

**e**conomics  
Division  
Working  
Papers

## **South Pacific**

*A general equilibrium model of  
Papua New Guinea  
Part II—Appendices*

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## Appendix 1 the equations of the cge model of papua new guinea

(Total number of equations is 5745)

### KEY TO SUBSCRIPTS AND SUPERSCRIPTS

superscript '1' = demand for an intermediate input  
 superscript '2' = consumer demand  
 superscript '3' = private investment demand  
 superscript '4' = government consumption  
 superscript '5' = government investment  
 superscript '6' = export demand  
 superscript 'p' = primary factor demand  
 $i$  = commodity of which there are 37  
 $j$  = industry of which there are 42  
 $s = 1$  = domestically produced commodity  
 $s = 2$  = imported commodity  
 $v = 1$  = labour  
 $v = 2$  = capital  
 $q=1$  = unskilled labour  
 $q=2$  = skilled labour

### KEY TO SETS OF INDUSTRIES AND COMMODITIES

$\mathfrak{a}$  = set of village industries defined at Table 1, of which there are 6  
 $\mathfrak{b}$  = set of plantation industries defined at Table 1, of which there are 9  
 $\mathfrak{g}$  = set of urban industries defined at Table 1, of which there are 25  
 $\mathfrak{d}$  = set of murky sector urban industries defined at Table 1, of which there are 2  
 $N$  = set of non-traded commodities defined at Table 2, of which there are 17  
 $T$  = set of traded commodities defined at Table 2, of which there are 20

### 1. CENTRAL SOURCES AND USES OF FUNDS EQUATIONS

(45 equations)

#### 1.1. Source and use of funds in production

$$\begin{aligned} \sum_i C_{i1j} (p_{i1} + x_{i1j}) = & \sum_i \sum_s H_{isj}^1 (p_{is} + x_{isj}^1) + \sum_i H_{i1j}^{tx} (t_{xi} + p_{i1} + x_{i1j}) \\ & + \sum_i H_{i2j}^{tm} (t_{mi} + p_{i2} + x_{i2j}^1) + H_j^{tk} (t_{kj} + r_j^g + x_{2j}^p) + H_j^o r_{oj}^t \\ & + H_{1j}^p (p_{1j}^p + x_{1j}^p) + H_{2j}^p (r_j + x_{2j}^p) + H_j^l (l_j + x_{2j}^p) \end{aligned} \quad j = 1, \dots, 42$$

#### 1.2. Source of disposable income

$$y_d = \sum_q \sum_j D_{1qj} (p_{1qj}^p + x_{1qj}^p) + \sum_j D_{2j} (r_j + x_{2j}^p) - D_b b - D_q q + D_o g^o - D_w r_w^t$$

#### 1.3. Application of disposable income

$$y_d = D_c c + D_i i^c + D_l \cdot c_{37}$$

#### 1.4. Government source and use of funds

$$G^r \cdot g^r + G^f \cdot f + G^b \cdot b = g^e$$

### 2. COMMODITY SUPPLIES

(1648 equations)

#### 2.1. Commodity supplies by industry

$$x_{i1j} = z_j + S_{i1j}^T (p_{i1}^p - \sum_i C_{i1j}^p \cdot p_{i1}^p) \quad i = 1, \dots, 37; j = 1, \dots, 42$$

#### 2.2. Total output of each commodity

$$x_{i1} = \sum_j B_{i1j} x_{i1j} \quad i = 1, \dots, 37$$

#### 2.3. Determination of producer price

$$p_{i1}^p = p_{i1} - \frac{T_{xi}}{1 - T_{xi}} \cdot t_{xi} \quad i = 1, \dots, 37$$

#### 2.4. Price of exported commodities

$$p_{i1} = p_{i1}^* + \tau \quad \text{for all } i \in T$$

### 3. FINAL DEMANDS FOR COMMODITIES

(331 equations)

#### 3.1. Consumer price of commodities undifferentiated by source

$$p_k^2 = \sum_s S_{ks}^2 \cdot p_{ks}^2 \quad i = 1, \dots, 37$$

#### 3.2. Consumer prices

$$p_{is}^2 = \hat{p}_{is} + \frac{T_{cis}}{1 + T_{cis}} \cdot t_{cis} \quad i = 1, \dots, 37; s = 1, 2$$

#### 3.3. Domestic price of commodities after tariffs

$$\hat{p}_{is} = p_{is} + \frac{T_{mi}}{1 + T_{mi}} \cdot t_{mi} \quad i = 1, \dots, 37; s = 1, 2$$

**3.4. Foreign currency price of imports**

$$p_{i2} = p_{i2}^* + f \quad i = 1, \dots, 37$$

**3.5. Household demand for commodities, except for crime, undifferentiated by source**

$$x_i^2 = e_i \cdot \tilde{c} + \sum_{k=1}^{36} h_{ik} p_k^2 \quad i = 1, \dots, 36$$

**3.6. Household demand for commodities, except for crime, by source**

$$x_{is}^2 = x_i^2 - S_i^2 (p_{is}^2 - \sum_s S_{is}^2 p_{is}^2) \quad i = 1, \dots, 36; \quad s = 1, 2$$

**3.7. Involuntary government demand for crime**

$$x_{37,1}^4 = z_{42}$$

**4. INDUSTRY INPUTS**

(3310 equations)

**4.1. Demands for primary factors: labour**

$$x_{1j}^p = \frac{1}{q_j} \cdot \frac{1}{S_j^p} \cdot z_j - S_j^p \cdot (p_{1j}^p - (S_{1j}^p \cdot p_{1j}^p + S_{2j}^p \cdot r_j^g)) \quad j = 1, \dots, 42$$

**4.2. Demands for primary factors: capital**

$$x_{2j}^p = \frac{1}{S_j^p} \cdot z_j - S_j^p \cdot (r_j^g - (S_{1j}^p \cdot p_{1j}^p + S_{2j}^p \cdot r_j^g)) \quad j = 1, \dots, 42$$

**4.3. Demands for intermediate inputs excluding crime**

$$x_{isj}^1 = z_j - S_{ij}^1 \cdot (\hat{p}_{is} - \sum_s S_{isj}^1 \cdot \hat{p}_{is}) \quad [i = 1, \dots, 36; \quad j = 1, \dots, 42; \quad s = 1, 2]$$

*and, [i = 37; \quad j = 1, \dots, 42; \quad s = 2]*

**4.4. Demand for labour by occupation**

$$x_{1qj}^p = x_{1j}^p - S_{1j}^p \cdot (p_{1qj}^p - p_{1j}^p) \quad [j = 1, \dots, 42 \text{ for } q = 1; \quad \text{and } j \in (b, g) \text{ for } q = 2]$$

**4.5. Composite price of labour by industry**

$$p_{1j}^p = \sum_q S_{1qj}^p \cdot p_{1qj}^p \quad j = 1, \dots, 42$$

**4.6. Involuntary intermediate input demand for domestically produced crime**

$$x_{37,1,j}^1 = z_{42} \quad j = 1, \dots, 42$$

**5. AGGREGATE LABOUR MARKET CONDITIONS**

(98 equations)

**5.1. Aggregate implicit demand for labour in the village sector**

$$x_1^{1p} = \sum_{j \in a} x_{11j}^p \cdot S_{11j}^{1p}$$

The superscript  $1p$  refers to factor demand in the village sector.

