Appendices

Appendix A

I will use a very simple model to sharpen the logic of the argument in chapter 4. I assume a small, open economy that produces (and exports) a single good, whose price is determined in world markets. This good is produced under constant returns to scale and using labor and capital. Unlike labor, capital can move across borders, but at a cost. The magnitude of this cost will be captured in a parameter for the degree of ''openness'' of the economy. Labor, whose welfare will be the focus of the analysis, consumes only the importable. The only source of uncertainty in the model is the terms of trade (the price of exports relative to the price of imports), which is assumed to be stochastic. Labor income consists of wage income plus the proceeds of a tax on domestic capital. To make the point as sharply as possible, I assume that the government maximizes domestic capitalists' welfare subject to a reservation level of utility for workers and chooses the tax on capital accordingly.

I will use the model to show the following. An increase in openness makes domestic capital more responsive to changes in international prices and correspondingly magnifies the amplitude of fluctuations in real wages at home. Hence labor becomes worse off, due to increased exposure to risk, even if the mean (expected) real wage remains unchanged. To restore the expected utility of workers to its reservation level, the government has to increase income transfers and raise the tax on capital. This strategy works as long as the openness of the economy and the international mobility of capital are not too high. However, when openness crosses a certain threshold, an attempt to compensate labor by increasing the tax on capital becomes self-defeating. Past that threshold, the flight of capital and the erosion of real wages at home would more than offset the value of income transfers. In an extremely open economy, therefore, the government loses its ability to compensate workers through the tax system, and the constraint that workers' utility be above a certain reservation level can no longer be satisfied. One "solution" would be to make it more costly for capital to move abroad.

Let the production function of the export sector be written as $f(k, l)$, with the usual regularity conditions: $f_k > 0$, $f_l > 0$, $f_{kk} < 0$, $f_{ll} < 0$, and $f_{kl} > 0$. We normalize the economy's fixed labor endowment to unity, so the production function can also be expressed as $f(k)$. The domestically owned capital stock is exogenously fixed at k_0. Note that k, the capital used at home, can differ from k_0 as capital moves in and out of the country. A key assumption is that an increasing cost is incurred by capitalists as capital moves across borders. We can think of this as the cost of setting up business in a less familiar environment, of transporting the final goods back to the home economy, and of communicating with subsidiaries in a different country, among other things. Increased globalization will be captured in the model by reductions in λ.

Let p stand for the relative price of the exported good or service. The model is described in three equations:

$$r = pf_k(k) - \tau \tag{A.1}$$

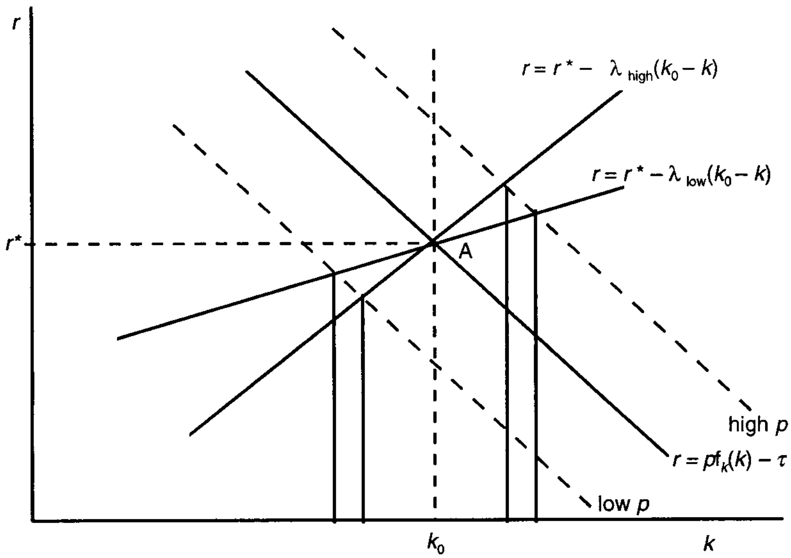
$$r = r^* - \lambda(k_0 - k) \tag{A.2}$$

$$w = pf_l(k) \tag{A.3}$$

The domestic return to capital (r) is given by the marginal value product of capital, net of the domestic tax. International trade in capital services requires that this return be equal to the international return (r^*) minus a margin that is related to the cost of moving capital abroad. Hence a capital outflow that reduces the capital stock at home to k_1 would depress the rate of return earned by domestic capitalists to $r^* - \lambda(k_0 - k_1)$. The second equation expresses this arbitrage condition. Finally, the third equation states that the domestic wage (w) equals the marginal value product of labor. These three equations determine the three endogenous variables in the system, w, r, and k.

Figure A.1 depicts how the model works. The downward sloping schedule shows the negative relationship between r and k expressed in equation (A.1). As the relative price of the export (p) moves around, so does this schedule. Intuitively, the return to capital fluctuates in tandem with the world price of the export. The upward-sloping schedule in turn represents the relationship expressed in equation (A.2). Two versions of this schedule are shown, one for high λ (low globalization) and one for low λ (high globalization). The lower is λ, the flatter this schedule. In the limit, with

Figure A.1



capital fully mobile at zero cost, the schedule would be horizontal, and it would fix the domestic rate of return at r^*.

