The Great Escape?
A Quantitative Evaluation of the Fed's Non-Standard Policies

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September 2010, Rome

Disclaimer: This talk does not reflect the views of the NY Fed

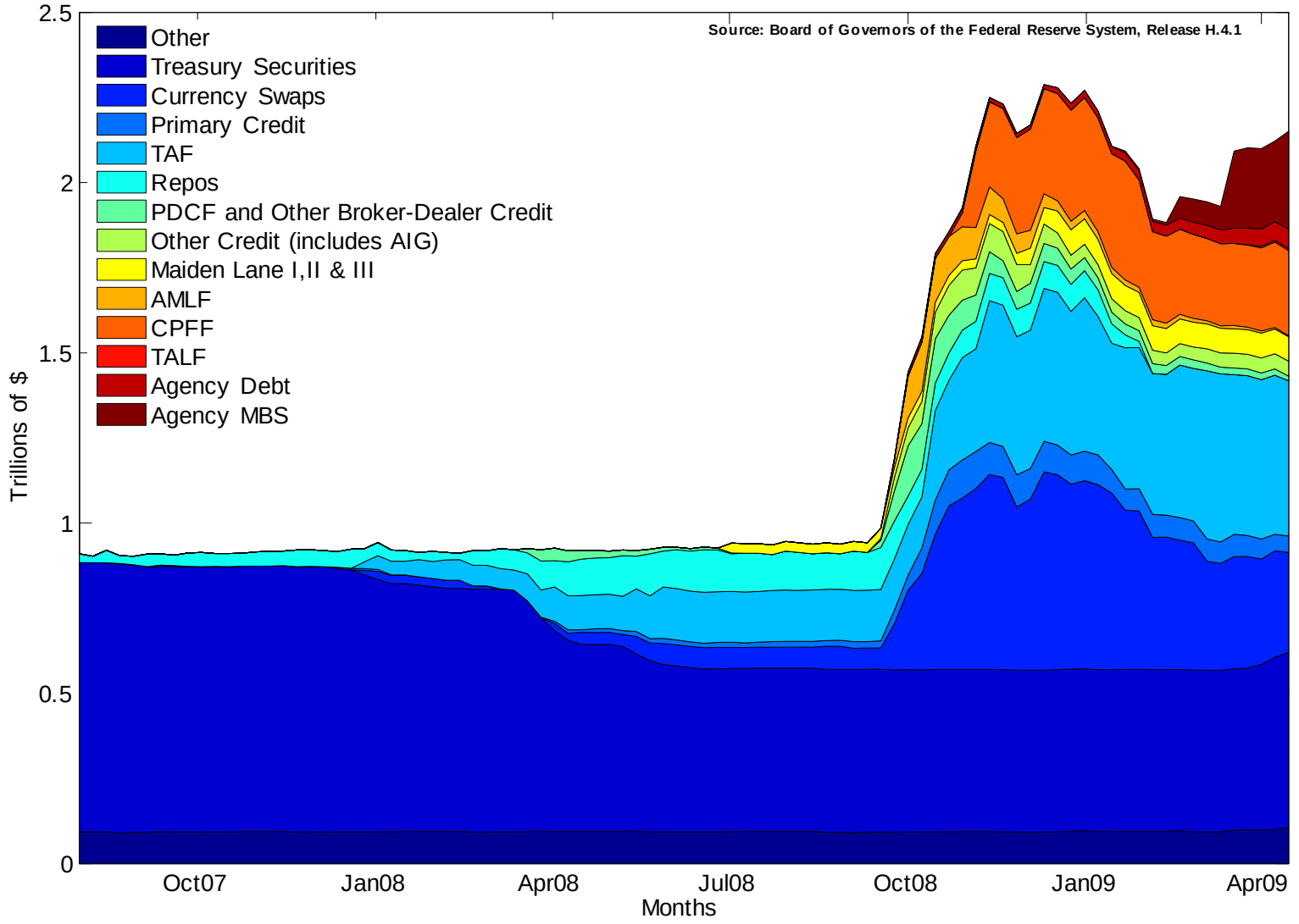
Question

What happens if you print money (reserves) corresponding to one dollar and buy private assets for that money…

… but without changing the nominal interest rate.

- Inflation
- Output
- etc

“Non-standard” open market operations


Source: Board of Governors of the Federal Reserve System, Release H.4.1
Other
Treasury Securities
Currency Swaps
Primary Credit
TAF
Repos
PDCF and Other Broker-Dealer Credit
Other Credit (includes AIG)
Maiden Lane I,II & III
AMLF
CPFF
TALF
Agency Debt
Agency MBS
Trillions of $
2.5
2
1.5
1
0.5
0
Oct07
Jan08
Apr08
Jul08
Oct08
Jan09
Apr09
Months

Motivation

- What is the effect of increasing the CB balance sheet?
  - Wallace (1982), Eggertsson and Woodford (2003)
  - Modigliani-Miller irrelevance theorem holds without financial frictions.
  - How large is the effect with financial frictions?

What we do

- Incorporate standard Kiyotaki-Moore (2008) into a DSGE model with standard real and nominal frictions.
- Findings:
  1. Liquidity shock in KM-model moves asset prices and investment but ***not aggregate output (quantitatively)***.
     → Quantitative effect of balance sheet (on output) tiny.
  2. If nominal rigidity and zero bound, the liquidity shock generates large output losses.
     →Quantitative effect of CB balance sheet possibly large (Great Escape?).
- Not a normative analysis – "crude" calibration

Model – Actors

1. Entrepreneurs : Financial frictions
2. Workers : Sticky wages
3. Capital Producers : Adjustment costs
4. Intermediate firms : Sticky prices
5. Final good producing firms : Aggregation
6. Government: Conventional (interest rate policy) and unconventional policies (credit policy).

Model – Assets

1. Equity (n): Illiquid
2. Government nominal bonds (b) : Liquid

Entrepreneurs & Frictions
Stochastic ideas

Entrepreneurs

- Saving with prob. 1-χ
- Investing with prob. χ

$$k_{t+1}(e) \begin{cases} \theta k_t(e) + i_t(e) & \text{with probability } \chi \\ \theta k_t(e) & \text{with probability } 1-\chi \end{cases}$$

Entrepreneurs & Frictions

Assets		Liabilities	
nominal bonds	b_{t+1}/P_t	*own* equity issued	$q_t n^I_{t+1}$
equity of *other* entrepreneurs	$q_t n^O_{t+1}$		
capital stock	$q_t k_{t+1}$	net worth	$q_t n_{t+1} - b_{t+1}/P_t$

where $n_t(e) \equiv n^O_t(e) + n^I_t(e)$

Assume that $\phi^I = \phi^O = \phi$

Then $n_{t+1}(e) \leq \frac{1}{\phi_t} n_t(e) + \frac{1}{q_t} b_t(e)$

Resellability constr. Borrowing constr.

