Is There a Fiscal Free Lunch in a Liquidity Trap?

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Federal Reserve Board

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Motivation

- Many countries implemented large fiscal expansions to offset sharp declines in economic activity

  – fiscal stimulus typically consisted of both tax cuts and increases in government spending.

- Key question is the size of the fiscal multiplier:

  – how much does GDP rise when government spending rises by 1 percent of GDP, or taxes fall by a similar magnitude?

Textbook Economic Theory

- Economic theory suggests a government spending multiplier of less than unity at medium-term horizons.

  – Higher demand from the government "crowds out" private demand.

- Private demand falls as:

  – higher real interest rates reduce domestic demand

  – higher taxes reduce permanent income and hence consumption.

  – real exchange rate appreciation reduces net exports.

Empirical Evidence on Government Spending Multiplier

- Estimates typically positive, but span fairly wide range from roughly 0.5 to modestly above 1 at horizons of 1-2 years.

- Two dominant approaches:

  – Examine how military buildups affect output.

  (Barro 1981, Ramey and Shapiro 1988, Ramey 2007, Hall 2009)

  – Structural VARS: in practice, Choleski factorization with government spending ordered first.

  (Blanchard and Perotti 2002, Perotti 2004, Gali, Lopez-Salido, Valles 2007).

Government Spending in a Liquidity Trap

- Estimated multipliers largely based on post-war data.

- Fiscal expansion may have larger effects in a liquidity trap given that monetary policy is not expected to raise interest rates for some time.

  – Keynes (1933, 1936)

- Key advantage of structural models is that they allow explicit consideration of how monetary policy affects the multiplier (including through the zero bound constraint).

Our paper

- We use a DSGE modeling framework to assess how the government spending multiplier is affected by a liquidity trap.

- "Liquidity trap" is a situation in which the central bank would like to reduce interest rates below zero, but is precluded due to the zero bound constraint.

- Examine three variants of the New Keynesian model

  – simple sticky price model w/o capital.

  – variant of the Smets-Wouters (2007) model.

  – Smets-Wouters (2007) model augmented with financial frictions (Bernanke, Gertler, and Gilchrist 1999) and hand-to-mouth agents (Erceg et al 2007).

Key Results

- Fiscal multiplier can be amplified substantially in a deep and prolonged liquidity trap.

- Larger multiplier means that government spending hike may put little upward pressure on public debt ("fiscal free lunch"!)

- Corroborates previous DGSE analysis showing that government spending can have outsized effects when monetary policy allows real interest rates to fall:

  –Eggertson (2008), Davig and Leeper (2009), and Christiano, Eichenbaum, and Rebelo (2009), Woodford (2010).

Why Pass on a Free Lunch?

- Key methodological innovation is to allow economy's exit from the liquidity trap trap to be determined endogenously.

  – multiplier decreases in the size of the fiscal response because higher fiscal spending pushes the economy out the liquidity trap more quickly.

- Crucial to distinguish between the average and marginal multiplier.

  – Under conditions in which marginal multiplier is very high for low increments to spending, it drops very quickly at higher spending levels.

  – In choosing the scale of fiscal response, need to know the marginal multiplier for various spending levels.

Identify (Other) Key Determinants of Multiplier

- Duration of liquidity trap.

- Sensitivity of expected inflation

  – depends on slope of Phillips Curve and monetary policy rule.

- Implementation lags (as in the U.S. stimulus plan)

- Nature of tax adjustment (cp. Uhlig 2009).

Conclusions

- In a deep and prolonged liquidity trap, modest increases in fiscal spending can have large output effects, and nearly "pay for themselves."

- But the benefits diminish sharply in the level of spending, especially if implementation lags are pronounced.

- High estimates of multipliers hinge on large movements in expected inflation.

- Crucial to determine marginal impact of fiscal spending initiatives, as marginal effect may be much lower than average.

Agenda

- Fiscal expansion in simple New Keynesian model.

  – identify factors that affect multiplier, and differentiate average vs. marginal response.

- Parallel analysis in Smets-Wouters (2007) model.

- Extend to variant with financial frictions and hand-to-mouth agents.

- Conclusions

Simple New Keynesian Model

- IS Curve

$$x_t = x_{t+1|t} - \hat{\sigma}(i_t - \pi_{t+1|t} - r_t^{pot})$$

- Price-Setting

$$\pi_t = \beta \pi_{t+1|t} + \kappa_p x_t$$

- Monetary Policy

$$i_t = \max\left[-i, \gamma_\pi \pi_t + \gamma_x x_t\right]$$

Potential Real Rate

$$r_t^{pot} = \frac{1}{\hat{\sigma}}\left(1 - \frac{1}{\hat{\phi}_{mc}}\right)\left[g_y(g_t - g_{t+1|t}) + (1 - g_y)\nu_c(\nu_t - \nu_{t+1|t})\right.$$

Simple New Keynesian Model (con't)

- Taste (consumption preference) shock

$$\nu_t = (1 - \rho_\nu)\nu_{t-1} + \varepsilon_{\nu,t}$$

- Govt spending shock (Implementation Lags)

$$g_t - g_{t-1} = \rho_{g_1}(g_{t-1} - g_{t-2}) - \rho_{g_2} g_{t-1} + \varepsilon_{g,t}$$

- Government Debt

$$b_t = (1 + r)b_{t-1} + g_y(g_t - l_t - \zeta_t) - \tau_t$$

Benchmark Calibration

- As in Adam and Billi (2006) and Eggertson (2008), monetary policy assumed to completely stabilize economy after exit from trap ($\gamma_\pi = 500$, $\gamma_x = 500$).

- Steady state inflation 2 percent, nominal interest rate 4 percent ($\beta = 0.995$, $\pi = 0.005$).

- Price contracts five quarters, $\xi_p = 0.8$, slope of Phillips curve (with homogenous factor markets) then 0.05.

- Frisch elasticity $= 0.4$ ($\chi = 2.5$).

- Labor share $= 0.7$ ($\alpha = 0.3$)

- Government spending share $= 0.2$.

- Both Shocks AR(1) with persistence 0.9 (but later also allow AR(2) as in Uhlig).

Some Implications of Calibration

- Unconstrained policy implies complete stabilization of inflation and the output gap (no tradeoffs).

  – output equals potential output, and real interest rate equals potential real interest rate.

  – movements in nominal interest rate track potential real rate.

- When policy constrained by ZLB, exit from liquidity trap as soon as the potential real rate rises above $-i$.

- Taste shock set so that duration of the liquidity trap is $T_n = 8$ quarters in baseline.

Figure 1a: Negative Taste Shock and Fiscal Response

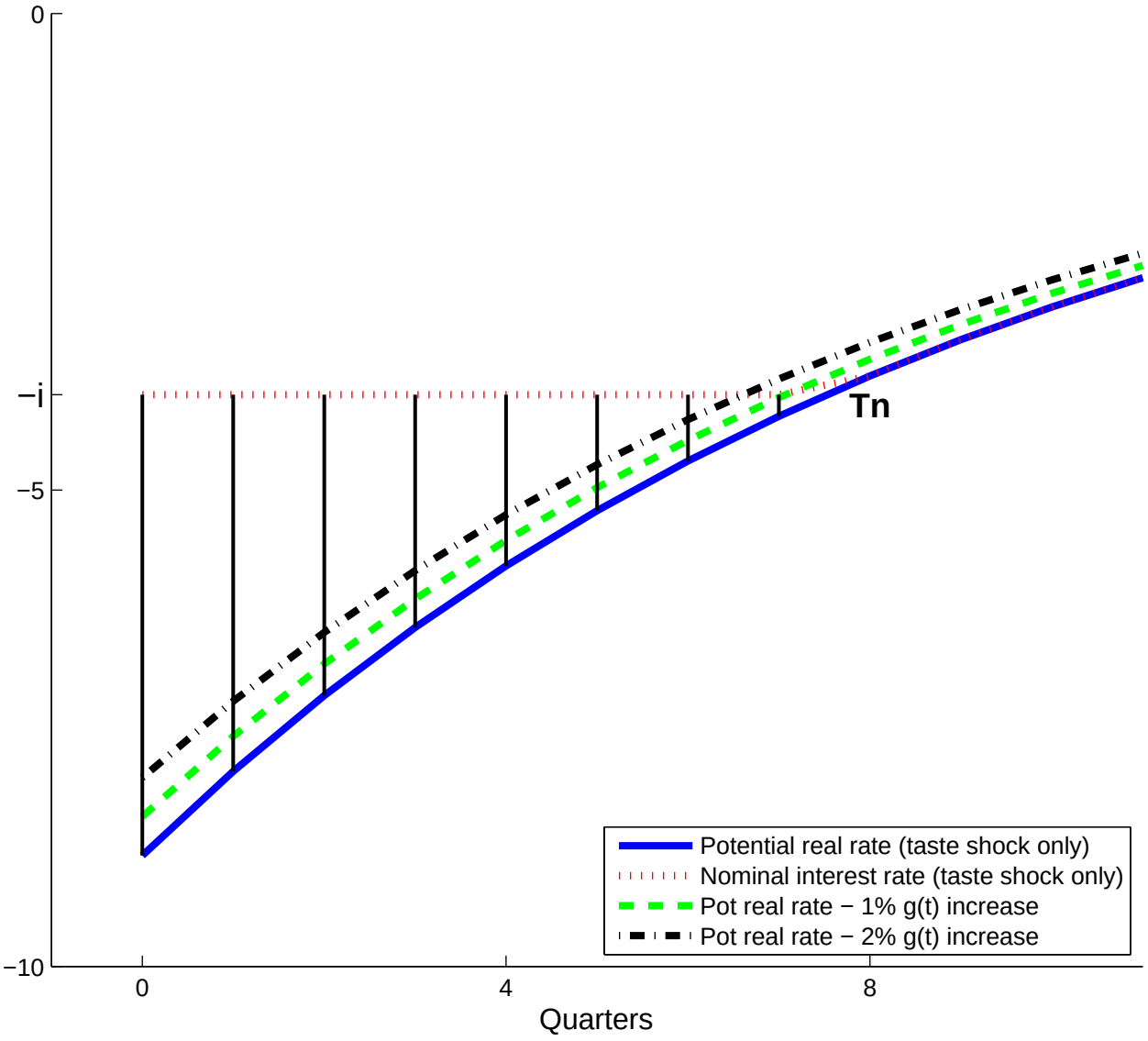
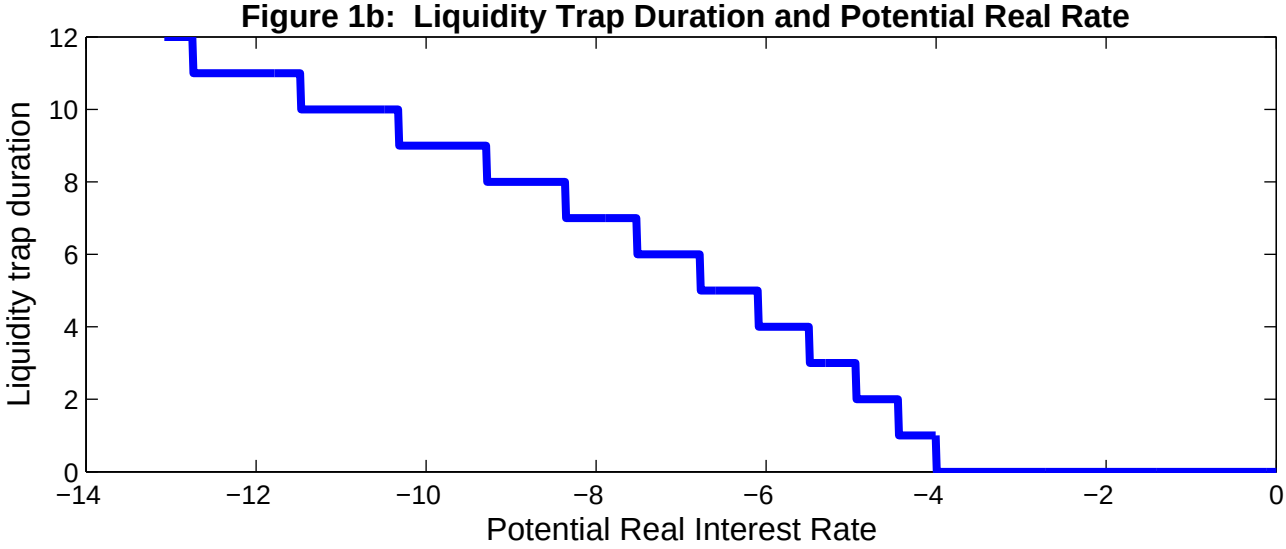


