

$$P\_EM\_a.t_t = P\_EM\_a.ts + shock\_P\_EM\_a.t_t \quad (1)$$

$$\log \left( \frac{epsi\_a.t_t}{epsi\_a.ts} \right) = rho\_eps\_a \log \left( \frac{epsi\_a.t_{t-1}}{epsi\_a.ts} \right) + shock\_epsi\_a.t_t \quad (2)$$

$$EM\_t_t = (1 - rho\_EM) EM\_t_{t-1} + ZZ\_1.a.t_t + ZZ\_2.a.t_t + ZZ\_3.a.t_t + ZZ\_4.a.t_t + ZZ\_5.a.t_t + ZZ\_6.a.t_t + ZZ\_7.a.t_t + ZZ\_8.a.t_t + ZZ\_9.a.t_t + ZZ\_10.a.t_t \quad (3)$$

$$Pen\_1.a.t_t = gama0\_1.a + EM\_t_t gama1\_1.a + gama2\_1.a EM\_t_t^2 \quad (4)$$

$$ZZ\_1.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.1.a Y.1.a.t_t \quad (5)$$

$$Pen\_2.a.t_t = gama0\_2.a + EM\_t_t gama1\_2.a + EM\_t_t^2 gama2\_2.a \quad (6)$$

$$ZZ\_2.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.2.a Y.2.a.t_t \quad (7)$$

$$Pen\_3.a.t_t = gama0\_3.a + EM\_t_t gama1\_3.a + EM\_t_t^2 gama2\_3.a \quad (8)$$

$$ZZ\_3.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.3.a Y.3.a.t_t \quad (9)$$

$$Pen\_4.a.t_t = gama0\_4.a + EM\_t_t gama1\_4.a + EM\_t_t^2 gama2\_4.a \quad (10)$$

$$ZZ\_4.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.4.a Y.4.a.t_t \quad (11)$$

$$Pen\_5.a.t_t = gama0\_5.a + EM\_t_t gama1\_5.a + EM\_t_t^2 gama2\_5.a \quad (12)$$

$$ZZ\_5.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.5.a Y.5.a.t_t \quad (13)$$

$$Pen\_6.a.t_t = gama0\_6.a + EM\_t_t gama1\_6.a + EM\_t_t^2 gama2\_6.a \quad (14)$$

$$ZZ\_6.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.6.a Y.6.a.t_t \quad (15)$$

$$Pen\_7.a.t_t = gama0\_7.a + EM\_t_t gama1\_7.a + EM\_t_t^2 gama2\_7.a \quad (16)$$

$$ZZ\_7.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.7.a Y.7.a.t_t \quad (17)$$

$$Pen\_8.a.t_t = gama0\_8.a + EM\_t_t gama1\_8.a + EM\_t_t^2 gama2\_8.a \quad (18)$$

$$ZZ\_8.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.8.a Y.8.a.t_t \quad (19)$$

$$Pen\_9.a.t_t = gama0\_9.a + EM\_t_t gama1\_9.a + EM\_t_t^2 gama2\_9.a \quad (20)$$

$$ZZ\_9.a.t_t = (1 + shock\_epsi\_carb.int.a.t_t) carb.int.9.a Y.9.a.t_t \quad (21)$$

$$Pen_{10.a.t_t} = gama0_{10.a} + EM_{.t_t} gama1_{10.a} + EM_{.t_t}^2 gama2_{10.a} \quad (22)$$

$$ZZ_{10.a.t_t} = (1 + shock\_epsi\_carb\_int_{.a.t_t}) carb\_int_{10.a} Y_{10.a.t_t} \quad (23)$$

$$ZZ_{.a.t_t} = ZZ_{1.a.t_t} + ZZ_{2.a.t_t} + ZZ_{3.a.t_t} + ZZ_{4.a.t_t} + ZZ_{5.a.t_t} + ZZ_{6.a.t_t} + ZZ_{7.a.t_t} + ZZ_{8.a.t_t} + ZZ_{9.a.t_t} + ZZ_{10.a.t_t} \quad (24)$$

$$\log\left(\frac{R_{.a.t_t}}{R_{.a.ts}}\right) = 0.4096000000000002 \log\left(\frac{R_{.a.t_{t-1}}}{R_{.a.ts}}\right) + 0.8855999999999997 \log(pi\_cpi_{.a.t_{t-1}}) \quad (25)$$

$$K_{.a.t_t} = (1 - delta) K_{.a.t_{t-1}} + I_{.a.t_t} \quad (26)$$

$$lambda_{.a.t_t} = C_{.a.t_t}^{(-sig)} \quad (27)$$

$$1 = \frac{R_{.a.t_t} \frac{betta \lambda_{.a.t_t+1}}{\lambda_{.a.t_t}}}{pi\_cpi_{.a.t_t+1}} \quad (28)$$

$$1 = \frac{\frac{betta \lambda_{.a.t_t+1}}{\lambda_{.a.t_t}} (rk_{.a.t_t+1} + (1 - delta) PI_{.a.t_t+1})}{PI_{.a.t_t}} \quad (29)$$

$$\lambda_{.a.t_t} w_{.a.t_t} = kappa N_{.a} N_{.a.t_t}^{lab.a} \quad (30)$$

$$1 = \left( Psi_{con.1.a} P_{1.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.2.a} P_{2.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.3.a} P_{3.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.4.a} P_{4.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.5.a} P_{5.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} \right. \\ \left. + Psi_{con.6.a} P_{6.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.7.a} P_{7.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.8.a} P_{8.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.9.a} P_{9.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.10.a} P_{10.a.t_t}^{\frac{(-sigc_a)}{1-sigc_a}} \right) \frac{(-(1-sigc_a))}{sigc_a} \quad (31)$$

$$pi\_cpi_{.a.t_t} = \left( Psi_{con.1.a} (pi\_ppi_{1.a.t_t} P_{1.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.2.a} (pi\_ppi_{2.a.t_t} P_{2.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.3.a} (pi\_ppi_{3.a.t_t} P_{3.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} \right. \\ + Psi_{con.4.a} (pi\_ppi_{4.a.t_t} P_{4.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.5.a} (pi\_ppi_{5.a.t_t} P_{5.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.6.a} (pi\_ppi_{6.a.t_t} P_{6.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} \\ + Psi_{con.7.a} (pi\_ppi_{7.a.t_t} P_{7.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.8.a} (pi\_ppi_{8.a.t_t} P_{8.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} + Psi_{con.9.a} (pi\_ppi_{9.a.t_t} P_{9.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} \\ \left. + Psi_{con.10.a} (pi\_ppi_{10.a.t_t} P_{10.a.t_{t-1}})^{\frac{(-sigc_a)}{1-sigc_a}} \right) \frac{(-(1-sigc_a))}{sigc_a} \quad (32)$$

$$PI_{.a.t_t} = \left( Psi_{inv.1.a} P_{1.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.2.a} P_{2.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.3.a} P_{3.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.4.a} P_{4.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.5.a} P_{5.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} \right. \\ \left. + Psi_{inv.6.a} P_{6.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.7.a} P_{7.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.8.a} P_{8.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.9.a} P_{9.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} + Psi_{inv.10.a} P_{10.a.t_t}^{\frac{(-sigi_a)}{1-sigi_a}} \right) \frac{(-(1-sigi_a))}{sigi_a} \quad (33)$$

$$\begin{aligned}
w_{.a.t_t} = & \left( \omega_{N.1.a} w_{.1.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.2.a} w_{.2.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.3.a} w_{.3.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.4.a} w_{.4.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} \right. \\
& + \omega_{N.5.a} w_{.5.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.6.a} w_{.6.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.7.a} w_{.7.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.8.a} w_{.8.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} \\
& \left. + \omega_{N.9.a} w_{.9.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} + \omega_{N.10.a} w_{.10.a.t_t}^{\frac{(-\psi_{N.a})}{1-\psi_{N.a}}} \right)^{\frac{(-(1-\psi_{N.a}))}{\psi_{N.a}}}
\end{aligned} \quad (34)$$

$$\begin{aligned}
rk_{.a.t_t} = & \left( \omega_{K.1.a} rk_{.1.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.2.a} rk_{.2.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.3.a} rk_{.3.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.4.a} rk_{.4.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} \right. \\
& + \omega_{K.5.a} rk_{.5.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.6.a} rk_{.6.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.7.a} rk_{.7.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.8.a} rk_{.8.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} \\
& \left. + \omega_{K.9.a} rk_{.9.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} + \omega_{K.10.a} rk_{.10.a.t_t}^{\frac{(-\psi_{K.a})}{1-\psi_{K.a}}} \right)^{\frac{(-(1-\psi_{K.a}))}{\psi_{K.a}}}
\end{aligned} \quad (35)$$

$$Y_{.VA.a.t_t} = C_{.a.t_t} + I_{.a.t_t} PI_{.a.t_t} \quad (36)$$

$$C_{.1.a.t_t} = C_{.a.t_t} \psi_{con.1.a} \left( \frac{1}{P_{.1.a.t_t}} \right)^{\frac{1}{1-\psi_{c.a}}} \quad (37)$$

$$I_{.1.a.t_t} = I_{.a.t_t} \psi_{inv.1.a} \left( \frac{PI_{.a.t_t}}{P_{.1.a.t_t}} \right)^{\frac{1}{1-\psi_{i.a}}} \quad (38)$$

$$N_{.1.a.t_t} = N_{.a.t_t} \omega_{N.1.a} \left( \frac{w_{.a.t_t}}{w_{.1.a.t_t}} \right)^{\frac{1}{1-\psi_{N.a}}} \quad (39)$$