Entrepreneurs' problem

$$\max E_t \sum_{s=t}^{\infty} \beta^{s-t} \log(c_s(e))$$

$$n_{t+1}(e) \leq (1-\chi)(1-\delta_k)n_t(e) + \chi \phi_t(e) i_t(e) \quad (1)$$

$$b_{t+1} \geq 0$$

$$c_t + p_t^I i_t + q_t(n_{t+1} - (1-\delta_k)n_t) + i_t(e) + \frac{b_{t+1}}{P_t} \leq w_t^k + (1-\delta_k)q_t k_t + \frac{R_{t-1} b_t}{P_t}$$

With probability $1-\chi$ → $i_t(e)=0$ & constraint (1) slack

With probability χ → $i_t(e)>0$ & constraint (1) binding

Workers

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} U\left(c_s - \int \frac{\psi_0}{1+\sigma_L} h_s(j)^{1+\sigma_L} dj\right)$$

$$c_t + q_t\left(n_{t+1} - \delta n_t\right) + \frac{b_{t+1} - R_{t-1} b_t}{P_t}$$

$$\leq r_t^k n_t + \int \frac{W_t(j)}{P_t} h_t(j)\, dj + \Pi_t^I + \int \Pi(i)\, di + T_t,$$

$$h_t(j) = \left[\frac{W_t(j)}{W_t}\right]^{-\frac{1+\lambda_w}{\lambda_w}} h_t \qquad n_{t+1} \geq 0, \qquad b_{t+1} \geq 0$$

In equilibrium

$$n_{t+1} = 0, \qquad b_{t+1} = 0$$

Three types of producers

- Capital goods producers (competitive): Source of adjustment costs. Transform consumption good into investment good for entrepreneurs at price p_t^I
- Intermediate good producers (monopolistic power). Calvo pricing (ξ_p). Rent labor from workers and capital from entrepreneurs.
- Final goods producers (competitive): Aggregate. Buy goods from intermediate goods producers and sell to consumers.

Policy Authority

- Conventional monetary policy

$$\frac{R_t}{R} = \max(1, \pi_t^{\phi_\pi})$$

- Unconventional policy

$$\frac{N^g_{t+1}}{K} = \rho_N \frac{N^g_t}{K} + \varepsilon_t$$

- Government budget constraint

$$\frac{B_{t+1}}{P_t} + q_t N^g_{t+1} = \frac{R_{t-1} B_t}{P_t} + \Phi^k_t + q_t \tau^N_t N^g_t + \tau_t$$

- Tax rule for government financing

$$\tau_t = \phi_\tau \left(q_t N^g_t + \frac{R_{t-1} B_t}{P_t} \right)$$

The intervention

- This is “open market operations” at market prices.
- Buying private paper for public debt.
- No re-salability constraints of the private sector violated.
- Only affects investment in period t through price effect.

→Next period private sector has more “liquid” assets.

→It is obvious that this will have an effect (boring question). Interesting question: Does it matter quantitatively?

Equilibrium and solution of the Model

- All agents maximize subject to their constraints and markets clear
- Focus on **constrained steady state**
  - Stock of capital is lower than in first best
  - Price of investment is strictly greater than one ($q > 1$)
  - Workers do not save
  - Investing entrepreneurs do not hold liquid assets
  - Spectrum of interest rates

- Linearize model about steady state and solve with standard techniques
- Liquidity shock $\hat{}t$ follows two-state Markov process (s.s. vs "crisis")
- Explicitly take into account zero bound (Eggertsson, 2008)

Liquidity Share

$$ls_t \equiv \frac{B_{t-1}/P_t}{B_{t-1}/P_t - \dot{q}_t K_{t-1}}$$

The liquidity share in the data.

