Real effects of risk easing by the Federal Reserve

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This paper:

Remaining pres.

Background. Literature.

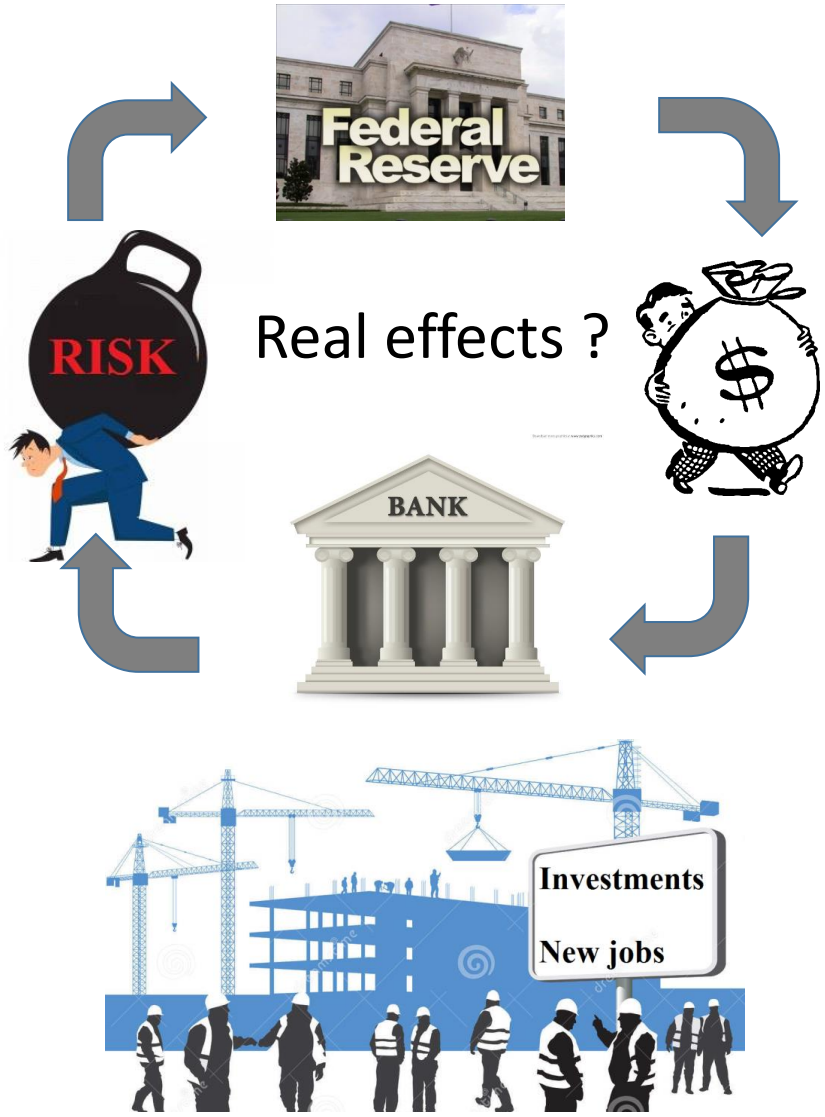
Research question

Model

Empirical results

Conclusion

Motivation.


Federal Reserve
RISK
Real effects ?
BANK
Investments
New jobs

Motivation. Research question. Contribution.

- **US$ 4,000,000,000,000**:
  The Federal Reserve responded to the 2008 Financial Crisis by buying large amounts of bonds and financial securities. This initiative is typically called QE.
- **What are the real effects of large scale asset purchases in the US? Can we learn from the past?**
  The real effects of this unprecedented scale of unconventional monetary policy initiative is still an open research question.
- **Contribution:**
  This paper attempts to consider large-scale asset purchases in a historical and more general perspective.
  - *Idea:* In evaluating the real effects of QE, it is not only about yield spread compression but also about risk reduction in the banking sector.
  - *Contribution:* Risk transfers from bank's balance sheet to the Fed and the real effects of this. Dynamic factor model. Identification by sign restrictions.

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Main finding.

(I) An unexpected increase in the relative duration of the Federal Reserve's assets (i.e. share of bond market risk) have plausible real effects:
Improvement in (un)employment, output, and housing activity. Inflation increases. Credit spreads shrink, lending activity improves and financial market volatility is lowered.

(II) What would have happened lately if the Fed did not buy all these Mortgage Backed Securities?

- In a counterfactual analysis where the Fed does not buy mortgage backed securities (MBS) from January 2009:
- Unemployment would have been about 2 percentage points higher
- Term spreads would have been 2 percentage points higher and credit spreads about $\frac{1}{2} - 1$ percentage point wider.
- Price level would fall, i.e. deflation

