

A Lesson from the Great Depression that the Fed  
Might have learned:  
A Comparison of the 1932 Open Market  
Purchases with Quantitative Easing

Michael Bordo (Rutgers University, Hoover Institute and NBER) and  
Arunima Sinha (Fordham University)

Fed System Conference on Economic and Financial History  
FRB Richmond  
May 23-25, 2016

# Overview

- Friedman and Schwartz (1963) argued that the Great Contraction in the US was caused by actions by the Federal Reserve
- Tight monetary policy to stem stock market speculation beginning in February 1928 was a precipitant of the downturn that began in July 1929 (Hetzel 2012)
- A series of banking panics that began in October 1930 that were not allayed by the Fed using the discount window or Open Market Operations turned a serious recession into the Great Contraction.
- A ton of articles has nuanced this story. the most prominent of which was Bernanke (1983) credit intermediation hypothesis

## Overview

- A key part of the FS story which was not original to them but goes back to work done earlier by Irving Fisher, Laughlin Currie and Clark Warburton was that had the Fed followed stable monetary policy consistent with what they had done in the 1920s that the Great Contraction could have been avoided
- Friedman (1960) first articulated his constant growth rate of the money supply rule. In FS (1963) and elsewhere he posited that had the Fed followed his rule keeping M2 growth at 4% per year that the US would have avoided the contraction entirely.
- Bordo, Choudhri and Schwartz (1995) and McCallum (1990) carried through variants of the FS suggestion.
- Our simulations which accounted for the shocks that hit the US economy backed up the FS conjecture
- FS also conducted several back of the envelope calculations to show that had a \$1 billion open market operation been taken at key junctures in the Great Contraction that the decline would have been arrested

# Overview

- On only one occasion did the Fed seriously follow an expansionary monetary policy and that was from April to July 1932 when it conducted a \$1 billion open market operation
- It did so under pressure from the Congress and promptly stopped when the Congress went into recess.
- FS argue that the OMO policy was very successful in arresting the decline in the money supply, the real economy and prices but that it was too brief to have attenuated the contraction
- An implication of their analysis is that had the Fed not abandoned its OMO policies in July 1932 that the Great Contraction would have ended in the fall of 1932 and the US would have avoided going through the last and worst banking panic in the winter of 1933.

# Overview

- In this paper we revisit the 1932 OMO from the perspective of the Quantitative Easing Policies followed by the Federal Reserve beginning in November 2008.
- Our paper backs up the FS conjecture that the OMO would have shortened the Great Contraction
- It also shows that the 1932 OMO was more effective (although it was short lived) in reducing spreads and stimulating the economy than was QE1

# A Comparison between 1932 and QE1

- Considerable debate about the effectiveness of the Quantitative Easing (QE) programs of the Federal Reserve, and their significance for the economic recovery
- Analyses have estimated the effect of the programs on the term structure of different types of yields, especially Treasury yields
- Two main challenges in analyzing the effects of the QE programs:
  - Decline in the state of the economy during the crisis period was unprecedented
  - There were several unconventional monetary policy tools deployed in the QE program: forward guidance which provided guidelines about the size and length of the programs, the presence of the zero-lower bound and the payment of interest rate on excess reserves.

# Motivation

- Context in the modern literature
  - Empirical analyses of QE1: Bauer and Rudebusch (2014), D'Amico and King (2012), Doh (2010), Hamilton and Wu (2012), Krishnamurthy and Vissing-Jorgensen (2011), Swanson (2011)
  - Theoretical: Baumeister and Benati (2010), Chen, Cúrdia and Ferrero (2012)

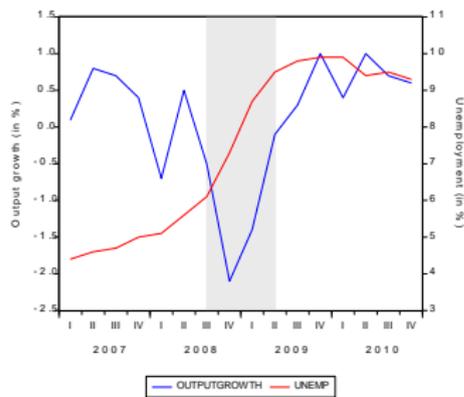
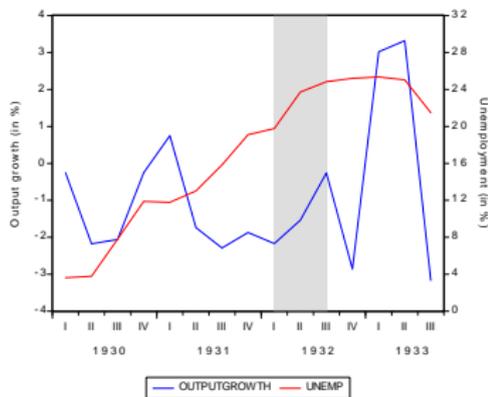
## What we do

