//Effective consumption of Ricardo-like households ：

$$c^e\tilde{c}_t^e = c^R\tilde{c}_t^R + v^{gm}g^m\tilde{g}_t^m + v^{gp}g^p\tilde{g}_t^p$$

Marginal utility of Ricardo-like households：

$$\left(1-\frac{\theta}{z}\right)\left(1-\frac{\beta\theta}{z^\sigma}\right)\left(\tilde{\lambda}_t + \frac{\tilde{\tau}_t^c}{1+\tau^c}\right) = -\sigma\left\{\tilde{c}_t^e - \frac{\theta}{z}(\tilde{c}_{t-1}^e - z_t^z)\right\} + \left(1-\frac{\theta}{z}\right)z_t^b$$
$$+\frac{\beta\theta}{z^\sigma}\left[\sigma\left\{E_t\tilde{c}_{t+1}^e + E_t z_{t+1}^z - \frac{\theta}{z}\tilde{c}_t^e\right\} - \left(1-\frac{\theta}{z}\right)E_t z_{t+1}^b\right]$$

Euler equations：

$$\tilde{\lambda}_t = E_t\tilde{\lambda}_{t+1} - \sigma E_t z_{t+1}^z + \tilde{R}_t^n - E_t\tilde{\pi}_{t+1}$$

Wage：

$$\tilde{w}_t - \tilde{w}_{t-1} + \tilde{\pi}_t - \lambda_w\tilde{\pi}_{t-1}$$
$$= \beta z^{1-\sigma}(E_t\tilde{w}_{t+1} - \tilde{w}_t + E_t\tilde{\pi}_{t+1} - \lambda_w\tilde{\pi}_t + E_t z_{t+1}^z)$$
$$+\frac{1-\xi_w}{\xi_w}\frac{(1-\beta\xi_w z^{1-\sigma})}{\lambda^w + \chi(1+\lambda^w)}\left(\chi\tilde{l}_t - \tilde{\lambda}_t - \tilde{w}_t + z_t^b\right) + z_t^w$$

capital：

$$\tilde{k}_t = \frac{1-\delta}{z}\left(\tilde{k}_{t-1} - z_t^z\right) - \frac{R^k}{z}\tilde{u}_t + \left(1-\frac{1-\delta}{z}\right)\tilde{\imath}_t$$

投資関数：

$$\frac{1}{\zeta}\left\{\tilde{\imath}_t - \tilde{\imath}_{t-1} + z_t^z + z_t^i\right\} = \tilde{q}_t + \frac{\beta z^{1-\sigma}}{\zeta}\left\{E_t\tilde{\imath}_{t+1} - \tilde{\imath}_t + E_t z_{t+1}^z + E_t z_{t+1}^i\right\}$$

investment：

$$\tilde{u}_t = \mu\left(\tilde{R}^k_t - \tilde{q}_t\right)$$

Tobin's q:

$$\tilde{q}_t = E_t\tilde{\lambda}_{t+1} - \tilde{\lambda}_t - \sigma E_t z^z_{t+1} + \frac{\beta}{z^\sigma}\left\{R^k E_t \tilde{R}^k_{t+1} + (1-\delta)E_t\tilde{q}_{t+1}\right\}$$

Consumption of Non-Ricardo-like household：

$$\frac{c^{NR}}{y}\{(1+\tau^c)\tilde{c}^{NR}_t + \tilde{\tau}^c_t\} = \frac{wl}{y}\left\{(1-\tau^w)\left(\tilde{w}_t + \tilde{l}_t\right) - \tilde{\tau}^w_t\right\} + \frac{\tau}{y}\tilde{\tau}_t$$

Market Clearing Conditions：

$$\tilde{y}_t = \frac{c}{y}\tilde{c}_t + \frac{i}{y}\tilde{\imath}_t + \frac{g^m}{y}\tilde{g}^m_t + \frac{g^p}{y}\tilde{g}^p_t + \frac{g^i}{y}\tilde{g}^i_t + \frac{g}{y}z^g_t$$

Marginal Cost：

$$\widetilde{mc}_t = (1-\alpha)\tilde{w}_t + \alpha\tilde{R}^k_t - v\left(\tilde{k}^g_{t-1} - z^z_t\right)$$

Cost Minimization：

$$\tilde{u}_t + \tilde{k}_{t-1} - \tilde{l}_t - z^z_t = \tilde{w}_t - \tilde{R}^k_t$$

Production function：

$$\tilde{y}_t = (1+\phi)\left\{(1-\alpha)\tilde{l}_t + \alpha\left(\tilde{u}_t + \tilde{k}_{t-1} - z^z_t\right) + v\left(\tilde{k}^g_{t-1} - z^z_t\right)\right\}$$

Price (New Keynesian Phillips Curve)：

$$\tilde{\pi}_t - \gamma^p \tilde{\pi}_{t-1} = \beta z^{1-\sigma}(E_t \tilde{\pi}_{t+1} - \gamma^p \tilde{\pi}_t) + \frac{(1-\xi^p)(1-\xi^p \beta z^{1-\sigma})}{\xi^p} \widetilde{mc}_t + z_t^p$$

dividends：

$$(\lambda^p - \phi)\tilde{d}_t = \lambda^p \tilde{y}_t - (1+\phi)\widetilde{mc}_t$$