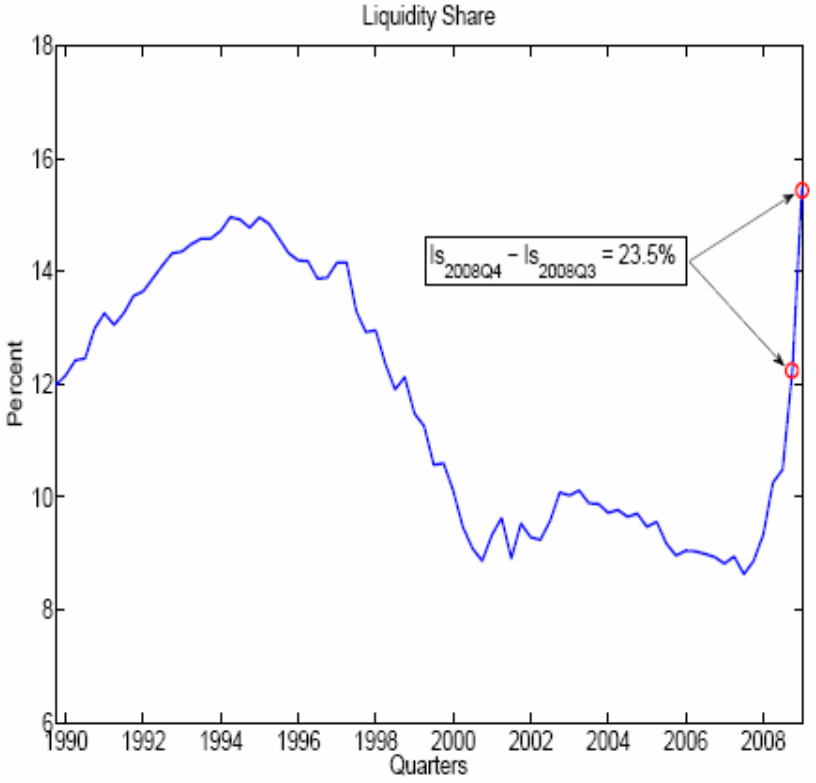
Calibration

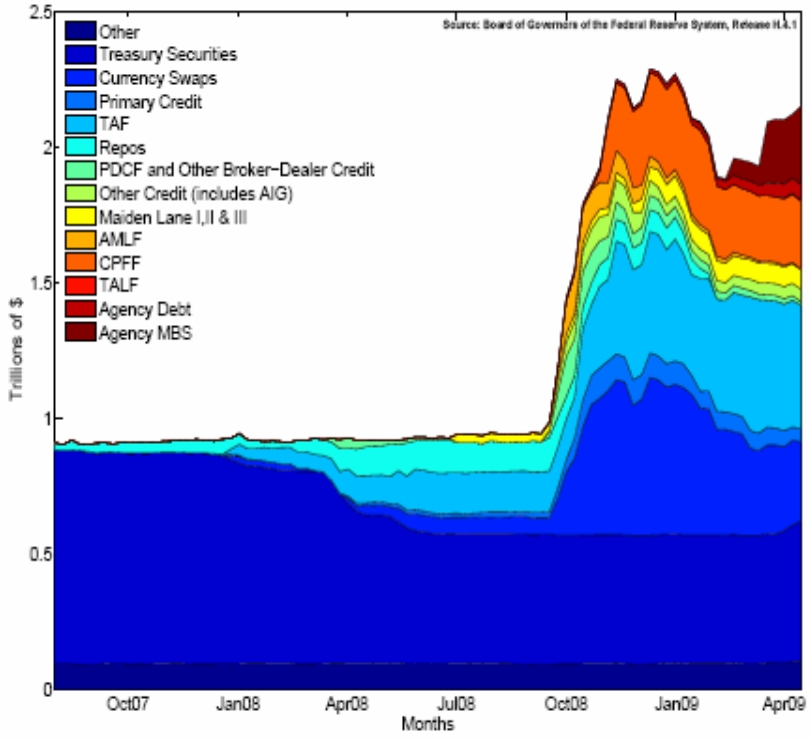
Standard Parameters			
β	=	0.99	Subjective discount factor
δ	=	0.975	Annual depreciation =10%
α	=	0.35	Capital share
σ	=	1	Inverse Fisch elasticity
θ_p = θ_w	=	0.1	Steady state markup =10%
ξ_p = ξ_w	=	0.66	Average duration price/wage contracts =3 qrts
$S''(\cdot)$	=	3	Investment adjustment cost
Liquidity Parameters			
κ	=	0.05	Doms and Dunne (1998); Cooper, Haltinwanger and Power (1999)
$L/4Y$	=	0.4	Average (government debt currency)/ GDP 1952Q1:2008Q4
γ = ρ	=	0.18	Real interest rate ◆2%; Liquidity share ◆14%
Zero Bound Parameters (shock duration)			
ξ_{zb}	=	0.125	Expected duration of zero bound =8qrts

Calibration of ϕ (shock) and ξ (intervention)

Two targets:

1. ≈ 24% increase in measured liquidity share
2. ≈$1 trillion (=8% of GDP) increase in Fed's assets

