The Zero Lower Bound, the Dual Mandate, and Unconventional Dynamics

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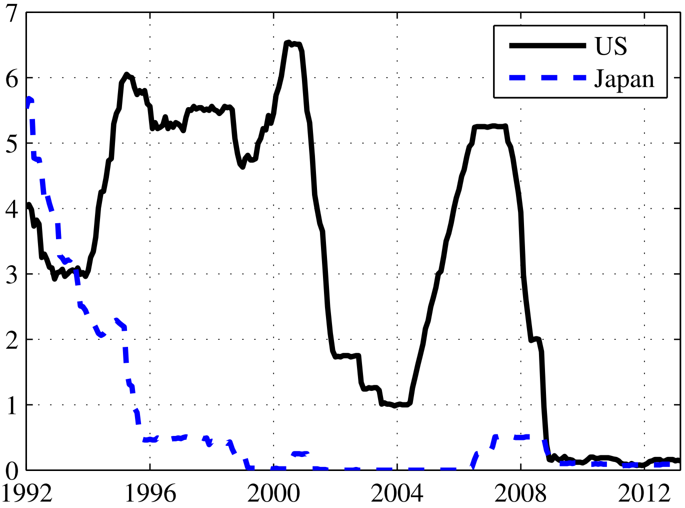
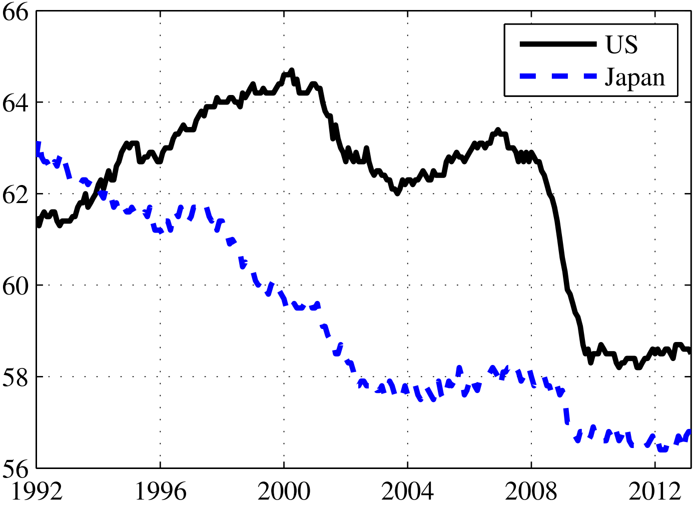
INTERBANK LENDING RATE (%)



EMPLOYMENT-TO-POPULATION (%)



MOTIVATION

- Five years after the crisis began
  - the Fed's target interest rate remains near zero
  - the economy is below potential
- Motivates the need for a better understanding of
  - the canonical model used for monetary policy analysis
  - the effect of the central bank's dual mandate
- This paper calculates global nonlinear solutions to standard New Keynesian models with and without capital and a provides a thorough explanation of the dynamics

ECONOMIC FRAMEWORK AND QUESTIONS

- Alternative model setups:
  - Model 1: Labor Only
  - Model 2: Capital
- Examine both technology and discount factor shocks
- Key questions:
  1. Do technology shocks have unconventional effects?
     - Paradox of Thrift
     - Paradox of Toil
  2. What are the effects of the Fed shifting their focus to the real economy?
  3. Is it important to include capital in the model?
  4. Is it important to solve the fully nonlinear model?

KEY FINDINGS

1. The output gap specification may reverse the effects of technology shocks at the ZLB:
   - Steady-state output gap ($y_t^* = \bar{y}$): unconventional dynamics
   - Potential output gap ($y_t^* = y_t^n$): conventional dynamics
2. When the central bank targets the steady-state output gap, a technology shock leads to more pronounced unconventional dynamics in Model 2 than in Model 1.
3. In Model 1, the constrained linear model provides a decent approximation of the nonlinear model, but meaningful differences exist between the Model 2 solutions

Key Model Features

- Representative Household
  - Values consumption and leisure with preferences

$$E_0 \sum_{t=0}^{\infty} \widetilde{\beta}_t \{\log(c_t) - \chi n_t^{1+\eta}/(1+\eta)\}$$

