Appendix

1 The Ricardian Example

We choose $A(z) = 1 - z^2$ and set $w_l = 1$, $L = 1$, $H = 0.5$, $H^* = 1$, $t^* = 0$, and $\lambda = 0.9$. The general equilibrium contains the following six equations:

$$1 - z_m^2 = \frac{\nu}{1+t}, \tag{A.1}$$

$$1 - z_x^2 = \nu, \tag{A.2}$$

$$\xi = \frac{\lambda z_x + 1 - \lambda}{(1 - z_m)\lambda/(1+t) + \lambda z_x + 1 - \lambda}, \tag{A.3}$$

$$w_h = \Big(z_m \xi + z_x(1-\xi) \Big) \frac{0.9}{0.1 * 0.5}, \tag{A.4}$$

$$w_h^* = \left(\frac{(1 - z_m)\xi}{1+t} + (1 - z_x)(1-\xi) \right) \frac{0.9}{0.1 * 1}, \tag{A.5}$$

$$\nu = w_h / w_h^*. \tag{A.6}$$

The first five steps in the Mathematica program are:

(1) Solve z_m from equation (A.1);

(2) Solve z_x from equation (A.2);

(3) Substituting the solutions of z_m and z_x into equation (A.3) to obtain ξ;

(4) Substituting the solutions of z_m, z_x, and ξ into equation (A.4) to obtain w_h;

(5) Substituting the solutions of z_m, z_x, and ξ into equation (A.5) to obtain w_h^*;

Note: If we substitute the solutions of w_h and w_h^* into equation (A.6), we obtain an equation that determines ν. Because the equation is complicated, Mathematica cannot solve ν explicitly as a function of t. So we use the "FindRoot" approach. The steps are:

(6) Set a tariff rate t;

(7) Set an initial value of ν. Mathematica finds the value of ν that satisfies equation (A.6).

(8) Substituting the equilibrium value of ν yields equilibrium values of other variables.

Note: Notations in the Mathematica program: $b \equiv \lambda$, $e \equiv \xi$, $w \equiv w_h$, $wn \equiv w_h^*$.

2 The Heckscher-Ohlin Example

We choose $\beta(z) = 3/4 + (1/4)\sqrt{z}$ and set $L/H = 1$, $L^*/H^* = 0.3$, $L^*/L = 1$, $\theta = 2/3$, and $t^* = 0$. The general equilibrium contains the following seven equations:

$$\nu_h^{3/4+(1/4)\sqrt{z_m}} \nu_l^{1-(3/4+(1/4)\sqrt{z_m})} = (1+t)(2/3), \tag{B.1}$$

$$\nu_h^{3/4+(1/4)\sqrt{z_x}} \nu_l^{1-(3/4+(1/4)\sqrt{z_x})} = 2/3, \tag{B.2}$$

$$\xi = \frac{z_x(1+t)}{1 - z_m + z_x(1+t)}, \tag{B.3}$$

$$\omega = \frac{\xi\left(\frac{3}{4}z_m + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_m^{(\frac{1}{2}+1)}\right) + (1-\xi)\left(\frac{3}{4}z_x + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_x^{(\frac{1}{2}+1)}\right)}{\xi\left(z_m - \left(\frac{3}{4}z_m + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_m^{(\frac{1}{2}+1)}\right)\right) + (1-\xi)\left(z_x - \left(\frac{3}{4}z_x + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_x^{(\frac{1}{2}+1)}\right)\right)}, \tag{B.4}$$

$$\omega^* = 0.3\left\{\frac{\frac{\xi}{1+t}\left(\frac{3}{4} + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)} - \left(\frac{3}{4}z_m + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_m^{(\frac{1}{2}+1)}\right)\right) + (1-\xi)\left(\frac{3}{4} + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)} - \left(\frac{3}{4}z_x + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_x^{(\frac{1}{2}+1)}\right)\right)}{\frac{\xi}{1+t}\left(1 - z_m - \left(\frac{3}{4} + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)} - \left(\frac{3}{4}z_m + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_m^{(\frac{1}{2}+1)}\right)\right)\right) + (1-\xi)\left(1 - z_x - \left(\frac{3}{4} + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)} - \left(\frac{3}{4}z_x + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_x^{(\frac{1}{2}+1)}\right)\right)\right)}\right\}, \tag{B.5}$$

$$\nu_l = \frac{\xi\left(z_m - \left(\frac{3}{4}z_m + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_m^{(\frac{1}{2}+1)}\right)\right) + (1-\xi)\left(z_x - \left(\frac{3}{4}z_x + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_x^{(\frac{1}{2}+1)}\right)\right)}{\frac{\xi}{1+t}\left(1 - z_m - \left(\frac{3}{4} + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)} - \left(\frac{3}{4}z_m + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_m^{(\frac{1}{2}+1)}\right)\right)\right) + (1-\xi)\left(1 - z_x - \left(\frac{3}{4} + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)} - \left(\frac{3}{4}z_x + \frac{1}{4}\frac{1}{(\frac{1}{2}+1)}z_x^{(\frac{1}{2}+1)}\right)\right)\right)}, \tag{B.6}$$

$$\omega/\omega^* = \nu_h/\nu_l. \tag{B.7}$$

The first five steps in the Mathematica program are:

(1) Solve z_m from equation (B.1);

(2) Solve z_x from equation (B.2);

(3) Substituting the solutions of z_m and z_x into equation (B.3) to obtain ξ;

(4) Substituting the solutions of z_m, z_x, and ξ into equation (B.4) to obtain ω;

(5) Substituting the solutions of z_m, z_x, and ξ into equation (B.5) to obtain ω^*;

Note: If we substitute the solutions of ω and ω^* into equations (B.6) and (B.7), we obtain a system of two equations that determine ν_h and ν_l. Because the equations are complicated, Mathematica cannot solve ν_h and ν_l explicitly as functions of t. So we use the "FindRoot" approach. The steps are:

(6) Set a tariff rate t;

(7) Set initial values of ν_h and ν_l. Mathematica finds the values of ν_h and ν_l that satisfy both equations (B.6) and (B.7).

(8) Substituting the equilibrium values of ν_h and ν_l yields equilibrium values of other variables.

Note: Notations in the Mathematica program: $e \equiv \xi$, $w \equiv \omega$, $wn \equiv \omega^*$, $v \equiv \nu_h$, $u \equiv \nu_l$.