Figure 1b: Liquidity Trap Duration and Potential Real Rate



Output Gap in a Liquidity Trap

- Helpful to rewrite IS curve as:

$$x_t = -\hat{\sigma} \sum_{j=0}^{T_n-1} (-i - r^{pot}_{t+j|t}) + \hat{\sigma} \sum_{j=1}^{T_n} \pi_{t+j|t} + x_{T_n}$$

- The output gap x_t at any date $t < T_n$ depends on:
  - the cumulative gap between $-i$ and r_t^{pot} over the interval the economy remains in a liquidity trap. This (first) term shows how shocks to r_t^{pot} would affect x_t if inflation were constant.
  - cumulated expected inflation over the duration of the liquidity trap (second term).
  - The output gap x_{T_n} when the economy exits the liquidity trap. Under complete stabilization, $x_{T_n} = 0$.

- The exit date T_n is endogenously determined.

The Multiplier when Inflation is Constant

- Outsized Multiplier Monetary policy leaves interest rates unchanged in response to higher government spending (and higher r_t^{pot}).

- Multiplier Rises in Duration of Trap.

- Duration of Trap Declines with Size of Spending Hike:

$$T_n = min_j(r^{pot}_{t+j|t} > -i)$$

- Implies that the multiplier declines discretely as g_t exceeds various threshold levels.

Expected Inflation Channel

- The IS curve and price-setting equation can be solved forward to yield:

$$\pi_t = -\widehat{\sigma}\kappa_p \sum_{j=0}^{T_n-1} \varphi(j)(-i - r^{pot}_{t+j|t})$$

- The weights φ_j are positive and determined by:

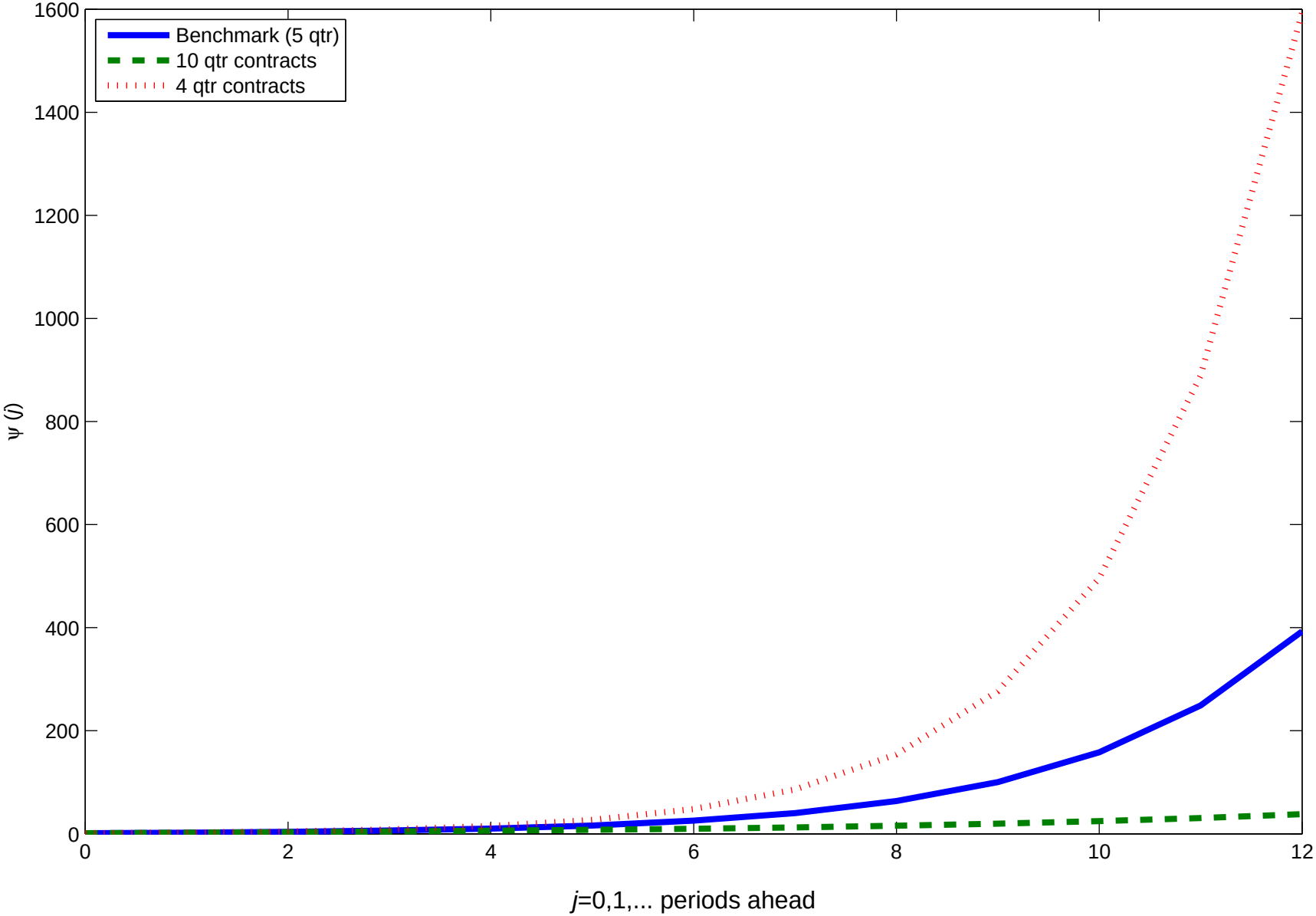
$$\varphi_j = \lambda_1 \varphi(j-1) + \lambda_2^j$$

subject to $\varphi(0) = 1$, and coefficients given by $\lambda_1\lambda_2 = \beta$ and :

$$\lambda_1 + \lambda_2 = 1 + \beta + \widehat{\sigma}\kappa_p$$

- Weights increase sharply in the duration of the liquidity trap (with the increase more dramatic as prices adjust more quickly)

Figure 4a. Weights on Leads of the Interest Rate Gap in Inflation Equation

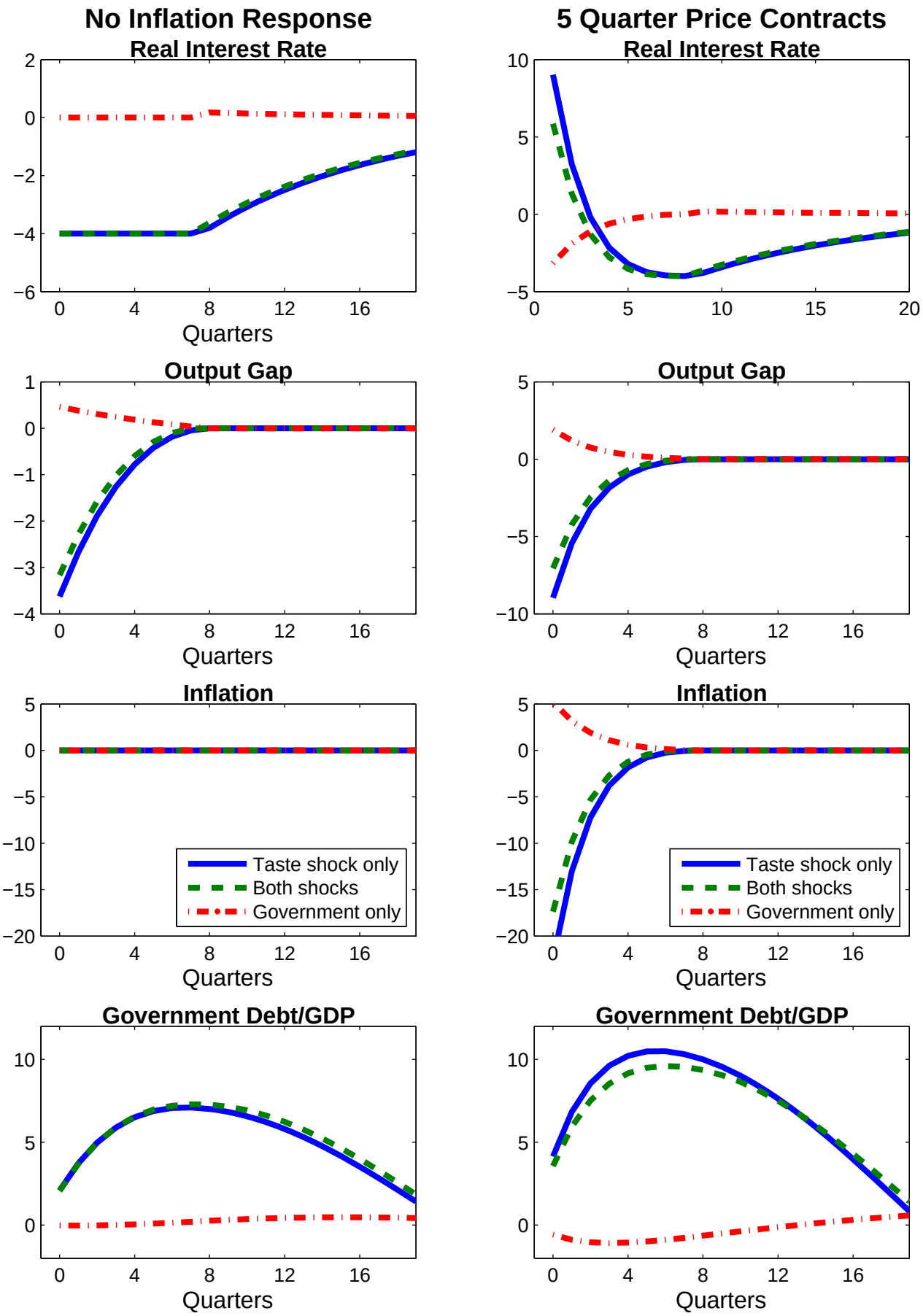


Govt Spending in New Keynesian model

- Figure 2 shows effects of 1 percent of baseline GDP rise in government spending assuming:
  - long-lived liquidity trap of 8 quarters
  - spending rise occurs immediately
  - higher spending financed with lump-sum taxes.

