Fiscal Policy and the Term Structure

Aleš Maršál (NBS)
Lorant Kaszab (MNB)
Roman Horvath (IES)

Modern Tools for Financial Analysis and Modeling - Matlab

4.6.2015

Outline

Motivation & Objectives

Table : Impact of QE on Yield Curve

	Financial market indicator	Jan 22	Apr 7
Risk Free	EA OIS 3m1y fwd	-0.1	-0.13
	EA OIS 10y % p.a.	0.5	0.3
	US OIS 10y % p.a.	1.75	1.75
Credit	IT Yield spread to OIS 10y bps	112	91
	Emerging market bond spread	448	397
Uncertainty	Bond implied volatility	5.2	3.8
	Stoxx 50 Implied vol	21	17.6
Inflation	Infl-linked swap 5y spot	0.74	1.12
	Infl-linked swap 5y spot	1.24	1.39

Motivation & Objectives

Fiscal Policy and the Term Structure of Interest rates

Term Structure in the model

- risk free US yield curve
- closest to sovereign curve or swap curve
- keep in mind through out the presentation that we do not model default (credit spread)
- data frequency = quarterly (macro model)
- fundamental long run average vs. high frequency fluctuations

Motivation & Objectives

Fiscal policy in the model

- what is government spending in most DSGE models?
- can we find appropriate counterpart in the data?
- G as exogenous shock (AR(1) process), can't be associated with total government spending in data;
- defense spending uncorrelated with the cycle
- defense spending (DS) drives the cycle - most of the volatility comes from DS

Motivation & Objectives

Fiscal Policy and the Term Structure of Interest rates

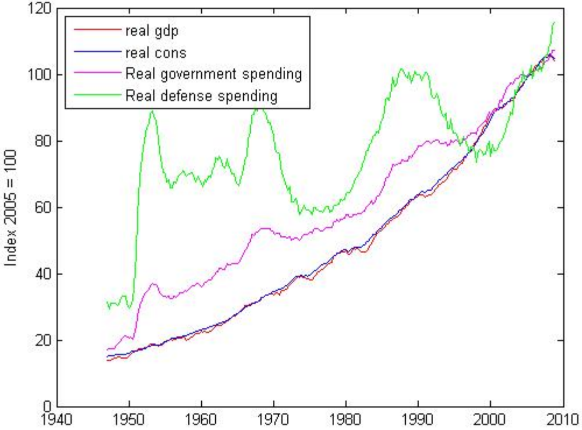

Figure : G breakdown

Motivation & Objectives

Fiscal Policy and the Term Structure of Interest rates

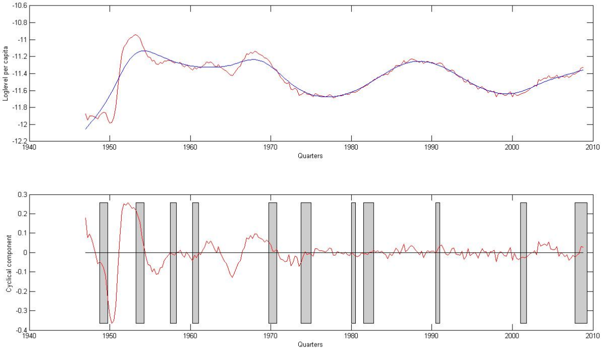

Figure : detrended defense expenditure

Motivation & Objectives

Why DSGE framework

- macro models used by most central banks for forecasting and policy analysis
  - arbitrage free models ignore micro foundation of the stochastic discount factor
  - Financial models do not account for monetary policy and macroeconomic fundamentals
  - Central bank behavior is the main source of information to determine the shape of yield curve
- can endogenize asset price - macroeconomy feedback
- structural model of asset prices (provides intuition, robustness to breaks and policy interventions)
- yield curve is silent feature of every DSGE model failure to explain term premia may signal flaws in the model to answer certain questions

Motivation & Objectives

- understanding the role of G in the dynamics of the term structure of interest rates

In particular, we ask:

- Are frequent changes and implied uncertainty in the size of government spending important for the market yields?
- What is the impact of G on the term structure?
- How does it depend on monetary policy conduct?
- Can fiscal policy immunize its impact on the term structure of interest rates?

