates may hence partly derive from the reserve expansions *per se*.
- Are these findings relevant outside Switzerland? Call for more research to better understand the bank and financial market impact of changes in central bank reserves.

Some Tentative Policy Implications

- Implications for the design of QE programs: At ZLB, long-lived asset purchases are not necessary for QE to affect long-term yields.

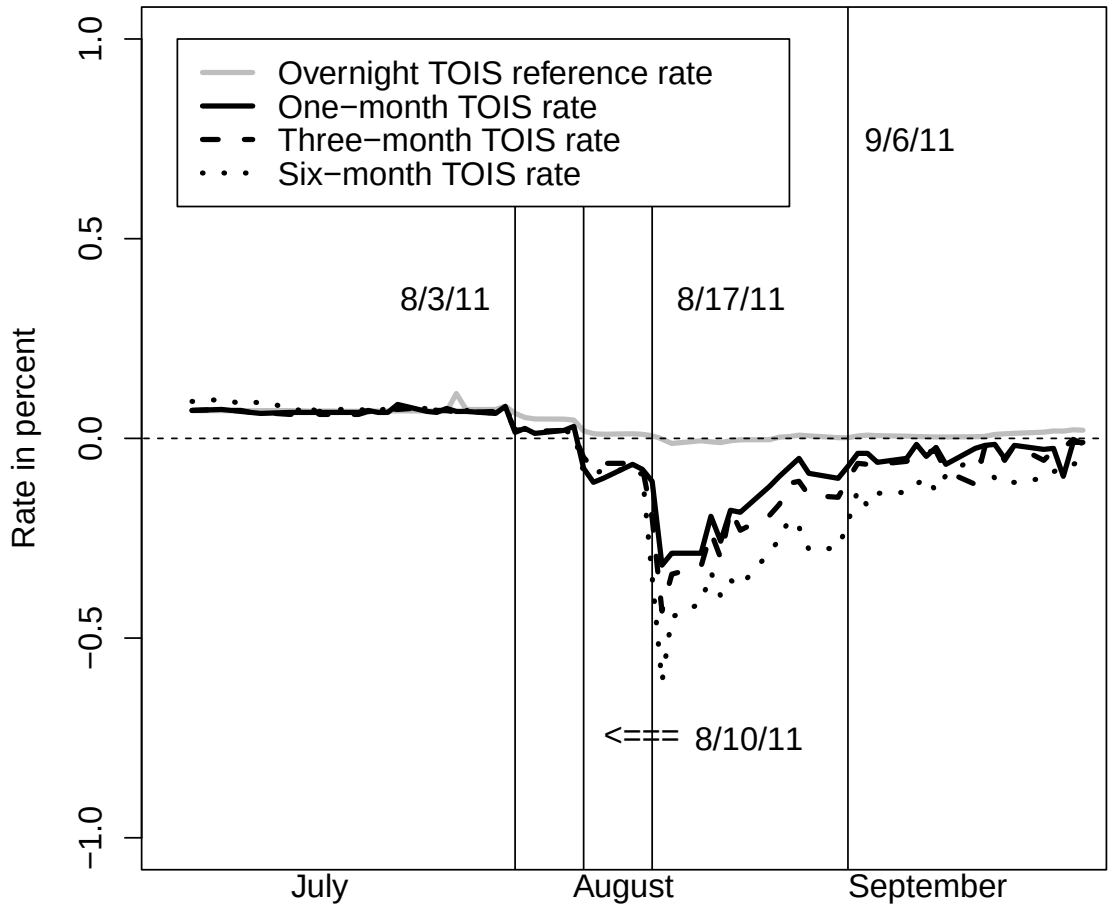
- Implications for the exit: Exit from QE through absorption of reserves without asset sales could nevertheless directly affect/disrupt long-term bond markets.

- Implications for communication: Signaling channel appears to be absent when QE is *not* combined with forward guidance, see also Christensen and Rudebusch (2012).