  - Cashless economy and bonds are in zero net supply
  - Model 1: no capital accumulation
  - Model 2: adds capital with quadratic adjustment costs
- Intermediate and final goods firms
  - Monopolistically competitive intermediate firms produce differentiated inputs
  - Rotemberg (1982) quadratic costs to adjusting prices
  - A competitive final goods firm combines the intermediate inputs to produce the consumption good

MONETARY POLICY

- Monetary policy rule

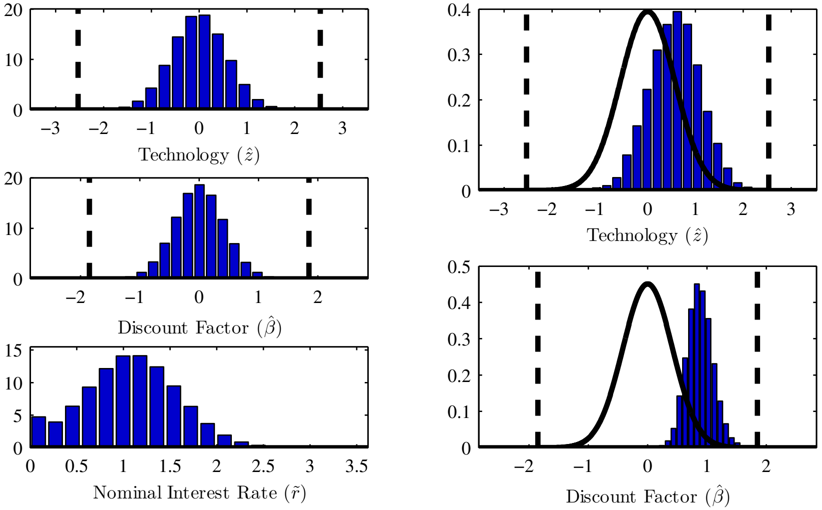
$$r_t = \max\{1, \bar{r}(\pi_t/\pi^*)^{\phi_\pi}(y_t/y_t^*)^{\phi_y}\}$$

- Output target (y_t^*)
  - Steady-state output target: $y_t^* = \bar{y}$
  - Potential output target: $y_t^* = y_t^n$
- Calibration:
  - Baseline: $\pi^* = 1.006$, $\bar{r} = 1.011$, $\phi_\pi = 1.5$, and $\phi_y = 0.1$
  - We also examine alternative values of ϕ_y

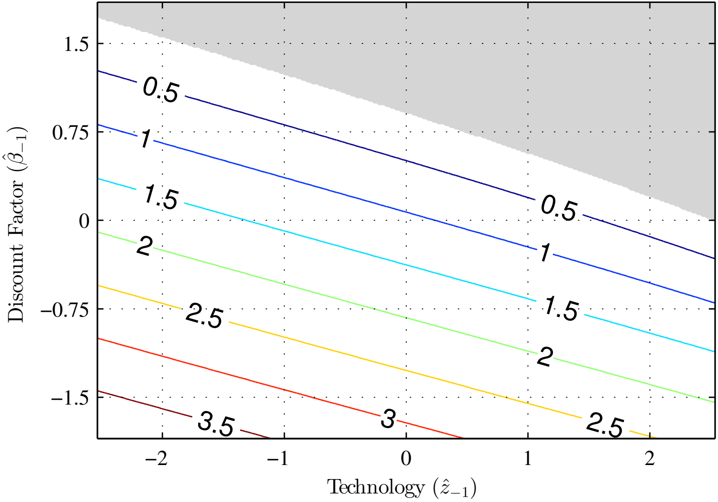
STOCHASTIC PROCESSES AND SOLUTION

- Discount factor (β) follows an AR(1) process
  - The mean is 0.995 and the AR(1) parameter is 0.8
  - The standard deviation of shocks is 0.25% per quarter
  - The state space is $\pm 1.9\%$ around the mean
- Technology (z) follows an AR(1) process
  - The mean is 1 and the AR(1) parameter is 0.9
  - The standard deviation of shocks is 0.25% per quarter
  - The state space is $\pm 2.5\%$ around the mean
- Compute nonlinear solutions using policy function iteration
  - Linear interpolation and Gauss Hermite quadrature
  - Duration of ZLB events is stochastic
  - Expectational effects of hitting and leaving ZLB