- Propose to examine the effectiveness of QE1 through the lens of another OMO conducted by the Fed:
  - Conducted at the height of the Great Depression
  - Fed's balance sheet increases holdings of long-term bonds (\$1 billion in 1932\$ or \$16 billion in 2009\$), and then divests Note holdings in 4-month period
  - Novel features: Yields were in the zero-bound range, largest operation at the time, pure OMO, no forward guidance (or Interest on Ex Reserves)

*"By entering upon a policy of controlled credit expansion, designed to turn the deflation in bank credit and to stimulate a rise in prices, the Federal Reserve System has undertaken the boldest of all central bank efforts to combat the depression."- The New York Times, quoted in the Commercial and Financial Chronicle, April 16, 1932.*

# States of the Economy

Output growth and Unemployment  
1932 QE1



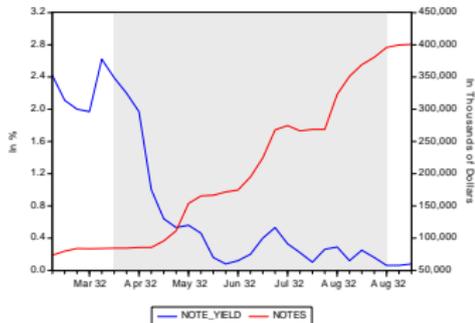
# States of the Economy

- Both economies were in a state of depression/recession when the operations were set forth
- But the conditions in 1932 were much worse

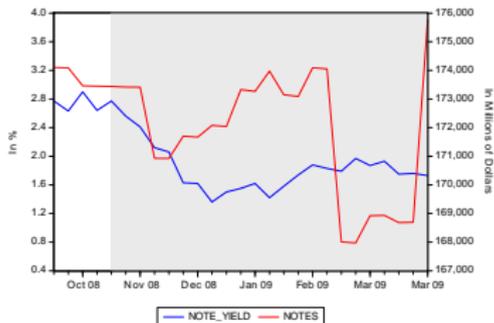
# States of the Economy

## US Treasury Notes and Yields

1932



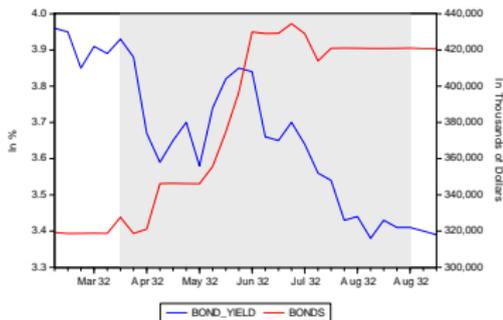
QE1



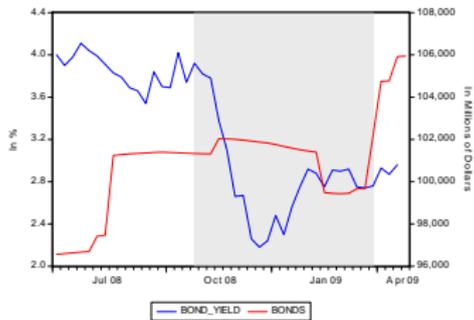
# States of the Economy

## US Treasury Bonds and Yields

1932



QE1



# States of the Economy

- In both episodes, bond yields were low
- Policy rates were close to the ZLB
- The size of the 1932 operation was comparable (adjusted for the size of the economy) to QE1

# The Environments Compared

- The depression environments in which the programs were conducted were similar, but there were also key differences
  - In 1932, the Fed did not make an announcement of its intention to conduct OMO or how long it would last or what the size would be
  - The Fed's portfolio in 1932 had a larger proportion of medium-term Treasury securities relative to bonds
  - The Fed did not pay interest rate on excess reserves
  - The 1932 operation was a pure OMO; the Fed only purchased Treasuries and not MBSs
- Despite the differences, we find that although the 1932 OMO was shorter in duration, and the balance sheet of the Fed was smaller, the 1932 operation had a large effect on the economy

# Strategy and Contributions

- We analyze the effect of the 1932 OMO on the cross section of Treasury yields using an event study methodology based on the historical narrative of the period
- We then use quarterly data from 1920-1932 to estimate the effect of the OMO in a DSGE model with segmented markets and two types of investors
  - Households and institutional investors; the households are required to pay a transactions cost to hold the long bonds
  - The model is used to evaluate the OMO and importance of the program structure, duration of debt and size of total debt
  - We find a higher degree of segmentation in 1920-32 than in 2008-09
  - Greater segmentation explains why the OMO was so effective in the earlier episode despite its shorter operation

