Appendix A

A.1 Short-Run Elasticities

A.1.1 Output

Direct

$$\varepsilon_{YP} = -\frac{r}{4Y}\left[e_{11}\left(\frac{C_1}{P}\right)^{.5} + e_{12}\left(\frac{C_2}{P}\right)^{.5} + e_{13}\left(\frac{C_3}{P}\right)^{.5} + 2g_{12}\left(\frac{W_1}{P}\right)^{.5} + 2g_{13}\left(\frac{W_2}{P}\right)^{.5}\right]$$

$$\varepsilon_{YW_1} = \frac{r}{2Y}g_{12}\left(\frac{W_1}{P}\right)^{.5}$$

$$\varepsilon_{YW_2} = \frac{r}{2Y}g_{13}\left(\frac{W_2}{P}\right)^{.5}$$

$$\varepsilon_{YC_1} = \frac{r}{4Y}e_{11}\left(\frac{C_1}{P}\right)^{.5}$$

$$\varepsilon_{YC_2} = \frac{r}{4Y}e_{12}\left(\frac{C_2}{P}\right)^{.5}$$

$$\varepsilon_{YC_3} = \frac{r}{4Y}e_{13}\left(\frac{C_3}{P}\right)^{.5}$$

Indirect

$$\varepsilon_{YP} = -\frac{r}{4Y}\left[m_1e_{11}\left(\frac{P}{C_1}\right)^{.5} + m_2e_{12}\left(\frac{P}{C_2}\right)^{.5} + m_3e_{13}\left(\frac{P}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{YW_1} = -\frac{r}{4Y}\left[m_1 e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + m_2 e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + m_3 e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{YW_2} = -\frac{r}{4Y}\left[m_1 e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + m_2 e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + m_3 e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{YC_1} = \frac{r}{4Y}\left[m_1 e_{11}\left(\frac{P}{C_1}\right)^{.5} + m_1 e_{21}\left(\frac{W}{C}\right)^{.5} + m_1 e_{31}\left(\frac{W_2}{C_1}\right)^{.5}\right.$$

$$\left. +2f_{12}\left\{m_1\left(\frac{C_2}{C_1}\right)^{.5} - m_2\left(\frac{C}{C_2}\right)^{.5}\right\} + 2f_{13}\left\{m_1\left(\frac{C_3}{C_1}\right)^{.5} - m_3\left(\frac{C_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{YC_2} = \frac{r}{4Y}\left[m_2 e_{12}\left(\frac{P}{C_2}\right)^{.5} + m_2 e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + m_2 e_{32}\left(\frac{W_2}{C_2}\right)^{.5}\right.$$

$$\left. +2f_{12}\left\{-m_2\left(\frac{C_2}{C_1}\right)^{.5} + m_2\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{23}\left\{-m_3\left(\frac{C_2}{C_3}\right)^{.5} + m_2\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

$$\varepsilon_{YC_3} = \frac{r}{4Y}\left[m_3 e_{13}\left(\frac{P}{C_3}\right)^{.5} + m_3 e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + m_3 e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right.$$

$$\left. +2f_{13}\left\{-m_1\left(\frac{C_3}{C_1}\right)^{.5} + m_3\left(\frac{C_1}{C_3}\right)^{.5}\right\} + 2f_{23}\left\{-m_2\left(\frac{C_3}{C_2}\right)^{.5} + m_3\left(\frac{C_2}{C_3}\right)^{.5}\right\}\right]$$

where

$$m_1 = (a_{11}b_{11} + a_{12}b_{21} + a_{13}b_{31})$$

$$m_2 = (a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32})$$

$$m_3 = (a_{11}b_{13} + a_{12}b_{23} + a_{13}b_{33})$$

A.1.2 Fertiliser

Direct

$$\varepsilon_{X_1P} = -\frac{r}{2X_1} g_{12}\left(\frac{P}{W_1}\right)^{.5}$$

$$\varepsilon_{X_1W_1} = \frac{r}{4X_1}\left[e_{21}\left(\frac{C_1}{W_1}\right)^{.5} + e_{22}\left(\frac{C_2}{W_1}\right)^{.5} + e_{23}\left(\frac{C_3}{W_1}\right)^{.5} + 2g_{12}\left(\frac{P}{W_1}\right)^{.5} + 2g_{23}\left(\frac{W_2}{W_1}\right)^{.5}\right]$$

$$\varepsilon_{X_1W_2} = -\frac{r}{2X_1} g_{23}\left(\frac{W_2}{W_1}\right)^{.5}$$

$$\varepsilon_{X_1C_1} = -\frac{r}{4X_1} e_{21}\left(\frac{C_1}{W_1}\right)^{.5}$$

$$\varepsilon_{X_1C_2} = -\frac{r}{4X_1} e_{22}\left(\frac{C_2}{W_1}\right)^{.5}$$

$$\varepsilon_{X_1C_3} = -\frac{r}{4X_1} e_{23}\left(\frac{C_3}{W_1}\right)^{.5}$$

Indirect

$$\varepsilon_{X_1P} = \frac{r}{4X_1}\left[n_1e_{11}\left(\frac{P}{C_1}\right)^{.5} + n_2e_{12}\left(\frac{P}{C_2}\right)^{.5} + n_3e_{13}\left(\frac{P}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{X_1W_1} = \frac{r}{4X_1}\left[n_1e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + n_2e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + n_3e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{X_1W_2} = \frac{r}{4X_1}\left[n_1e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + n_2e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + n_3e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{X_1C_1} = -\frac{r}{4X_1}\left[n_1e_{11}\left(\frac{P}{C_1}\right)^{.5} + n_1e_{21}\left(\frac{W_1}{C_1}\right)^{.5} - n_1e_{31}\left(\frac{W_2}{C_1}\right)^{.5}\right.$$

$$\left. +2f_{12}\left\{n_1\left(\frac{C_2}{C_1}\right)^{.5} - n_2\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{13}\left\{n_1\left(\frac{C_3}{C_1}\right)^{.5} - n_3\left(\frac{C_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{X_1C_2} = -\frac{r}{4X_1}\left[n_2e_{12}\left(\frac{P}{C_2}\right)^{.5} + n_2e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + n_2e_{32}\left(\frac{W_2}{C_2}\right)^{.5}\right.$$

$$\left. +2f_{12}\left\{-n_1\left(\frac{C_2}{C_1}\right)^{.5} + n_2\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{23}\left\{-n_3\left(\frac{C_2}{C_3}\right)^{.5} + n_2\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

$$\varepsilon_{X_1C_3} = -\frac{r}{4X_1}\left[n_3e_{13}\left(\frac{P}{C_3}\right)^{.5} + n_3e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + n_3e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right.$$

$$\left. +2f_{13}\left\{-n_1\left(\frac{C_3}{C_1}\right)^{.5} + n_3\left(\frac{C_1}{C_3}\right)^{.5}\right\} + 2f_{23}\left\{-n_2\left(\frac{C_3}{C_2}\right)^{.5} + n_3\left(\frac{C_2}{C_3}\right)^{.5}\right\}\right]$$

where

$$n_1 = (a_{21}b_{11} + a_{22}b_{21} + a_{23}b_{31})$$

$$n_2 = (a_{21}b_{12} + a_{22}b_{22} + a_{23}b_{32})$$

$$n_3 = (a_{21}b_{13} + a_{22}b_{23} + a_{23}b_{33})$$

A.1.3 Hired Labour

Direct

$$\varepsilon_{X_2P} = -\frac{r}{2X_2} g_{13}\left(\frac{P}{W_2}\right)^{.5}$$

$$\varepsilon_{X_2W_1} = -\frac{r}{2X_2} g_{23}\left(\frac{W_1}{W_2}\right)^{.5}$$

$$\varepsilon_{X_2W_2} = \frac{r}{4X_2}\left[e_{31}\left(\frac{C_1}{W_2}\right)^{.5} + e_{32}\left(\frac{C_2}{W_2}\right)^{.5} + e_{33}\left(\frac{C_3}{W_2}\right)^{.5} + 2g_{13}\left(\frac{P}{W_2}\right)^{.5} + 2g_{23}\left(\frac{W_1}{W_2}\right)^{.5}\right]$$

$$\varepsilon_{X_2C_1} = -\frac{r}{4X_2} e_{31}\left(\frac{C_1}{W_2}\right)^{.5}$$

$$\varepsilon_{X_2C_2} = -\frac{r}{4X_2} e_{32}\left(\frac{C_2}{W_2}\right)^{.5}$$

$$\varepsilon_{X_2C_3} = -\frac{r}{4X_2} e_{33}\left(\frac{C_3}{W_2}\right)^{.5}$$

