E C O N O M I C S B U L L E T I N

Endogenous Wealth-Depending Time Preference and Fiscal Policy in Open Economy

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Abstract

In this paper, we propose two alternative formulations of representative consumer¡¯s endogenous time preference that depends on consumption as well as wealth and/or revenue. We solve one of these formulations and apply it to study the effectiveness of fiscal policies in a small open economy facing a perfect international financial market

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1. Introduction

The open economy extension of Ramsey's model is characterised by external position indeterminacy as well as hysteresis effect of fiscal policy and real exogenous shocks. This is due to that representative consumer has fixed rate of time preference. Authors like Obstfeld (1980, 1981), Svensson & Razin (1983), Pitchford (1989, 1991), Engel & Ketzler (1989) and Devereux & Shi (1991) have introduced variable time preference[1] in open economy study. One can address two critics to these developments. First, an increase in fiscal pressure will induce in the short run a very sharp reduction in consumption and a surplus of balance of payments in order to return to the same level of long-term consumption as at the initial equilibrium. This is radically contrary to the behaviour of consumption smoothing in the absence of liquidity constraint, defended by the life cycle or permanent revenue theory of consumption. Second, as endogenous time preference rate depends only on consumption in these above quoted works, for some level of world real interest rate, the small open economy will accumulate a rather significant wealth, likely to make its actions significant on international financial market, so invalidating the hypothesis of small open economy without market power. Zee (1997) introduces a discount function depending on consumption and output ratio. But, as national output represents only a source of current revenue, it is not necessarily a relevant determinant of time preference. As time preference rate plays a role in the arbitrage between current and future consumption and the latter is related to accumulated wealth, so wealth may be a better determinant for it. With this idea in mind, we will introduce in this paper a wealth effect on endogenous rate of time preference.

Recent developments in the study of fiscal policy (Obstfeld & Rogoff, 1995; Ganelli & Lane, 2003; Coutinho, 2005) in the framework of new open economy macroeconomics (NEOM) have ignored initially the problem of external position indeterminacy and hysteresis effect due to fixed rate of time preference of representative consumer. If the rate of time preference is different from the world interest rate, the country can accumulate an external net position without limit. To insure the existence of a stationary steady-state, it is assumed that the exogenous rate of time preference is equal to the world interest rate. But this has the inconvenience of suppressing the dynamics of consumption and having history-dependent external net position. To ensure the stationarity and the possibility of setting speed of convergence at any desired rate, Ganelli & Lane (2003) suggest several alternatives revisited recently[2], including the solution of an endogenous discount factor which depends on consumption. In introducing an endogenous discount factor which depends on consumption as well as wealth, our model allows the dynamics of consumption without the non-desired effects of accentuating the consumption movement and of a too strong wealth accumulation.

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[1] The theory of endogenous time preference is first developed by Boehm-Bawerck (1912) and Fisher (1930). Koopmans (1960), Koopmans et *al.* (1964), Uzawa (1968), Epstein & Hynes (1983), Espstein (1987a, b) and Obstfeld (1990) have further contributed to it. Ryder & Heal (1973), Becker & Murphy (1988) and others have applied this « habit formation » to diverse problems.

[2] In a framework other than NOEM, Schmitt-Grohé & Uribe (2003) have considered this possibility and others such as a debt-elastic interest rate premium, convex portfolio adjustment costs and completeness of international asset markets. Alternatively, Cavallo and Ghironi (2002) and Ghironi (2006) achieve stationarity by imposing an overlapping generations (OLG) structure with infinitely-lived households following Weil (1989). Ganelli (2005) introduces, in a NOEM model, a finite-horizon OLG structure of the Blanchard (1985) type which allows remedying to the very slow convergence back to steady-state predicted by the Weil's type model.

In this sense, our analysis is useful for future research in the NEOM. To keep things simple, we neglect the supply side developed in the NOEM. Without loss of generally, we assume that goods supply is fixed at level of full-employment.

2. The Model

Two alternatives formulations in our line can be formulated.

1) Accumulated wealth enters into subjective discount rate function:

$$U[C(0)] = \int_0^\infty u[c(t)] e^{-\int_0^t \theta[c(s), w(s)] ds} dt \, , \tag{1}$$

where, $U[.]$ represents the life time utility of representative consumer, $C(0)$ his life time consumption, $u[.]$ the temporary utility function with $c(t)$ as consumption at time t, $\theta(.,.)$ the subjective discount rate function which depends on current consumption and accumulated wealth (w).

