# Fiscal Multipliers in a Nonlinear World

Jesper Lindé and Mathias Trabandt

ECB-EABCN-Atlanta Nonlinearities Conference, December 15-16, 2014

Sveriges Riksbank and Federal Reserve Board

December 16, 2014

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  - Erceg and Lindé (2010) show that spending hikes can be associated with a "fiscal free lunch" in a long-lived liquidity trap
- Hence, this literature suggests that it is hard to reduce government debt in the short-run through aggressive spending cuts

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- Recent work (Braun, Körber and Waki, 2013) suggests that analysis based on linearization might produce misleading results at the zero lower bound
- Hence, open question: can fiscal austerity really be self-defeating in a liquidity trap in a nonlinear environment?

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- Robustness in workhorse CEE model with BGG-style financial frictions

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  - Pin down key features which account for the differences between both solutions
- Apart from our focus on government debt, we add to Braun et al. (2013) by using a model with real rigidities
  - Allows us to match *macroevidence* of a low linearized Phillips curve slope (0.01) and *microevidence* of frequent price re-optimization (3-4 quarters)

# Presentation outline

- Benchmark model
- Parameterization
- Spending multiplier schedules in nonlinear vs. linearized model
- Robustness in a workhorse model with endogenous capital
- Concluding remarks

# Benchmark Model

## Households

- Variant of the simple NK model in Woodford (2003)
- Household preferences

$$E_t \sum_{j=0}^{\infty} \beta^j \left\{ \frac{1}{1-\frac{1}{\sigma}} \left( C_{t+j} - C\nu_{t+j} \right)^{1-\frac{1}{\sigma}} - \frac{N_{t+j}^{1+\chi}}{1+\chi} \right\}$$

  - $\nu_t$ consumption demand shock

- Households' flow budget constraint

$$P_t C_t + B_{G,t} = (1-\tau_N) W_t N_t + (1+i_{t-1}) B_{G,t-1} - T_t + \Gamma_t$$

# Model

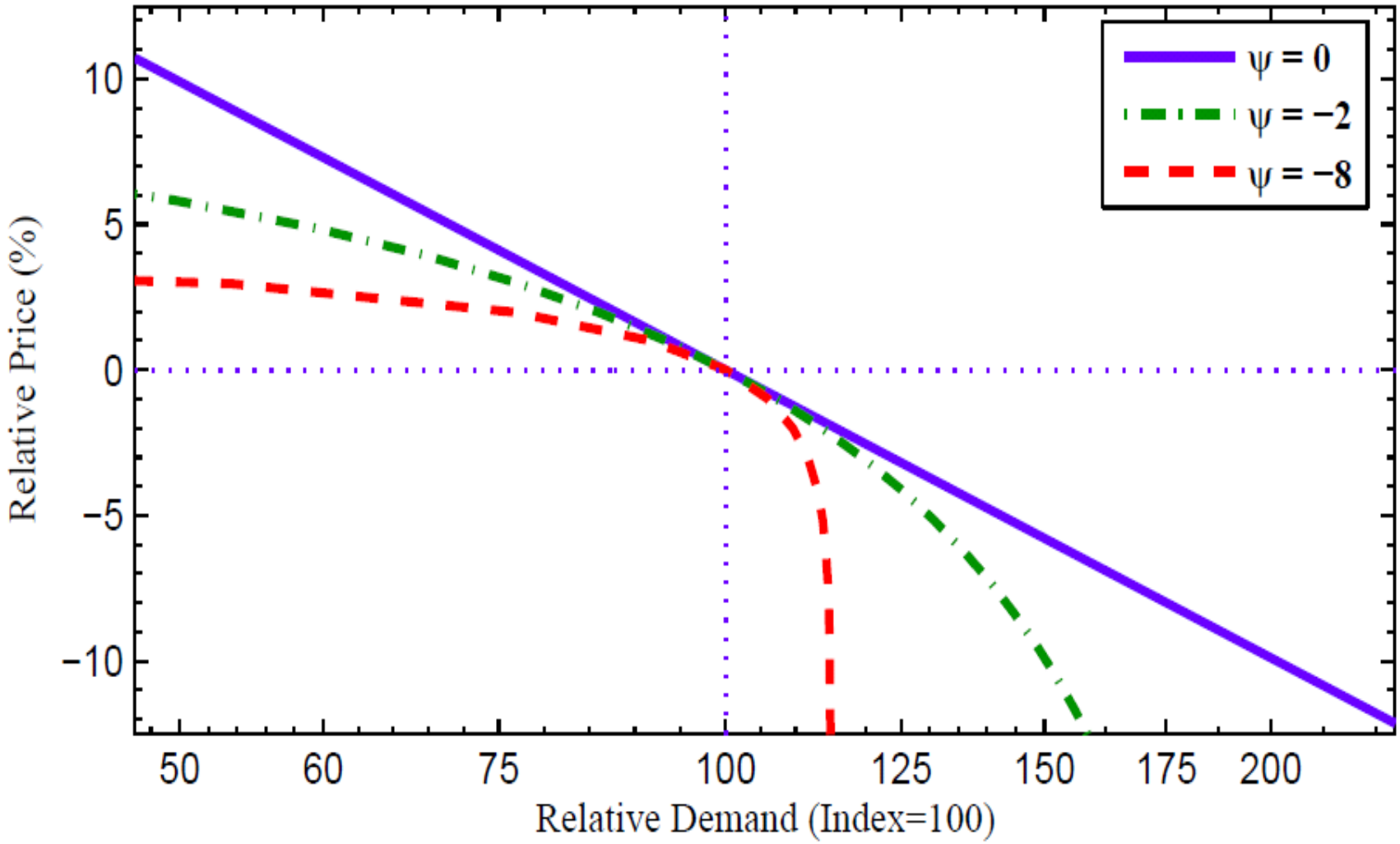
## Final Goods Firms

- A perfectly competitive firm aggregates intermediate goods into a final consumption good
- Following Kimball (1995) we assume that intermediate firms' demand elasticity is an increasing function of its relative price; this dampens the intermediate firms' price response to variations in marginal costs