## Context for the 1932 Operation

- Fed does very little at the start of the Great Depression; does not prevent three banking panics
  - Organizational disarray (*Friedman and Schwartz, 1963*); Reliance on nominal interest rates and member bank borrowing from the discount window as policy guide, i.e., Burgess-Riefler-Strong doctrine (*Meltzer, 2003*); Absence of clear lender of last resort policy and adherence to Gold Standard (*Bordo and Wheelock, 2013*)
- Congress pressured the Fed to act; concern over the Thomas bill which would have created \$2.4 billion in greenbacks and a veterans bonus
- Governor Harrison of New York Fed proposes and helps initiate purchases of government securities on April 13, 1932
  - \$100 million for 5 weeks
  - Second round of purchases of \$500 million is agreed upon on May 17, 1932
- By July 1932, Harrison's pleas for the program's continuation are overwhelmed by dissent within the Fed system

## Context for the 2008-09 Operation

- The 2007 financial crisis was the largest shock to global financial markets since the Depression
  - Bank faced enormous liquidity pressures, and credit markets froze
  - Concerns about the weakening state of the economy began to appear in the minutes and statements of the FOMC in August 2007
- The first cut in the FFR was implemented in September 2007
- The crisis worsened dramatically after the unexpected collapse of Lehman Brothers in September 2008
- The Fed cut interest rates close to zero in the next two months but the economy was still in a recession
- On Dec. 1, 2008, Chairman Bernanke announced "...the Fed could purchase longer-term Treasury or agency securities on the open market in substantial quantities [...]"
- In the statement on March 18, 2009, the FOMC also decided to purchase up to \$300 billion of longer-term Treasury securities over the next six months.

# 1932 Operation vs. QE1: Differences and their Implications

- Gold Standard in 1932 vs. Floating exchange rate in 2008
  - Although the U.S. was on the GS, the OMO did not threaten the credibility of the Fed's commitment to the GS or cause expectations of devaluation (*Hsieh and Romer, 2006 and Bordo, Choudhari and Schwartz, 2002*)
- No forward guidance in 1932; only discussions in the Open Market Policy Conference
  - However, financial markets observed and understood that the balance sheet of the Fed was changing (narrative evidence from the NY Times)
- QE entailed purchases of non-Treasury assets, conducted at the time of IOER
  - Restrict our analysis to comparing effects of the OMOs

# Channels for the Effects of the OMOs

- The following channels have been proposed in the literature:
  - Portfolio balance
  - Signaling
  - Duration risk
  - Liquidity
  - Safety
- We will focus on the first two for the 1932 operation

# Empirical Strategy for the Event Study

- To analyze the effect of the operation on the term structure of yields:
  - Construct weekly series of holdings of Treasury assets by the Federal Reserve, decomposed into different maturities from Fed Bulletins
  - Corresponding series of Treasury yields
- There is no "announcement" of the open-market operation  $\implies$  the strategy used in QE1 studies cannot be used
- Instead, use the narrative record, and also identify weeks in which Fed's holdings of Treasury assets changed by 5% or more
- Our strategy contrasts with other analyses which only look at the changes in total debt holdings to estimate the effects of the operation (*Meltzer (2003), Hsieh and Romer (2006)*)

# Narrative Record from the New York Times

- Feb 17, 1932:
  - There is much conjecture in Wall Street whether the Federal Reserve authorities will utilize the excess reserves to be liberated by the Glass-Steagall bill making United States Government securities eligible as collateral behind Federal Reserve notes to increase their holdings of "governments."
- Feb 28, 1932:
  - [T]he Federal Reserve has given unmistakable signs [...], of its intentions to relax credit. [...] **Open market buying of government securities appears to be the only effective means whereby the Federal Reserve can pump out credit**
- Mar 11, 1932:
  - This week's Federal Reserve statements present some extremely interesting developments, all of which are likely to make pleasant reading for the banking community. The open market operations to expand credit, begun a week ago, were pursued with increased vigor. Holdings of United States Government securities rose \$25,168,000 and bill holdings were up \$21,944,000.

## Narrative Record from the New York Times

- Apr 13, 1932
  - The Federal Reserve system has been engaged since the final week in February in an easy-money campaign [...]. This policy has already resulted in [...] **a relaxation of bank credit so considerable as to cause a drop of 1-1/3% per cent in open market bill rates.** [...] Whether the time is not now ripe for the Federal Reserve to **enlarge its campaign by stepping up the rate of weekly purchases** of "governments" to say \$75,000,000
- Apr 14, 1932
  - Governor Harrison testifies before a House Banking and Currency sub-committee
- Apr 15, 1932
  - Interest in the weekly bank statement converged upon the single item of United States Government securities which showed a rise of \$100,010,000, **lifting the system's holdings to a high record** at \$985,024,000

# Narrative Record from the New York Times

Special to THE NEW YORK TIMES.  
New York Times (1923:CurrentHist), Apr 14, 1932.  
ProQuest Historical Newspapers: The New York Times with Index

