Government Spending Multipliers Under the Zero Lower Bound: Evidence from Japan

Wataru Miyamoto
Bank of Canada

Thuy Lan Nguyen
Santa Clara University

Dmitriy Sergeyev
Bocconi University

Columbia Japan Economic Seminar
February 10, 2017

The views are of the authors and not of the Bank of Canada

What We Do

- Are multipliers different across ZLB and normal periods?
  - On-impact Output Multipliers: 1.5 in ZLB vs 0.6 outside ZLB using Japanese data
- Can a standard New Keynesian model be consistent with the empirical findings?
  - ZLB period caused by low confidence, and with not too persistent spending, can replicate some features of output and inflation multipliers

Plan

- Motivation
- Data
- Specification
- Output multiplier
- Other results
- Model

Multipliers During ZLB: Theory

MULTIPLIERS DURING ZLB: THEORY

Neoclassical models

- Baxter-King (1993), etc.
- Output multiplier is *independent* of monetary policy

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New Keynesian models with "confidence-driven" ZLB

- Mertens-Ravn (2014)
- Output multiplier can be *smaller* during ZLB

MULTIPLIERS DURING ZLB: EMPIRICS

Multipliers During ZLB: Empirics

Evidence from the Great Depression

- Ramey (2011), Crafts-Mills (2012)
- Estimates: 0.3-0.9
- ZLB overlaps with recession, rationing, patriotism (WWII)

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Evidence from the Great Depression and Recession

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- ZLB periods coincide with recessions

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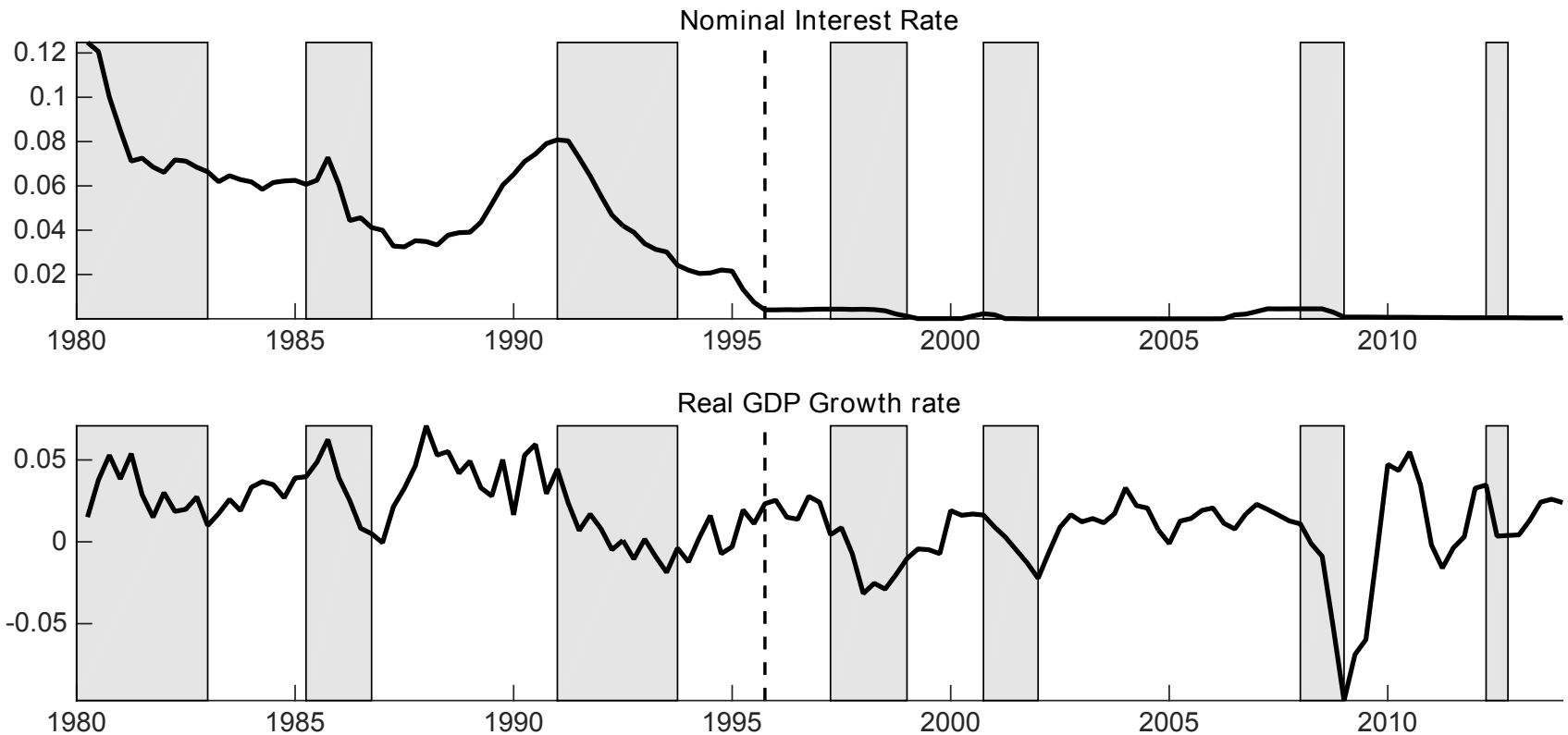
Evidence from monetary unions

- Nakamura-Steinsson (2014), Bruckner-Tuladhar (2014)
- Estimates: 1.5, 0.4-0.8
- Need a model to map to aggregate multiplier

JAPANESE DATA



DATA

Sample Period

- 1980:I-1995:III (normal period)
- 1995:IV-2014:I (ZLB period)

Quarterly macro variables $Y_t, G_t, T_t, C_t, I_t, \pi_t, i_t$

- Source: National Accounts

New Quarterly forecasts of G_t, Y_t, π_t

- Source: Japan Center for Economic Research (JCER)
- Other forecast: Japan Government Outlook, OECD, IMF

Identification Assumptions

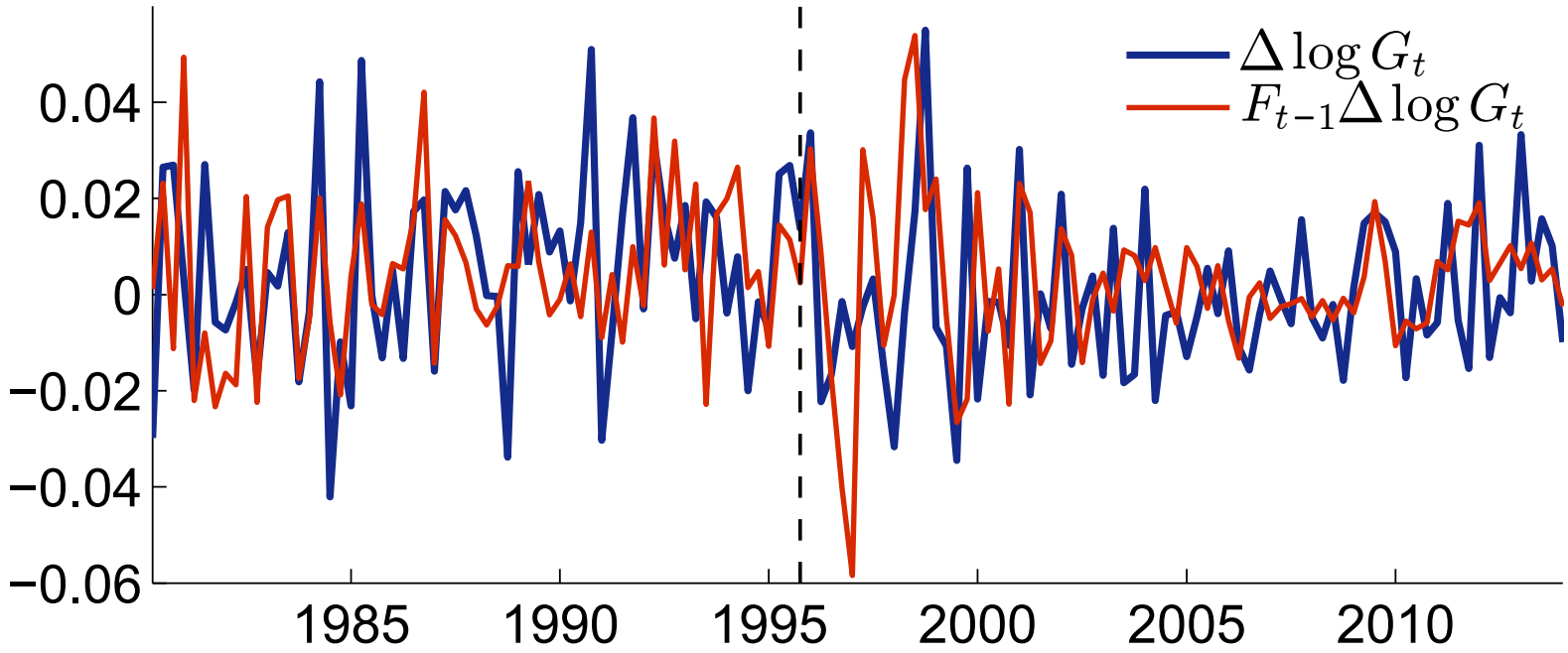
Exogenous government spending changes

- Gov spending does not respond to output within a quarter [Blanchard-Perotti, 2002]

Unexpected government spending shocks

- Remove one-quarter forecast of government spending and past variables [$F_{t-1}G_t$ and $\psi(L)y_{t-1}$]

Government Spending and its Forecast



SPECIFICATION

1. Remove expected government spending growth

$$\Delta \ln G_t = \alpha + \gamma F_{t-1} \Delta \ln G_t + \psi(L) y_{t-1} + \epsilon_t$$

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$$\Delta \ln G_t = \alpha + \gamma F_{t-1} \Delta \ln G_t + \psi(L) y_{t-1} + \epsilon_t$$

2. Project variable of interest x_{t+h} on estimated shock $\widehat{\epsilon}_t$ $\widehat{\epsilon}_t$ plot

$$x_{t+h} = \alpha_h^x + \beta_h^x \cdot \widehat{\epsilon}_t + \psi_h^x(L) y_{t-1} + \epsilon_{t+h}^x$$

- Controls $y_t = \{G_t, T_t, Y_t, u_t\}$
- Include 4 lags for each control variables
- All variables are per capita and deflated by GDP deflator

3. Estimate for each subperiod: ZLB, outside ZLB

CUMULATIVE OUTPUT MULTIPLIER

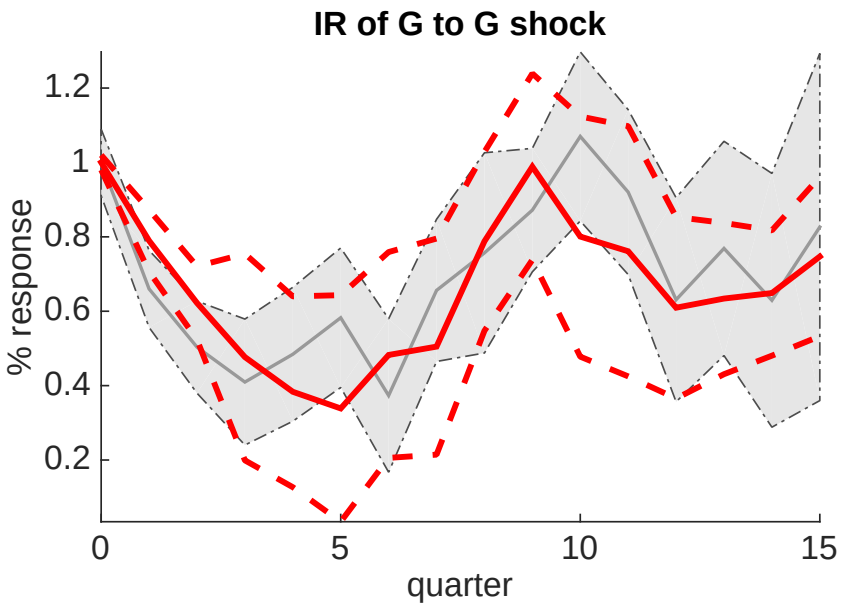
$$\sum_{j=0}^{h} \frac{Y_{t+j} - Y_{t-1}}{Y_{t-1}} = \alpha_h^x + M_h^Y \sum_{j=0}^{h} \frac{G_{t+j} - G_{t-1}}{Y_{t-1}} + \psi_h^x(L) y_{t-1} + \epsilon_{t+h}^x,$$