Overview of the remaining presentation

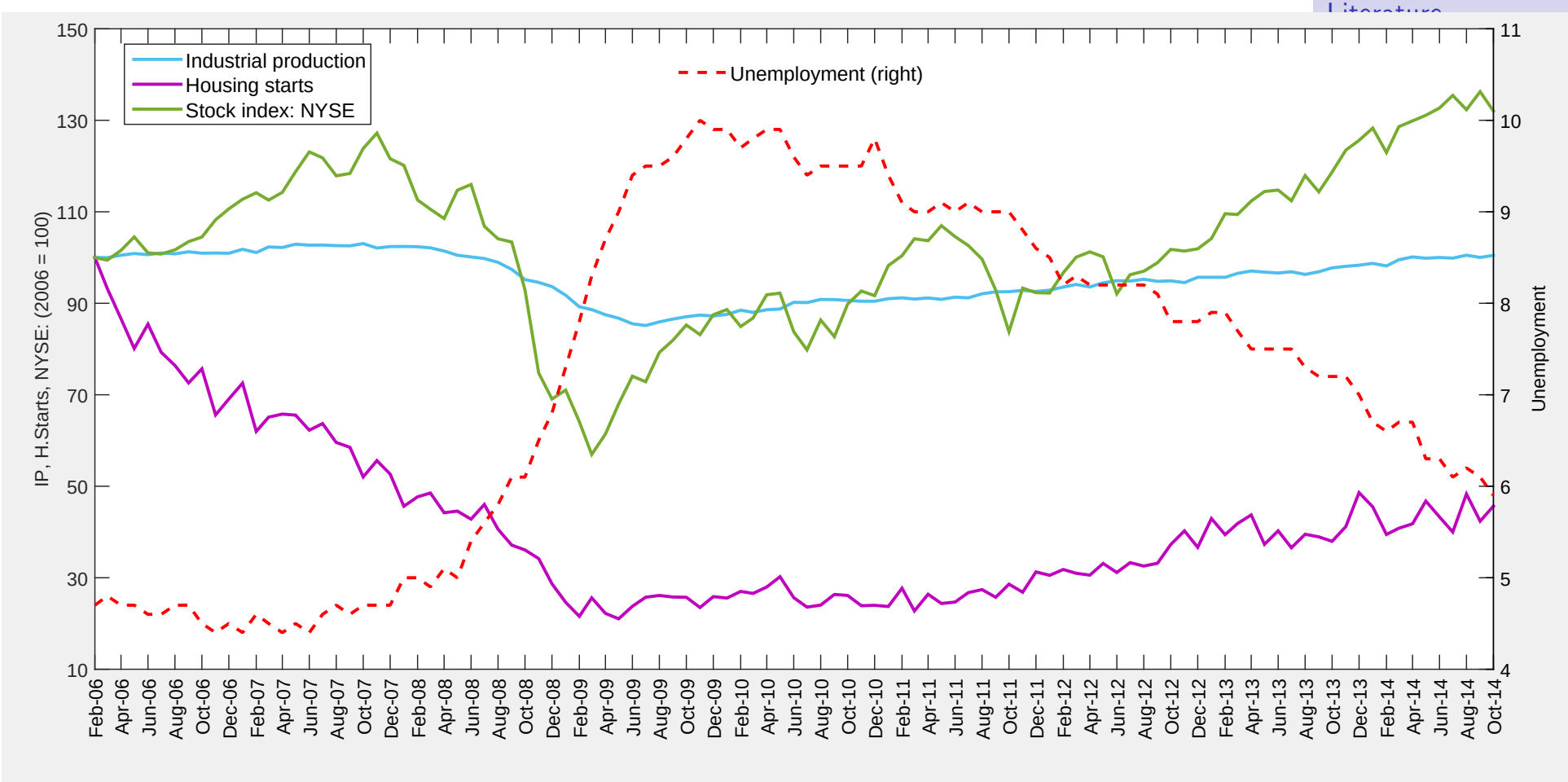
- **Background and literature**: A few comments.
- **Model**: Structural dynamic factor model
- **Identification** using zero- and sign restrictions
- **Monthly data**: 126 US macroeconomic and financial time series. 1959:01 to 2014:09
  - Mostly balanced, but additionally filter missing observations for Vix, Ted spread, and various condition indices
  - Maturity distribution of treasury securities let us calculate the amount of relative bond market risk ($-duration) that the Fed holds on its balance sheet.
- **Results**: Focus on impulse responses of key variables and counter-factual results. Robustness analyses in the paper.
- Conclusion

Background.

As a response to the mounting crisis during 2007-2008, the Federal Reserve Bank embarked on unconventional monetary policy initiatives:

- **QE 1**: (2009-2010). The Fed buy large amounts of mortgage backed securities (MBS) and GSE debt
- **QE 2**: (2010-2011). Reinvestment of principals into US Treasury bonds (UST)
- **Twist**: (2011): The Fed buys long bonds and sells short
- **QE 3**: (2012): The Fed continues to buy MBS and UST
- Part of this initiative is to provide liquidity and lower long-term interest rates, which is achieved by massive Fed purchases of securities from the banks.
- But this is effectively a shift of interest rate risk from the banks to the Fed. Therefore, we can think about QE as **risk easing** by the Fed

Background: A few graphs.



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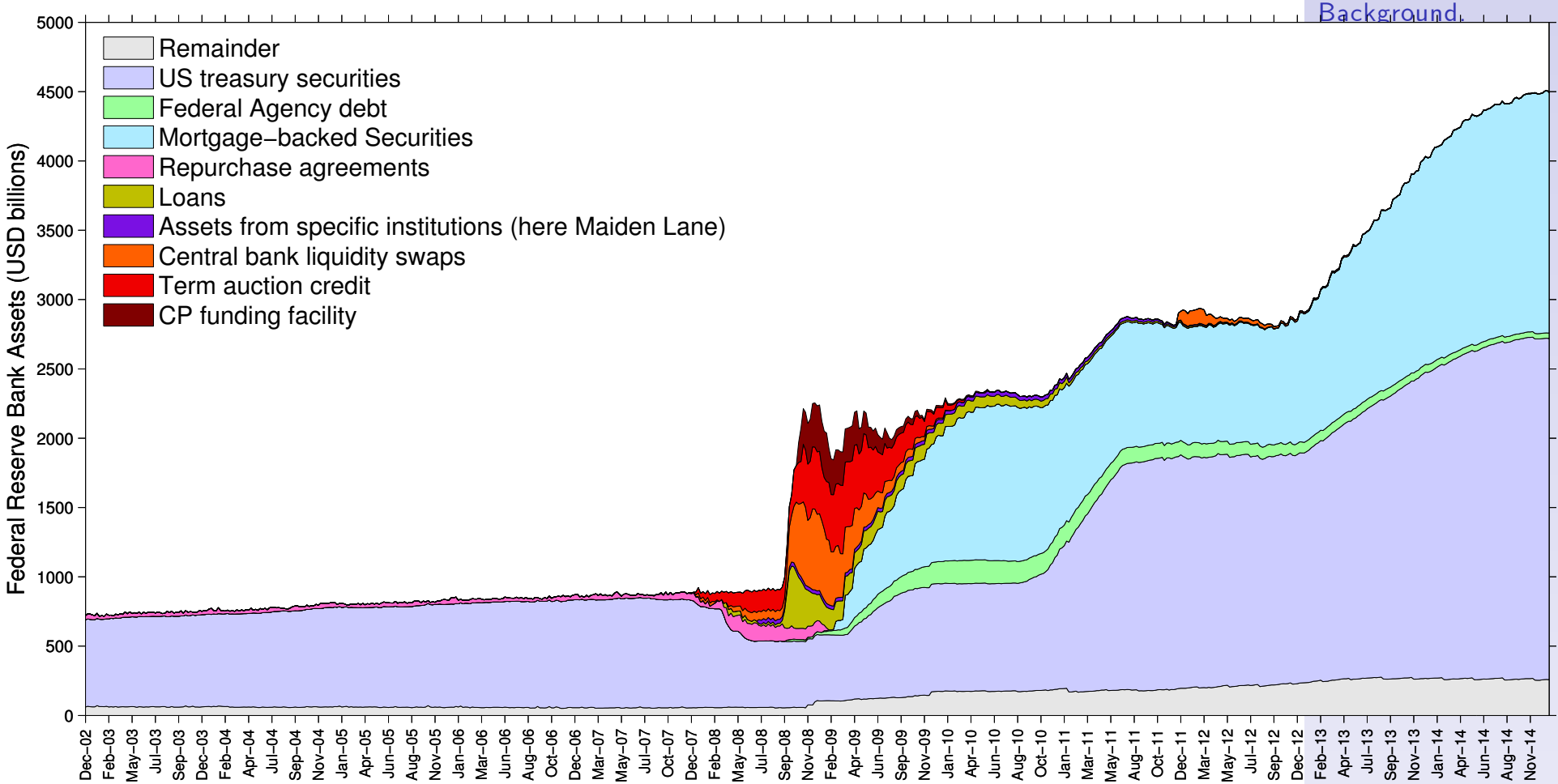

