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Deep habits, tax cuts and fiscal spending

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Abstract: Recently, there is a growing clamor from the Filipino public to reduce the income tax rate, which currently stands as one of ASEAN's highest. According to proponents, a significant tax rate cut would spur consumption spending and savings, leading to output growth. Those who oppose, however, point to the impracticality of such a policy shift on the grounds that public finance may not be sustainable as tax revenues may no longer support more government expenditures. But what is missing in the conversation is the role of countercyclical markups, the realization of which is critical in making sure that earnings tax cuts are expansionary. This note shows that reducing earnings taxes promotes growth, renders markups still countercyclical and increases private consumption. But such effects are clearly anchored on preference structures.

JEL Classification: E32
Key words: fiscal stimulus; DSGE, deep habits

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1. INTRODUCTION

Based on the studies of Ravn, Schmitt – Grohe and Uribe (2004) [henceforth RSGU], Cantore, Levine, Melina and Yang [henceforth CLMY], and Leith, Moldovan and Rossi (2015) [henceforth LMR], it is clear that the assumption on habit formation stemming from deep habits leads to above-unity fiscal multipliers. Under such habits, government spending shocks induce countercyclical markups leading to cyclical movements in output and wages, both of which are expected to spur higher private consumption. As consumption represents a significant proportion of aggregate demand, the positive cyclical movement enhances the effects of government spending on output. This regularity has generated robust support for the integration of deep habits in DSGE models that focus on fiscal policy.

Related to the theoretical and empirical issues pursued by RSGU, CLMY, and LMR, an interesting research question is: how does a favourable tax shock compare with government spending in a deep habits model? Will the dynamics yield countercyclical markups or will there be results similar to those under superficial habits?

This note contributes to the literature by investigating the impact of tax cuts on key macroeconomic outcomes. We pay close attention to preference structures since a growing body of literature emphasizes the key role of complementarities in consumption (Ganelli and Tervala, 2009; Linnemann and Schabert, 2004).

The note is organized as follows: the model is presented in section 2. Section 3 shows the results. and the last section concludes.

2. THE MODEL[1]

2.1 Households

A continuum of price – taking households, monopolistically competitive firms that face nominal inertia, and government and monetary authorities that set fiscal and monetary policies populate the economy. Household preferences are assumed to exhibit deep habits, implying that habits are formed with respect to the level of individual goods.[2]

Following RSGU and LMR, define the habit – adjusted consumption commodity composite X_t^j consumed by household j as

$$X_t^j = \left[\int_0^1 \left(C_{it}^j - \theta s_{it-1}\right)^{1-\frac{1}{\eta}} di\right]^{\frac{1}{1-\frac{1}{\eta}}} \quad (1)$$

where C_{it}^j refers to the level of the ith variety consumed by household j; s_{it-1} is the stock of habits of private consumption up to t – 1; and η is the intertemporal elasticity of substitution. The stock of habits evolves in the following way:

$$s_{it} = \rho s_{it-1} + (1-\rho) C_{it}^j \quad (2)$$

where ρ is a persistence parameter.

Using (1) as a constraint, the optimal level of C_{it}^j after minimizing expenditures $\int_0^1 P_{it}^c C_{it}^j di + \int_0^1 \tau_{it}^c P_{it}^c C_{it}^j di$ is

$$C_{it}^j = (P_{it}^c / P_t^c)^{-\eta} X_t^j + \theta s_{it-1} \quad (3)$$

The price index is given by $P_t^c = \left[\int_0^1 \left((1+\tau_{it}^c) P_{it}^c\right)^{1-\eta} di\right]^{\frac{1}{1-\eta}}$ as long as $\tau_{it}^c = \tau_t^c \, \forall i$. As explained in RSGU, CLMY, and LMR, the optimal demand has two components, an elastic part consisting of $(P_{it}^c / P_t^c)^{-\eta} X_t^j$ and an inelastic portion, θs_{it-1} which depends on stock of past private consumption habits. The presence of the lagged component implies that when optimal demand is taken as a constraint, firms' pricing policy will have to factor in lagged habits, thereby rendering their pricing policy dynamic.

Moreover, an increase in government spending leads to an increase in aggregate demand. Since firms use household's optimal demand as a constraint, this may lead to countercyclical markups, thereby explaining the crowding – in effect on consumption and the rise in wage rate.