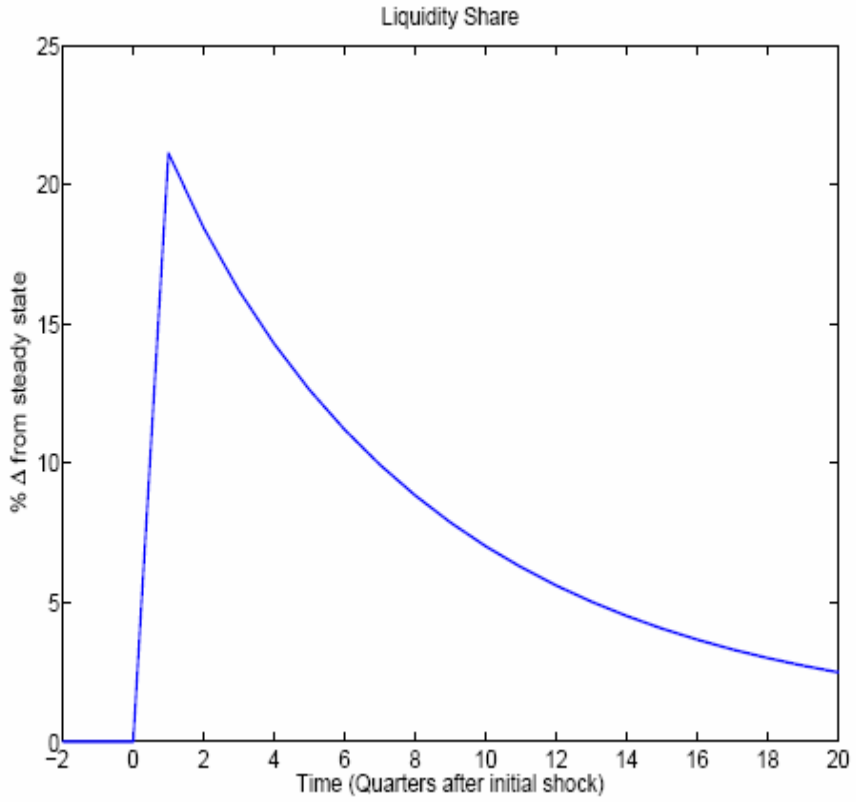


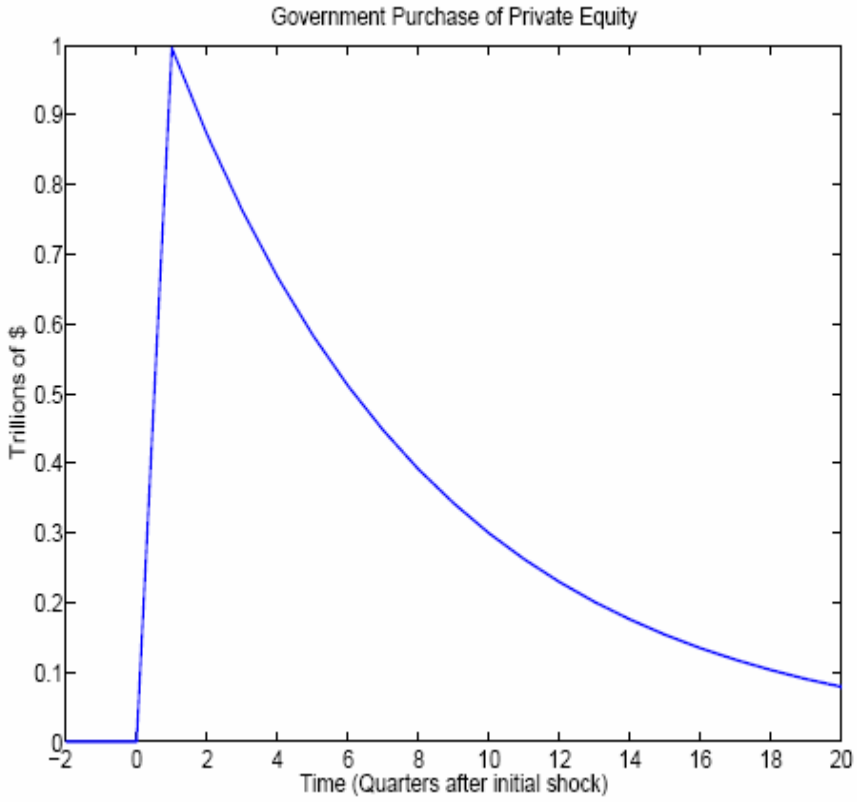


Calibration of ϕ (shock) and ξ (intervention)

Two targets:

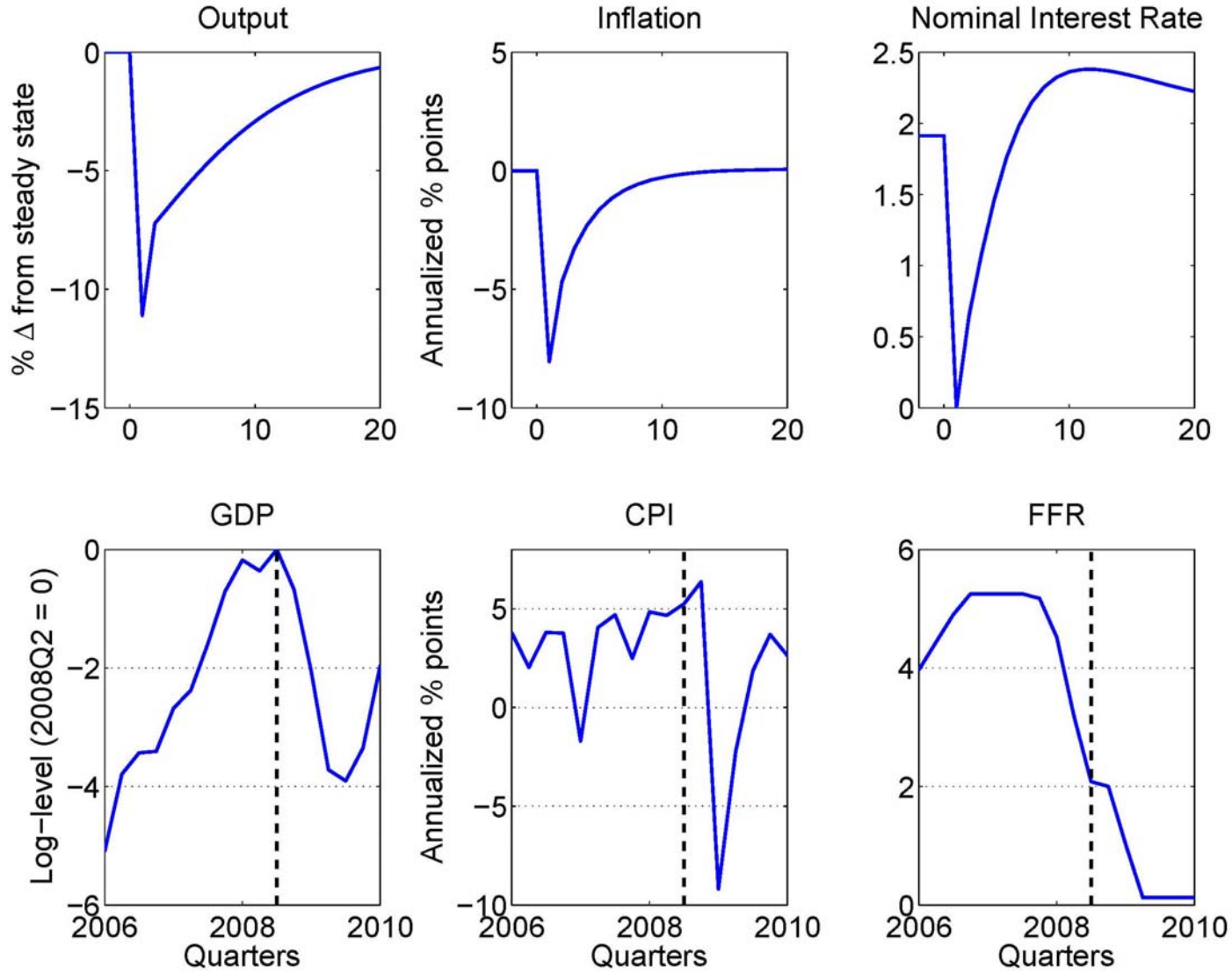
1. ≈ 20% increase in measured liquidity share
2. ≈$1 trillion (=7 percent of GDP) increaser in Fed's assets