Indirect

$$\varepsilon_{X_2P} = \frac{r}{4X_2}\left[o_1e_{11}\left(\frac{P}{C_1}\right)^{.5} + o_2e_{12}\left(\frac{P}{C_2}\right)^{.5} + o_3e_{13}\left(\frac{P}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{X_2W_1} = \frac{r}{4X_2}\left[o_1e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + o_2e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + o_3e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{X_2W_2} = \frac{r}{4X_2}\left[o_1e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + o_2e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + o_3e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{X_2C_1} = -\frac{r}{4X_2}\left[o_1e_{11}\left(\frac{P}{C_1}\right)^{.5} + o_1e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + o_1e_{31}\left(\frac{W_2}{C_1}\right)^{.5}\right.$$

$$\left. +2f_{12}\left\{o_1\left(\frac{C_2}{C_1}\right)^{.5} - o_2\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{13}\left\{o_1\left(\frac{C_3}{C_1}\right)^{.5} - o_3\left(\frac{C_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{X_2C_2} = -\frac{r}{4X_2}\left[o_2e_{12}\left(\frac{P}{C_2}\right)^{.5} + o_2e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + o_2e_{32}\left(\frac{W_2}{C_2}\right)^{.5}\right.$$

$$\left. +2f_{12}\left\{-o_1\left(\frac{C_2}{C_1}\right)^{.5} + o_2\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{23}\left\{-o_3\left(\frac{C_2}{C_3}\right)^{.5} + o_2\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

$$\varepsilon_{X_2C_3} = -\frac{r}{4X_2}\left[o_3e_{13}\left(\frac{P}{C_3}\right)^{.5} + o_3e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + o_3e_{33}\left(\frac{W_2}{C_2}\right)^{.5}\right.$$

$$\left. +2f_{13}\left\{-o_1\left(\frac{C_3}{C_1}\right)^{.5} + o_3\left(\frac{C_1}{C_3}\right)^{.5}\right\} + 2f_{23}\left\{-o_2\left(\frac{C_3}{C_2}\right)^{.5} + o_3\left(\frac{C_2}{C_3}\right)^{.5}\right\}\right]$$

where

$$o_1 = (a_{31}b_{11} + a_{32}b_{21} + a_{33}b_{31})$$

$$o_2 = (a_{31}b_{12} + a_{32}b_{22} + a_{33}b_{32})$$

$$o_3 = (a_{31}b_{13} + a_{32}b_{23} + a_{33}b_{33})$$

A.1.4 Capital

$$\varepsilon_{K_1P} = \frac{r}{4K_1}\left[b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_1W_1} = \frac{r}{4K_1}\left[b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_1W_2} = \frac{r}{4K_1}\left[b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_1C_1} = \frac{r}{4K_1}\left[-b_{11}\left\{e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5}\right\}\right.$$

$$\left. +2f_{12}\left\{-b_{11}\left(\frac{C_2}{C_1}\right)^{.5} + b_{12}\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{13}\left\{-b_{11}\left(\frac{C_3}{C_1}\right)^{.5} + b_{13}\left(\frac{C_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_1C_2} = \frac{r}{4K_1}\left[-b_{12}\left\{e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} - e_{32}\left(\frac{W_2}{C_2}\right)^{.5}\right\}\right.$$

$$\left. +2f_{12}\left\{b_{11}\left(\frac{C_2}{C_1}\right)^{.5} - b_{12}\left(\frac{C_1}{C_2}\right)^{5}\right\} + 2f_{23}\left\{b_{13}\left(\frac{C_2}{C_3}\right)^{.5} - b_{12}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_1C_3} = \frac{r}{4K_1}\left[-b_{13}\left\{e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$\left. +2f_{13}\left\{b_{11}\left(\frac{C_3}{C_1}\right)^{.5} - b_{13}\left(\frac{C_1}{C_3}\right)^{5}\right\} + 2f_{23}\left\{b_{12}\left(\frac{C_3}{C_2}\right)^{.5} - b_{13}\left(\frac{C_2}{C_3}\right)^{.5}\right\}\right]$$

A.1.5 Operator Labour

$$\varepsilon_{K_2P} = \frac{r}{4K_2}\left[b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_2W_1} = \frac{r}{4K_2}\left[b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_2W_2} = \frac{r}{4K_2}\left[b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_2C_1} = \frac{r}{4K_2}\left[-b_{21}\left\{e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5}\right\}\right.$$

$$\left. +2f_{12}\left\{-b_{21}\left(\frac{C_2}{C_1}\right)^{.5} + b_{22}\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{13}\left\{-b_{21}\left(\frac{C_3}{C_1}\right)^{.5} + b_{23}\left(\frac{C_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_2C_2} = \frac{r}{4K_2}\left[-b_{22}\left\{e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5}\right\}\right.$$

$$\left. +2f_{12}\left\{b_{21}\left(\frac{C_2}{C_1}\right)^{.5} - b_{22}\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{23}\left\{b_{23}\left(\frac{C_2}{C_3}\right)^{.5} - b_{22}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_2C_3} = \frac{r}{4K_2}\left[-b_{23}\left\{e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$\left. +2f_{13}\left\{b_{21}\left(\frac{C_3}{C_1}\right)^{.5} - b_{23}\left(\frac{C_1}{C_3}\right)^{.5}\right\} + 2f_{23}\left\{b_{22}\left(\frac{C_3}{C_2}\right)^{.5} - b_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right\}\right]$$

A.1.6 Unpaid Family Labour

$$\varepsilon_{K_3P} = \frac{r}{4K_3}\left[b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_3W_1} = \frac{r}{4K_3}\left[b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_3W_2} = \frac{r}{4K_3}\left[b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right]$$

$$\varepsilon_{K_3C_1} = \frac{r}{4K_3}\left[-b_{31}\left\{e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5}\right\}\right.$$

$$\left. +2f_{12}\left\{-b_{31}\left(\frac{C_2}{C_1}\right)^{.5} + b_{32}\left(\frac{C}{C_2}\right)^{.5}\right\} + 2f_{13}\left\{-b_{31}\left(\frac{C_3}{C_1}\right)^{.5} + b_{33}\left(\frac{C_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_3C_2} = \frac{r}{4K_3}\left[-b_{32}\left\{e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5}\right\}\right.$$

$$\left. +2f_{12}\left\{b_{31}\left(\frac{C_2}{C_1}\right)^{.5} - b_{32}\left(\frac{C_1}{C_2}\right)^{.5}\right\} + 2f_{23}\left\{b_{33}\left(\frac{C_2}{C_3}\right)^{.5} - b_{32}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_3C_3} = \frac{r}{4K_3}\left[-b_{33}\left\{e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$\left. +2f_{13}\left\{b_{31}\left(\frac{C_3}{C_1}\right)^{.5} - b_{33}\left(\frac{C_1}{C_3}\right)^{.5}\right\} + 2f_{23}\left\{b_{32}\left(\frac{C_3}{C_2}\right)^{.5} - b_{33}\left(\frac{C_2}{C_3}\right)^{.5}\right\}\right]$$

A.2 Long-Run Elasticities

A.2.1 Output

Direct

$$\varepsilon_{YP} = -\frac{r}{4Y}\left[e_{11}\left(\frac{C_1}{P}\right)^{.5} + e_{12}\left(\frac{C_2}{P}\right)^{.5} + e_{13}\left(\frac{C_3}{P}\right)^{.5} + 2g_{12}\left(\frac{W_1}{P}\right)^{.5} + 2g_{13}\left(\frac{W_2}{P}\right)^{.5}\right]$$

$$\varepsilon_{YW_1} = \frac{r}{2Y}g_{12}\left(\frac{W_1}{P}\right)^{.5}$$

$$\varepsilon_{YW_2} = \frac{r}{2Y}g_{13}\left(\frac{W_2}{P}\right)^{.5}$$

$$\varepsilon_{YC_1} = \frac{r}{4Y}e_{11}\left(\frac{C_1}{P}\right)^{.5}$$

$$\varepsilon_{YC_2} = \frac{r}{4Y}e_{12}\left(\frac{C_2}{P}\right)^{.5}$$

$$\varepsilon_{YC_3} = \frac{r}{4Y}e_{13}\left(\frac{C_3}{P}\right)^{.5}$$

Indirect

$$\varepsilon_{YP} = \frac{r}{4Y}\left[\mu_1\left\{b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right.$$

$$+\mu_2\left\{b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}$$

$$\left.+\mu_3\left\{b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{YW_1} = \frac{r}{4Y}\left[\mu_1\left\{b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right.$$

$$+\mu_2\left\{b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}$$

$$\left.+\mu_3\left\{b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{YW_2} = \frac{r}{4Y}\left[\mu_1\left\{b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$+\mu_2\left\{b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}$$

$$\left.+\mu_3\left\{b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{YC_1} = \frac{r}{4Y}\left[\mu_1\left\{-b_{11}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.\right.$$

$$\left.+2b_{12}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2b_{13}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\right\}$$

$$+\mu_2\left\{-b_{21}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.$$

$$\left.+2b_{22}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2b_{23}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\right\}$$

$$+\mu_3\left\{-b_{31}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.$$

$$+2b_{32}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{33}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{YC_2}=\frac{r}{4Y}\Bigg[\mu_1\Bigg\{-b_{12}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{11}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{13}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\mu_2\Bigg\{-b_{22}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}-2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{21}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{23}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\mu_3\Bigg\{-b_{32}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}-e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{31}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{33}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{YC_3}=\frac{r}{4Y}\Bigg[\mu_1\Bigg\{-b_{13}\Bigg(e_{13}\left(\frac{P}{C_3}\right)^{.5}+e_{23}\left(\frac{W_1}{C_3}\right)^{.5}+e_{33}\left(\frac{W_2}{C_3}\right)^{.5}+2f_{13}\left(\frac{C_1}{C_3}\right)^{.5}+2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg)$$

$$+2b_{11}f_{13}\left(\frac{C_3}{C_1}\right)^{.5}+2b_{12}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg\}$$

$$+\mu_2\Bigg\{-b_{23}\Bigg(e_{13}\left(\frac{P}{C_3}\right)^{.5}+e_{23}\left(\frac{W_1}{C_3}\right)^{.5}+e_{33}\left(\frac{W_2}{C_3}\right)^{.5}+2f_{13}\left(\frac{C_1}{C_3}\right)^{.5}+2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg)$$