- Left column shows case where inflation constant, right column where price contracts last 5 quarters.

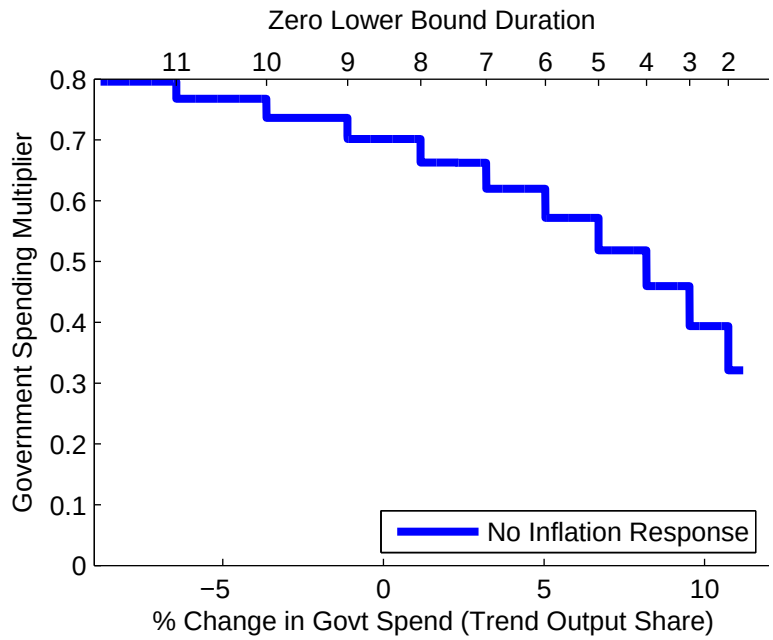
Figure 2: Immediate Rise in Government Spending

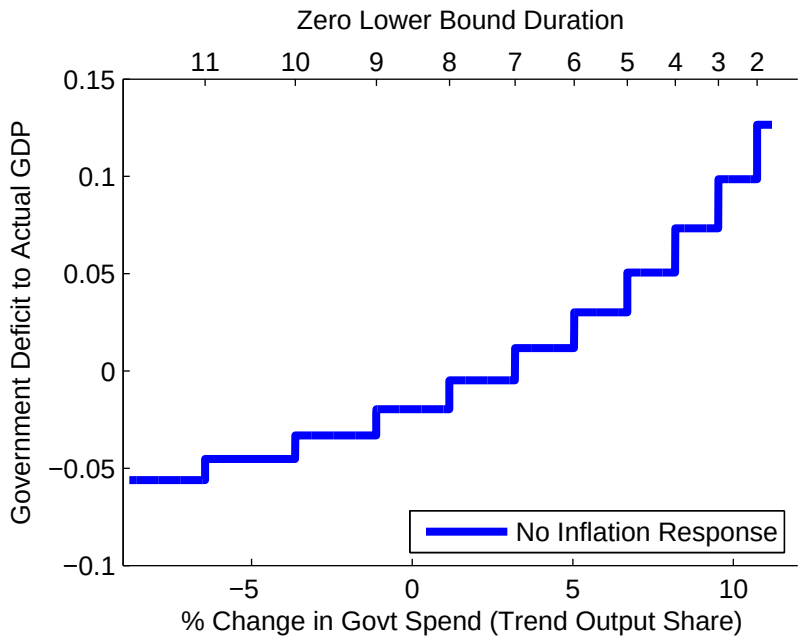


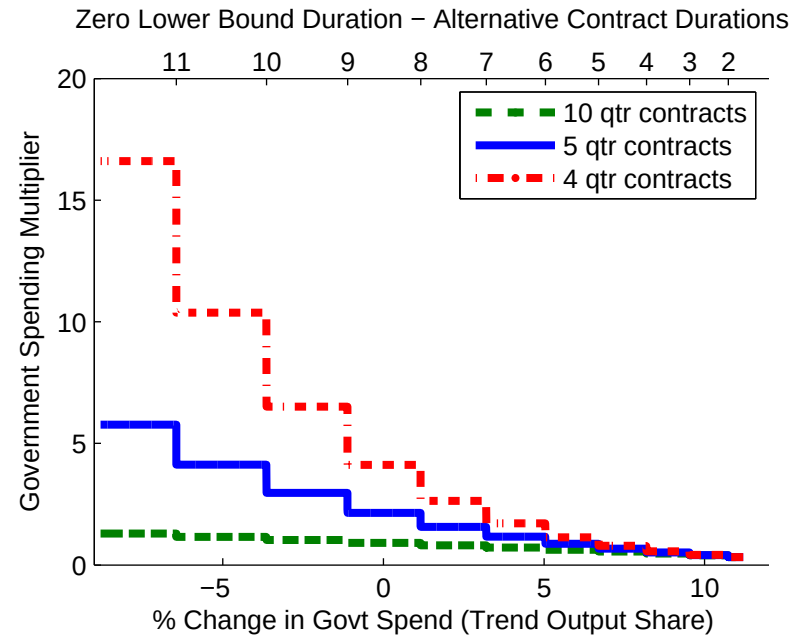
Size of Spending Plan: The Marginal Multiplier

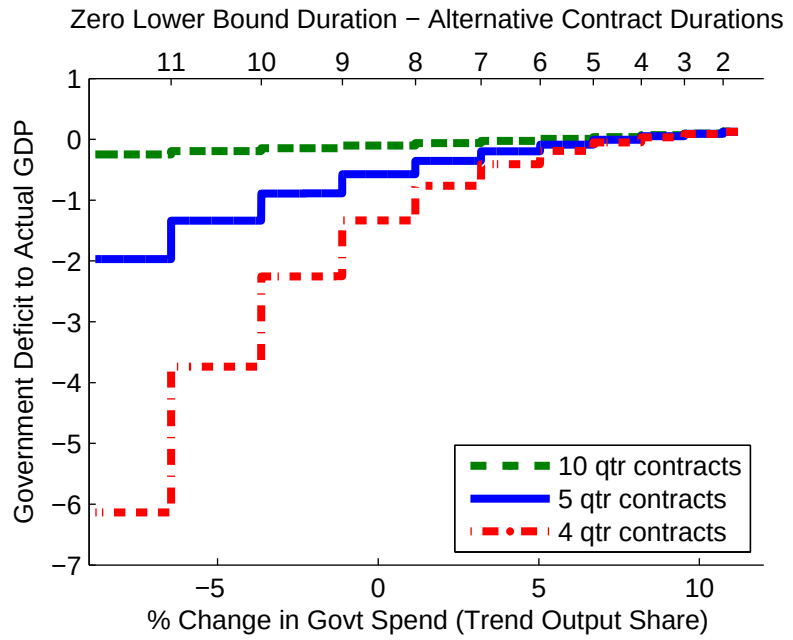
- Figure 3 plots the government spending multiplier (the impact response) as a function of the size of the stimulus plan when prices are completely sticky (very long contracts)
  - larger spending plans induce earlier exit from the trap, so that the multiplier declines with the size of the plan
  - multiplier eventually converges to the response under "normal" conditions in which policy is unconstrained
- Figure 3 also plots the marginal multipliers for shorter-lived contracts, i.e. higher slope of the Phillips curve
  - small increases/decreases in spending very stimulative/contractionary; but also means that multiplier declines sharply

Figure 3: Marginal Output and Government Deficit Spending Multipliers in the Simple New−Keynesian Model









Effects of Implementation Lags

- Finally, we study the effects of implementation lags.

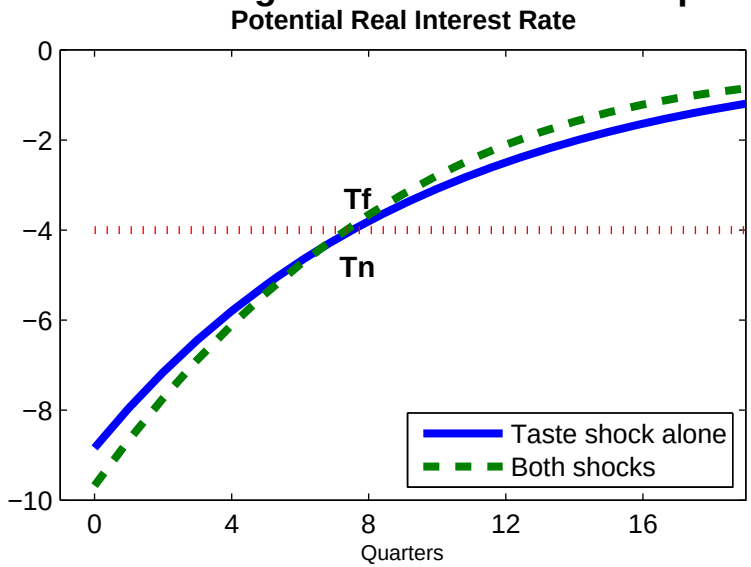
- To do this, we use the AR(2) process for government spending, i.e.