$$K_{.1.a.t_t} = K_{.a.t_t} \omega_{K.1.a} \left( \frac{rk_{.a.t_t+1}}{rk_{.1.a.t_t+1}} \right)^{\frac{1}{1-\psi_{K.a}}} \quad (40)$$

$$\begin{aligned}
Y_{.1.a.t_t} P_{.1.a.t_t} = & P_{.1.a.t_t} C_{.1.a.t_t} + P_{.1.a.t_t} I_{.1.a.t_t} + P_{.1.a.t_t} H_{.1.1.a.t_t} + P_{.1.a.t_t} H_{.2.1.a.t_t} + P_{.1.a.t_t} H_{.3.1.a.t_t} + P_{.1.a.t_t} H_{.4.1.a.t_t} \\
& + P_{.1.a.t_t} H_{.5.1.a.t_t} + P_{.1.a.t_t} H_{.6.1.a.t_t} + P_{.1.a.t_t} H_{.7.1.a.t_t} + P_{.1.a.t_t} H_{.8.1.a.t_t} + P_{.1.a.t_t} H_{.9.1.a.t_t} + P_{.1.a.t_t} H_{.10.1.a.t_t}
\end{aligned} \quad (41)$$

$$Y_{.1.a.t_t} = \epsilon_{\psi_{.a.t_t}} \epsilon_{\psi_{.1.a.t_t}} (1 - Pen_{.1.a.t_t}) \left( N_{.1.a.t_t}^{\alpha_{N.1.a}} K_{.1.a.t_t-1}^{1-\alpha_{N.1.a}} \right)^{\alpha_{H.1.a}} H_{.1.a.t_t}^{1-\alpha_{H.1.a}} \quad (42)$$

$$EM_{cost.1.a.t_t} = P_{EM.a.t_t} (1 + shock_{\psi_{carb.int.a.t_t}}) carb_{int.1.a} \quad (43)$$

$$mc_{tild.1.a.t_t} = EM_{cost.1.a.t_t} + mc_{.1.a.t_t} \quad (44)$$

$$P_{.1.a.t_t} = mc_{tild.1.a.t_t} \quad (45)$$

$$w_{1.a.t_t} = \frac{Y_{1.a.t_t} mc_{1.a.t_t} \alpha N_{1.a} \alpha H_{1.a}}{N_{1.a.t_t}} \quad (46)$$

$$rk_{1.a.t_t} = \frac{Y_{1.a.t_t} mc_{1.a.t_t} (1 - \alpha N_{1.a}) \alpha H_{1.a}}{K_{1.a.t_t-1}} \quad (47)$$

$$PH_{1.a.t_t} = \frac{Y_{1.a.t_t} (1 - \alpha H_{1.a}) mc_{1.a.t_t}}{H_{1.a.t_t}} \quad (48)$$

$$\begin{aligned} PH_{1.a.t_t} = & \left( Psi_{1.1.a} P_{1.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.2.a} P_{2.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.3.a} P_{3.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.4.a} P_{4.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.5.a} P_{5.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} \right. \\ & + Psi_{1.6.a} P_{6.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.7.a} P_{7.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.8.a} P_{8.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} + Psi_{1.9.a} P_{9.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} \\ & \left. + Psi_{1.10.a} P_{10.a.t_t}^{\frac{(-sigh_{1.a})}{1-sigh_{1.a}}} \right)^{\frac{(-sigh_{1.a})}{sigh_{1.a}}} \quad (49) \end{aligned}$$

$$H_{1.1.a.t_t} = H_{1.a.t_t} Psi_{1.1.a} \left( \frac{PH_{1.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (50)$$

$$H_{1.2.a.t_t} = H_{1.a.t_t} Psi_{1.2.a} \left( \frac{PH_{1.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (51)$$

$$H_{1.3.a.t_t} = H_{1.a.t_t} Psi_{1.3.a} \left( \frac{PH_{1.a.t_t}}{P_{3.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (52)$$

$$H_{1.4.a.t_t} = H_{1.a.t_t} Psi_{1.4.a} \left( \frac{PH_{1.a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (53)$$

$$H_{1.5.a.t_t} = H_{1.a.t_t} Psi_{1.5.a} \left( \frac{PH_{1.a.t_t}}{P_{5.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (54)$$

$$H_{1.6.a.t_t} = H_{1.a.t_t} Psi_{1.6.a} \left( \frac{PH_{1.a.t_t}}{P_{6.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (55)$$

$$H_{1.7.a.t_t} = H_{1.a.t_t} Psi_{1.7.a} \left( \frac{PH_{1.a.t_t}}{P_{7.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (56)$$

$$H_{1.8.a.t_t} = H_{1.a.t_t} Psi_{1.8.a} \left( \frac{PH_{1.a.t_t}}{P_{8.a.t_t}} \right)^{\frac{1}{1-sigh_{1.a}}} \quad (57)$$

$$H\_1.9\_a.t_t = H\_1.a.t_t \textit{Psi}.1.9.a \left( \frac{PH\_1.a.t_t}{P\_9.a.t_t} \right)^{\frac{1}{1-\textit{sig}h.1.a}} \quad (58)$$

$$H\_1.10.a.t_t = H\_1.a.t_t \textit{Psi}.1.10.a \left( \frac{PH\_1.a.t_t}{P\_10.a.t_t} \right)^{\frac{1}{1-\textit{sig}h.1.a}} \quad (59)$$

$$\log \left( \frac{\textit{epsi}.1.a.t_t}{\textit{epsi}.1.a.ts} \right) = \textit{rho}.eps.a \log \left( \frac{\textit{epsi}.1.a.t_{t-1}}{\textit{epsi}.1.a.ts} \right) + \textit{shock}.epsi.1.a.t_t \quad (60)$$

$$C\_2.a.t_t = C\_a.t_t \textit{Psi}.con.2.a \left( \frac{1}{P\_2.a.t_t} \right)^{\frac{1}{1-\textit{sig}c.a}} \quad (61)$$

$$I\_2.a.t_t = I\_a.t_t \textit{Psi}.inv.2.a \left( \frac{PI\_a.t_t}{P\_2.a.t_t} \right)^{\frac{1}{1-\textit{sig}i.a}} \quad (62)$$

$$N\_2.a.t_t = N\_a.t_t \textit{omega}.N.2.a \left( \frac{w\_a.t_t}{w\_2.a.t_t} \right)^{\frac{1}{1-\textit{upsi}.N.a}} \quad (63)$$

$$K\_2.a.t_t = K\_a.t_t \textit{omega}.K.2.a \left( \frac{rk\_a.t_{t+1}}{rk\_2.a.t_{t+1}} \right)^{\frac{1}{1-\textit{upsi}.K.a}} \quad (64)$$

$$\begin{aligned} Y\_2.a.t_t P\_2.a.t_t = & P\_2.a.t_t C\_2.a.t_t + P\_2.a.t_t I\_2.a.t_t + P\_2.a.t_t H\_1.2.a.t_t + P\_2.a.t_t H\_2.2.a.t_t + P\_2.a.t_t H\_3.2.a.t_t + P\_2.a.t_t H\_4.2.a.t_t \\ & + P\_2.a.t_t H\_5.2.a.t_t + P\_2.a.t_t H\_6.2.a.t_t + P\_2.a.t_t H\_7.2.a.t_t + P\_2.a.t_t H\_8.2.a.t_t + P\_2.a.t_t H\_9.2.a.t_t + P\_2.a.t_t H\_10.2.a.t_t \end{aligned} \quad (65)$$

$$Y\_2.a.t_t = \textit{epsi}.a.t_t \textit{epsi}.2.a.t_t (1 - \textit{Pen}.2.a.t_t) \left( N\_2.a.t_t^{\textit{alpha}N.2.a} K\_2.a.t_{t-1}^{1-\textit{alpha}N.2.a} \right)^{\textit{alpha}H.2.a} H\_2.a.t_t^{1-\textit{alpha}H.2.a} \quad (66)$$

$$\textit{EM}.cost.2.a.t_t = P\_EM.a.t_t (1 + \textit{shock}.epsi.carb.int.a.t_t) \textit{carb}.int.2.a \quad (67)$$

$$\textit{mc}.tild.2.a.t_t = \textit{EM}.cost.2.a.t_t + \textit{mc}.2.a.t_t \quad (68)$$

$$P\_2.a.t_t = \textit{mc}.tild.2.a.t_t \quad (69)$$

$$w\_2.a.t_t = \frac{Y\_2.a.t_t \textit{mc}.2.a.t_t \textit{alpha}N.2.a \textit{alpha}H.2.a}{N\_2.a.t_t} \quad (70)$$

$$rk\_2.a.t_t = \frac{Y\_2.a.t_t \textit{mc}.2.a.t_t (1 - \textit{alpha}N.2.a) \textit{alpha}H.2.a}{K\_2.a.t_{t-1}} \quad (71)$$

$$PH\_2.a.t_t = \frac{Y\_2.a.t_t (1 - \textit{alpha}H.2.a) \textit{mc}.2.a.t_t}{H\_2.a.t_t} \quad (72)$$

$$\begin{aligned}
PH_{2.a.t_t} = & \left( Psi_{2.1.a} P_{1.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.2.a} P_{2.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.3.a} P_{3.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.4.a} P_{4.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.5.a} P_{5.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} \right. \\
& + Psi_{2.6.a} P_{6.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.7.a} P_{7.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.8.a} P_{8.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} + Psi_{2.9.a} P_{9.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} \\
& \left. + Psi_{2.10.a} P_{10.a.t_t}^{\frac{(-sigh_{2.a})}{1-sigh_{2.a}}} \right)^{\frac{(-(1-sigh_{2.a}))}{sigh_{2.a}}} \quad (73)
\end{aligned}$$