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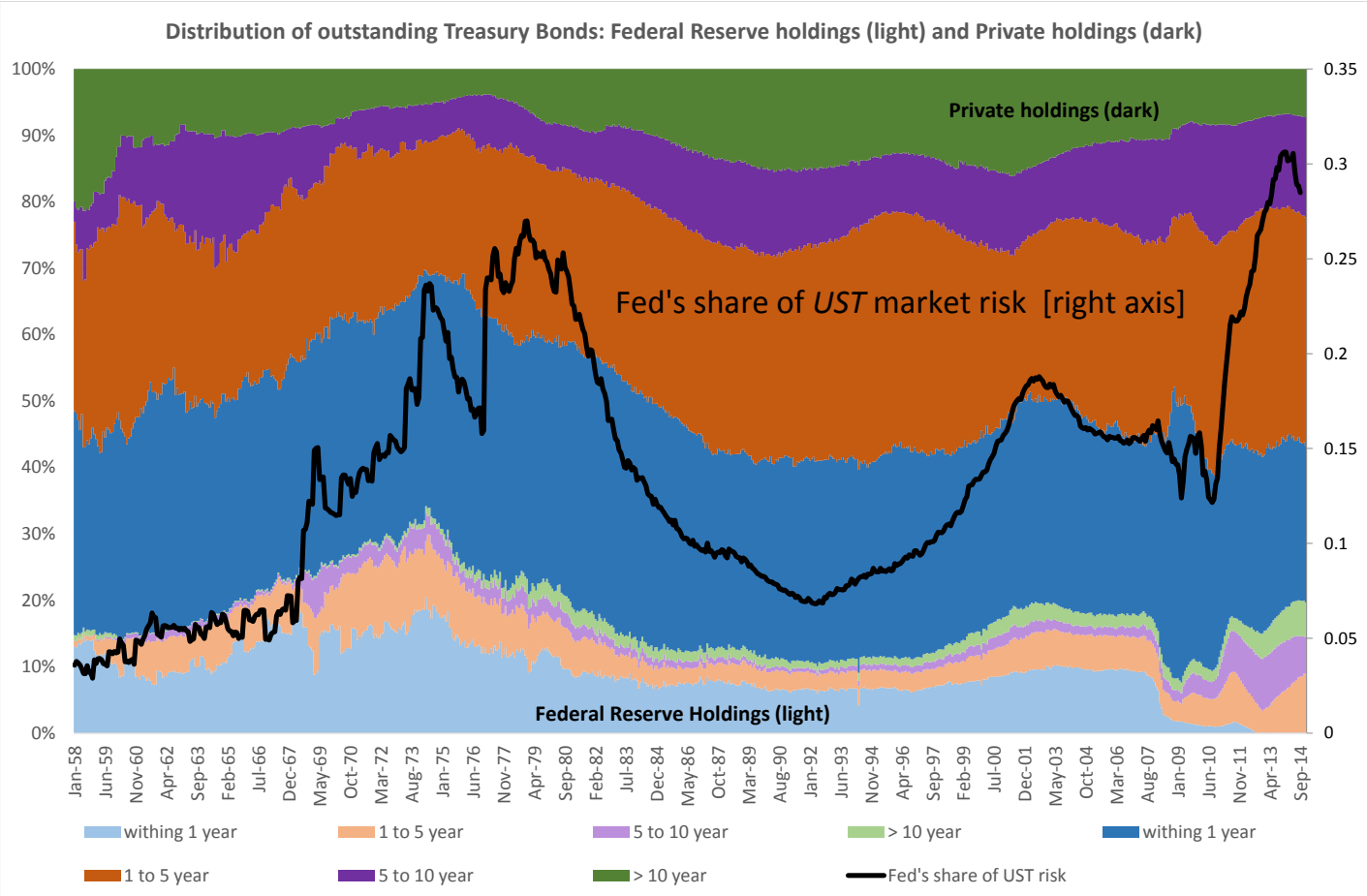