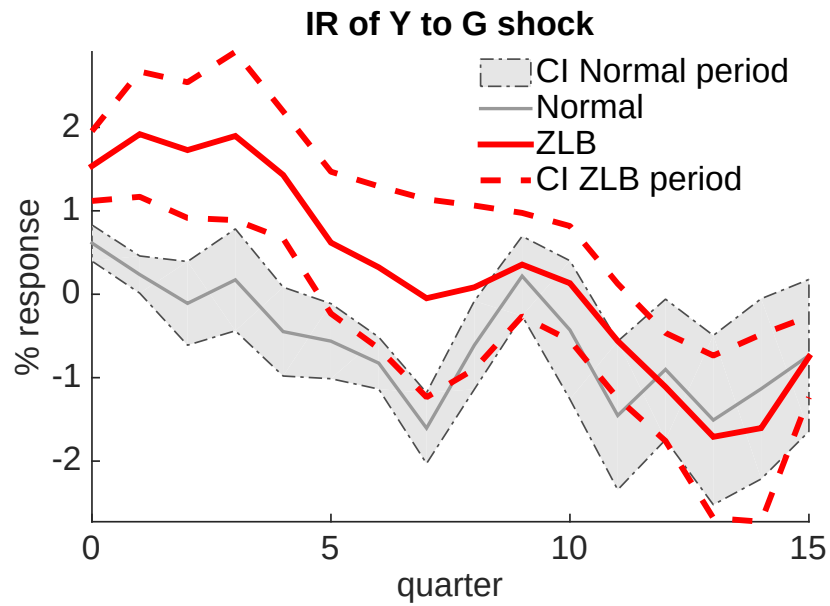
with $\sum_{j=0}^{h} \frac{G_{t+j}-G_{t-1}}{Y_{t-1}}$ IV by $\widehat{\epsilon}_t$.

- Interpretation: M_h^Y measures dollar changes in output when G changes by \$1 after h quarters

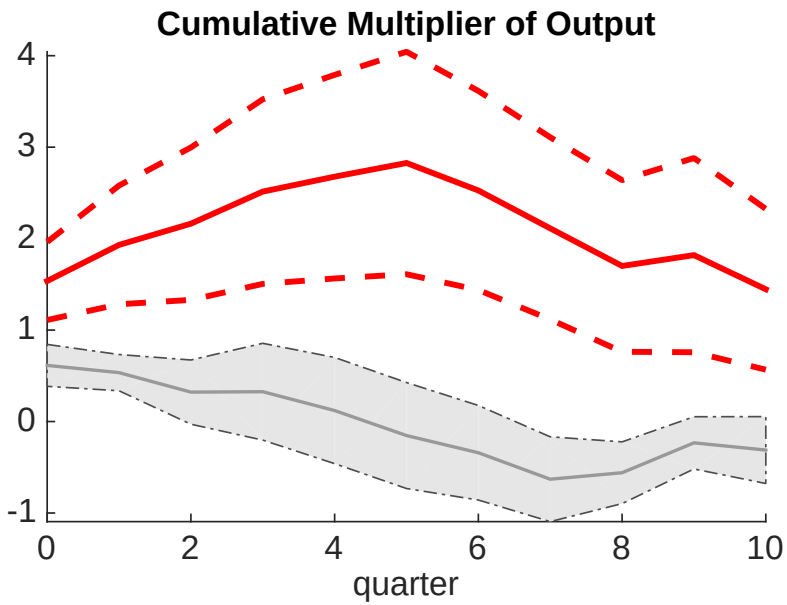
Impulse Response Functions of G and Y

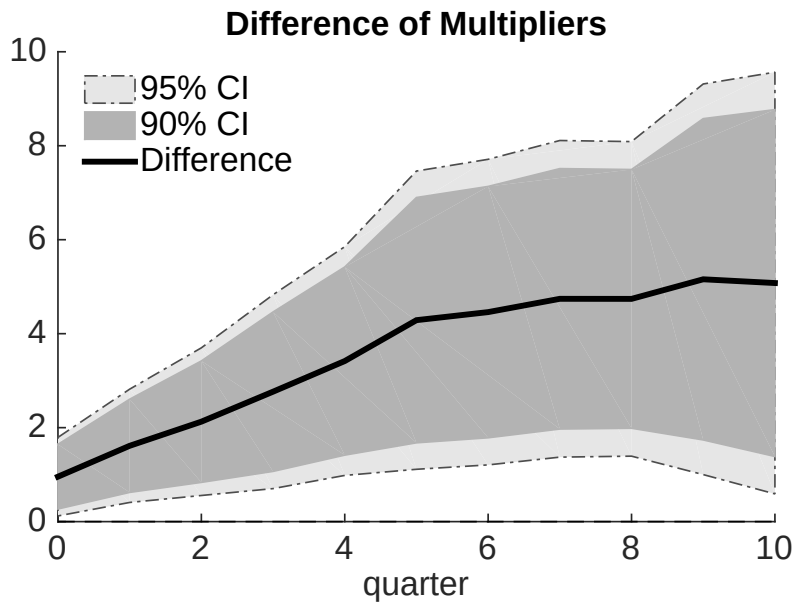
after Government Spending Shock



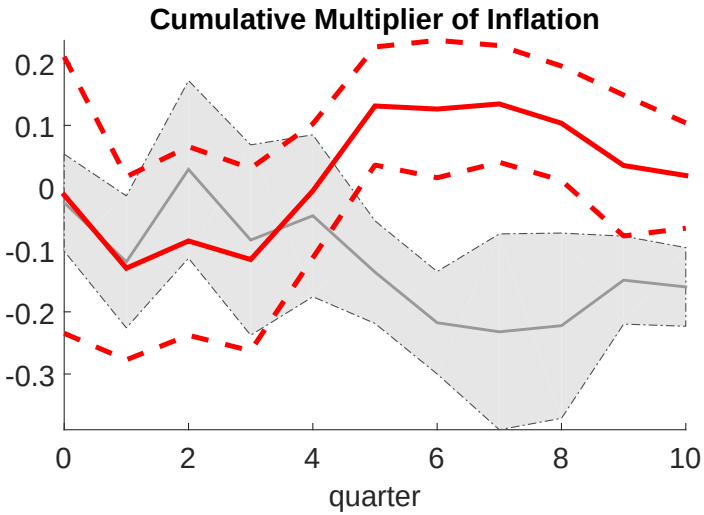


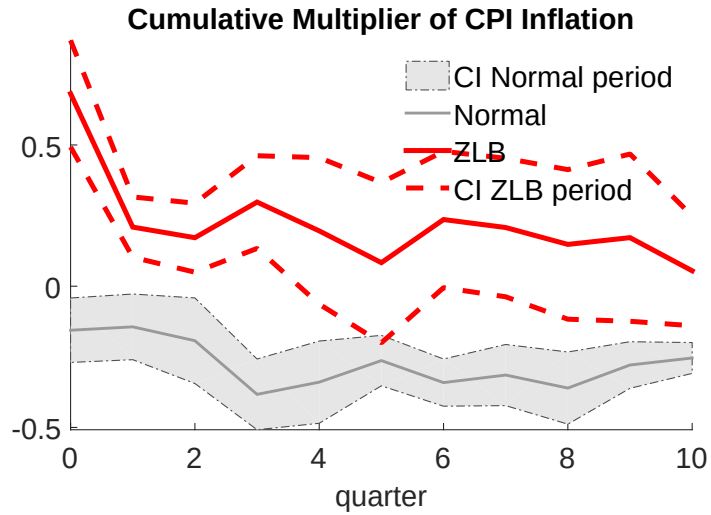
Output Multiplier

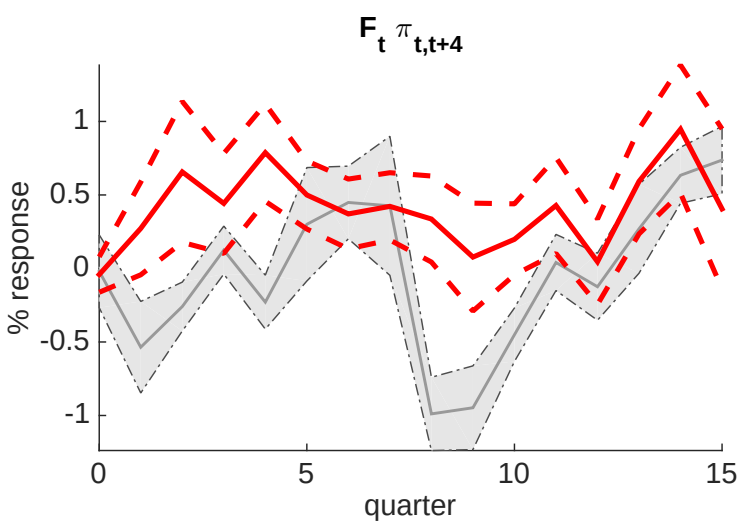


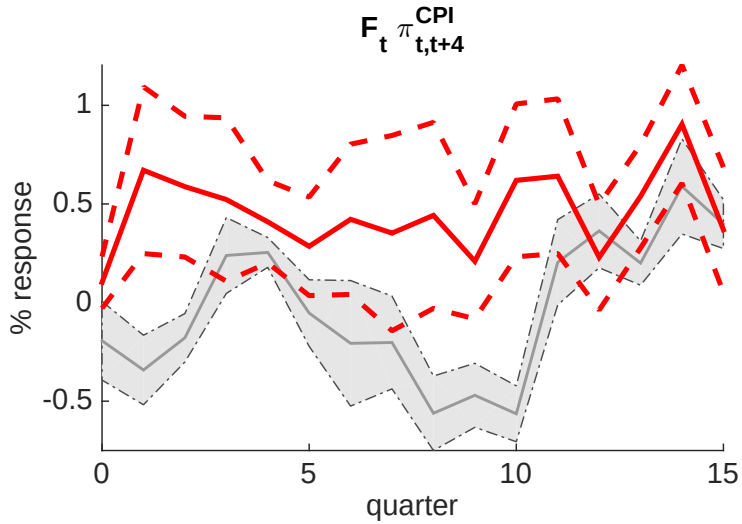


Inflation and Expected Inflation IRFs









Interest Rate

Other Variables

Output Multiplier in Recessions

Multipliers in recessions and booms

- Theory: Michaillat (2014)
- Empirics: Auerbach-Gorodnichenko (2012a,b)