# Model

## Comparing Kimball and Dixit-Stiglitz Demand Schedules

Figure 1: Quasi-Kinked Demand



- We assume a continuum of monopolistically competitive firms $f$ to rationalize Calvo-style price stickiness
  - No nominal wage frictions
- Aggregate capital $K$ is fixed
- Firms which not reoptimize their prices in period $t$ (which is the case with probability $\xi_p$), update according to

$$\tilde{P}_t = (1 + \pi) P_{t-1},$$

where $\pi$ is the steady-state (net) inflation rate and $\tilde{P}_t$ the updated price

# Model

## Aggregate resource constraints

- Actual output $Y_t$ is divided into private consumption and government spending:

$$Y_t = C_t + G_t$$

- Aggregate resource constraint (useage = aggregate production function)

$$\underbrace{C_t + G_t}_{\equiv Y_t} \leq (p_t^*)^{-1} \underbrace{K^{\alpha} {N_t}^{1-\alpha}}_{\equiv Y_t^*}$$

where $Y_t^* = \int_0^1 Y_t(f)df$ and $p_t^*$ aggregate price dispersion

# Model

## Details on fiscal and monetary policy

- Government spends $G_t$ and collects revenues from labor income taxes $\tau_{N,t}$ and lump-sum taxes

$$B_{G,t} = (1 + i_{t-1}) B_{G,t-1} + P_t G_t - \tau_N W_t N_t - T_t$$

  - Lump-sum tax rule $\frac{T_t}{P_t Y} = \varphi_b \left( \frac{B_{G,t}}{P_t Y} - \overline{\frac{B_G}{P_t Y}} \right)$
- Monetary policy rule

$$1 + i_t = \max \left\{ 1, (1 + i) \left( \frac{1 + \pi_t}{1 + \pi} \right)^{\gamma_\pi} \left( \frac{Y_t}{Y_t^{pot}} \right)^{\gamma_x} \right\}$$

  where $Y_t^{pot}$ is flex-price equilibrium output
- Compute perfect foresight solution

# Parameterization of model I

## Key parameters

- Price mark-up $\theta_p = 0.2$, 3 quarter price contracts ($\xi_p = 0.667$), Kimball parameter then determined residually so that $\kappa_{mc}$ in

$$\hat{\pi}_t = \beta \mathrm{E}_t \hat{\pi}_{t+1} + \kappa_{mc} \widehat{mc}_t$$

  equals 0.012 (GG 1999, ACEL 2011)
- Government spending share $g_y = 0.2$, financed by labor income taxes in SS
- All shocks AR(1) with persistence 0.95

# Parameterization of model II

## Other parameters standard

- Log cons util ($\sigma = 1$), Frisch elasticity $= 0.4$ ($\chi = 2.5$), Labor share $= 0.7$ ($\alpha = 0.3$)
- Steady state inflation 2 percent, nominal interest rate 4 percent ($\beta = 0.995$, $\pi = 0.005 => i = 0.01$)
- Standard Taylor rule coeffs ($\gamma_\pi = 1.5$, $\gamma_x = 0.125$)
- Lump sum tax rule $\tau_t = 0.01\left(b_{G,t-1} - b_G\right)$ stabilize debt, $b_G = 0.6$
- $\tau_N = \frac{1+\theta_p}{1-\alpha}\left(g_y + 4r \times b_G\right)$ in SS