## **RESERVE BANKS ACT TO STEM DEPRESSION BY SPURRING CREDIT**

**Purchases of Government Securities to Be Increased to 75 or 100 Millions Weekly.**

### **HARRISON REVEALS POLICY**

**Opposes Before House Committee Bill Calling on Board to Raise Level of Prices.**

### **SAME AIM NOW ATTEMPTED**

**Washington and Wall Street Expect System to Use Its Facilities to Fullest Extent.**

# Narrative Record from the New York Times

- Apr 22, 1932
  - The weekly bank statement was **favorable beyond the general expectations of Wall Street in the indications it gave of the progress of the Federal Reserve's new policy.** [...] Loans and investments, which had been falling sharply, went up \$148,000,000, the rise in loans amounting to \$64,000,000 and that in investments to \$84,000,000
- May 13, 1932
  - This brings purchases for the last five weeks up to \$500,000,000 and indicates that **there has been no slackening in the credit expansion program**
- July 19, 1932
  - The **adjournment of Congress** has recalled the prediction in some quarters that **when this event occurred the Federal Reserve System would terminate its policy of keeping money easy** through the purchase of United States Government securities. There are indications that this may prove to be the case.

# Narrative Record from the New York Times

- Aug 13, 1932
  - With gold returning to the country and currency coming back from circulation, **there appears to be no further need for continued purchases** of United States Government securities by the Federal Reserve Banks.
- Aug 19, 1932
  - Open market purchases of United States Government securities by the Federal Reserve Banks, [...] **came to the expected end this week**

# Narrative Record from the New York Times

Dates identified:

2/17/1932

2/28/1932

3/11/1932

4/1/1932

4/13/1932

4/14/1932

4/15/1932

## Changes in Yields on Notes (Daily)

NYT Quotes (Reports from previous trading day)	Yields levels on Notes mat in 1 year (in %)	Change in yields (in b.p.)
February 17, 1932 (T)	3.57	
February 18, 1932	3.57	0
February 27, 1932 (St)	3.50	
March 1, 1932 (T)	3.50	0
March 11, 1932 (F)	3.44	
March 12, 1932	3.42	-2
April 1, 1932 (F)	2.90	
April 2, 1932	2.90	0
April 13, 1932 (W)	2.05	
April 14, 1932	1.91	-14
April 15, 1932 (F)	1.55	-36
April 16, 1932	1.45	-10
Cumulative change from narrative dates		-60

## Changes in Yields on Notes (Daily)

NYT Quotes (Reports from previous trading day)	Yields levels on Notes dated Feb. 1933 (in %)	Change in Yields (in b.p.)
February 17, 1932 (T)	3.57	
February 18, 1932	3.57	0
February 27, 1932 (St)	3.50	
March 1, 1932 (T)	3.50	0
March 11, 1932 (F)	3.38	
March 12, 1932	3.38	0
April 1, 1932 (F)	2.74	
April 2, 1932	2.74	0
April 13, 1932 (W)	1.84	
April 14, 1932	1.64	-20
April 15, 1932 (F)	1.23	-41
April 16, 1932	1.11	-12
Cumulative change from narrative dates		-73

## Changes in Yields on Notes (Weekly)

Dates from Narrative record	Yields levels on 3-5 year notes (On Tuesdays)	Changes in yields on 3-5 year notes (in b.p.)
February 13, 1932	2.57	
February 20, 1932	2.42	-15
February 27, 1932	2.11	-31
March 5, 1932	2.00	-11
March 12, 1932	1.97	-3
March 19, 1932	2.62	65
March 26, 1932	2.39	-23
April 2, 1932	2.20	-19
April 9, 1932	1.97	-3
April 16, 1932	1.00	-97
Cumulative change from narrative dates		-145

## Changes in Yields on Bonds (Daily)

NYT Quotes (Reports from previous trading day)	Yields levels on T-Bonds 1944-54 (in %)	Change in yields (in b.p.)
February 17, 1932 (T)	4.12	
February 18, 1932	4.09	-3
February 27, 1932 (St)	4.00	
March 1, 1932 (T)	4.00	0
March 11, 1932 (F)	3.91	
March 12, 1932	3.90	-1
April 1, 1932 (F)	3.98	
April 2, 1932	3.98	0
April 13, 1932 (W)	3.80	
April 14, 1932	3.78	-2
April 15, 1932 (F)	3.71	-7
April 16, 1932	3.75	4
Cumulative change from narrative dates		-9

## Changes in Yields on Bonds (Weekly)

Dates from Narrative record	Yields levels on Bonds (On Tuesdays)	Changes in yields on Bonds (in b.p.)
February 13, 1932	4.03	-
February 20, 1932	3.96	-7
February 27, 1932	3.95	-1
March 5, 1932	3.85	-10
March 12, 1932	3.91	6
March 19, 1932	3.89	-2
March 26, 1932	3.93	4
April 2, 1932	3.88	-5
April 9, 1932	3.67	-21
April 16, 1932	3.59	-8
Cumulative change from narrative dates		-24

