

We define the government's actual fiscal position as follows:

$$D_{t+1} \equiv B_{t+1} - B_t = P_t^d G_t + BEN_t + (R_{t-1} - 1) B_t - \mathbb{E}_{t-1} \{T_t\}. \quad (14)$$

Expressing equation (14) in real terms and stationarizing, we get:

$$\frac{D_{t+1}}{P_t^d z_t} = \frac{G_t}{z_t} + \frac{BEN_t}{P_t^d z_t} + (R_{t-1} - 1) \frac{B_t P_{t-1}^d z_{t-1}}{P_{t-1}^d z_{t-1} P_t^d z_t} - \mathbb{E}_{t-1} \left\{ \frac{T_t}{P_t^d z_t} \right\} \quad (15)$$

or:

$$d_t = g_t + ben_t + (R_{t-1} - 1) \frac{b_{t-1}}{\pi_t^d \mu_{z,t}} - \mathbb{E}_{t-1} \{t_t\}, \quad (16)$$

where, as usual, lower-case variables denote real stationarized variables. The structural budget balance is then obtained by correcting the actual budget balance for automatic responses of revenues and transfers resulting from deviations of the bases of revenue components and transfers from their trend values, i.e.  $z_t$ . Hence, structural budget balance (denoted by  $d_t^*$ ) evolves according to:

$$\begin{aligned} d_t^* &= d_t + \mathbb{E}_{t-1} \{t_t\} - ben_t \\ &= g_t + (R_{t-1} - 1) \frac{b_{t-1}}{\pi_t^d \mu_{z,t}}. \end{aligned} \quad (17)$$

Dividing the variables with output  $y_t$  and log-linearizing, yields the following expression:

$$\begin{aligned} \tilde{d}_{y,t}^* &= d_{y,t}^* - d_y^* = \frac{g}{y} (\hat{g}_t - \hat{y}_t) + \frac{Rb_y}{\pi^d \mu_z} \hat{R}_{t-1} \\ &\quad + \frac{(R-1)b_y}{\pi^d \mu_z} \left( \hat{b}_{y,t-1} + \hat{y}_{t-1} - \hat{y}_t - \hat{\pi}_t^d - \hat{\mu}_{z,t} \right), \end{aligned} \quad (18)$$

where  $d_{y,t}^* \equiv \frac{d_t^*}{y_t}$  and  $b_{y,t-1} \equiv \frac{b_{t-1}}{y_{t-1}}$ . Further, we assume that the structural budget balance is adjusted according to the following rule (in log-linear form) (Bilbiie et al., 2008):

$$\tilde{d}_{y,t}^* = \phi_d \tilde{d}_{y,t-1}^* + \phi_b \hat{b}_{y,t-1}. \quad (19)$$

where the parameter  $\phi_d$  captures the possibility that budget decisions are autocorrelated and the parameter  $\phi_b$  governs the response of the deficit to the beginning-of-period ratio of debt to GDP, hence capturing a debt stabilization motive: a negative value of  $\phi_b$  indicates that deficits are adjusted in order to stabilize outstanding debt. For simulation purposes, we set  $\phi_d = 0.46$  and  $\phi_b = 0.02$ .