**5.2. Aggregate demand for labour in the plantation sector by occupation**

$$x_{1q}^{2p} = \sum_{j \in b} x_{1qj}^p \cdot S_{1qj}^{2p} \quad q = 1, 2$$

Superscript  $2p$  refers to factor demand in the plantation sector.

**5.3. Aggregate demand for labour in the urban formal sector by occupation**

$$x_{1q}^{3p} = \sum_{j \in g} x_{1qj}^p \cdot S_{1qj}^{3p} \quad q = 1, 2$$

Superscript  $3p$  refers to factor demand in the urban formal sector.

**5.4. Aggregate implicit demand for labour in the urban murky sector**

$$x_1^{4p} = \sum_{j \in d} x_{11j}^p \cdot S_{11j}^{4p}$$

where superscript  $4p$  refers to factor demand in the urban murky sector.

**5.5. Returns to labour for industries in the village sector**

$$\frac{dW_1^1}{W_1^1} = p_{11j}^p \quad \text{for all } j \in a$$

**5.6. Plantation sector return to labour**

$$\frac{dW_q^2}{W_q^2} = p_{1qj}^p - \frac{T_q^2}{1-T_q^2} \cdot t_q^2 \quad [\text{for all } j \in b; q=1,2]$$

**5.7. Urban sector return to unskilled labour**

$$\frac{dW_1^3}{W_1^3} = p_{11}^3 - \frac{T_1^3}{1-T_1^3} \cdot t_1^3$$

**5.8. Urban sector return to skilled labour**

$$\frac{dW_2^3}{W_2^3} = p_{12j}^p - \frac{T_2^3}{1-T_2^3} \cdot t_2^3 \quad [for\ all\ j \in g]$$

**5.9. Murky sector return to labour**

$$\frac{dW_1^4}{W_1^4} = p_{11j}^p \quad for\ all\ j \in d$$

**5.10. The equivalent expected urban wage for unskilled labour**

$$\begin{aligned} \frac{dW_1^e}{W_1^e} = & \frac{1}{N_1^3 W_1^{3d} + N_1^4 W_1^{4d}} \cdot \frac{N_1^3 N_1^4}{N_1^3 + N_1^4} \cdot \left\{ \left[ \frac{N_1^3 + N_1^4}{N_1^4} \cdot W_1^{3d-1} \cdot dW_1^3 + \frac{N_1^3 + N_1^4}{N_1^3} \cdot W_1^{4d-1} \cdot dW_1^4 \right] \right. \\ & \left. + \frac{1}{d} \cdot [W_1^{3d} - W_1^{4d}] \cdot \left[ \frac{dN_1^3}{N_1^3} - \frac{dN_1^4}{N_1^4} \right] \right\} \end{aligned}$$

**5.11. Clearing village sector labour market**

$$\frac{dN_1^1}{N_1^1} = x_1^1 p$$

**5.12. Clearing plantation sector labour market**

$$\frac{dN_q^2}{N_q^2} = x_{1q}^{2p} \quad q = 1,2$$

**5.13. Clearing urban formal sector labour market**

$$\frac{dN_q^3}{N_q^3} = x_1^3 p^3 \quad q = 1, 2$$

**5.14. Clearing murky sector labour market**

$$\frac{dN_1^4}{N_1^4} = x_1^4 p^4$$

**5.15. Aggregate unskilled labour supply**

$$dN_1^1 = -dN_1^2 - (1+y_1).dN_1^3 - (1+y_1).dN_1^4$$

**5.16. Aggregate skilled labour supply**

$$dN_2^3 = -\frac{1}{1+y_2}.dN_2^2$$

**5.17. Equilibrium in return to unskilled labour between the village and plantation sectors**

$$dW_1^1 = dW_1^2$$

**5.18. Equilibrium in return to unskilled labour between the rural and urban sectors**

$$dW_1^e = (1+y_1).dW_1^1$$

**5.19. Equilibrium in return to skilled labour between the urban and plantation sectors**

$$dW_2^3 = (1+y_2).dW_2^2$$

**5.20. Urban unskilled wage determination**

$$p_{11}^3 = m \frac{de^c}{e^c} + \frac{dF_1^3}{F_1^3}$$

**5.21. Consumer price index**

$$\frac{de^c}{e^c} = \sum_{s=1}^2 \sum_{i=1}^{36} W_{is}^2 \cdot p_{is}^2$$

**5.22. Urban unskilled wage by industry**

$$p_{11j}^P = p_{11j}^3, \quad (j \in \mathcal{G})$$

**5.23. Divergence of urban unskilled real wages**

$$dA = \frac{dW_1^3}{e^c} - \frac{dW_1^4}{e^c} - A \cdot \frac{de^c}{e^c}$$

**6. CAPITAL MARKET**

(168 equations)

**6.1. Rate of return to capital**

$$p_{2j}^P = S_{rj}^g \cdot r_j^g + S_{lj}^l \cdot l_j \quad j = 1, \dots, 42$$

**6.2. Determination of the rate of extenal cost due to crime**

$$l_j = z_{42} - k_j \quad j = 1, \dots, 42$$

**6.3. Relationship of net and gross rate of return**

$$r_j^g = r_j - \frac{T_{kj}}{1 - T_{kj}} \cdot t_{kj} \quad j = 1, \dots, 42$$

**6.4. Clearing capital market**

$$k_j = x_{2j}^P \quad j = 1, \dots, 42$$

**7. GOVERNMENT REVENUE AND EXPENDITURE**

(11 equations)

**7.1. Income tax revenue**

$$r_w^t = \sum_q \sum_j S_{1qj}^t (t_{qj}^w + p_{1qj}^P + x_{1qj}^P)$$

**7.2. Company tax revenue**

$$r_k^t = \sum_j S_{kj}^t (t_{kj} + r_j^g + x_{2j}^P)$$

**7.3. Government revenue from import duties**

$$r_m^t = \sum_i S_{mi}^t \cdot (t_{mi} + p_{i2} + x_{i2}^{pr})$$

**7.4. Government revenue from production taxes**

$$r_x^t = \sum_i S_{xi}^t \cdot (t_{xi} + p_{i1} + x_{i1})$$

**7.5. Government revenue from consumption taxes**

$$r_c^t = \sum_s \sum_i S_{cis}^t \cdot (t_{cis} + \hat{p}_{is} + x_{is}^2)$$

**7.6. Other government revenue from tax and non-tax sources**

$$r_o^t = \sum_j S_{oj}^t \cdot r_{oj}^t$$

**7.7. Total government revenue**

$$g^r = R_w r_w^t + R_k r_k^t + R_m r_m^t + R_x r_x^t + R_c r_c^t + R_o r_o^t$$

**7.8. Nominal government consumption expenditure**

$$g^c = \sum_i \sum_s S_{is}^4 \cdot (x_{is}^4 + p_{is})$$

**7.9. Nominal government investment expenditure**

$$g^i = \sum_i \sum_s S_{is}^5 \cdot (x_{is}^5 + p_{is})$$

**7.10. Government expenditure due to external cost of crime**

$$g^l = x_{37,1}^4$$

**7.11. Total government expenditure**

$$g^e = E_c g^c + E_o g^o + E_i g^i + E_l g^l$$

**8. OTHER EQUATIONS**

(120 equations)