[1] This section builds upon the seminal model of RSGU and draws heavily from their Technical Notes.

[2] Habits do form around aggregate consumption goods. When this appears to be the case, they are called superficial habits.

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In this economy, households own physical capital which evolves in the following way:

$$k_{t+1}^j = (1-\delta)k_{t+1}^j + i_t^j \quad (4)$$

Investment decisions rest on households. The level of investment i_t^j is specified as a composite good consisting of differentiated investment goods.

$$i_t^j = \left[\int_0^1 \left(i_{it}^j\right)^{1-\frac{1}{\eta}} di\right]^{\frac{1}{1-\frac{1}{\eta}}}$$

The optimal level is given by

$$i_{it}^j = (P_{it}^c/P_t^c)^{-\eta} i_t^j \quad (5)$$

Aside from investing and consuming, households enter the labor market and earn but they also make decisions on optimal portfolio holdings. Following RSGU and LMR, the constraint is given by

$$\begin{aligned}&(1+\tau_t^c)x_t^j + i_t^j + (1+\tau_t^h)\omega_t \\ &+B_{t+1}^j = R_t B_t^j + (1-\tau_t^h)w_t h_t^j \\ &+\Phi_t + r_t^j k_t^j\end{aligned} \quad (6)$$

where τ_t^c and τ_t^h represent consumption and labor earnings tax rates, $x_t^j + \omega_t$ is the aggregate consumption of all households; Φ_t refers to the amount of dividend payments; and B_{t+1}^j represents bonds bought by the household.

2.2 Government

As modelled, private consumption exhibits deep habit formation. Maintaining symmetry, habits are also formed over a continuum of public consumption goods. The optimization problem seeks to maximize the amount of habit adjustment government consumption goods.

$$\begin{aligned}&\max X_t^G = \left[\int_0^1 \left(G_{it} - \theta^G s_{t-1}^g\right)^{1-\frac{1}{\eta}} di\right]^{\frac{1}{1-\frac{1}{\eta}}} \\ &s.t. \int_0^1 P_{it}^G G_{it}^j di \leq P_t^G G_t^j\end{aligned} \quad (7)$$

The stock of habits is

$$s_t^g = \rho s_{t-1}^g + (1-\rho)g_t \quad (8)$$

The optimal amount is given by

$$G_{it} = \left(P_{it}^G/P_t^G\right)^{-\eta_t} X_t^G + \theta^G G_{it-1} \quad (9)$$

Since the government levies taxes on labor income $w_t h_t^j$, total tax revenue amounts to $\tau_t^h w_t h_t^j$. Similar to LMR, we assume that the portfolio of households consists of government bonds $B_{t+1} = R_t B_t$. The flow budget constraint gives us

$$\begin{aligned}&B_t = R_{t-1}B_{t-1} + g_t \\ &-\tau_t^h w_t h_t^j - (1+\tau_t^c)x_t^j\end{aligned} \quad (10)$$

where the interest rate R_t evolves according to the following process:

$$\begin{aligned}&\log(R_t/R) = \rho_r \log(R_{t-1}/R) + \\ &\rho_y \log(Y_t/Y) + \epsilon_t^R\end{aligned} \quad (11)$$

Following Villaverde (2010), we have the respective simple laws of motion for earnings income and consumption tax rates:

$$\log\left(\tau_t^h\right) = \rho_\tau^h \log\left(\tau_{t-1}^h\right) + d_g \frac{B_{t+1}}{y_t} + \epsilon_t^h \quad (12)$$

$$\log(\tau_t^c) = \rho_\tau^c \log(\tau_{t-1}^c) + d_g \frac{B_{t+1}}{y_t} + \epsilon_t^c \quad (13)$$

where d_g represents the sensitivity of tax rates on the debt-output ratio; ϵ_t^h and ϵ_t^c represent i.i.d. innovations to earnings and consumption tax rates, respectively.

As shown in Villaverde (2010), it is also possible to allow a form of stabilization policy involving government spending by integrating the debt – output ratio. Thus, we have a variation of government spending's law of motion:

$$\log(g_t/g) = \rho_g \log(g_{t-1}/g) + d_g\, B_{t+1}/y_t + \epsilon_t^g \quad (14)$$

where g is steady state government expenditures and ϵ_t^g is the innovation to government spending.