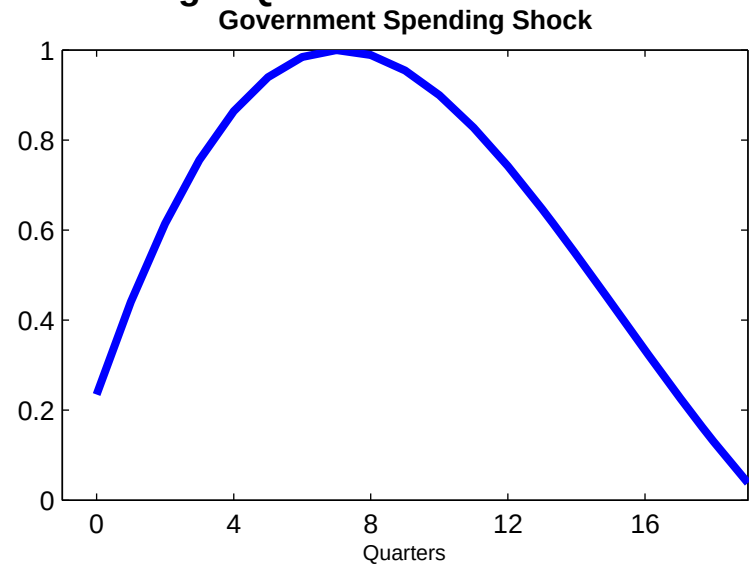
$$\Delta g_t = \rho_{g,1} \Delta g_{t-1} - \rho_{g,2} \left(g_{t-1} - g_y \right) + \varepsilon_{g,t},$$

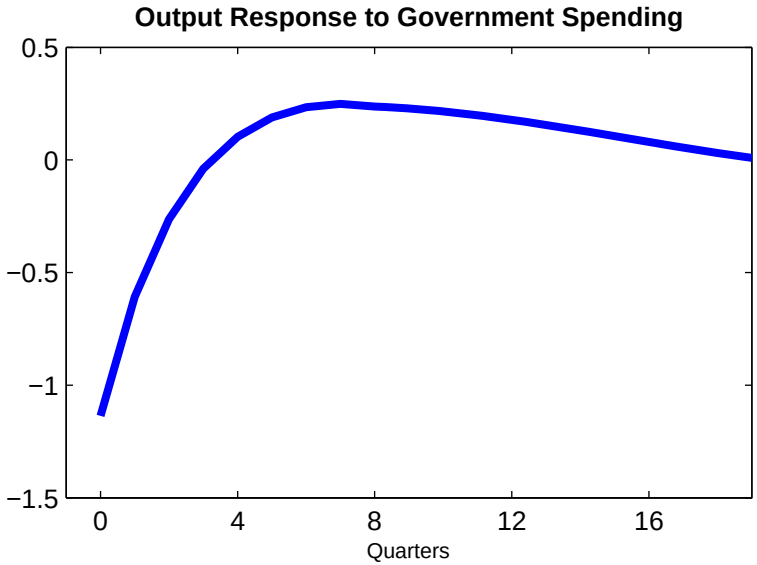
- We set $\rho_{g,1} = 0.9$ and $\rho_{g,2} = 0.025$ so that peak spending hike occurs after 8 quarters (i.e. at the exit date of the Liquidity trap without any spending).

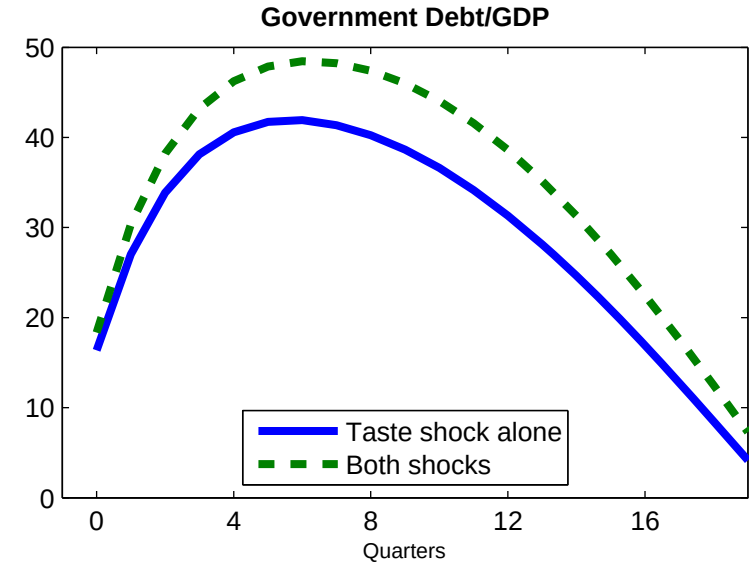
- Results are reported in Figure 4b.

Figure 4b: Government Spending Peaks after Eight Quarters









Model with Endogenous Capital

- The channels discussed remain operative in a "fully fledged" DSGE model with endogenous capital accumulation. Similar to Christiano, Eichenbaum, Evans (2005) and Smets-Wouters (2007), our model includes:

  –nominal price and wage stickiness (Calvo contracts).

  –external habit formation in preferences over consumption.

  –adjustment costs of changing the investment.

Calibration

- Calibration reflects the empirical estimates of CEE (2005), Smets and Wouters (2003), and recent work by ACEL (2010).

  – Effective duration of price contracts 10 quarters ($\psi_p = 0.9$), and of wage contracts 7 quarters ($\psi_w = 0.85$).

- Monetary policy follows Taylor rule with smoothing, except allows for larger inflation and output gap responses ($\gamma_i = 0.7, \gamma_\pi = 3, \gamma_x = 1$).

- Initial conditions (generated by adverse demand shock) chosen to match broad features of U.S. experience during recent recession.

- More flexible price and wage adjustment would imply very large inflation decline.

Figure 4a: Quasi First Difference of Change in Inflation versus Log, Marginal Cost

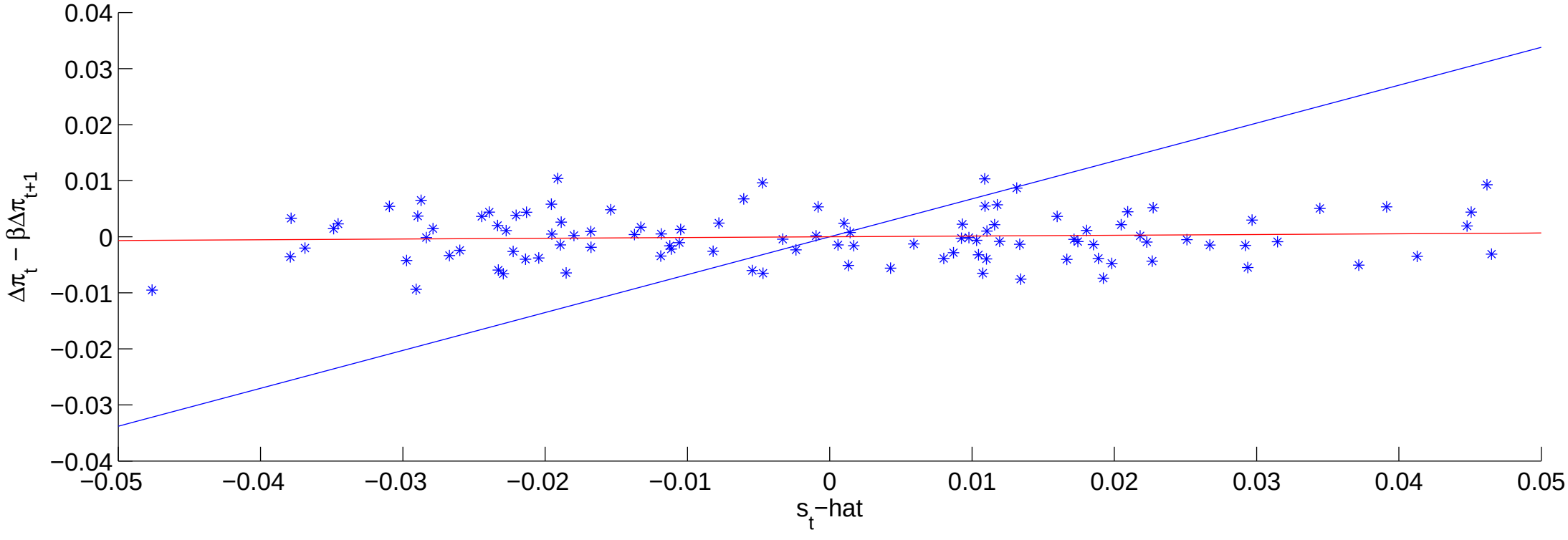


Figure 4b: Projection of Quasi First Difference of the Change in Inflation versus Projection of Log, Marginal Cost

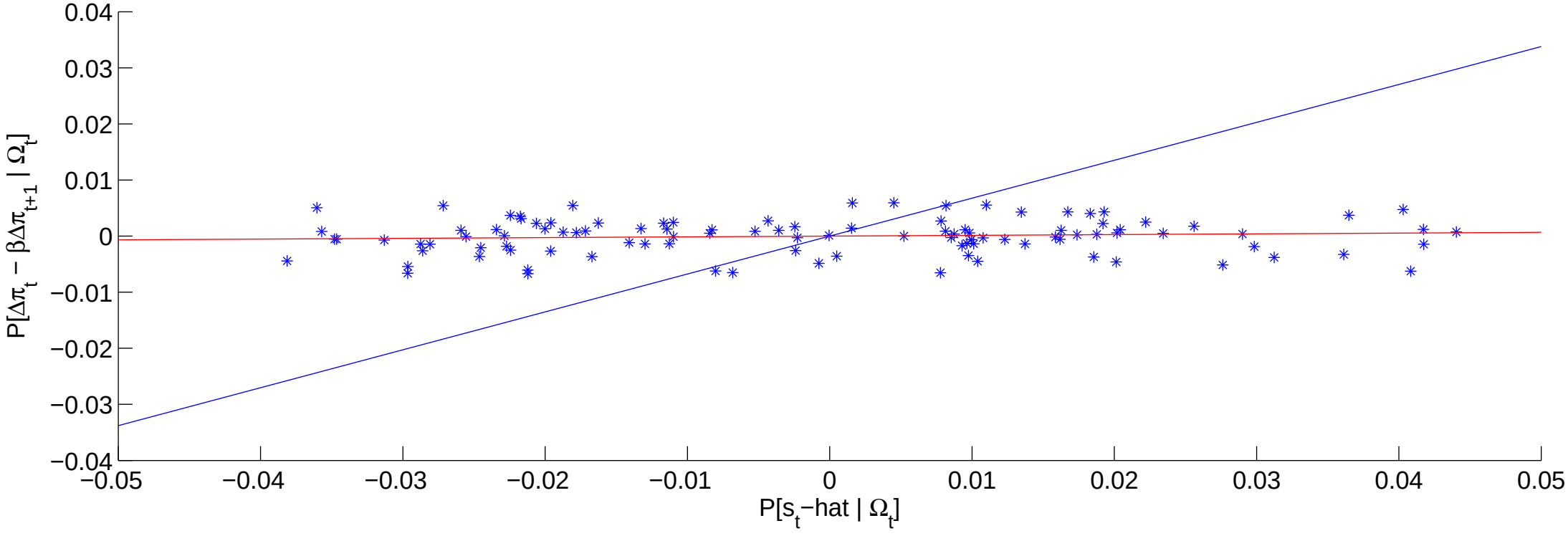


Figure 5a: Simulated and Actual Paths for Key Macroeconomic Variables in CEE/SW Model