**8.1. Aggregate domestic currency imports**

$$m^d = \sum_i M_{i2} \cdot (p_{i2} + x_{i2})$$

**8.2. Aggregate domestic currency exports**

$$e^d = \sum_{i \in T} E_{i1} \cdot (p_{i1}^* + x_{i1}^6 + f)$$

**8.3. Clearing commodity markets for traded domestically produced goods**

$$x_{i1} = \sum_j B_{i1j}^1 \cdot x_{i1j}^1 + B_{i1}^2 \cdot x_{i1}^2 + B_{i1}^3 \cdot x_{i1}^3 + B_{i1}^4 \cdot x_{i1}^4 + B_{i1}^5 \cdot x_{i1}^5 + B_{i1}^6 \cdot x_{i1}^6 \quad i \in T$$

**8.4. Clearing commodity markets for non-traded domestically produced goods**

$$x_{i1} = \sum_j B_{i1j}^1 \cdot x_{i1j}^1 + B_{i1}^2 \cdot x_{i1}^2 + B_{i1}^3 \cdot x_{i1}^3 + B_{i1}^4 \cdot x_{i1}^4 + B_{i1}^5 \cdot x_{i1}^5 \quad i \in N$$

**8.5. Clearing market for imported goods**

$$x_{i2} = \sum_j B_{i2j}^1 \cdot x_{i2j}^1 + B_{i2}^2 \cdot x_{i2}^2 + B_{i2}^3 \cdot x_{i2}^3 + B_{i2}^4 \cdot x_{i2}^4 + B_{i2}^5 \cdot x_{i2}^5 \quad i = 1, \dots, 37$$

**8.6. Nominal gdp**

$$gdp = S_c \cdot \tilde{c} + S_i \cdot i^c + S_{gc} \cdot g^c + S_{gi} \cdot g^i + S_x e^d - S_m m^d$$

**8.7. Determination of private investment expenditure**

$$i^c = \sum_i \sum_s S_{is}^3 \cdot (\hat{p}_{is} + x_{is}^3)$$

**8.8. Determination of the voluntary consumption expenditure constraint**

$$c = S_v \cdot \tilde{c} + S_{37} \cdot c_{37}$$

**8.9. Involuntary consumption of crime**

$$c_{37} = x_{37(1)}^2 + p_{37(1)}^2$$

**8.10. Voluntary consumption - check**

$$\hat{c} = \sum_{i=1}^{36} \sum_s \tilde{S}_{is}^2 \cdot (x_{is}^2 + p_{is}^2)$$

**8.11. Defining aggregate external cost of crime**

$$l = \sum_j \Lambda_j^k \cdot (l_j + k_j) + \Lambda^c \cdot c_{37} + \Lambda^g \cdot g^l$$

**8.12. Defining imports for private sector demand**

$$x_{i2}^{pr} = \sum_j B_{i2j}^{1pr} \cdot x_{i2j}^1 + B_{i2}^{2pr} \cdot x_{i2}^2 + B_{i2}^{3pr} \cdot x_{i2}^3 \quad i = 1, \dots, 37$$

**8.13. Determination of the price of crime**

$$p_{37,1} = \frac{de^c}{e^c}$$

**9. WELFARE EQUATIONS**

(14 equations)

**9.1. Change in social welfare - basic specification**

$$dV = - \sum_{i=1}^{36} \sum_s C_{is}^2 \cdot p_{is}^2 + \tilde{C} \cdot \tilde{c}$$

**9.2. Change in social welfare - partially disaggregated specification**

$$\begin{aligned} d\hat{V} = & \sum_{i=1}^{36} J_{i1} \cdot x_{i1}^1 - \sum_{i=1}^{36} \sum_s \sum_j J_{isj}^1 \cdot x_{isj}^1 + \sum_{i \in T} J_{i1}^6 \cdot p_{i1} - \sum_i J_{i2} \cdot p_{i2} + \sum_{i=1}^{36} T_{ci1} J_{i1}^2 \cdot x_{i1}^2 \\ & + \sum_{i=1}^{36} (T_{mi} + T_{ci2} + T_{mi} \cdot T_{ci2}) \cdot J_{i2}^2 \cdot x_{i2}^2 - Q \cdot q - \Lambda \cdot l + F \cdot f \end{aligned}$$

**9.3. Change in social welfare - disaggregated specification**

$$\begin{aligned} d\hat{V}_2 = & \sum_{j \in a} x_j^1 \cdot x_{1j}^p + \sum_{j \in g} x_j^3 \cdot x_{1,1,j}^p + x^4 \cdot x_{1,41}^p + x^5 \cdot x_{1,42}^p + \sum_{j \in b, g} J_j^{tw} \cdot x_{12j}^p + \sum_{i \in T} J_{i1}^6 \cdot p_{i1} - \sum_i J_{i2} \cdot p_{i2} \\ & + \sum_i J_i^{tx} \cdot x_{i1} + \sum_i \sum_j J_{i2j}^{tm} \cdot x_{i2j}^1 + \sum_{i=1}^{36} T_{ci1} J_{i1}^2 \cdot x_{i1}^2 + \sum_{i=1}^{36} (T_{mi} + T_{ci2} + T_{mi} \cdot T_{ci2}) \cdot J_{i2}^2 \cdot x_{i2}^2 - Q \cdot q + F \cdot f \end{aligned}$$

**9.4. The effect of reallocation of labour resources - unskilled village labour component**

$$dV^{vil} = \sum_{j \in a} x_j^1 \cdot x_{1j}^p$$

**9.5. The effect of reallocation of labour resources - unskilled urban formal labour component**

$$dV^{urb} = \sum_{j \in g} x_j^3 \cdot x_{1qj}^p, \quad \text{for } q = 1, \text{ i.e. unskilled labour}$$

**9.6. The effect of reallocation of labour resources - informal industry labour**

$$dV^{inf} = x^4 \cdot x_{1j}^p, \quad \text{for } j = 41, \text{ i.e. the informal industry}$$

**9.7. The effect of reallocation of labour resources - crime industry labour**

$$dV^{crm} = x^5 \cdot x_{1j}^p, \quad \text{for } j = 42, \text{ i.e. the crime industry}$$