## Changes in Corporate Bond Prices (Daily)

Based on the narrative record

Dates from Narrative record	Dow Jones 40-Bond Average Prices	Changes in bond prices
February 17, 1932	79.17	
February 18, 1932	79.39	0.22
February 27, 1932	79.92	
February 29, 1932	79.96	0.04
March 11, 1932	82.21	
March 12, 1932	82.09	-0.12
April 1, 1932	77.69	
April 2, 1932	77.26	-0.43
April 13, 1932	73.34	
April 14, 1932	73.45	0.11
April 15, 1932	74.69	1.24
April 16, 1932	76.16	1.47

# Changes in Holdings of Notes and Corresponding Yields

Based on the 5% criterion

Week	% $\Delta$ Note Holdings	Changes in yields on 3-5 year notes (in b.p.)
April 27, 1932	11.7	-36
May 4, 1932	16.5	-11
May 11, 1932	38.2	3
May 18, 1932	7.6	-10
June 15, 1932	11.7	8
June 22, 1932	15.2	20
June 29, 1932	19.3	13
August 3, 1932	20.3	3
August 10, 1932	8.7	-17
August 17, 1932	5.1	13
Cumulative change		-14

# Changes in Holdings of Bonds and Corresponding Yields

Based on the 5% criterion

Week	% $\Delta$ Bond Holdings	Changes in yields on Bonds (in b.p.)
April 20, 1932	7.8	-8
May 25, 1932	5.4	8
June 1, 1932	5.9	3
June 8, 1932	8.4	-1
Cumulative change		2

## QE1: Effects on Yields

Week	Changes in yields on			
	10-year Bonds (in b.p.)	GRRS	5-year Notes	1-year Notes
	K-V		K-V	K-V
November 25, 2008	-36	-22	-23	-2
December 1, 2008	-25	-19	-28	-13
December 16, 2008	-33	-26	-15	-5
January 28, 2009	28	14	28	4
March 18, 2009	-41	-47	-36	-9
Cumulative change	-107	-104	-74	-25

Source: Krishnamurthy and Vissing-Jorgensen (2011) and Gagnon, Raskin, Remache and Sack (2010). We use announcement dates listed in section 3.2.1 of the paper.

## QE1: Effects on Yields

Week	Change in yields on		
	10-year Bonds	5-year Notes	1-year Notes
November 25, 2008	-28	-6	-3
December 1, 2008	-44	-43	-24
December 16, 2008	-18	-20	-1
January 28, 2009	19	16	6
March 18, 2009	-17	-18	-6
Cumulative change	-88	-71	-28

Calculations based on weekly windows

# Event Study Conclusions

- Significant reaction of Note and Bond yields to news reports of the OMO, and in response to its operation
- Corporate bond prices also reacted to the news
- Results from 1932 and 2009 suggest that the **portfolio composition** and **signaling** channels are important in explaining the effects of the Fed's operation

## Motivating Questions

- Was the structure of the open-market operation announcement in QE1 important?

*"Moreover, to help improve conditions in private credit markets, the Committee decided to purchase up to \$300 billion of longer-term Treasury securities over the next six months"*  
(FOMC Statement, March 18, 2009)

- Does the duration of debt being purchased by the Fed matter?
- Is the size of debt being held by the public important?

# Modeling the Effects on the Economy

- Analyze the effects of the OMO on the economy using a segmented markets model
- Assume two types of investors: households and institutional investors
  - Investors are segmented by the cost of accessing long bonds

# Market Segmentation: Overview

- Evidence of segmentation in the 1920s and 1930s:
  - Bond denominations were large relative to per capita income
  - Non-bank public had limited access to the government securities markets which was dominated by a few investment banks (Garbade, 2012)
  - Asset holdings of Nonfarm households and the Finance sectors are available for 1945 (Goldsmith and Lipsey, 1963)
  - Variations in discount rates across Federal Reserve districts: 50-150 b.p.
  - Loan rates varied: NY banks charged 3.82% on commercial loans; this was 5.01% in the South and West
  - We will also use the Survey of Consumer Expenditures for 1935-36 to further understand the changes in households holdings of bonds

## Market Segmentation: Denominations of Liberty Bonds in WWI

Denominations on June 20, 1920	Denominations in 2009\$	% of All Bonds Outstanding
\$50	536.34	7.87
100	1072.69	12.11
500	5363.43	9.33
1000	10,726.85	41.49
5000	53,634.25	7.23
10,000	107,268.50	16.10
50,000	536,342.50	1.32
100,000	1,072,685.00	4.54

Source: Kang and Rockoff (2015)

# Market Segmentation: Denominations of Liberty Bonds in WWI

- Modal denomination was \$1000 in 1920
- Denominations of the bonds suggest that a large % was sold to wealthy individuals or institutional investors
- The smaller denominations, \$50 and \$100 (~20% of the outstanding debt) may have more plausible for middle class investors

## Market Segmentation: Asset Holdings in 1945

	Non-farm households (% of total assets in 1945)	Finance
<b>Financial assets</b>	<b>67.9</b>	<b>99.3</b>
Bonds	13.0	58.6
Stocks	17.9	2.1
<b>Debt</b>	<b>4.9</b>	<b>93.9</b>
Short-term	1.9	72.9
Long-term	3.0	21.0