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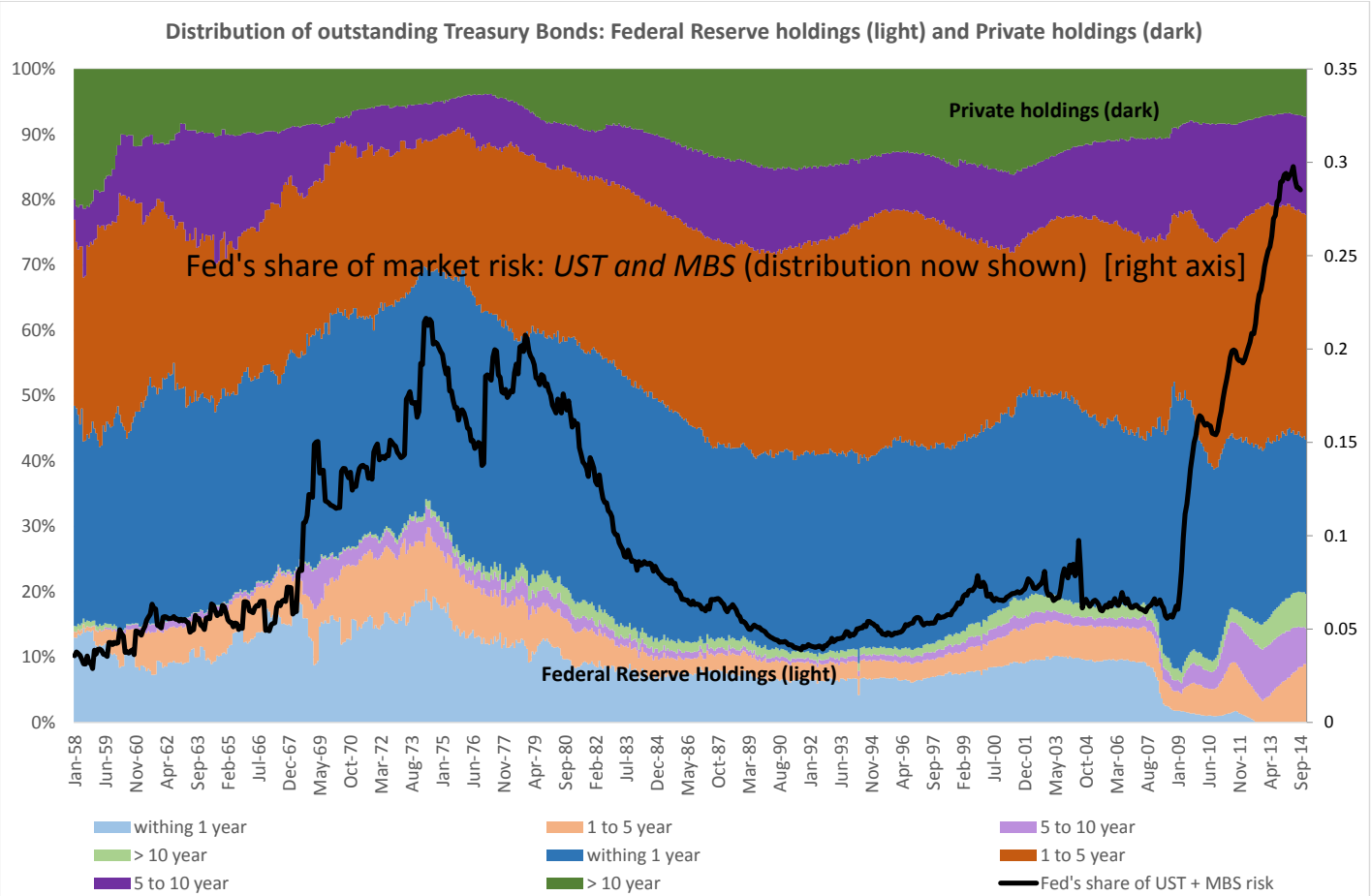

Background: A few graphs.

Background: A few comments on the literature

Existing literature:
Event studies. QE impact on 10-yr gov. bond. yield: Gagnon et al. (2011) and Krishnamurthy and Vissing-Jorgensen (2011).

- *However, no assessment of real effects*

Low-dimensional TVP-VAR: Baumeister and Benati (2013) but also a larger BVAR in Kapetanios et al. (2012). Their identification of unconventional monetary policy depends primarily on the 10-year spread to the Federal funds rate.

- Is a negative innovation to this spread together with sign restrictions on inflation and output *sufficient to identify unconventional monetary policy shocks*?

Research questions

- **Research question**:
  What are the real economy-wide effects of unconventional monetary policy shocks, in the form of risk absorbing shocks through the Federal Reserve's balance sheet?
  - What if the Fed did not embark on large scale asset purchases recently?
- **Approach in this paper:**
  - A structural dynamic factor model (SDFM) that facilitates a sharper identification of unconventional monetary policy shocks using zero and sign restrictions on a number of variables.

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Dynamic factor model (DFM) - outline

The reduced form dynamic factor model in state space form

$$\begin{array}{rc} \text{Observation eqs.:} & X_t = \Lambda F_t + \xi_t \\ \text{State eqs.:} & F_t = \Phi(L) F_{t-1} + U_t \end{array} \quad (1)$$

If (1) is invertible, the reduced-form vector moving average form follows as:

$$X_t = C(L) u_t + \xi_t$$

where $C(L) = \Lambda \left[I - \Phi(L)^{-1} \right] V$, and V is a selection matrix such that $U_t = V u_t$.

- A note on the econometric identification

To get to the *structural* form

$$X_t = B(L) \varepsilon_t + \xi_t$$

structurally identifying assumptions are needed. Detailed in a moment.

Estimation by the EM algorithm

The EM algorithm is an iterative maximum likelihood method that switches between an Expectation step and Maximization step. The maximization step results in the following closed form estimators at iteration j

$$\begin{aligned} \text{vec}\left(\Lambda^{(j)}\right) &= \text{vec}\left(DC^{-1}\right) && (2) \\ R^{(j)} &= \frac{1}{T}\left(E - DC^{-1}D^{\top}\right) && (3) \\ \text{vec}\left(\Phi^{(j)}\right) &= \text{vec}\left(BA^{-1}\right) && (4) \\ Q^{(j)} &= \frac{1}{T}\left[C - BA^{-1}B^{\top}\right] && (5) \end{aligned}$$

where the following moments are available from the Kalman smoother:

$$\begin{aligned} A &= \sum_{t=1}^{T}\left(\hat{F}_{t-1|T}\hat{F}_{t-1|T}^{\top} + \hat{P}_{t-1|T}\right) & B &= \sum_{t=1}^{T}\left(\hat{F}_{t|T}\hat{F}_{t-1|T}^{\top} + \hat{P}_{\{t,t-1\}|T}\right) \\ C &= \sum_{t=1}^{T}\left(\hat{F}_{t|T}\hat{F}_{t|T}^{\top} + \hat{P}_{t|T}\right) & D &= \sum_{t=1}^{T} X_t\hat{F}_{t|T}^{\top} \\ E &= \sum_{t=1}^{T} X_t X_t^{\top} & \hat{F}_{t|T} &= E\left[F_t \middle| \mathcal{X}_T\right] \\ \hat{P}_{t|T} &= var\left(F_t \middle| \mathcal{X}_T\right) & \hat{P}_{\{t,t-1\}|T} &= cov\left(F_t, F_{t-1} \middle| \mathcal{X}_T\right). \end{aligned} \quad (6)$$

see Watson & Engle (1983) and Doz, Reichlin and Giannone (2011). Λ subject to restrictions seen in Bork, Dewachter & Houssa.