$$H_{2.1.a.t_t} = H_{2.a.t_t} Psi_{2.1.a} \left( \frac{PH_{2.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (74)$$

$$H_{2.2.a.t_t} = H_{2.a.t_t} Psi_{2.2.a} \left( \frac{PH_{2.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (75)$$

$$H_{2.3.a.t_t} = H_{2.a.t_t} Psi_{2.3.a} \left( \frac{PH_{2.a.t_t}}{P_{3.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (76)$$

$$H_{2.4.a.t_t} = H_{2.a.t_t} Psi_{2.4.a} \left( \frac{PH_{2.a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (77)$$

$$H_{2.5.a.t_t} = H_{2.a.t_t} Psi_{2.5.a} \left( \frac{PH_{2.a.t_t}}{P_{5.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (78)$$

$$H_{2.6.a.t_t} = H_{2.a.t_t} Psi_{2.6.a} \left( \frac{PH_{2.a.t_t}}{P_{6.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (79)$$

$$H_{2.7.a.t_t} = H_{2.a.t_t} Psi_{2.7.a} \left( \frac{PH_{2.a.t_t}}{P_{7.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (80)$$

$$H_{2.8.a.t_t} = H_{2.a.t_t} Psi_{2.8.a} \left( \frac{PH_{2.a.t_t}}{P_{8.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (81)$$

$$H_{2.9.a.t_t} = H_{2.a.t_t} Psi_{2.9.a} \left( \frac{PH_{2.a.t_t}}{P_{9.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (82)$$

$$H_{2.10.a.t_t} = H_{2.a.t_t} Psi_{2.10.a} \left( \frac{PH_{2.a.t_t}}{P_{10.a.t_t}} \right)^{\frac{1}{1-sigh_{2.a}}} \quad (83)$$

$$\log \left( \frac{epsi\_2\_a\_t_t}{epsi\_2\_a\_ts} \right) = rho\_eps\_a \log \left( \frac{epsi\_2\_a\_t_{t-1}}{epsi\_2\_a\_ts} \right) + shock\_epsi\_2\_a\_t_t \quad (84)$$

$$C\_3\_a\_t_t = C\_a\_t_t Psi\_con\_3\_a \left( \frac{1}{P\_3\_a\_t_t} \right)^{\frac{1}{1-sigc\_a}} \quad (85)$$

$$I\_3\_a\_t_t = I\_a\_t_t Psi\_inv\_3\_a \left( \frac{PI\_a\_t_t}{P\_3\_a\_t_t} \right)^{\frac{1}{1-siga\_a}} \quad (86)$$

$$N\_3\_a\_t_t = N\_a\_t_t omega\_N\_3\_a \left( \frac{w\_a\_t_t}{w\_3\_a\_t_t} \right)^{\frac{1}{1-upsi\_N\_a}} \quad (87)$$

$$K\_3\_a\_t_t = K\_a\_t_t omega\_K\_3\_a \left( \frac{rk\_a\_t_{t+1}}{rk\_3\_a\_t_{t+1}} \right)^{\frac{1}{1-upsi\_K\_a}} \quad (88)$$

$$Y\_3\_a\_t_t P\_3\_a\_t_t = P\_3\_a\_t_t C\_3\_a\_t_t + P\_3\_a\_t_t I\_3\_a\_t_t + P\_3\_a\_t_t H\_1\_3\_a\_t_t + P\_3\_a\_t_t H\_2\_3\_a\_t_t + P\_3\_a\_t_t H\_3\_3\_a\_t_t + P\_3\_a\_t_t H\_4\_3\_a\_t_t \\ + P\_3\_a\_t_t H\_5\_3\_a\_t_t + P\_3\_a\_t_t H\_6\_3\_a\_t_t + P\_3\_a\_t_t H\_7\_3\_a\_t_t + P\_3\_a\_t_t H\_8\_3\_a\_t_t + P\_3\_a\_t_t H\_9\_3\_a\_t_t + P\_3\_a\_t_t H\_10\_3\_a\_t_t \quad (89)$$

$$Y\_3\_a\_t_t = epsi\_a\_t_t epsi\_3\_a\_t_t (1 - Pen\_3\_a\_t_t) \left( N\_3\_a\_t_t^{\alpha N\_3\_a} K\_3\_a\_t_{t-1}^{1-\alpha N\_3\_a} \right)^{\alpha H\_3\_a} H\_3\_a\_t_t^{1-\alpha H\_3\_a} \quad (90)$$

$$EM\_cost\_3\_a\_t_t = P\_EM\_a\_t_t (1 + shock\_epsi\_carb\_int\_a\_t_t) carb\_int\_3\_a \quad (91)$$

$$mc\_tild\_3\_a\_t_t = EM\_cost\_3\_a\_t_t + mc\_3\_a\_t_t \quad (92)$$

$$P\_3\_a\_t_t = mc\_tild\_3\_a\_t_t \quad (93)$$

$$w\_3\_a\_t_t = \frac{Y\_3\_a\_t_t mc\_3\_a\_t_t \alpha N\_3\_a \alpha H\_3\_a}{N\_3\_a\_t_t} \quad (94)$$

$$rk\_3\_a\_t_t = \frac{Y\_3\_a\_t_t mc\_3\_a\_t_t (1 - \alpha N\_3\_a) \alpha H\_3\_a}{K\_3\_a\_t_{t-1}} \quad (95)$$

$$PH\_3\_a\_t_t = \frac{Y\_3\_a\_t_t (1 - \alpha H\_3\_a) mc\_3\_a\_t_t}{H\_3\_a\_t_t} \quad (96)$$

$$PH\_3\_a\_t_t = \left( Psi\_3\_1\_a P\_1\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_2\_a P\_2\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_3\_a P\_3\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_4\_a P\_4\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_5\_a P\_5\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} \right. \\ \left. + Psi\_3\_6\_a P\_6\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_7\_a P\_7\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_8\_a P\_8\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} + Psi\_3\_9\_a P\_9\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} \right. \\ \left. + Psi\_3\_10\_a P\_10\_a\_t_t^{\frac{(-sigh\_3\_a)}{1-sigh\_3\_a}} \right)^{\frac{(-(1-sigh\_3\_a))}{sigh\_3\_a}} \quad (97)$$

$$H_{3.1.a.t_t} = H_{3.a.t_t} Psi_{3.1.a} \left( \frac{PH_{3.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (98)$$

$$H_{3.2.a.t_t} = H_{3.a.t_t} Psi_{3.2.a} \left( \frac{PH_{3.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (99)$$

$$H_{3.3.a.t_t} = H_{3.a.t_t} Psi_{3.3.a} \left( \frac{PH_{3.a.t_t}}{P_{3.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (100)$$

$$H_{3.4.a.t_t} = H_{3.a.t_t} Psi_{3.4.a} \left( \frac{PH_{3.a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (101)$$

$$H_{3.5.a.t_t} = H_{3.a.t_t} Psi_{3.5.a} \left( \frac{PH_{3.a.t_t}}{P_{5.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (102)$$

$$H_{3.6.a.t_t} = H_{3.a.t_t} Psi_{3.6.a} \left( \frac{PH_{3.a.t_t}}{P_{6.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (103)$$

$$H_{3.7.a.t_t} = H_{3.a.t_t} Psi_{3.7.a} \left( \frac{PH_{3.a.t_t}}{P_{7.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (104)$$

$$H_{3.8.a.t_t} = H_{3.a.t_t} Psi_{3.8.a} \left( \frac{PH_{3.a.t_t}}{P_{8.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (105)$$

$$H_{3.9.a.t_t} = H_{3.a.t_t} Psi_{3.9.a} \left( \frac{PH_{3.a.t_t}}{P_{9.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (106)$$

$$H_{3.10.a.t_t} = H_{3.a.t_t} Psi_{3.10.a} \left( \frac{PH_{3.a.t_t}}{P_{10.a.t_t}} \right)^{\frac{1}{1-sigh_{3.a}}} \quad (107)$$

$$\log \left( \frac{epsi_{3.a.t_t}}{epsi_{3.a.ts}} \right) = rho_{eps.a} \log \left( \frac{epsi_{3.a.t_{t-1}}}{epsi_{3.a.ts}} \right) + shock_{epsi_{3.a.t_t}} \quad (108)$$

$$C_{4.a.t_t} = C_{a.t_t} Psi_{con.4.a} \left( \frac{1}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigc.a}} \quad (109)$$

$$I_{4.a.t_t} = I_{a.t_t} Psi_{inv.4.a} \left( \frac{PI_{a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigi.a}} \quad (110)$$



$$N_{4.a.t_t} = N_{a.t_t} \omega_{N_{4.a}} \left( \frac{w_{a.t_t}}{w_{4.a.t_t}} \right)^{\frac{1}{1-\psi_{N_{4.a}}}} \quad (111)$$

$$K_{4.a.t_t} = K_{a.t_t} \omega_{K_{4.a}} \left( \frac{rk_{a.t_t+1}}{rk_{4.a.t_t+1}} \right)^{\frac{1}{1-\psi_{K_{4.a}}}} \quad (112)$$

$$Y_{4.a.t_t} P_{4.a.t_t} = P_{4.a.t_t} C_{4.a.t_t} + P_{4.a.t_t} I_{4.a.t_t} + P_{4.a.t_t} H_{1.4.a.t_t} + P_{4.a.t_t} H_{2.4.a.t_t} + P_{4.a.t_t} H_{3.4.a.t_t} + P_{4.a.t_t} H_{4.4.a.t_t} \\ + P_{4.a.t_t} H_{5.4.a.t_t} + P_{4.a.t_t} H_{6.4.a.t_t} + P_{4.a.t_t} H_{7.4.a.t_t} + P_{4.a.t_t} H_{8.4.a.t_t} + P_{4.a.t_t} H_{9.4.a.t_t} + P_{4.a.t_t} H_{10.4.a.t_t} \quad (113)$$