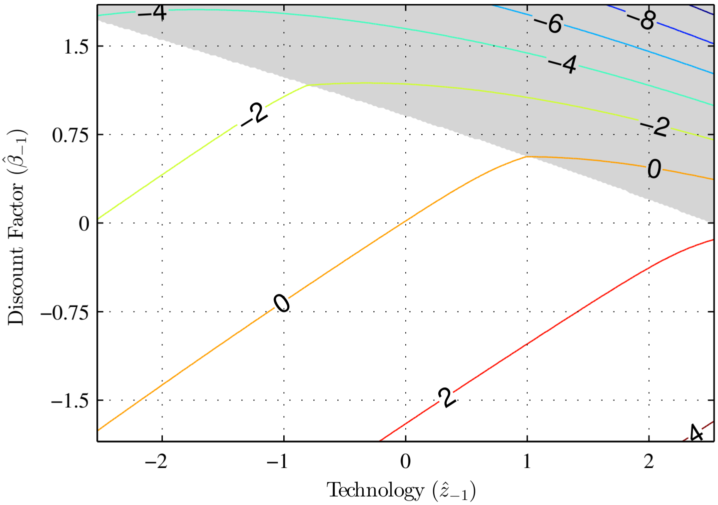
MODEL 1: DISTRIBUTIONS ($y_t^* = \bar{y}$)



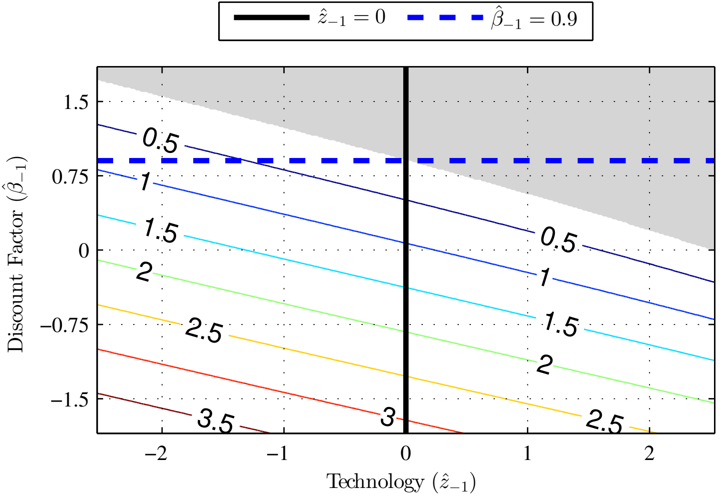
MODEL 1: NOMINAL INTEREST RATE ($y_t^* = \bar{y}$)



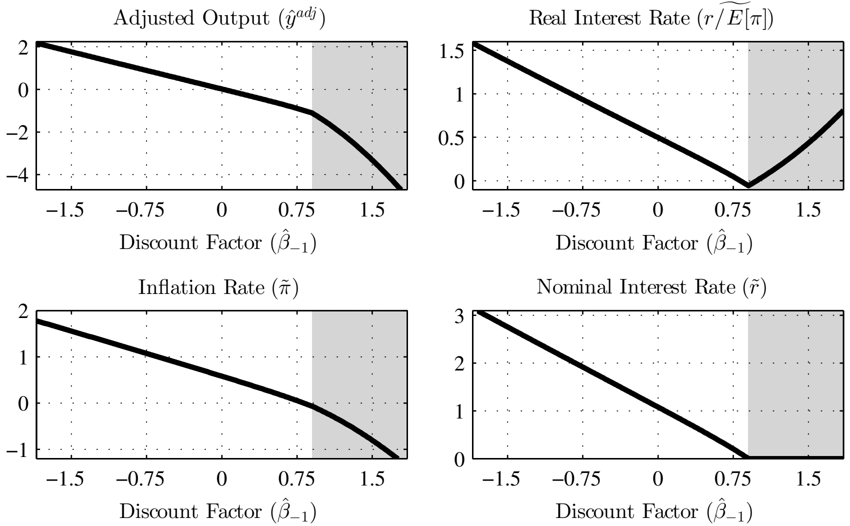
MODEL 1: ADJUSTED OUTPUT ($y_t^* = \bar{y}$)