Obtained from the National Balance Sheet of the United States, Goldsmith and Lipsey (1963)

# Model Components

- Andrés, López-Salido and Nelson (2004) and Chen, Cúrdia and Ferrero (2012)
- Investors:
  - $\omega_u$  Unrestricted - hold long and short bonds; pay transactions cost to purchase long bonds
  - $\omega_r$  Restricted - hold long bonds only
- Intermediate, capital and final goods producers
- Government collects lump-sum taxes and issues long- and short-term debt
- Central bank sets the federal funds rate in response to output gap and inflation (Orphanides 2003, Taylor 1999)

## Model Equations: Euler Equations

- For the short-term bond:

$$1 = \beta_u E_t \left[ \frac{MU_{t+1}^u}{MU_t^u} \frac{R_{S,t}}{\Pi_{t+1}} e^{-\gamma - z_{t+1}} \right]$$

- For the long bond:

$$1 + \zeta_t = \beta_u E_t \left[ \frac{MU_{t+1}^u}{MU_t^u} \frac{R_{L,t}}{\Pi_{t+1}} \frac{P_{L,t+1}}{P_{L,t}} e^{-\gamma - z_{t+1}} \right]$$

## Model Equations: Euler Equations

- For the short-term bond:

$$1 = \beta_u E_t \left[ \frac{MU_{t+1}^u}{MU_t^u} \frac{R_{S,t}}{\Pi_{t+1}} e^{-\gamma - z_{t+1}} \right]$$

- For the long bond:

$$1 + \zeta_t = \beta_u E_t \left[ \frac{MU_{t+1}^u}{MU_t^u} \frac{R_{L,t}}{\Pi_{t+1}} \frac{P_{L,t+1}}{P_{L,t}} e^{-\gamma - z_{t+1}} \right]$$

- Pricing equation for restricted households:

$$1 = \beta_r E_t \left[ \frac{MU_{t+1}^r}{MU_t^r} \frac{R_{L,t}}{\Pi_{t+1}} \frac{P_{L,t+1}}{P_{L,t}} e^{-\gamma - z_{t+1}} \right]$$

## Model Intuition: Effect of asset purchases

- The risk premium between  $R_L^{EH}$  and  $R_L$  with transactions cost is:

$$R_{L,t} - R_{L,t}^{EH} = \frac{1}{D_L} \sum_{j=0}^{\infty} \left( \frac{D_L - 1}{D_L} \right)^j E_t \zeta_{t+j}$$

## Model Intuition: Effect of asset purchases

- The risk premium between  $R_L^{EH}$  and  $R_L$  with transactions cost is:

$$R_{L,t} - R_{L,t}^{EH} = \frac{1}{D_L} \sum_{j=0}^{\infty} \left( \frac{D_L - 1}{D_L} \right)^j E_t \zeta_{t+j}$$

- Transactions cost function:

$$\zeta_t = \zeta \left[ \frac{P_{L,t} B_{L,t}}{B_{S,t}}, \varepsilon_{\zeta,t} \right]$$

- Assume  $\zeta, \zeta' > 0 \implies$  as public's holdings of long bonds fall, yields on long bonds decline
  - Change in returns on long bonds affects the consumption and savings decisions of the restricted households

# Model Estimation

- Estimate model with Bayesian methods
- Construct likelihood using Kalman filter based on the RE state space representation
- Posterior:
  - Maximize posterior density function to obtain the posterior mode
  - Use normal approximation around mode to generate a sample of parameter vector draws based on MCMC

# Key Parameters

- Average duration of debt is set to match the duration of 5-year Notes
- Debt is 15% of the GDP on average over 1920s
- ZLB characterization: Short yields remained in the zero-lower bound range for approximately two years during and after the 1932 operation