2) Subjective discount rate is function of accumulated wealth to output ratio:

$$U[C(0)] = \int_0^\infty u[c(t)] e^{-\int_0^t \theta[c(s), \frac{w(s)}{y(s)}] ds} dt \, , \tag{2}$$

where the wealth to output ratio w/y can be considered as consumer's sacrifice ratio during its past life. It can be positive or negative.

In the second formulation, wealth enters in the discount rate function scaled by output, contrarily to the first formulation where wealth is un-scaled by output. In open economy, the accumulation of wealth (or debt) is determined by the difference between the interest rate on international financial market and the national rate of time preference. If the latter depends on the absolute value of wealth, a country will accumulate a fixed level of wealth (or debt) implying equality between the international interest rate and the national rate of time preference. The second formulation will be useful when we consider the steady state with growing output, consumption and wealth. Having endogenous time preference depending on wealth scaled by output allows the country to accumulate a level of wealth proportional to its national production.

These two formulations have similar implications for fiscal policy in open economy when the output is assumed to be fixed. So, we resolve consumer's program with first formulation only. The concavity conditions of the utility function are verified (i.e., $u(c) > 0$, $u'(c) > 0$ and $u''(c) < 0$). We admit also, $\theta(.,.) > 0$, $\theta_2^{'} > 0$, $\theta_{22}^{''} > 0$, $\theta_1^{'} > 0$, $\theta_{11}^{'} > 0$ and $\theta_{12}^{''} = \theta_{21}^{''} > 0$.

Define $\Theta(t) = \int_0^t \{\theta[c(s), w(s)] - r^*\} ds$, with r^* as world real interest rate, and $\Theta(0) = 0$. Its time derivative is given out as:

$$\dot{\Theta}(t) = \theta[c(t), w(t)] - r^* \, . \tag{3}$$

The consumer's problem becomes then:

$$\min_{c(t)} U[C(0)] = \int_0^\infty u[c(t)] e^{-\Theta(t)} e^{-r^* t} dt \, , \tag{4}$$

under dynamic constraint (3) and following budgetary constraint:

$$\dot{w}(t) = r^* w(t) + y(t) - c(t) - \tau(t) \, , \tag{5}$$

where $\tau(t)$ represents taxes or redistributed revenue, $w(t)$ can be seen as the external position of the small economy. The international financial market is perfect in the sense that, when w

is positive, the small economy lends to the rest of the world at r^*, and inversely when w is negative, it borrows from the rest of the world at the same rate.

The Hamiltonian associated with this problem is:

$$H = u[c(t)]e^{-\Theta(t)} + \hat{\lambda}(t)[r^* w(t) + y(t) - c(t) - \tau(t)] - \hat{\phi}(t)\{\theta[c(t), w(t)] - r^*\}, \qquad (6)$$

where $\hat{\phi}(t)$ and $\hat{\lambda}(t)$ are multipliers associated respectively with (3) and (5). The first-order conditions are:

$$u'[c(t)]e^{-\Theta(t)} - \hat{\phi}(t)\theta_1'[c(t), w(t)] = \hat{\lambda}(t), \qquad (7)$$

$$\dot{\hat{\lambda}} = \hat{\phi}(t)\theta_2'[c(t), w(t)], \qquad (8)$$

$$\dot{\hat{\phi}} = r^*\hat{\phi} - u[c(t)]e^{-\Theta(t)}. \qquad (9)$$

Noting $\lambda(t) = \hat{\lambda}(t)e^{\Theta(t)}$ and $\phi(t) = \hat{\phi}(t)e^{\Theta(t)}$, the previous conditions can be rewritten as:

$$u'[c(t)] - \phi(t)\theta_1'[c(t), w(t)] = \lambda(t), \qquad (10)$$

$$\dot{\lambda} = \phi(t)\theta_2'[c(t), w(t)] + \lambda(t)\{\theta[c(t), w(t)] - r^*\}, \qquad (11)$$

$$\dot{\phi} = \phi(t)\theta[c(t), w(t)] - u[c(t)]. \qquad (12)$$

We note that, according to (11) and at steady state, the diminution of marginal value of wealth must be exactly equal to the excess of real interest rate over subjective discount rate. In models where the wealth does not enter the time preference rate function, one has simply $r^* = \theta(\bar{c})$ at steady state.