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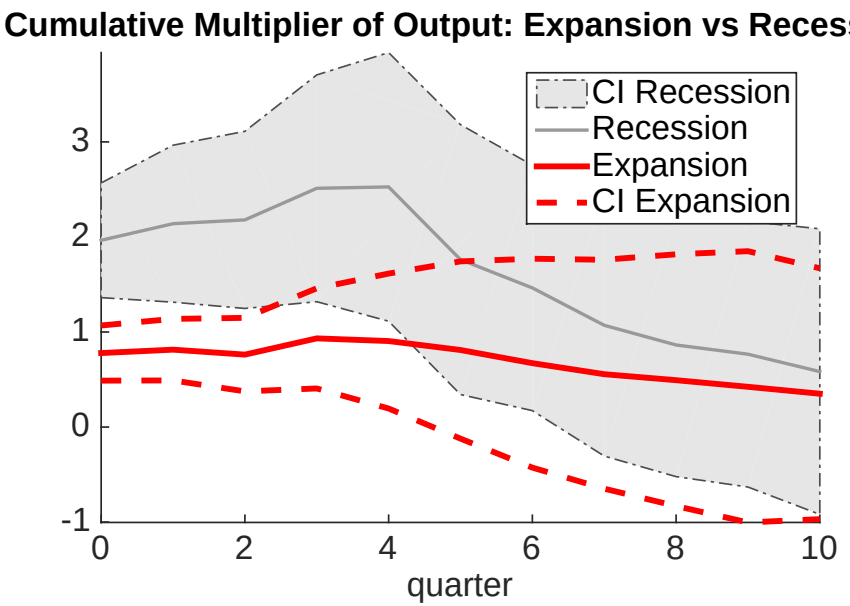
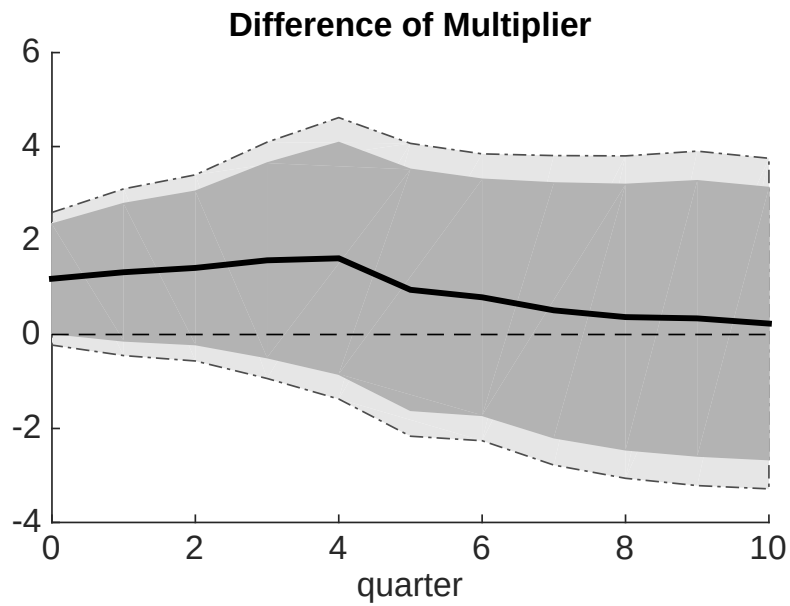
Multipliers in recessions and booms in Japan

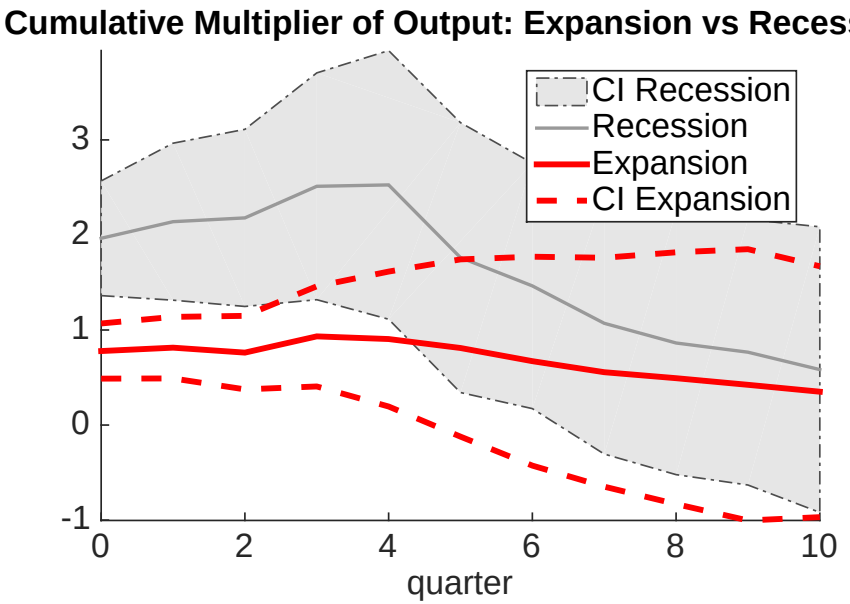
- Recessions: the Cabinet Office of Japan classification
- Specification: add recession dummies

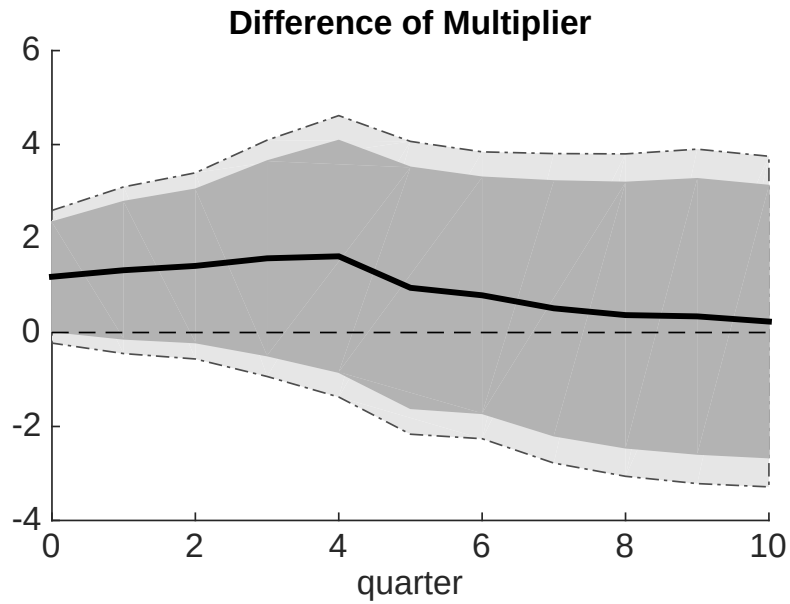
Output Multiplier in Recessions





Output Multiplier in Recessions



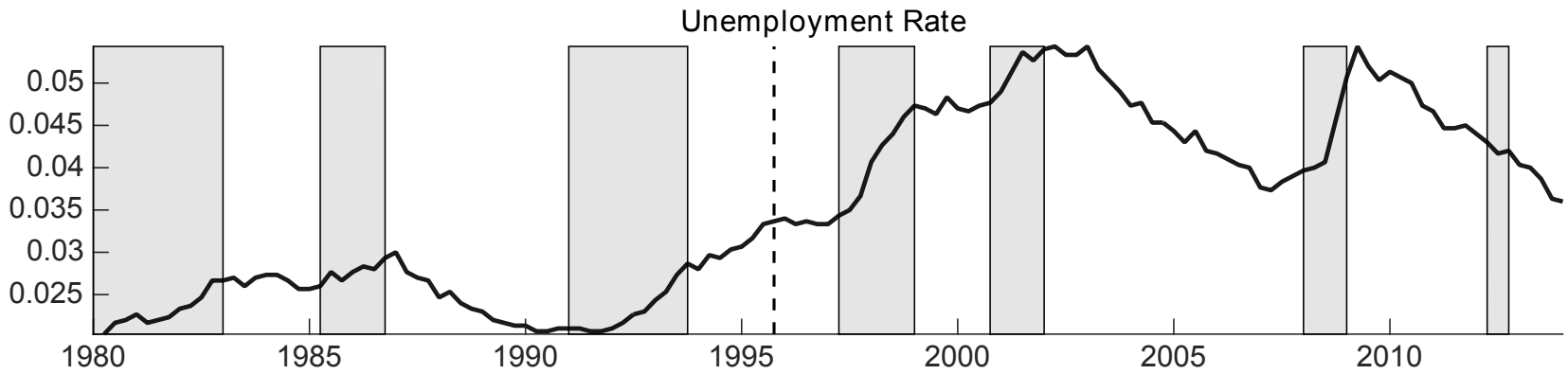


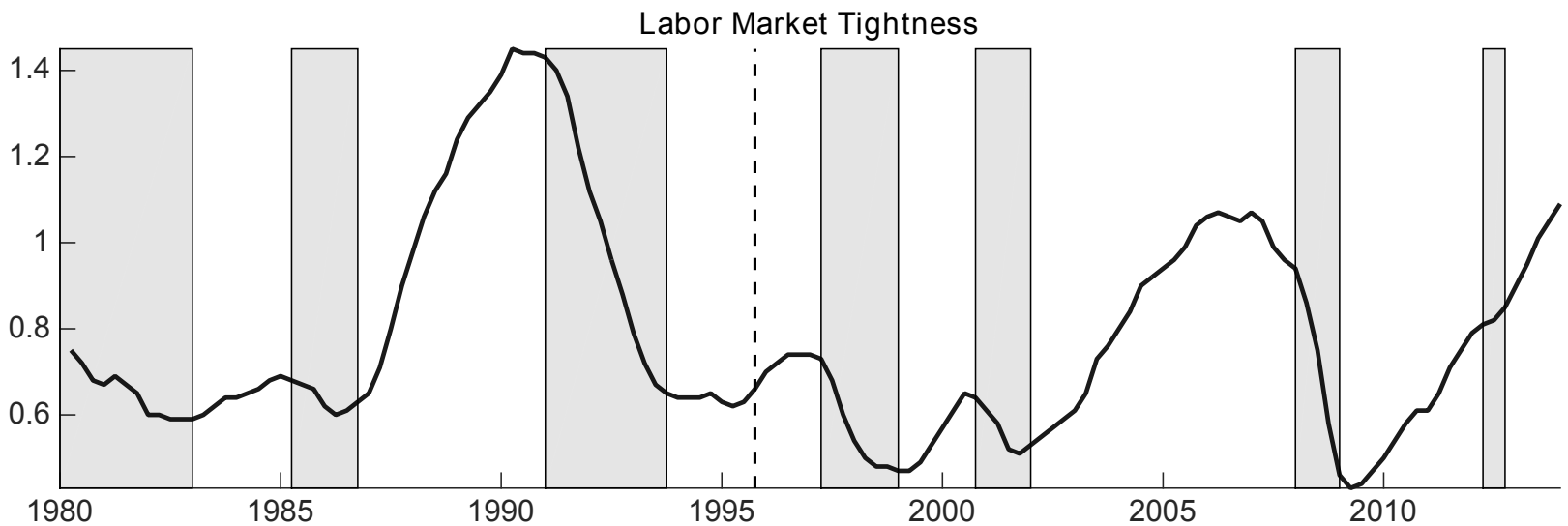
Note: recessions are 45% of normal period, 30% of ZLB period

PERMANENT RECESSION

◂ Rolling over

Permanent Recession





◂ Rolling over

Contemporaneous Reaction of G to Y

Baseline identification assumption

- G_t does not react to Y_t
- Blanchard-Perotti (2002), etc.
- Can change in this assumption explain results?