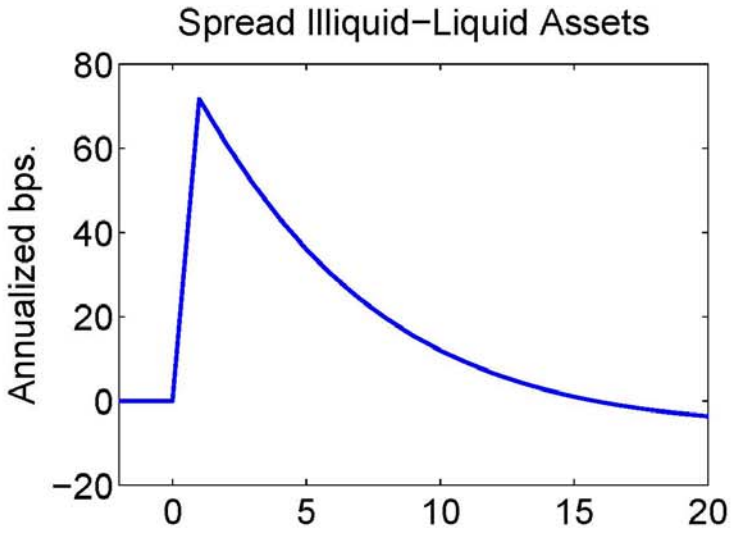


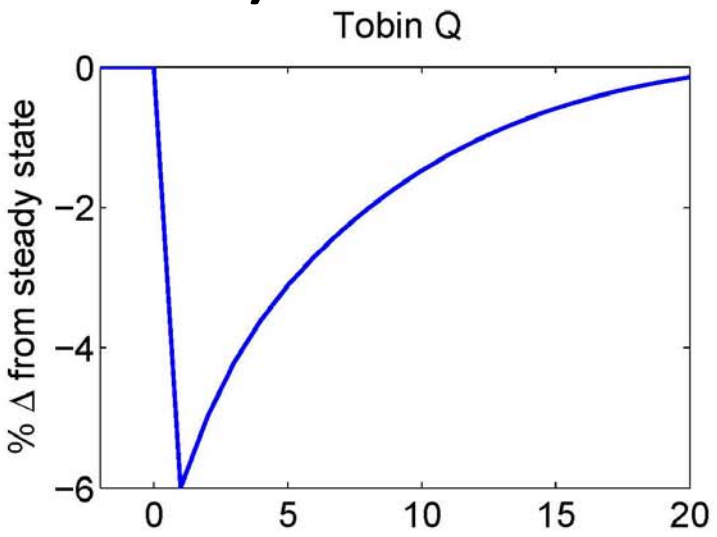
- Size of the shock: ϕ drops by -0.40

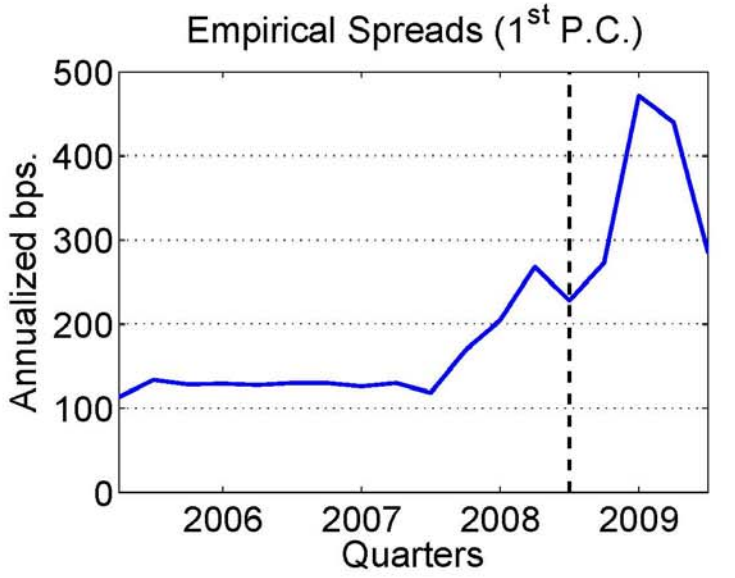
Response of Macro Variables (with intervention)

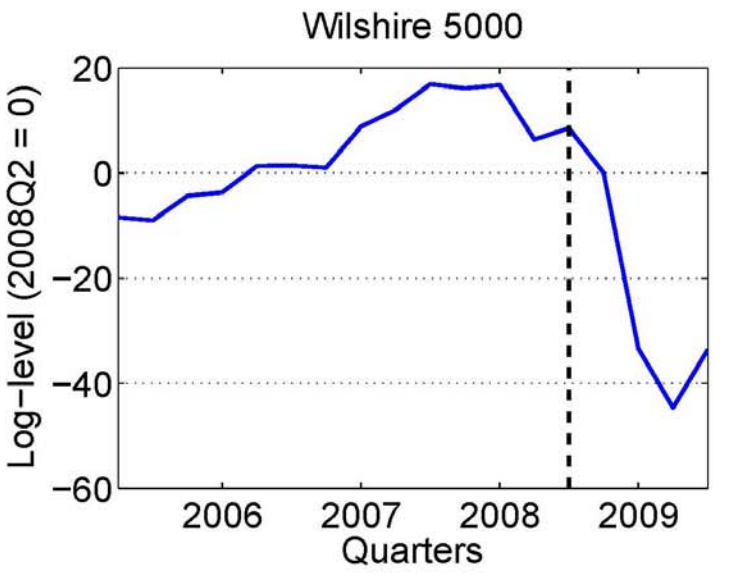


Response of Financial Variables (with intervention)