The rate of time preference can be defined as follows:

$$\rho = \frac{d}{dt}\log\{[u'(c) - \theta_1'(c,w)\phi]e^{-\Theta t - r^* t}\}\Big|_{\dot{c}=0} = \theta(c,w) + \frac{\theta_{12}''(c,w)\dot{w}\phi + \theta_1'(c,w)\dot{\phi}}{u'(c) - \phi\theta_1'(c,w)}.$$

Its partial derivatives are given by: $\rho_c = -\frac{\theta_{12}''(c,w)}{u'(c) - \phi\theta_1'(c,w)}$, $\rho_w = \frac{\theta_2'(c,w)u'(c) + r^*\theta_{12}''(c,w)}{u'(c) - \phi\theta_1'(c,w)}$ and $\rho_\phi = \frac{\theta_1'(c,w)\theta(c,w)}{u'(c) - \phi\theta_1'(c,w)}$.

In differentiating (10) to time and in substituting terms λ, $\dot{\lambda}$ and $\dot{\phi}$ by their expressions given by (10)-(12) in resulting equation, we obtain short-run dynamic equation for consumption as follows:

$$\dot{c} = \alpha\left(\rho + \frac{\phi\theta_2'(c,w)}{u'(c) - \phi\theta_1'(c,w)} - r^*\right), \qquad \text{with} \quad \alpha = \frac{u'(c) - \phi\theta_1'(c,w)}{u''(c) - \phi\theta_{11}''(c,w)}. \qquad (13)$$

3. Stability analysis

Equations (5), (12) and (13) constitute a dynamic system. Its linear form is given as follows:

$$\begin{bmatrix} \dot{c} \\ \dot{w} \\ \dot{\phi} \end{bmatrix} = \begin{bmatrix} \alpha\varphi_1 & \alpha\varphi_2 & \alpha\varphi_3 \\ -1 & r^* & 0 \\ \phi\theta_1' - u' & \phi\theta_2' & \theta \end{bmatrix} \begin{bmatrix} c - \bar{c} \\ w - \bar{w} \\ \phi - \bar{\phi} \end{bmatrix}, \qquad (14)$$

with $\varphi_1 = -\frac{\phi\theta_{12}''(c,w)[u''(c) - \phi\theta_{11}''(c,w)]}{[u'(c) - \phi\theta_1'(c,w)]^2}$,

$$\varphi_2 = \frac{[\theta_2^{'}(c,w)u'(c) + r^*\theta_{12}^{''}(c,w) + \phi\theta_{22}^{''}(c,w)][u'(c) - \phi\theta_1^{'}(c,w)] + \phi^2\theta_2^{'}(c,w)\theta_{12}^{''}(c,w)}{[u'(c) - \phi\theta_1^{'}(c,w)]^2},$$

$$\varphi_3 = \frac{\theta_1^{'}(c,w)\theta(c,w)[u'(c) - \phi\theta_1^{'}(c,w)] + \theta_2^{'}(c,w)u'(c)}{[u'(c) - \phi\theta_1^{'}(c,w)]^2}.$$

The determinant of stability matrix is:

$$|\Delta| = \alpha\theta(c,w)(r^*\varphi_1 + \varphi_2) + \alpha\varphi_3\{-\phi\theta_2^{'}(c,w) + r^*[u'(c) - \phi\theta_1^{'}(c,w)]\}.$$

As $\theta_{22}^{''}(c,w) > 0$ and $\theta_{12}^{''}(c,w) > 0$[3], one has $\varphi_1, \varphi_2, \varphi_3 > 0$. The determinant is then negative if one can demonstrate that $\Omega = -\phi\theta_2^{'}(c,w) + r^*[u'(c) - \phi\theta_1^{'}(c,w)] > 0$. To show that $\Omega = -\phi\theta_2^{'}(c,w) + r^*[u'(c) - \phi\theta_1^{'}(c,w)] > 0$, we consider (10) and (11) at steady state. As we have $\theta_2^{'}(c,w) = 0$ and $\theta = r^*$ for a positive λ. That gives:

$$\Omega = -\phi\theta_2^{'}(c,w) + r^*[u'(c) - \phi\theta_1^{'}(c,w)] = \theta(c,w)[u'(c) - \phi\theta_1^{'}(c,w)] > 0. \quad (15)$$

The last condition ensures also that the trace is positive:

$$Tr. = \alpha\varphi_1 + r^* + \theta = \frac{-\phi\theta_2^{'}(c,w) + r^*[u'(c) - \phi\theta_1^{'}(c,w)] + \theta(c,w)[u'(c) - \phi\theta_1^{'}(c,w)]}{[u'(c) - \phi\theta_1^{'}(c,w)]^2} > 0.$$

Given that the determinant is negative and the trace is positive, the system possesses one stable eigenvalue and two unstable eigenvalues. As there are one predetermined variable (w) and two non-predetermined variables (ϕ and c), the system has a saddle-point equilibrium.