# Spending multipliers in nonlinear and linearized model

## Construction of baseline

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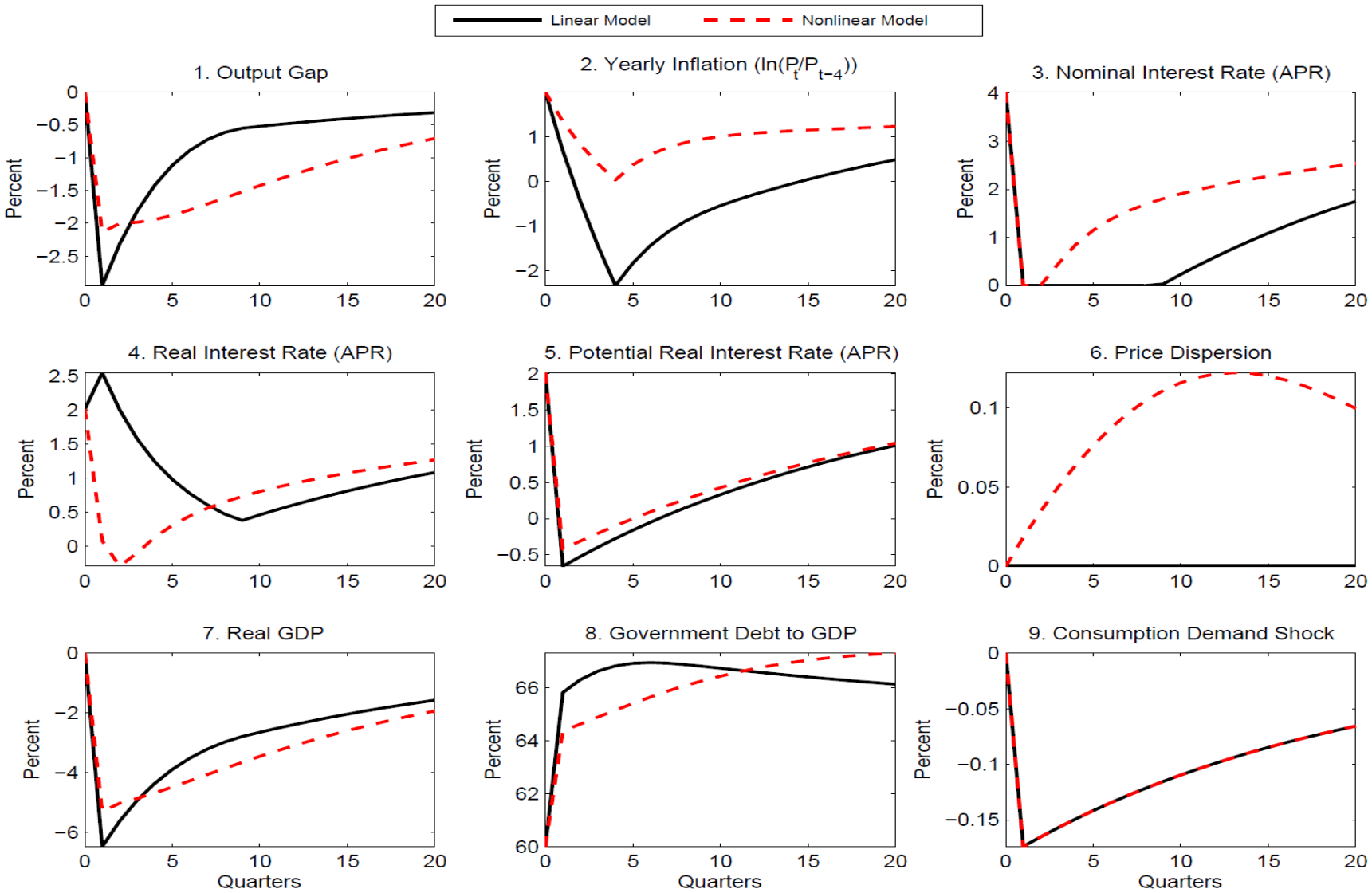
  - These shocks push the economy into a 1,2,...,12 quarter liquidity trap
- Size of $\nu_t$ shocks differ in linear and nonlinear solutions, but set to generate same liquidity trap duration absent any fiscal actions

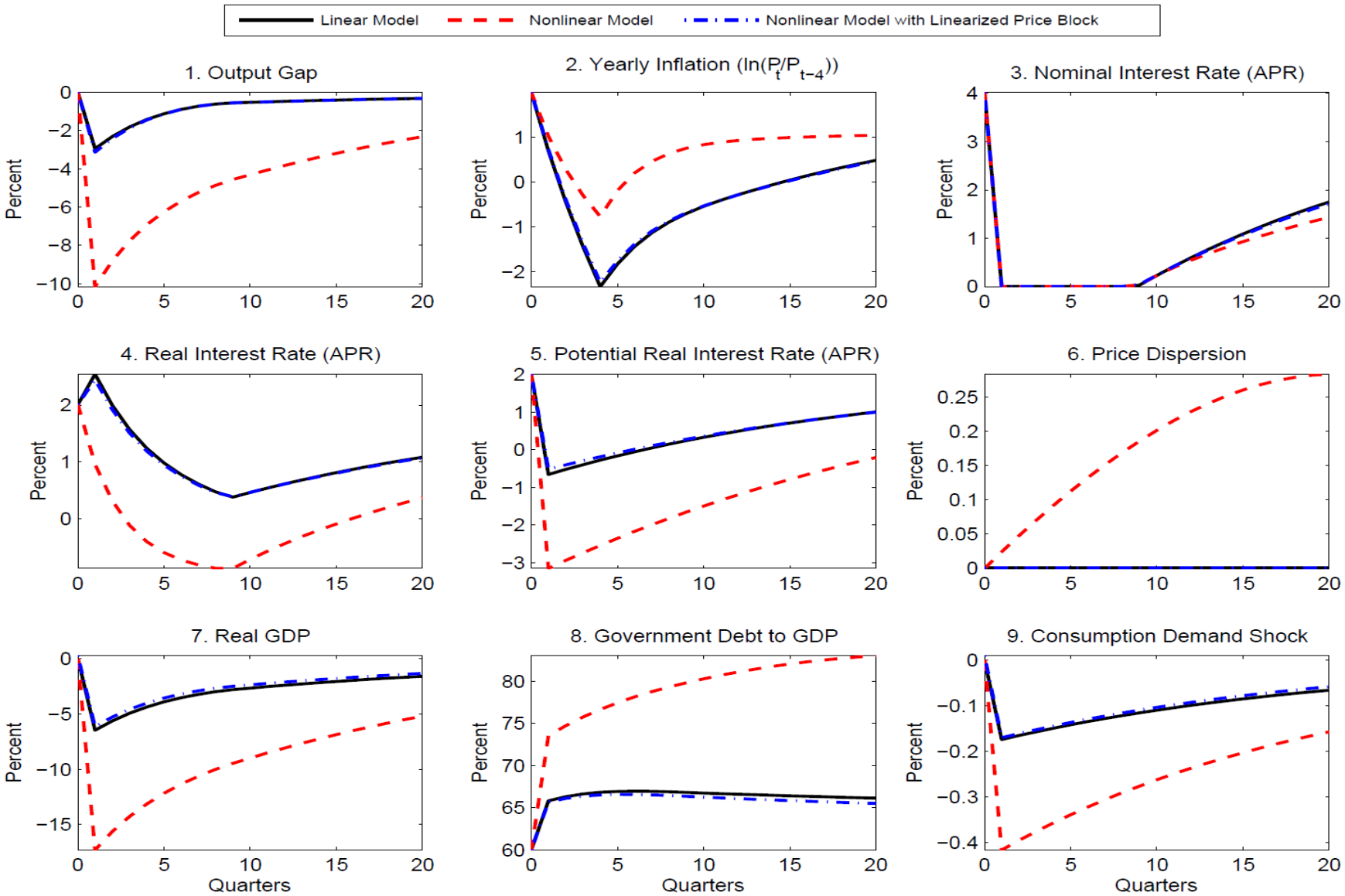
# Spending multipliers in nonlinear and linearized model