**9.8. Change in social welfare - income tax component**

$$dV^{it} = \sum_{j \in b, g} J_j^{tw} \cdot x_{12j}^p$$

**9.9. Change in social welfare - terms of trade effect**

$$dV^{tot} = \sum_{i \in T} J_{i1}^6 \cdot p_{i1} - \sum_i J_{i2} \cdot p_{i2}$$

**9.10. Change in social welfare - the excess of the social return to the producer return on change in output**

$$dV^{pro} = \sum_i J_i^{tx} \cdot x_{i1}$$

**9.11. Change in social welfare - the excess of the price of intermediate inputs over their social price**

$$dV^{int} = \sum_i \sum_j J_{i2j}^{tm} \cdot x_{i2j}^1$$

**9.12. Change in social welfare - effect of the marginal social value of consumption exceeding the marginal social cost**

$$dV^{con} = \sum_{i=1}^{36} T_{ci1} J_{i1}^2 \cdot x_{i1}^2 + \sum_{i=1}^{36} (T_{mi} + T_{ci2} + T_{mi} \cdot T_{ci2}) \cdot J_{i2}^2 \cdot x_{i2}^2$$

**9.13. Change in social welfare - the impact of the change in capital exports (or an increase in the current account surplus)**

$$dV^{cap} = -Q \cdot q$$

**9.14. The impact of the change in foreign grants - the equivalent variation or compensating variation with the appropriate closure**

$$dV^{for} = F \cdot f$$

## Appendix 2

### Variables of the CGE model of Papua New Guinea

Equation	Variable	No.	En/Ex	Description
1.1, 2.3, 2.4, 3.3, 3.4, 3.8, 7.3, 7.4, 7.8, 7.9, 8.1, 8.13, 9.2, 9.3, 9.8, 9.9	$p_{is}$	74		Change in price of the domestic and imported commodities
1.1, 2.1, 2.2	$x_{i1j}$	1554		Change in industry $j$ 's output of ' $i$ '
1.1, 4.3, 4.6, 8.3, 8.4, 8.5, 8.12, 9.2, 9.3, 9.11	$x_{isj}^1$	3108		Change in demand for intermed. input ' $is$ ' by industry ' $j$ '
1.1, 2.3, 3.8, 7.4	$t_{xi}$	37	exogenous	Change in ad valorem production tax on commodity ' $i$ '
1.1, 3.3, 7.3	$t_{mi}$	37	exogenous	Change in ad valorem import tariff on commodity ' $i$ '
1.1, 1.2, 4.1, 4.2, 4.4, 6.4, 7.2, 9.3, 9.4, 9.6, 9.7	$x_{vj}^P$	84		Change in industry ' $j$ ' demand for primary factor ' $v$ '
1.1, 6.3, 7.2	$t_{kj}$	42	exogenous	Change in ad valorem tax rate on returns to capital
1.1, 4.1, 4.2, 4.7, 6.1, 6.3, 7.2	$r_j^g$	42		Change in gross rental rate of capital for industry ' $j$ '
1.1, 7.6	$r_{oj}^t$	42	exogenous	Change in government revenue from other tax sources imposed on industry ' $j$ '
1.1, 4.1, 4.2, 4.4, 4.5, 6.1	$p_{vj}^P$	84		Change in price of primary factor ' $v$ ' for industry ' $j$ '
1.1, 1.2, 6.3	$r_j$	42		Change in net rental rate of capital for industry ' $j$ '
1.1, 6.1, 8.11	$l_j$	42		Change in the rate of external costs due to crime with respect to capital
1.2, 4.4, 4.5, 5.5, 5.6, 5.8, 5.9, 5.22, 7.1	$p_{1qj}^P$	76		Change in price of labour of skill type ' $q$ ' for industry ' $j$ '.
1.2, 4.3, 4.4, 7.1	$p_{1qj}^P$	8	exog for $q=2$ , & $j \in (a, d)$	
1.2, 4.4, 5.1, 5.2, 5.3, 5.4, 7.1, 9.3, 9.5, 9.8	$x_{1qj}^P$	76		Change in demand for labour of skill type ' $q$ ' by industry ' $j$ '
1.2, 4.4, 7.1	$x_{1qj}^P$	8	exog for $q=2$ , & $j \in (a, d)$	
1.2, 1.4	$b$	1	exogenous	Change in budget deficit
1.2, 9.2, 9.3, 9.13	$q$	1	exogenous	Change in capital transfers abroad
1.2, 7.11	$g^O$	1		Change in 'other' government spending
1.2, 7.1, 7.7	$r_w^t$	1		Change in income tax revenue

Equation	Variable	No.	En/Ex	Description
1.2, 1.3	$y_d$	1		Change in disposable income
1.3, 8.8	$c$	1		Change in nominal consumption expenditure
1.3, 8.6, 8.7	$i^c$	1		Change in nominal private investment expenditure
1.3, 8.8, 8.9, 8.11	$c_{37}$	1		Aggregate value of consumption of crime
1.4, 9.2, 9.3, 9.14	$f$	1	optional	Change in foreign grants
1.4, 7.7	$g^r$	1		Change in government revenue
1.4, 7.11	$g^e$	1		Change in government expenditure
2.1, 3.7, 4.1, 4.2, 4.3, 4.6	$z_j$	42		Change in aggregate output of industry $j$
2.1, 2.3	$p_{i1}^p$	37		Change in the producer price of output of commodity $i$
2.2, 6.2, 7.4, 8.1, 8.3, 8.4, 8.5, 9.2, 9.3, 9.10	$x_{is}$	74		Change in supply of commodity 'is'
2.4, 8.2	$p_{i1}^*$	20	exogenous	Change in foreign currency price of exported commodities
2.4, 3.4, 8.2	$f$	1	exogenous	Change in the exchange rate
3.1, 3.5	$p_k^2, p_i^2$	37		Change in composite consumer price of commodity group $i$ (or $k$ )
3.1, 3.2, 3.6, 5.21, 8.9, 8.10, 9.1	$p_{ks}^2, p_{is}^2$	74		Change in consumer price of commodity 'is'
3.2, 3.3, 4.3, 7.5, 8.7	$\hat{p}_{is}$	74		Change in price of commodity 'is' before consumption taxes and after import tariffs
3.2, 7.5	$t_{cis}$	74	exogenous	Change in ad valorem consumption tax rate on commodity 'is'
3.4	$p_{i2}^*$	37	exogenous	Change in foreign currency price of imported goods
3.5, 3.6	$x_i^2$	36		Change in consumption from commodity group 'i', excluding crime
3.5, 8.6, 8.8, 9.1	$\tilde{c}$	1		Aggregate value of voluntary consumption - i.e. excluding crime
3.6, 7.5, 8.3, 8.4, 8.5, 8.9, 8.10, 8.12, 9.2, 9.3, 9.12	$x_{is}^2$	73		Change in consumption of commodity 'is'
7.5, 8.5	$x_{is}^2$	1	exog for $i=37$ $s=2$	Change in consumption of imported commodity crime
8.3, 8.4, 8.5, 8.7, 8.12	$x_{is}^3$	74	exogenous	Change in purchases of commodity 'is' for private investment
8.2, 8.3	$x_{i1}^6$	20		Change in export demand for domestic produced commodity 'i'