Empirical evidence

Literature review

The literature studying the effects of fiscal policy on interest rates documents relationship. For instance:

- Barth (1991) surveys 43 studies; 18 positive effect, 6 mixed effects, 19 not significant or negative
- Gale and Orsag (2003) redo Barth (1991); from 19 studies with projected deficits 13 positive, 5 mixed effects, 1 no effect
- similar conclusion Mankiw (1999)
- often cited papers as Evans (1987) or Plosser (1982) no effect
- Afonso Martins (2010) using macro - finance model find government debt and the budget deficit rise sovereign yield curve in US

Empirical evidence

Afonso Martins (2010)

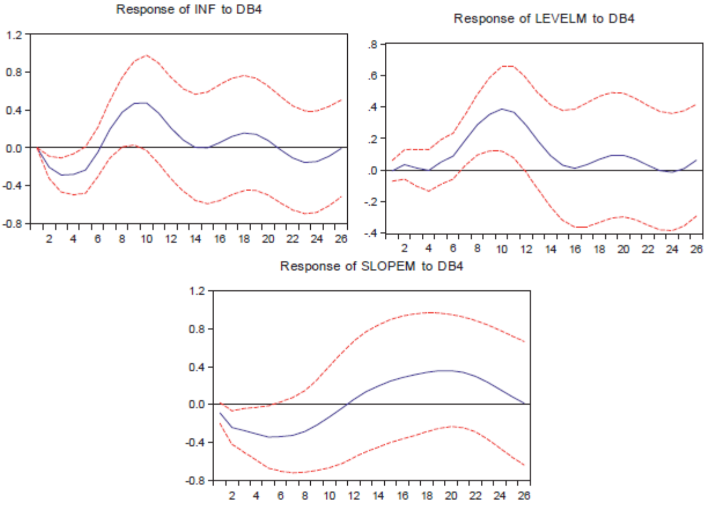

Figure : Response to Debt to GDP ratio

Empirical evidence

Afonso Martins (2010)

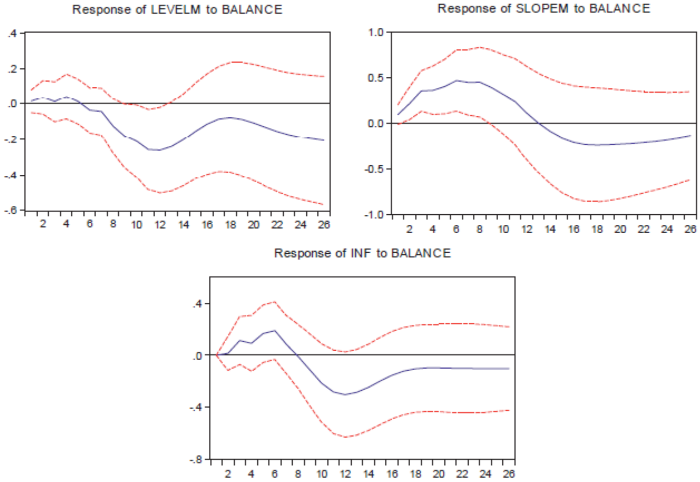

Figure : Response to Budget Balance

Literature review

DSGE perspective

Backus,Gregory and Zin (1989), Den Hann (1995)

- downward sloping yield curve

Hordahl, Tristani, Vestin (2006), Ravenna-Seppala (2005)

- match yield curve stylized facts (2nd,3th order)
- using habits but huge shocks

Piazzesi-Schneider (2006), Cambell and Cochrane (1999)

- EZ preferences, habits
- Endowment economy

Rudebusch-Swanson (2008)

- habits in consumption
- compromises macro moments

Literature review
DSGE perspective

Rudebush and Swanson (2012)

- EZ preference and long run risk
- successful but sensitive to output gap coef in Taylor rule

Van Binsbergen et al. (2012)

- EZ preference, similar model to RS (2012)
- estimated using maximum likelihood

Ferman (2012)

- EZ preference, similar model to RS (2012)
- using MS switching in TR

Unlike in our two papers on 1) fiscal policy and term premium and 2) explaining jointly term and equity premium (Kaszab and Marsal 2013, 2015) we focus on

- using simpler model to highlight the transmission
- answer policy questions

Model

Modeling framework . . .