## Baseline scenarios for same-sized shock



# Nonlinear vs. linear spending multipliers

## Comparing baseline scenarios for an 8q liquidity trap



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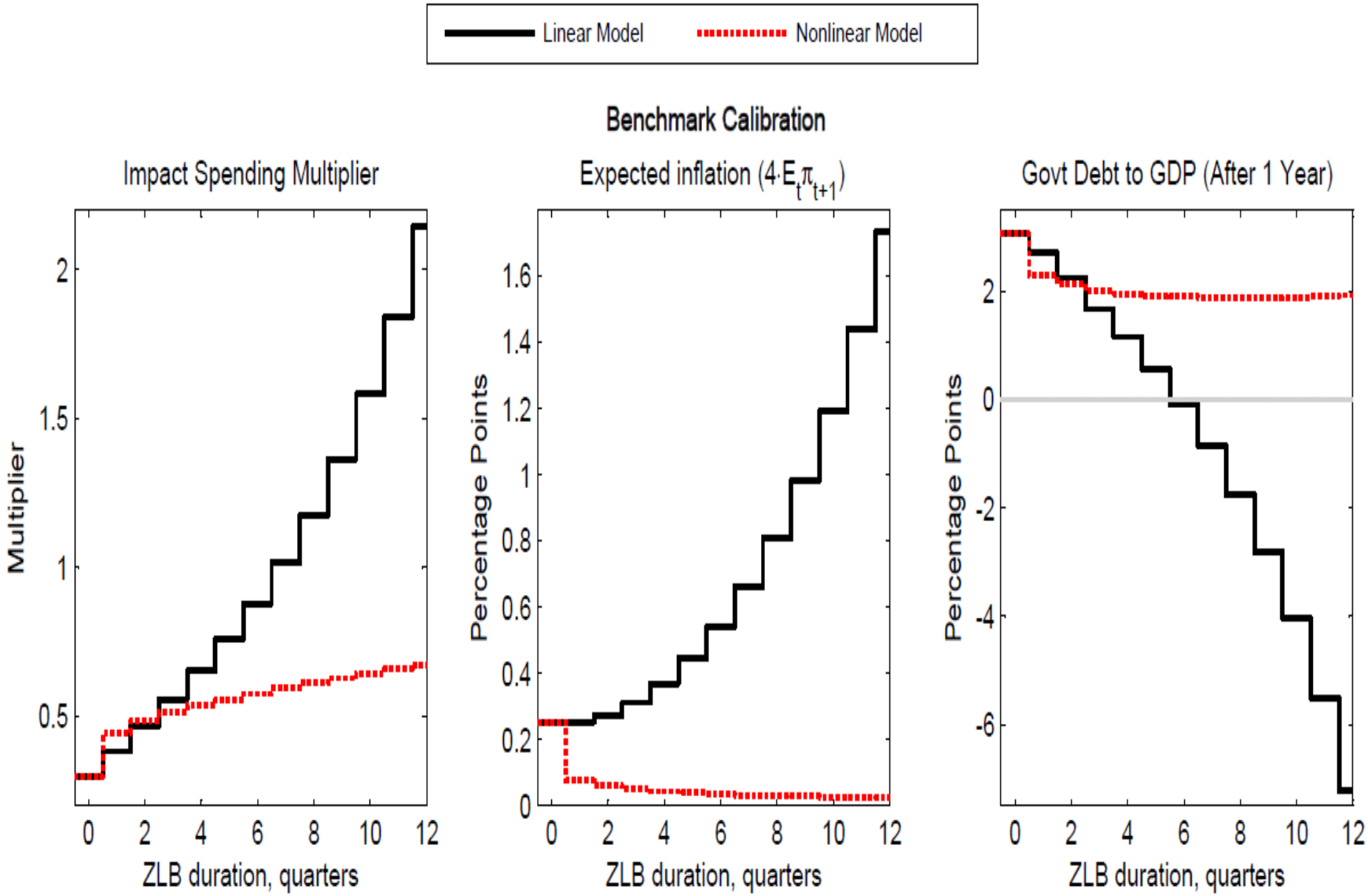
  - Study impact output multiplier; annualized expected inflation, one-year debt multiplier