Structural dynamic factor model (DFM) - identification by zero and sign restrictions

An *expansionary* unconventional monetary policy shock is a shock that moves:

Fed's assets	Fed's mkt. share UST + MBS	Fed funds	Credit spread	VIX	Infl.	IP	Unemp	Empl.
↑	↑ (mkt impact)	**0** (ZLB)	↓	↓	↑	*	* (agnostic)	*

- Note, *several* variables used to identify the unconventional monetary policy shock.
- A combination of zero and sign restrictions are used. Follows Arias et al. (2014). Essentially rotates a base set of structural shocks by Q and keeps the **IRFs** that satisfy the above restrictions

$$\tilde{B}(L) = B(L)Q = C(L)A_0^{-1}Q = \Lambda\left[I - \Phi(L)^{-1}\right]VA_0^{-1}Q$$

Adding events to the identification by zero and sign restrictions

One might still be sceptical about the derived structural interpretation from zero and sign restrictions.
"Is it really a policy shock?". "Is it really a demand shock?".

Antolin-Diaz & Rubio-Ramirez (2016) and Ludvigson, Ma & Ng (2017) propose to add narratives to the identification.
For instance, that:

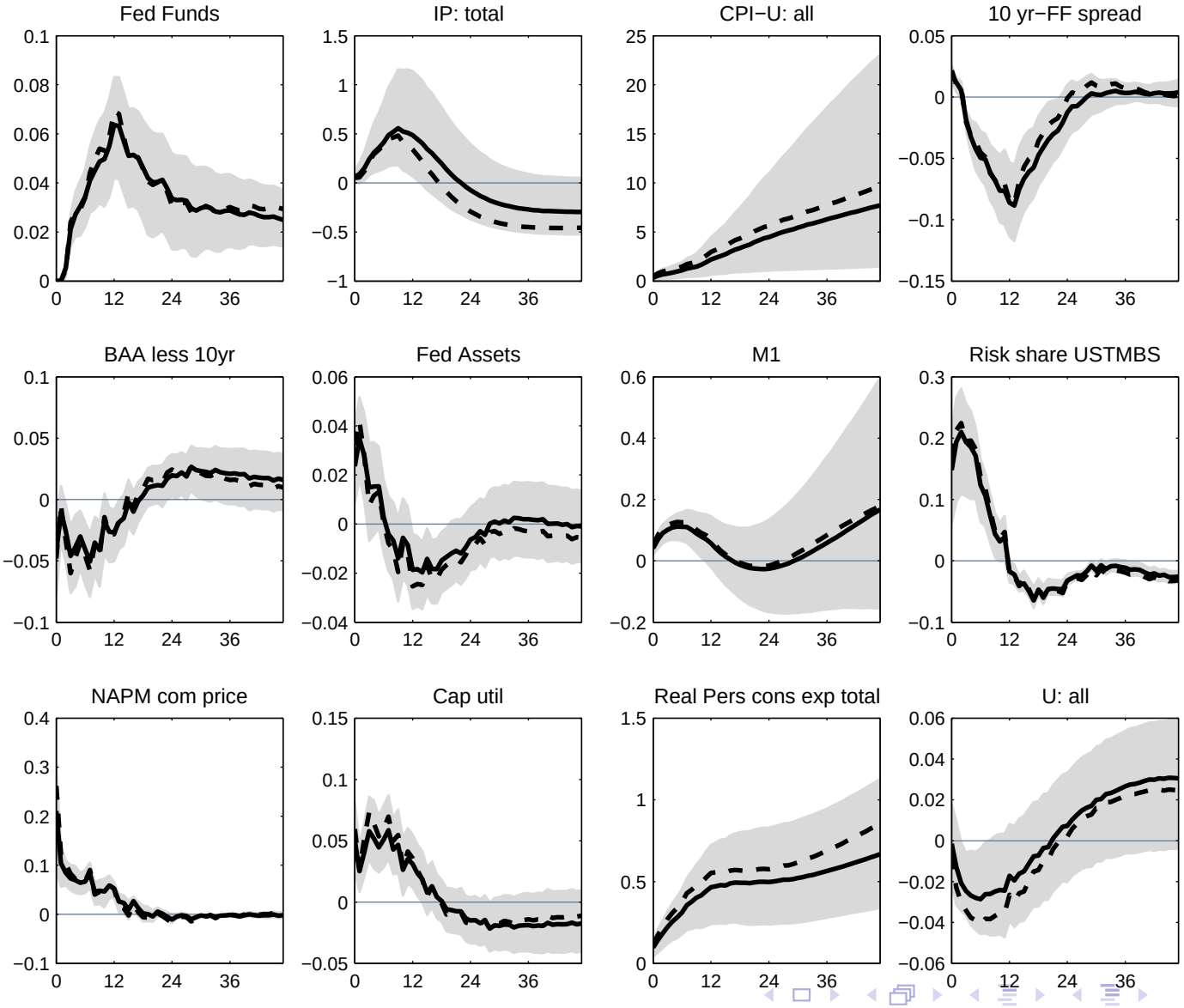
- The structural shock on a given date has a certain sign. Example: The innovation to the Fed funds rate in October 1979 was positive
- On a given date, a particular structural shock is the most important driver in explaining the historical decomposition of a given variable
- *This paper*: Use event-study results to sharpen inference

Overview of empirical results

- Model estimated by the EM-algorithm. 6 dynamic factors guided by Hallin and Liska (2007) which are related to
  - inflation
  - unemployment
  - employment
  - Fed's market share of UST and MBS $(\xi_i = 0)$
  - Fed funds (alt: shadow rate) $(\xi_i = 0)$
  - Aaa - 10yr credit spread.
- Focus on IRFs and counter-factual result.
- Then present preliminary results with identification by narrative sign restrictions.
- Robustness analyses in the paper.

Impulse responses: fully agnostic

The response of key economic variables to a shock to the Federal Reserve relative risk share.