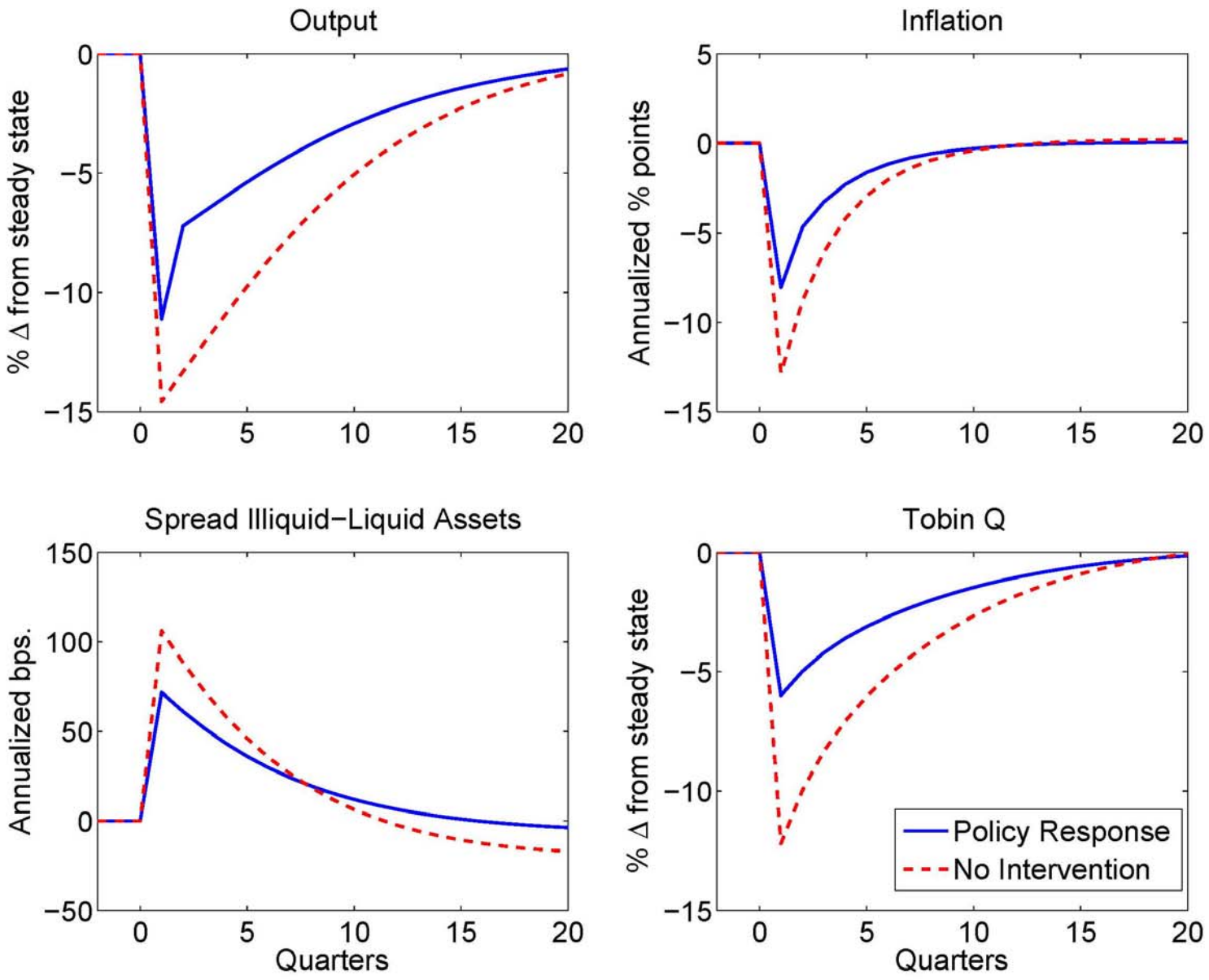






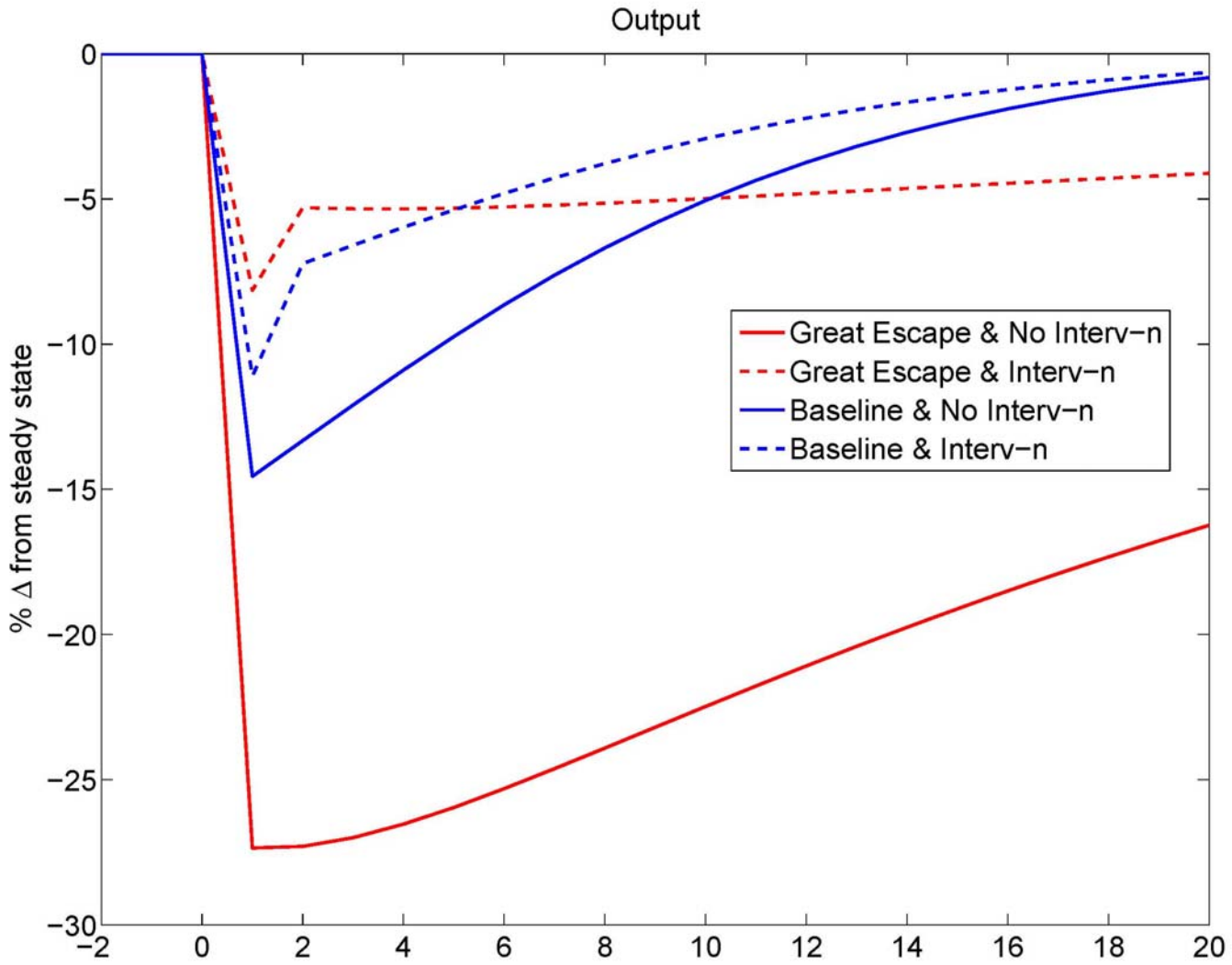


The effect of the intervention



The Great Escape?

Suppose expected duration of zero bound = 10 years (ZB = 1/40), then …..