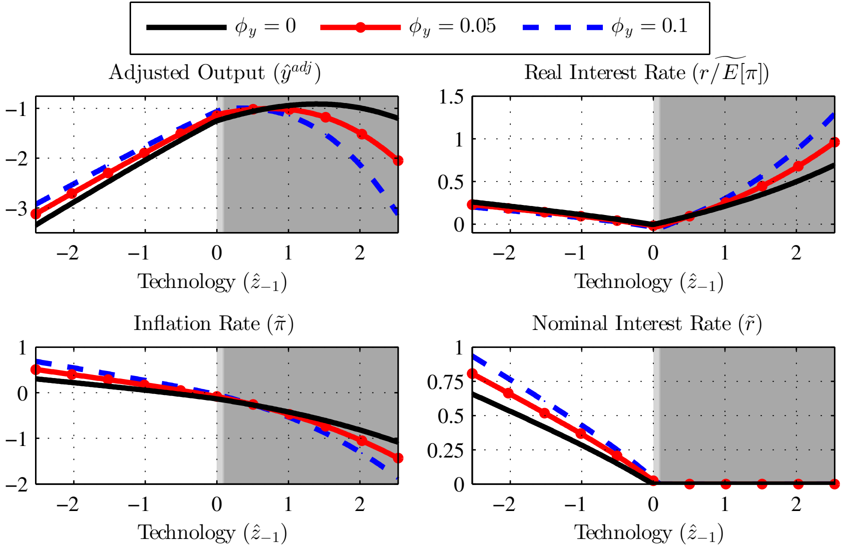
Model 1: Cross Sections ($y_t^* = \bar{y}$)