4. The long-term effects of fiscal policies and the short-run dynamics

The steady state of the economy is described by the following equations

$$\bar{\phi}\theta(\bar{c},\bar{w}) - u(\bar{c}) = 0, \quad (16)$$

$$\bar{\rho} + \frac{\bar{\phi}\theta_2^{'}(\bar{c},\bar{w})}{u'(\bar{c}) - \phi\theta_1^{'}(\bar{c},\bar{w})} - r^* = 0, \text{ with } \bar{\rho} = \theta(\bar{c},\bar{w}), \quad (17)$$

$$r^*\bar{w} + y_0 - \bar{c}(t) - \tau_0 = 0. \quad (18)$$

Consider a balanced-budget fiscal policy $\Delta\tau = \Delta g$ (taxes = spending). Its effects on consumption, wealth and marginal value of wealth can be deduced in differentiating (16)-(18):

$$\begin{bmatrix} \alpha\varphi_1 & \alpha\varphi_2 & \alpha\varphi_3 \\ -1 & r^* & 0 \\ \phi\theta_1^{'} - u' & \phi\theta_2^{'} & \theta \end{bmatrix} \begin{bmatrix} d\bar{c} \\ d\bar{w} \\ d\bar{\phi} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} d\tau, \quad (19)$$

The determinant of the Jacobean is negative as demonstrated before:

$$|\Delta| = \alpha\theta(r^*\varphi_1 + \varphi_2) + \alpha\varphi_3[-\phi\theta_2^{'} + r^*(u' - \phi\theta_1^{'})] < 0.$$

The solution of this system is:

$$\begin{bmatrix} d\bar{c} \\ d\bar{w} \\ d\bar{\phi} \end{bmatrix} = \frac{1}{|\Delta|} \begin{bmatrix} A_{11} \\ A_{12} \\ A_{13} \end{bmatrix} d\tau, \quad (20)$$

[3] The condition $\theta_{22}^{''}(c,w) > 0$ is necessary for ensuring the concavity of objective function and the concavity of the Hamiltonian function in terms of w as $\partial^2 H / \partial w^2 = -\phi\theta_{22}^{''} < 0$. The condition $\theta_{12}^{''}(c,w) > 0$ imposes certain degree of complementarities between consumption and accumulated wealth in time preference rate function.

with, $A_{11} = \frac{-\alpha[\theta\theta_2^{'}(u'-\phi\theta_1^{'})^2 + \theta(r^*\theta_{12}^{''} + \phi\theta_{22}^{''})(u'-\phi\theta_1^{'}) + \theta_2^{'}\phi(\phi\theta_{12}^{''} - u'\theta_2^{'})]}{(u'-\phi\theta_1^{'})^2} > 0$, if $\phi\theta_{12}^{''} - u'\theta_2^{'} > 0$. $A_{12} = \alpha\varphi_1 + \alpha\varphi_3(u'-\phi\theta_1^{'}) < 0$ and $A_{13} = -\alpha\varphi_1\phi\theta_2^{'} - \alpha\varphi_2(u'-\phi\theta_1^{'}) > 0$.

A fiscal policy will have negative effect on long-term consumption under the condition $\phi\theta_{12}^{''} - u'\theta_2^{'} > 0$, positive effect on wealth and negative effect on marginal value of wealth.

As the system has one stable eigenvalue, the solution under perfect foresight can be written as:

$$\begin{bmatrix} c(t)-\bar{c} \\ w(t)-\bar{w} \\ \phi(t)-\bar{\phi} \end{bmatrix} = \begin{bmatrix} V_{11} \\ V_{21} \\ V_{31} \end{bmatrix} k_1 e^{\lambda_1 t}, \tag{21}$$

where V_{11}, V_{21} and V_{31} are eigenvectors corresponding to λ_1, and k_1 can be found in resolving the following equation at $t = 0$:

$$w(t) - \bar{w} = V_{21} k_1 e^{\lambda_1 t}. \tag{22}$$

As w is a predetermined variable, its value at $t = 0$ is given by $w(0)$. Using this result, we have, $k_1 = [w(0) - \bar{w}]/V_{21}$. Then, we can rewrite the solution (21) as follows:

$$c(t) - \bar{c} = \frac{V_{11}}{V_{21}}[w(0) - \bar{w}]e^{\lambda_1 t}, \tag{23}$$

$$w(t) - \bar{w} = [w(0) - \bar{w}]e^{\lambda_1 t}, \tag{24}$$

$$\phi(t) - \bar{\phi} = \frac{V_{31}}{V_{21}}[w(0) - \bar{w}]e^{\lambda_1 t}. \tag{25}$$