# Spending multipliers in nonlinear and linearized model

## Marginal multiplier schedules



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  - Second, we linearize NKPC and the resource constraint, keep all other equations in nonlinear form

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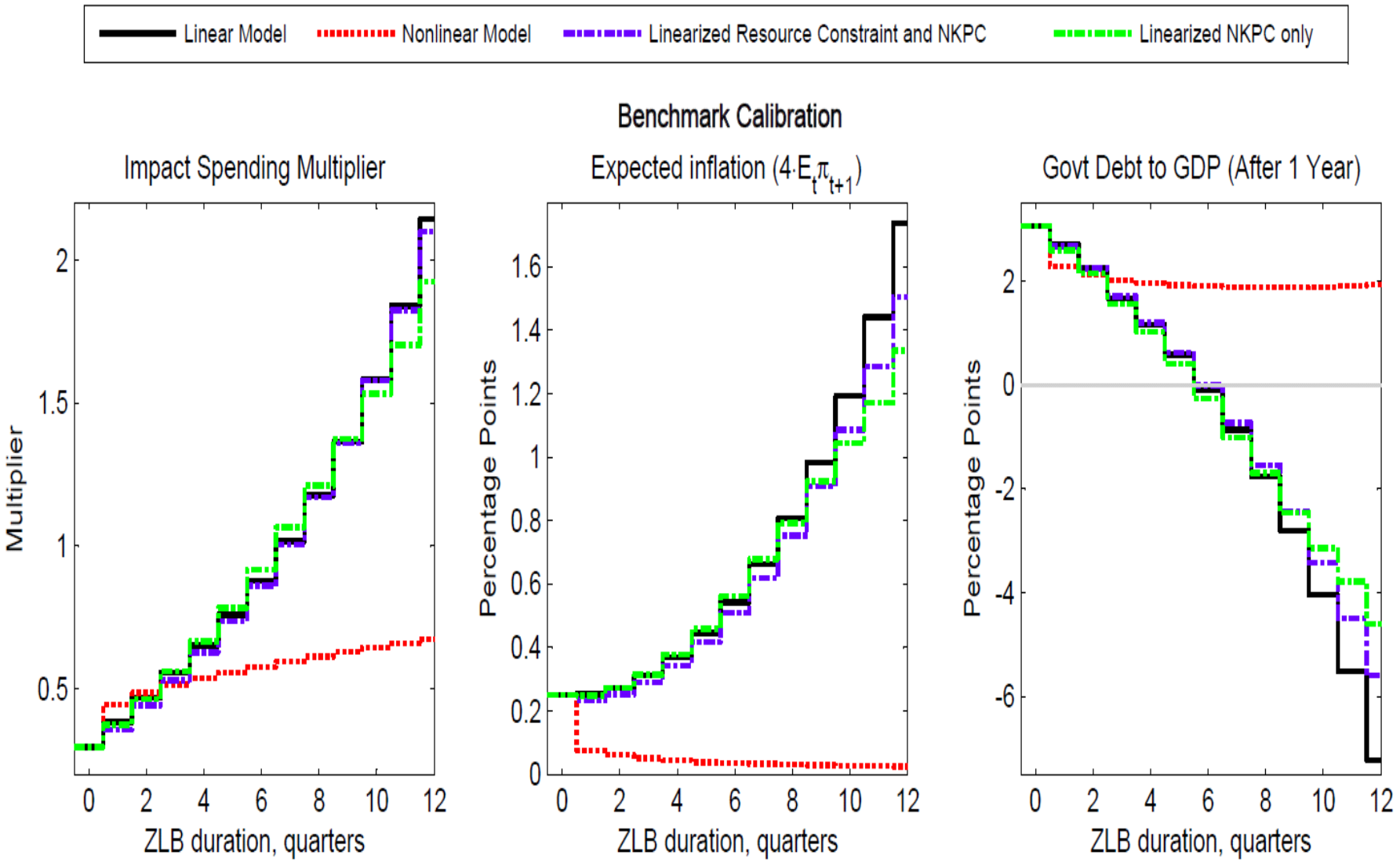
## Why do marginal multiplier schedules differ?



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  - Keep $\xi_p$ unchanged at 0.667 implies a higher slope of Phillips curve ($\kappa_{mc}$) and stronger sensitivity of expected inflation