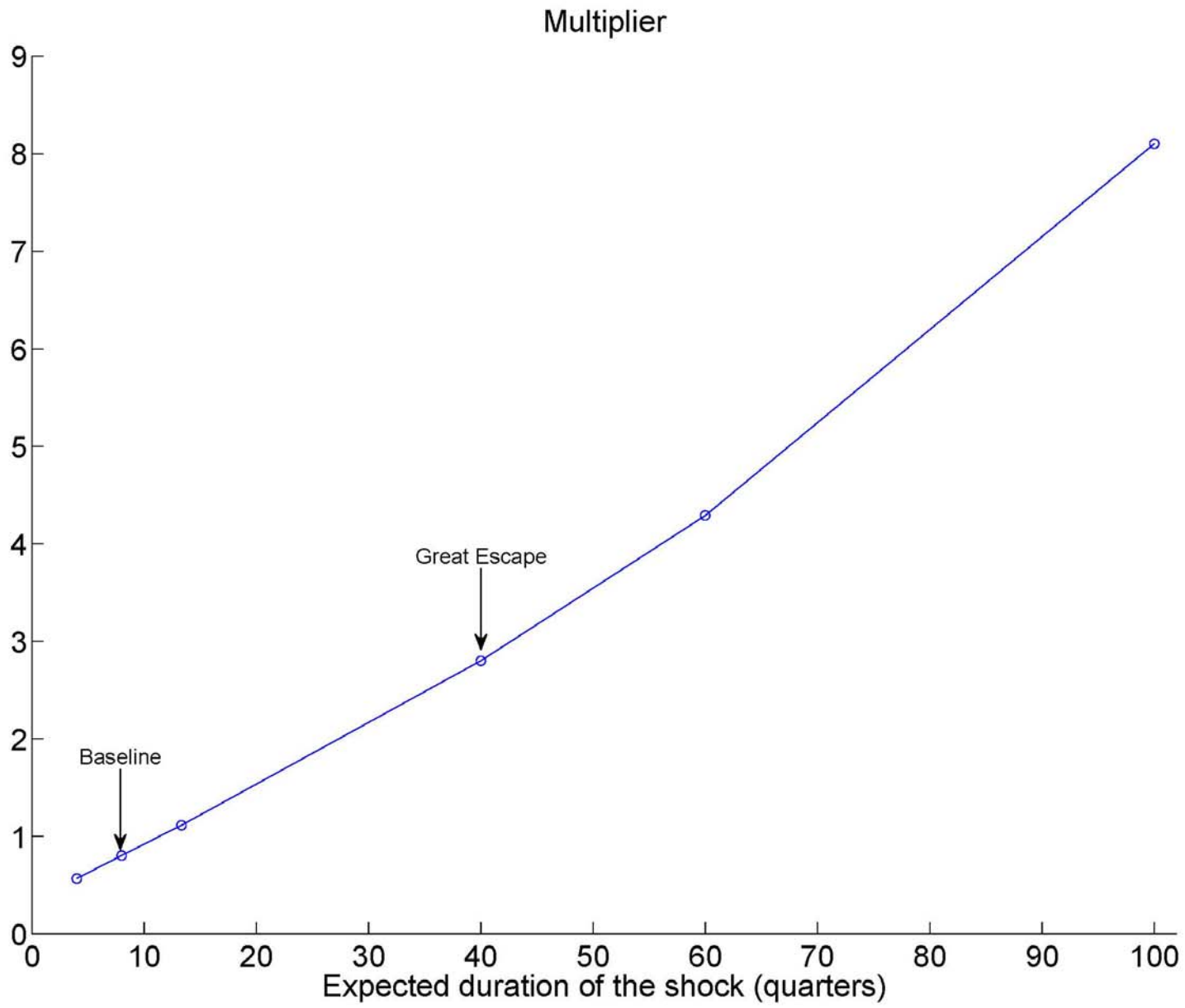


Multipliers

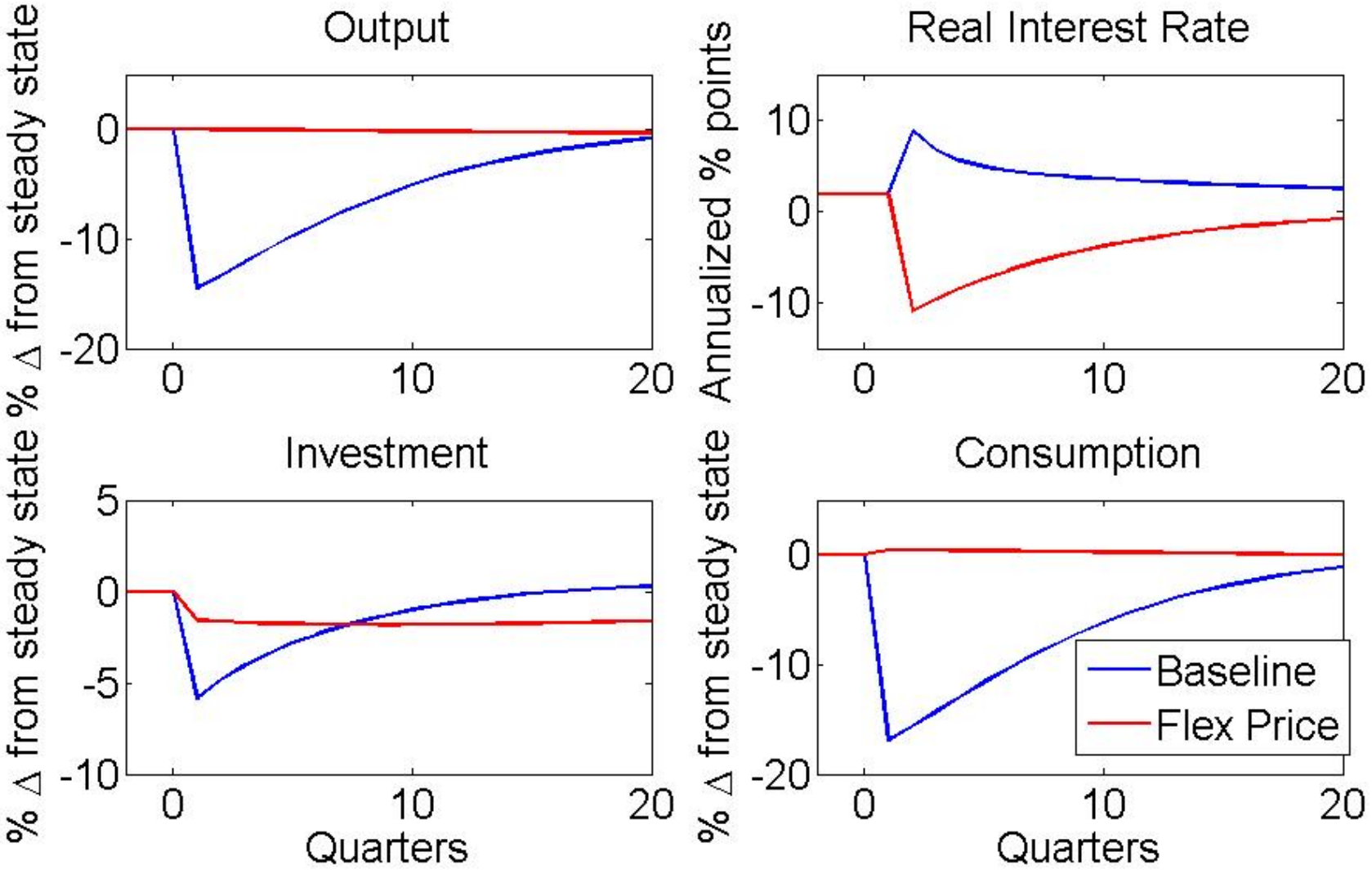
- By how much does output increase, per dollar in intervention?
- As outcome gets worse, the effectiveness of policy becomes greater ('divine coincident')
- Similar result as Eggertsson (2009) and Christiano, Eichenbaum and Rebelo (2009) for government spending at the zero bound
- Important for policy making?