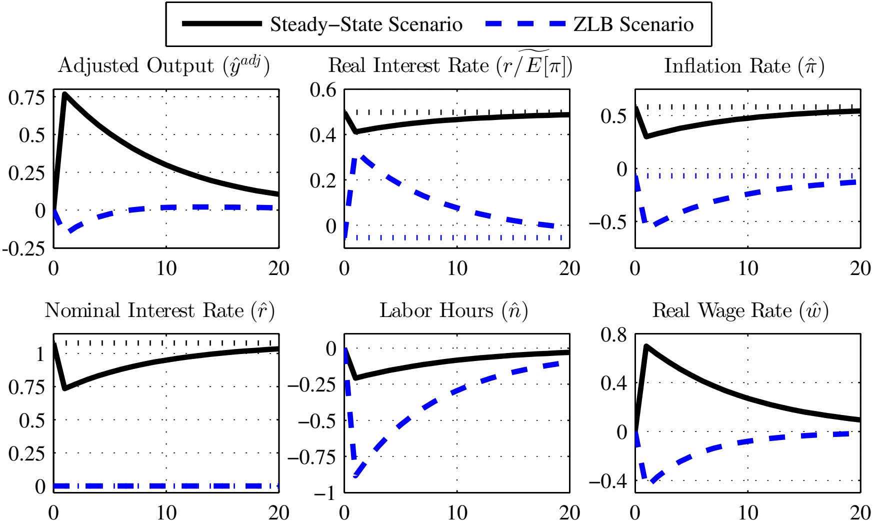
Model 1: Solution Across Disc. Factor



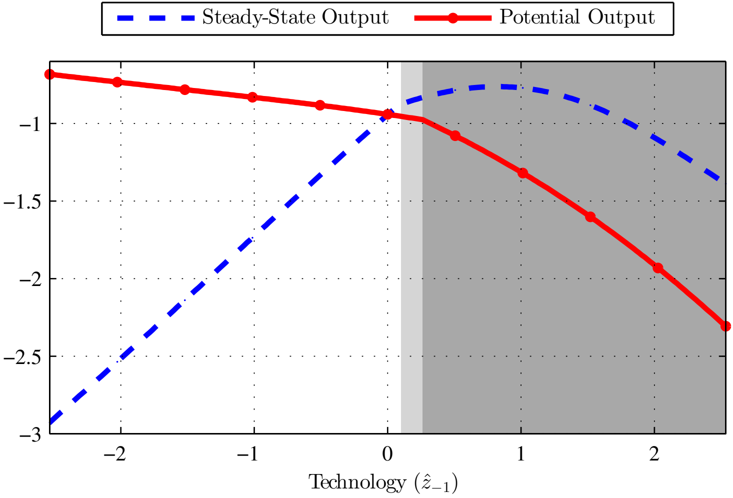
MODEL 1: SOLUTION ACROSS TECHNOLOGY



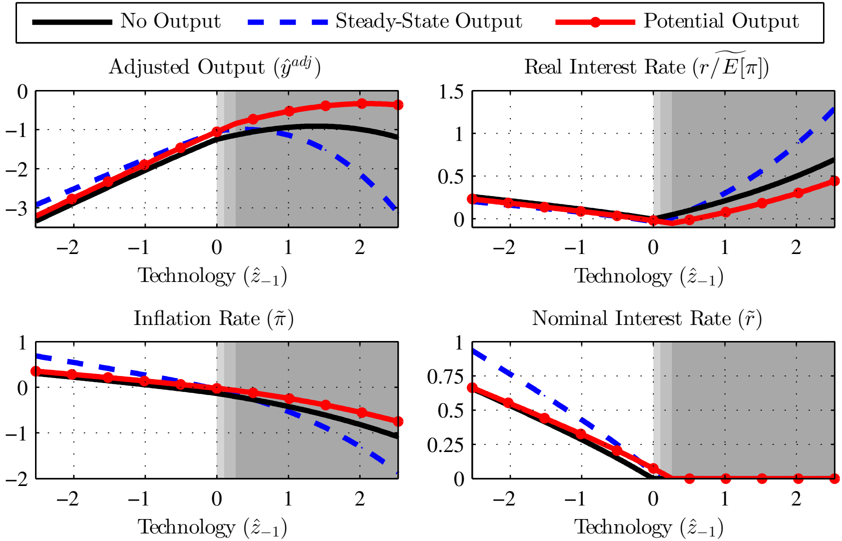
Impulse Response: Technology Shock



Model 1: Output Gap



MODEL 1: OUTPUT TARGET COMPARISON

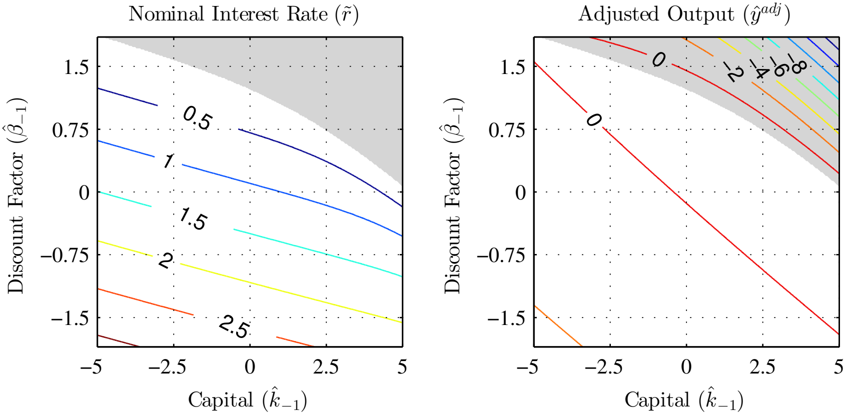


MODEL 1: SIMULATION

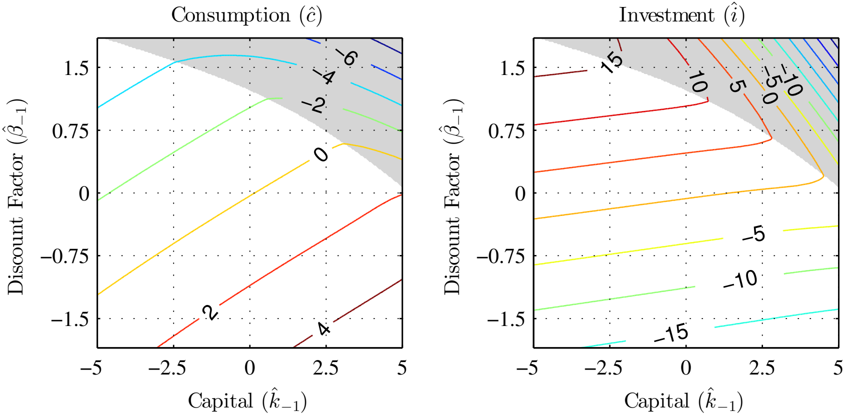
	Steady-State Output ($y_t^* = \bar{y}$)			Potential Output ($y_t^* = y_t^n$)		
	ZLB Binds	Std. Dev. (% of mean)		ZLB Binds	Std. Dev. (% of mean)	
ϕ_y	% of quarters	Output	Inflation	% of quarters	Output	Inflation
0.125	2.73	0.6501	0.3326	1.56	0.6993	0.2800
0.100	2.56	0.6704	0.3308	1.67	0.7107	0.2908
0.075	2.45	0.6925	0.3311	1.80	0.7234	0.3025
0.050	2.38	0.7167	0.3335	1.95	0.7376	0.3152
0.025	2.33	0.7431	0.3379	2.13	0.7537	0.3293
0.000	2.33	0.7719	0.3447	2.33	0.7719	0.3447

*500,000 quarter simulation. $\phi_\pi = 1.50$, $\rho_z = 0.90$, $\sigma_z = 0.0025$, $\rho_\beta = 0.80$, and $\sigma_\beta = 0.0025$.

