Tough Policies, Incredible Policies?[1]

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1 Introduction

Credibility is the mother of good policy, or so claims much recent work in macroeconomics and international finance. If a government borrows in foreign currency, it has to show a credible commitment to repay. If it borrows in its own currency, it has to show a credible commitment not to devalue or inflate away the real value of the debt.

But if opportunistic behavior is possible, credibility is hard to attain. *Ex ante* (before the loan) is expected, it is obviously optimal for a borrowing government to vow full repayment. But *ex post*, a well-meaning government may find of optimal to default partially in order to raise spending or reduce the distortions caused by high tax rates. Understanding this temptation, lenders may charge exorbitant risk premia or refuse to extend credit altogether. This is arguably a key problem faced by emerging market economies in Latin America, Asia or Eastern Europe. And with external credit scarce and expensive, the tough job of investing and growing becomes harder still.

How to deal with this so-called time inconsistency problem?[1] The most popular approach involves *invisible handcuffs*: tie the hands of the policy maker to prevent him from acting opportunistically. Monetary examples include rules that punish central bank official for high inflation, delegation of policy to an anti-inflation conservative, currency boards that peg the value of the currency and make discretionary monetary policy almost impossible and, if all else fails, the adoption of a foreign currency such as the dollar. Handcuffs to eliminate sovereign risk in international lending are arguably harder to design and apply, but they do exist. IMF conditionality and international fines and sanctions on defaulting nations are meant to do precisely that job.

If eliminating opportunistic behavior is the name of the game, the tighter the handcuffs or the bigger the punishment, presumably the less likely the policymaker will misbehave. In the models of Barro and Gordon (1983), Rogoff (1985), Lohmann (1992), Walsh (1995), Velasco (1996), Obstfeld (1997) and Svensson (1997), among many others, tougher or more rigid policies lead to lower expectations of inflation/devaluation/default. This does not mean, of course, that the most rigid policy is necessarily welfare-maximizing, since in an uncertain economic environment there is a trade-off between the credibility and flexibility of policies. But it does mean that, the greater the

[1] The concept dates back to the seminal work of Kydland and Prescott (1977) and Calvo (1979).

temptation to act opportunistically, the stronger is the case for erring on the side of maximizing credibility, even if it means severely limiting flexibility. This is the main theoretical justification for super-rigid systems like the currency board in force in Argentina in 1991-2001.

Put differently, when precommitment is not possible and time inconsistency is a problem, the second best policy typically involves placing limits on the government's willingness or ability to react to changing economic circumstances. An example is Rogoff's (1985) famous claim that conservatives (people who are more averse to inflation/devaluation than the population at large) make good central bank presidents.

In this paper we argue that this approach to credibility is incomplete and therefore flawed. Two realistic features are missing from much theoretical work on the subject. The first is that sometimes governments devalue/default not because they *want to*, but because they *have to*. If expenditure is unexpectedly high (war calling for high defense expenditures, recession causing an increase in unemployment compensation payments) and tax revenues cannot be increased accordingly (either because of political constraints or because the economy is at the top of its Laffer curve), then default may be inevitable even for a non-opportunistic government.

A second crucial point is that the costs of misbehavior are *pecuniary* and involve more that a utility loss for the policymaker, as much of the literature assumes. Once Argentina abandoned its currency board in 2002, there was surely loss of face for the country vis a vis the rest of the world and much discomfort for policymakers, both present and past. But the currency board was so hard to leave behind precisely because its abandonment involved other very large pecuniary costs: the breaking or rewriting of contracts, massive redistributions of wealth between some borrowers and lenders, the paralysis of the financial system for months and, soon thereafter, a mega recession that decimated government revenue.

