1 Investment Adjustment Costs

Preferences:

$$E_0 \sum_{t=0}^{\infty} \tilde{\beta}_t [\log(c_t) - \chi n_t^{1+\eta}/(1+\eta)]$$

Budget Constraint:

$$c_t + i_t + b_t = w_t n_t + r_t^k k_{t-1} + r_{t-1} b_{t-1}/\pi_t + d_t$$
$$k_t = (1-\delta)k_{t-1} + i_t \left[1 - \frac{\nu}{2}\left(\frac{i_t}{\bar{g} i_{t-1}} - 1\right)^2\right]$$

Equilibrium system (17 equations):

$$w_t = \chi n_t^{\eta} c_t \tag{1}$$
$$1 = r_t E_t \left[\frac{\beta_{t+1}}{\pi_{t+1}} \frac{c_t}{c_{t+1}}\right] \tag{2}$$
$$q_t = E_t \left\{\beta_{t+1} \frac{c_t}{c_{t+1}} \left(r_{t+1}^k + q_{t+1}(1-\delta)\right)\right\} \tag{3}$$
$$1 = \mu_t q_t \left[1 - \frac{\nu}{2}\left(\frac{i_t}{\bar{g} i_{t-1}} - 1\right)^2 - \nu \frac{i_t}{\bar{g} i_{t-1}}\left(\frac{i_t}{\bar{g} i_{t-1}} - 1\right)\right] + \nu \bar{g} E_t \left[\beta_{t+1} \mu_{t+1} q_{t+1} \frac{c_t}{c_{t+1}} \left(\frac{i_{t+1}}{\bar{g} i_t}\right)^2 \left(\frac{i_{t+1}}{\bar{g} i_t} - 1\right)\right] \tag{4}$$
$$y_t = k_{t-1}^{\alpha} (z_t n_t)^{1-\alpha} \tag{5}$$
$$k_t = (1-\delta)k_{t-1} + \mu_t i_t \left[1 - \frac{\nu}{2}\left(\frac{i_t}{\bar{g} i_{t-1}} - 1\right)^2\right] \tag{6}$$
$$w_t = (1-\alpha) mc_t y_t / n_t \tag{7}$$
$$r_t^k = \alpha mc_t y_t / k_{t-1} \tag{8}$$
$$\varphi\left(\frac{\pi_t}{\bar{\pi}} - 1\right)\frac{\pi_t}{\bar{\pi}} = (1-\theta) + \theta mc_t + \varphi E_t \left[\beta_{t+1} \frac{c_t}{c_{t+1}} \left(\frac{\pi_{t+1}}{\bar{\pi}} - 1\right)\frac{\pi_{t+1}}{\bar{\pi}} \frac{y_{t+1}}{y_t}\right] \tag{9}$$
$$c_t + i_t = y_t^{gdp} \tag{10}$$
$$y_t^{gdp} = [1 - \varphi(\pi_t/\bar{\pi} - 1)^2/2] y_t \tag{11}$$
$$r_t = \max\{\underline{r}, r_t^*\} \tag{12}$$
$$r_t^n = (r_{t-1}^n)^{\rho_r} (\bar{r}(\pi_t/\bar{\pi})^{\phi_\pi} (y_t^{gdp}/(\bar{g} y_{t-1}^{gdp}))^{\phi_y})^{1-\rho_r} \exp(\nu_t) \tag{13}$$
$$z_t = z_{t-1} g_t \tag{14}$$
$$g_t = \bar{g}(g_{t-1}/\bar{g})^{\rho_g} \exp(\varepsilon_t) \tag{15}$$
$$\beta_t = \beta(\beta_{t-1}/\beta)^{\rho_\beta} \exp(\upsilon_t) \tag{16}$$
$$\mu_t = \mu_{t-1}^{\rho_\mu} \exp(\xi_t) \tag{17}$$

Variables: $\{w, c, y, y^{gdp}, n, r, r^n, \pi, mc, k, i, q, r^k, g, \beta, \mu, z\}$