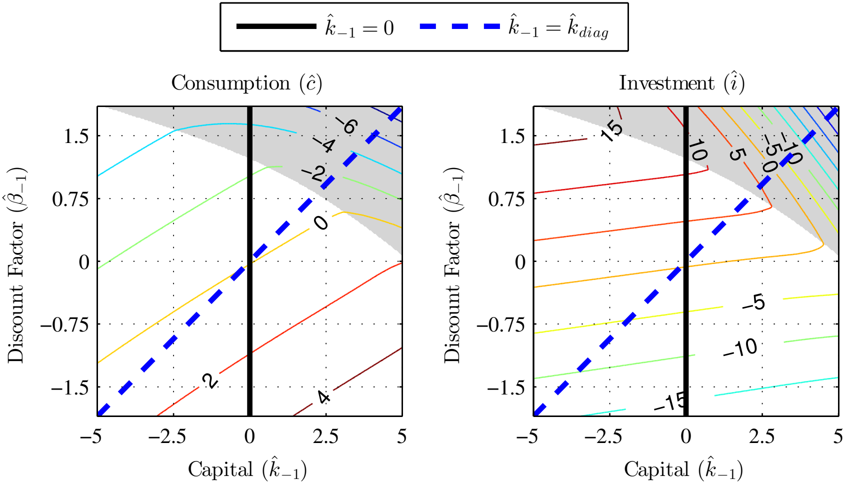
MODEL 2: COMPLETE SOLUTION



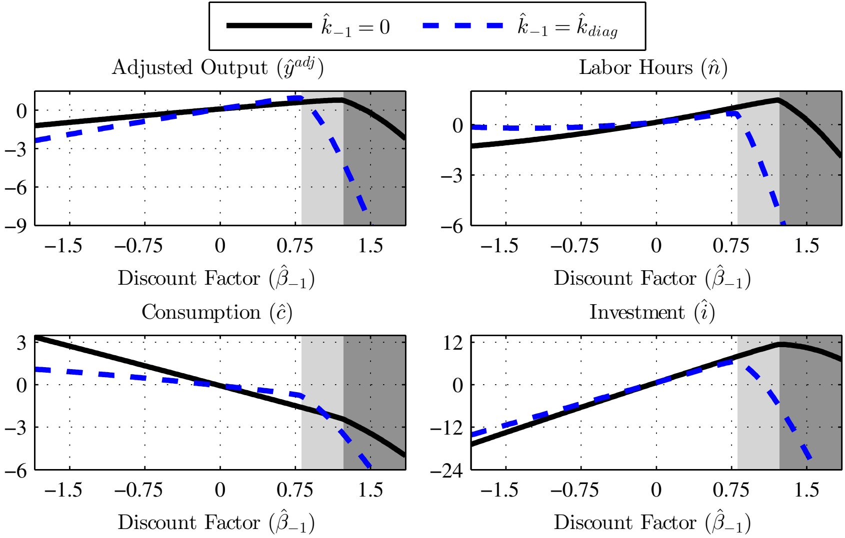
MODEL 2: COMPLETE SOLUTION



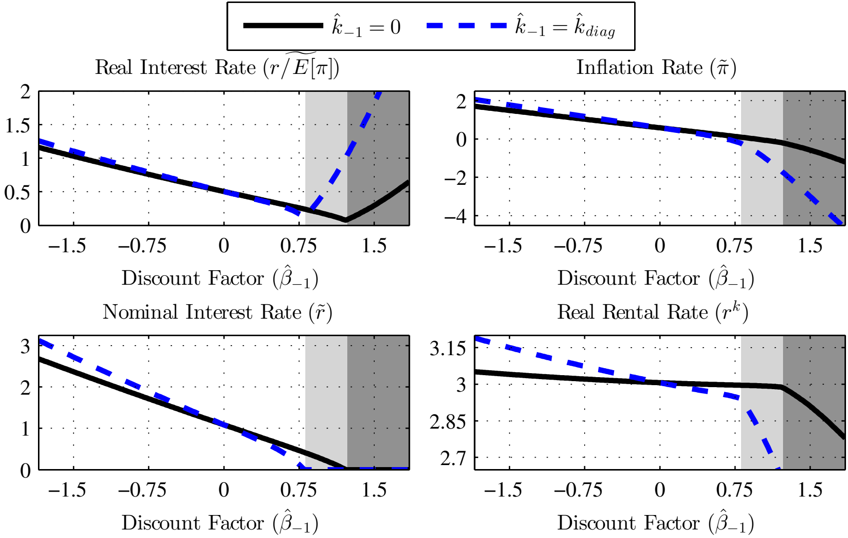
Model 2: Cross Sections



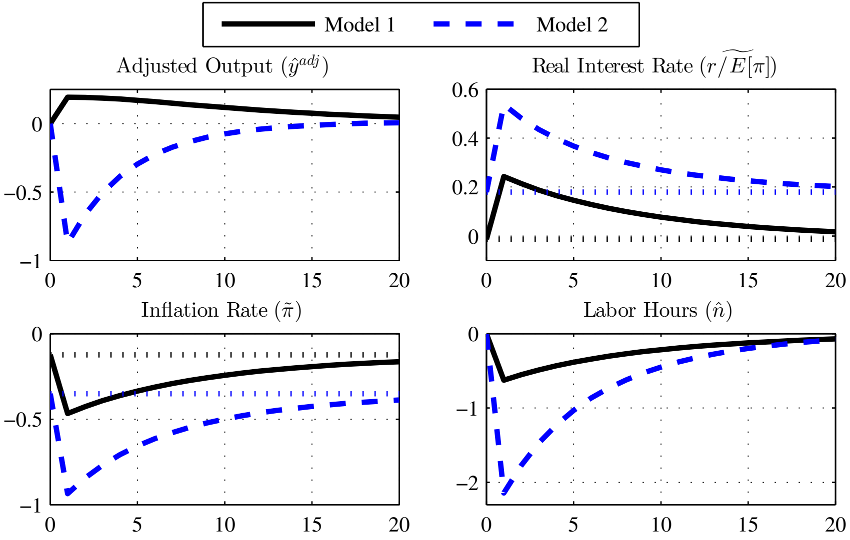
MODEL 2: SOLUTION ACROSS DISC. FACTOR



Model 2: Solution Across Disc. Factor



IMPULSE RESPONSE: TECHNOLOGY SHOCK



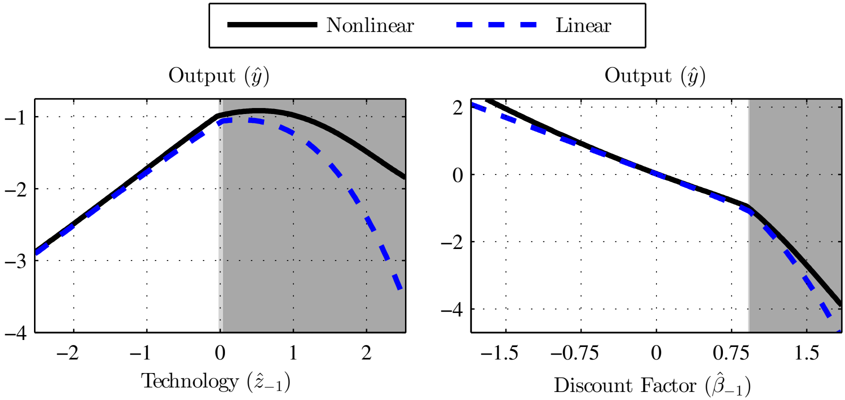
SIMULATION COMPARISON ($y_t^* = \bar{y}$)

- Both models only contain discount factor shocks
- Without technology shocks, $\bar{y} = y_t^n$ in Model 1

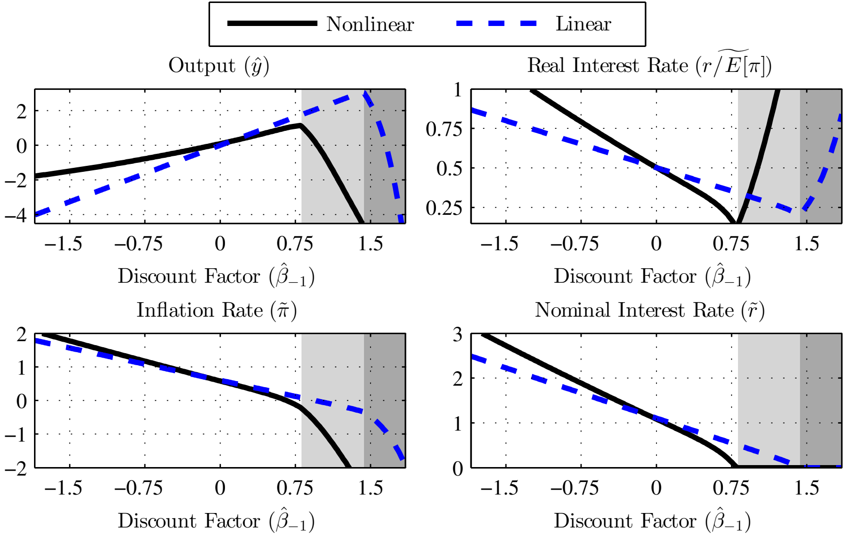
	Model 1			Model 2		
	ZLB Binds	Std. Dev. (% of mean)		ZLB Binds	Std. Dev. (% of mean)	
ϕ_y	% of quarters	Output	Inflation	% of quarters	Output	Inflation
0.100	1.20	0.4972	0.2769	1.15	0.4005	0.2979
0.075	1.29	0.5168	0.2878	0.35	0.4127	0.2654
0.050	1.39	0.5382	0.2997	0.16	0.4271	0.2473
0.025	1.51	0.5615	0.3126	0.07	0.4421	0.2304
0.000	1.64	0.5870	0.3268	0.03	0.4581	0.2133

*500,000 quarter simulation. $\phi_\pi = 1.50$, $\rho_\beta = 0.80$, and $\sigma_\beta = 0.0025$.

Model 1: Nonlinearities ($y_t^* = \bar{y}$)



MODEL 2: NONLINEARITIES ($y_t^* = \bar{y}$)



SUMMARY OF FINDINGS

- Our models show that technology shocks at the ZLB can have unconventional effects on the economy.
- Whether the central bank targets the steady-state output gap or the potential output matters.
- Whether capital is included in the model matters.
- Linearization works well for the model without capital but does not work well in the model with capital.
- The dual mandate probably does not help stabilize output because potential output is generally unknown in real time.