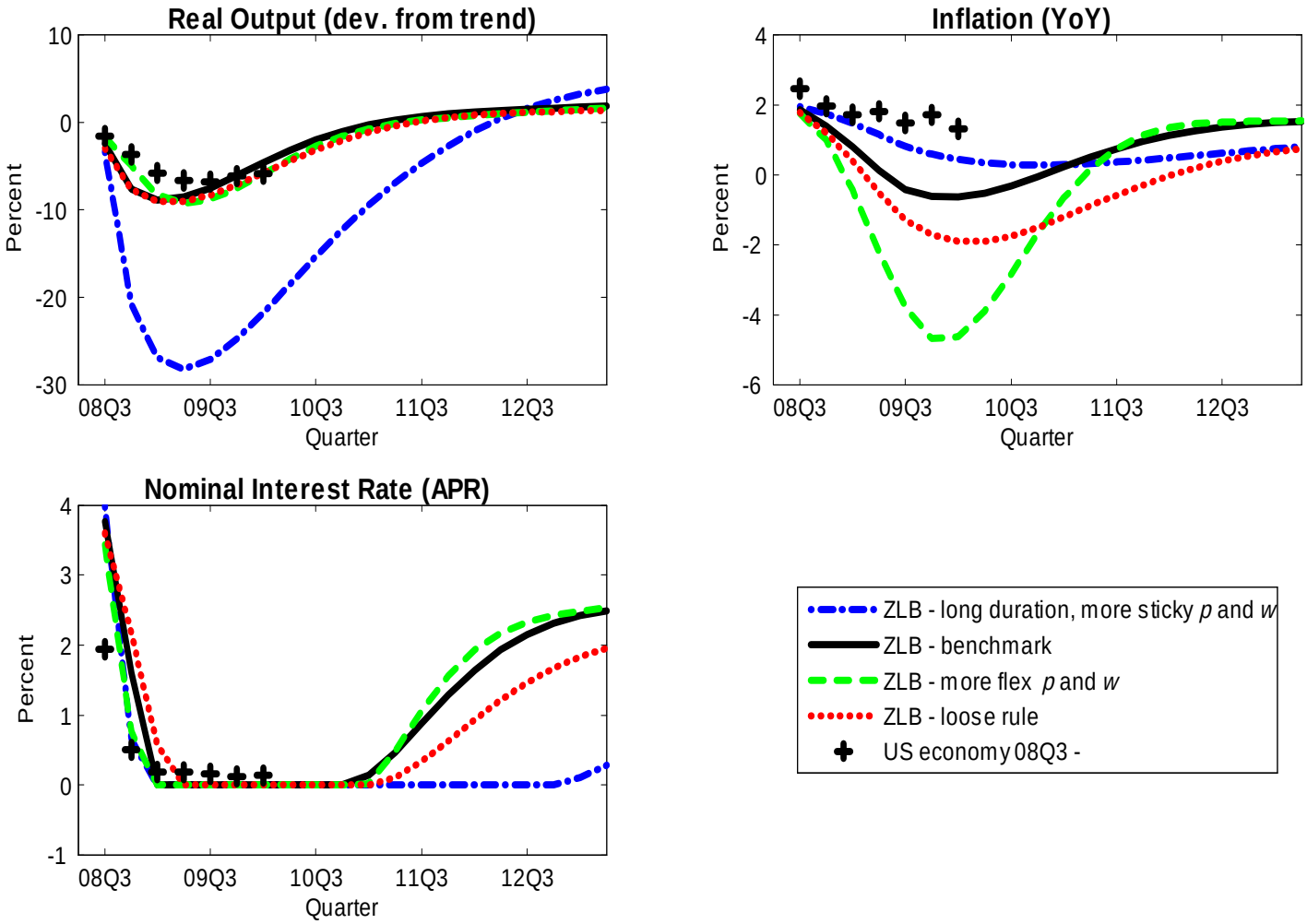


Figure 5b: Actual and Expected FFR and Core Inflation Rates

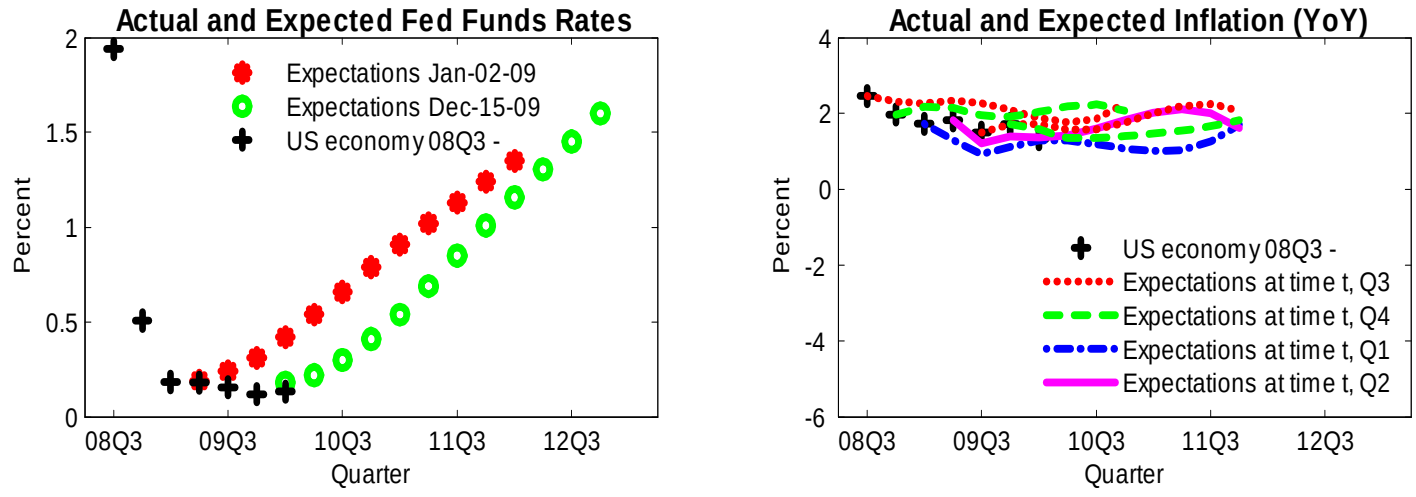


Figure 6: Responses to a Front-Loaded Increase in Government Spending in Normal Times and in a Liquidity Trap in the CEE-SW Model with Capital

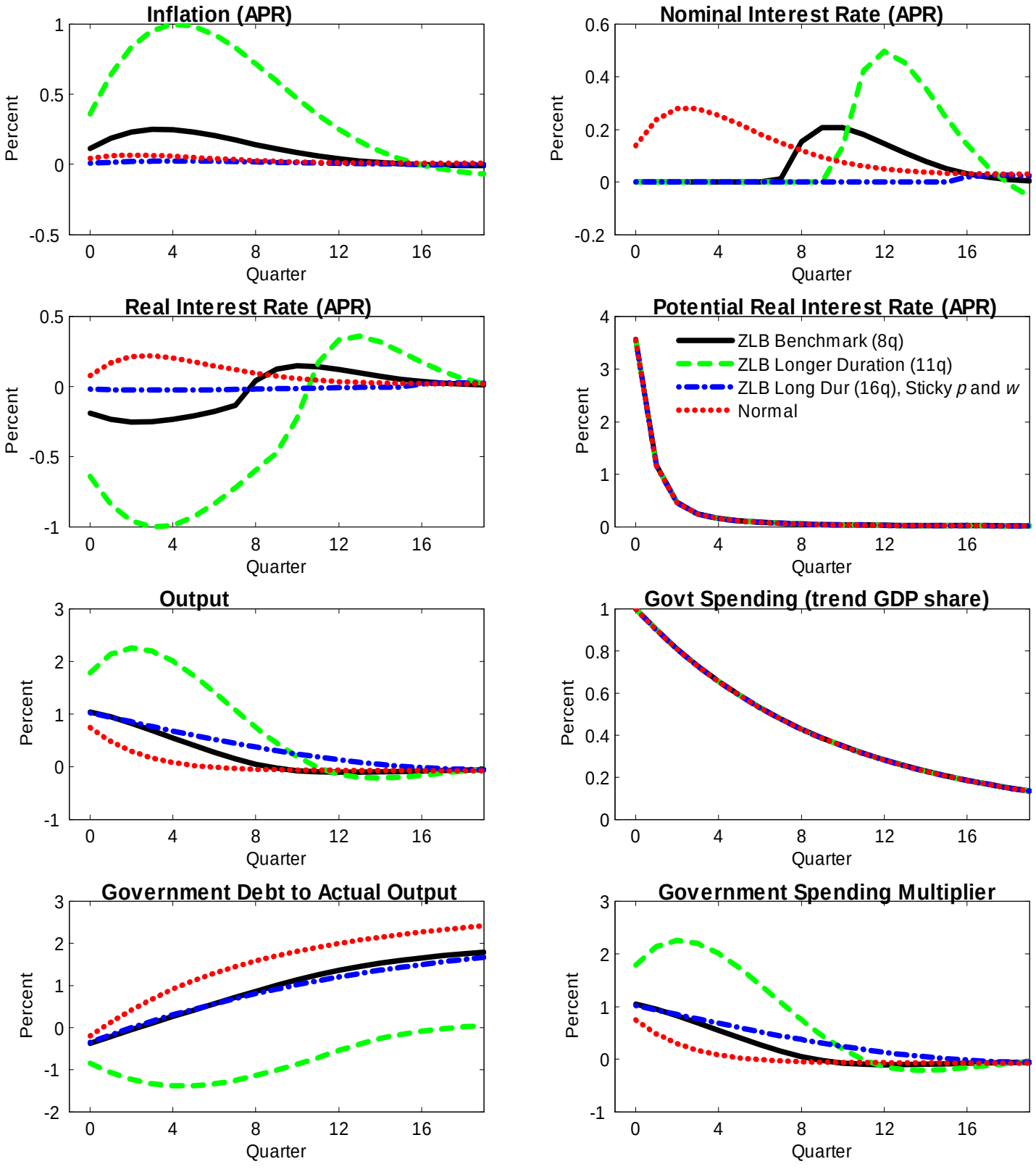
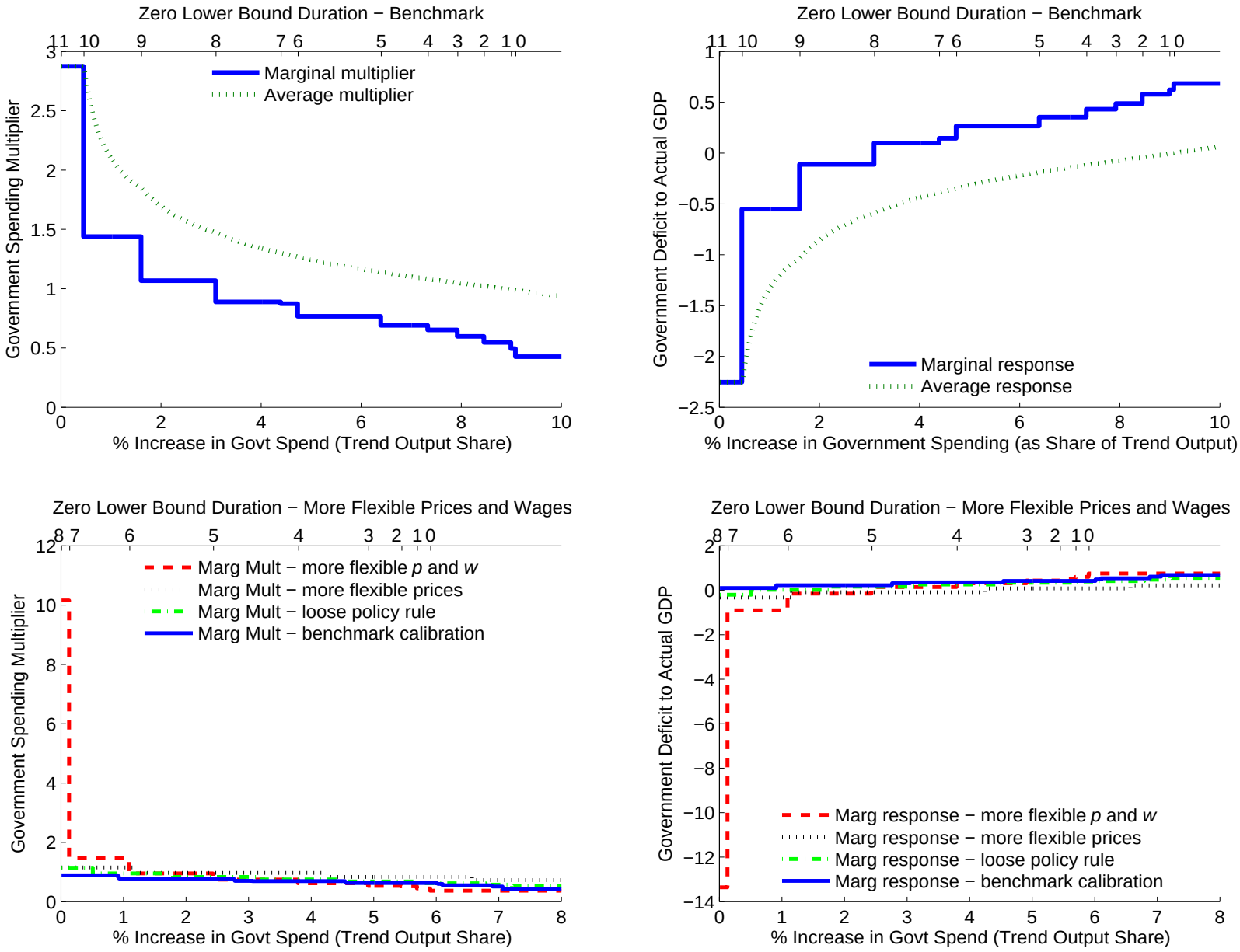