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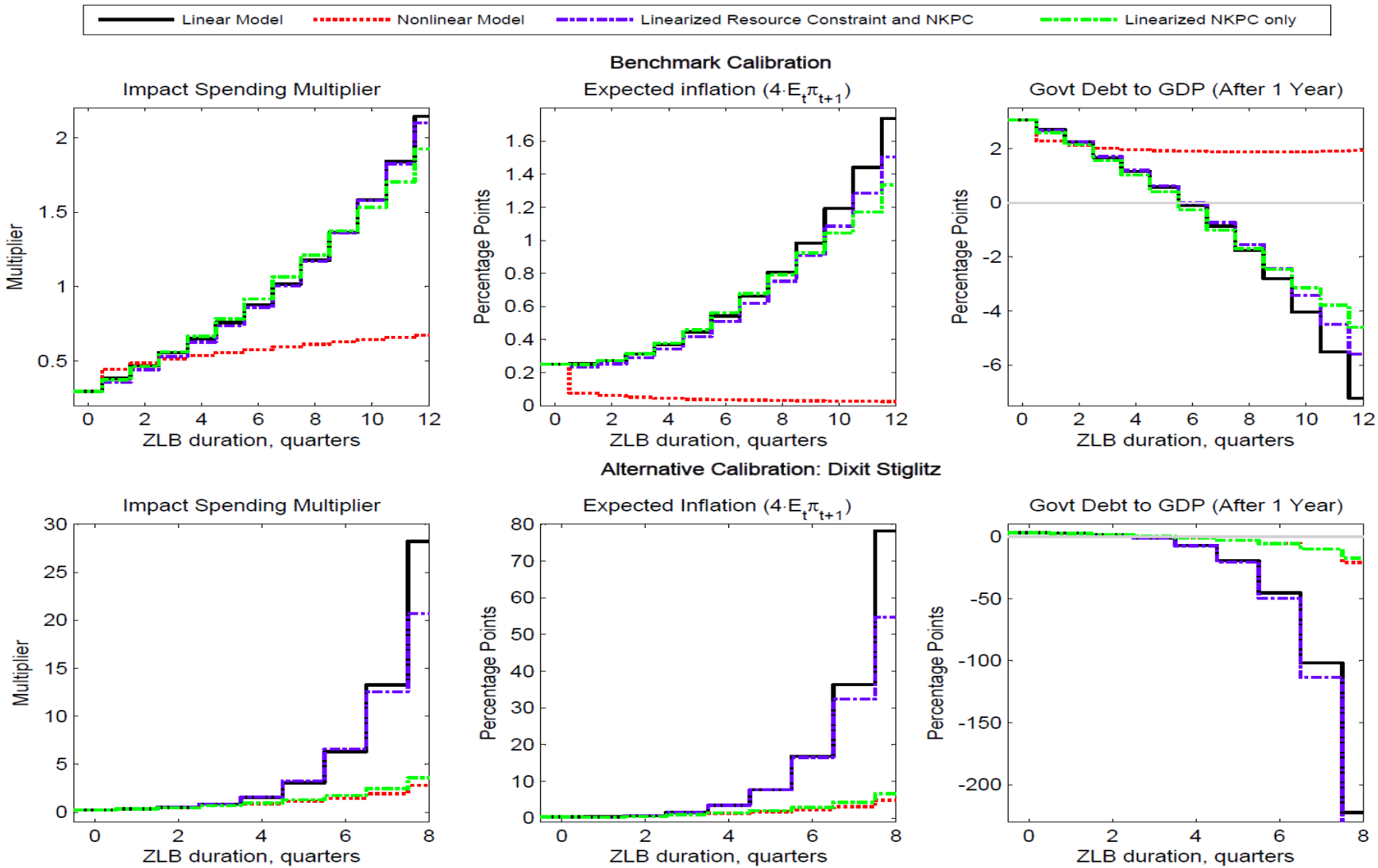
## Marginal multiplier schedules: Kimball vs. Dixit-Stiglitz

Figure 4: Marginal Multipliers



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  - Habit persistence in consumption and CEE (2005) investment adjustment costs
  - Financial accelerator mechanism; CMR (2007) variant of BGG (1999)
  - A detailed fiscal block (VAT, labor income and capital income taxes, govt cons, lump sum transfers)

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## Idea behind analysis in larger-scale model

- We pick a calibration which generates an impact output multiplier ($\Delta Y_t / \Delta G_t$) about unity in normal times; which seems to be in the mid-range of empirical evidence

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- We pick a calibration which generates an impact output multiplier $(\Delta Y_t / \Delta G_t)$ about unity in normal times; which seems to be in the mid-range of empirical evidence
- Model with a reasonable spending multiplier and monetary transmission mechanism in normal times allows us to analyze effects on output and government in an empirically realistic model

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  - Against adverse baseline, we study impact of marginal (small) change in govt consumption that does not affect the duration of the ZLB