Denote by $k(p, \tau, \lambda)$ the equilibrium level of capital employed at home. Consider an initial equilibrium in which the combination of parameters is such that $k(p, \tau, \lambda) = k_0$. In this equilibrium, denoted by point A in figure A.1, $r = r^*$. Changes in λ would have no effect on w or k (or r) starting from this initial equilibrium, since

$$\frac{dk}{d\lambda} = \frac{k - k_0}{pf_{kk} - \lambda},$$

$$\frac{dw}{d\lambda} = pf_{kl}\left[\frac{k - k_0}{pf_{kk} - \lambda}\right]$$

and both expressions equal zero when $k = k_0$. Intuitively, we fix the initial equilibrium such that capital has no incentive to move in or out of the domestic economy, and consequently changes in the cost of mobility are of no consequence.

Now consider what happens as p fluctuates. A reduction in p drives down the domestic return to capital and results in a capital outflow, the magnitude of which is inversely proportional to λ. As the figure demonstrates, the greater the mobility of capital, the wider the fluctuations in the domestic capital stock in response to changes in the world price. Formally,

$$\frac{dk}{dp} = \frac{f_k}{\lambda - pf_{kk}} > 0,$$

which is decreasing in λ. The consequences for labor can be easily deduced. Because the domestic wage (in terms of the imported good) is determined by the value marginal product of labor in the exported good (equation A.3), capital mobility accentuates the fluctuation in the consumption wage. The lower is λ, the wider the amplitude of fluctuations in w:

$$\frac{dw}{dp} = f_l + \frac{pf_{kl}f_k}{\lambda - pf_{kk}} > 0,$$

which is decreasing in λ.

In fact, things are even worse for labor insofar as part of workers' income comes from the tax on capital. Denoting workers' total (real) income by I,

$$I = w + \tau k \tag{A.4}$$

Fluctuations in I therefore result not only from fluctuations in wages, but also from fluctuations in the tax base (k) as capital moves back and forth in search of higher returns.

Now consider the effect of changing the tax on capital, holding world prices constant. We have

$$\frac{dl}{d\tau} = k + \left[\frac{dw}{d\tau} + \tau\frac{dk}{d\tau}\right]$$

$$= k - \frac{\tau + pf_{kl}}{\lambda - pf_{kl}}$$

This expression is increasing in λ, indicating that the tax on capital is most effective as a redistributive tool when capital cannot move abroad easily. For values of λ sufficiently close to zero, on the other hand, $dI/d\tau$ can be shown to be unambiguously negative for any strictly positive level of τ.[1] The implication is that an increase in the tax on capital will enhance workers' incomes in a situation in which globalization is low but reduce it when globalization is high. This plays a key role in the argument.

Consider the following timing of events:

- λ is determined;
- the government sets τ to maximize capitalists' income subject to a reservation level of (expected) utility for workers;

1. This follows from setting $\lambda = 0$ and noting that $k\mathrm{f}_{kk} + \mathrm{f}_{kl} = 0$.

- p is revealed;
- the equilibrium levels of w, r, and k are determined.

Since τ is selected before p is revealed, the government must take into account the stochastic properties of p and how uncertainty affects workers' expected utility.

Assume that p is a random variable with a mean $\overline{p}$ and a standard deviation σ. Let $I(p, \tau, \lambda)$ stand for the realized equilibrium value of income. Taking a Taylor expansion around $\overline{p}$, expected utility, $EV(I[p, \tau, \lambda])$, can be approximated in the following manner:

$$EV[I(p, \tau, \lambda)] = E\left[V(I([\overline{p}, \tau, \lambda]) + \frac{dV(I[\overline{p}, \tau, \lambda])}{dp}(p - \overline{p}) + \frac{1}{2}\frac{d^2V(I[\overline{p}, \tau, \lambda])}{dp^2}(p - \overline{p})^2\right]$$

$$= V(I(\overline{p}, \tau, \lambda) + \frac{1}{2}\frac{d^2V[I(\overline{p}, \tau, \lambda)]}{dp^2}\sigma^2$$

Now assume that workers' utility (V) is logarithmic:

