

# Reconciling Output and Unemployment Fiscal Multipliers

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# Motivation

- Fiscal effects on unemployment & labor market variables are key interest in policy circle
- Academic research mostly focus on output multiplier.

# Empirical Backgrounds

- Fiscal effect on private consumption and output
  - ▶ VAR literature (US or developed countries)
    - ★ Recursive (Fatas & Mihov 2001) : Output increase, ordering has no theoretical justification.
    - ★ Sign Restriction (Mountford and Uhlig 2009) : but prior restriction upon the qualitative response is problematic.
    - ★ Narrative approach (Ramey and Shapiro 1998) : dummy variable capturing fiscal episodes.
    - ★ Blanchard & Perotti (2002) : Output increase, private consumption increase but private investment decrease.
  - ▶ VAR literature ( Korea )
    - ★ Fiscal shock insignificantly increase output, maybe slightly significant when exchange rate is taken into account ( Huh (2007) )
    - ★ Fiscal shock increase quite significantly increase output and also private consumption ( Kim (2011) )

# Empirical Backgrounds

- Fiscal effect on Labor

- ▶ Burnside, Eichenbaum & Fisher(2004) : RBC model, labor hours and real wage movements.
- ▶ Monacelli, Perotti & Trigari(2010) : Search and friction model á la Mortensen & Pissarides(1995)
  - ★ Search and friction per se in RBC model
  - ★ Nominal price friction coupled with complementarity between consumption and employment

# Goal of this paper

- Limitation of standard DSGE model : output multiplier above one, negative unemployment rate multiplier
- Provide a model reconciling the gap between empirical findings and theoretical models, particularly with the focus on fiscal multipliers of both output and unemployment rate
- To generate output multiplier above one : deep habit formation
- To generate unemployment multiplier : labor dynamics in Galí(2011)

# Theoretical Backgrounds

- RBC Model
  - ▶ Forward looking consumer understands government purchases today have to be financed by taxes in the future.
  - ▶ Present value of household life time wealth reduces and thus negative wealth effect.
  - ▶ Consumption declines whereas interest rate, saving and labor supply increase.
  - ▶ Real wages fall while investment and output increase.
- New Keynesian Model (Linnemann and Schabert (2003))
  - ▶ Private consumption declines due to negative wealth effect
  - ▶ Real wages rise because the resulting output increase raises the labor demand which offsets the increase in labor supply.

# Three candidates

- 1 Edgeworth complementarity between private and public consumption (McGrattan 1994)
- 2 Rule of Thumb Consumers (Gali, Lopez-Salido & Valles 2007)
- 3 Deep Habit (Ravn, Schmitt-Grohe & Uribe 2012, Zubairy 2014)

# Edgeworth Complementarity

- Public consumption in utility

$$E_0 \sum_{t=0}^{\infty} \beta^t \{ \log (c_t + \alpha_g g_t) - \psi (l_t) \}$$

- $\alpha_g > 0$  : substitutes ( $\alpha_g = 1$  perfect substitutes)
- $\alpha_g < 0$  : complements
- $\alpha_g = 0$  : RBC model

# Edgeworth Complementarity

- Feve, Matheron and Sahuc(2012) estimates Smets-Wouter type of model and finds  $\alpha_g < 0$  and thus complementarity.
- Private consumption responds positively to fiscal spending shock.
- However, the model cannot produce any other mechanism than co-movement of private consumption and public consumption.
- The rest of implications with external sector variables cannot be different from either RBC model or New Keynesian model.
- Moreover, this specification resembles the sign restriction of VAR which induces positive response of consumption by construction and no endogenous transmission mechanism behind.