## Prior and Posterior Estimates of Key Parameters

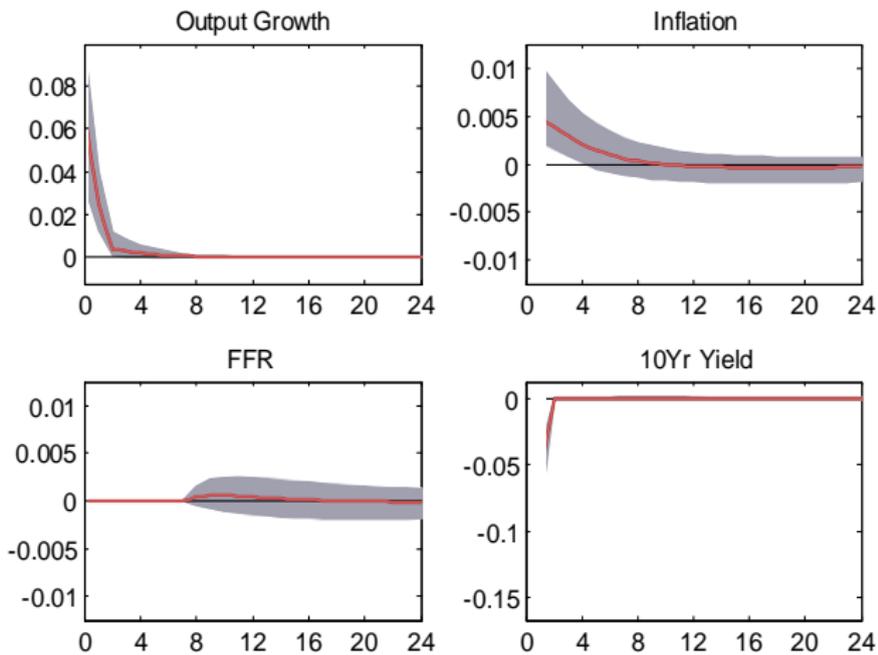
	Prior		Posterior			
	Dist	Median	Mean	5%	Median	95%
$100\zeta'$	G	1.2846	0.3635	0.2479	0.3667	0.4884
$\omega_u$	B	0.7334	0.7624	0.7098	0.7583	0.8292
$\zeta_p$	B	0.5000	0.8017	0.7626	0.7974	0.8492
$\sigma_u$	G	1.8360	1.6409	1.3758	1.6497	1.8528
$\sigma_r$	G	1.8360	1.2687	0.5824	1.1006	1.6119
$\phi_T$	G	1.4448	1.1026	0.7862	1.0804	1.4645
$\phi_\pi$	G	1.7026	1.0457	1.0059	1.0449	1.0929
$\phi_y$	G	0.3672	0.4369	0.3877	0.4312	0.4950

## Parameters from benchmark simulation

- Segmentation: Posterior mean of  $\omega_u$  of 76%; for 2008-09, CCF (2012) estimate this parameter to be 94%
- Risk aversion:  $\sigma_u$  of 1.64; for 2008-09, CCF (2012) estimate this to be 3.49

# Benchmark simulation

\$1 billion increase in Fed's holdings over 1Q; divests over next quarter

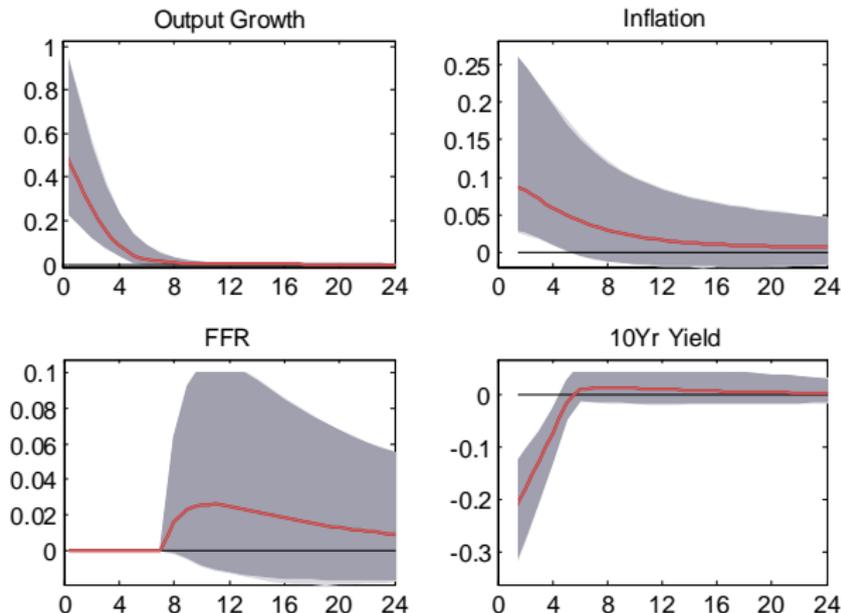


## Benchmark simulation

- \$1 billion increase in Fed's holdings over 1Q; divests over next quarter. Households expect the operation to only last 1 quarter
- Output growth increases by 0.07%
- Long yields decline by 12 b.p.

# Effects of Program Structure Announcement

\$1 billion increase in Fed's holdings over 2Q; assets are held on the balance sheet for 2Q and then divested (agents understand the full path)