De-trended System (17 equations):

$$\tilde{\lambda}_t = \tilde{c}_t \tag{18}$$

$$\tilde{w}_t = \chi n_t^{\eta} \tilde{\lambda}_t \tag{19}$$

$$1 = r_t E_t[\beta_{t+1}(\tilde{\lambda}_t/\tilde{\lambda}_{t+1})(1/(g_{t+1}\pi_{t+1}))] \tag{20}$$

$$q_t = E_t[\beta_{t+1}(\tilde{\lambda}_t/\tilde{\lambda}_{t+1})(r^k_{t+1} + q_{t+1}(1-\delta))/g_{t+1}] \tag{21}$$

$$1 = \mu_t q_t \left[1 - \frac{\nu}{2}\left(\frac{g_t\tilde{\imath}_t}{\bar{g}\tilde{\imath}_{t-1}} - 1\right)^2 - \nu\frac{g_t\tilde{\imath}_t}{\bar{g}\tilde{\imath}_{t-1}}\left(\frac{g_t\tilde{\imath}_t}{\bar{g}\tilde{\imath}_{t-1}} - 1\right)\right] + \nu\bar{g}E_t\left[\frac{\beta_{t+1}\mu_{t+1}q_{t+1}}{g_{t+1}}\frac{\tilde{\lambda}_t}{\tilde{\lambda}_{t+1}}\left(\frac{g_{t+1}\tilde{\imath}_{t+1}}{\bar{g}\tilde{\imath}_t}\right)^2\left(\frac{g_{t+1}\tilde{\imath}_{t+1}}{\bar{g}\tilde{\imath}_t} - 1\right)\right] \tag{22}$$

$$\tilde{y}_t = (\tilde{k}_{t-1}/g_t)^{\alpha} n_t^{1-\alpha} \tag{23}$$

$$\tilde{k}_t = (1-\delta)(\tilde{k}_{t-1}/g_t) + \mu_t\tilde{\imath}_t\left[1 - \frac{\nu}{2}\left(\frac{g_t\tilde{\imath}_t}{\bar{g}\tilde{\imath}_{t-1}} - 1\right)^2\right] \tag{24}$$

$$\tilde{w}_t = (1-\alpha)\Psi_t\tilde{y}_t/n_t \tag{25}$$

$$r^k_t = \alpha\Psi_t g_t\tilde{y}_t/\tilde{k}_{t-1} \tag{26}$$

$$\varphi\left(\frac{\pi_t}{\bar{\pi}} - 1\right)\frac{\pi_t}{\bar{\pi}} = (1-\theta) + \theta mc_t + \varphi E_t\left[\beta_{t+1}\frac{\tilde{\lambda}_t}{\tilde{\lambda}_{t+1}}\left(\frac{\pi_{t+1}}{\bar{\pi}} - 1\right)\frac{\pi_{t+1}}{\bar{\pi}}\frac{\tilde{y}_{t+1}}{\tilde{y}_t}\right] \tag{27}$$

$$\tilde{c}_t + \tilde{\imath}_t = \tilde{y}^{gdp}_t \tag{28}$$

$$\tilde{y}^{gdp}_t = [1 - \varphi(\pi_t/\bar{\pi} - 1)^2/2]\tilde{y}_t \tag{29}$$

$$r_t = \max\{\underline{r}, r^*_t\} \tag{30}$$

$$r^*_t = (r^*_{t-1})^{\rho_r}(\bar{r}(\pi_t/\bar{\pi})^{\phi_\pi}(g_t\tilde{c}_t/(\bar{g}\tilde{c}_{t-1}))^{\phi_y})^{1-\rho_r}\exp(\nu_t) \tag{31}$$

$$g_t = \bar{g}(g_{t-1}/\bar{g})^{\rho_g}\exp(\upsilon_t) \tag{32}$$

$$\beta_t = \beta(\beta_{t-1}/\beta)^{\rho_\beta}\exp(\varepsilon_t) \tag{33}$$

$$\mu_t = \mu^{\rho_\mu}_{t-1}\exp(\xi_t) \tag{34}$$

Variables: $\{\tilde{\lambda}, \tilde{w}, \tilde{c}, \tilde{y}, \tilde{y}^{gdp}, n, r, r^n, \pi, mc, \tilde{k}, \tilde{\imath}, q, r^k, g, \beta, \mu\}$. $\tilde{x}_t \equiv x_t/z_t$