$$V(I) = \log I = \log (w + \tau k)$$

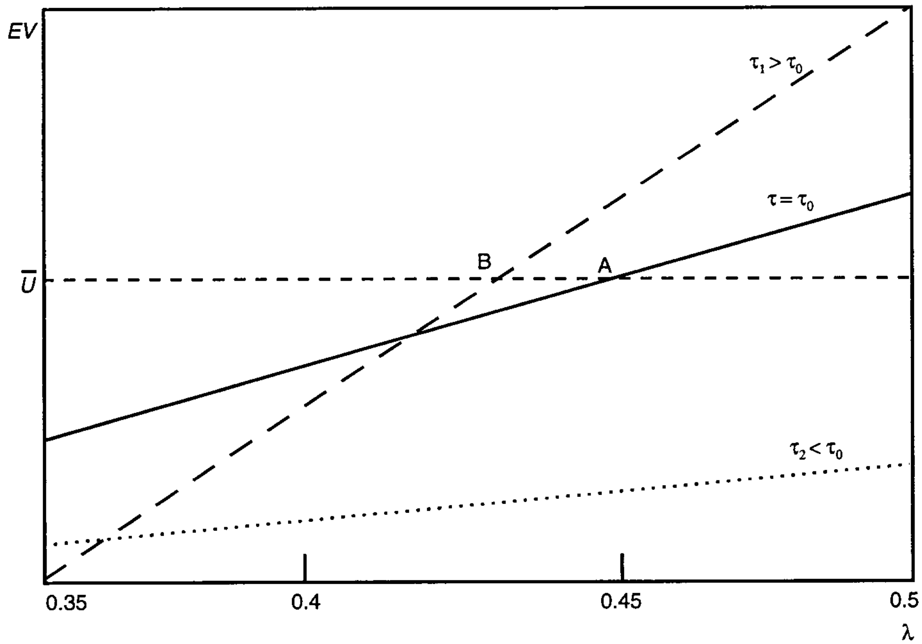
Expected utility can then be written as:

$$EV[I(p, \tau, \lambda)] = \log [w(\overline{p}, \tau, \lambda) + \tau k(\overline{p}, \tau, \lambda)] - \frac{1}{2}[w(\overline{p}, \tau, \lambda) + \tau k(\overline{p}, \tau, \lambda)]^{-2} \left[f_l(k[\overline{p}, \tau, \lambda]) + f_k(k[\overline{p}, \tau, \lambda])\frac{\tau + pf_{kl}(k[\overline{p}, \tau, \lambda])}{\lambda - pf_{kk}(k[\overline{p}, \tau, \lambda])}\right]^2\sigma^2$$

Since the utility function is concave in income, and hence workers are risk-averse, expected utility is decreasing in the variance of the world price. Moreover, an increase in openness increases the weight received by price volatility and reduces expected utility *ceteris paribus*. This can be seen by evaluating this expression at an equilibrium at which $k = k_0$ (so that w and k are insensitive to changes in λ) and by noting that a reduction in λ increases the second (negative) term in absolute value. The reason for this has been discussed above: enhanced mobility of capital magnifies the fluctuations in workers' income for any given change in p.

Note that this effect is purely a consequence of increased exposure to risk and is independent of any other consequences of openness. If

Figure A.2



increased openness further translated into a capital outflow, the losses to workers would, of course, be greater. Conversely, if increased openness were to reduce the relative price of imports (a channel from which we have abstracted), there would be a compensating gain.

As mentioned above, the government is assumed to operate under a constraint that puts a floor below the expected utility of workers:

$$EV[(I(p, \tau, \lambda)] \geq U$$

Let the initial levels of τ and λ be τ_0 and λ_0. As before, assume that the domestic capital stock is such that $k(\bar{p}, \tau_0, \lambda_0) = k_0$. It is convenient to assume further that the above constraint just binds in this equilibrium. This is shown as point A in figure A.2. The figure shows the consequences of a reduction in λ. As discussed above, expected utility falls as λ decreases. For some range of λ, the government can compensate for the reduction in workers' expected utility by raising τ. At point B, for example, workers have the same level of expected utility as at A, thanks to an increase in the tax from τ_0 to τ_1. However, as the figure shows, once the cost of moving capital abroad becomes sufficiently small, this is no longer a viable strategy. Neither an increase nor a decrease in τ can fully compensate for the loss in expected utility suffered as a result of a fall in λ. Consequently, for sufficiently high degrees of ''globalization,'' the government can no longer meet the constraint on workers' utility.

What might then happen is left outside the model. But it is reasonable to think that the government would come under severe pressure from workers to restrict international economic integration (for instance, by imposing taxes on firms that move abroad).

Appendix B

Table B.1 List of variables and sources[a]

Variable	Definition	Source
AREA	Land area	Barro and Lee 1994
ASIAE	Dummy for East Asian countries	Barro and Lee 1994
CGAVGxxyy	Real government consumption as a percentage of GDP	PWT 5.6a
DEPEND90	Dependency ratio	WD
GDPSH5xx	Real per capita GDP	Barro and Lee 1994
LAAM	Dummy for Latin American countries	Barro and Lee 1994
OECD	Dummy for OECD countries	Barro and Lee 1994
OPENAVGxxyy	Exports plus imports divided by GDP	PWT 5.6a
SAFRICA	Dummy for sub-Saharan African countries	Barro and Lee 1994
SOC	Dummy for socialist countries	Sachs and Warner 1995
TOTDLOGSTD	Standard deviation of log differences in terms of trade, 71-90	WD
URBAN90	Urbanization rate	WD

a. "xx" refers to year 19xx, while "xxyy" refers to an average during 19xx-19yy (unless specified otherwise). All government expenditure and revenue data are expressed as a percentage of GDP or GNP. "PWT 5.6" stands for Penn World Tables Mark 5.6a; "WD" for *World Data 1995* (World Bank).