Putting these two factors together leads to new and different view of the relationship between policy rules and credibility. Consider the following setup, which is a simplified version of the model we study below. The government has debt outstanding, a share θ of which is nominal and can be defaulted on via devaluation or inflation. What remains must be financed via conventional taxes. Spending is stochastic. The policy rule in force allows for devaluations up to x percent, but calls for paying a pecuniary cost c if devaluation is ever above x. The amount c is paid by the government out of fiscal resources. The larger are x and c, the tougher policy. Social welfare is decreasing in the rates of devaluation and conventional taxation.

In the low-spending (non-crisis) states of the world, no devaluation larger than x occurs. But in high-spending states the economy is in a fiscal crisis, devaluation exceeds x, and the cost c is incurred. Notice that since this cost worsens the fiscal balance, the devaluation required to restore fiscal equilibrium is increasing in c.

Such an economy behaves very differently than standard theory suggests:

- Expected devaluation (with the expectation computed across crisis and non-crisis states) can be decreasing in x. This is because the lower is x the more often crises occur, since large devaluations cannot be used in response to shocks without violating the rule. And the more often crises occur, the more often c is paid. If one thinks of conservatives as choosing a lower x (as we do below), then appointing a more conservative policymaker can raise and not lower expectations of devaluation. This is exactly the opposite of what Barro and Gordon (1983), Rogoff (1985), Fischer and Summers (1989), Walsh (1995) and others found.

- As long as expected devaluation is decreasing in x, there is no trade-off between credibility and flexibility of policy. On the contrary, making the policy more flexible by raising x also enhances credibility. In fact, in the range in which expected devaluation is increasing in x, expected social welfare is maximized by choosing the highest x in that range.

- If again we think of policymaker preferences determining the chosen x, it is not necessarily the case that social welfare is maximized by choosing a policymaker who is more conservative (devaluation-averse) than society as a whole, as Rogoff (1985) argued. In fact, the welfare-maximizing policymaker may well be more liberal than society as a whole.

- Expected devaluation can be decreasing in θ, the share of nominal debt in total public debt. This is because in an uncertain environment fiscal crises occur with positive probability, and the lower is the share of nominal debt the larger is the devaluation required to restore fiscal solvency in crisis situations. This result is exactly the opposite of Calvo (1988) and of much conventional wisdom, which argue for dollarizing or indexing debt as a way to enhance credibility.

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- A higher cost c can cause self-fulfilling devaluation crises. Two equilibria with distinct expected rates of devaluation and expected social loss (which can be Pareto-ranked) obtain if c is above a certain level. The intuition is that expecting high devaluation raises interest rates and raises the fiscal burden, lowering the threshold between crisis and non-crisis states. This in turn increases the probability that the high cost c will be paid and a large devaluation will occur. This result is in contrast to the results in Obstfeld (1997) and Velasco (1996), where a sufficiently high cost of devaluing ensures low and unique expectations of devaluation.

- If the high cost c is needed to induce the policymakers to behave more conservatively than they would if left to their own devices –as in the case of IMF conditionality, for instance– then a tougher (high c) IMF package may cause multiple equilibria with distinct country risk and welfare levels. If the economy lands in the bad equilibrium, then the IMF program may achieve the opposite of what it aimed to.

The remainder of the paper is structured as follows. Section 2 sets up the basic model, while sections 3 presents an example of equilibria under a uniform distribution of shocks. Section 4 analyzes the consequences of two policy alternatives (appointing conservative policymakers and dollarizing/indexing debt) under the simplifying assumptions of a constant and exogenous cost of misbehavior. Section 5 endogenizes this cost and analyzes policy options, while 6 concludes.

2 The model

The total fiscal burden is

$$b\left(1+\theta\delta^{e}\right)+g+z \tag{1}$$

where $b =$ inherited public debt coming due, $g =$ exogenous net expenditure and $z =$ random fiscal shock, all denominated in terms of the economy's single tradable good.[2] The variable δ^e should be interpreted as the expected default or devaluation rate, which translates into the risk premium charged on the debt. The parameter θ, which lies between 0 and 1, indicates how much of the total debt is denominated in domestic currency (or subjected to a possible default). The budget shock may have to do with random fluctuations in expenditures (war, natural disasters calling for higher transfer payments, recessions requiring higher unemployment compensation) or random fluctuations in revenues (commodity price shocks affecting the profits of state enterprises, recessions causing lower value-added tax receipts). Assume that z has a p.d.f. $f(z)$ with mean zero, upper bound $\bar{z}$ and lower bound $\underline{z}$.