1. We build our analysis on the variant of standard NK DSGE model (e.g. Gali (2002), De Paoli et al. (2010) or Erceg et al. (1999))
2. We add EZ preferences, fixed capital, budget deficit, additional shocks (preference shocks, G shock, mark-up shock)
3. Implement Markov switching in policy rule as in Ferman (2012)
4. commitment to fiscal consolidation as in Corsetti et al. (2012)

Model Structure

Model contains four type of agents...

1. households
2. firms
3. monetary authority
4. exogenous government

and is assumed to be driven by the productivity, mark-up, government, monetary and time preference shock.

Model Structure

Households

Representative, infinitely-lived agent specific by Epstein and Zin (1989) preferences.

$$V_t = u(C_t, N_t) + \beta[E_t V_{t+1}^{1-\alpha}]^{\frac{1}{1-\alpha}} \tag{1}$$

The period utility is given by:

$$E_0 \sum_{t=0}^{\infty} e^{\beta_t} \left\{ \frac{C_t^{1-\sigma_1}}{1-\sigma_1} - \omega \frac{N_t^{1+\sigma_2}}{1+\sigma_2} \right\} \tag{2}$$

subject to:

$$P_t C_t + E_t Q_{t,t+1} B_{t+1} \leq B_t + D + W_t N_t + T_t \tag{3}$$

where C_t *is composite consumption index*, B *risk free bonds*, β_t is time preference shock, N_t *hours worked*, D *firm profits*

Model Structure

SDF

From HHs optimization problem we can derive SDF.

$$Q_{t,t+1} = e^{b_{t+1}-b_t} \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \pi_{t+1}^{-1} \beta \left[\frac{R_t}{V_{t+1}} \right]^{\alpha} \tag{4}$$

SDF can be used to price bonds using recursion.

$$P_t^n = E_t \left\{ \beta^n \left(\frac{C_{t+n}}{C_t} \right)^{-\gamma} \prod_j^n \left[\frac{R_{t+j}}{V_{t+j+1}} \right]^{\alpha} \zeta_{t+j} \right\} \tag{5}$$

where

$$R_t = E_t [V_{t+1}^{1-\alpha}]^{\frac{1}{1-\alpha}} \tag{6}$$

Model Structure

Monetary authority follows interest rate rule:

$$i_t = \bar{i} + \Phi_{\pi(s_t)}\pi_t + \Phi_{y(s_t)}Y_t \tag{7}$$

The market clearing condition in the final good market

$$Y_t = C_t + G_t + \delta\bar{K} \tag{8}$$

Calibration

- Standard value for US
- based on Ferman (2012), Christiano, Eichenbaum, Rebelo (2010), Corsetti (2012)
- very specific parameter values not important for us as we do careful sensitivity analysis
- results are neither model nor calibration dependent

The model can match the macro (consumption, consumption growth, inflation, interest rate) and asset pricing (10Y slope, level and NTP) stylized facts comparably with Rudebush Swanson (2012), Ferman (2012) etc.

Calibration

Table : Calibration of the model

Monetary Policy Rule				Exogenous processes			
$\phi_{\pi(1)}$	2.19	$\phi_{\pi(2)}$	0.948	ρ_b	0.83	σ_b	0.020
$\phi_{y(1)}$	0.075	$\phi_{y(2)}$	0.075	ρ_A	0.98	σ_A	0.005
p_{11}	0.993	p_{22}	0.967	ρ_λ	0.18	σ_λ	0.051
				ρ_G	0.94	σ_G	0.008
Structural Parameters				**The Steady-State**			
β	0.99	θ	0.33	$\bar{\Pi}$	1.004		
γ	2	$\bar{\lambda}$	0.2	$\bar{K}/(4\bar{Y})$	2.5		
η	0.40	ζ	233	$\bar{G}/\bar{Y}$	0.2		
α	-108	δ	0.02				