Figure 7: Average and Marginal Multipliers in the CEE-SW Model With Capital and Their Sensitivity to Alternative Parameterizations

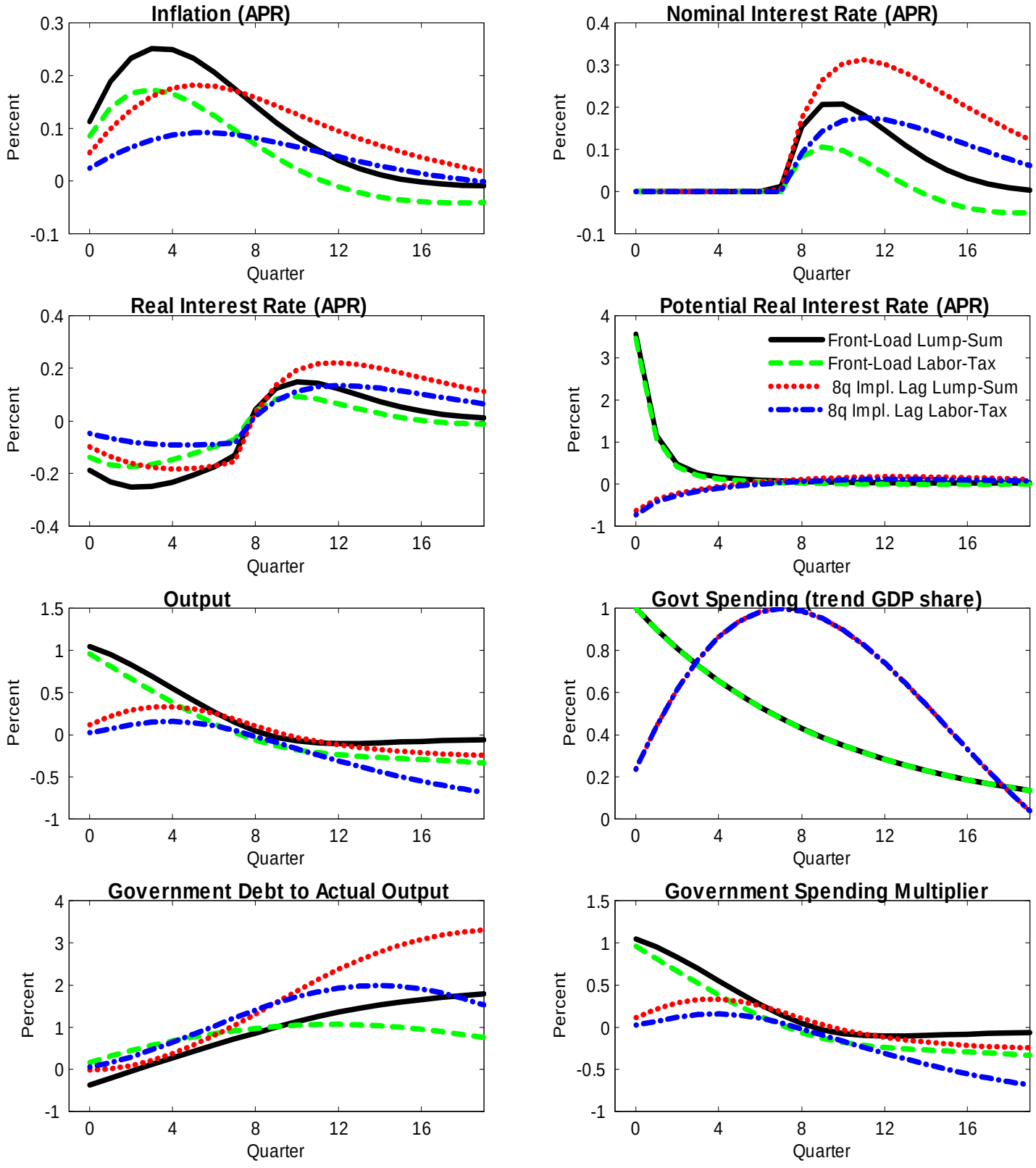


Other Key Factors affecting Multiplier

- Implementation Lags can depress output multiplier (even cause it to be negative) by reducing potential real rate.

- Multiplier can be depressed substantially if govt spending must be financed with distortionary taxes (Uhlig 2009).

Figure 8: Responses to Alternative Implementation and Financing of the Government Spending Increase in the CEE-SW Model with Capital



Keynesian Households and Financial Frictions

- VAR-based evidence shows consumption rises in response to higher government spending.

  –Gali, Lopez-Salido, and Valles (2007)

- Inclusion of non-Ricardian households that simply consume after-tax disposable income boosts multiplier even in normal times.

  – GLV (2007) – Erceg, Guerrieri, Gust (2006)

- Workhorse model omits financial channels, including movements in private credit spreads due to balance sheets effects.

Full Model

- Add financial frictions following Bernanke, Gertler, and Gilchrist (1999) and Christiano, Motto, Rostagna (2007):

  – debt contract between entrepeneurs and banks in nominal terms; calibration follows BGG.

- Introduce Keynesian households following Erceg, Guerrieri, and Gust (2006) and GLV (2007)

  – These households consume their after-tax income, set their wage to the economy wide average, and face same labor demand as optimizers.

  –Share of population 0.5, of consumption 0.3.

- These features amplify effect of govt spending on potential real interest rate.

Figure 9: Responses to a Front-Loaded Government Spending hike in Normal Times and a Liquidity Trap in Model With Keynesian Agents and Financial Frictions and Benchmark CEE-SW Model