$$+2b_{21}f_{13}\left(\frac{C_3}{C_1}\right)^{.5}+2b_{22}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg\}$$

$$+\mu_3\left\{-b_{33}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5}+e_{23}\left(\frac{W_1}{C_3}\right)^{.5}+e_{33}\left(\frac{W_2}{C_3}\right)^{.5}+2f_{13}\left(\frac{C_1}{C_3}\right)^{.5}+2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left.\left.+2b_{31}f_{13}\left(\frac{C_3}{C_1}\right)^{.5}+2b_{32}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

where

$$\mu_1 = r(a_{11}\theta_{11}+a_{12}\theta_{21}+a_{13}\theta_{31})$$

$$\mu_2 = r(a_{11}\theta_{12}+a_{12}\theta_{22}+a_{1}\ \theta_{32})$$

$$\mu_3 = r(a_{11}\theta_{13}+a_{12}\theta_{23}+a_{13}\theta_{33})$$

$$\theta_{11} = -\left(\frac{(b_{22}+r)(b_{33}+r)-b_{32}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{12} = \left(\frac{b_{12}(b_{33}+r)-b_{32}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{13} = -\left(\frac{b_{12}b_{23}-(b_{22}+r)b_{13}}{|B+rI_3|}\right)$$

$$\theta_{21} = \left(\frac{b_{21}(b_{33}+r)-b_{31}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{22} = -\left(\frac{(b_{11}+r)(b_{33}+r)-b_{31}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{23} = \left(\frac{(b_{11}+r)b_{23}-b_{21}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{31} = -\left(\frac{b_{21}b_{32}-b_{31}(b_{22}+r)}{|B+rI_3|}\right)$$

$$\theta_{32} = \left(\frac{(b_{11} + r)b_{32} - b_{31}b_{12}}{|B + rI_3|} \right)$$

$$\theta_{33} = -\left(\frac{(b_{11} + r)(b_{22} + r) - b_{21}b_{12}}{|B + rI_3|} \right)$$

$$|B + rI_3| = (b_{11} + r)(b_{22} + r)(b_{33} + r) + b_{12}b_{23}b_{31} + b_{13}b_{21}b_{32} - b_{31}b_{13}(b_{22} + r)$$

$$-b_{32}b_{23}(b_{11} + r) - (b_{33} + r)b_{21}b_{12}$$

A.2.2 Fertiliser

Direct

$$\varepsilon_{X_1P} = -\frac{r}{2X_1} g_{12} \left(\frac{P}{W_1} \right)^{.5}$$

$$\varepsilon_{X_1W_1} = \frac{r}{4X_1} \left[e_{21} \left(\frac{C_1}{W_1} \right)^{.5} + e_{22} \left(\frac{C_2}{W_1} \right)^{.5} + e_{23} \left(\frac{C_3}{W_1} \right)^{.5} + 2g_{12} \left(\frac{P}{W_1} \right)^{.5} + 2g_{23} \left(\frac{W_2}{W_1} \right)^{.5} \right]$$

$$\varepsilon_{X_1W_2} = -\frac{r}{2X_1} g_{23} \left(\frac{W_2}{W_1} \right)^{.5}$$

$$\varepsilon_{X_1C_1} = -\frac{r}{4X_1} e_{21} \left(\frac{C_1}{W_1} \right)^{.5}$$

$$\varepsilon_{X_1C_2} = -\frac{r}{4X_1} e_{22} \left(\frac{C_2}{W_1} \right)^{.5}$$

$$\varepsilon_{X_1C_3} = -\frac{r}{4X_1} e_{23} \left(\frac{C_3}{W_1} \right)^{.5}$$

Indirect

$$\varepsilon_{X_1P} = -\frac{r}{4X_1}\left[v_1\left\{ b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5} \right\}\right.$$

$$+v_2\left\{ b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5} \right\}$$

$$\left.+v_3\left\{ b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5} \right\}\right]$$

$$\varepsilon_{X_1W_1} = -\frac{r}{4X_1}\left[v_1\left\{ b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5} \right\}\right.$$

$$+v_2\left\{ b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5} \right\}$$

$$\left.+v_3\left\{ b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5} \right\}\right]$$

$$\varepsilon_{X_1W_2} = -\frac{r}{4X_1}\left[v_1\left\{ b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5} \right\}\right.$$

$$+v_2\left\{ b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5} \right\}$$

$$\left.+v_3\left\{ b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5} \right\}\right]$$

$$\varepsilon_{X_1C_1} = -\frac{r}{4X_1}\left[v_1\left\{ -b_{11}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5} \right)\right.\right.$$

$$+2b_{12}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{13}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\nu_2\Bigg\{-b_{21}\Bigg(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{W_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\Bigg)$$

$$+2b_{22}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{23}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\nu_3\Bigg\{-b_{31}\Bigg(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{W_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\Bigg)$$

$$+2b_{32}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{33}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{X_1C_2}=-\frac{r}{4X_1}\Bigg[\nu_1\Bigg\{-b_{12}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{11}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{13}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\nu_2\Bigg\{-b_{22}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{21}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{23}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\nu_3\Bigg\{-b_{32}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{31}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{33}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{X_1C_3} = -\frac{r}{4X_1}\left[\nu_1\left\{-b_{13}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.\right.$$

$$\left. +2b_{11}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} + 2b_{12}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\nu_2\left\{-b_{23}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left. +2b_{21}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} + 2b_{22}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\nu_3\left\{-b_{33}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left.\left. +2b_{31}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} + 2b_{32}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

where

$$\nu_1 = r\left(a_{21}\theta_{11} + a_{22}\theta_{21} + a_{23}\theta_{31}\right)$$

$$\nu_2 = r\left(a_{21}\theta_{12} + a_{22}\theta_{22} + a_{23}\theta_{32}\right)$$

$$\nu_3 = r\left(a_{21}\theta_{13} + a_{22}\theta_{23} + a_{23}\theta_{33}\right)$$

$$\theta_{11} = -\left(\frac{(b_{22}+r)(b_{33}+r) - b_{32}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{12} = \left(\frac{b_{12}(b_{33}+r) - b_{32}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{13} = -\left(\frac{b_{12}b_{23} - (b_{22}+r)b_{13}}{|B+rI_3|}\right)$$

$$\theta_{21} = \left(\frac{b_{21}(b_{33} + r) - b_{31}b_{23}}{|B + rI_3|} \right)$$

$$\theta_{22} = -\left(\frac{(b_{11} + r)(b_{33} + r) - b_{31}b_{13}}{|B + rI_3|} \right)$$

$$\theta_{23} = \left(\frac{(b_{11} + r)b_{23} - b_{21}b_{13}}{|B + rI_3|} \right)$$

$$\theta_{31} = -\left(\frac{b_{21}b_{32} - b_{31}(b_{22} + r)}{|B + rI_3|} \right)$$

$$\theta_{32} = \left(\frac{(b_{11} + r)b_{32} - b_{31}b_{12}}{|B + rI_3|} \right)$$

$$\theta_{33} = -\left(\frac{(b_{11} + r)(b_{22} + r) - b_{21}b_{12}}{|B + rI_3|} \right)$$

$$|B + rI_3| = (b_{11} + r)(b_{22} + r)(b_{33} + r) + b_{12}b_{23}b_{31} + b_{13}b_{21}b_{32} - b_{31}b_{13}(b_{22} + r)$$

$$-b_{32}b_{23}(b_{11} + r) - (b_{33} + r)b_{21}b_{12}$$

A.2.3 Hired Labour

Direct

$$\varepsilon_{X_2P} = -\frac{r}{2X_2} g_{13} \left(\frac{P}{W_2} \right)^{.5}$$

$$\varepsilon_{X_2W_1} = -\frac{r}{2X_2} g_{23} \left(\frac{W_1}{W_2} \right)^{.5}$$

$$\varepsilon_{X_2W_2} = \frac{r}{4X_2} \left[e_{31} \left(\frac{C_1}{W_2} \right)^{.5} + e_{32} \left(\frac{C_2}{W_2} \right)^{.5} + e_{33} \left(\frac{C_3}{W_2} \right)^{.5} + 2g_{13} \left(\frac{P}{W_2} \right)^{.5} + 2g_{23} \left(\frac{W_1}{W_2} \right)^{.5} \right]$$

$$\varepsilon_{X_2C_1} = -\frac{r}{4X_2} e_{31}\left(\frac{C_1}{W_2}\right)^{.5}$$

$$\varepsilon_{X_2C_2} = -\frac{r}{4X_2} e_{32}\left(\frac{C_2}{W_2}\right)^{.5}$$

$$\varepsilon_{X_2C_3} = -\frac{r}{4X_2} e_{33}\left(\frac{C_3}{W_2}\right)^{.5}$$