Calibration

Period	σ_g	std(G)
1947 - 1957	5.83	17
1957 - 1967	1.55	4.53
1967 - 1977	1.61	4.71
1977 - 1987	0.49	1.43
1987 - 1997	0.61	1.79
1997 - 2007	0.9	2.63
1969 - 2009	0.8	2.43

Table : Standard deviation of defense spending and implied innovations. Results are in % deviations from the HP trend

Benchmark model

- to explain the transmission of exogenous government spending on term structure it is necessary to understand how the model economy works
- imagine that the economy is in the steady state (long run equilibrium)
- next, the economy is hit by exogenous G shock ($\varepsilon_G > 0$ at $t = 1$ and $\varepsilon_G = 0$ at $t > 1$)
- economy response is driven by wealth effect

Results

Benchmark model

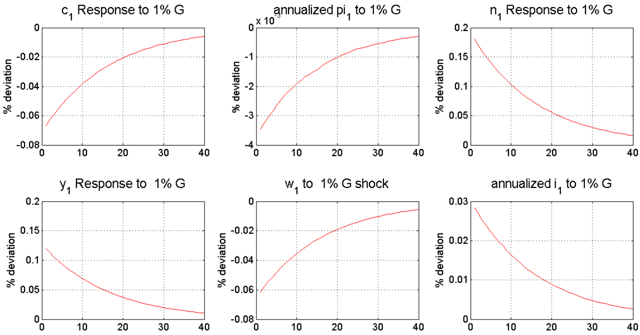

Figure : IR functions to 0.8% shock in G in basic NK model with regime shifts. In Taylor rule $\rho_y > 0$

Benchmark model

- $\Delta\ G > 0$ decreases disposable income implies $\frac{\partial C}{\partial G}, \frac{\partial L}{\partial G} < 0$ assuming they are normal goods
- less leisure causes $\Delta N > 0$
- aggregate demand goes up because $\frac{\partial C}{\partial G} < \Delta G \uparrow$
- $\frac{\partial N}{\partial G} > 0$ implies higher $Y_t = A_t \bar{K}^{\theta} N_t^{1-\theta}$ than in real terms $Y_t = C_t + G_t + \delta \bar{K}$ thus prices must go down
  - firms cannot cut prices fully because of nominal rigidities
  - they respond by reducing output and labor demand, this decreases wages
  - MP rices nominal interest rate - accommodating the rise in Y, real rate falls

Important: consumption and prices fall

Benchmark model

- imagine that the economy is in the steady state (long run equilibrium)
- next, the economy is hit by exogenous G shock ($\varepsilon_G > 0$ at $t = 1$ and $\varepsilon_G = 0$ at $t > 1$)
- we study the impact of different size of the shock on:
  1. level of the yield curve
  2. slope of the yield curve
- further we decompose the analysis into
  1. shifts in long run stochastic average yield curve
  2. period impact (IRF function)

Results

Benchmark model

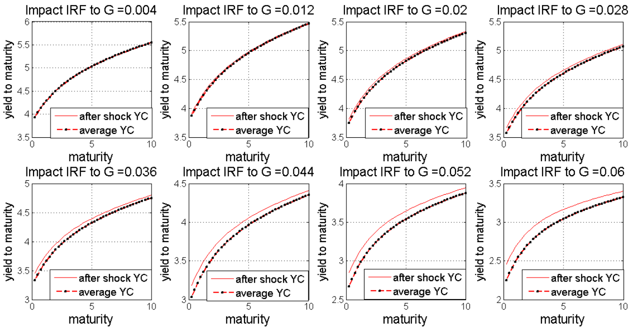

Figure : irf on impact to varying size of G shock in basic NK model with regime shifts. In Taylor rule $\rho_y > 0$