More

Contemporaneous Reaction of G to Y

Alternative

- Assume G_t responds to Y_t with elasticity η
- First stage regression

$$\Delta \ln G_t = \alpha + \eta \Delta \ln Y_t + \gamma F_{t-1} \Delta \ln G_t + \psi(L) y_{t-1} + \epsilon_t$$

- $\eta \neq 0$ changes the magnitude of the multipliers but in same direction for *both* periods

Table: Automatic Stabilizer

η	Normal	ZLB
0	0.6	1.5
-0.1	0.7	1.7
0.1	0.5	1.4

- Would need a different η in each period to explain the difference

▸ More

New Keynesian Model

- Can a standard New Keynesian model be consistent with the empirical findings?
- Main Findings:
  - ZLB period caused by low confidence, and with not too persistent spending, can generate output and inflation multipliers close to empirics.
    - Not ZLB period caused by fundamental shocks
  - Model matches the output multiplier in the normal period at short horizons

Model Details

Intuition

- Model mechanism:
  - G shock leads to inflation $\rightarrow$ Real rate goes down in ZLB $\rightarrow$ Private demand up
    - **Important**: G elevated during the ZLB
- In the data: G shock is persistent
- In the model, expected duration:
  - Fundamental-driven ZLB: short 2 years
  - Confidence-driven shock ZLB: long 5 years
- So the model can explain majority of the difference of output multipliers only in the confidence-driven ZLB

CONCLUSION

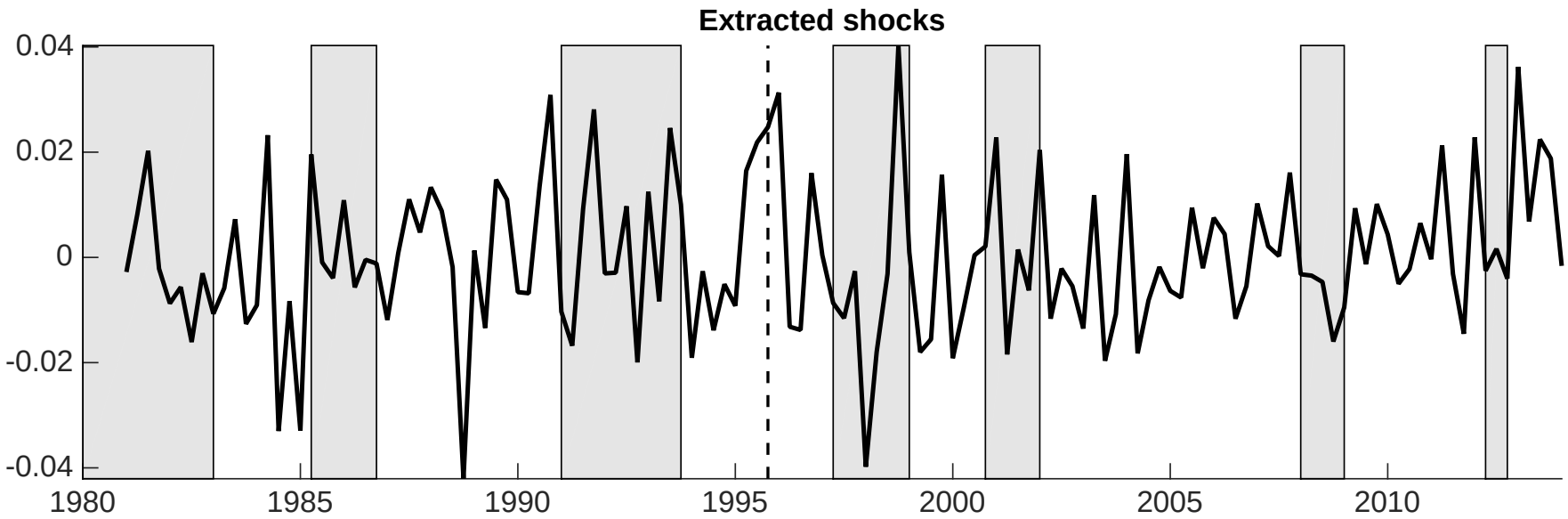
1. Output multiplier is larger during the ZLB period.

2. A standard NK model with not too persistent government spending shock in the ZLB period caused by low confidence can explain some of the empirical features.

THANK YOU

Extra Slides

EXTRACTED SHOCKS $\widehat{\epsilon}_t$



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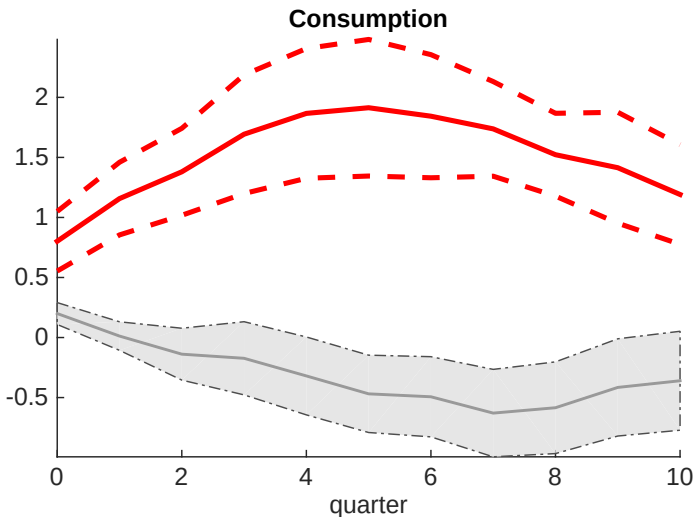
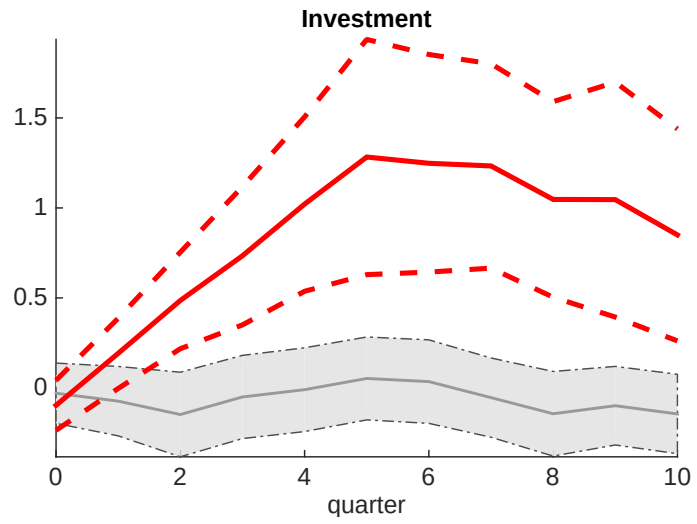
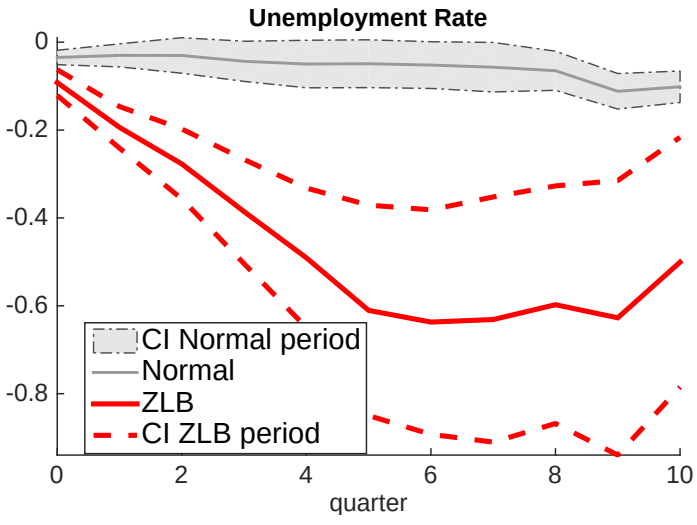
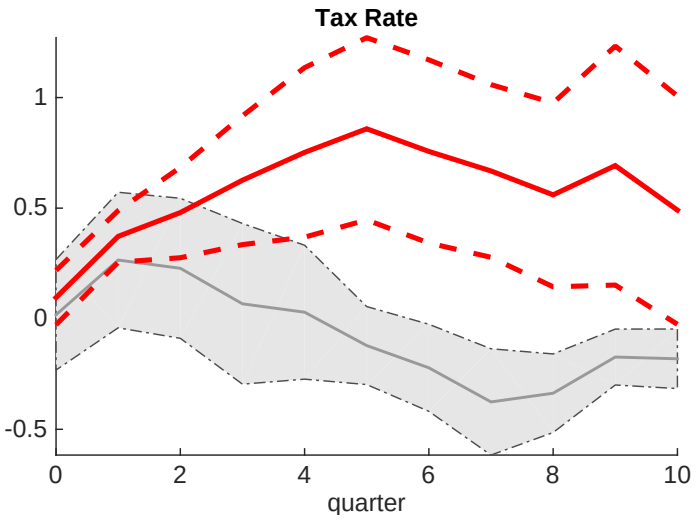
Other Variable Multipliers









Other Variables

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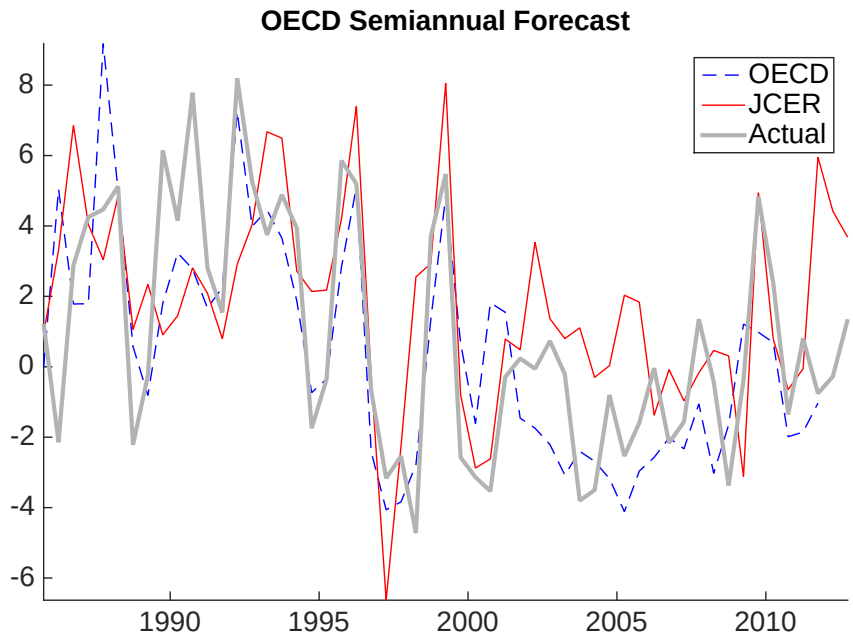
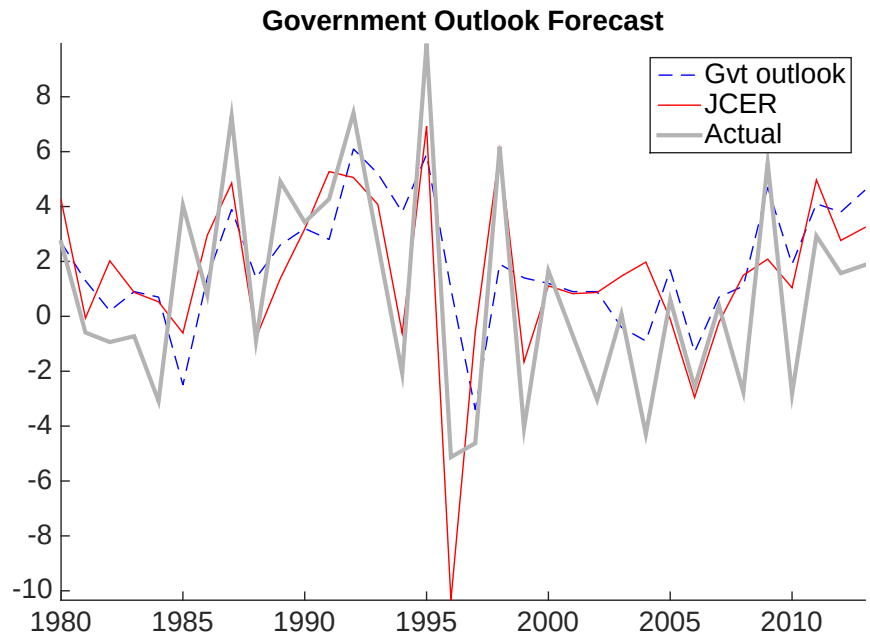
Components