Policy rule (Tylor rule)：

$$\tilde{R}_t^n = \phi_r \tilde{R}_{t-1}^n + (1-\phi_r)\left\{\phi_\pi \left(\frac{1}{4}\sum_{j=0}^{3} \frac{\pi_{t-j}}{\pi}\right) + \phi_y^r (\tilde{y}_t - \tilde{y}_t^*)\right\} + z_t^r$$

Potential output：

$$\tilde{y}_t^* = -(1+\phi)(\alpha + v) z_t^z$$

Government budget constraint：

$$b^{tar}\tilde{b}_t = \frac{b^{tar}}{\beta z^{1-\sigma}}\left(\tilde{R}_{t-1}^n - \tilde{\pi}_t - z_t^z + \tilde{b}_{t-1}\right); \frac{g^m}{y}\tilde{g}_t^m$$

$$+\frac{g^p}{y}\tilde{g}_t^p + \frac{g^i}{y}\tilde{g}_t^i + \frac{\tau}{y}\tilde{\tau}_t - \frac{c}{y}(\tilde{\tau}_t^c + \tau^c \tilde{c}_t)$$

$$-\frac{wl}{y}\left\{\tilde{\tau}_t^w + \tau^w\left(\tilde{w}_t + \tilde{l}_t\right)\right\} - \frac{d}{y}\left(\tau_t^k + \tau^k \tilde{d}_t\right)$$

$$-\frac{R^k k}{zy}\left\{\tilde{\tau}_t^k + \tau^k\left(\tilde{R}_t^k + \tilde{u}_t + \tilde{k}_{t-1} - z_t^z\right)\right\}$$

btar =b/y

Social Capital accumlation：

$$\tilde{k}_t^g = \frac{1-\delta^g}{z}\left(\tilde{k}_{t-1}^g - z_t^z\right) + \left(1 - \frac{1-\delta^g}{z}\right)\tilde{g}_t^i$$

Government spending rule：

$$\tilde{g}_t^m = \phi^{gm}(\tilde{g}_{t-1}^m - z_t^z) + (1-\phi^{gm})\left\{\phi_y^{gm}(\tilde{y}_{t-1} - \tilde{y}_{t-1}^*) + \phi_b^{gm}\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + z_t^{gm}$$
$$\tilde{g}_t^p = \phi^{gp}\left(\tilde{g}_{t-1}^p - z_t^z\right) + (1-\phi^{gp})\left\{\phi_y^{gp}(\tilde{y}_{t-1} - \tilde{y}_{t-1}^*) + \phi_b^{gp}\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + z_t^{gp}$$
$$\tilde{g}_t^i = \phi^{gi}\left(\tilde{g}_{t-1}^i - z_t^z\right) + \left(1-\phi^{gi}\right)\left\{\phi_y^{gi}(\tilde{y}_{t-1} - \tilde{y}_{t-1}^*) + \phi_b^{gi}\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + z_t^{gi}$$
$$\tilde{\tau}_t = \phi^T(\tilde{\tau}_{t-1} - z_t^z) + (1-\phi^T)\left\{\phi_y^T(\tilde{y}_{t-1} - \tilde{y}_t^*) + \phi_b^T\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + z_t^T$$

Tax rule：

$$\tilde{\tau}_t^c = \phi^{tc}\tilde{\tau}_{t-1}^c - (1-\phi^{tc})\left\{\phi_y^{tc}(\tilde{y}_{t-1} - \tilde{y}_{t-1}^*) + \phi_b^{tc}\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + \epsilon_t^{tc}$$
$$\tilde{\tau}_t^w = \phi^{tw}\tilde{\tau}_{t-1}^w - (1-\phi^{tw})\left\{\phi_y^{tw}(\tilde{y}_{t-1} - \tilde{y}_{t-1}^*) + \phi_b^{tw}\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + \epsilon_t^{tw}$$
$$\tilde{\tau}_t^k = \phi^{tk}\tilde{\tau}_{t-1}^k - \left(1-\phi^{tk}\right)\left\{\phi_y^{tk}(\tilde{y}_{t-1} - \tilde{y}_{t-1}^*) + \phi_b^{tk}\left(\tilde{b}_{t-1} - \tilde{y}_{t-1}\right)\right\} + \epsilon_t^{tk}$$

Total consumption：

$$\frac{c}{y}\tilde{c}_t = \frac{(1-\omega)c^R}{y}\tilde{c}_t^R + \frac{\omega c^{NR}}{y}\tilde{c}_t^{NR}$$

exogenous shock processes：

$$z_t^j = \rho^j z_{t-1}^j + \epsilon_t^j,$$
$$\epsilon_t^j \sim N\left(0, \sigma_j^2\right),$$
$$j \in \{b, w, p, z, i, g, r, gm, gp, gi, T\}$$