Benchmark model - on impact

Term structure can be decomposed to:

$$ytm_t = \sum_j E_t[i_{t+j}] + NTP_t \tag{9}$$

Nominal term premium captures the compensation for inflation risk

$$NTP_t = -f\left(\sum_j cov(c_{t+j}, \pi_{t+j})\right) \tag{10}$$

- covariance term capture the inflation uncertainty
- $\Delta \sum_j E_t[i_{t+j}] > 0$
- $\Delta NTP_t < 0$
- the expectation term overweights the drop in NTP at impact
- for ρ_y high enough there is drop in expectation term

Benchmark model

- we study the effects of uncertainty about G
- we look at the impact of varying the size innovations in government spending AR(1) process on the long-run stochastic average
- we look at the impact on
  1. level of the yield curve
  2. slope of the yield curve

Results

Benchmark model

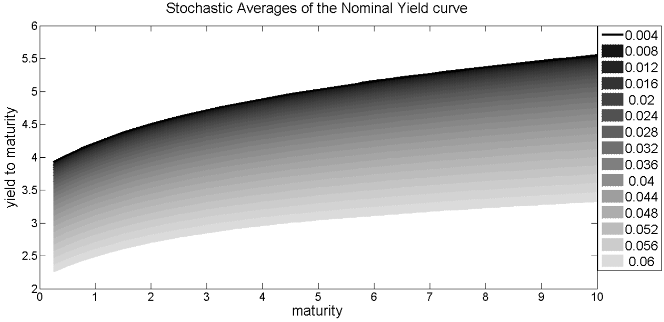

Figure : Term structure and varying volatility of G shocks. In the legend is the volatility of the G innovation.

Banchmark model - volatility

- higher uncertainty implies decrease in the level as well as slope
- drop in level is driven by precautionary saving motive
- incentive to smooth consumption combined with rise in uncertainty - agents seek to buy insurance
- rolling forward one year bond vs. buying long maturity bond
- in case of higher uncertainty there is drop in inflation premium

Results

Baseline model with output stabilization

- imagine that the economy is in the steady state (long run equilibrium)
- next, the economy is hit by exogenous G shock ($\varepsilon_G > 0$ at $t = 1$ and $\varepsilon_G = 0$ at $t > 1$)
- MP is not responding to rise in Y_t and accommodates the additional money demand
- firms can respond to additional demand by rising their prices

Important: consumption fall, prices rise

Results

Baseline model with output stabilization

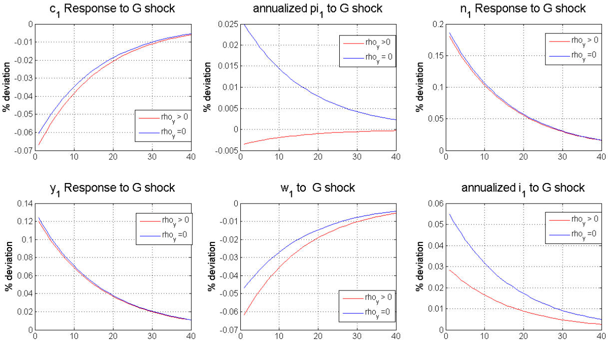

Figure : IR functions to 0.8% shock in G

Results

Baseline model with output stabilization

- the economy is hit by exogenous G shock ($\varepsilon_G > 0$ at $t = 1$ and $\varepsilon_G = 0$ at $t > 1$)
- we study the impact of different size of the shock conditional MP regime
- in economy with lower volatility of G inflation targeting like regime implies lower level and slope
- economy with higher volatility of G output stabilization regime implies lower level and slope

Results

Baseline model with output stabilization

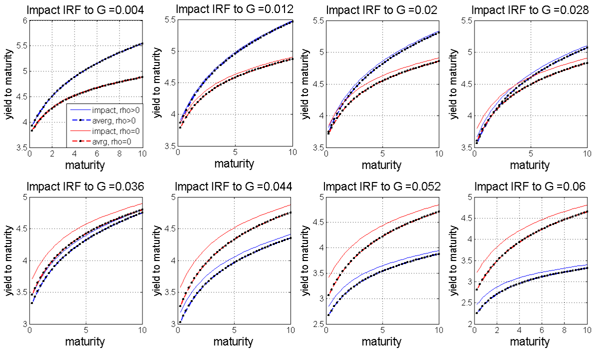

Figure : The Role of Monetary Policy. The stochastic steady state of the term structure and the impact of increase in government spending on the yield curve for two policy regimes.