Equation	Variable	No.	En/Ex	Description
5.1,5.11	$x_1^{1p}$	1		Change in aggregate demand for unskilled labour by the village sector
5.2, 5.12	$x_{1q}^{2p}$	2		Change in aggregate demand for labour of skill type 'q' by the plantation sector
5.3, 5.13	$x_{1q}^{3p}$	2		Change in aggregate demand for labour of skill type 'q' by the urban sector
5.4, 5.14	$x_1^{4p}$	1		Change in aggregate demand for unskilled labour by the murky sector
	$dW^1$	1		the village sector (Kina)
5.6, 5.17, 5.19	$q$	2		Change in net return to labour of skill type
5.6	$t^2$	2	exogenous	Change in income tax rate for plantation sector labour of type 'q'
5.7, 5.20, 5.22	$P_{11}^{3p}$	1		Change in gross return to labour for unskilled urban sector workers
5.7, 5.10, 5.23	$dW_1^3$	1		Change in net return to labour for unskilled urban sector workers (Kina)
5.8, 5.19	$dW_2^3$	1		Change in net return to labour for skilled urban sector workers (Kina)
5.7, 5.8	$t_q^3$	2	exogenous	Change in income tax rate for urban sector labour of type 'q'
5.9, 5.10, 5.23	$dW_1^4$	1		Change in net return to labour for unskilled murky sector workers (Kina)
5.10, 5.18	$dW_1^e$	1		Change in net expected return to labour for unskilled workers in urban centres (Kina)
5.10, 5.13, 5.15, 5.16	$dN_q^3$	2		Change in supply of labour of skill type 'q' to the urban sector
5.10, 5.14, 5.15	$dN_1^4$	1		Change in supply of unskilled labour to the murky sector
5.11, 5.15	$dN_1^1$	1		Change in supply of unskilled labour to the village sector
5.12, 5.15, 5.16	$dN_q^2$	2		Change in supply of labour of skill type 'q' to the plantation sector
5.20, 5.21, 5.23, 8.13	$de^c$	1		Change in the consumer price index (index = 1 at initial scenario)
5.20	$dF_1^3$	1	optional	Shift term to capture unexplained changes to the minimum unskilled urban wage (Kina)
5.23	$dA$	1	optional	Change in divergence of urban unskilled real wages (Kina)
6.2, 6.4, 8.11	$k_j$	42	exogenous	Change in supply of capital to industry 'j'

Equation	Variable	No.	En/Ex	Description
7.1	$t_{qj}^w$	84	<i>exogenous</i>	Change in income tax rate applying to labour of skill type 'q' in industry 'j'
7.2, 7.7	$r_k^t$	1		Change in government revenue from company taxes
7.3, 7.7	$r_m^t$	1		Change in government revenue from import tariffs
7.3, 8.12	$x_{i2}^{pr}$	37		Change in demand for imports from the private sector
7.4, 7.7	$r_x^t$	1		Change in government revenue from production taxes
7.5, 7.7	$r_c^t$	1		Change in government revenue from consumption taxes
7.6, 7.7	$r_o^t$	1		Change in government revenue from other sources
7.8, 7.11, 8.6	$g^c$	1		Change in government consumption expenditure
7.8, 8.3, 8.4, 8.5	$x_{is}^4$	73	<i>exogenous</i> <i>i ≠ 37 and</i> <i>s ≠ 1</i>	Change in government consumption demand for commodity 'is'
3.7, 7.8, 8.4	$x_{is}^4$	1	<i>i = 37 and</i> <i>s = 1</i>	
7.9, 7.11, 8.6	$g^i$	1		Change in government investment expenditure
7.9, 8.3, 8.4, 8.5	$x_{is}^5$	74	<i>exogenous</i>	Change in government investment demand for commodity 'is'
7.10, 7.11, 8.11	$g^l$	1		Change in government expenditure on the external effects of crime
8.6	$gdp$	1		Change in Gross Domestic Product
8.2, 8.6	$e^d$	1		Change in the aggregate value of exports
8.1, 8.6	$m^d$	1		Change in the aggregate value of imports
8.10	$\hat{c}$	1		Total voluntary consumption check variable
8.11, 9.2	$l$	1		Change in aggregate external losses due to crime
9.1	$dV$	1		The change in social welfare (K'000)
9.2	$d\hat{V}$	1	<i>optional</i>	The change in social welfare - check variable (K'000)
9.3	$d\hat{V}_2$	1	<i>optional</i>	The change in social welfare - second check variable (K'000)
9.4	$dV^{vil}$	1		Unskilled village labour component of labour resource reallocation effect (K'000)

Equation	Variable	No.	En/Ex	Description
9.5	$dV^{urb}$	1		Unskilled urban formal labour component of labour resource reallocation effect (K'000)
9.6	$dV^{inf}$	1		Unskilled informal industry labour component of labour resource reallocation effect (K'000)
9.7	$dV^{crm}$	1		Unskilled crime industry component of labour resource reallocation effect (K'000)
9.8	$dV^{it}$	1		The effect of changes in income tax payments (K'000)
9.9	$dV^{tot}$	1		The terms of trade effect (K'000)
9.10	$dV^{pro}$	1		The effect of change in production in distorted producer markets (K'000)
9.11	$dV^{int}$	1		The effect of change in intermediate input purchases from distorted markets (K'000)
9.12	$dV^{con}$	1		Impact from marginal social value of consumption exceeding marginal social cost (K'000)
9.13	$dV^{cap}$	1		Impact of change in capital exports (K'000)
9.14	$dV^{for}$	1		Impact of change in foreign grants (K'000). Alternatively, the equivalent variation (or compensating variation) of a change in welfare.

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<b>TOTAL ENDOGENOUS VARIABLES</b>	<b>5745</b>
<b>TOTAL EXOGENOUS VARIABLES</b>	<b><u>662</u></b>
<b>TOTAL VARIABLES</b>	<b>6407</b>

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### OPTIONAL CLOSURES

1. We can choose between having equation 9.2 determine  $d\hat{V}$  or  $f$ . We make one or the other exogenous depending on whether we want to determine the change in welfare or the equivalent variation (or compensating variation) as determined by the change in foreign grants. We can similarly choose between  $d\hat{V}_2$  and  $f$  in equation 9.3, or between  $dV$  and  $f$ .
2. We can choose between a simulation in which the urban wages remain distorted or we can allow the real wage differential to be eliminated. In the former case we make  $dA$  endogenous and  $dF_1^3$  exogenous, while the second scenario requires the reverse and for a shock to eliminate the wage differential,  $A$ .