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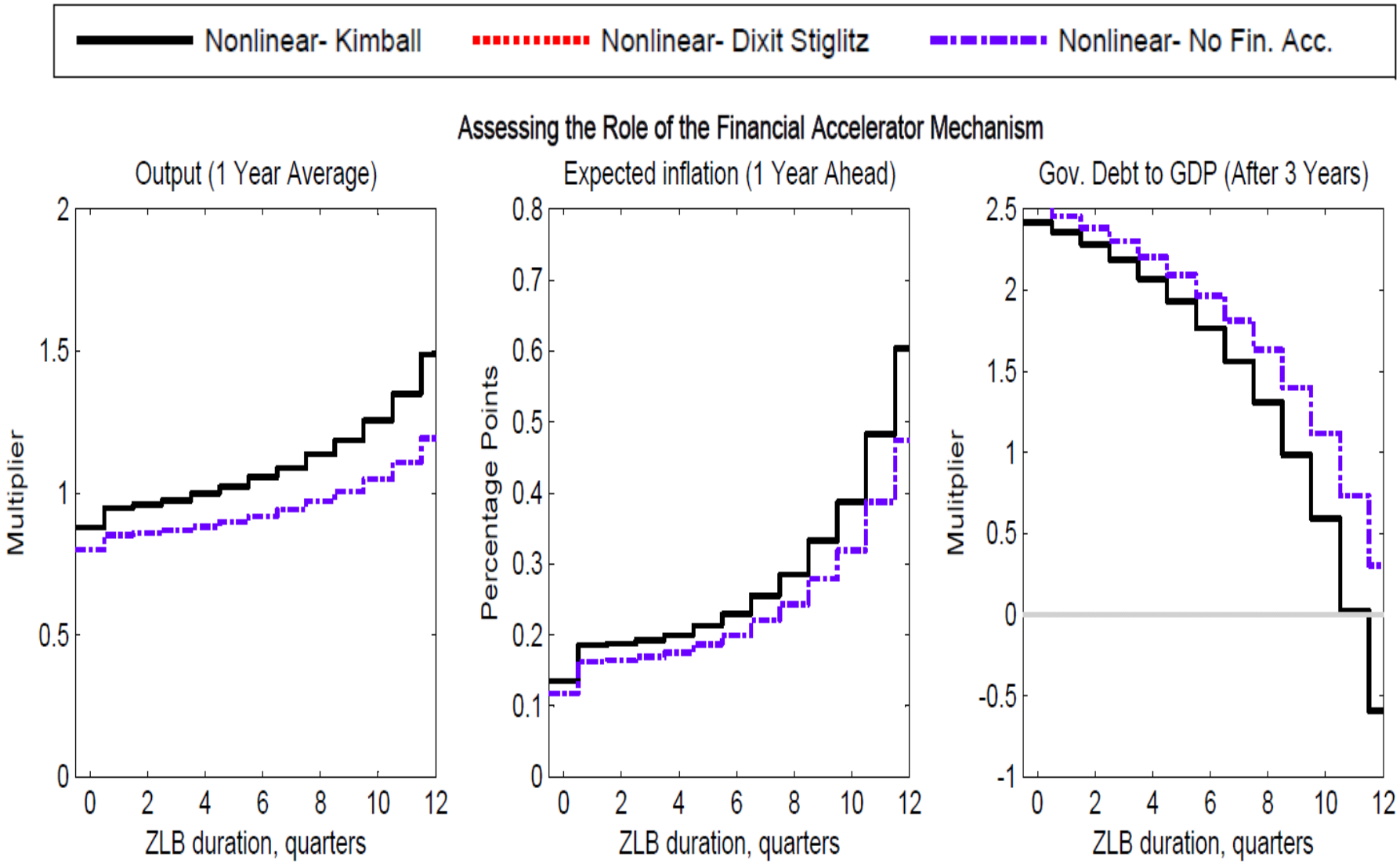
## Marginal Multipliers: Benchmark model vs. variant without Financial Accelerator



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  - Financial accelerator mechism is key behind this result

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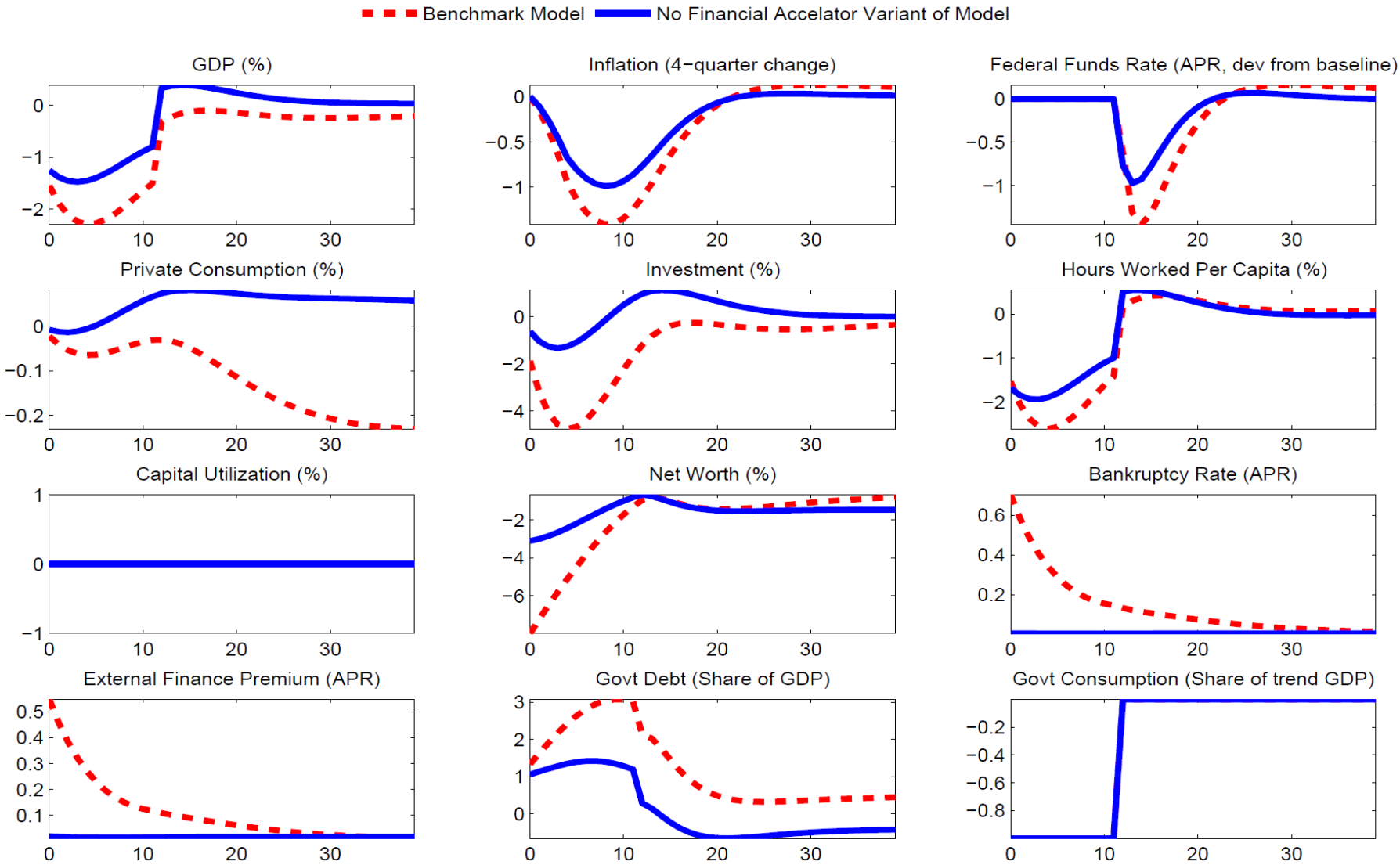
## Impulses to a transient spending cut in a 12-quarter trap