$$Y_{4.a.t_t} = \psi_{a.t_t} \psi_{4.a.t_t} (1 - \text{Pen}_{4.a.t_t}) \left( N_{4.a.t_t}^{\alpha_{N_{4.a}}} K_{4.a.t_t-1}^{1-\alpha_{N_{4.a}}} \right)^{\alpha_{H_{4.a}}} H_{4.a.t_t}^{1-\alpha_{H_{4.a}}} \quad (114)$$

$$EM_{cost_{4.a.t_t}} = P_{EM_{a.t_t}} (1 + \text{shock}_{\psi_{carb.int_{a.t_t}}}) \text{carb.int}_{4.a} \quad (115)$$

$$mc_{tild_{4.a.t_t}} = EM_{cost_{4.a.t_t}} + mc_{4.a.t_t} \quad (116)$$

$$P_{4.a.t_t} = mc_{tild_{4.a.t_t}} \quad (117)$$

$$w_{4.a.t_t} = \frac{Y_{4.a.t_t} mc_{4.a.t_t} \alpha_{N_{4.a}} \alpha_{H_{4.a}}}{N_{4.a.t_t}} \quad (118)$$

$$rk_{4.a.t_t} = \frac{Y_{4.a.t_t} mc_{4.a.t_t} (1 - \alpha_{N_{4.a}}) \alpha_{H_{4.a}}}{K_{4.a.t_t-1}} \quad (119)$$

$$PH_{4.a.t_t} = \frac{Y_{4.a.t_t} (1 - \alpha_{H_{4.a}}) mc_{4.a.t_t}}{H_{4.a.t_t}} \quad (120)$$

$$PH_{4.a.t_t} = \left( \psi_{4.1.a} \psi_{1.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.2.a} \psi_{2.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.3.a} \psi_{3.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.4.a} \psi_{4.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.5.a} \psi_{5.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} \right. \\ \left. + \psi_{4.6.a} \psi_{6.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.7.a} \psi_{7.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.8.a} \psi_{8.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.9.a} \psi_{9.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} + \psi_{4.10.a} \psi_{10.a.t_t}^{\frac{(-\psi_{4.a})}{1-\psi_{4.a}}} \right)^{\frac{(-\psi_{4.a})}{\psi_{4.a}}} \quad (121)$$

$$H_{4.1.a.t_t} = H_{4.a.t_t} \psi_{4.1.a} \left( \frac{PH_{4.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-\psi_{4.a}}} \quad (122)$$

$$H_{4.2.a.t_t} = H_{4.a.t_t} \psi_{4.2.a} \left( \frac{PH_{4.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-\psi_{4.a}}} \quad (123)$$

$$H\_4.3\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.3.a \left( \frac{PH\_4.a.t_t}{P\_3.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (124)$$

$$H\_4.4\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.4.a \left( \frac{PH\_4.a.t_t}{P\_4.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (125)$$

$$H\_4.5\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.5.a \left( \frac{PH\_4.a.t_t}{P\_5.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (126)$$

$$H\_4.6\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.6.a \left( \frac{PH\_4.a.t_t}{P\_6.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (127)$$

$$H\_4.7\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.7.a \left( \frac{PH\_4.a.t_t}{P\_7.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (128)$$

$$H\_4.8\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.8.a \left( \frac{PH\_4.a.t_t}{P\_8.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (129)$$

$$H\_4.9\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.9.a \left( \frac{PH\_4.a.t_t}{P\_9.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (130)$$

$$H\_4.10\_a.t_t = H\_4.a.t_t \textit{Psi}\_4.10.a \left( \frac{PH\_4.a.t_t}{P\_10.a.t_t} \right)^{\frac{1}{1-\textit{sig}h\_4.a}} \quad (131)$$

$$\log \left( \frac{\textit{epsi}\_4.a.t_t}{\textit{epsi}\_4.a.ts} \right) = \textit{rho}\_eps.a \log \left( \frac{\textit{epsi}\_4.a.t_{t-1}}{\textit{epsi}\_4.a.ts} \right) + \textit{shock}\_epsi\_4.a.t_t \quad (132)$$

$$C\_5.a.t_t = C\_a.t_t \textit{Psi}\_con.5.a \left( \frac{1}{P\_5.a.t_t} \right)^{\frac{1}{1-\textit{sig}c.a}} \quad (133)$$

$$I\_5.a.t_t = I\_a.t_t \textit{Psi}\_inv.5.a \left( \frac{PI\_a.t_t}{P\_5.a.t_t} \right)^{\frac{1}{1-\textit{sig}i.a}} \quad (134)$$

$$N\_5.a.t_t = N\_a.t_t \textit{omega}\_N.5.a \left( \frac{w\_a.t_t}{w\_5.a.t_t} \right)^{\frac{1}{1-\textit{upsi}\_N.a}} \quad (135)$$

$$K\_5.a.t_t = K\_a.t_t \textit{omega}\_K.5.a \left( \frac{rk\_a.t_{t+1}}{rk\_5.a.t_{t+1}} \right)^{\frac{1}{1-\textit{upsi}\_K.a}} \quad (136)$$

$$Y_{.5.a.t_t} P_{.5.a.t_t} = P_{.5.a.t_t} C_{.5.a.t_t} + P_{.5.a.t_t} I_{.5.a.t_t} + P_{.5.a.t_t} H_{.1.5.a.t_t} + P_{.5.a.t_t} H_{.2.5.a.t_t} + P_{.5.a.t_t} H_{.3.5.a.t_t} + P_{.5.a.t_t} H_{.4.5.a.t_t} \\ + P_{.5.a.t_t} H_{.5.5.a.t_t} + P_{.5.a.t_t} H_{.6.5.a.t_t} + P_{.5.a.t_t} H_{.7.5.a.t_t} + P_{.5.a.t_t} H_{.8.5.a.t_t} + P_{.5.a.t_t} H_{.9.5.a.t_t} + P_{.5.a.t_t} H_{.10.5.a.t_t} \quad (137)$$

$$Y_{.5.a.t_t} = \text{epsi}_{.a.t_t} \text{epsi}_{.5.a.t_t} (1 - \text{Pen}_{.5.a.t_t}) \left( N_{.5.a.t_t}^{\alpha N_{.5.a}} K_{.5.a.t_t-1}^{1-\alpha N_{.5.a}} \right)^{\alpha H_{.5.a}} H_{.5.a.t_t}^{1-\alpha H_{.5.a}} \quad (138)$$

$$EM_{cost.5.a.t_t} = P_{EM.a.t_t} (1 + \text{shock\_epsi\_carb\_int\_a.t_t}) \text{carb\_int}_{.5.a} \quad (139)$$

$$mc_{tild.5.a.t_t} = EM_{cost.5.a.t_t} + mc_{.5.a.t_t} \quad (140)$$

$$P_{.5.a.t_t} = mc_{tild.5.a.t_t} \quad (141)$$

$$w_{.5.a.t_t} = \frac{Y_{.5.a.t_t} mc_{.5.a.t_t} \alpha N_{.5.a} \alpha H_{.5.a}}{N_{.5.a.t_t}} \quad (142)$$

$$rk_{.5.a.t_t} = \frac{Y_{.5.a.t_t} mc_{.5.a.t_t} (1 - \alpha N_{.5.a}) \alpha H_{.5.a}}{K_{.5.a.t_t-1}} \quad (143)$$

$$PH_{.5.a.t_t} = \frac{Y_{.5.a.t_t} (1 - \alpha H_{.5.a}) mc_{.5.a.t_t}}{H_{.5.a.t_t}} \quad (144)$$

$$PH_{.5.a.t_t} = \left( \text{Psi}_{.5.1.a} P_{.1.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.2.a} P_{.2.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.3.a} P_{.3.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.4.a} P_{.4.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.5.a} P_{.5.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} \right. \\ \left. + \text{Psi}_{.5.6.a} P_{.6.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.7.a} P_{.7.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.8.a} P_{.8.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} + \text{Psi}_{.5.9.a} P_{.9.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} \right. \\ \left. + \text{Psi}_{.5.10.a} P_{.10.a.t_t}^{\frac{(-\text{sig}h_{.5.a})}{1-\text{sig}h_{.5.a}}} \right)^{\frac{(-1-\text{sig}h_{.5.a})}{\text{sig}h_{.5.a}}} \quad (145)$$

$$H_{.5.1.a.t_t} = H_{.5.a.t_t} \text{Psi}_{.5.1.a} \left( \frac{PH_{.5.a.t_t}}{P_{.1.a.t_t}} \right)^{\frac{1}{1-\text{sig}h_{.5.a}}} \quad (146)$$

$$H_{.5.2.a.t_t} = H_{.5.a.t_t} \text{Psi}_{.5.2.a} \left( \frac{PH_{.5.a.t_t}}{P_{.2.a.t_t}} \right)^{\frac{1}{1-\text{sig}h_{.5.a}}} \quad (147)$$

$$H_{.5.3.a.t_t} = H_{.5.a.t_t} \text{Psi}_{.5.3.a} \left( \frac{PH_{.5.a.t_t}}{P_{.3.a.t_t}} \right)^{\frac{1}{1-\text{sig}h_{.5.a}}} \quad (148)$$