JCER vs Other Forecast





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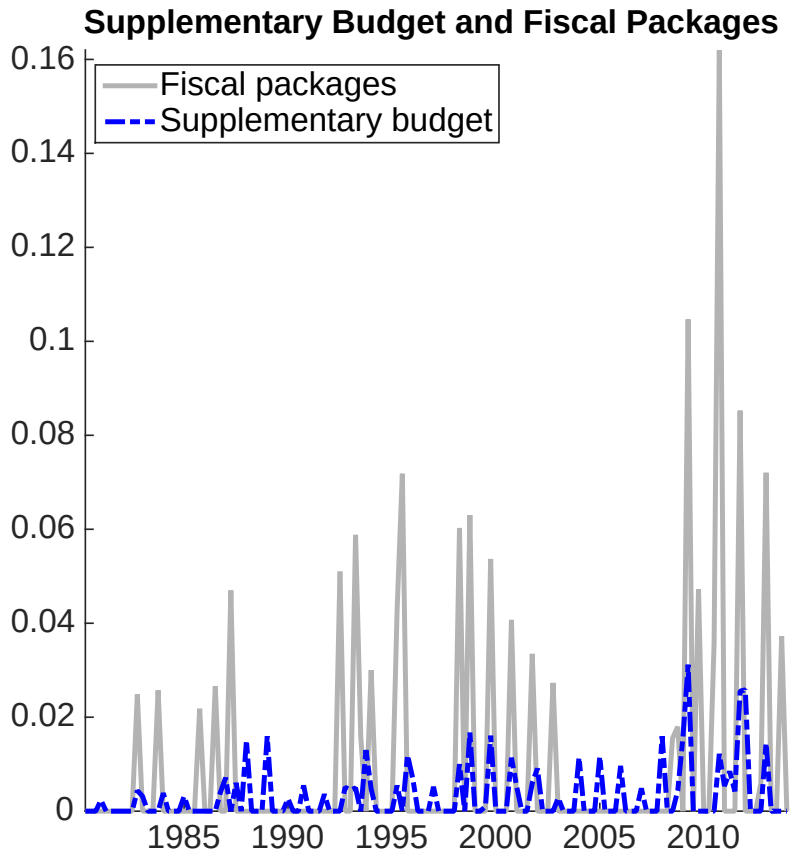
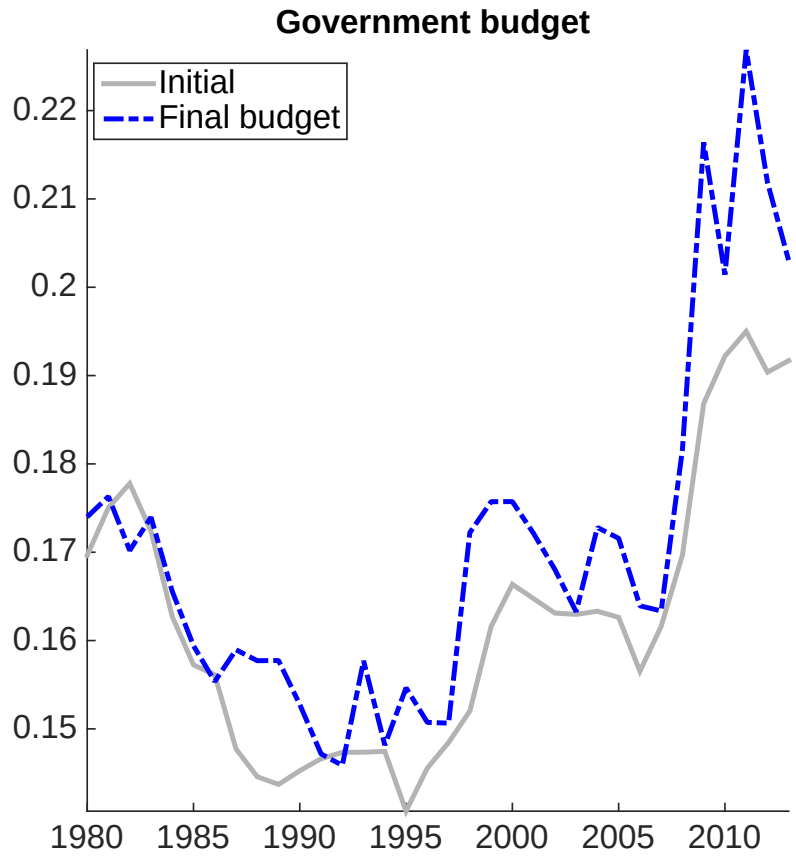
Non-standard Changes to the Budget





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Importance of Forecast Data

How "predictable" the G shocks without forecast?

- Project G-growth on past observables

$$\Delta \ln G_t = \alpha + \psi(L) y_{t-1} + \epsilon_t^g$$

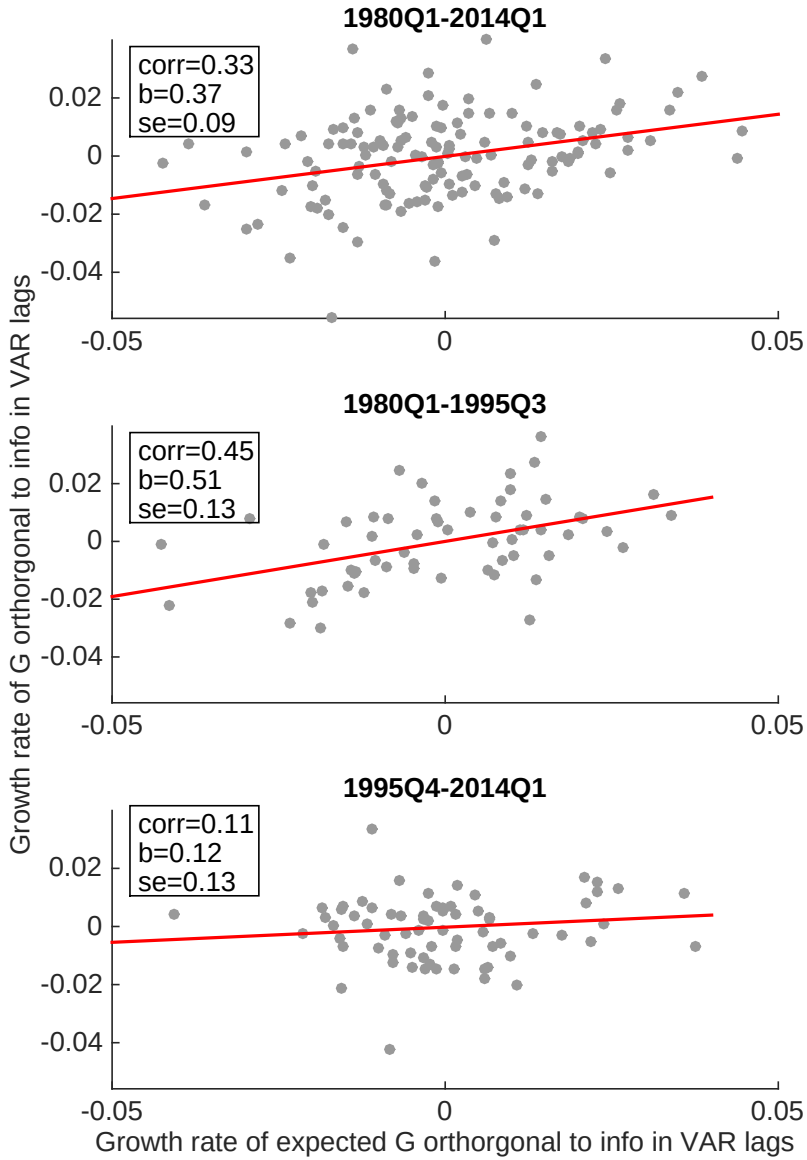
- Project forecasted G-growth on observables

$$\Delta F_{t-1} \ln G_t = \alpha + \psi(L) y_{t-1} + \epsilon_t^{Fg}$$

- If forecasts are useless, no correlation between $\widehat{\epsilon}_t^g$ and $\widehat{\epsilon}_t^{Fg}$

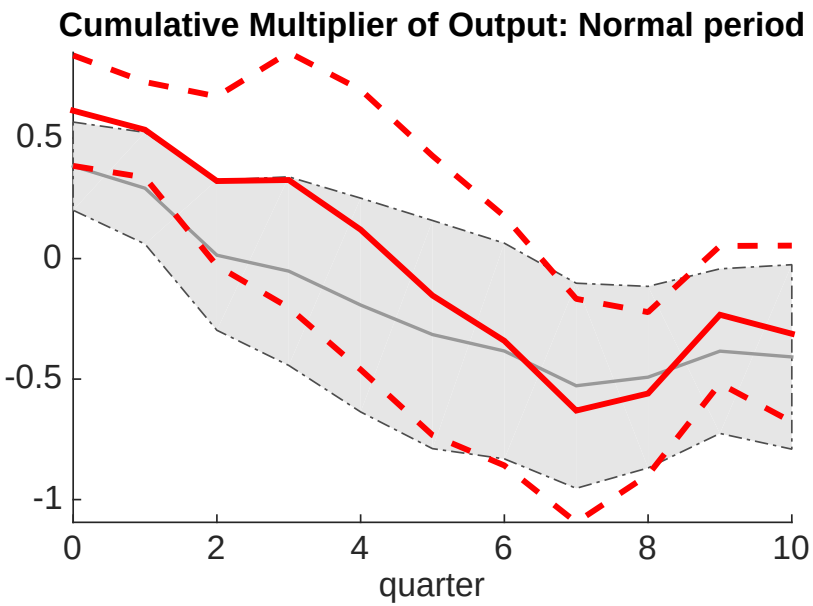
Back

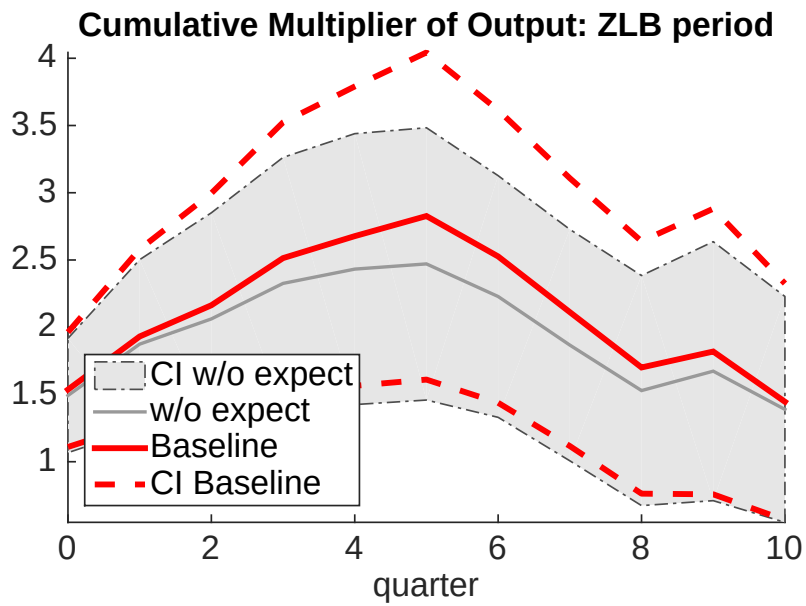
$\widehat{\epsilon}_t^g$ vs. $\widehat{\epsilon}_t^{Fg}$