2.3 Optimization problem

The objective function of households can be generically written as

$$\max_{\left\{(X_t^j, K_{t+1}^j, B_{t+1}^j, I_t^j, h_{t+1}^j\right\}} E_t \sum_{s=0}^{\infty} \beta^{t+s} U^{\mathcal{M}}\left((X_{t+s})^j, 1-h_{t+s}^j\right) \quad (15)$$

where $(X_{t+s})^j = (X_{t+s}^C, X_{t+s}^G)^j$ and $\mathcal{M}$ denotes the model variant.

Based on RSGU, LMR and CLMY, $U^{\mathcal{M}}(\cdot)$, is modelled with additive CRRA components but public consumption does not affect the marginal utility of private consumption.

$$U^{A} = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ v_t \begin{pmatrix} (x_t - \epsilon_t^{v})^{1-\vartheta}/(1-\vartheta) - \\ \psi\,(1-h_t)^{1-\chi}/(1-\chi) \\ + g_t{}^{1-\vartheta}/(1-\vartheta) \end{pmatrix} \right\} \quad (16.1)$$

As mentioned the structure discounts heavily the presence of consumption complementarities. Following Ganelli and Tervala, we specify the utility function such that private and public consumption are complementary up to a degree ω.[3] The subutility functions follow the CRRA specification with ϑ representing the inverse of the relative risk aversion parameter and ξ is the inverse of the Frisch substitution elasticity.

$$U^{B} = E_0 \sum_{t=0}^{\infty} \gamma_t \beta^t \left\{ \begin{matrix} \dfrac{\left((x_t - \epsilon_t^{v}) + \omega g_t\right)^{1-\vartheta}}{1-\vartheta} \\ -\psi \dfrac{(1-h_t)^{1+\xi}}{1+\xi} \end{matrix} \right\} \quad (16.2)$$

Apparently, the relationship between x_t and g_t depends on the sign of ω.

Using the logic of Linnermann and Schabert (2004), we can specify the CES functional form.[4] Based on their theoretical model, private consumption is predicted to rise after a fiscal spending shock as long as the elasticity of substitution between public and private spending is sufficiently low.

$$U^{C} = E_0 \sum_{t=0}^{\infty} \gamma_t \beta^t \left\{ \begin{matrix} \dfrac{\left((\alpha (x_t - \epsilon_t^{v})^{\kappa} + (1-\alpha) g_t^{\kappa})^{1/\kappa}\right)^{1-\vartheta}}{1-\vartheta} \\ +\psi \dfrac{(1-h_t)^{1+\xi}}{1+\xi} \end{matrix} \right\} \quad (16.3)$$

[3] Note that the specification does not include output and the elasticity parameter. In Ganelli and Tervala, a sufficient condition for the positive response of private consumption to fiscal spending shocks is that $\boldsymbol{\omega < 0}$.

[4] CLMY also uses a CES aggregator function to form the consumption composite embedded in a multiplicative utility function.

Since the Lagrangian multiplier is equal to the marginal utility of consumption, the first order condition with respect to h_{t+s}^{j} is

$$-\frac{MU_{h,t}^{\mathcal{M}}}{MU_{x,t}^{\mathcal{M}}} = \frac{(1-\tau_t^{n})}{(1+\tau_t^{c})} W_t, \quad \mathcal{M} = A, B, C \quad (17)$$

Conditional on the model considered, it is clear in (17) that the tax rates affect the marginal rates of substitution between labor supply and habit adjusted consumption.

Households also decide on the optimal B_{t+1}^{j} and the first order condition is

$$MU_{x,t}^{\mathcal{M}} = \beta MU_{x,t+1}^{\mathcal{M}}(r_{t+1}), \mathcal{M} = A, B, C \quad (18)$$

2.4 Firms

Firms are assumed to supply goods to both private and public final goods producers. It is assumed that firms are monopolistically competitive and face nominal inertia in the form of quadratic price adjustment costs. Let nominal profits be specified as

$$\Phi_{it} = P_{it+s}(C_{it+s} + I_{it+s} + G_{it+s}) - w_{it+s}h_{it+s} - r_{it+s}k_{it+s} \quad (19)$$

As a result, the present discounted value of profits is given by $\Phi_{it} = E_t\{\sum_{s=0}^{\infty} \Omega_{t,t+s}\Phi_{it}\}$, where $\Omega_{t,t+s}$ is the one s-period stochastic discount factor.