$$H_{.5.4.a.t_t} = H_{.5.a.t_t} \text{Psi}_{.5.4.a} \left( \frac{PH_{.5.a.t_t}}{P_{.4.a.t_t}} \right)^{\frac{1}{1-\text{sig}h_{.5.a}}} \quad (149)$$

$$H\_5\_5\_a.t_t = H\_5\_a.t_t Psi\_5\_5\_a \left( \frac{PH\_5\_a.t_t}{P\_5\_a.t_t} \right)^{\frac{1}{1-sigh\_5\_a}} \quad (150)$$

$$H\_5\_6\_a.t_t = H\_5\_a.t_t Psi\_5\_6\_a \left( \frac{PH\_5\_a.t_t}{P\_6\_a.t_t} \right)^{\frac{1}{1-sigh\_5\_a}} \quad (151)$$

$$H\_5\_7\_a.t_t = H\_5\_a.t_t Psi\_5\_7\_a \left( \frac{PH\_5\_a.t_t}{P\_7\_a.t_t} \right)^{\frac{1}{1-sigh\_5\_a}} \quad (152)$$

$$H\_5\_8\_a.t_t = H\_5\_a.t_t Psi\_5\_8\_a \left( \frac{PH\_5\_a.t_t}{P\_8\_a.t_t} \right)^{\frac{1}{1-sigh\_5\_a}} \quad (153)$$

$$H\_5\_9\_a.t_t = H\_5\_a.t_t Psi\_5\_9\_a \left( \frac{PH\_5\_a.t_t}{P\_9\_a.t_t} \right)^{\frac{1}{1-sigh\_5\_a}} \quad (154)$$

$$H\_5\_10\_a.t_t = H\_5\_a.t_t Psi\_5\_10\_a \left( \frac{PH\_5\_a.t_t}{P\_10\_a.t_t} \right)^{\frac{1}{1-sigh\_5\_a}} \quad (155)$$

$$\log \left( \frac{epsi\_5\_a.t_t}{epsi\_5\_a.ts} \right) = rho\_eps\_a \log \left( \frac{epsi\_5\_a.t_{t-1}}{epsi\_5\_a.ts} \right) + shock\_epsi\_5\_a.t_t \quad (156)$$

$$C\_6\_a.t_t = C\_a.t_t Psi\_con\_6\_a \left( \frac{1}{P\_6\_a.t_t} \right)^{\frac{1}{1-sigc\_a}} \quad (157)$$

$$I\_6\_a.t_t = I\_a.t_t Psi\_inv\_6\_a \left( \frac{PI\_a.t_t}{P\_6\_a.t_t} \right)^{\frac{1}{1-sigi\_a}} \quad (158)$$

$$N\_6\_a.t_t = N\_a.t_t omega\_N\_6\_a \left( \frac{w\_a.t_t}{w\_6\_a.t_t} \right)^{\frac{1}{1-ups\_i\_N\_a}} \quad (159)$$

$$K\_6\_a.t_t = K\_a.t_t omega\_K\_6\_a \left( \frac{rk\_a.t_{t+1}}{rk\_6\_a.t_{t+1}} \right)^{\frac{1}{1-ups\_i\_K\_a}} \quad (160)$$

$$Y\_6\_a.t_t P\_6\_a.t_t = P\_6\_a.t_t C\_6\_a.t_t + P\_6\_a.t_t I\_6\_a.t_t + P\_6\_a.t_t H\_1\_6\_a.t_t + P\_6\_a.t_t H\_2\_6\_a.t_t + P\_6\_a.t_t H\_3\_6\_a.t_t + P\_6\_a.t_t H\_4\_6\_a.t_t \\ + P\_6\_a.t_t H\_5\_6\_a.t_t + P\_6\_a.t_t H\_6\_6\_a.t_t + P\_6\_a.t_t H\_7\_6\_a.t_t + P\_6\_a.t_t H\_8\_6\_a.t_t + P\_6\_a.t_t H\_9\_6\_a.t_t + P\_6\_a.t_t H\_10\_6\_a.t_t \quad (161)$$

$$Y\_6\_a.t_t = epsi\_a.t_t epsi\_6\_a.t_t (1 - Pen\_6\_a.t_t) \left( N\_6\_a.t_t^{alpha N\_6\_a} K\_6\_a.t_{t-1}^{1-alpha N\_6\_a} \right)^{alpha H\_6\_a} H\_6\_a.t_t^{1-alpha H\_6\_a} \quad (162)$$

$$EM\_cost\_6\_a\_t_t = P\_EM\_a\_t_t (1 + shock\_epsi\_carb\_int\_a\_t_t) carb\_int\_6\_a \quad (163)$$

$$mc\_tild\_6\_a\_t_t = EM\_cost\_6\_a\_t_t + mc\_6\_a\_t_t \quad (164)$$

$$P\_6\_a\_t_t = mc\_tild\_6\_a\_t_t \quad (165)$$

$$w\_6\_a\_t_t = \frac{Y\_6\_a\_t_t mc\_6\_a\_t_t alpha N\_6\_a alpha H\_6\_a}{N\_6\_a\_t_t} \quad (166)$$

$$rk\_6\_a\_t_t = \frac{Y\_6\_a\_t_t mc\_6\_a\_t_t (1 - alpha N\_6\_a) alpha H\_6\_a}{K\_6\_a\_t_{t-1}} \quad (167)$$

$$PH\_6\_a\_t_t = \frac{Y\_6\_a\_t_t (1 - alpha H\_6\_a) mc\_6\_a\_t_t}{H\_6\_a\_t_t} \quad (168)$$

$$\begin{aligned} PH\_6\_a\_t_t = & \left( Psi\_6\_1\_a P\_1\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_2\_a P\_2\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_3\_a P\_3\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_4\_a P\_4\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_5\_a P\_5\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} \right. \\ & + Psi\_6\_6\_a P\_6\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_7\_a P\_7\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_8\_a P\_8\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} + Psi\_6\_9\_a P\_9\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} \\ & \left. + Psi\_6\_10\_a P\_10\_a\_t_t^{\frac{(-sigh\_6\_a)}{1-sigh\_6\_a}} \right)^{\frac{(-(1-sigh\_6\_a))}{sigh\_6\_a}} \end{aligned} \quad (169)$$

$$H\_6\_1\_a\_t_t = H\_6\_a\_t_t Psi\_6\_1\_a \left( \frac{PH\_6\_a\_t_t}{P\_1\_a\_t_t} \right)^{\frac{1}{1-sigh\_6\_a}} \quad (170)$$

$$H\_6\_2\_a\_t_t = H\_6\_a\_t_t Psi\_6\_2\_a \left( \frac{PH\_6\_a\_t_t}{P\_2\_a\_t_t} \right)^{\frac{1}{1-sigh\_6\_a}} \quad (171)$$

$$H\_6\_3\_a\_t_t = H\_6\_a\_t_t Psi\_6\_3\_a \left( \frac{PH\_6\_a\_t_t}{P\_3\_a\_t_t} \right)^{\frac{1}{1-sigh\_6\_a}} \quad (172)$$

$$H\_6\_4\_a\_t_t = H\_6\_a\_t_t Psi\_6\_4\_a \left( \frac{PH\_6\_a\_t_t}{P\_4\_a\_t_t} \right)^{\frac{1}{1-sigh\_6\_a}} \quad (173)$$

$$H\_6\_5\_a\_t_t = H\_6\_a\_t_t Psi\_6\_5\_a \left( \frac{PH\_6\_a\_t_t}{P\_5\_a\_t_t} \right)^{\frac{1}{1-sigh\_6\_a}} \quad (174)$$

$$H\_6\_6\_a\_t_t = H\_6\_a\_t_t Psi\_6\_6\_a \left( \frac{PH\_6\_a\_t_t}{P\_6\_a\_t_t} \right)^{\frac{1}{1-sigh\_6\_a}} \quad (175)$$

$$H\_6\_7\_a.t_t = H\_6\_a.t_t \textit{Psi}\_6\_7\_a \left( \frac{PH\_6\_a.t_t}{P\_7\_a.t_t} \right)^{\frac{1}{1-\textit{sig}\_h\_6\_a}} \quad (176)$$

$$H\_6\_8\_a.t_t = H\_6\_a.t_t \textit{Psi}\_6\_8\_a \left( \frac{PH\_6\_a.t_t}{P\_8\_a.t_t} \right)^{\frac{1}{1-\textit{sig}\_h\_6\_a}} \quad (177)$$

$$H\_6\_9\_a.t_t = H\_6\_a.t_t \textit{Psi}\_6\_9\_a \left( \frac{PH\_6\_a.t_t}{P\_9\_a.t_t} \right)^{\frac{1}{1-\textit{sig}\_h\_6\_a}} \quad (178)$$

$$H\_6\_10\_a.t_t = H\_6\_a.t_t \textit{Psi}\_6\_10\_a \left( \frac{PH\_6\_a.t_t}{P\_10\_a.t_t} \right)^{\frac{1}{1-\textit{sig}\_h\_6\_a}} \quad (179)$$

$$\log \left( \frac{\textit{epsi}\_6\_a.t_t}{\textit{epsi}\_6\_a.ts} \right) = \textit{rho\_eps\_a} \log \left( \frac{\textit{epsi}\_6\_a.t_{t-1}}{\textit{epsi}\_6\_a.ts} \right) + \textit{shock\_epsi}\_6\_a.t_t \quad (180)$$

$$C\_7\_a.t_t = C\_a.t_t \textit{Psi}\_con\_7\_a \left( \frac{1}{P\_7\_a.t_t} \right)^{\frac{1}{1-\textit{sig}\_c\_a}} \quad (181)$$