Output Multipliers

with and without Forecast Data





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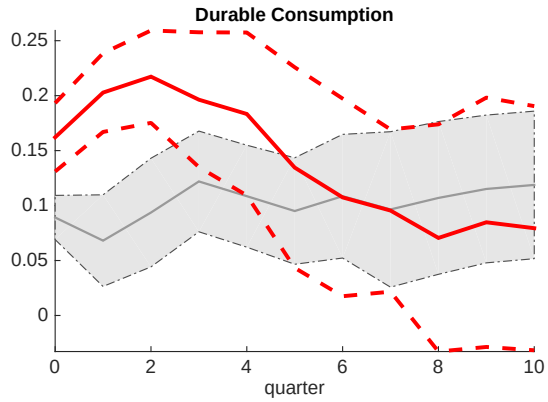
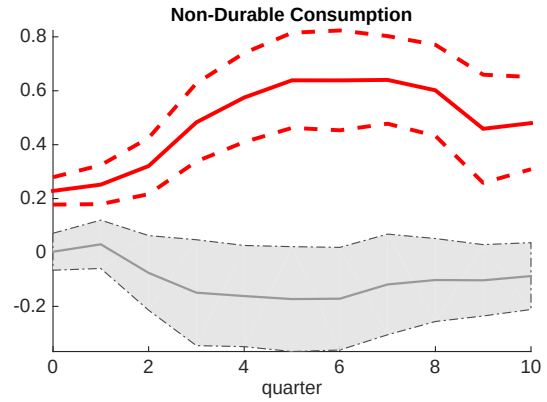
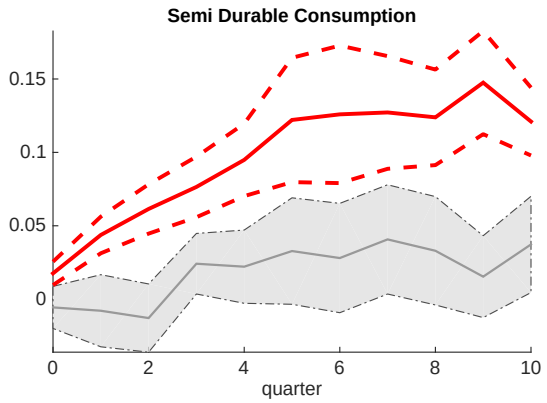
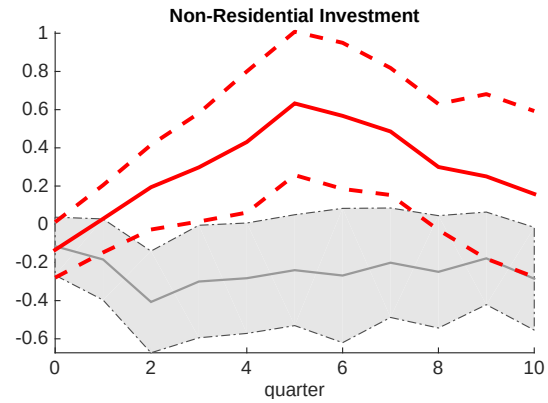
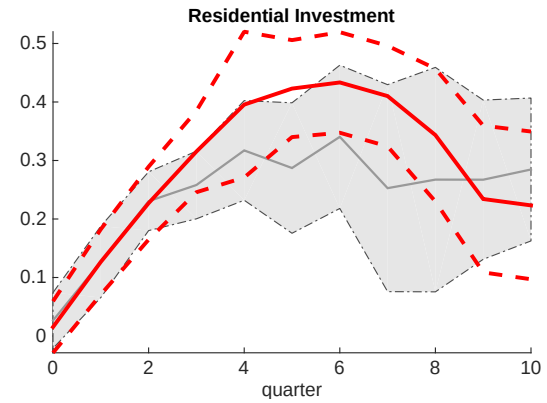
COMPONENTS OF C AND I











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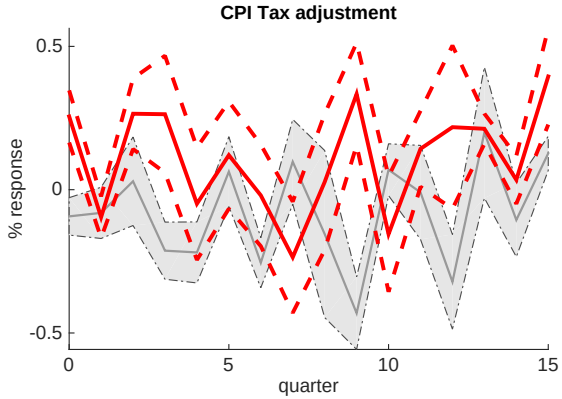
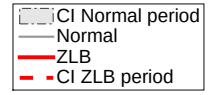
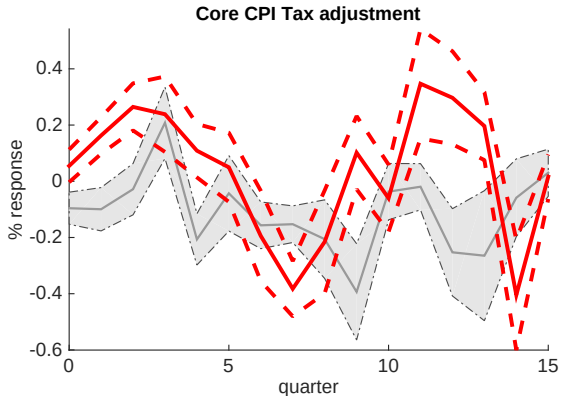
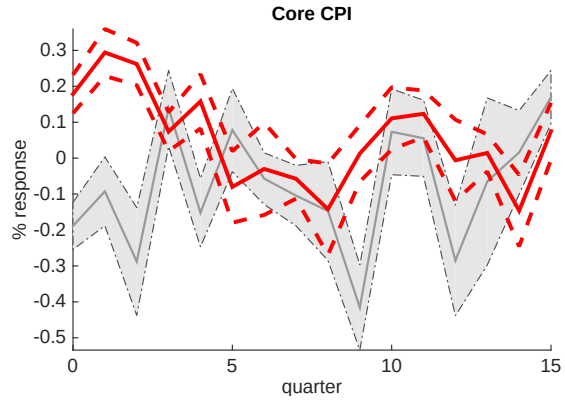
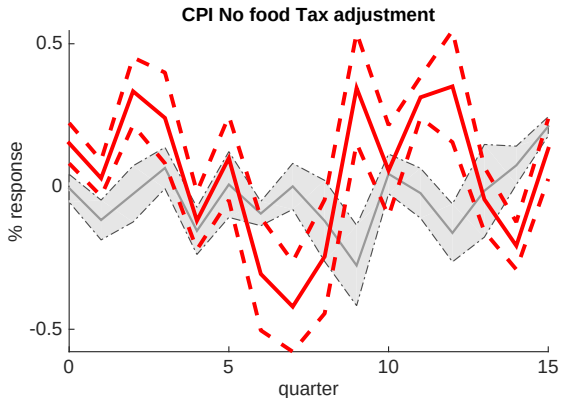
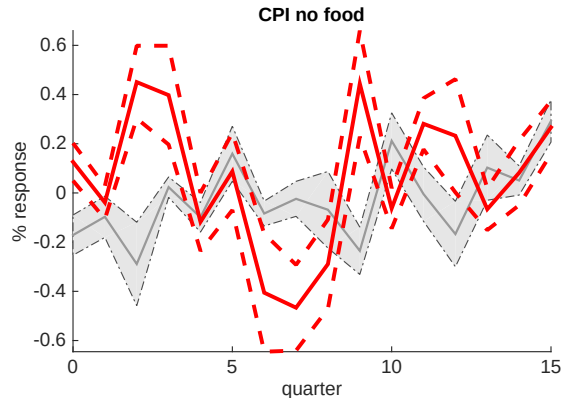






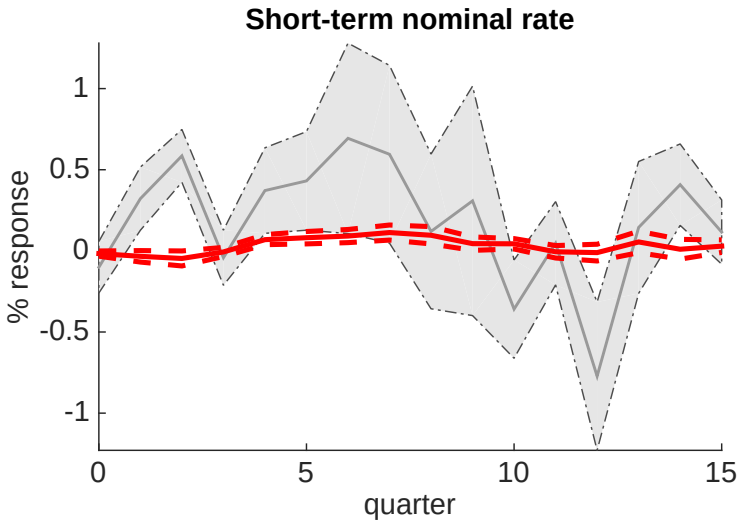


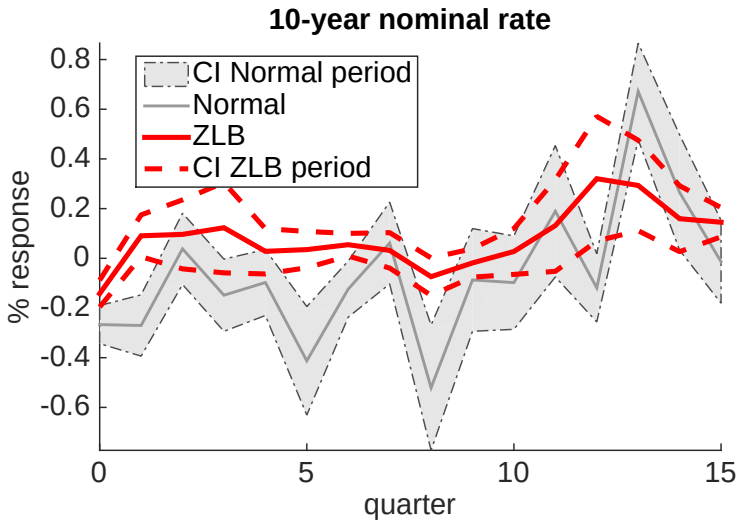




◂ Back to Inflation ◂ Back to Overview

Nominal Interest Rate





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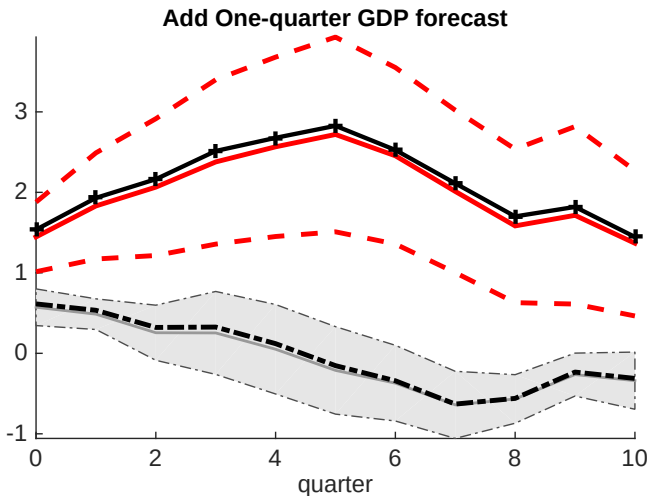
ROBUSTNESS

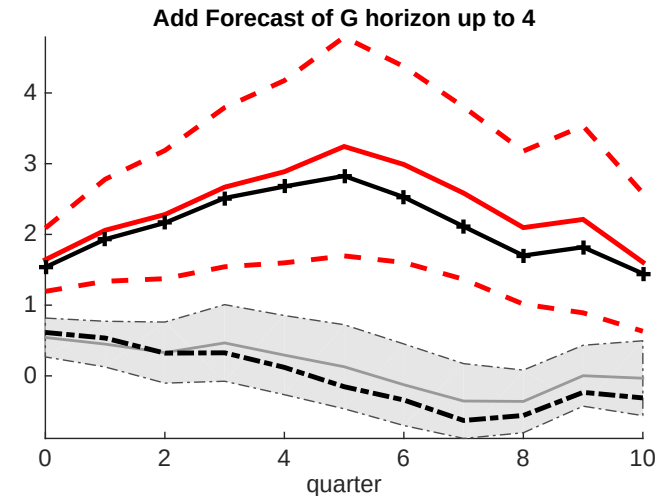
Results do not change if we add

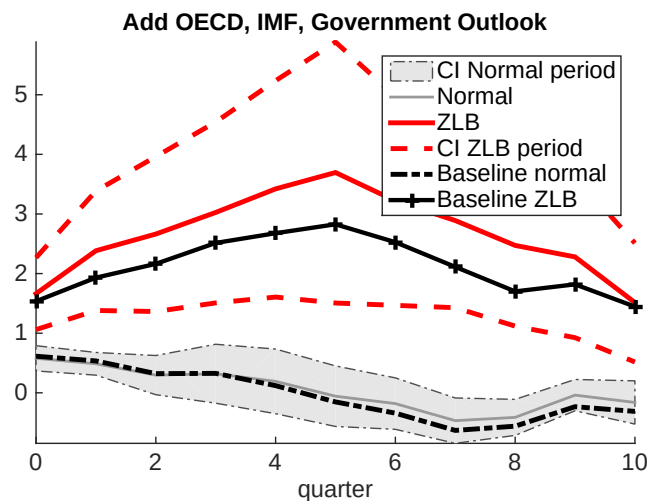
- 1-quarter ahead GDP forecast
- 1-year ahead GDP forecast
- 2-year ahead GDP forecast
- 1-year ahead G forecast
- 2-year ahead G forecast
- OECD semiannual measures of expectations
- IMF quarterly (since 2003) measures of expectations