Indirect

$$\varepsilon_{X_2P} = -\frac{r}{4X_2}\left[\varpi_1\left\{b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right.$$

$$+\varpi_2\left\{b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}$$

$$\left.+\varpi_3\left\{b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{X_2W_1} = -\frac{r}{4X_2}\left[\varpi_1\left\{b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right.$$

$$+\varpi_2\left\{b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}$$

$$\left.+\varpi_3\left\{b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{X_2W_2} = -\frac{r}{4X_2}\left[\varpi_1\left\{b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$+\varpi_2\left\{b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}$$

$$+\varpi_3\left\{b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\Bigg]$$

$$\varepsilon_{X_2C_1}=-\frac{r}{4Y}\Bigg[\varpi_1\left\{-b_{11}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{W_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.$$

$$\left.+2b_{12}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{13}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\right\}$$

$$+\varpi_2\left\{-b_{21}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{W_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.$$

$$\left.+2b_{22}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{23}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\right\}$$

$$+\varpi_3\left\{-b_{31}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{W_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.$$

$$\left.+2b_{32}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2b_{33}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\right\}\Bigg]$$

$$\varepsilon_{X_2C_2}=-\frac{r}{4X_2}\Bigg[\varpi_1\left\{-b_{12}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)\right.$$

$$\left.+2b_{11}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{13}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right\}$$

$$+\varpi_2\left\{-b_{22}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)\right.$$

$$+2b_{21}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{23}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\varpi_3\Bigg\{-b_{32}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$+2b_{31}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2b_{33}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{X_2C_3}=-\frac{r}{4X_2}\Bigg[\varpi_1\Bigg\{-b_{13}\Bigg(e_{13}\left(\frac{P}{C_3}\right)^{.5}+e_{23}\left(\frac{W_1}{C_3}\right)^{.5}+e_{33}\left(\frac{W_2}{C_3}\right)^{.5}+2f_{13}\left(\frac{C_1}{C_3}\right)^{.5}+2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg)$$

$$+2b_{11}f_{13}\left(\frac{C_3}{C_1}\right)^{.5}+2b_{12}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg\}$$

$$+\varpi_2\Bigg\{-b_{23}\Bigg(e_{13}\left(\frac{P}{C_3}\right)^{.5}+e_{23}\left(\frac{W_1}{C_3}\right)^{.5}+e_{33}\left(\frac{W_2}{C_3}\right)^{.5}+2f_{13}\left(\frac{C_1}{C_3}\right)^{.5}+2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg)$$

$$+2b_{21}f_{13}\left(\frac{C_3}{C_1}\right)^{.5}+2b_{22}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg\}$$

$$+\varpi_3\Bigg\{-b_{33}\Bigg(e_{13}\left(\frac{P}{C_3}\right)^{.5}+e_{23}\left(\frac{W_1}{C_3}\right)^{.5}+e_{33}\left(\frac{W_2}{C_3}\right)^{.5}+2f_{13}\left(\frac{C_1}{C_3}\right)^{.5}+2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg)$$

$$+2b_{31}f_{13}\left(\frac{C_3}{C_1}\right)^{.5}+2b_{32}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg\}\Bigg]$$

where

$$\varpi_1=r(a_{31}\theta_{11}+a_{32}\theta_{21}+a_{33}\theta_{31})$$

$$\varpi_2=r(a_{31}\theta_{12}+a_{32}\theta_{22}+a_{33}\theta_{32})$$

$$\varpi_3=r(a_{31}\theta_{13}+a_{32}\theta_{23}+a_{33}\theta_{33})$$

$$\theta_{11} = -\left(\frac{(b_{22}+r)(b_{33}+r) - b_{32}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{12} = \left(\frac{b_{12}(b_{33}+r) - b_{32}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{13} = -\left(\frac{b_{12}b_{23} - (b_{22}+r)b_{13}}{|B+rI_3|}\right)$$

$$\theta_{21} = \left(\frac{b_{21}(b_{33}+r) - b_{31}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{22} = -\left(\frac{(b_{11}+r)(b_{33}+r) - b_{31}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{23} = \left(\frac{(b_{11}+r)b_{23} - b_{21}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{31} = -\left(\frac{b_{21}b_{32} - b_{31}(b_{22}+r)}{|B+rI_3|}\right)$$

$$\theta_{32} = \left(\frac{(b_{11}+r)b_{32} - b_{31}b_{12}}{|B+rI_3|}\right)$$

$$\theta_{33} = -\left(\frac{(b_{11}+r)(b_{22}+r) - b_{21}b_{12}}{|B+rI_3|}\right)$$

$$|B+rI_3| = (b_{11}+r)(b_{22}+r)(b_{33}+r) + b_{12}b_{23}b_{31} + b_{13}b_{21}b_{32} - b_{31}b_{13}(b_{22}+r)$$

$$-b_{32}b_{23}(b_{11}+r) - (b_{33}+r)b_{21}b_{12}$$

A.2.4 Capital

$$\varepsilon_{K_1P} = \frac{r}{4K_1}\left[\theta_{11}\left\{b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{12}\left\{b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} - b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{13}\left\{b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} - b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_1W_1} = \frac{r}{4K_1}\left[\theta_{11}\left\{b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{12}\left\{b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{13}\left\{b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_1W_2} = \frac{r}{4K_1}\left[\theta_{11}\left\{b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{12}\left\{b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{13}\left\{b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_1C_1} = -\frac{r}{4K_1}\left[\theta_{11}\left\{b_{11}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} - e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.\right.$$

$$-2b_{12}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} - 2b_{13}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{12}\Bigg\{b_{21}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{V_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)$$

$$-2b_{22}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} - 2b_{23}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{13}\Bigg\{b_{31}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{V_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)$$

$$-2b_{32}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} - 2b_{33}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{K_1C_2} = -\frac{r}{4K_1}\Bigg[\theta_{11}\Bigg\{b_{12}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + 2f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)$$

$$-2b_{11}f_{12}\left(\frac{C_2}{C_1}\right)^{.5} - 2b_{13}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{12}\Bigg\{b_{22}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{V_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + 2f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)$$

$$-2b_{21}f_{12}\left(\frac{C_2}{C_1}\right)^{.5} - 2b_{23}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{13}\Bigg\{b_{32}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{V_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + 2f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)$$

$$-2b_{31}f_{12}\left(\frac{C_2}{C_1}\right)^{.5} - 2b_{33}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{K_1C_3} = -\frac{r}{4K_1}\left[\theta_{11}\left\{b_{13}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} - e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.\right.$$

$$\left. -2b_{11}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{12}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\theta_{12}\left\{b_{23}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left. -2b_{21}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{22}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\theta_{13}\left\{b_{33}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left.\left. -2b_{31}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{32}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

where

$$\theta_{11} = -\left(\frac{(b_{22}+r)(b_{33}+r) - b_{32}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{12} = \left(\frac{b_{12}(b_{33}+r) - b_{32}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{13} = -\left(\frac{b_{12}b_{23} - (b_{22}+r)b_{13}}{|B+rI_3|}\right)$$

$$|B+rI_3| = (b_{11}+r)(b_{22}+r)(b_{33}+r) + b_{12}b_{23}b_{31} + b_{13}b_{21}b_{32} - b_{31}b_{13}(b_{22}+r)$$

$$-b_{32}b_{23}(b_{11}+r) - (b_{33}+r)b_{21}b_{12}$$

A.2.5 Operator Labour

$$\varepsilon_{K_2P} = \frac{r}{4K_2}\left[\theta_{21}\left\{b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{22}\left\{b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{23}\left\{b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_2W_1} = \frac{r}{4K_2}\left[\theta_{21}\left\{b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{22}\left\{b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{23}\left\{b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_2W_2} = \frac{r}{4K_2}\left[\theta_{21}\left\{b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{22}\left\{b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{23}\left\{b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_2C_1} = -\frac{r}{4K_2}\left[\theta_{21}\left\{b_{11}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} - e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.\right.$$

$$-2b_{12}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} - 2b_{13}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{22}\Bigg\{b_{21}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)$$

$$-2b_{22}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} - 2b_{23}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{23}\Bigg\{b_{31}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)$$

$$-2b_{32}f_{12}\left(\frac{C_1}{C_2}\right)^{.5} - 2b_{33}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{K_2C_2} = -\frac{r}{4K_2}\Bigg[\theta_{21}\Bigg\{b_{12}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + 2f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)$$

$$-2b_{11}f_{12}\left(\frac{C_2}{C_1}\right)^{.5} - 2b_{13}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{22}\Bigg\{b_{22}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + 2f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)$$

$$-2b_{21}f_{12}\left(\frac{C_2}{C_1}\right)^{.5} - 2b_{23}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{23}\Bigg\{b_{32}\left(e_{12}\left(\frac{P}{C_2}\right)^{.5} + e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + 2f_{12}\left(\frac{C_1}{C_2}\right)^{.5} + 2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right)$$

$$-2b_{31}f_{12}\left(\frac{C_2}{C_1}\right)^{.5} - 2b_{33}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{K_2C_3} = -\frac{r}{4K_2}\left[\theta_{21}\left\{b_{13}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.\right.$$

$$\left. -2b_{11}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{12}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\theta_{22}\left\{b_{23}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left. -2b_{21}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{22}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\theta_{23}\left\{b_{33}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left.\left. -2b_{31}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{32}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

where

$$\theta_{21} = \left(\frac{b_{21}(b_{33}+r) - b_{31}b_{23}}{|B+rI_3|}\right)$$

$$\theta_{22} = -\left(\frac{(b_{11}+r)(b_{33}+r) - b_{31}b_{13}}{|B+rI_3|}\right)$$

$$\theta_{23} = \left(\frac{(b_{11}+r)b_{23} - b_{21}b_{13}}{|B+rI_3|}\right)$$

$$|B+rI_3| = (b_{11}+r)(b_{22}+r)(b_{33}+r) + b_{12}b_{23}b_{31} + b_{13}b_{21}b_{32} - b_{31}b_{13}(b_{22}+r)$$