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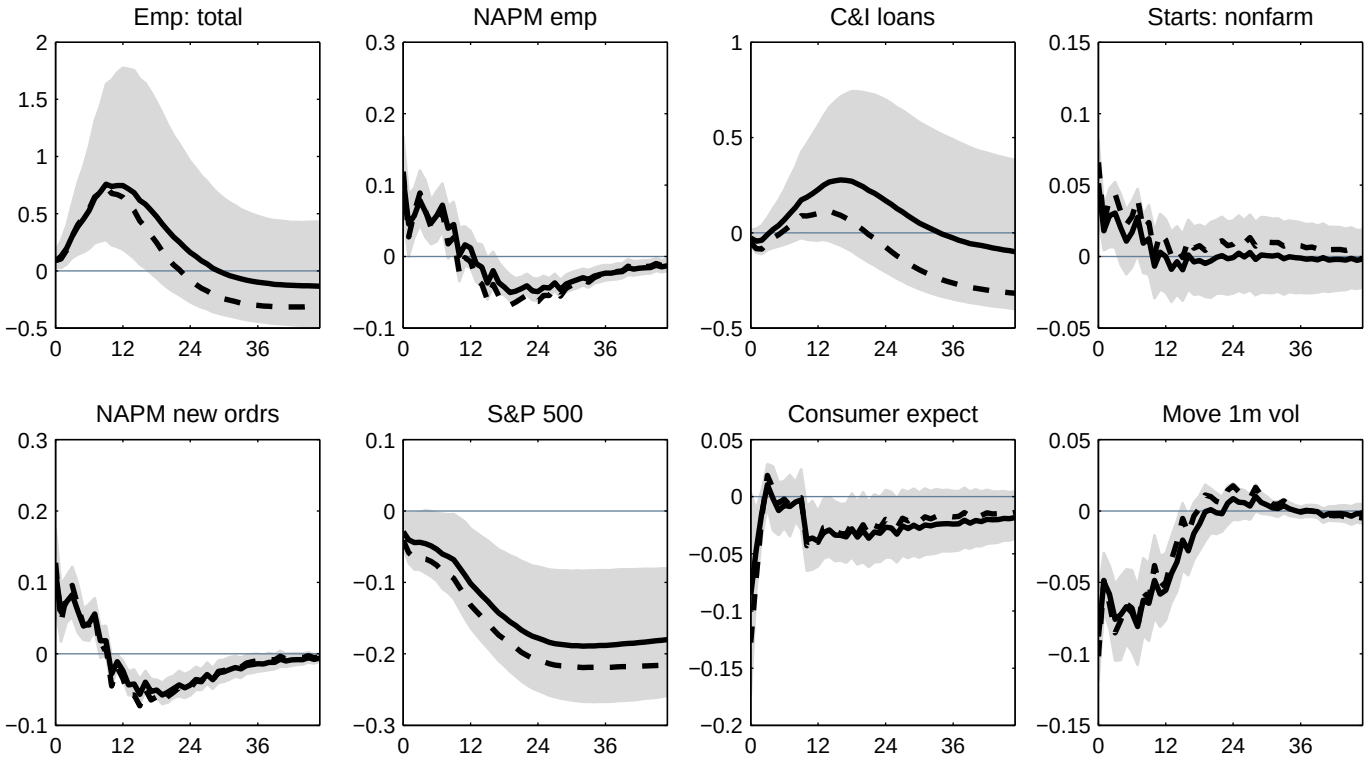


Impulse responses: Adding event-study results

This is work in progress but the idea is presented.

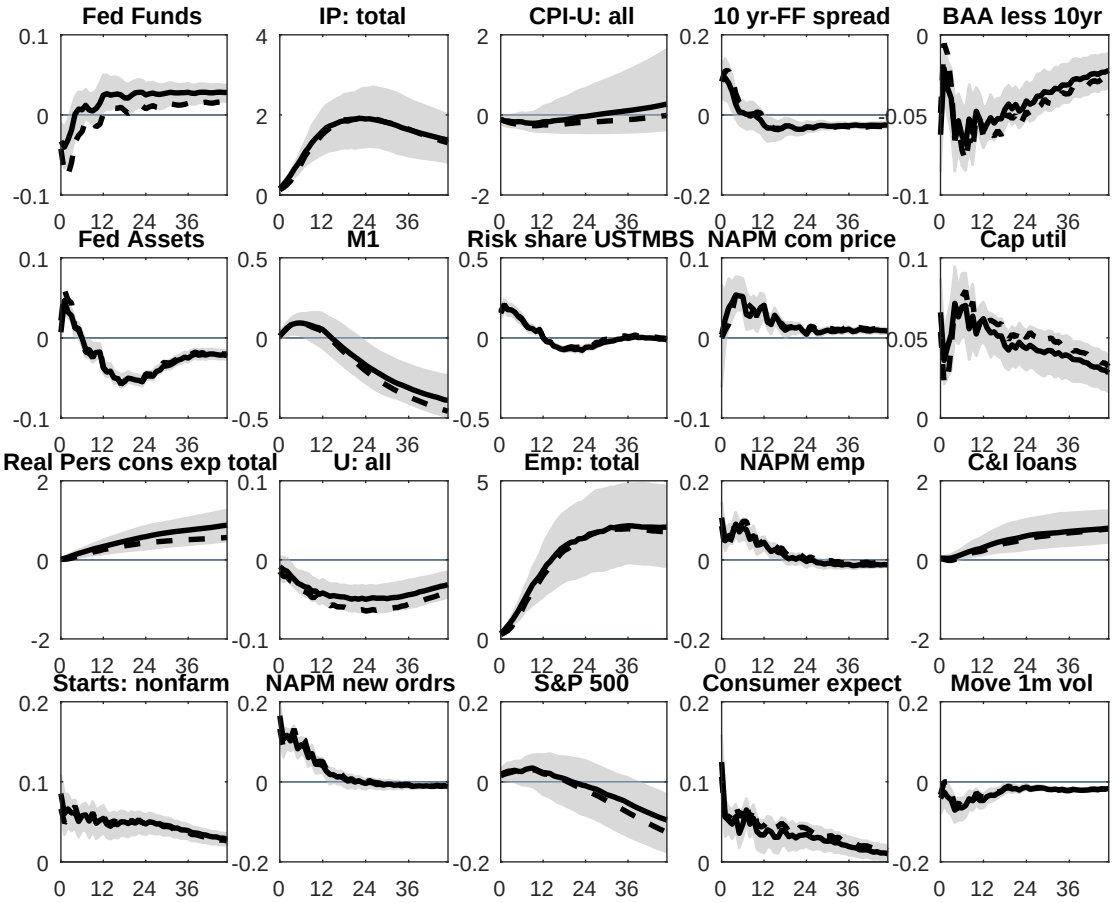
Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), and Neely (2014) study the QE announcement effects on bond yields. Not all QE announcements resulted in decreased yields depending on the degree to which market expecations were met. However, some consensus on key announcement days with significant yield effects have emerged, e.g. on March 18th, 2009. The idea is that the impulse responses should satisfy the sign restrictions and:

- In March 2009: the structural innovation to the 10yr bond yield is required to be negative consistent with the event-study literature. Moreover, the unconventional monetary policy shock is required to be the main driver of the historical decomposition of the Federal Reserve assets in that month.