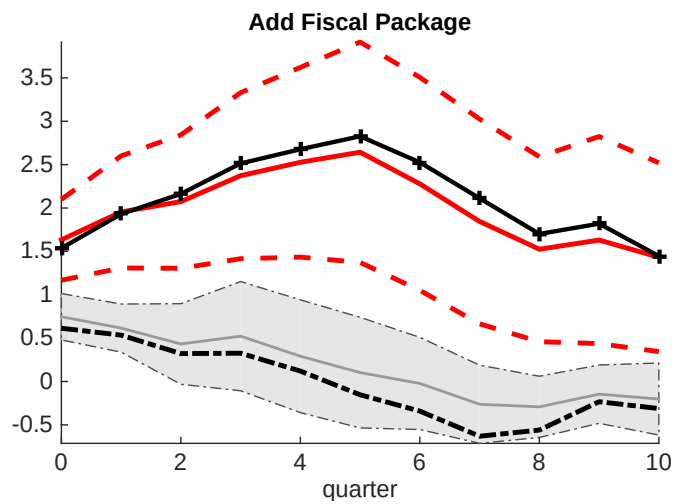
◂ Back ▸ More controls ▸ Longer-term controls

Additional Forecast Controls









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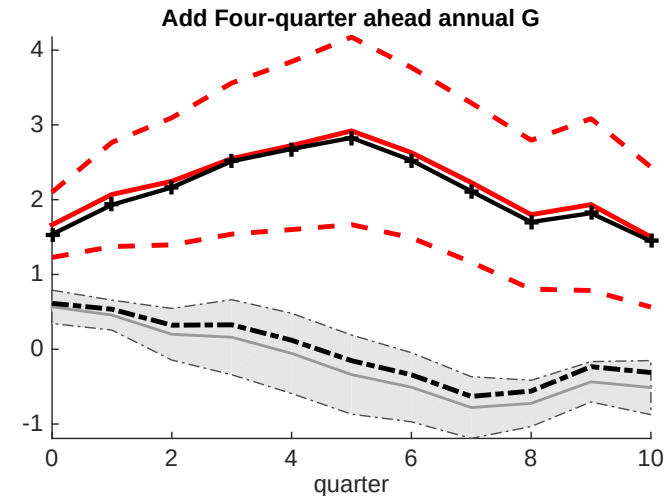
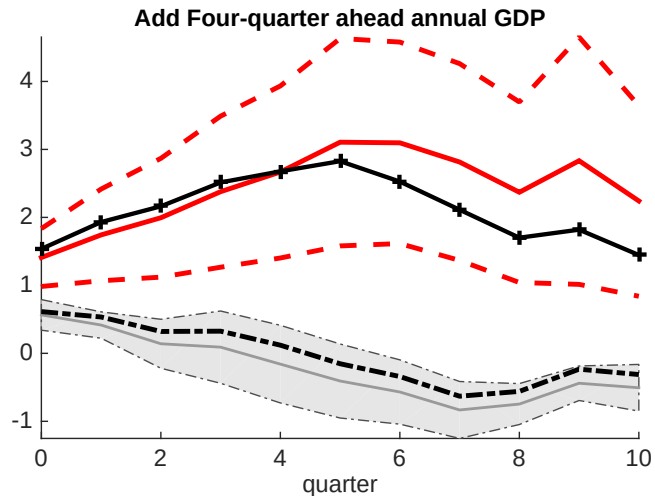
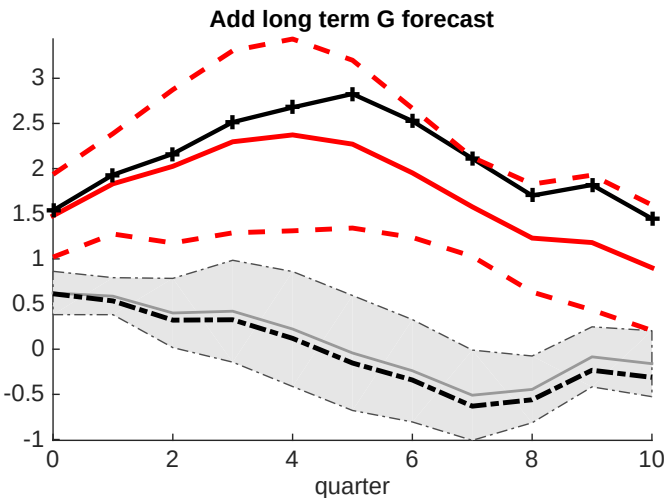
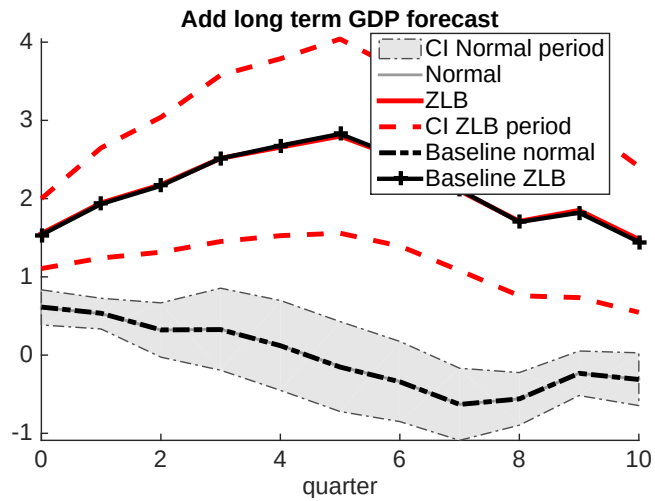
Longer-term Forecast Controls









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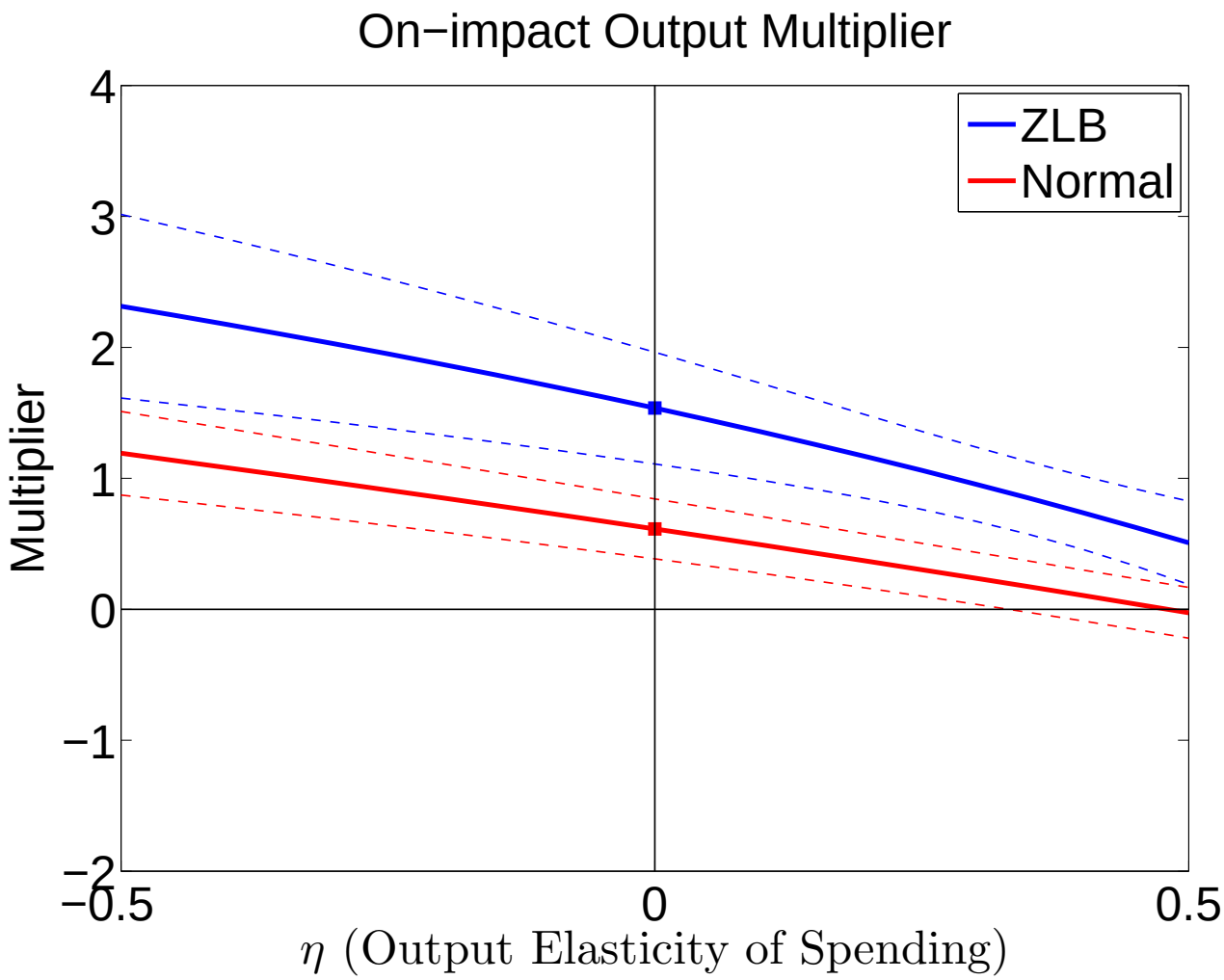
Elasticity of G to Y



