11.16 (a).

$$Q^d = \alpha_1 + \alpha_2 P_i + \varepsilon_{di} \qquad Q^s = \beta_1 + \beta_2 P_i + \beta_3 W_i + \varepsilon_{si}$$

$$\Rightarrow Q^d = Q^s$$

$$\alpha_1 + \alpha_2 P_i + \varepsilon_{di} = \beta_1 + \beta_2 P_i + \beta_3 W_i + \varepsilon_{si}$$

$$(\alpha_2 - \beta_2) P_i = \beta_1 - \alpha_1 + \beta_3 W_i + \varepsilon_{si} - \varepsilon_{di}$$

$$P_i = \frac{\beta_1 - \alpha_1}{\alpha_2 - \beta_2} + \frac{\beta_3}{\alpha_2 - \beta_2} W_i + \left(\frac{\varepsilon_{si} - \varepsilon_{di}}{\alpha_2 - \beta_2} \right)$$

$$\downarrow \qquad \downarrow \qquad \downarrow$$

$$\pi_1 \qquad \pi_2 \qquad v_i$$

$$Q = \alpha_1 + \alpha_2 (\pi_1 + \pi_2 W_i + v_i) + \varepsilon_{di}$$

$$\theta_1 = \alpha_1 + \alpha_2 \pi_1 \;, \quad \theta_2 = \alpha_2 \pi_2 \;, \quad V_i = \alpha_2 v_i + \varepsilon_{di}$$

$$Q = \alpha_1 + \alpha_2 \pi_1 + \alpha_2 \pi_2 W_i + \alpha_2 v_i + \varepsilon_{di}$$

11.16 (b)

Q^d is identified

11.16 (c)

$$\begin{cases} p_i = \underbrace{\frac{\beta_1 - \alpha_1}{\alpha_2 - \beta_2}}_{\downarrow \pi_1} + \underbrace{\frac{\beta_3}{\alpha_2 - \beta_2}}_{\downarrow \pi_2} w_i + \underbrace{\left(\frac{e_{si} - e_{di}}{\alpha_2 - \beta_2}\right)}_{\downarrow v_i} \\ \hat{Q} = \alpha_1 + \alpha_2 \pi_1 + \alpha_2 \pi_2 w_i + \alpha_2 v_i + e_{di} \end{cases}$$

$\hat{\beta} = 2.4 + w.$

$\hat{\alpha} = 5 + 0.5 w.$

$$\frac{\beta_1 - \alpha_1}{\alpha_2 - \beta_2} = 2.4 \qquad \frac{\beta_3}{\alpha_2 - \beta_2} = 1$$

$$\alpha_1 + \alpha_2 \frac{\beta_1 - \alpha_1}{\alpha_2 - \beta_2} = 5 \qquad \alpha_2 \left(\frac{\beta_3}{\alpha_2 - \beta_2}\right) = 0.5$$

$\Rightarrow \beta_3 = \alpha_2 - \beta_2 \Rightarrow \alpha_2 = 0.5$

$$\frac{\beta_1 - a_1}{\beta_3} = 2.4 \quad , \quad a_1 + 0.5 \times 2.4 = 5, \quad a_1 = 3.8$$

11.16 (d).

$$\hat{P}_t = 2.4 + w_t$$

$$[\hat{P}_{T+1}] = [4.4,\ 5.4,\ 3.4,\ 3.4,\ 5.4]$$

$$\Rightarrow Q_t^d = a_1 + a_2 \hat{P}_t + e_{d_t}$$

$$\hat{a}_2 = 0.5 \qquad \hat{a}_1 = 3.8$$

$$Q_t = 3.8 + 0.5 \hat{P}_t + e_t$$