$$I\_7\_a.t_t = I\_a.t_t \textit{Psi}\_inv\_7\_a \left( \frac{PI\_a.t_t}{P\_7\_a.t_t} \right)^{\frac{1}{1-\textit{sig}\_i\_a}} \quad (182)$$

$$N\_7\_a.t_t = N\_a.t_t \textit{omega}\_N\_7\_a \left( \frac{w\_a.t_t}{w\_7\_a.t_t} \right)^{\frac{1}{1-\textit{upsi}\_N\_a}} \quad (183)$$

$$K\_7\_a.t_t = K\_a.t_t \textit{omega}\_K\_7\_a \left( \frac{rk\_a.t_{t+1}}{rk\_7\_a.t_{t+1}} \right)^{\frac{1}{1-\textit{upsi}\_K\_a}} \quad (184)$$

$$\begin{aligned} Y\_7\_a.t_t P\_7\_a.t_t = & P\_7\_a.t_t C\_7\_a.t_t + P\_7\_a.t_t I\_7\_a.t_t + P\_7\_a.t_t H\_1\_7\_a.t_t + P\_7\_a.t_t H\_2\_7\_a.t_t + P\_7\_a.t_t H\_3\_7\_a.t_t + P\_7\_a.t_t H\_4\_7\_a.t_t \\ & + P\_7\_a.t_t H\_5\_7\_a.t_t + P\_7\_a.t_t H\_6\_7\_a.t_t + P\_7\_a.t_t H\_7\_7\_a.t_t + P\_7\_a.t_t H\_8\_7\_a.t_t + P\_7\_a.t_t H\_9\_7\_a.t_t + P\_7\_a.t_t H\_10\_7\_a.t_t \end{aligned} \quad (185)$$

$$Y\_7\_a.t_t = \textit{epsi}\_a.t_t \textit{epsi}\_7\_a.t_t (1 - \textit{Pen}\_7\_a.t_t) \left( N\_7\_a.t_t^{\textit{alpha}\_N\_7\_a} K\_7\_a.t_{t-1}^{1-\textit{alpha}\_N\_7\_a} \right)^{\textit{alpha}\_H\_7\_a} H\_7\_a.t_t^{1-\textit{alpha}\_H\_7\_a} \quad (186)$$

$$\textit{EM\_cost}\_7\_a.t_t = P\_EM\_a.t_t (1 + \textit{shock\_epsi\_carb\_int}\_a.t_t) \textit{carb\_int}\_7\_a \quad (187)$$

$$\textit{mc\_tild}\_7\_a.t_t = \textit{EM\_cost}\_7\_a.t_t + \textit{mc}\_7\_a.t_t \quad (188)$$

$$P\_7\_a.t_t = \textit{mc\_tild}\_7\_a.t_t \quad (189)$$

$$w_{7.a.t_t} = \frac{Y_{7.a.t_t} mc_{7.a.t_t} \alpha N_{7.a} \alpha H_{7.a}}{N_{7.a.t_t}} \quad (190)$$

$$rk_{7.a.t_t} = \frac{Y_{7.a.t_t} mc_{7.a.t_t} (1 - \alpha N_{7.a}) \alpha H_{7.a}}{K_{7.a.t_t-1}} \quad (191)$$

$$PH_{7.a.t_t} = \frac{Y_{7.a.t_t} (1 - \alpha H_{7.a}) mc_{7.a.t_t}}{H_{7.a.t_t}} \quad (192)$$

$$\begin{aligned} PH_{7.a.t_t} = & \left( Psi_{7.1.a} P_{1.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.2.a} P_{2.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.3.a} P_{3.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.4.a} P_{4.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.5.a} P_{5.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} \right. \\ & + Psi_{7.6.a} P_{6.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.7.a} P_{7.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.8.a} P_{8.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} + Psi_{7.9.a} P_{9.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} \\ & \left. + Psi_{7.10.a} P_{10.a.t_t}^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} \right)^{\frac{(-\text{sign}_{7.a})}{1-\text{sign}_{7.a}}} \quad (193) \end{aligned}$$

$$H_{7.1.a.t_t} = H_{7.a.t_t} Psi_{7.1.a} \left( \frac{PH_{7.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (194)$$

$$H_{7.2.a.t_t} = H_{7.a.t_t} Psi_{7.2.a} \left( \frac{PH_{7.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (195)$$

$$H_{7.3.a.t_t} = H_{7.a.t_t} Psi_{7.3.a} \left( \frac{PH_{7.a.t_t}}{P_{3.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (196)$$

$$H_{7.4.a.t_t} = H_{7.a.t_t} Psi_{7.4.a} \left( \frac{PH_{7.a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (197)$$

$$H_{7.5.a.t_t} = H_{7.a.t_t} Psi_{7.5.a} \left( \frac{PH_{7.a.t_t}}{P_{5.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (198)$$

$$H_{7.6.a.t_t} = H_{7.a.t_t} Psi_{7.6.a} \left( \frac{PH_{7.a.t_t}}{P_{6.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (199)$$

$$H_{7.7.a.t_t} = H_{7.a.t_t} Psi_{7.7.a} \left( \frac{PH_{7.a.t_t}}{P_{7.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (200)$$

$$H_{7.8.a.t_t} = H_{7.a.t_t} Psi_{7.8.a} \left( \frac{PH_{7.a.t_t}}{P_{8.a.t_t}} \right)^{\frac{1}{1-\text{sign}_{7.a}}} \quad (201)$$

$$H\_7\_9\_a\_t_t = H\_7\_a\_t_t \textit{Psi}\_7\_9\_a \left( \frac{PH\_7\_a\_t_t}{P\_9\_a\_t_t} \right)^{\frac{1}{1-\textit{sig}h\_7\_a}} \quad (202)$$

$$H\_7\_10\_a\_t_t = H\_7\_a\_t_t \textit{Psi}\_7\_10\_a \left( \frac{PH\_7\_a\_t_t}{P\_10\_a\_t_t} \right)^{\frac{1}{1-\textit{sig}h\_7\_a}} \quad (203)$$

$$\log \left( \frac{\textit{epsi}\_7\_a\_t_t}{\textit{epsi}\_7\_a\_t_s} \right) = \textit{rho\_eps\_a} \log \left( \frac{\textit{epsi}\_7\_a\_t_{t-1}}{\textit{epsi}\_7\_a\_t_s} \right) + \textit{shock\_epsi}\_7\_a\_t_t \quad (204)$$

$$C\_8\_a\_t_t = C\_a\_t_t \textit{Psi}\_con\_8\_a \left( \frac{1}{P\_8\_a\_t_t} \right)^{\frac{1}{1-\textit{sig}c\_a}} \quad (205)$$

$$I\_8\_a\_t_t = I\_a\_t_t \textit{Psi}\_inv\_8\_a \left( \frac{PI\_a\_t_t}{P\_8\_a\_t_t} \right)^{\frac{1}{1-\textit{sig}i\_a}} \quad (206)$$

$$N\_8\_a\_t_t = N\_a\_t_t \textit{omega}\_N\_8\_a \left( \frac{w\_a\_t_t}{w\_8\_a\_t_t} \right)^{\frac{1}{1-\textit{upsi}\_N\_a}} \quad (207)$$

$$K\_8\_a\_t_t = K\_a\_t_t \textit{omega}\_K\_8\_a \left( \frac{rk\_a\_t_{t+1}}{rk\_8\_a\_t_{t+1}} \right)^{\frac{1}{1-\textit{upsi}\_K\_a}} \quad (208)$$

$$\begin{aligned} Y\_8\_a\_t_t P\_8\_a\_t_t = & P\_8\_a\_t_t C\_8\_a\_t_t + P\_8\_a\_t_t I\_8\_a\_t_t + P\_8\_a\_t_t H\_1\_8\_a\_t_t + P\_8\_a\_t_t H\_2\_8\_a\_t_t + P\_8\_a\_t_t H\_3\_8\_a\_t_t + P\_8\_a\_t_t H\_4\_8\_a\_t_t \\ & + P\_8\_a\_t_t H\_5\_8\_a\_t_t + P\_8\_a\_t_t H\_6\_8\_a\_t_t + P\_8\_a\_t_t H\_7\_8\_a\_t_t + P\_8\_a\_t_t H\_8\_8\_a\_t_t + P\_8\_a\_t_t H\_9\_8\_a\_t_t + P\_8\_a\_t_t H\_10\_8\_a\_t_t \end{aligned} \quad (209)$$

$$Y\_8\_a\_t_t = \textit{epsi}\_a\_t_t \textit{epsi}\_8\_a\_t_t (1 - \textit{Pen}\_8\_a\_t_t) \left( N\_8\_a\_t_t^{\textit{alpha}N\_8\_a} K\_8\_a\_t_{t-1}^{1-\textit{alpha}N\_8\_a} \right)^{\textit{alpha}H\_8\_a} H\_8\_a\_t_t^{1-\textit{alpha}H\_8\_a} \quad (210)$$

$$\textit{EM\_cost}\_8\_a\_t_t = P\_EM\_a\_t_t (1 + \textit{shock\_epsi\_carb\_int}\_a\_t_t) \textit{carb\_int}\_8\_a \quad (211)$$

$$\textit{mc\_tild}\_8\_a\_t_t = \textit{EM\_cost}\_8\_a\_t_t + \textit{mc}\_8\_a\_t_t \quad (212)$$

$$P\_8\_a\_t_t = \textit{mc\_tild}\_8\_a\_t_t \quad (213)$$

$$w\_8\_a\_t_t = \frac{Y\_8\_a\_t_t \textit{mc}\_8\_a\_t_t \textit{alpha}N\_8\_a \textit{alpha}H\_8\_a}{N\_8\_a\_t_t} \quad (214)$$