The maximization of $\Phi_{it} = E_t\{\sum_{s=0}^{\infty} \Omega_{t,t+s}\Phi_{it}\}$ is subject to (2), (3), (5), (8), (9), and the resource constraint shown by

$$A_t F(k_t, h_t) - FC = C_{it+s} + I_{it+s} + G_{it+s} \quad (20)$$

where $F(k_t, h_t)$ is a Cobb – Douglas production function and FC is fixed costs.

Thus the Lagrangian is given by

$$\begin{aligned} \mathcal{L} = E_t \left\{ \sum_{s=0}^{\infty} \Omega_{t,t+s}\Phi_{it} \right\} &+ MC_t(A_t F(k_t, h_t) - FC - C_{it+s} - I_{it+s} - G_{it+s}) \\ &+ \upsilon_t((P_{it})^{-\eta_t} x_t + \theta s_{it-1} - \theta c_{it}) + \mu_t(\rho s_{it-1} + (1-\rho)c_{it} - s_{it}) \\ &+ \upsilon_t^{g}\left((P_{it})^{-\eta_t} x_t^{g} + \theta s_{it-1} - \theta g_{it}\right) + \mu_t^{g}\left(\rho s_{it-1}^{g} + (1-\rho)g_{it} - s_{it}^{g}\right) \end{aligned}$$

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where MC_t is the marginal cost and the multiplier of the resource constraint; v_t is the multiplier associated with the optimal demand constraint; μ_t represents the multiplier associated with the evolution of private consumption habit stock; v_t^g and μ_t^g are the multipliers for the optimal demand for public consumption and evolution of public consumption habits, respectively.

Similar to CLMY and RSGU, the first order conditions are derived with respect to $C_{it}, G_{it}, s_{it}, s_{it}^G, h_{it}, k_{it}, P_{it}$, respectively.

$$-MC_t - v_t^g + \mu_t(1-\rho) + P_{it} = 0 \quad (21)$$

$$-MC_t - v_t + \mu_t^g(1-\rho) + P_{it} = 0 \quad (22)$$

$$E_t\Omega_{t,t+s}v_{t+1} - \mu_t + \rho E_t\Omega_{t,t+s}\mu_{t+1} = 0 \quad (23)$$

$$E_t\Omega_{t,t+s}v_{t+1}^g - \mu_t^g + \rho E_t\Omega_{t,t+s}\mu_t^g = 0 \quad (24)$$

$$-w_{it} + MC_tA_tF_h(k_t, h_t) = 0 \quad (25.1)$$

$$-r_t^K + MC_tA_tF_k(k_t, h_t) = 0 \quad (25.2)$$

$$(C_{it+s} + I_{it+s} + G_{it+s}) - \eta(P_{it})^{-\eta-1}v_tx_t - \eta(P_{it})^{-\eta-1}v_t^gx_t^g + (1-\eta)(P_{it})^{-\eta}i_t + \eta(P_{it})^{-\eta-1}MC_ti_t = 0 \quad (26)$$

3. RESULTS AND DISCUSSION

Using our model, we examine whether or not there's evidence that a reduction in earnings or consumption tax will preserve the countercyclical pricing behaviour of firms.[5]

As shown in figure 1[6], we can observe that the addition of distortionary taxes dampens private consumption in the presence of a government

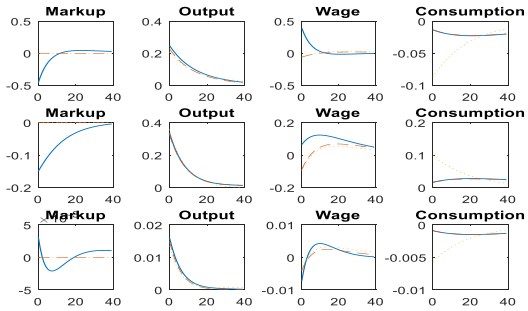

Fig. 1. Effects of fiscal spending, earnings and consumption tax shocks: Base specification (deep habits – solid line; superficial habits – dashed line; no habits – dotted line)

spending shock. Wages retain their downward trajectory, output expands and markup remains countercyclical. In contrast, a 1% reduction in earnings taxes is expected to boost private consumption. This is a consequence of a countercyclical markup and expansionary output but such reduction allows wages to increase as workers now have less incentive to work longer. A 1% reduction in consumption tax rates lead to a different set of dynamics, however. Instead of responding positively, private consumption declines sustainably and markup initially increases before exhibiting a roller coaster profile. Wages also go up, indicating that workers work more due to a big decline in wages.