### Appendix 3: Coefficients of the model

Equation	Parameter	Description	Source
1.1	$C_{ilj}$	Revenue share out of industry $j$ 's total revenue attributable to commodity $i$ at undistorted prices	Derived from output matrix at undistorted prices
1.1	$H_{isj}^1$	Share of industry $j$ 's total costs attributable to intermediate input 'is'	Calculated from intermediate input matrix at undistorted prices
1.1	$H_{ilj}^{tx}$	Share of industry $j$ 's total costs attributable to production taxes on output of 'i1'	Estimates mostly based on information from; Investment Promotion Authority (1995); National Statistics Office publications; and 1995 Budget Papers.
1.1	$H_{i2j}^{tm}$	Share of industry $j$ 's total costs attributable to import tariffs on purchases of imported intermediate input 'i2'	Estimates based on intermediate input matrix and Investment Promotion Authority (1995).
1.1	$H_j^{tk}$	Share of industry $j$ 's total costs attributable to payment of profit taxes	Mostly calculated as a proportion of output and sourced from 1995 Budget Papers.
1.1	$H_j^o$	Share of industry $j$ 's total costs attributable to payments of 'other' taxes	Largely derived from 1995 Budget Papers.
1.1	$H_{1j}^P$	Share of industry $j$ 's total costs attributable to labour costs	Derived from a vast array of sources, but mostly Census of Employment, 1988; and 1995 Budget Papers.
1.1	$H_{2j}^P$	Share of industry $j$ 's total costs attributable to capital costs	Capital costs are mostly calculated as a residual with some reference to Vincent et al. model data base.
1.1	$H_j^l$	Share of industry $j$ 's total costs attributable to external costs of crime	Derived as a proportion of capital costs with total external costs taken from Levantis (1997)
1.2	$D_{1qj}$	The ratio of return to labour of skill type 'q' in industry 'j' to aggregate disposable income	As for $H_{1j}^P$
1.2	$D_{2j}$	The ratio of return from capital in industry 'j' to aggregate disposable income	As for $H_{2j}^P$
1.2	$D_b$	The ratio of the budget deficit to aggregate disposable income	Calculated as a residual in the governments budgetary position
1.2	$D_q$	The ratio of net capital transfers abroad to aggregate disposable income	Calculated as a residual to offset the current account position
1.2	$D_o$	The ratio of aggregate government transfers to aggregate disposable income	1995 Budget Papers
1.2	$D_w$	The ratio of aggregate income tax revenue to aggregate disposable income	1995 Budget Papers
1.3	$D_c$	The ratio of aggregate consumption expenditure to aggregate disposable income	An array of sources
1.3	$D_i$	The ratio of aggregate private investment expenditure to aggregate disposable income	Estimates based on Vicent et al. database and 1995 Budget Papers

1.3	$D_1$	<i>The ratio of aggregate expenditure due to external costs of crime to aggregate disposable income</i>	<i>External costs taken from Levantis (1997)</i>
1.4	$G^r$	<i>Ratio of government revenue from sources other than foreign grants to govt expenditure</i>	<i>1995 Budget Papers</i>
1.4	$G^f$	<i>Ratio of government revenue from foreign grants to govt expenditure</i>	<i>1995 Budget Papers</i>
1.4	$G^b$	<i>Ratio of government revenue attributable to the budget deficit to govt expenditure</i>	<i>1995 Budget Papers</i>
2.1	$S_{ilj}^T$	<i>Transformation elasticity between products produced by industry j</i>	<i>As for Vincent et al. model we assume elasticity of 2 for multiproduct agricultural industries and 0 for mining industries.</i>
2.1	$C_{ilj}^p$	<i>Revenue share out of industry j's total revenue attributable to commodity i at producer prices</i>	<i>Derived from output matrix at producer prices.</i>
2.2	$B_{ilj}$	<i>Industry j's share of output of commodity 'i'</i>	<i>Calculated from output matrix at undistorted prices.</i>
2.3	$T_{xi}$	<i>Ad valorem production tax rate on commodity 'i'</i>	<i>Investment Promotion Authority (1995).</i>
3.1, 3.6	$S_{ks}^2, S_{is}^2$	<i>Share of household consumption of commodity 'ks' out of total household consumption from commodity group 'k' at consumer prices</i>	<i>Derived from <math>C_{is}^2</math></i>
3.2, 9.2, 9.3, 9.12	$T_{cis}$	<i>Ad valorem consumption tax rate for commodity 'is'</i>	<i>1995 Budget Papers and Investment Promotion Authority (1995).</i>
3.3, 9.2, 9.3, 9.12	$T_{mi}$	<i>Ad valorem import tariff rate for commodity 'i2'</i>	<i>Investment Promotion Authority (1995).</i>
3.5	$e_i$	<i>Household expenditure elasticity for commodity group 'i', excluding crime.</i>	<i>Based on estimates from Finlayson (1991), Gibson (1995) and data base of Vincent et al. model.</i>
3.5	$h_{ik}$	<i>Household own and cross price elasticities, excluding crime.</i>	<i>Calculated from expenditure elasticities - refer Section 5.1 of text.</i>
3.6	$S_i^2$	<i>Substitution elasticity for households between the consumption of the domestic and imported versions of commodity 'i', excluding crime</i>	<i>As for Vincent et al. model, we assume 2 where there is an import substitute.</i>
4.1	$q_j$	<i>Returns to scale parameter for primary factors of industry j</i>	<i>Agriculture elasticities based on Finlayson results, crime industry estimated at 0.6, the remainder have CRS so are set at 1.</i>
4.1, 4.2	$S_j^p$	<i>Primary factor cost share out of all other costs excluding intermediate inputs</i>	<i>Calculated from data for <math>H_{1j}^p, H_{2j}^p, H_j^o</math>, and <math>H_j^l</math></i>

4.1, 4.2	$S_{vj}^p$	Cost share of primary factor 'v' out of total primary factor costs of industry 'j', excluding external cost of crime to capital	Calculated from data for $H_{1j}^p$ for labour and $H_{2j}^p$ for capital.
4.1, 4.2	$S_j^p$	Substitution elasticity between primary factors in industry j	Taken from Vincent et al model.
4.3	$S_{ij}^1$	Substitution elasticity between the imported and domestic varieties of commodity 'i' for intermediate input of industry j	Assumed to be 2, as in Vincent et al., and 0 if the commodity category is not used.
4.3	$S_{isj}^1$	Share of industry j's purchases of 'is' out of total purchases from commodity group 'i' at producer's purchase prices	Based on intermediate input matrix at purchase prices.
4.4	$S_{1j}^p$	Substitution elasticity between skill type of labour	A default elasticity of 0.5 is used to reflect the proposition that there are limitations to the ability to substitute between skill types.
4.5	$S_{1qj}^p$	Share of skill type 'q' labour cost out of total labour costs for industry 'j'	Calculated from data for the shares by sector below.
5.1	$S_{11j}^{1p}$	Share out of total village sector unskilled labour employed in village industry 'j'	1990 Census, Handbook on Agricultural Statistics, and others.
5.2	$S_{1qj}^{2p}$	Share out of total plantation sector labour of type 'q' employed in plantation industry 'j'	Estimates are extapolations based on Census of Employment, 1988.
5.3	$S_{1qj}^{3p}$	Share out of urban sector labour of type 'q' employed in urban industry 'j'	Census of Employment, 1988, 1995 Budget Papers, and others.
5.4	$S_{11j}^{4p}$	Share of murky sector unskilled labour employed in murky industry j	Estimates based on Levantis (1997) survey results and 1990 Census.
5.6	$T_q^2$	Income tax rate for plantation workers of skill type 'q'	Estimates based on information from McGavin (1991) and Investment Promotion Authority, (1995).
5.7, 5.8	$T_q^3$	Income tax rate for urban workers of skill type 'q'	Estimates based on information from Investment Promotion Authority (1995).
5.5	$W_1^1$	Wage rate for unskilled village workers	The minimum annual rural rate
5.6	$W_q^2$	Wage rate for plantation workers of skill type q	The minimum annual rural rate for unskilled, extrapolation of results from McGavin (1991) for skilled
5.7, 5.8, 5.10, 5.20	$W_q^3$	Urban formal sector wage rate for workers of skill type q	Results from survey in Levantis (1997)
5.9, 5.10	$W_1^4$	Urban murky sector unskilled wage rate	Calculated from survey results in Levantis (1997), the annual rate.
5.10	$W_1^e$	Certainty equivalent expected urban wage for unskilled workers	Calculated using equation (7.3) in the text.
5.10, 5.13	$N_q^3$	Number of workers of skill type q employed in the urban formal sector	Census of Employment, 1988, 1995 Budget Papers, and others.