# Effects of Program Structure Announcement

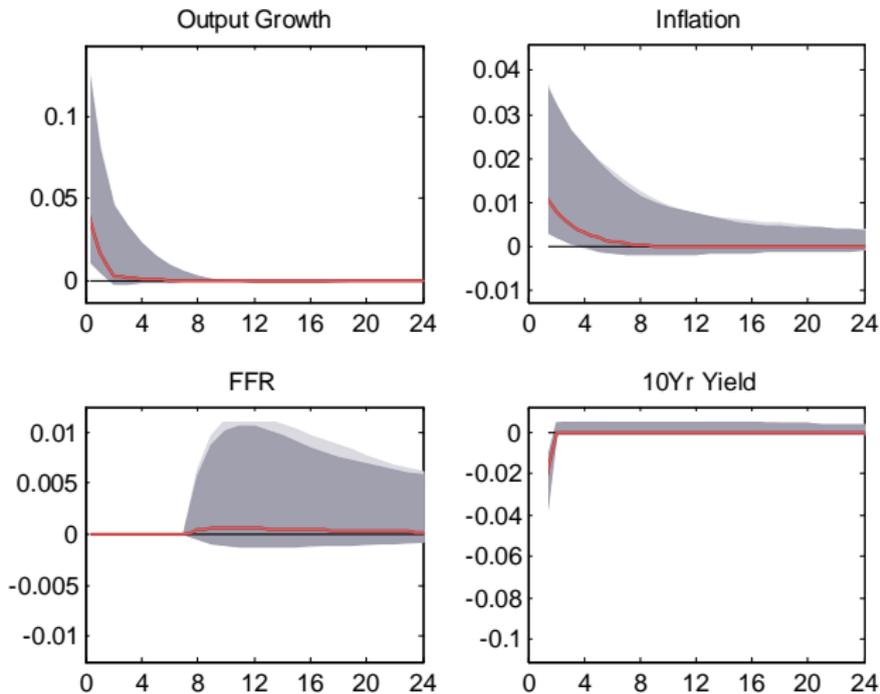
- \$1 billion increase in Fed's holdings over 2Q; assets are held on the balance sheet for 2Q and then divested (agents understand the full path)
- Similar to the announcement of the QE1 operation
- Output growth increases by 0.5%
- Long yields decline by 23 b.p.

## Intuition for Effects

- Bond purchase operation by the Federal Reserve affects the long-term yield, and the expected returns for the restricted households
- This alters the discount factor of these households, and their consumption
- As the pricing decisions of intermediate firms and investment decisions of capital goods producers change, consumption and investment are affected in equilibrium
- As the duration of the program is increased (and the central bank holds the purchased bonds on its balance sheet), the effect of the risk premium is stronger; output and inflation responses are magnified, and are more persistent

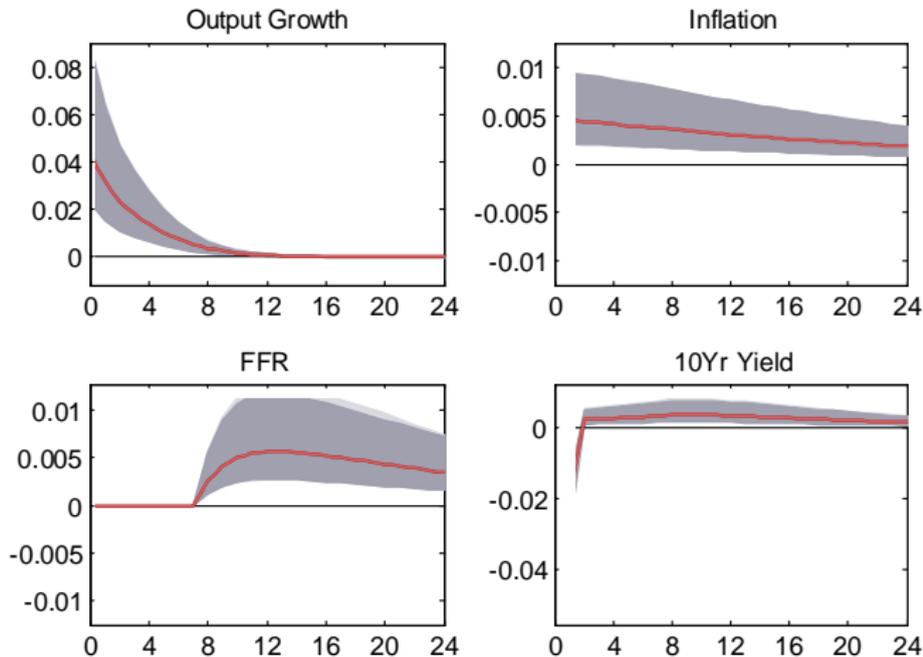
## Effects of Debt Maturity

\$1 billion increase in Fed's holdings over 1Q; divests over next quarter;  
Debt maturity is increased to 20Q



## Effects of Debt Level

\$1 billion increase in Fed's holdings over 1Q; divests over next quarter;  
Debt is increased to 20% of GDP



# Conclusions

- Our empirical results suggest that the 1932 OMO had very significant effects on US Treasury Notes and Bonds.
- Based on our segmented markets model , the purchases affected the risk premium on long term bonds leading to a noticeable decline in yields and a rise in real growth
- Estimates of segmentation are large (approximately 76% of investors pay transactions costs to purchase long bonds)
- Had the Fed followed the announcement strategy of QE1, the effects on the real economy would have been larger
- The Great Contraction could have been attenuated had the Fed not abandoned course