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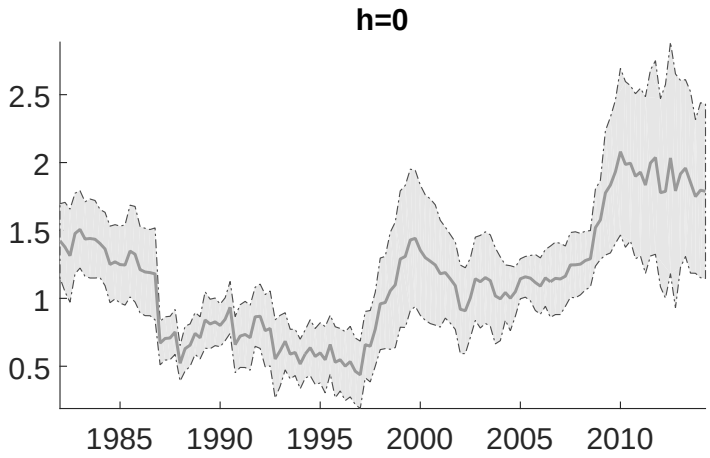
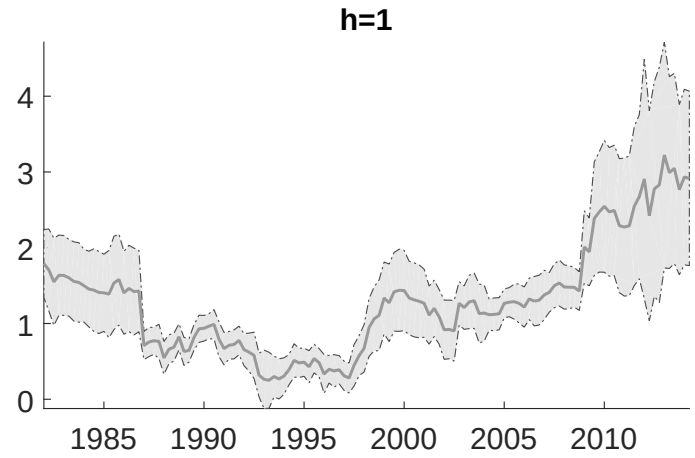
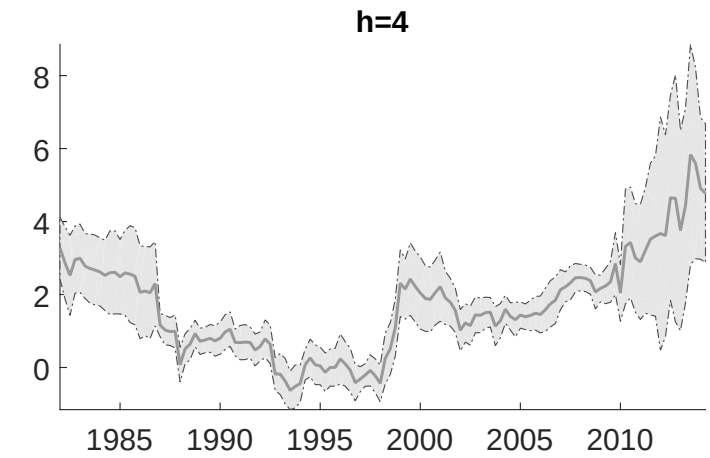
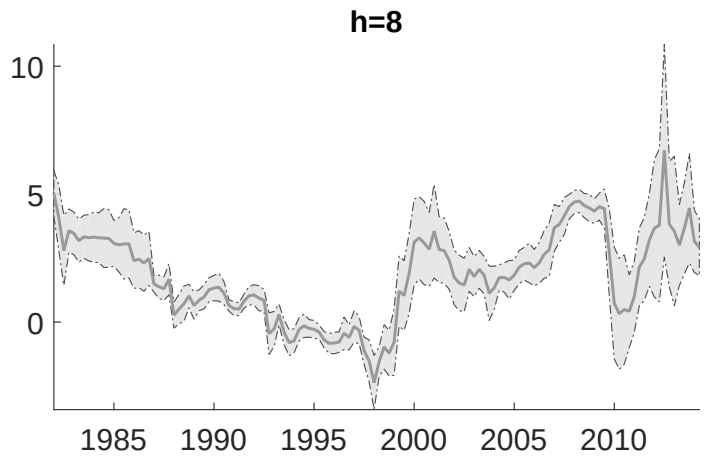
Rolling Multipliers Estimation









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Model

IS and Phillips curves

$$\widehat{y}_t - \widehat{g}_t = \mathbb{E}_t\left(\widehat{y}_{t+1} - \widehat{g}_{t+1}\right) - \widetilde{\sigma}\left(i_t - \mathbb{E}_t\pi_{t+1} - r_t^{net}\right)$$
$$\pi_t = \beta\mathbb{E}\pi_{t+1} + \kappa\left(\widehat{y}_t - \Gamma\widehat{g}_t\right)$$

Monetary policy

$$i_t = \max\left\{0, (1-\rho_i)(\bar{r} + \phi_\pi\pi_t + \phi_y\widehat{y}_t) + \rho_i i_{t-1}\right\}$$

Fiscal policy

$$\widehat{g}_t = \begin{cases} \widehat{g}_t^{estimated} & 0 \le t \le 15 \\ \widehat{g}_{15}^{estimated} \cdot \rho^{t-15} & t > 15 \end{cases}$$

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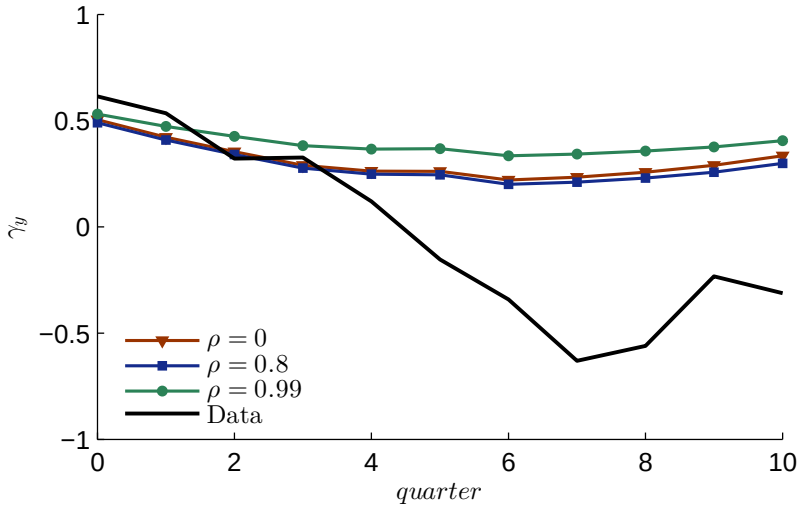
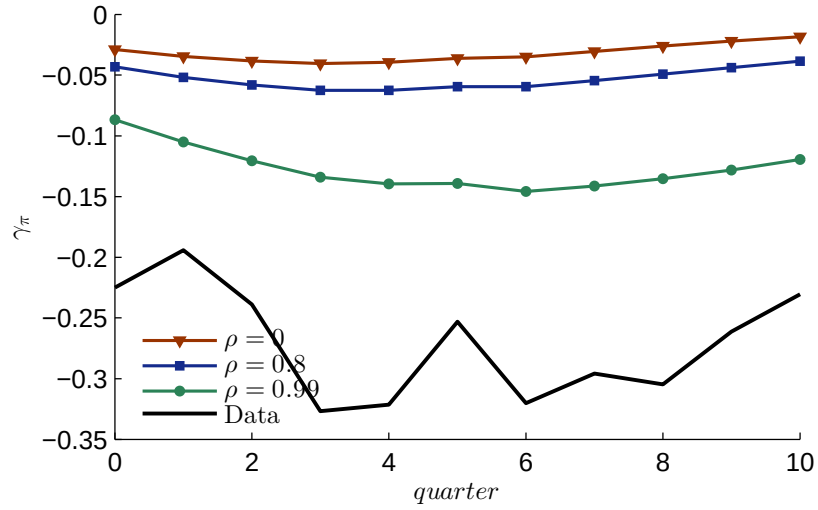
TAYLOR RULE



Output Multipliers



Inflation Multipliers

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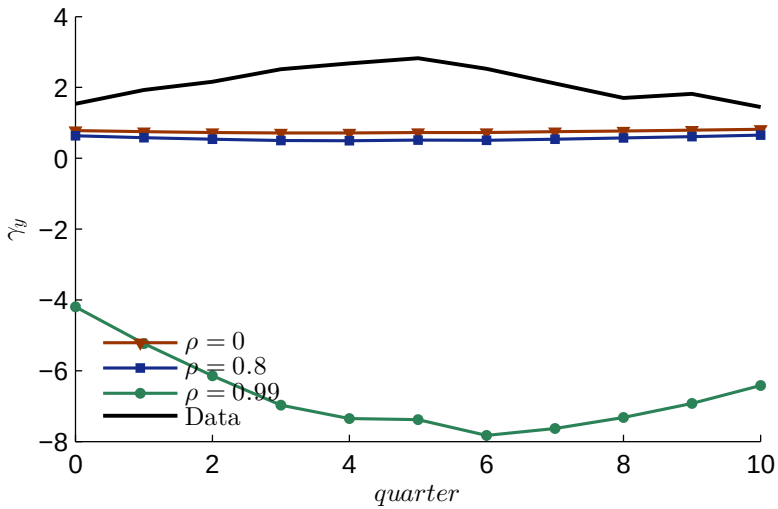
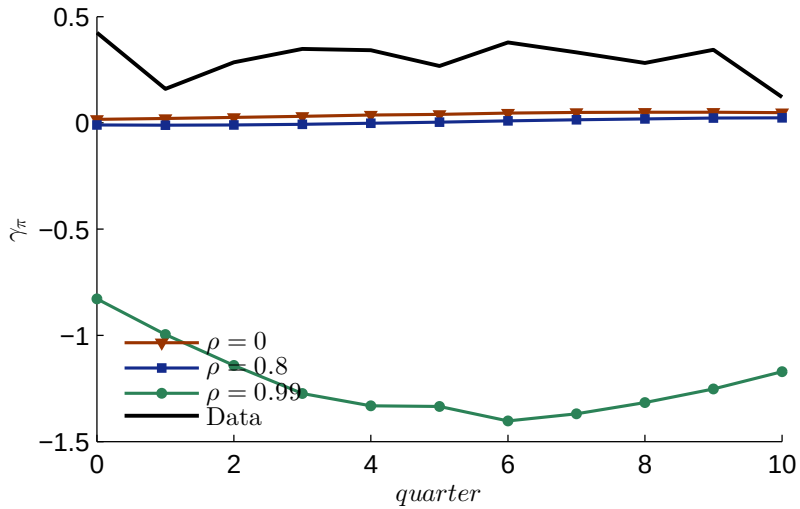
Temporary Interest Rate Spreads Shock



Output Multipliers



Inflation Multipliers

Expected duration of ZLB: 2 years

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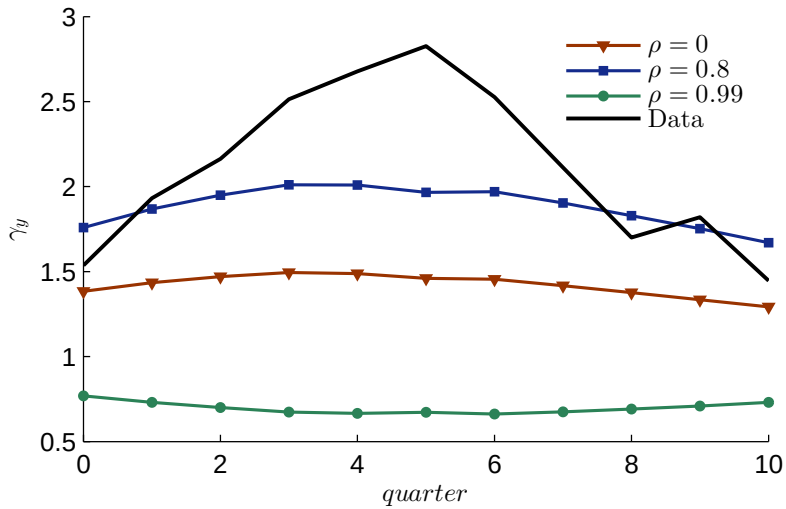
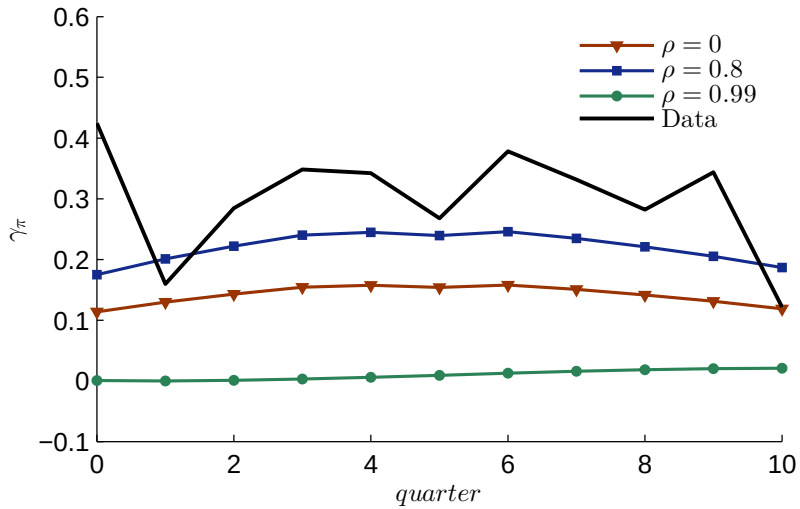
Deflationary Trap



Output Multipliers



Inflation Multipliers

Expected duration of ZLB: 5 years

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