$$M_{B,0} = \frac{\mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} (\hat{Y}_t^I - \hat{Y}_t^N) \right\}}{\mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \hat{N}_t^g \right\}}$$

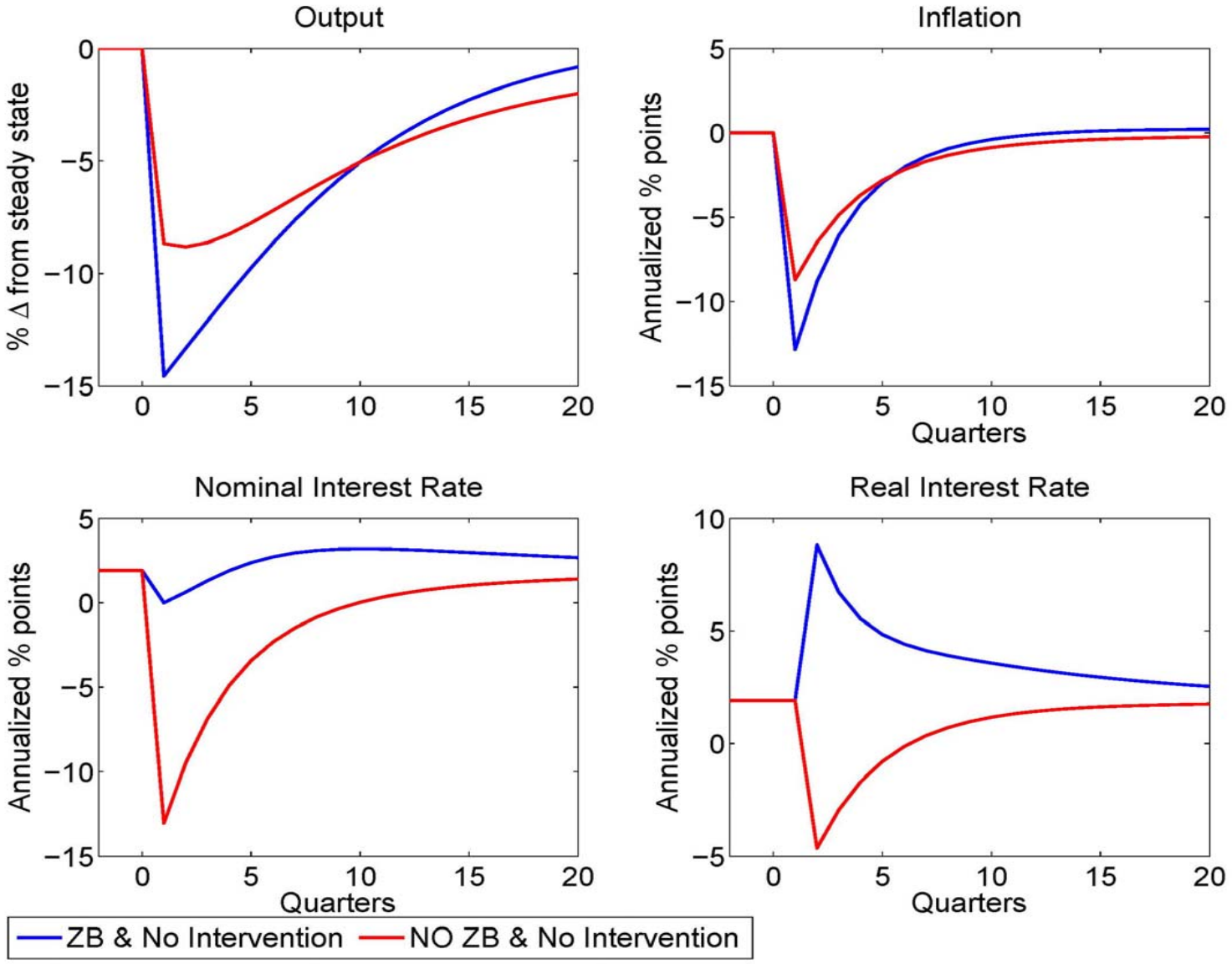
	Baseline	Great Escape
Standard	0.8	2.8
No zerobound	0.6	0.8
Flexible Prices	0.009	0.007


Multiplier
9
8
7
6
5
4
3
2
1
0
Great Escape
Baseline
0
10
20
30
40
50
60
70
80
90
100
Expected duration of the shock (quarters)

The role of nominal frictions



The role of the zero bound



Conclusions

- What are the quantitative effects of the Fed's non-standard policies?
- At the zero bound, interest rate policy ineffective; Fed becomes "creative"
- **Quantitative results:**
  - Liquidity frictions/shocks provide coherent story for financial crisis (the Holy Grail?)
  - Substantial effects of Fed's non-standard policies
  - Does not imply *current* balance sheet expansion effective!
- Moving forward:
  - Theoretical foundations of resaleability constraint
    - Exogeneity of the resaleability shock, i.e., feedback from real economy and resellability.
  - Formal estimation of the model
  - The BIG question: Why has the crisis led to such a PERSISTENT weakness. → Macro theory has an incomplete answer.

Path for the nominal Interest Rate