## Rule of Thumb Consumer (Gali et al 2007)

- Mankiw(2000) suggests non-Ricardian household since empirical studies find substantial deviation of permanent income hypothesis.

$$E_0 \sum_{t=0}^{\infty} \beta^t U(c_t, l_t)$$

- Standard optimizing households with fraction of  $(1 - \lambda)$

$$s.t. P_t (c_t^o + i_t^o) + B_{t+1}^0 = W_t l_t^o + R_t^k k_t^o + R_{t-1} B_t^0 + D_t - T_t^0$$

- Rule of Thumb households with fraction of  $\lambda$

$$s.t. P_t c_t^r = W_t l_t^r - T_t^r$$

# Rule of Thumb Consumer

- Positive response of private consumption is only possible with high degree of  $\lambda (> 0.6)$
- With combination of New Keynesian model, Taylor principle does not hold anymore.
  - ▶ Taylor rule exploits the price of inter-temporal decision, which is the interest rate, to anchor the long-run inflation goal but the presence of rule of thumb consumers partially kills this linkage and thus resulting need of more aggressive monetary policy.
- Fails to resolve Monacelli and Perotti(2006) puzzle.

## Deep Habit

- Household  $j$  derives utility from an object  $x_t^j$

$$E_0 \sum_{t=0}^{\infty} \beta^t U(x_t^j, l_t^j)$$

where

$$x_t^j = \left[ \int_0^1 (c_{it}^j - \theta c_{it-1})^{1-1/\eta} di \right]^{1/(1-1/\eta)}$$
$$c_{it-1} \equiv \int_0^1 c_{it-1}^j dj$$

- As opposed to superficial habit

$$x_t^j = c_t^j - \theta c_{t-1}$$
$$c_t^j = \left[ \int_0^1 (c_{it}^j)^{1-1/\eta} di \right]^{1/(1-1/\eta)}$$

# Deep Habit

- FOC with superficial habit

$$c_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\eta} c_t$$

Price elasticity of demand for  $c_{it}$  is  $\eta$ , thus time-invariant markup  $\frac{\eta}{\eta-1}$ .

- FOC with deep habit

$$c_{it} = \left( \frac{P_{it}}{P_t} \right)^{-\eta} x_t + \theta c_{it-1}$$

Price elasticity of demand for  $c_{it}$  is  $\frac{\eta \left( \frac{P_{it}}{P_t} \right)^{-\eta} x_t}{c_{it}}$  which is increasing in  $x_t$ ! and thus countercyclical markup.

# Deep Habit

- Public consumption behaves similarly under deep habit formation.
- Since the firm lowers markup in response to fiscal expansion, the firm demand more labor and give upward pressure to real wage.
- If this pressure is strong enough to offset the labor supply increase stemming from negative wealth effect, the private consumption might rise.
- Moreover, introduction of habit stock reinforces the persistence of decline in markup.
- In open economy(two country model), the price elasticity effect induces lowering domestic markups of both domestically produced and foreign produced goods relative to foreign markups and thus real exchange rate depreciates and trade balance deteriorates.
- Home bias tends to give pressure to raise the price of domestically produced goods and thus pressure to appreciate the real exchange rate. But the effect is small enough.

# Model Summary

- Identical households : members differentiated in two dimensions(labor disutility, labor service)
- Monopolistic competition in labor services
- Deep habit formation on private and public consumption
- Rotemberg style of stick price and wage

# Household

- a continuum of members each of whom is indexed by a unit square,  $(i, j) \in [0, 1] \times [0, 1]$
- $i$  denotes the type of labor service
- the disutility is given by  $\varphi_t \psi j^\theta$  if the household member is employed and zero otherwise
- Following the assumptions of Merz(1995), individuals' income risks are fully insured among themselves

- Household utility,

$$\begin{aligned} & E_0 \sum_{t=0}^{\infty} \beta^t d_t \left\{ \log(x_t^c) - \varphi_t \psi \int_0^1 \int_0^{n_{it}^s} j^\vartheta dj di + V(x_t^g) \right\} \\ = & E_0 \sum_{t=0}^{\infty} \beta^t d_t \left\{ \log(x_t^c) - \varphi_t \psi \int_0^1 \frac{(n_{it}^s)^{1+\vartheta}}{1+\vartheta} di + V(x_t^g) \right\} \end{aligned}$$