$$rk\_8\_a\_t_t = \frac{Y\_8\_a\_t_t \textit{mc}\_8\_a\_t_t (1 - \textit{alpha}N\_8\_a) \textit{alpha}H\_8\_a}{K\_8\_a\_t_{t-1}} \quad (215)$$

$$PH\_8\_a\_t_t = \frac{Y\_8\_a\_t_t (1 - \textit{alpha}H\_8\_a) \textit{mc}\_8\_a\_t_t}{H\_8\_a\_t_t} \quad (216)$$



$$\begin{aligned}
PH_{8.a.t_t} = & \left( Psi_{8.1.a} P_{1.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.2.a} P_{2.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.3.a} P_{3.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.4.a} P_{4.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.5.a} P_{5.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} \right. \\
& + Psi_{8.6.a} P_{6.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.7.a} P_{7.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.8.a} P_{8.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} + Psi_{8.9.a} P_{9.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} \\
& \left. + Psi_{8.10.a} P_{10.a.t_t}^{\frac{(-sigh_{8.a})}{1-sigh_{8.a}}} \right)^{\frac{(-(1-sigh_{8.a}))}{sigh_{8.a}}}
\end{aligned} \tag{217}$$

$$H_{8.1.a.t_t} = H_{8.a.t_t} Psi_{8.1.a} \left( \frac{PH_{8.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{218}$$

$$H_{8.2.a.t_t} = H_{8.a.t_t} Psi_{8.2.a} \left( \frac{PH_{8.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{219}$$

$$H_{8.3.a.t_t} = H_{8.a.t_t} Psi_{8.3.a} \left( \frac{PH_{8.a.t_t}}{P_{3.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{220}$$

$$H_{8.4.a.t_t} = H_{8.a.t_t} Psi_{8.4.a} \left( \frac{PH_{8.a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{221}$$

$$H_{8.5.a.t_t} = H_{8.a.t_t} Psi_{8.5.a} \left( \frac{PH_{8.a.t_t}}{P_{5.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{222}$$

$$H_{8.6.a.t_t} = H_{8.a.t_t} Psi_{8.6.a} \left( \frac{PH_{8.a.t_t}}{P_{6.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{223}$$

$$H_{8.7.a.t_t} = H_{8.a.t_t} Psi_{8.7.a} \left( \frac{PH_{8.a.t_t}}{P_{7.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{224}$$

$$H_{8.8.a.t_t} = H_{8.a.t_t} Psi_{8.8.a} \left( \frac{PH_{8.a.t_t}}{P_{8.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{225}$$

$$H_{8.9.a.t_t} = H_{8.a.t_t} Psi_{8.9.a} \left( \frac{PH_{8.a.t_t}}{P_{9.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{226}$$

$$H_{8.10.a.t_t} = H_{8.a.t_t} Psi_{8.10.a} \left( \frac{PH_{8.a.t_t}}{P_{10.a.t_t}} \right)^{\frac{1}{1-sigh_{8.a}}} \tag{227}$$

$$\log \left( \frac{epsi\_8\_a\_t_t}{epsi\_8\_a\_ts} \right) = rho\_eps\_a \log \left( \frac{epsi\_8\_a\_t_{t-1}}{epsi\_8\_a\_ts} \right) + shock\_epsi\_8\_a\_t_t \quad (228)$$

$$C\_9\_a\_t_t = C\_a\_t_t Psi\_con\_9\_a \left( \frac{1}{P\_9\_a\_t_t} \right)^{\frac{1}{1-sigc\_a}} \quad (229)$$

$$I\_9\_a\_t_t = I\_a\_t_t Psi\_inv\_9\_a \left( \frac{PI\_a\_t_t}{P\_9\_a\_t_t} \right)^{\frac{1}{1-sigi\_a}} \quad (230)$$

$$N\_9\_a\_t_t = N\_a\_t_t omega\_N\_9\_a \left( \frac{w\_a\_t_t}{w\_9\_a\_t_t} \right)^{\frac{1}{1-upsi\_N\_a}} \quad (231)$$

$$K\_9\_a\_t_t = K\_a\_t_t omega\_K\_9\_a \left( \frac{rk\_a\_t_{t+1}}{rk\_9\_a\_t_{t+1}} \right)^{\frac{1}{1-upsi\_K\_a}} \quad (232)$$

$$Y\_9\_a\_t_t P\_9\_a\_t_t = P\_9\_a\_t_t C\_9\_a\_t_t + P\_9\_a\_t_t I\_9\_a\_t_t + P\_9\_a\_t_t H\_1\_9\_a\_t_t + P\_9\_a\_t_t H\_2\_9\_a\_t_t + P\_9\_a\_t_t H\_3\_9\_a\_t_t + P\_9\_a\_t_t H\_4\_9\_a\_t_t \\ + P\_9\_a\_t_t H\_5\_9\_a\_t_t + P\_9\_a\_t_t H\_6\_9\_a\_t_t + P\_9\_a\_t_t H\_7\_9\_a\_t_t + P\_9\_a\_t_t H\_8\_9\_a\_t_t + P\_9\_a\_t_t H\_9\_9\_a\_t_t + P\_9\_a\_t_t H\_10\_9\_a\_t_t \quad (233)$$

$$Y\_9\_a\_t_t = epsi\_a\_t_t epsi\_9\_a\_t_t (1 - Pen\_9\_a\_t_t) \left( N\_9\_a\_t_t^{\alpha N\_9\_a} K\_9\_a\_t_{t-1}^{1-\alpha N\_9\_a} \right)^{\alpha H\_9\_a} H\_9\_a\_t_t^{1-\alpha H\_9\_a} \quad (234)$$

$$EM\_cost\_9\_a\_t_t = P\_EM\_a\_t_t (1 + shock\_epsi\_carb\_int\_a\_t_t) carb\_int\_9\_a \quad (235)$$

$$mc\_tild\_9\_a\_t_t = EM\_cost\_9\_a\_t_t + mc\_9\_a\_t_t \quad (236)$$

$$P\_9\_a\_t_t = mc\_tild\_9\_a\_t_t \quad (237)$$

$$w\_9\_a\_t_t = \frac{Y\_9\_a\_t_t mc\_9\_a\_t_t \alpha N\_9\_a \alpha H\_9\_a}{N\_9\_a\_t_t} \quad (238)$$

$$rk\_9\_a\_t_t = \frac{Y\_9\_a\_t_t mc\_9\_a\_t_t (1 - \alpha N\_9\_a) \alpha H\_9\_a}{K\_9\_a\_t_{t-1}} \quad (239)$$

$$PH\_9\_a\_t_t = \frac{Y\_9\_a\_t_t (1 - \alpha H\_9\_a) mc\_9\_a\_t_t}{H\_9\_a\_t_t} \quad (240)$$

$$PH\_9\_a\_t_t = \left( Psi\_9\_1\_a P\_1\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_2\_a P\_2\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_3\_a P\_3\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_4\_a P\_4\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_5\_a P\_5\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} \right. \\ \left. + Psi\_9\_6\_a P\_6\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_7\_a P\_7\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_8\_a P\_8\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} + Psi\_9\_9\_a P\_9\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} \right. \\ \left. + Psi\_9\_10\_a P\_10\_a\_t_t^{\frac{(-sig\_h\_9\_a)}{1-sig\_h\_9\_a}} \right)^{\frac{(-(1-sig\_h\_9\_a))}{sig\_h\_9\_a}} \quad (241)$$

$$H\_9\_1\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_1\_a \left( \frac{PH\_9\_a.t_t}{P\_1\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (242)$$

$$H\_9\_2\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_2\_a \left( \frac{PH\_9\_a.t_t}{P\_2\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (243)$$

$$H\_9\_3\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_3\_a \left( \frac{PH\_9\_a.t_t}{P\_3\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (244)$$

$$H\_9\_4\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_4\_a \left( \frac{PH\_9\_a.t_t}{P\_4\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (245)$$

$$H\_9\_5\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_5\_a \left( \frac{PH\_9\_a.t_t}{P\_5\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (246)$$

$$H\_9\_6\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_6\_a \left( \frac{PH\_9\_a.t_t}{P\_6\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (247)$$

$$H\_9\_7\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_7\_a \left( \frac{PH\_9\_a.t_t}{P\_7\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (248)$$

$$H\_9\_8\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_8\_a \left( \frac{PH\_9\_a.t_t}{P\_8\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (249)$$

$$H\_9\_9\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_9\_a \left( \frac{PH\_9\_a.t_t}{P\_9\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (250)$$

$$H\_9\_10\_a.t_t = H\_9\_a.t_t \textit{Psi}\_9\_10\_a \left( \frac{PH\_9\_a.t_t}{P\_10\_a.t_t} \right)^{\frac{1}{1-sigh\_9\_a}} \quad (251)$$

$$\log \left( \frac{epsi\_9\_a.t_t}{epsi\_9\_a.ts} \right) = rho\_eps\_a \log \left( \frac{epsi\_9\_a.t_{t-1}}{epsi\_9\_a.ts} \right) + shock\_epsi\_9\_a.t_t \quad (252)$$

$$C\_10\_a.t_t = C\_a.t_t \textit{Psi}\_con\_10\_a \left( \frac{1}{P\_10\_a.t_t} \right)^{\frac{1}{1-sigc\_a}} \quad (253)$$

$$I\_10\_a.t_t = I\_a.t_t \textit{Psi}\_inv\_10\_a \left( \frac{PI\_a.t_t}{P\_10\_a.t_t} \right)^{\frac{1}{1-sigt\_a}} \quad (254)$$