Results

Baseline model with output stabilization

- we study the effects of uncertainty about G
- we look at the impact of varying the size innovations in government spending AR(1) process on the long-run stochastic average
- we look at the impact on
  1. level of the yield curve
  2. slope of the yield curve
- precautionary saving motive in place
- higher compensation for inflation

Results

Baseline model with output stabilization

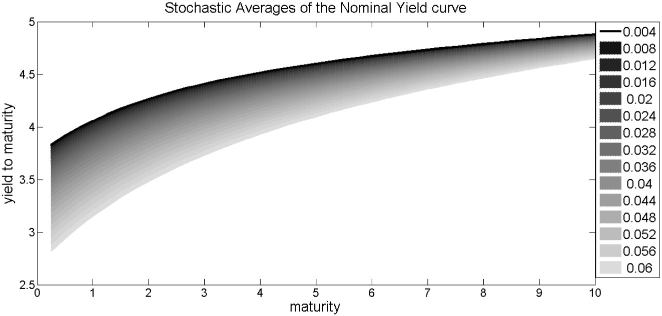

Figure : Term structure and varying volatility of G shocks. In the legend is the volatility of the shock. In the box is the maximal slope over the whole grid of parameters.

Spending reversals

1) Government budget constrain Government consumption is financed through either lump-sum taxes, T_t (taxes are in nominal terms) or the issuance of nominal debt, D_t, G_t are real government expenditures.

$$T_t + Q_{t,t+1} D_{t+1} = D_t + P_t G_t \tag{11}$$

2) Fiscal rule Corsetti uses simple fiscal rule

$$T_{Rt} = \Psi_t D_{Rt} \tag{12}$$

3) Endogenous government feedback rule

$$G_t = (1-\rho)G + \rho G_{t-1} - \Psi_G D_{Rt} + \eta_t \tag{13}$$

Results

Model with spending reversals

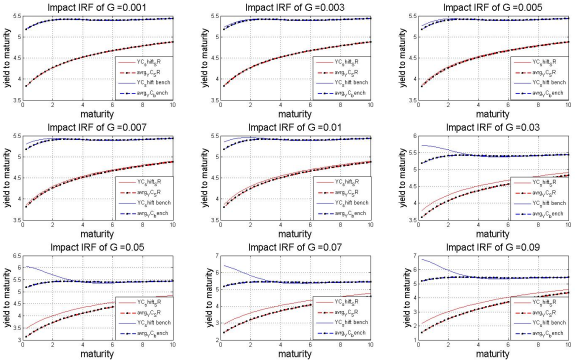

Figure : Term structure and varying volatility of G shocks. In the legend is the volatility of the shock. In the box is the maximal slope over the whole grid of parameters.

Summing it up . . .

- rise in G increases level of yield curve at the impact
- rise in uncertainty about G lowers the level of yield curve and slope depends on MP conduct
- the impact of MP stabilizing output gap depends on the volatility of the shocks
- commitment to fiscal consolidation significantly decrease the impact of G on yield curve

Appendix

Thank you for your attention

$$\widehat{ytm_t}^{(n)} = \frac{1}{n}\left\{ \begin{array}{l} -E_t[\Delta^{(n)}\hat{\lambda}_{t+n}] + \sum_{j=1}^{n} E_t[\hat{\pi}_{t+j}] - \frac{1}{2} Var_t\left[\Delta^{(n)}\hat{\lambda}_{t+n}\right] \\ -\frac{1}{2} Var_t\left[\sum_{j=1}^{n}\hat{\pi}_{t+j}\right] + Cov_t\left[\sum_{j=1}^{n}\hat{\pi}_{t+j}, \Delta^{(n)}\hat{\lambda}_{t+n}\right] \end{array} \right\}$$