5.10, 5.14	$N_1^4$	Number of unskilled workers employed in the urban murky sector	Based on survey data in Levantis (1997) and 1990 Census data
5.10	d	Risk aversion parameter	Arbitrarily determined
5.11	$N_1^1$	Number of unskilled workers employed in the village sector	1990 Census
5.12	$N_q^2$	Number of workers of skill type q employed in the plantation sector	McGavin (1991), Census of Employment, 1988, and others.
5.15, 5.16, 5.18, 5.19	$y_q$	Parameter to equilibrate the value of nominal income in rural and urban areas	Calculated as ratio of expected urban wage and rural.
5.20	$\pi$	Wage indexation parameter	Set according to requirements of simulation.
5.20, 5.21, 5.23, 8.13	$e^c$	Consumer price index	Base value for the initial situation is set at 1
5.20	$F_1^3$	The initial urban unskilled real wage	The same as the initial nominal annual wage
5.21	$W_{is}^2$	Weights for the consumer price index	Calculated using $C_{is}^2$
5.23	A	The initial urban real wage differential	The difference between the 2 urban annual wage rates
6.1	$S_{rj}^g$	Gross return to capital ratio out of total gross price of capital	Capital calculated from $H_{2j}^D$ and external costs taken from Levantis (1997).
6.1	$S_{lj}$	Cost due to external effects of crime to capital ratio out of total gross price of capital	Capital calculated from $H_{2j}^D$ and external costs taken from Levantis (1997).
6.3	$T_{kj}$	Company tax rate for industry 'j'	Investment Promotion Authority, (1995).
7.1	$S_{1qj}^t$	Share of income tax revenue obtained from workers of skill type 'q' in industry 'j'	Census of Employment, 1988, 1995 Budget Papers, Investment Promotion Authority (1995), and others.
7.2	$S_{kj}^t$	Share of total company tax revenue attributable to industry 'j'	Mostly calculated as a proportion of output and from 1995 Budget Papers.
7.3	$S_{mi}^t$	Share of total import tariff revenue from commodity 'i2'	Calculated using imports from $M_{i2}$ and tariff rates from $T_{mi}$
7.4	$S_{xi}^t$	Share of total production tax revenue from commodity 'i1'	Calculated from output by commodity from output matrix and production tax rate from $T_{xi}$
7.5	$S_{cis}^t$	Share of total consumption tax revenue from commodity 'is'	Calculated from tax rates from $T_{cis}$ and consumption from $C_{is}^2$ .
7.6	$S_{oj}^t$	Share of total other tax revenue attributable to industry j	Calculated using other taxes from $H_j^0$

7.7	$R_w$	Share of total government revenue obtained from income taxes	1995 Budget Papers.
7.7	$R_k$	Share of total government revenue obtained from company taxes	1995 Budget Papers
7.7	$R_m$	Share of total government revenue obtained from import tariffs	1995 Budget Papers
7.7	$R_x$	Share of total government revenue obtained from production taxes	Export taxes from 1995 Budget Papers
7.7	$R_c$	Share of total government revenue obtained from consumption taxes	1995 Budget Papers
7.7	$R_o$	Share of total government revenue obtained from other taxes	1995 Budget Papers
7.8	$S_{is}^4$	Share of government consumption expenditure on commodity 'is'	Calculations mostly based on Vincent et al. model database and 1995 Budget Papers.
7.9	$S_{is}^5$	Share of government investment expenditure on commodity 'is'	Calculations mostly based on Vincent et al. model database and 1995 Budget Papers.
7.11	$E_c$	Share of government consumption expenditure out of total government expenditure	1995 Budget Papers
7.11	$E_o$	Share of government other expenditure out of total government expenditure	1995 Budget Papers
7.11	$E_i$	Share of government investment expenditure out of total government expenditure	1995 Budget Papers
7.11	$E_l$	Share of government expenditure on the external effects of crime out of total government expenditure	External costs taken from Levantis (1997).
8.1	$M_{i2}$	Commodity 'i2' share out of total value of imports	Calculated from National Statistics Office data, Handbook of Agricultural Statistics, 1992, Bank of Papua New Guinea data, and other sources.
8.2	$E_{i1}$	Commodity 'i1' share out of total value of exports	Mostly based on Bank of Papua New Guinea statistics.
8.3, 8.4	$B_{il}^1$	Share of output of 'il' used as intermediate input by industry 'j'	Calculated from intermediate input matrix and output matrix.
8.3, 8.4	$B_{il}^2$	Share of output of 'il' consumed by households	Calculated from $J_{is}^2$ and output matrix.
8.3, 8.4	$B_{il}^3$	Share of output of 'il' used for private investment	Calculated from $J_{is}^3$ and output matrix.
8.3, 8.4	$B_{il}^4$	Share of output of 'il' used for government consumption	Calculated from $S_{is}^4$ and output matrix.
8.3, 8.4	$B_{il}^5$	Share of output of 'il' used for government investment	Calculated from $S_{is}^5$ and output matrix.
8.3	$B_{il}^6$	Share of output of 'il' used for exports	Calculated from $E_{i1}$ and output matrix.