# Household

- The household's budget constraint is given by:

$$\begin{aligned} & \int_0^1 \frac{p_{zt}}{p_t} c_{zt} dz + i_t + \frac{B_t}{p_t} + w_t \frac{\theta_w}{2} \int_0^1 \left( \frac{w_{it}}{w_{it-1}} \pi_t - \pi_{ss} \right)^2 di \\ = & (1 - \tau_t^w) \int_0^1 w_{it} n_{it} di + \left( r_t u_t (1 - \tau_t^k) + \delta \tau_t^k - \phi(u_t) \right) k_{t-1} \\ & + R_{t-1} \frac{B_{t-1}}{p_t} + T_t + \Phi_t \end{aligned}$$

# Deep Habit

- $x_t^c$  is a composite of habit adjusted consumption of a continuum of differentiated goods,

$$x_t^c = \left[ \int_0^1 (c_{zt} - b_c s_{zt-1}^c)^{\frac{\eta_c - 1}{\eta_c}} dz \right]^{\frac{\eta_c}{\eta_c - 1}}$$

- Assuming habit stock,

$$s_{zt}^c = \theta_c s_{zt-1}^c + (1 - \theta_c) c_{zt}$$

- expenditure minimization problem gives

$$c_{zt} = \left( \frac{p_{zt}}{p_t} \right)^{-\eta_c} x_t^c + b_c s_{zt-1}^c$$

- Similarly,

$$g_{zt} = \left( \frac{p_{zt}}{p_t} \right)^{-\eta_g} x_t^g + b_g s_{zt-1}^g$$

## Labor Market Variables

- household individual member's participation condition is

$$\frac{d_t}{\lambda_t} \varphi_t \psi j^{\vartheta} \leq (1 - \tau_t^w) w_{it}$$

the marginal supplier of type  $i$  labor, which is denoted by  $l_{it}$ , is given by

$$\frac{d_t}{\lambda_t} \varphi_t \psi l_{it}^{\vartheta} = (1 - \tau_t^w) w_{it}$$

integrate the participation constraint over  $i$  given that the wages are symmetric from the equilibrium conditions

$$l_t = \left[ \frac{\lambda_t (1 - \tau_t^w)}{d_t \varphi_t \psi} w_t \right]^{\frac{1}{\vartheta}}$$

Then, the unemployment rate is,

$$u_t^e \equiv 1 - \frac{n_t^d}{l_t}$$

# Firms

- Firms' problems :  $\max_{\{p_{zt}, c_{zt}, i_{zt}, g_{zt}\}}$

$$E_t \sum_{\tau=0}^{\infty} \beta^{\tau} \frac{\lambda_{t+\tau}}{\lambda_t} \left\{ \left( \frac{p_{z,t+\tau}}{p_{t+\tau}} - mc_{t+\tau} \right) y_{z,t+\tau} - \frac{\alpha^p}{2} \left( \frac{p_{z,t+\tau}}{p_{z,t+\tau-1}} - \pi_{ss} \right)^2 \right\}$$

subject to

$$c_{z,t} = \left( \frac{p_{z,t}}{p_t} \right)^{-\varepsilon} x_t^c + b_c s_{z,t-1}^c$$

$$i_{z,t} = \left( \frac{p_{z,t}}{p_t} \right)^{-\varepsilon} i_t$$

$$g_{z,t} = \left( \frac{p_{z,t}}{p_t} \right)^{-\varepsilon} x_t^g + b_g s_{z,t-1}^g$$

where

$$y_{z,t} = c_{z,t} + i_{z,t} + g_{z,t}$$

$$s_{z,t}^c = \theta_c s_{z,t-1}^c + (1 - \theta_c) c_{z,t}$$

$$s_{z,t}^g = \theta_g s_{z,t-1}^g + (1 - \theta_g) g_{z,t}$$

# Gov't Budget

- Gov't Budget

$$b_t = g_t + T_t + \frac{R_{t-1}b_{t-1}}{\pi_t} - \tau_t$$

where the tax revenues,  $\tau_t$ , is

$$\tau_t = \left( r_t u_t - \frac{1}{\mu_t} \delta \right) \tau_t^k k_{t-1} + \tau_t^w w_t n_t^d$$