$$-b_{32}b_{23}(b_{11}+r) - (b_{33}+r)b_{21}b_{12}$$

A.2.6 Unpaid Family Labour

$$\varepsilon_{K_3P} = \frac{r}{4K_3}\left[\theta_{31}\left\{b_{11}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{12}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{13}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{32}\left\{b_{21}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{22}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{23}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{33}\left\{b_{31}e_{11}\left(\frac{P}{C_1}\right)^{.5} + b_{32}e_{12}\left(\frac{P}{C_2}\right)^{.5} + b_{33}e_{13}\left(\frac{P}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_3W_1} = \frac{r}{4K_3}\left[\theta_{31}\left\{b_{11}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{12}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{13}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{32}\left\{b_{21}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{22}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{23}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{33}\left\{b_{31}e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + b_{32}e_{22}\left(\frac{W_1}{C_2}\right)^{.5} + b_{33}e_{23}\left(\frac{W_1}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_3W_2} = \frac{r}{4K_3}\left[\theta_{31}\left\{b_{11}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{12}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{13}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right.$$

$$+\theta_{32}\left\{b_{21}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{22}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{23}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}$$

$$\left.+\theta_{33}\left\{b_{31}e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + b_{32}e_{32}\left(\frac{W_2}{C_2}\right)^{.5} + b_{33}e_{33}\left(\frac{W_2}{C_3}\right)^{.5}\right\}\right]$$

$$\varepsilon_{K_3C_1} = -\frac{r}{4K_3}\left[\theta_{31}\left\{b_{11}\left(e_{11}\left(\frac{P}{C_1}\right)^{.5} + e_{21}\left(\frac{W_1}{C_1}\right)^{.5} + e_{31}\left(\frac{W_2}{C_1}\right)^{.5} + 2f_{12}\left(\frac{C_2}{C_1}\right)^{.5} + 2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\right)\right.\right.$$

$$-2b_{12}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}-2b_{13}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{32}\Bigg\{b_{21}\Bigg(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{V_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\Bigg)$$

$$-2b_{22}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}-2b_{23}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{33}\Bigg\{b_{31}\Bigg(e_{11}\left(\frac{P}{C_1}\right)^{.5}+e_{21}\left(\frac{V_1}{C_1}\right)^{.5}+e_{31}\left(\frac{W_2}{C_1}\right)^{.5}+2f_{12}\left(\frac{C_2}{C_1}\right)^{.5}+2f_{13}\left(\frac{C_3}{C_1}\right)^{.5}\Bigg)$$

$$-2b_{32}f_{12}\left(\frac{C_1}{C_2}\right)^{.5}-2b_{33}f_{13}\left(\frac{C_1}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{K_3C_2}=-\frac{r}{4K_3}\Bigg[\theta_{31}\Bigg\{b_{12}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$-2b_{11}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}-2b_{13}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{32}\Bigg\{b_{22}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$-2b_{21}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}-2b_{23}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}$$

$$+\theta_{33}\Bigg\{b_{32}\Bigg(e_{12}\left(\frac{P}{C_2}\right)^{.5}+e_{22}\left(\frac{W_1}{C_2}\right)^{.5}+e_{32}\left(\frac{W_2}{C_2}\right)^{.5}+2f_{12}\left(\frac{C_1}{C_2}\right)^{.5}+2f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\Bigg)$$

$$-2b_{31}f_{12}\left(\frac{C_2}{C_1}\right)^{.5}-2b_{33}f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\Bigg\}\Bigg]$$

$$\varepsilon_{K_3C_3} = -\frac{r}{4K_3}\left[\theta_{31}\left\{b_{13}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.\right.$$

$$\left. -2b_{11}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{12}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\theta_{32}\left\{b_{23}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left. -2b_{21}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{22}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}$$

$$+\theta_{33}\left\{b_{33}\left(e_{13}\left(\frac{P}{C_3}\right)^{.5} + e_{23}\left(\frac{W_1}{C_3}\right)^{.5} + e_{33}\left(\frac{W_2}{C_3}\right)^{.5} + 2f_{13}\left(\frac{C_1}{C_3}\right)^{.5} + 2f_{23}\left(\frac{C_2}{C_3}\right)^{.5}\right)\right.$$

$$\left.\left. -2b_{31}f_{13}\left(\frac{C_3}{C_1}\right)^{.5} - 2b_{32}f_{23}\left(\frac{C_3}{C_2}\right)^{.5}\right\}\right]$$

where

$$\theta_{31} = -\left(\frac{b_{21}b_{32} - b_{31}(b_{22} + r)}{|B + rI_3|}\right)$$

$$\theta_{32} = \left(\frac{(b_{11} + r)b_{32} - b_{31}b_{12}}{|B + rI_3|}\right)$$

$$\theta_{33} = -\left(\frac{(b_{11} + r)(b_{22} + r) - b_{21}b_{12}}{|B + rI_3|}\right)$$

$$|B + rI_3| = (b_{11} + r)(b_{22} + r)(b_{33} + r) + b_{12}b_{23}b_{31} + b_{13}b_{21}b_{32} - b_{31}b_{13}(b_{22} + r)$$

$$-b_{32}b_{23}(b_{11} + r) - (b_{33} + r)b_{21}b_{12}$$

Appendix B

Table B.1: Programming in SHAZAM for constructing the CCD multilateral price and implicit quantity indexes

```
file output index9.out
file 4 revise8.txt
read(4) y1-y10 p1-p10 c1 r1 c2 r2 c3 r3 f f0 u1 up1 u2 up2 u3
*********************************************************************
* Estimate output price index (pi) and implicit output index (oi)
*********************************************************************
genr pi=0
genr tv=0
do #=1,10
genr tv=tv+y#*p#
endo
do #=1,10
genr w=y#*p#/tv
genr lp=log(p#)
stat w/mean=wm
stat lp/mean=lpm
genr pi=pi+0.5*(w+wm)*(lp-lpm)
endo
genl base=pi:56
genr pi=pi-base
genr pi=exp(pi)*100
genr oi=tv/pi
*********************************************************************
* Estimate capital price index (ri) and implicit capital index (ci)
*********************************************************************
genr tv=0
genr ri=0
do #=1,3
genr tv=tv+c#*r#
endo
do #=1,3
genr w=c#*r#/tv
genr lr=log(r#)
stat w/mean=wm
stat lr/mean=lrm
genr ri=ri+0.5*(w+wm)*(lr-lrm)
endo
genl base=ri:56
genr ri=ri-base
genr ri=exp(ri)*100
genr ci=tv/ri
```

```
********************************* :********************************
* Estimate unpaid labour wage (up3i)
********************************* :********************************
genr tv=0
genr up3i=0
do #=1,2
genr tv=tv+u#*up#
endo
do #=1,2
genr w=u#*up#/tv
genr lup=log(up#)
stat w/mean=wm
stat lup/mean=lupm
genr up3i=up3i+0.5*(w+wm)*(lup-lupm)
endo
genl base=up3i:56
genr up3i=up3i-base
genr up3i=exp(up3i)*100
********************************* :********************************
* Estimate fertiliser price, hired labour anc operator wage indexes
********************************* :********************************
genr t=time(0)
genl base=fp:56
genr fpi=fp/base*100
genl base=up1:56
genr up1i=up1/base*100
genl base=up2:56
genr up2i=up2/base*100
********************************* :********************************
*  Estimate per unit quantity indexes
********************************* :********************************
genr oi=oi/l
genr fi=f/l
genr ci=ci/l
genr u1i=u1/l
genr u2i=u2/l
genr u3i=u3/l
********************************* :********************************
* Normalise all variables by observation 5(
********************************* :********************************
genl base=oi:56
genr y=oi/base*100
genr p=pi
genl base=fi:56
genr x1=fi/base*100
genr w1=fpi
genl base=u1i:56
genr x2=u1i/base*100
genr w2=up1i
genl base=ci:56
genr k1=ci/base*100
genr c1=ri
genl base=u2i:56
genr k2=u2i/base*100
genr c2=up2i
genl base=u3i:56
genr k3=u3i/base*100
genr c3=up3i
```

```
file 36 index9.dta
write(36) t y x1 x2 k1-k3 p w1 w2 c1-c3
stop
```

