Fiscal Multipliers with Time-inconsistent Preferences

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May 2012

Multiplier definitions and considerations

$$\frac{dY_{t+s}}{dG_t} \quad \text{and} \quad \frac{dY_{t+s}}{dT_t}$$

- Short-term, medium-term, or long-term s
- Temporary or permanent shock
- How stimulus is financed (balanced budget or deficit)
- Where taxing comes from (capital or labor tax)
- Where is spending (household transfers, gov't consumption, gov't investment)
- How much slack (expansion or recession)
- Do constraints bind (ZLB, borrowing constraints)

Multiplier research: vast and varied

- Standard RBC models: -2.5 to 1.2
  - multipliers increase with:
    - shock permanence
    - deficit financing
  - Most multipliers less than 1
    - Barro and King (1984), Aiyagari, Christiano, and Eichenbaum (1992), Baxter and King (1993)
- New Keynesian RE models: 0.5 to 1.0
  - Price frictions increase multipliers
  - Demand determined employment increases multipliers
  - Cogan, Cwik, Taylor, and Weiland (2010): 0.64 at peak
  - Galí, Lopéz-Salido, and Vallés (2007):

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    - Up to 2.0 if:
    - 50% of workers are rule-of-thumb
    - employment demand determined

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Multiplier research: vast and varied

- New Keynesian RE models with constraints: 1.0+
  - Zero lower bound: as high as 2.3
    - Egertsson(2001,2012), Woodford (2003,2011), Christiano, Eichenbaum, and Rebelo (2011)
  - Borrowing constraints:
    - Parker (2011) argues for including these

- Keynesian non-RE models: 1.5 to 2+
  - Fixed expectations (irrationality) increases multiplier
  - Evans (1969): 2+
  - Romer and Bernstein (2009): 1.5

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Multiplier research: vast and varied

- Regression, VAR, SVAR: -0.5 to 2+
  - Many of these are above unity (0.6 to 1.5)
    - Barro (1981), Hall (1986,2009) Ramey and Shapiro (1998), Fisher and Peters (2010), Ramey (2011), Barro and Redlick (2011), Blanchard and Perotti (2002)
  - Notable exceptions (-0.5 to 0.0) are Taylor (2009,2011), Pereira and Lopes (2010), Kirchner, Cimadomo, and Hauptmeir (2010)
  - Auerbach and Gorodnichenko (2012): expansion -0.3 to 0.8; recession 1.0 to 3.6

Our question: rationality

We focus on the effect of time-inconsistent preferences on multipliers (a la Galí, Lopéz-Salido, and Vallés, 2007)

1. Estimate discount factor in standard model
   - stochastic capital tax
   - balanced budget spending
2. Estimate discount factors in quasi-hyperbolic model
3. Compare multipliers in each

Results

- We estimate quasi-hyperbolic parameters similar to micro-studies
- Multipliers bigger with quasi-hyperbolic households
- Estimation tempers how much bigger the multipliers can be

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Hyperbolic discounting

- Standard exponential discounting

$$E_0\left[\sum_{t=0}^{\infty}\xi_t u(c_t, h_t)\right] \quad \text{where} \quad \xi_t = \delta^t \quad \forall t$$

- Quasi-hyperbolic discounting

$$\xi_t = \begin{cases} 1 & \text{if} \quad t = 0 \\ \beta\delta^{t-1} & \text{if} \quad t \geq 1 \end{cases} \qquad \text{with} \quad \beta < \delta$$

  - Discount factors are $\{1, \beta, \beta\delta, \beta\delta^2, \beta\delta^3, ...\}$

- Implies two Euler equations, rather than one recursive

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Hyperbolic discounting micro estimates

- Standard exponential discount factors: $\delta = 0.96$
  - Life cycle consumption and wealth data
  - Engen, Gale, and Scholz (1994), Hubbard, Skinner, and Zeldes (1994), Laibson, Repetto, and Tobacman (1998), Engen, Gale, Uccello (1999)
- Quasi-hyperbolic estimates
  - Shui and Ausubel (2005): $\beta = 0.81 - 0.83$ and $\delta = 0.999$
  - Passerman (2008): $\beta = 0.52 - 0.90$ and $\delta = 0.99$
  - Fang and Silverman (2009): $\beta = 0.48$ and $\delta = 0.88$
  - Laibson, Repetto, and Tobacman: $\beta = 0.70$ and $\delta = 0.95$
- Percent population hyperbolic discounters
  - Eisenhauer and Ventura (2006)
  - Italian and Dutch survey data
  - Less than 25% hyperbolic

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Model

- Standard representative agent RBC model
- Quasi-hyperbolic discounting
- Flexible prices
- Perfectly competitive firms
- Aggregate uninsurable shocks
- Distortionary stochastic capital tax
- Balanced budget constraint with public goods