- Gov't tax

$$\log \frac{\tau_t^k}{\tau_{ss}^k} = \rho_k \log \frac{\tau_{t-1}^k}{\tau_{ss}^k} + \rho_{k,b} \log \frac{b_{t-1}}{b_{ss}} + \rho_{k,y} \log \frac{y_{t-1}}{y_{ss}} + \sigma_k \varepsilon_t^k$$

and

$$\log \frac{\tau_t^w}{\tau_{ss}^w} = \rho_w \log \frac{\tau_{t-1}^w}{\tau_{ss}^w} + \rho_{w,b} \log \frac{b_{t-1}}{b_{ss}} + \rho_{w,y} \log \frac{y_{t-1}}{y_{ss}} + \sigma_w \varepsilon_t^w$$

# Gov't Expenditure

- Gov't spending and lumpsum transfers

$$\log \frac{g_t}{g_{ss}} = \rho_g \log \frac{g_{t-1}}{g_{ss}} - \rho_{g,b} \log \frac{b_{t-1}}{b_{ss}} - \rho_{g,y} \log \frac{y_{t-1}}{y_{ss}} + \sigma_g \varepsilon_t^g$$

and

$$\log \frac{T_t}{T_{ss}} = \rho_{tr} \log \frac{T_{t-1}}{T_{ss}} - \rho_{tr,b} \log \frac{b_{t-1}}{b_{ss}} - \rho_{tr,y} \log \frac{y_{t-1}}{y_{ss}} + \sigma_{tr} \varepsilon_t^{tr}$$

# Monetary Authority

- Augmented Taylor rule

$$\log \frac{R_t}{R_{ss}} = \rho_R \log \frac{R_{t-1}}{R_{ss}} + (1 - \rho_R) \left( \gamma_\pi \log \frac{\pi_t}{\pi_{ss}} + \gamma_y \log \frac{y_t}{y_{ss}} \right) + \sigma_m \varepsilon_t^m$$

# Calibration I

Table: Calibrated Parameters I

Parameter	Value	Description
$\beta$	0.9926	Discount factor
$\delta$	0.025	Depreciation rate
$\alpha$	0.3	Capital share
$\Phi_1$	free	Capacity utilization cost
$\phi$	free	Production fixed cost
$\psi$	free	Preference parameter
$\vartheta$	1.5	Inverse of Frisch Elasticity
$\eta_w$	13.5	Elasticity of substitution btw differentiated labor
$\eta$	6	Elasticity of substitution btw differentiated good
$\theta_w$	102	Nominal wage adjustment cost
$\theta_p$	10	Nominal price adjustment cost
$\tau_{ss}^w$	0.23	Wage income tax rate
$\tau_{ss}^k$	0.41	Capital income tax rate

# Calibration II

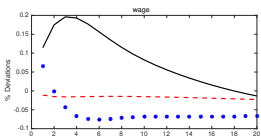
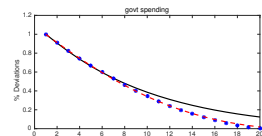
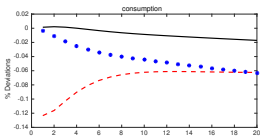
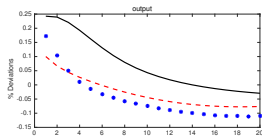
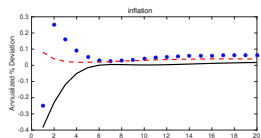
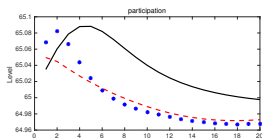
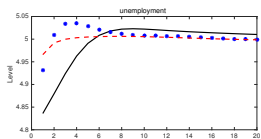
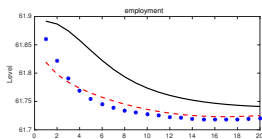
Table: Calibrated Parameters II