Table B.2: Programming in SHAZAM for estimating the unknown parameters of the dynamic model

```
file output dy.out
sample 1 80
read(index9.dta) t y x1 x2 k1-k3 np w1 w2 c1-c3
if(t.le.20) d1=1
if((t.ge.21).and.(t.le.40)) d2=1
if(t.ge.61) d3=1
if((t.le.7).or.((t.ge.21).and.(t.le.27)).or.((t.ge.41).and.(t.le.47))&
 .or.((t.ge.61).and.(t.le.67))) d4=1
sample 1 20
genr t=time(0)
sample 21 40
genr t=time(-20)
sample 41 60
genr t=time(-40)
sample 61 80
genr t=time(-60)
sample 1 80
genr p = lag(np)
genr z1 = lag(k1)
genr z2 = lag(k2)
genr z3 = lag(k3)
genr dk1 = k1-z1
genr dk2 = k2-z2
genr dk3 = k3-z3
genr r=0.06

sample 1 69
format(6x,f)
read x/format
 D11      15.8642
 D21      4.56284
 D31     -1.45674
 A11      .091094
 A12      .017168
 A13      .172091
 E11     -141.191
 E12      270.609
 E13      194.754
 G11      1157.78
 G12      146.600
 G13     -33.2613
 H1      -15.2791
 H1D      .497334
 D12     -17.2497
 D22     -11.0716
 D32     -4.83996
 A21      .249978
 A22      .257809
 A23     -.355798
 E21      40.7403
 E22     -628.004
 E23     -530.618
 G22     -935.108
 G23     -608.367
```

```
H2      -162.836
H2D      46.4233
D13     -7.32651
D23     -1.10364
D33      30.1419
A31     -3.44578
A32      3.53349
A33     -.090659
E31      25.8004
E32     -3557.28
E33      1458.02
G33     -67.8643
H3      -68.6260
H3D      5.57513
D14     -.140855
D24      5.59727
D34      4.80035
B11     -.244319
B12     -.197639
B13     -.064422
F11     -346.802
F12     -87.3038
F13     -65.1692
F22     -469.759
F23     -730.298
F33     -176.203
H4      -81.4331
H4D      105.787
H5      -45.0847
H5D     -191.016
H6       31.4794
H6D      98.5151
D15     -.403275
D25      7.39043
D35     -3.82545
B22     -.158145
B21     -.123717
B23     -.115919
D16     -3.48100
D26      6.05733
D36      4.63401
B33     -.125873
B31     -.103121
B32     -.199679

sample 2 20 22 40 42 60 62 80
nl 6/ncoef=69 dn start=x piter=200 iter=500 conv=0.0001
eq y = d11*d1 + d21*d2 + d31*d3 + a11* r*z1-dk1) &
        + a12*(r*z2-dk2) + a13*(r*z3-dk3) &
  + (r/2)*(e11*sqrt(c1/p) + e12*sqrt(c2/p) + e13*sqrt(c3/p)&
        +  2*g11 + 2*g12*sqrt(w1/p) &
        + 2*g13*sqrt(w2/p))+ (h1+h1d*d4)*(r*t-1)
eq x1 =  d12*d1 + d22*d2 + d32*d3 + a21*(dk1-(r*z1))&
        + a22*(dk2-(r*z2)) + a23*(dk3-(r*z3)) &
  - (r/2)*(e21*sqrt(c1/w1) + e22*sqrt(c2/w1) + e23*sqrt(c3/w1) &
        + 2*g22 + 2*g23*sqrt(w2/w1) &
        + 2*g12*sqrt(p/w1)) + (h2+h2d*d4)*(1-r*t)
eq x2 =  d13*d1 + d23*d2 + d33*d3 + a3  *(dk1-(r*z1)) &
```

```
        + a32*(dk2-(r*z2)) + a33*(dk3-(r*z3)) &
  - (r/2)*(e31*sqrt(c1/w2) + e32*sqrt(c2/w2) + e33*sqrt(c3/w2) &
          + 2*g33 + 2*g13*sqrt(p/w2)  &
          + 2*g23*sqrt(w1/w2)) + (h3+h3d*d4)*(1-r*t)
eq dk1 = d14*d1+d24*d2+d34*d3 + (b11-r)*z1 + b12*z2 + b13*z3 &
  + (r/2)*b11*(e11*sqrt(p/c1)+e21*sqrt(w1/c1)+e31*sqrt(w2/c1) &
  + 2*f11 + 2*f12*sqrt(c2/c1) + 2*f13*sqr (c3/c1))  &
  + (r/2)*b12*(e12*sqrt(p/c2)+e22*sqrt(w1/c2)+e32*sqrt(w2/c2) &
  + 2*f22 + 2*f23*sqrt(c3/c2) + 2*f12*sqr (c1/c2)) &
  + (r/2)*b13*(e13*sqrt(p/c3)+e23*sqrt(w1/c3)+e33*sqrt(w2/c3) &
  + 2*f33 + 2*f13*sqrt(c1/c3) + 2*f23*sqr (c2/c3)) &
  + (b11*(h4+h4d*d4) + b12*(h5+h5d*d4) + b13*(h6+h6d*d4))*(r*t-1)
eq dk2 = d15*d1+d25*d2+d35*d3 + (b22-r)*z2 + b21*z1 + b23*z3 &
  + (r/2)*b21*(e11*sqrt(p/c1)+e21*sqrt(w1/c1)+e31*sqrt(w2/c1) &
  + 2*f11 + 2*f12*sqrt(c2/c1) + 2*f13*sqr (c3/c1)) &
  + (r/2)*b22*(e12*sqrt(p/c2)+e22*sqrt(w1/c2)+e32*sqrt(w2/c2) &
  + 2*f22 + 2*f23*sqrt(c3/c2) + 2*f12*sqr (c1/c2)) &
  + (r/2)*b23*(e13*sqrt(p/c3)+e23*sqrt(w1/c3)+e33*sqrt(w2/c3) &
  + 2*f33 + 2*f13*sqrt(c1/c3) + 2*f23*sqr (c2/c3)) &
  + (b21*(h4+h4d*d4) + b22*(h5+h5d*d4) + b23*(h6+h6d*d4))*(r*t-1)
eq dk3 = d16*d1+d26*d2+d36*d3 + (b33-r)*z3 + b31*z1 + b32*z2 &
  + (r/2)*b31*(e11*sqrt(p/c1)+e21*sqrt(w1/c1)+e31*sqrt(w2/c1) &
  + 2*f11 + 2*f12*sqrt(c2/c1) + 2*f13*sqr (c3/c1)) &
  + (r/2)*b32*(e12*sqrt(p/c2)+e22*sqrt(w1/c2)+e32*sqrt(w2/c2) &
  + 2*f22 + 2*f23*sqrt(c3/c2) + 2*f12*sqr (c1/c2)) &
  + (r/2)*b33*(e13*sqrt(p/c3)+e23*sqrt(w1/c3)+e33*sqrt(w2/c3) &
  + 2*f33 + 2*f13*sqrt(c1/c3) + 2*f23*sqr (c2/c3)) &
  + (b31*(h4+h4d*d4) + b32*(h5+h5d*d4  + b33*(h6+h6d*d4))*(r*t-1)
end
stop
```

Table B.3: Programming in TSP for estimating the unknown parameters of the static model

```
smpl 1 80 ;
read(file='index91.dta') t y x1 x2 k1 k2 k3 np w1 w2 c1 c2 c3 d1 d2 d3 d4 ;
smpl 2,20 22,40 42,60 62,80 ;
genr p = np(-1) ;
genr q1 = y ;
genr q2 = -x1 ;
genr q3 = -x2 ;
genr q4 = -k1 ;
genr q5 = -k2 ;
genr q6 = -k3 ;
genr p1 = p ;
genr p2 = w1 ;
genr p3 = w2 ;
genr p4 = c1 ;
genr p5 = c2 ;
genr p6 = c3 ;
frml q1eq q1 = b11*sqrt(p1/p1) + b12*sqr (p2/p1) + b13*sqrt(p3/p1)
        + b14*sqrt(p4/p1) + b15*sqrt(p5/p1) + b16*sqrt(p6/p1)
        + (a1+a1d*d4)*t + d11*d1 + d21*d2 + d31*d3 ;
frml q2eq q2 = b12*sqrt(p1/p2) + b22*sqr (p2/p2) + b23*sqrt(p3/p2)
        + b24*sqrt(p4/p2) + b25*sqrt(p5/p2) + b26*sqrt(p6/p2)
        + (a2+a2d*d4)*t + d12*d1 + d22*d2 + d32*d3 ;
frml q3eq q3 = b13*sqrt(p1/p3) + b23*sqr (p2/p3) + b33*sqrt(p3/p3)
        + b34*sqrt(p4/p3) + b35*sqrt(p5/p3) + b36*sqrt(p6/p3)
        + (a3+a3d*d4)*t + d13*d1 + d23*d2 + d33*d3 ;
frml q4eq q4 = b14*sqrt(p1/p4) + b24*sqr (p2/p4) + b34*sqrt(p3/p4)
        + b44*sqrt(p4/p4) + b45*sqrt(p5/p4) + b46*sqrt(p6/p4)
        + (a4+a4d*d4)*t + d14*d1 + d24*d2 + d34*d3 ;
frml q5eq q5 = b15*sqrt(p1/p5) + b25*sqr (p2/p5) + b35*sqrt(p3/p5)
        + b45*sqrt(p4/p5) + b55*sqrt(p5/p5) + b56*sqrt(p6/p5)
        + (a5+a5d*d4)*t + d15*d1 + d25*d2 + d35*d3 ;
frml q6eq q6 = b16*sqrt(p1/p6) + b26*sqr (p2/p6) + b36*sqrt(p3/p6)
        + b46*sqrt(p4/p6) + b56*sqrt(p5/p6) + b66*sqrt(p6/p6)
        + (a6+a6d*d4)*t + d16*d1 + d26*d2 + d36*d3 ;
param
B11  B12  B13  B14  B15  B16  A1  A1D  D11  D21  D31
     B22  B23  B24  B25  B26  A2  A2D  D12  D22  D32
          B33  B34  B35  B36  A3  A3D  D13  D23  D33
               B44  B45  B46  A4  A4D  D14  D24  D34
                    B55  B56  A5  A5D  D15  D25  D35
                         B66  A6  A5D  D16  D26  D36 ;
sur (noprint, maxit=800) q1eq, q2eq, q3eq  q4eq, q5eq, q6eq ;
stop ;
```

Appendix C

Table C.1: CCD multilateral price and implicit quantity indexes of the Northeastern Region of Thailand, 1971 to 1990