It is easy to show that: $V_{11}/V_{21} = r^* - \lambda_1 > 0$. In contrast, it is a little more complex to determine the sign of $\frac{V_{31}}{V_{21}} = \frac{|\Gamma|}{-\alpha\varphi_3}$, with $|\Gamma| = \begin{vmatrix} \alpha\varphi_1 - \lambda_1 & \alpha\varphi_2 \\ -1 & r^* - \lambda_1 \end{vmatrix}$. Developing:

$$\begin{bmatrix} \alpha\varphi_1 - \lambda_1 & \alpha\varphi_2 & \alpha\varphi_3 \\ -1 & r^* - \lambda_1 & 0 \\ \phi\theta_1^{'} - u' & \phi\theta_2^{'} & \theta - \lambda_1 \end{bmatrix} = 0, \tag{26}$$

we obtain $|\Gamma| = \frac{-\alpha\varphi_3[r^*(u'-\phi\theta_1^{'}) - \phi\theta_2^{'} - \lambda_1(u'-\phi\theta_1^{'})]}{\theta - \lambda_1} > 0$ since $\Omega = r^*(u'-\phi\theta_1^{'}) - \phi\theta_2^{'} > 0$ and $u'-\phi\theta_1^{'} > 0$. Using this result, it yields:

$$\frac{V_{31}}{V_{21}} = \frac{r^*(u'-\phi\theta_1^{'}) - \phi\theta_2^{'} - \lambda_1(u'-\phi\theta_1^{'})}{\theta - \lambda_1} > 0. \tag{27}$$

Using result (27) into solutions (23) and (25) for $t = 0$, it leaves:

$$c(0) - \bar{c} = \frac{V_{11}}{V_{21}}[w(0) - \bar{w}] < 0, \tag{28}$$

$$\phi(0) - \bar{\phi} = \frac{V_{31}}{V_{21}}[w(0) - \bar{w}] < 0. \tag{29}$$

As the consumption and the marginal value of wealth have both an increasing time path, it follows that they will experience an initial downward over-adjustment. The wealth will follow a growing path without jump from the moment of fiscal policy announcement (see Figure 1).

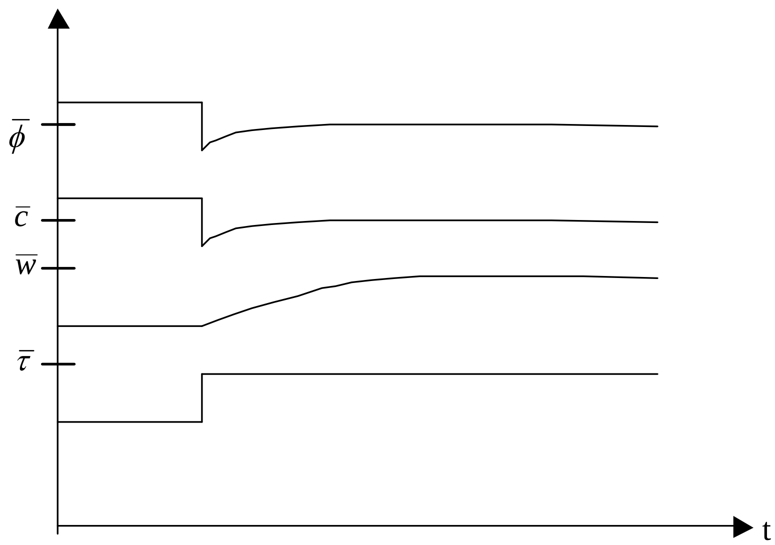

Figure 1. Time path of consumption, wealth, marginal value of wealth, and taxes.

The important point of our formulation is that, the new steady state consumption will not return to the initial level after a permanent fiscal policy is taken place, contrary to the case in the formulations of previous endogenous time preference (except Zee, 1997). Consequently, the time adjustment path of consumption, wealth and marginal value of wealth will be smoother in time.

5. Conclusion

The formulation of endogenous time preference is one road to escape from external position indeterminacy problem in representative agent open economy model. The first generation of models of endogenous time preference has the non-desired effects of accentuating the consumption movement and of a too strong wealth accumulation, when the government increases its spending and taxes. In introducing wealth in subjective discount rate function, our formulation can smooth these effects and constitutes then an interesting extension for further theoretical or empirical applications in the new open economy macroeconomics.

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