As long as total liabilities are positive, the government budget constraint is given by

$$b\left[1+\theta\left(\delta^e-\delta\right)\right]+g+z=\tau \tag{2}$$

where $\tau =$ policy-determined tax revenue and $\delta =$ the actual default/devaluation rate applied by the government. If all debt is in domestic currency, for instance, $\theta = 1$, and a devaluation surprise of $(\delta^e - \delta)$ yields $b(\delta^e - \delta)$ net revenue (in units of output) for the government. If all debt is in foreign currency or indexed, by contrast, so that $\theta = 0$, a devaluation surprise yields no real net revenue. If outright default and not devaluation is at stake, a high θ indicates that the fines and legal fees associated with unexpected default are small, so that a given rate of surprise default yields a relatively large amount of revenue. The opposite is true if θ is low. If the actual default/devaluation rate is fully anticipated, so that $\delta^e = \delta$, then government still has to pay all inherited public debt b. If the government ever hits the maximum tax revenue constraint, it enters a *fiscal crisis*, involving the abandonment of the government's optimal policy rule (to be computed below). In that case, it has no option but to default or devalue.

More formally, our assumptions are:

1 *Upper bound on tax revenue*: $\tau \leq \bar{\tau}$. This limit can arise because of political constraints on further tax collection or because the economy finds itself at the top of the Laffer curve.

[2] If this good has a price of one in foreign currency and the law of one price holds, then the domestic price level equals the nominal exchange rate, and inflation and devaluation become identical. Below we speak of devaluation, but all results can be reinterpreted in terms of inflation.

2 *Cost of crises*: a fiscal crisis increases the government's liabilities by an amount $c \geq 0$. In the next two sections we treat c as exogenous, but endogenize it later. One interpretation is that this c includes all those other liabilities that are easily and cheaply postponed or "rolled over" under normal circumstances, but not so under a fiscal crisis. An alternative is that the IMF or some external monitoring agency refuses to roll over short-term credits if the government violates fiscal conditionality. Or the surprise default/devaluation that comes with a fiscal crisis could cause losses in the domestic private sector (especially in local banks), which are soon transferred to the government because of political pressures or concerns over the health of the payments system.

To avoid considering uninteresting sub-cases, we make the following additional assumptions about the size of $\bar{\tau}$:

3 *No crises on average*: $\bar{\tau} > g + b$. This means that regular taxes are enough to pay for regular expenditure and service debt if no surprise takes place ($\delta^e = \delta$) and if the fiscal shock is no larger than it is on average.[3]

4 *Default always staves bankruptcy*: $g + \bar{z} + c < \bar{\tau}$. This means that defaulting on all debt is sufficient to avoid bankruptcy, even if the fiscal shock is as large as can be.

Finally we specify the preferences of local residents and of the government. Locals have the loss function

$$L^s = \frac{\alpha^s}{2}\tau^2 + \frac{1-\alpha^s}{2}(\delta b)^2 \tag{3}$$

where $0 < \alpha^s < 1$. Quite naturally, loss is increasing in both default/devaluation and taxes. Note that defaul/devaluation is costly even if debt is owed to foreigners, because of standard cost-of-inflation (or devaluation) arguments, or because of the other distortions/costs a default might bring. The government has a loss function that is identical to 3 except that the weight α it places on taxes need not equal α^s. The higher α^s, the more liberal (less conservative) is the government.

[3]If, conversely, $\overline{\tau} < g + b$, the fisc would be bankrupt in an expected value sense, even without crises.