Year	Y	P	X1	W1	X2	W2	K1	C1	K2	C2	K3	C3
1971	41.7642	31.6142	10.4395	42.7757	7.9030	64.1388	0.1057	49.8594	130.5291	34.2277	179.3249	37.0153
1972	36.3312	43.1742	14.0943	47.5285	17.6032	48.7652	0.0715	56.4271	111.1424	42.6550	134.6276	44.0300
1973	36.9437	60.4420	7.6507	76.2357	20.9373	64.5966	0.0821	46.4012	111.0575	56.2807	140.2800	58.1098
1974	32.5414	68.6652	6.4225	102.4715	10.2786	105.9219	0.6375	61.3551	117.2055	72.7862	148.0121	76.9156
1975	41.9508	66.9882	9.9407	94.1065	14.3328	102.1604	2.3470	60.4724	126.0670	67.9227	166.1393	72.1362
1976	39.7018	66.2777	12.0375	67.6806	21.8785	96.0086	2.8174	51.3527	131.5520	69.7876	159.5789	73.5451
1977	34.8275	75.4312	15.5614	68.4411	20.2119	83.4388	5.0245	64.4032	133.2782	72.5263	176.6434	74.9159
1978	43.9716	82.1551	15.1168	64.6388	14.6106	90.6603	6.4673	82.9244	137.7811	87.6612	197.6437	89.6833
1979	49.6521	94.0935	15.8363	81.1787	27.0696	108.6827	7.7729	85.2018	136.1832	94.6991	172.0101	97.7709
1980	47.1131	103.6385	14.8951	92.5856	23.8888	142.6623	9.2790	91.0162	136.5590	106.3532	190.2833	111.7731
1981	46.5254	95.9551	16.4155	109.6958	31.9697	114.3855	9.8412	41.3253	132.2788	111.5980	208.7297	113.7030
1982	45.6769	100.0195	20.9924	101.9011	38.9897	98.3972	11.1658	28.4183	129.7024	102.6317	190.5930	103.6198
1983	57.1167	96.3839	22.8432	88.2129	22.1934	129.5059	12.6214	82.8359	140.6108	111.5752	205.9182	115.3552
1984	53.5522	81.0868	21.7813	82.1293	26.5356	107.0307	14.9156	74.3936	145.9036	98.0943	200.3598	100.7373
1985	55.2127	83.8598	21.1030	109.6958	32.3450	99.8414	11.6141	99.3038	145.1552	90.2114	182.1045	92.7383
1986	51.0901	102.3096	23.2824	100.0000	37.8533	100.0000	13..3447	99.5024	144.2296	100.0000	189.2894	101.5546
1987	45.9584	116.6068	24.5557	85.5513	25.3772	127.5083	15.4858	99.3494	139.5342	113.3190	191.6132	116.7547
1988	54.8955	121.8858	31.7307	86.5019	31.7989	145.5416	17.8251	114.7062	142.7044	137.8630	179.0299	140.9782
1989	58.2902	115.1958	36.4500	96.3878	37.6327	125.9119	20.5036	110.4024	143.3889	141.5377	188.1861	141.9435
1990	60.1954	122.1150	41.8844	98.4791	39.1438	165.7267	23.6779	127.3860	162.9468	121.4091	217.4175	128.1270

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Table C.2: CCD multilateral price and implicit quantity indexes of the Northern Region of Thailand, 1971 to 1990

Year	Y	P	X1	W1	X2	W2	K1	C1	K2	C2	K3	C3
1971	67.4494	30.6858	3.3190	42.7757	13.7596	64.1388	0.4177	48.4246	167.2407	34.2277	213.1659	37.1382
1972	53.3006	40.9466	4.4809	47.5285	24.2619	48.7652	0.2789	56.5887	143.5919	42.6550	169.1801	44.0272
1973	64.9783	60.2550	4.8883	76.2357	32.4706	64.5966	0.3076	48.5164	149.6651	56.2807	171.3127	58.1015
1974	65.7872	70.3507	6.0681	102.4715	19.7473	105.9219	3.2976	61.6922	139.9738	72.7862	139.4847	77.1316
1975	68.3019	67.8742	6.7922	94.1065	20.9410	102.1604	12.5570	60.9048	160.2102	67.9227	159.8346	72.2124
1976	70.6794	66.5400	7.4325	67.6806	25.8969	96.0086	15.6311	51.5287	176.0124	69.7876	168.3034	73.4955
1977	60.9324	78.7044	9.2601	68.4411	41.0435	83.4388	27.1270	64.4767	172.9132	72.5263	181.1512	74.8861
1978	79.1965	77.9165	8.8906	64.6388	59.6922	90.6603	37.2833	82.9349	162.8710	87.6612	182.3111	89.1704
1979	73.2370	91.1127	9.0869	81.1787	64.6413	108.6827	44.6356	85.2722	153.9788	94.6991	177.8927	97.6704
1980	77.3200	107.3942	8.3452	92.5856	59.5727	142.6623	51.2140	91.1831	147.7540	106.3532	174.4204	112.4248
1981	84.5517	98.8308	9.2712	109.6958	72.7277	114.3855	52.1783	41.1050	148.2293	111.5980	195.2373	113.1021
1982	71.3571	98.6539	32.3193	101.9011	72.9090	98.3972	57.5053	27.8251	147.6947	102.6317	173.7443	103.0359
1983	80.5750	98.1730	36.0746	88.2129	87.7167	129.5059	65.2271	82.8853	159.4237	111.5752	160.7560	115.2357
1984	87.8609	83.5806	33.4622	82.1293	94.9528	107.0307	78.2005	74.6450	163.0639	98.0943	174.4605	100.2448
1985	84.5891	81.8628	32.1745	109.6958	86.1369	99.8414	74.5613	99.2881	164.1167	90.2114	157.4744	92.4549
1986	81.4196	97.0094	36.2591	100.0000	98.6858	100.0000	88.0865	99.5042	155.3165	100.0000	157.3927	100.6762
1987	70.2410	119.6992	43.1454	85.5513	98.2026	127.5083	101.6848	99.4462	155.9296	113.3190	135.0178	116.3673
1988	97.8843	125.5874	55.3094	86.5019	93.6823	145.5416	116.8999	114.6333	164.6970	137.8630	160.5834	140.1591
1989	97.0246	116.9804	63.7173	96.3878	110.3219	125.9119	135.8792	110.1855	161.9633	141.5377	165.1394	139.8118
1990	83.0835	120.1812	73.7708	98.4791	82.8546	165.7267	159.3709	127.1097	171.4462	121.4091	166.2024	128.9842

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Table C.3: CCD multilateral price and implicit quantity indexes of the Central Region of Thailand, 1971 to 1990

Year	Y	P	X1	W1	X2	W2	K1	C1	K2	C2	K3	C3
1971	60.1005	33.3183	25.0537	42.7757	21.3596	64.1388	1.2782	47.4303	102.1379	34.2277	127.7486	37.7948
1972	68.8545	41.4058	33.8296	47.5285	51.6554	48.7652	0.8456	56.7088	104.4297	42.6550	115.3535	43.9524
1973	71.6760	58.7101	40.3931	76.2357	42.6322	64.5966	0.9081	49.8550	97.4997	56.2807	104.7396	58.0430
1974	68.2215	68.2876	35.9652	102.4715	34.1021	105.9219	11.7007	61.8405	79.5292	72.7862	69.2011	78.1227
1975	73.0533	68.5799	43.2697	94.1065	33.3582	102.1604	44.7666	60.0975	100.1679	67.9227	108.5103	73.0255
1976	77.8801	68.6732	60.1830	67.6806	48.2929	96.0086	54.4218	51.5614	106.4943	69.7876	116.5207	74.1919
1977	69.9608	77.7174	76.0616	68.4411	52.3982	83.4388	63.6932	64.4908	106.3094	72.5263	123.8589	74.8084
1978	81.4862	80.7401	73.3770	64.6388	64.8827	90.6603	72.8559	82.9309	101.2407	87.6612	119.1189	88.7249
1979	79.8205	93.0962	77.3661	81.1787	51.7006	108.6827	84.8082	85.2567	97.9867	94.6991	99.1429	97.6272
1980	83.2816	113.4671	74.0062	92.5856	54.2596	142.6623	102.9191	91.3286	96.3594	106.3532	111.1334	112.8118
1981	103.6568	102.5675	85.3296	109.6958	77.6585	114.3855	106.9914	41.1462	103.5452	111.5980	132.1975	112.5763
1982	94.6816	99.1891	86.5804	101.9011	90.2726	98.3972	120.9152	27.8888	97.6510	102.6317	112.7390	101.9668
1983	94.3660	97.6468	91.9784	88.2129	88.0257	129.5059	138.6896	82.8580	108.7000	111.5752	109.8256	115.1737
1984	101.9189	81.2454	91.8513	82.1293	95.5303	107.0307	105.4856	75.2256	111.4401	98.0943	112.3992	99.9788
1985	102.0400	81.9699	90.5626	109.6958	92.0942	99.8414	95.2466	99.2494	114.2885	90.2114	115.0086	92.2410
1986	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
1987	95.6151	117.0336	101.8015	85.5513	99.3463	127.5083	109.8586	99.3330	119.5304	113.3190	105.6905	116.2298
1988	108.5423	122.4022	132.2585	86.5019	106.9290	145.5416	117.4537	114.6644	125.6178	137.8630	123.1775	139.6210
1989	110.6683	116.0245	154.5206	96.3878	148.9682	125.9119	126.9771	110.3985	119.8035	141.5377	112.0506	137.6615
1990	75.9280	119.9154	179.3937	98.4791	76.1270	165.7267	137.3471	127.5060	123.9969	121.4091	108.2656	129.3781