Model: Households and firms

- Households

$$\max_{c_t, h_t} E_0 \left[\sum_{t=0} \xi_t u\left(c_t, h_t, G_t\right) \right]$$

$$\text{s.t.} \quad c_t + k_{t+1} = w_t h_t + (1 + r_t - \tau_t - \kappa) k_t + X_t$$

$$\text{where} \quad u\left(c_t, h_t, G_t\right) = \frac{c_t^{1-\sigma_c} - 1}{1 - \sigma_c} + A \frac{(1 - h_t)^{1-\sigma_h} - 1}{1 - \sigma_h} + \chi \frac{G_t^{1-\sigma_g} - 1}{1 - \sigma_g}$$

- Firms

$$Y_t = e^{z_t} K_t^{\theta} L_t^{1-\theta} \quad \text{where} \quad \underbrace{\mathbf{U}_t}_{1\times 2} = \underbrace{[1 \ \ \mathbf{U}_{t-1}]}_{1\times 3} \underbrace{\Gamma}_{3\times 2} + \underbrace{\varepsilon_t}_{1\times 2},$$

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Model: Market clearing and government

- Market clearing

$$K_t = k_t$$
$$L_t = h_t$$

- Government balanced budget constraint

$$\underbrace{\tau_t k_t}_{\text{revenues}} = \underbrace{\gamma G_t + (1-\gamma) X_t}_{\text{expenditures}}$$

Equilibrium definition

Recursive rational expectations equilibrium

Policy functions $c(k, z, \tau)$, $k'(k, z, \tau)$, and $h(k, z, \tau)$ and price functions $r(k, z, \tau)$ and $w(k, z, \tau)$ such that:

- households maximize lifetime expected utility
- firms maximize profits
- markets clear
- government budget constraint holds

Equilibrium: standard exponential households

$$u_c(c_t, h_t) = \delta E_t \left[(1 + r_{t+1} - \tau_{t+1} - \kappa) u_c(c_{t+1}, h_{t+1})\right]$$

$$w_t u_c(c_t, h_t) = -u_h(c_t, h_t)$$

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$$K_t = k_t$$

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Equilibrium: quasi-hyperbolic households

$$
\begin{aligned}
u_c(c_t, h_t) &= \beta E_t \left[(1 + r_{t+1} - \tau_{t+1} - \kappa) u_c(c_{t+1}, h_{t+1}) \right] \\
E_t \left[u_c(c_{t+1}, h_{t+1}) \right] &= \delta E_t \left[(1 + r_{t+2} - \tau_{t+2} - \kappa) u_c(c_{t+2}, h_{t+2}) \right] \\
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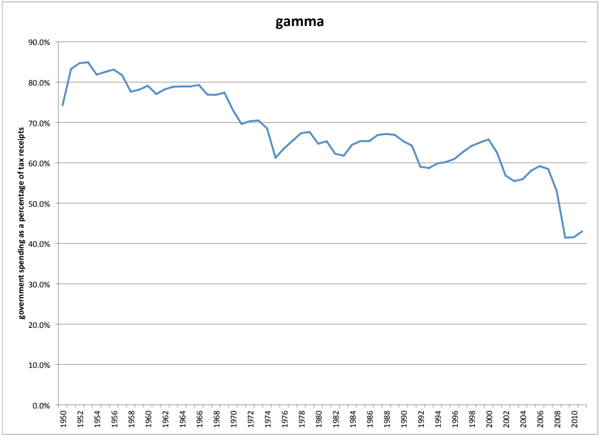
w_t &= (1-\theta) e^{z_t} \left(\frac{K_t}{L_t} \right)^{\theta} \\
K_t &= k_t \\
L_t &= h_t \\
\tau_t k_t &= \gamma G_t + (1-\gamma) X_t
\end{aligned}
$$

Calibrated parameters

Parameter	Source to match	Value
σ_c,σ_h,σ_g	log utility	1
A	shape parameter on leisure $1 - h_t$ in utility function, set to match steady-state hours worked $\bar{h} = 0.3$.[a]	1.72
χ	shape parameter on public goods spending G_t in utility function	1
θ	capital share of income	0.36
κ	annual depreciation rate	0.06
γ	percent of government revenues spent on public goods G_t, set to match avg. household transfers percent of revenues.[b]	0.7

[a] This approach to calibrating A follows Hansen (1984).
[b] Total tax revenue data (SCTAX+W055RC1+AFLPITAX) and household transfers (PCTR) come from St. Louis Fed FRED, 1947-2011.