The policy problem then boils down to minimizing 3 subject to its budget constraint, the upper bound on tax collection, and to private sector devaluation/default expectations.

3 Computing equilibrium

Suppose that the government moves after the private sector has set its expectations, which it takes as given. Computing the equilibrium for the resulting game is simple. If not against the maximum tax constraint ($\tau < \bar{\tau}$), the government chooses tax and default/devaluation levels according to

$$\tau = (1-\lambda)(b + x^e + g + z) \tag{4}$$
$$x = \lambda (b + x^e + g + z) \tag{5}$$

where $x \equiv \theta\delta b$ is actual revenue raised by devaluation/default and $x^e \equiv \theta\delta^e b$ is expected revenue raised by devaluation/default. Notice that $\lambda \equiv \frac{\alpha\theta^2}{\alpha\theta^2+(1-\alpha)} < 1$ is increasing in θ and in α.

A government may be constrained by the upper bound on taxes. Define z^* as the realization of expenditure such that taxes are at their maximum level:

$$\bar{\tau} = (1-\lambda)(b + x^e + g + z^*) \tag{6}$$

This level z^* is a trigger or threshold. If $-(b + x^e + g) \leq z \leq z^*$, then the fiscal situation is strong and policy rules 4 and 5 determine τ and x.[4]

But if the shock is larger and $z > z^*$, then the economy is in a *fiscal crisis* and

$$\tau = \bar{\tau}. \tag{7}$$

In this case, the government cannot abide by 4 and 5 above. Actual default/devaluation is given by

$$x = b + x^e + g + c + z - \bar{\tau}. \tag{8}$$

Figure 1 shows x as a function of the shock z. The figure depicts two distinct regions. From now on we label the range $-(b + x^e + g) \leq z \leq z^*$ as the *no crisis region* and the range $z > z^*$ as the *crisis region*. Denote the probability of the former as p^{nc} and the probability of the later as p^c.[5]

[4]Note tha $z < -(b + x^e + g)$ implies that the total fiscal burden is $b + x^e + g + z$. If $z < -(b + x^e + g)$, there is no need to default on debt or to raise any taxes.

[5]Note these probabilities need not add up to one.

Rational expectations dictate that

$$E(x|x^e) = \int_{-(b+g+x^e)}^{z^*} \lambda(b+g+z+x^e)f(z)dz + \int_{z^*}^{\bar{z}} (b+g+z+x^e+c-\bar{\tau})f(z)dz, \tag{9}$$

where the threshold z^* is given by

$$z^* = -(b+g+x^e) + \frac{\bar{\tau}}{1-\lambda} \tag{10}$$

With only a slight abuse of language, we will refer to $E(x)$ as *country risk*.[6]

Using Leibnitz's rule one can calculate

$$\frac{\partial E(x|x^e)}{\partial x^e} = \lambda p^{nc} + p^c + cf(z^*) > 0, \tag{11}$$

so that $E(x|x^e)$ is increasing in x^e. The second derivative of $E(x|x^e)$ is

$$\frac{\partial^2 E(x|x^e)}{\partial (x^e)^2} = \lambda f\left[-(b+g+x^e)\right] + (1-\lambda)f(z^*) - cf'(z^*). \tag{12}$$

From now on we assume that $f'(z) \leq 0$ (which is satisfied for many commonly used distributions: uniform and Poisson are two examples). With this assumption, $E(x|x^e)$ is convex in x^e as long as $z^* \geq \underline{z}$. As x^e grows, eventually $z^* < \underline{z}$; in that range, $E(x|x^e)$ is a straight line with slope equal to one (in other words, in that range $E(x|x^e) = b + g + x^e + c - \bar{\tau}$).