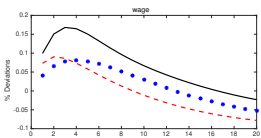
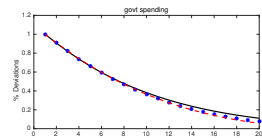
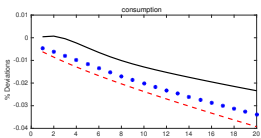
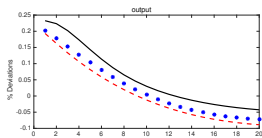
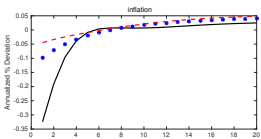
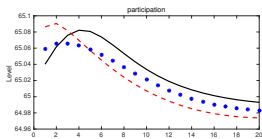
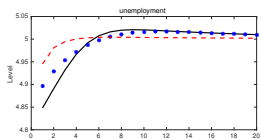
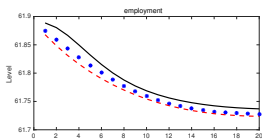
Parameter	Value	Description
$\kappa$	2	Investment adjustment cost
$\Phi_2$	$2.52 \times \Phi_1$	Capacity utilization cost
$b_c$	0.96	Deep habit on private consumption
$b_g$	0.85	Deep habit on public consumption
$\theta_c$	0.53	Private consumption habit stock persistence
$\theta_g$	0.98	Public consumption habit stock persistence

# Calibration III

Table: Calibrated Steady States

Variable	Steady State Value	Description
$u$	1	Capacity utilization
$\pi$	1	Inflation rate
$n^s$	0.65	Labor participation
$u^e$	0.05	Unemployment Rate
$\frac{g}{y}$	0.195	Gov't spending to output ratio
$\frac{b}{y}$	0.30	Debt to output ratio



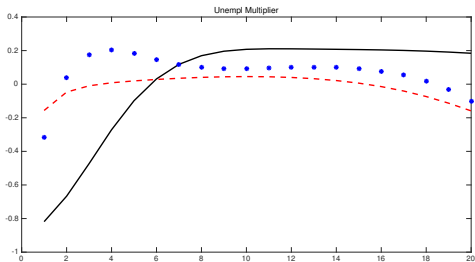
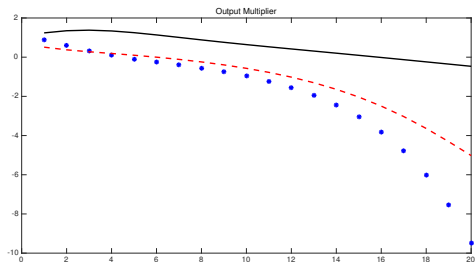


# Fiscal Multiplier

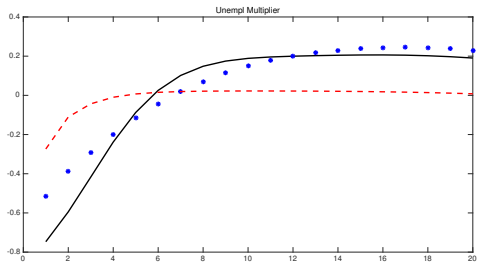
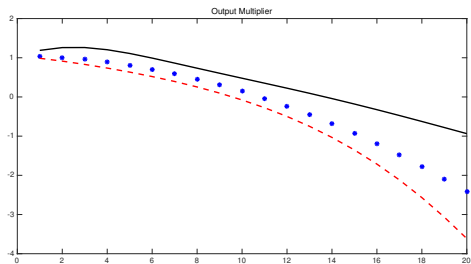
- Fiscal multipliers have been calculated following Mountford & Uhlig(2009).

$$\text{P.V. multiplier } k \text{ periods ahead} = \frac{E_t \sum_{j=0}^k (1 + R)^{-j} \Delta Y_{t+j}}{E_t \sum_{j=0}^k (1 + R)^{-j} \Delta G_{t+j}}$$

# Multipliers I



# Multipliers II



# P.V. Cumulative Fiscal Multipliers

Table: P.V. of Fiscal Multipliers on Output and Unemployment Rate

Variables	Output	Unemployment Rate
Quarter 2	1.3494	-0.6669
Quarter 4	1.3383	-0.2713
Quarter 8	0.8816	0.1697
Quarter 12	0.4193	0.2105
Peak	1.3781 (3Qs)	-0.8184(1Q)

# Thank You