IRFs conditioning on event-study results

** work in progress **

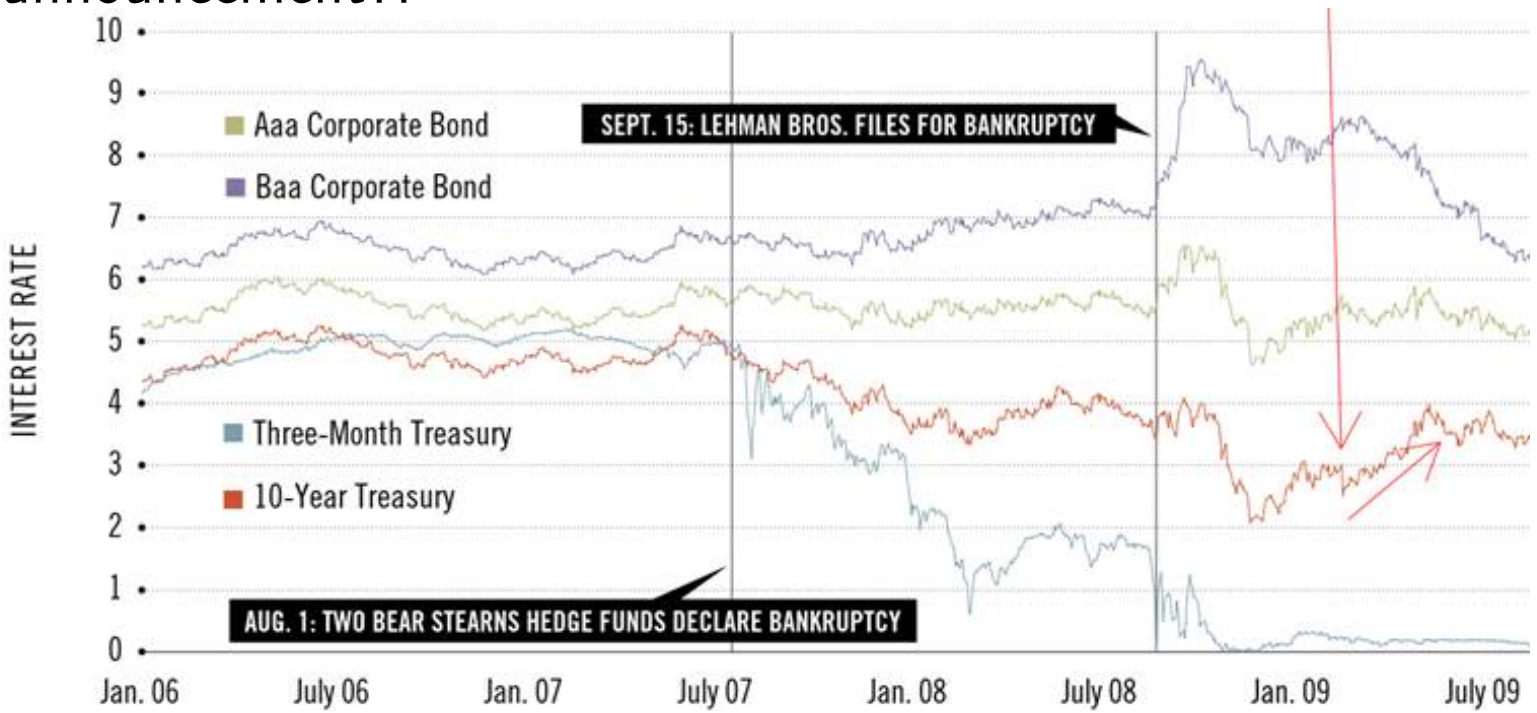
The response of key variables to an expansionary unconventional monetary policy shock when aligned with March 2009 event-study results



Note: work in progress. The impulse responses satisfy sign restrictions and 1) A negative structural innovation to 10 year yield spread in March 2009; 2) The policy shock was the main driver of the historical decomposition of FRB assets that month.

IRF based on events: Some challenges (1)

Why does the 10 year interest spread **rise** after March 18th announcement?!



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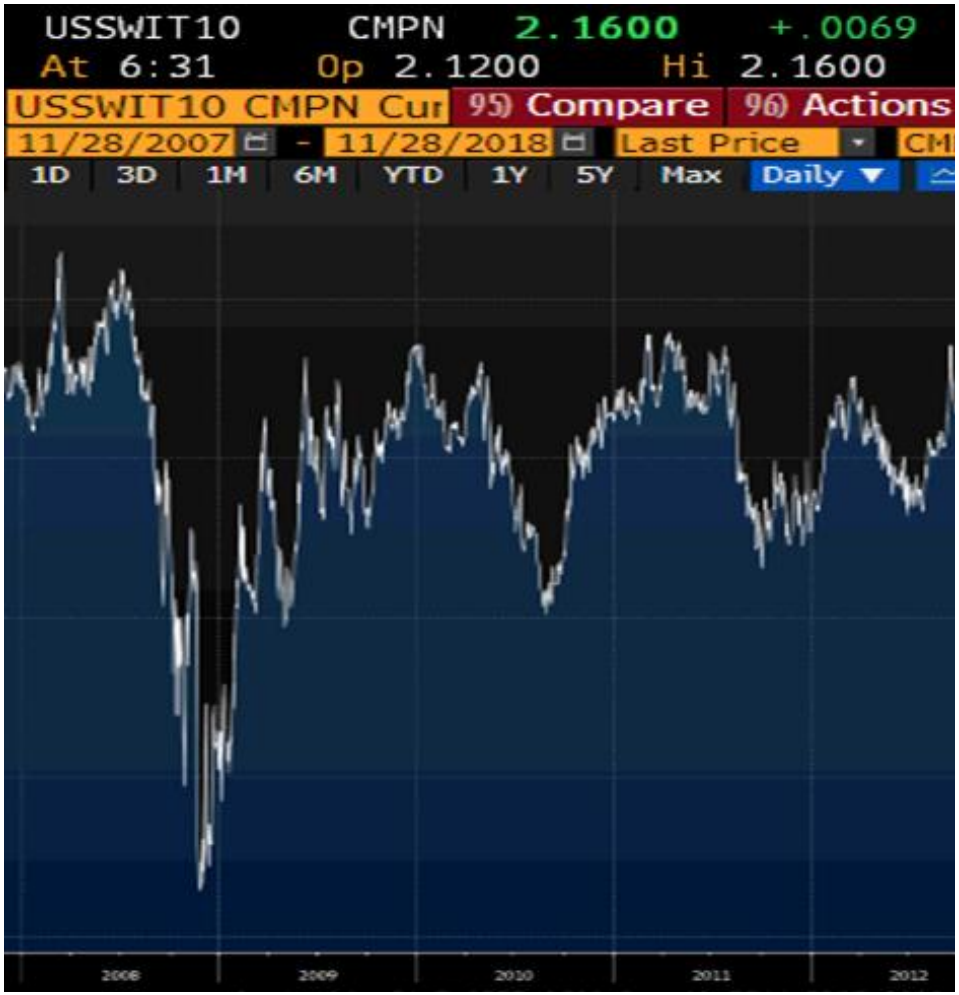