End of Slides

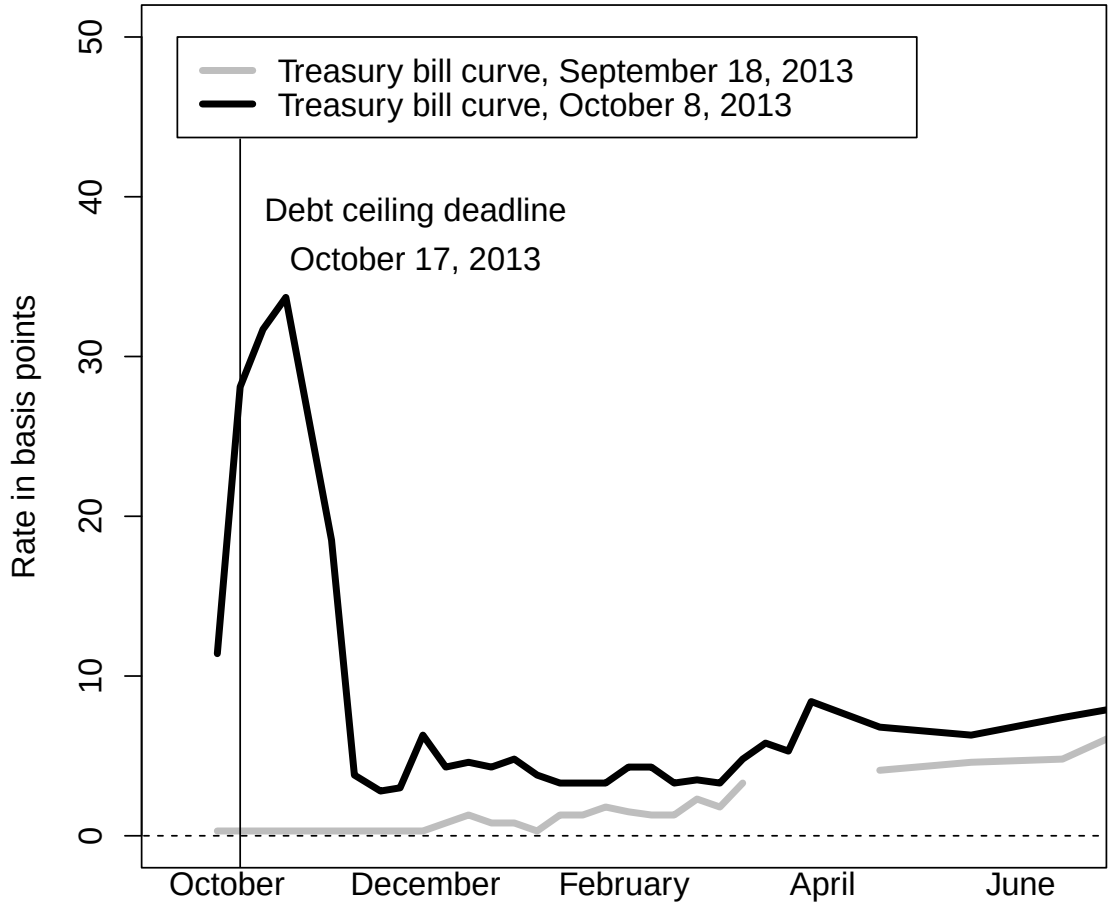
Thank you!

Reaction of Swiss Money Market Rates



- Swiss money market rates did exhibit a strong initial reaction.
- Is this evidence of a signaling effect?
- First, our model-based results suggest that this is not the case.
- Second, we argue that this reaction was exaggerated and has similarity with the U.S. Treasury bond market reaction around the U.S. debt ceiling debate in the fall of 2013.

U.S. T-Bill Rates around Debt Ceiling Deadline



- Days before the U.S. federal government would be constrained by the legal limit on federal debt, T-bills with maturities immediately after the deadline saw their yields spike.
- However, T-bills with later maturities were hardly affected.
- Thus, short-maturity exaggerated reactions can co-exist with no changes to expectations for future monetary policy.

The AFNS Class of Models

The zero-coupon yields have the dynamic Nelson-Siegel factor structure:

$$y_t(\tau) = L_t + \left(\frac{1-e^{-\lambda\tau}}{\lambda\tau}\right)S_t + \left(\frac{1-e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right)C_t - \frac{A(\tau)}{\tau}.$$

The risk-free rate is defined by

$$r_t = L_t + S_t$$

- This defines the AFNS model class.
- The constant yield-adjustment term, $A(\tau)/\tau$, ensures absence of arbitrage.
- This is the measurement equation in the Kalman filter.

The AFNS Class of Models cont.

The dynamics of the factors are characterized by the P-dynamics:

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} \kappa_{11}^P & \kappa_{12}^P & \kappa_{13}^P \\ \kappa_{21}^P & \kappa_{22}^P & \kappa_{23}^P \\ \kappa_{31}^P & \kappa_{32}^P & \kappa_{33}^P \end{pmatrix} \left[\begin{pmatrix} \theta_1^P \\ \theta_2^P \\ \theta_3^P \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt$$

$$+ \begin{pmatrix} \sigma_{11} & 0 & 0 \\ \sigma_{21} & \sigma_{22} & 0 \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{pmatrix} \begin{pmatrix} dW_t^{L,P} \\ dW_t^{S,P} \\ dW_t^{C,P} \end{pmatrix}.$$

This is the transition equation in the Kalman filter estimation.

To reduce the number of parameters:

- We restrict the Σ matrix to be diagonal (following CDR, 2011).
- We employ a general-to-specific approach to obtain an appropriate specification of K^P.
- We use the 1998-2007 period for model selection to stay clear of the noise from the financial and sovereign debt crises.

The Preferred AFNS Model

Our preferred specification of the AFNS model for the Swiss Confederation yields has P-dynamics given by

$$\begin{pmatrix} dL_t \\ dS_t \\ dC_t \end{pmatrix} = \begin{pmatrix} \kappa_{11}^P & 0 & 0 \\ 0 & \kappa_{22}^P & 0 \\ \kappa_{31}^P & 0 & \kappa_{33}^P \end{pmatrix} \left[\begin{pmatrix} \theta_1^P \\ \theta_2^P \\ \theta_3^P \end{pmatrix} - \begin{pmatrix} L_t \\ S_t \\ C_t \end{pmatrix} \right] dt$$

$$+ \begin{pmatrix} \sigma_{11} & 0 & 0 \\ 0 & \sigma_{22} & 0 \\ 0 & 0 & \sigma_{33} \end{pmatrix} \begin{pmatrix} dW_t^{L,P} \\ dW_t^{S,P} \\ dW_t^{C,P} \end{pmatrix}.$$

1. The five parameter restrictions on the mean-reversion matrix are statistically insignificant throughout most of our sample period as indicated by standard likelihood ratio tests.
2. To get policy expectations and the term premium, the model is re-estimated daily, based on real-time available data.