$$N_{10.a.t_t} = N_{.a.t_t} \omega_{N_{10.a}} \left( \frac{w_{.a.t_t}}{w_{10.a.t_t}} \right)^{\frac{1}{1-\psi_{N.a}}} \quad (255)$$

$$K_{10.a.t_t} = K_{.a.t_t} \omega_{K_{10.a}} \left( \frac{rk_{.a.t_t+1}}{rk_{10.a.t_t+1}} \right)^{\frac{1}{1-\psi_{K.a}}} \quad (256)$$

$$Y_{10.a.t_t} P_{10.a.t_t} = P_{10.a.t_t} C_{10.a.t_t} + P_{10.a.t_t} I_{10.a.t_t} + P_{10.a.t_t} H_{1.10.a.t_t} + P_{10.a.t_t} H_{2.10.a.t_t} + P_{10.a.t_t} H_{3.10.a.t_t} + P_{10.a.t_t} H_{4.10.a.t_t} \\ + P_{10.a.t_t} H_{5.10.a.t_t} + P_{10.a.t_t} H_{6.10.a.t_t} + P_{10.a.t_t} H_{7.10.a.t_t} + P_{10.a.t_t} H_{8.10.a.t_t} + P_{10.a.t_t} H_{9.10.a.t_t} + P_{10.a.t_t} H_{10.10.a.t_t} \quad (257)$$

$$Y_{10.a.t_t} = \psi_{.a.t_t} \psi_{10.a.t_t} (1 - \text{Pen}_{10.a.t_t}) \left( N_{10.a.t_t}^{\alpha_{N_{10.a}}} K_{10.a.t_t-1}^{1-\alpha_{N_{10.a}}} \right)^{\alpha_{H_{10.a}}} H_{10.a.t_t}^{1-\alpha_{H_{10.a}}} \quad (258)$$

$$EM_{cost_{10.a.t_t}} = P_{EM_{.a.t_t}} (1 + \text{shock}_{\psi_{carb.int_{.a.t_t}}}) \text{carb.int}_{10.a} \quad (259)$$

$$mc_{tild_{10.a.t_t}} = EM_{cost_{10.a.t_t}} + mc_{10.a.t_t} \quad (260)$$

$$P_{10.a.t_t} = mc_{tild_{10.a.t_t}} \quad (261)$$

$$w_{10.a.t_t} = \frac{Y_{10.a.t_t} mc_{10.a.t_t} \alpha_{N_{10.a}} \alpha_{H_{10.a}}}{N_{10.a.t_t}} \quad (262)$$

$$rk_{10.a.t_t} = \frac{Y_{10.a.t_t} mc_{10.a.t_t} (1 - \alpha_{N_{10.a}}) \alpha_{H_{10.a}}}{K_{10.a.t_t-1}} \quad (263)$$

$$PH_{10.a.t_t} = \frac{Y_{10.a.t_t} (1 - \alpha_{H_{10.a}}) mc_{10.a.t_t}}{H_{10.a.t_t}} \quad (264)$$

$$PH_{10.a.t_t} = \left( \psi_{10.1.a} \psi_{1.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.2.a} \psi_{2.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.3.a} \psi_{3.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.4.a} \psi_{4.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.5.a} \psi_{5.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} \right. \\ \left. + \psi_{10.6.a} \psi_{6.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.7.a} \psi_{7.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.8.a} \psi_{8.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} + \psi_{10.9.a} \psi_{9.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} \right. \\ \left. + \psi_{10.10.a} \psi_{10.a.t_t}^{\frac{(-\text{sig}h_{10.a})}{1-\text{sig}h_{10.a}}} \right)^{\frac{-(1-\text{sig}h_{10.a})}{\text{sig}h_{10.a}}} \quad (265)$$

$$H_{10.1.a.t_t} = H_{10.a.t_t} \psi_{10.1.a} \left( \frac{PH_{10.a.t_t}}{P_{1.a.t_t}} \right)^{\frac{1}{1-\text{sig}h_{10.a}}} \quad (266)$$

$$H_{10.2.a.t_t} = H_{10.a.t_t} \psi_{10.2.a} \left( \frac{PH_{10.a.t_t}}{P_{2.a.t_t}} \right)^{\frac{1}{1-\text{sig}h_{10.a}}} \quad (267)$$

$$H_{10.3.a.t_t} = H_{10.a.t_t} Psi_{10.3.a} \left( \frac{PH_{10.a.t_t}}{P_{3.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (268)$$

$$H_{10.4.a.t_t} = H_{10.a.t_t} Psi_{10.4.a} \left( \frac{PH_{10.a.t_t}}{P_{4.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (269)$$

$$H_{10.5.a.t_t} = H_{10.a.t_t} Psi_{10.5.a} \left( \frac{PH_{10.a.t_t}}{P_{5.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (270)$$

$$H_{10.6.a.t_t} = H_{10.a.t_t} Psi_{10.6.a} \left( \frac{PH_{10.a.t_t}}{P_{6.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (271)$$

$$H_{10.7.a.t_t} = H_{10.a.t_t} Psi_{10.7.a} \left( \frac{PH_{10.a.t_t}}{P_{7.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (272)$$

$$H_{10.8.a.t_t} = H_{10.a.t_t} Psi_{10.8.a} \left( \frac{PH_{10.a.t_t}}{P_{8.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (273)$$

$$H_{10.9.a.t_t} = H_{10.a.t_t} Psi_{10.9.a} \left( \frac{PH_{10.a.t_t}}{P_{9.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (274)$$

$$H_{10.10.a.t_t} = H_{10.a.t_t} Psi_{10.10.a} \left( \frac{PH_{10.a.t_t}}{P_{10.a.t_t}} \right)^{\frac{1}{1-sigh_{10.a}}} \quad (275)$$

$$\log \left( \frac{epsi_{10.a.t_t}}{epsi_{10.a.ts}} \right) = rho_{eps.a} \log \left( \frac{epsi_{10.a.t_{t-1}}}{epsi_{10.a.ts}} \right) + shock_{epsi_{10.a.t_t}} \quad (276)$$

$$\frac{pi_{ppi_{1.a.t_t}}}{pi_{ppi_{2.a.t_t}}} = \frac{P_{1.a.t_t}}{P_{2.a.t_t}} \frac{P_{2.a.t_{t-1}}}{P_{1.a.t_{t-1}}} \quad (277)$$

$$\frac{pi_{ppi_{1.a.t_t}}}{pi_{ppi_{3.a.t_t}}} = \frac{P_{1.a.t_t}}{P_{3.a.t_t}} \frac{P_{3.a.t_{t-1}}}{P_{1.a.t_{t-1}}} \quad (278)$$

$$\frac{pi_{ppi_{1.a.t_t}}}{pi_{ppi_{4.a.t_t}}} = \frac{P_{1.a.t_t}}{P_{4.a.t_t}} \frac{P_{4.a.t_{t-1}}}{P_{1.a.t_{t-1}}} \quad (279)$$

$$\frac{pi_{ppi_{1.a.t_t}}}{pi_{ppi_{5.a.t_t}}} = \frac{P_{1.a.t_t}}{P_{5.a.t_t}} \frac{P_{5.a.t_{t-1}}}{P_{1.a.t_{t-1}}} \quad (280)$$

$$\frac{\overline{pi\_ppi\_1\_a\_t_t}}{\overline{pi\_ppi\_6\_a\_t_t}} = \frac{\overline{P\_1\_a\_t_t}}{\overline{P\_6\_a\_t_t}} \frac{\overline{P\_6\_a\_t_{t-1}}}{\overline{P\_1\_a\_t_{t-1}}} \quad (281)$$

$$\frac{\overline{pi\_ppi\_1\_a\_t_t}}{\overline{pi\_ppi\_7\_a\_t_t}} = \frac{\overline{P\_1\_a\_t_t}}{\overline{P\_7\_a\_t_t}} \frac{\overline{P\_7\_a\_t_{t-1}}}{\overline{P\_1\_a\_t_{t-1}}} \quad (282)$$

$$\frac{\overline{pi\_ppi\_1\_a\_t_t}}{\overline{pi\_ppi\_8\_a\_t_t}} = \frac{\overline{P\_1\_a\_t_t}}{\overline{P\_8\_a\_t_t}} \frac{\overline{P\_8\_a\_t_{t-1}}}{\overline{P\_1\_a\_t_{t-1}}} \quad (283)$$

$$\frac{\overline{pi\_ppi\_1\_a\_t_t}}{\overline{pi\_ppi\_9\_a\_t_t}} = \frac{\overline{P\_1\_a\_t_t}}{\overline{P\_9\_a\_t_t}} \frac{\overline{P\_9\_a\_t_{t-1}}}{\overline{P\_1\_a\_t_{t-1}}} \quad (284)$$

$$\frac{\overline{pi\_ppi\_1\_a\_t_t}}{\overline{pi\_ppi\_10\_a\_t_t}} = \frac{\overline{P\_1\_a\_t_t}}{\overline{P\_10\_a\_t_t}} \frac{\overline{P\_10\_a\_t_{t-1}}}{\overline{P\_1\_a\_t_{t-1}}} \quad (285)$$

$$Y\_a\_t_t = Y\_10\_a\_t_t + Y\_9\_a\_t_t + Y\_8\_a\_t_t + Y\_7\_a\_t_t + Y\_6\_a\_t_t + Y\_5\_a\_t_t + Y\_4\_a\_t_t + Y\_3\_a\_t_t + Y\_1\_a\_t_t + Y\_2\_a\_t_t \quad (286)$$