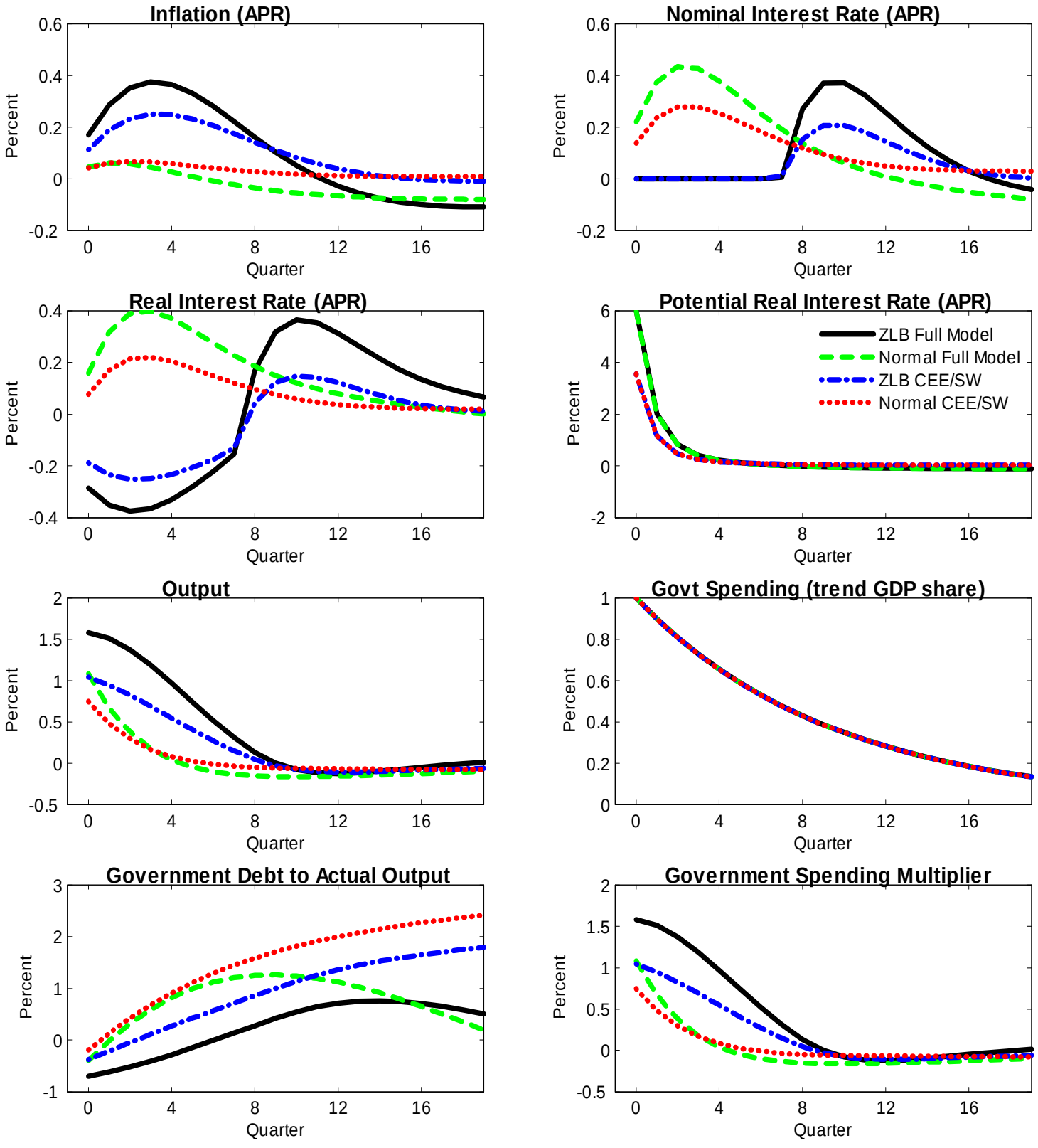
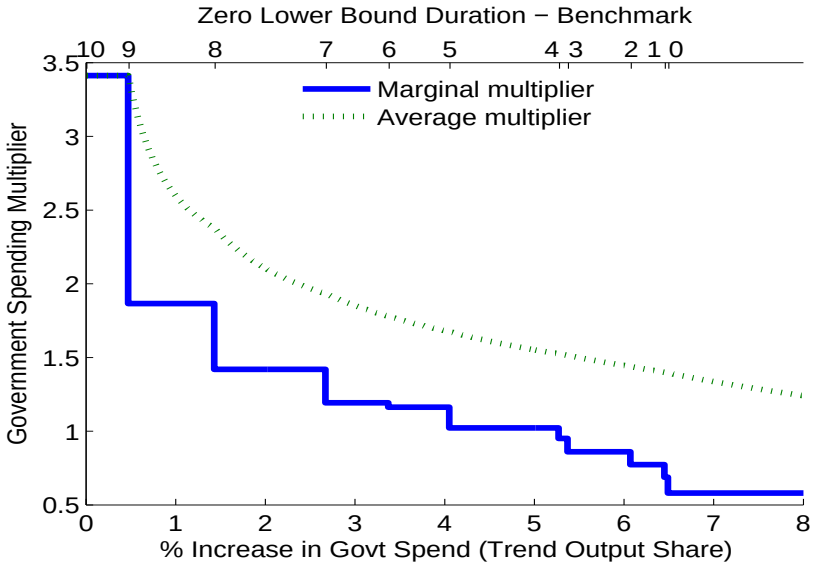
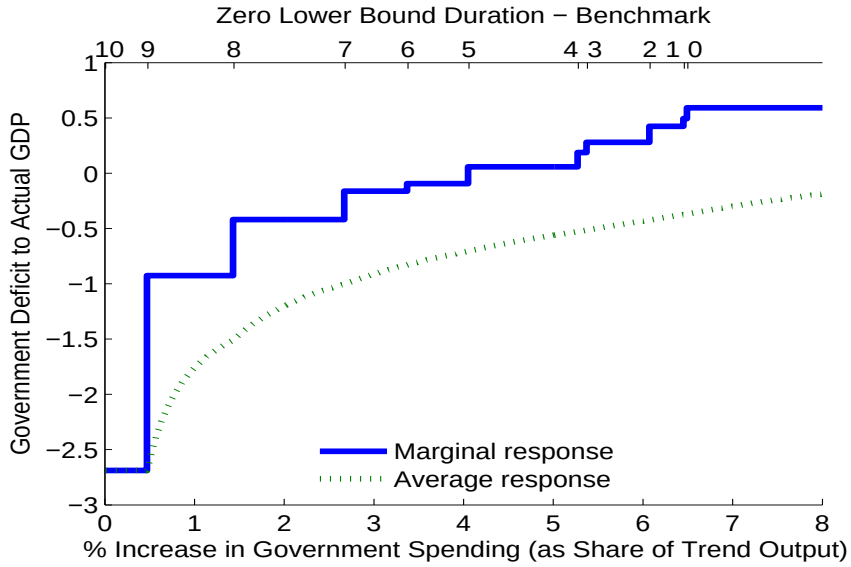
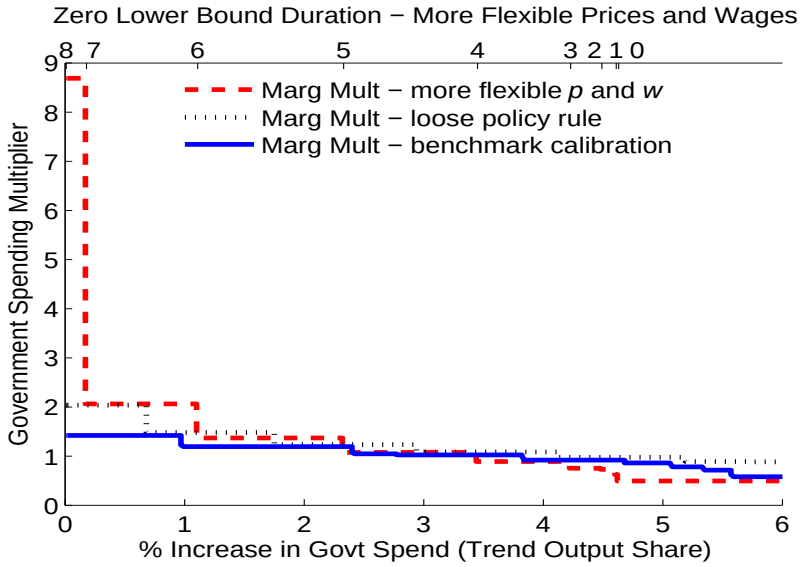
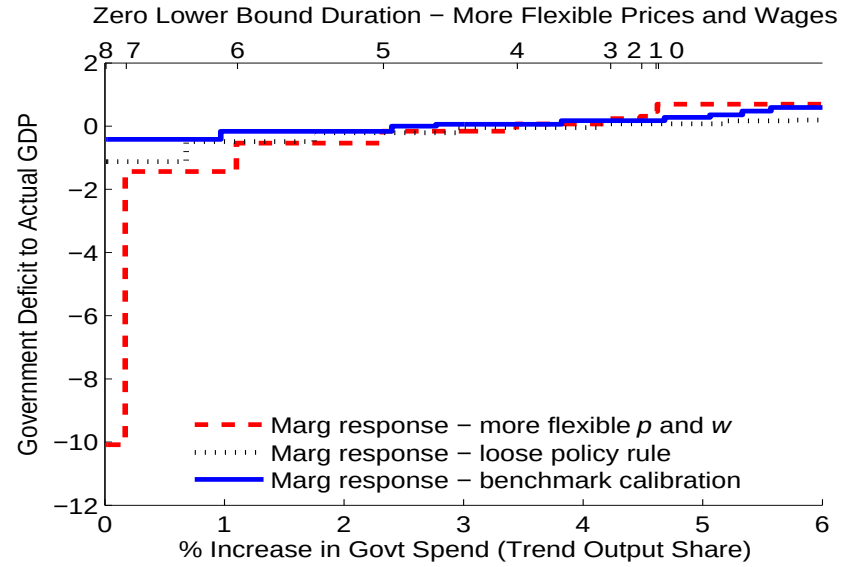


Figure 10: Average and Marginal Multipliers in the CEE-SW Model Extended With Financial Frictions and Keynesian Agents and Their Sensitivity to Alternative Parameterizations









Conclusions

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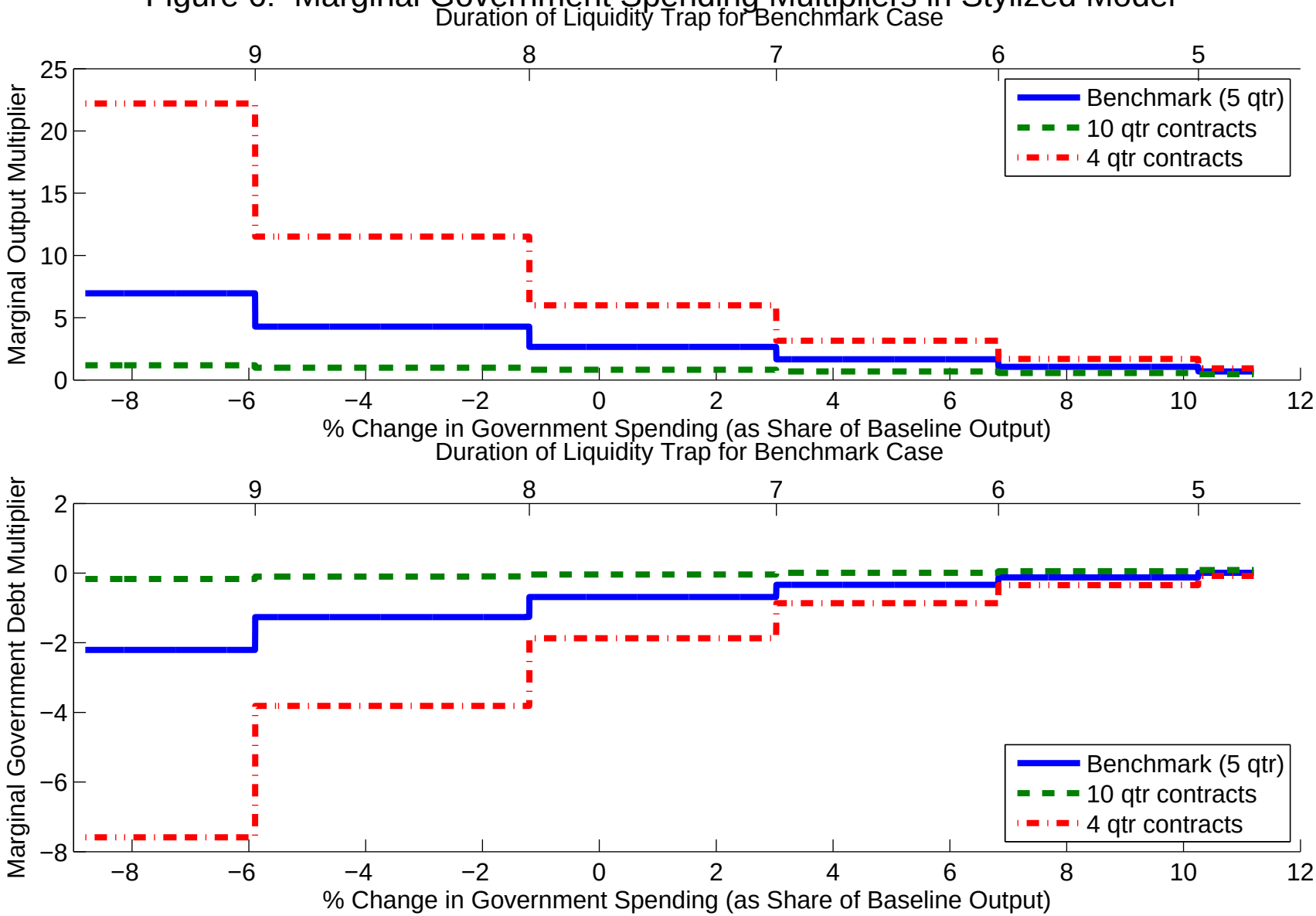
- Crucial to determine marginal impact of fiscal spending initiatives, as marginal may be well lower than average.