Other government expenditures: γ



Calibration: VAR estimation $[z_t, \tau_t]$

- τ_t, use real federal corporate tax revenues as percent of total revenues
- z_t, use Solow residual approach from production function

$$z_t = \log(Y_t) - \theta \log(K_t) - (1-\theta)\log(L_t)$$

  - Y_t, real GDP 1951-2011
  - K_t, capital stock series from BEA
  - L_t, nonfarm employment times average annual hours

- VAR: $\tilde{\mathbf{U}}_t = \tilde{\mathbf{U}}_{t-1}\hat{\Gamma} + \varepsilon_t, \quad \varepsilon_t \sim N(\mathbf{0}, \hat{\Sigma}), \quad \tilde{\mathbf{U}}_t = [\tilde{z}_t, \tilde{\tau}_t]$

$$\hat{\Gamma} = \begin{bmatrix} 0.1298 & 0.2551 \\ -0.0571 & 0.9030 \end{bmatrix} \quad \text{and} \quad \hat{\Sigma} = \begin{bmatrix} 0.000057 & 0.000007 \\ 0.000007 & 0.000062 \end{bmatrix}$$

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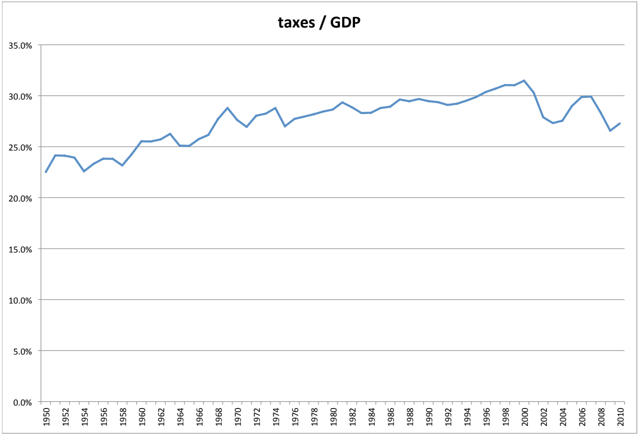
Tax rates: R_t / Y_t



MSM Estimation

- Data moments (1951-2011, annual)
  - mean(I/Y), mean(K/Y), mean(C/Y), mean(MPK)
  - standard deviation(I/Y)
  - corr(C_{t+1}, C_t), corr(C_t, h_t), PCE, detrended
- Estimate standard exponential model $\beta = \delta$ and $\bar{z}$
- Estimate quasi-hyperbolic model β, δ, and $\bar{z}$
- Choose parameters to minimize error between model moments and data moments
- 2,000 simulations per iteration of 61 periods each
- Log-linear solution technique for policy functions

MSM Estimation

Moments	Data[a]	Exponential Model		Quasi-hyperbolic Model	
		moment	std. err.[b]	moment	std. err.[b]
mean(I/Y)	0.129	0.125	(0.003)	0.132	(0.004)
mean(C/Y)	0.653	0.507	(0.002)	0.478	(0.002)
mean(K/Y)	2.204	2.090	(0.038)	2.209	(0.043)
mean(MPK)	0.164	0.172	(0.003)	0.163	(0.003)
st.dev.(I/Y)	0.021	0.030	(0.004)	0.033	(0.004)
corr(C_t, C_{t+1})	0.269	0.624	(0.118)	0.589	(0.127)
corr(C_t, h_t)	0.108	-0.843	(0.031)	-0.856	(0.037)
Estimated parameters					
β				0.774	(?)
δ		0.921	(0.160)	0.948	(?)
$\bar{z}$		1.170	(0.469)	1.388	(?)

[a] Data sample is 1948 to 2011 annual data.
[b] MSM standard errors are derived from 50,000 simulations.

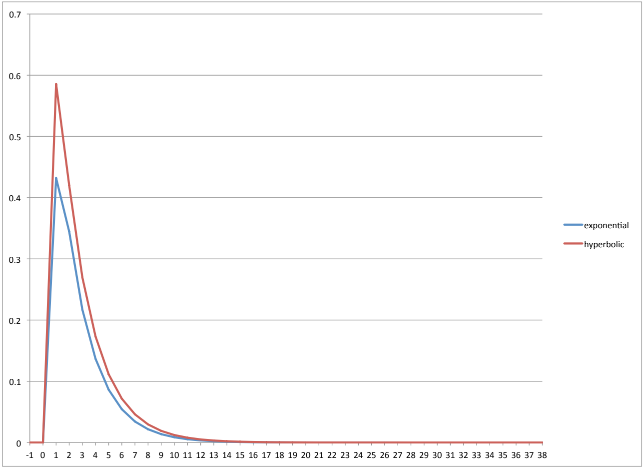
IRFs and Multipliers

- We set $z_t = \bar{z}$ for all t and set $\tau_t = \bar{\tau}$ for all t except for impulse $\tau_1 = \bar{\tau} - \sigma_{\tau,\tau}^{1/2}$
- Multiplier definition:

$$\frac{\Delta Y_{t+s}}{\Delta \tau_t k_t} \quad \text{for} \quad s \geq 0$$

- Look at both short-run and medium-run multipliers

Output multipliers



Results

- We estimate quasi-hyperbolic discount factors in DSGE model with values close to Laibson, et al (2012)
- Degree of "irrationality" probably not large
- Increase in multipliers minimal

Further work

- Use better tax series
- Add two types and estimate percent quasi-hyperbolic
- Add price or wage frictions
- Deficit financing
- Try nonlinear solution methods: DYNARE
  - VFI probably not feasible