Decomposition.

$$\begin{bmatrix} y_{1,t} \\ y_{2,t} \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} y^w_{1,t} \\ y^w_{2,t} \end{bmatrix}$$

Within-model.

$$\begin{bmatrix} y^w_{1,t} \\ y^w_{2,t} \end{bmatrix} = \begin{bmatrix} \phi_{11(1)} & \phi_{21(1)} \\ \phi_{12(1)} & \phi_{22(1)} \end{bmatrix} \begin{bmatrix} y^w_{1,t-1} \\ y^w_{2,t-1} \end{bmatrix} + \begin{bmatrix} \zeta_{1,t} \\ \zeta_{2,t} \end{bmatrix},$$
$$\text{with } \zeta_{y,i} \sim MVN(\mathbf{0}, \mathbf{\Psi})$$

Between-model.

$$\begin{bmatrix} \mu_{1,i} \\ \mu_{2,i} \\ \phi_{11;(1),i} \\ \phi_{12;(1),i} \\ \phi_{21;(1),i} \\ \phi_{22;(1),i} \\ \log(\pi_{1,i}) \\ \log(\pi_{2,i}) \end{bmatrix} = \begin{bmatrix} \gamma_{0,\mu_1} \\ \gamma_{0,\mu_2} \\ \gamma_{0,\phi_{11;(1)}} \\ \gamma_{0,\phi_{12;(1)}} \\ \gamma_{0,\phi_{21;(1)}} \\ \gamma_{0,\phi_{22;(1)}} \\ \gamma_{0,\log(\pi_1)} \\ \gamma_{0,\log(\pi_2)} \end{bmatrix} + \begin{bmatrix} \upsilon_{\mu_1,i} \\ \upsilon_{\mu_2,i} \\ \upsilon_{\phi_{11;(1)},i} \\ \upsilon_{\phi_{12;(1)},i} \\ \upsilon_{\phi_{21;(1)},i} \\ \upsilon_{\phi_{22;(1)},i} \\ \upsilon_{\log(\pi_1),i} \\ \upsilon_{\log(\pi_2),i} \end{bmatrix},$$
$$\text{with } \upsilon_i \sim MVN(\mathbf{0}, \mathbf{\Omega})$$

$$\begin{bmatrix} y \\ y2 \end{bmatrix} = \begin{bmatrix} \gamma_{1,y} & \gamma_{2,y} & \gamma_{3,y} & \gamma_{4,y} & \gamma_{5,y} & \gamma_{6,y} & \gamma_{7,y} & \gamma_{8,y} \\ \gamma_{1,y2} & \gamma_{2,y2} & \gamma_{3,y2} & \gamma_{4,y2} & \gamma_{5,y2} & \gamma_{6,y2} & \gamma_{7,y2} & \gamma_{8,y2} \end{bmatrix} \begin{bmatrix} \mu_1 \\ \mu_2 \\ \phi_{11;(1)} \\ \phi_{12;(1)} \\ \phi_{21;(1)} \\ \phi_{22;(1)} \\ \log(\pi_1) \\ \log(\pi_2) \end{bmatrix} + \begin{bmatrix} \varepsilon_y \\ \varepsilon_{y2} \end{bmatrix}$$