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Table C.4: CCD multilateral price and implicit quantity indexes of the Southern Region of Thailand, 1971 to 1990

Year	Y	P	X1	W1	X2	W2	K1	C1	K2	C2	K3	C3
1971	20.6496	30.6473	14.6417	42.7757	71.0108	64.1388	0.2604	46.8449	139.4719	34.2277	156.1807	39.0257
1972	24.3148	41.5085	19.7702	47.5285	51.5294	48.7652	0.1713	56.7767	133.9540	42.6550	111.4901	43.9756
1973	18.2995	61.1968	20.6041	76.2357	57.1915	64.5966	0.1810	50.7092	137.5747	56.2807	104.3202	58.0483
1974	19.6344	69.0289	18.7734	102.4715	45.3643	105.9219	2.5726	61.9094	132.1921	72.7862	95.9724	77.8547
1975	19.9108	66.2225	22.9498	94.1065	48.5885	102.1604	9.8911	60.0008	154.9203	67.9227	100.6535	72.9543
1976	21.3099	64.1773	22.9375	67.6806	33.4725	96.0086	11.5042	51.5845	181.3332	69.7876	107.8269	73.5914
1977	25.7146	78.8750	29.2356	68.4411	69.6528	83.4388	16.6292	64.5178	177.2219	72.5263	101.6307	74.8370
1978	22.1192	77.8509	28.8521	64.6388	54.5511	90.6603	20.9594	82.9472	167.8985	87.6612	129.4504	89.2458
1979	21.8489	91.4751	29.9662	81.1787	48.8494	108.6827	25.6910	85.3209	172.4470	94.6991	111.9821	97.7303
1980	22.0294	106.2708	28.1402	92.5856	44.6531	142.6623	30.9498	90.9993	184.1040	106.3532	136.3872	111.9801
1981	20.8449	97.1892	31.0155	109.6958	41.5242	114.3855	30.4600	40.9743	160.2228	111.5980	132.8880	113.6572
1982	21.7538	98.8358	55.3145	101.9011	58.4795	98.3972	34.1617	27.5460	154.9420	102.6317	133.7413	103.3782
1983	17.5252	95.2247	56.1013	88.2129	40.9303	129.5059	39.6850	82.9411	176.8252	111.5752	137.6434	115.3299
1984	18.9615	79.6000	56.0189	82.1293	59.8812	107.0307	49.2888	74.1898	187.1752	98.0943	143.2057	100.5506
1985	17.9927	79.8362	55.4610	109.6958	65.0023	99.8414	50.5771	99.3165	174.8994	90.2114	122.8942	92.5906
1986	16.9441	99.4109	61.2261	100.0000	49.0799	100.0000	58.8527	99.2127	175.0567	100.0000	126.9575	101.5070
1987	19.6997	122.4113	79.1883	85.5513	49.9711	127.5083	68.6289	99.5149	175.9255	113.3190	132.7396	116.6543
1988	16.6772	129.5742	95.7352	86.5019	70.7502	145.5416	74.3540	114.6159	163.1103	137.8630	139.5860	140.4548
1989	15.6487	117.1483	109.0801	96.3878	63.9985	125.9119	85.4395	110.0923	170.2742	141.5377	141.0427	141.3088
1990	12.8128	123.3545	122.4979	98.4791	86.6173	165.7267	97.1260	126.9876	169.4123	121.4091	123.2060	129.0722

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Appendix D

Table D.1: Descriptive statistics of CCD multilateral price and implicit quantity indexes of the Northeastern Region of Thailand, 1971 to 1990

Variables	Mean	Std Dev	Minimum	Maximum
Y	46.6655	8.2359	32.5414	60.1954
P	86.3949	25.2101	31.6142	122.1150
X1	19.1517	9.3055	6.4225	41.8844
W1	84.8099	18.8834	42.7757	109.6958
X2	25.1277	9.5132	7.9030	39.1438
W2	106.0442	28.7440	48.7652	165.7267
K1	9.2800	7.1080	0.0715	23.6779
C1	76.3518	27.1198	28.4183	127.3860
K2	134.8905	12.3342	111.0575	162.9468
C2	91.6570	28.9838	34.2277	141.5377
K3	180.8892	22.3171	134.6276	217.4175
C3	94.5703	29.1601	37.0153	141.9435

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Table D.2: Descriptive statistics of CCD multilateral price and implicit quantity indexes of the Northern Region of Thailand, 1971 to 1990

Variables	Mean	Std Dev	Minimum	Maximum
Y	75.9885	11.4985	53.3006	97.8843
P	86.6169	25.9019	30.6858	125.5874
X1	24.2034	21.9069	3.3190	73.7708
W1	84.8099	18.8834	42.7757	109.6958
X2	63.0109	31.4800	13.7596	110.3219
W2	106.0442	28.7440	48.7652	165.7267
K1	56.1172	46.8801	0.2789	159.3709
C1	76.4075	27.0707	27.8251	127.1097
K2	158.3046	10.0046	139.9738	176.0124
C2	91.6570	28.9838	34.2277	141.5377
K3	169.1533	17.2735	135.0178	213.1659
C3	94.3165	28.9060	37.1382	140.1591

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Table D.3: Descriptive statistics of CCD multilateral price and implicit quantity indexes of the Central Region of Thailand, 1971 to 1990

Variables	Mean	Std Dev	Minimum	Maximum
Y	86.0876	15.4187	60.1005	110.6683
P	87.0995	25.6103	33.3183	122.4022
X1	82.6891	39.6457	25.0537	179.3937
W1	84.8099	18.8834	42.7757	109.6958
X2	71.4797	31.4239	21.3596	148.9682
W2	106.0442	28.7440	48.7652	165.7267
K1	79.8581	46.4884	0.8456	138.6896
C1	76.4885	27.1333	27.8888	127.5060
K2	105.8364	11.0111	79.5292	125.6178
C2	91.6570	28.9838	34.2277	141.5377
K3	111.3341	13.1188	69.2011	132.1975
C3	94.1965	28.5331	37.7948	139.6210

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Table D.4: Descriptive statistics of CCD multilateral price and implicit quantity indexes of the Southern Region of Thailand, 1971 to 1990

Variables	Mean	Std Dev	Minimum	Maximum
Y	19.7346	3.0188	12.8128	25.7146
P	86.4919	26.7456	30.6473	129.5742
X1	47.8755	31.9891	14.6417	122.4979
W1	84.8099	18.8834	42.7757	109.6958
X2	55.5549	12.8325	33.4725	86.6173
W2	106.0442	28.7440	48.7652	165.7267
K1	35.3692	29.5970	0.1713	97.1260
C1	76.3501	27.0614	27.5460	126.9876
K2	164.4481	17.0285	132.1921	187.1752
C2	91.6570	28.9838	34.2277	141.5377
K3	124.4899	16.7709	95.9724	156.1807
C3	94.6873	28.8598	39.0257	141.3088

Note: Y is output, P is the price of output, X1 is fertiliser, W1 is the price of fertiliser, X2 is hired labour, W2 is the wage rate of hired labour, K1 is capital, C1 is the price of capital, K2 is operator labour, C2 is the wage rate of operator labour , K3 is unpaid family labour, and C3 is the wage rate of unpaid family labour.

Appendix E

Table E.1: Estimates of the regional dummy variables in the dynamic and static models

Parameters	Estimates of the dynamic model	Estimates of the static model
d_{11}	-58.7320	-40.1622
	(9.6792)	(2.5032)
d_{12}	-163.7600	66.0331
	(48.1630)	(4.5696)
d_{13}	-132.9100	47.7455
	(42.9540)	(4.4617)
d_{14}	0.5314	74.2354
	(1.8476)	(5.8881)
d_{15}	12.4180	-30.0032
	(1.7272)	(2.9451)
d_{16}	38.4740	-69.5449
	(4.4603)	(4.1132)
d_{21}	-145.0300	-10.6971
	(17.9620)	(2.5017)
d_{22}	-792.0100	60.3956
	(69.7870)	(4.5693)
d_{23}	-642.5500	8.3357
	(67.4340)	(4.4608)
d_{24}	14.9880	24.9690
	(2.2599)	(5.8878)
d_{25}	16.3980	-52.0411
	(2.4100)	(2.9231)
d_{26}	38.7910	-56.2108
	(5.5144)	(4.0906)
d_{31}	-145.3400	-67.2277
	(13.9950)	(2.5069)
d_{32}	-458.5700	36.0369
	(50.6160)	(4.5697)
d_{33}	-385.7900	19.0177
	(49.8030)	(4.4621)
d_{34}	10.2870	46.7704
	(1.5110)	(5.8881)
d_{35}	2.4566	-60.7747
	(1.5918)	(2.9540)
d_{36}	-0.6829	-11.3696
	(4.5096)	(4.1221)

Note: Standard errors of estimates are in parentheses.

The i and j in d_{ij} refer to the region and to the equation, respectively. For the regions: 1 = Northeast, 2 = North, 3 = South; and for the equations: 1 = Output, 2 = Fertiliser, 3 = Hired labour, 4 = Capital, 5 = Operator labour, 6 = Unpaid family labour.