Counter-factual analysis I

Starting point: A historical decomposition of X_t in terms of the structural shocks. In this papers it suffices to consider the decomposition of the factors (F).

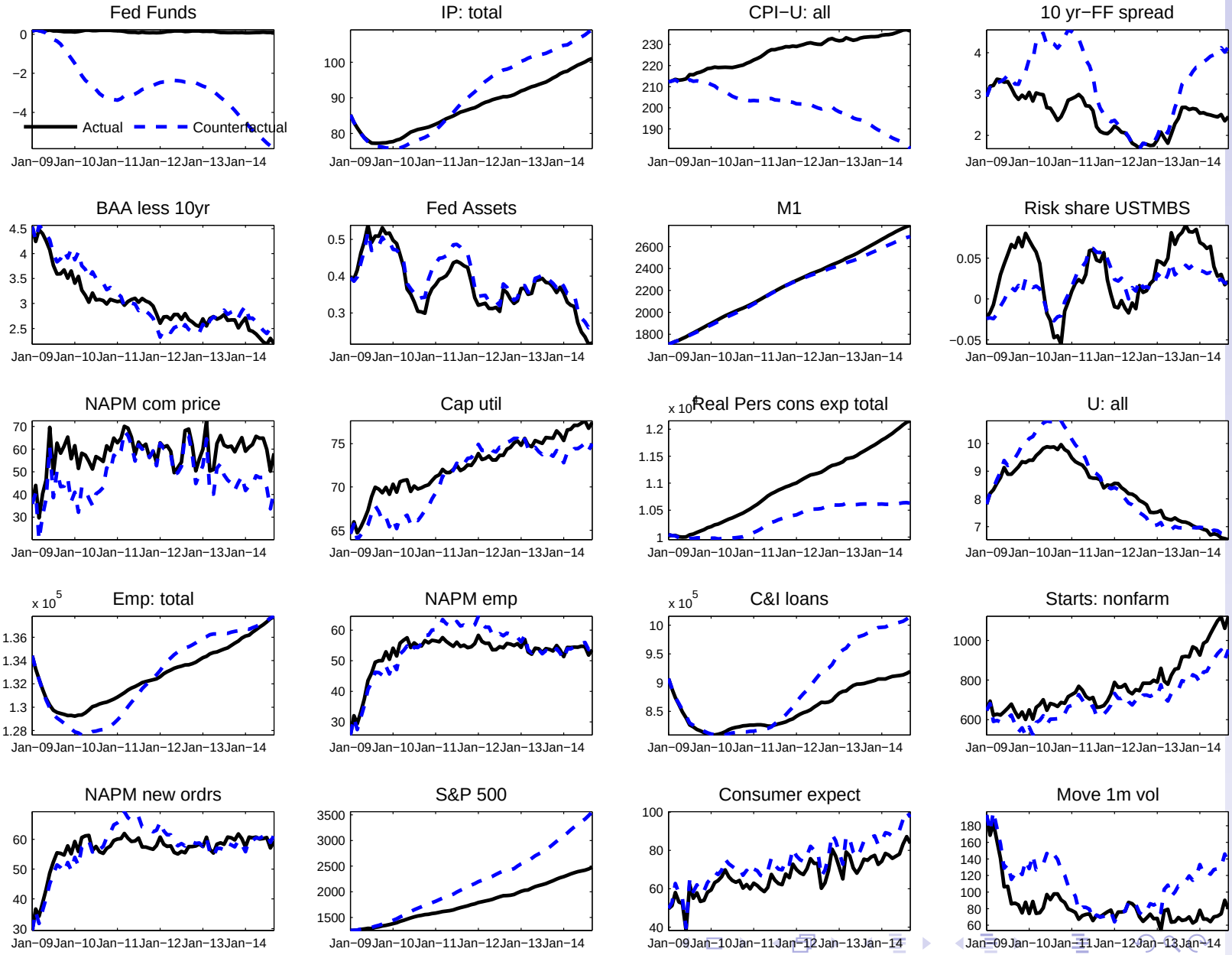
$$F_t = \sum_{i=0}^{t-1} \Psi_i \varepsilon_{t-i} + \Phi_1^{(t)} F_0 + ... + \Phi_p^{(t)} F_{-p+1}$$

where Ψ_i is the resursion from Lütkepohl (2005).

- Imagine that we want consider a particular counterfactual sequence $\left\{ F_{j,\tau}^* \right\}_{\tau=t}^{t^*}$, where $F_{j,\tau}^*$ is different from the estimated $F_{j,\tau}$.
- This amount to choosing the structural shocks, $\left\{ \varepsilon_{j,\tau}^* \right\}_{\tau=t}^{t^*}$ such that $F_{j,\tau}^*$ is achieved.
- Now ask: What would have happened if the Fed did not embark on buying MBS?

Counter-factual analysis II

Work in progress.



Conclusion

- This paper contributes with positive empirical results, new data, and a new way of identifying unconventional policy shocks:
- *Unconventional monetary policy (LSAPs) have significant real effects*
- An unconventional monetary policy shock is identified as an increase in the Federal Reserve's holdings of US treasuries and mortgage backed securities that have a financial market impact, that decreases the yield spread and credit spread, that improves the financial market conditions, and increases inflation and measures of real activity. Results from event-study literature used to sharpen inference.
- Unemployment would have been 2 percentage point higher according to a counterfactual analysis based on the absense of MBS purchases

Thank you!