Figure 10: Impulses to a Transient Cut in Govt Spending: Assessing the Role of the Fin. Acc. Channel



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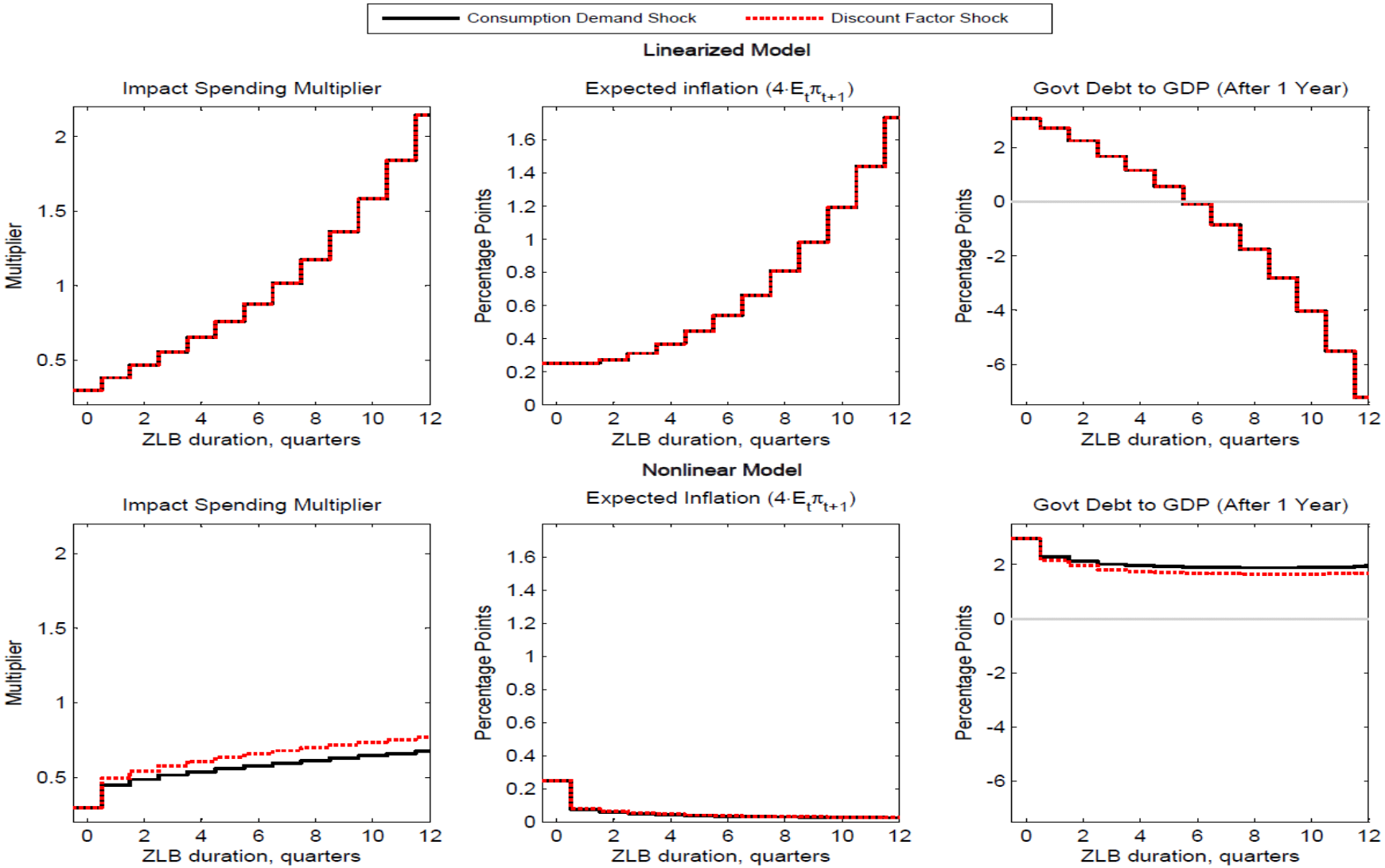
  - Suggest that multiplier can be large (around 2) in a long-lived liquidity trap
  - Fiscal free lunch possible in a sufficiently long-lived liquidity trap

# Extra Material

## Sensitivity w.r.t. baseline shock: consumption demand vs. discount factor

Figure A1: Marginal Multipliers, Shock Modeled as AR(1) Process



# Extra Material

## Sensitivity w.r.t. alternative modelling of spending change: AR(1) vs MA

Figure A2: Marginal Multipliers, Consumption Demand Shock