Figure 6: Marginal Government Spending Multipliers in Stylized Model



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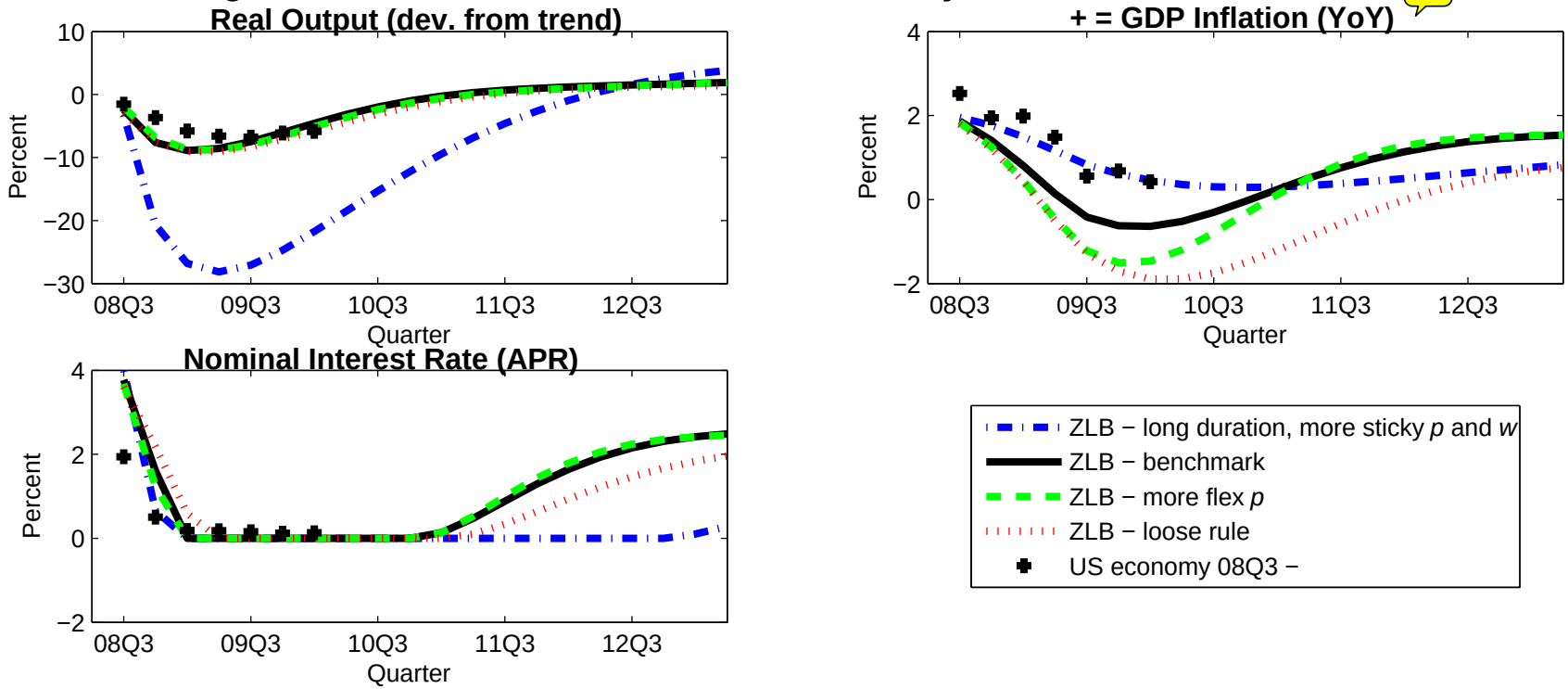
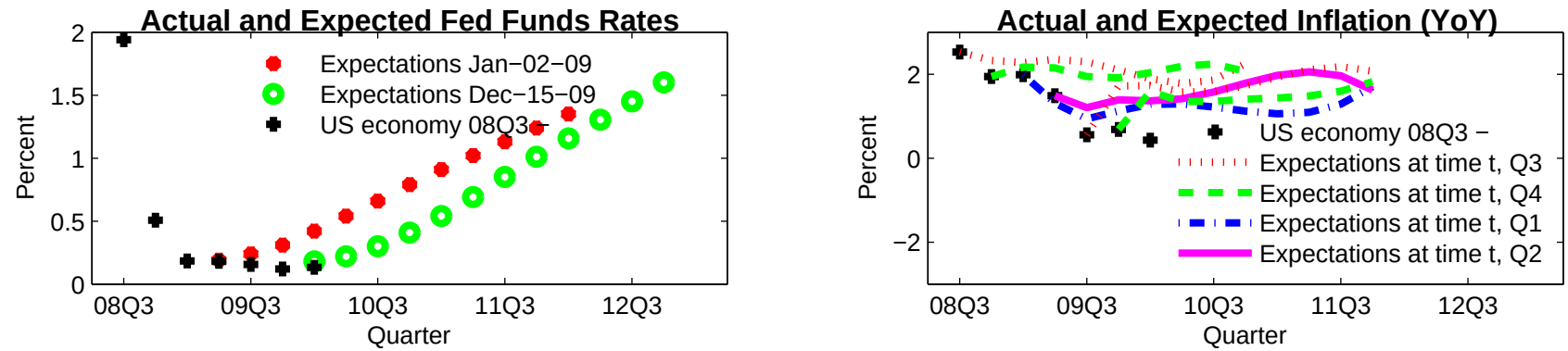


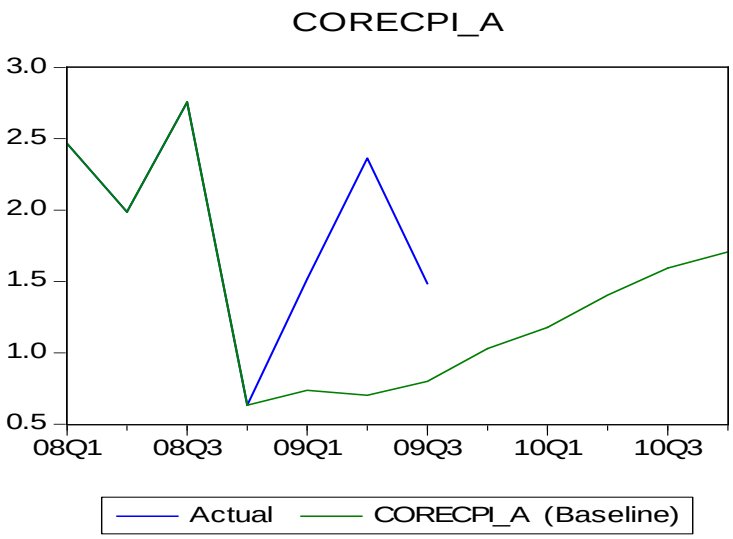
Figure 5b: Actual and Expected FFR and Core Inflation Rates

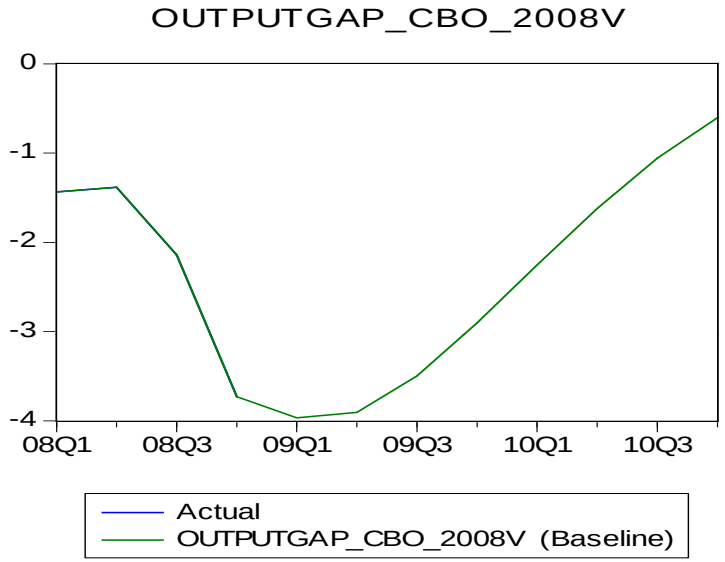


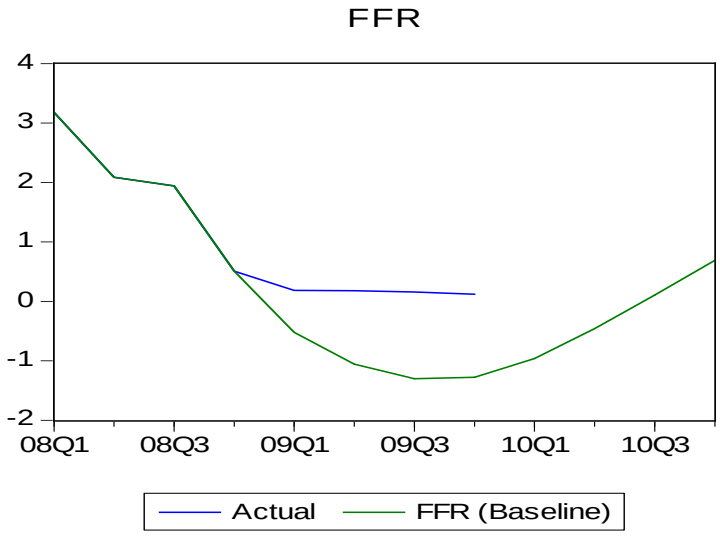
- Estimate three equation VAR(4) model with output gap (CBO), inflation and the FFR on the first vintage of data spanning $2008Q4$
  - Sample period $1982Q1 - 2008Q4$
  - Experiment with alternative measures of inflation: CPI, core CPI and PCE
  - Use estimated VAR model to make projections for $2009Q1 - 2010Q4$

- Figures with projections follows below 

Dynamic VAR projection 2009Q1-2010Q4 using data up to 2008Q4: core CPI inflation instead of CPI inflation







Dynamic VAR projection 2009Q1-2010Q4 using data up to 2008Q4 (with intercept restrictions): core CPI