As shown in figure 2, when the preference structure follows (16.2), private consumption falls as a result of fiscal spending. While markup initially dips, there is clearly an upward pressure before levelling up. The not-so countercyclical profile induces households to substitute away from private consumption goods and this sets up a decline in output. A 1% reduction in earnings tax replicates results in terms of a countercyclical pricing behavior, and mild output increase and private consumption increases insignificantly.

[5] For replicability, we use MATLAB codes of RSGU, appropriately modifying some codes. The code was downloaded from http://www.columbia.edu/~mu2166/1st_order/1st_order.htm.

[6] For all graphs, the first, second and third rows represent the effects of fiscal spending, earnings and consumption tax shocks, respectively.

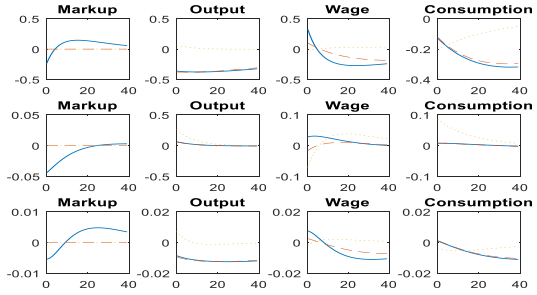

Fig. 2. Effects of fiscal spending, earnings and consumption tax shocks: Perfect substitutes (deep habits – solid line; superficial habits – dashed line; no habits – dotted line)

As already known, a negative coefficient of public consumption in specification (16.2) may change the dynamics of the outcomes. When government spending increases, markup remains countercyclical; output is robustly positive; wages retain their downward trajectory; and private consumption increases. A reduction in earnings taxes would preserve everything except that wages now face upward pressure. This is consistent with the labor supply effect of increases in income. It is also noteworthy that consumption tax reduction increases output, private consumption and even wages.

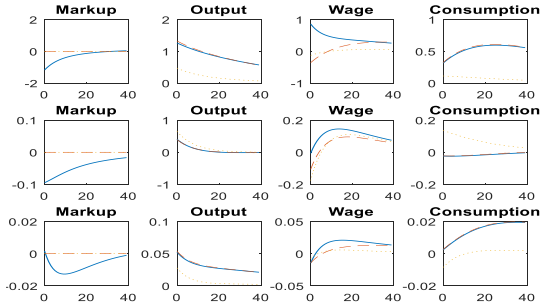

Fig. 3. Effects of fiscal spending, earnings and consumption tax shocks: complements ($\omega = -1.5$) (deep habits – solid line; superficial habits – dashed line; no habits – dotted line)

Finally, figure 4 shows dynamic outcomes when private and public consumption flexibly enter the specification as complements using a CES specification. It seems that increasing fiscal spending replicates results in RSGU, except that private consumption falls. In contrast, a reduction in earnings tax appears consistent with an increase in fiscal spending under the deep habits framework. Given a fall in consumption tax, the dynamics of markups do not resemble the consistently negative response of pricing policies.

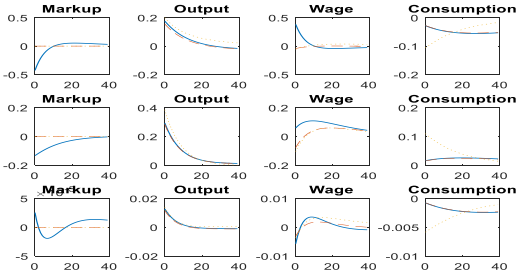

Fig. 4. Effects of fiscal spending, earnings and consumption tax shocks: CES ($\alpha = 0.9; \kappa = 0.9$) (deep habits – solid line; superficial habits – dashed line; no habits – dotted line)

4. CONCLUDING REMARKS

Using stochastic simulations, this note provides preliminary evidence on the effectiveness of tax and fiscal policies in determining key outcomes. Building upon RSGU's model, the note shows that preference structures have an important role to play in determining the response of private consumption to changes in fiscal policy.

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