8.5	$B_{i2j}^1$	Share of imports of 'i2' used as intermediate input by industry 'j'	Calculated from intermediate input matrix and output matrix.
8.5	$B_{i2}^2$	Share of imports of 'i2' consumed by households	Calculated from $J_{is}^2$ and output matrix.
8.5	$B_{i2}^3$	Share of imports of 'i2' used for private investment	Calculated from $J_{is}^3$ and output matrix.
8.5	$B_{i2}^4$	Share of imports of 'i2' used for government consumption	Calculated from $S_{is}^4$ and output matrix.
8.5	$B_{i2}^5$	Share of imports of 'i2' used for government investment	Calculated from $S_{is}^5$ and output matrix.
8.6	$S_c$	Voluntary consumption ratio out of GDP	Calculated using $\tilde{C}$
8.6	$S_i$	Private investment ratio out of GDP	Calculated using $D_i$
8.6	$S_{gc}$	Government consumption expenditure ratio out of total GDP	1995 Budget Papers
8.6	$S_{gi}$	Government investment expenditure ratio out of total GDP	1995 Budget Papers
8.6	$S_x$	Export ratio out of total GDP	Exports taken from $E_{i1}$
8.6	$S_m$	Import ratio out of total GDP	Imports taken from $M_{i2}$
8.7	$S_{is}^3$	Share of private investment purchases of commodity 'is' out of total value of private investment purchases	Calculated using data from Vincent et al. model and from 1995 Budget Papers.
8.8	$S_v$	Share of voluntary consumption out of total consumption	Derived using $C_{is}^2$
8.8	$S_{37}$	Share of involuntary consumption out of total consumption	Derived using $C_{is}^2$
8.10	$\tilde{S}_{is}^2$	Share of consumption of commodity 'is' out of total voluntary consumption	Derived using $C_{is}^2$
8.11	$\Lambda_j^k$	Share of external costs of crime incurred by industry j out of aggregate external costs	External costs taken from Levantis (1997).
8.11	$\Lambda^c$	Share of external costs of crime incurred by households out of aggregate external costs	External costs taken from Levantis (1997).
8.11	$\Lambda^g$	Share of external costs of crime incurred by the government out of aggregate external costs	External costs taken from Levantis (1997).
8.12	$B_{i2j}^{1pr}$	Share of imports of 'i2' used as intermediate input by industry 'j' out of the total private sector demand of 'i2'	Derived using Intermediate input matrix.
8.12	$B_{i2}^{2pr}$	Share of imports of 'i2' consumed by households out of the total private sector demand of 'i2'	Derived using $J_{is}^2$ .

8.12	$B_{i2}^{3pr}$	Share of imports of 'i2' used for private investment out of the total private sector demand of 'i2'	Derived using $S_{is}^3$ and $T_{mi}$
9.1	$\tilde{C}$	Aggregate value of voluntary consumption expenditure (excluding crime consumption)	Calculated from $C_{is}^2$
9.1	$C_{is}^2 = X_{is}^2 \cdot P_{is}^2$	Value of consumption of commodity 'is' in K'000	Calculated using data from Vincent et al. model, Handbook on Agricultural Statistics, 1992, 1995 Budget Papers and others.
9.2, 9.3, 9.9	$J_{i1}^6 = P_{i1} \cdot X_{i1}^6$	Value of exports of commodity i at undistorted prices in K'000	Derived from $E_{i1}$
9.2, 9.3, 9.9	$J_{i2} = P_{i2} \cdot X_{i2}$	Value of imports of commodity i at undistorted prices in K'000	Derived from $M_{i2}$
9.2, 9.3, 9.12	$J_{is}^2 = X_{is}^2 \cdot P_{is}$	Value of consumption of commodity 'is' at undistorted prices in K'000	Derived with $T_{cis}$ , $T_{mi}$ and $C_{is}^2$
9.2	$J_{isj}^1 = P_{is} \cdot X_{isj}^1$	Value of usage of commodity 'is' as intermediate input into industry j in K'000	Taken from intermediate input matrix
9.2	$J_{i1} = P_{i1} \cdot X_{i1}$	Value of output of commodity i in K'000	Taken from output matrix
9.2, 9.3, 9.13	$Q$	Net capital outflow abroad	Calculated as a residual to offset the current account position
9.2	$\Lambda$	Aggregate external cost of crime in K'000	External costs taken from Levantis (1997).
9.2, 9.3, 9.14	$F$	Foreign grants in K'000	1995 Budget Papers
9.3, 9.8	$J_j^{tw} = T_q \cdot P_{12j}^P \cdot X_{2j}^P$	Value of income tax paid by workers in industry j in K'000	Derived from data at $S_{1qj}^t$
9.3, 9.10	$J_i^{tx} = T_{xi} \cdot P_{i1} \cdot X_{i1}$	Value of production taxes on commodity i in K'000	Derived from data at $S_{xi}^t$
9.3, 9.11	$J_{i2j}^{tm} = T_{mi} \cdot P_{i2} \cdot X_{i2j}^1$	Value of import tariffs on intermediate input of commodity i into industry j in K'000	The difference between the intermediate input matrix at producer prices and the intermediate input matrix at undistorted prices.
9.3, 9.4	$X_j^1$	Aggregate value of the distortion between the marginal product of labour in village industries and the rural wage - refer Table 7.3	Calculated from data for the rural wage, employment in each village industry, and $\alpha_j$ .
9.3, 9.5	$X_j^3$	Aggregate value of the distortion between the marginal product of labour in urban industries and the expected urban wage - refer Table 7.3	Calculated from data for the urban unskilled wage, the urban expected wage and unskilled employment by urban industry.

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9.3, 9.6	x <sup>4</sup>	<i>Aggregate value of the distortion between the marginal product of labour in the informal industry and the expected urban wage - refer Table 7.3</i>	<i>Calculated from data for the murky wage, the expected urban wage, and employment in the informal industry.</i>
9.3, 9.7	x <sup>5</sup>	<i>Aggregate value of the distortion between the marginal product of labour in the crime industry and the expected urban wage - refer Table 7.3</i>	<i>Calculated from the urban expected wage, employment in crime, and the aggregate external costs of crime.</i>

## Appendix 4

### Disaggregating the Walrasian equilibrium condition

The terms of the central equations of the model below that come directly from the Walrasian equilibrium condition are explained by the numbers above the respective terms. The remaining terms are merely flows of funds from one sector of the economy to another. These flows are described by the arrows. As an example, the arrow connecting government transfers explains the flow of funds for this purpose from the government sector to the household sector of the economy. The terms on the left hand sides of the central equations are sources of funds while those on the right hand sides are applications of funds.

#### Walrasian equilibrium condition

$$\begin{aligned}
 (1) \quad & \text{production} + (2) \quad \text{imports} = (3) \quad \text{intermediate inputs} + (4) \quad \text{private consumption} + (5) \quad \text{private investment} \\
 & + (6) \quad \text{govt consumption} + (7) \quad \text{govt investment} + (8) \quad \text{exports}
 \end{aligned}$$

#### Central equations of the model:

##### 1. Sources and uses of funds in production

$$(1) \quad \text{production} = (3) \quad \text{intermediate inputs} + \text{factor payments} + \text{tax payments} + \text{external costs}$$

##### 2. Sources and uses of funds for households

$$\begin{aligned}
 & (\text{factor payments} - \text{capital repatriation} - \text{govt borrowings}) + \text{govt transfers} \\
 & = (4) \quad \text{private consumption} + (5) \quad \text{private investment} + \text{tax payments} + \text{external costs}
 \end{aligned}$$

##### 3. Sources and uses of funds for foreign traders

$$(2) \quad \text{imports} + \text{capital repatriation} + \text{external costs} = (8) \quad \text{exports} + \text{foreign grants}$$

##### 4. Sources and uses of funds for the government

$$\begin{aligned}
 & \text{Govt borrowings} + \text{tax revenue} + \text{foreign grants} \\
 & = (6) \quad \text{govt consump} + (7) \quad \text{govt invest} + \text{govt transfers} + \text{external costs}
 \end{aligned}$$

*Note: external costs refers to the external costs of crime*