Finally, expectations are formed rationally. Equilibrium country risk (x^e_{eq}) is given by

$$x^e_{eq} = E(x|x^e_{eq}) \tag{13}$$

There are three possible cases:

- Case 1: One equilibrium, as depicted in Figure 2.1. In this case, $0 < \frac{\partial E(x|x^e)}{\partial x^e} \leq 1$ at the equilibrium x^e. Therefore, shifting up the $E(x|x^e)$ curve (for instance by raising b or g) results in a larger x^e_{eq}. This case holds if and only if $c < \bar{\tau} - b - g$ (recall the quantity on the RHS is positive by assumption). In words, c has to be relatively small.

[6] In equilibrium $E(x) = x^e$. Recall that $x^e = \theta\delta^e b$. Strictly speaking, only δ^e is an indicator of country risk. But since b is exogenous, and θ a parameter that is constant for much of the paper, the product $\theta\delta^e b$ moves together with country risk. Hence our short-hand label. In the sections on dollarization below, when we allow θ to vary, we are careful to take into account the effects that changes in θ have on $\delta^e b$.

- Case 2: No equilibrium, as depicted in Figure 2.2. This is the case for a very large c.

- Case 3: Two equilibria, as depicted in Figure 2.3. In this case, $0 < \frac{\partial E(x|x^e)}{\partial x^e} \leq 1$ at the low equilibrium x^e_{eq1} and $\frac{\partial E(x|x^e)}{\partial x^e} > 1$ at the high equilibrium x^e_{eq2}. This case requires a larger c than in case 1 but a smaller one than in case 2. Shifting up the $E(x|x^e)$ curve results in a larger x^e_{eq1} and a smaller x^e_{eq2}.

An important implication of this is that a sufficiently large c can cause multiple equilibria, possibly shifting the economy from Case 1 to Case 2. The intuition is that starting from an position of equilibrium, expecting higher default/devaluation raises the fiscal burden, lowering the threshold between crisis and non-crisis states. This in turn increases the probability that the high cost c will be paid and a large devaluation will occur, thereby making the initial increase in expected default/devaluation self-validating.[7]

If a second equilibrium exists and bad "animal spirits" cause a shift to it, one would have an instance of self-fulfilling pessimism and crises.[8]. An announcement on the part of external creditors, for instance, that they would not reschedule loans coming due if the government devalues, could be enough to trigger an equilibrium shift and the very devaluation the creditors were presumably trying to avoid.

4 Equilibria: an example

To gain more insight into the sources of multiplicity of equilibria, consider the following example. Suppose the distribution of z is uniform, with lower bound $-\bar{z}$, upper bound $\bar{z}$ and standard deviation $3^{-1/2}\bar{z}$.

Country-risk equation 9 then implies

[7]This cannot happen if $c = 0$ because of the following. In non crisis states, $x = \lambda(b + g + x^e + z)$, so that a given increase in x^e yields a less than one-for-one increase in x. In crisis states $x = b + g + x^e + z - \overline{\tau}$, so that x increases one-for-one with x^e. The rational expectation of x is the weighted average of these two cases, with the weights given by the relevant probabilities. But whatever the weights, the increase is always less than one-for-one, so an exogenous rise in x^e can never be self-validating.

[8]This is a static model, so we cannot say much about the stability properties of both equilibria. Arguably the lower or good equilibrium is stable under learning and the higher or bad one is not. But learning is surely not the only expectations-adjustment mechanism.

$$2\bar{z}x^e = \begin{cases} \frac{1}{2}\Delta_z^2 + \left(\frac{\lambda\bar{\tau}}{1-\lambda} + c\right)\Delta_z + \frac{\lambda\bar{\tau}^2}{2(1-\lambda)^2} & \text{if } \Delta_z \in \left(0, 2\bar{z} - \frac{\bar{\tau}}{1-\lambda}\right) \\ \frac{1-\lambda}{2}\Delta_z^2 + (2\lambda\bar{z} + c)\Delta_z + 2\bar{z}\lambda\left(\frac{\bar{\tau}}{1-\lambda} - \bar{z}\right) & \text{if } \Delta_z \in \left(2\bar{z} - \frac{\bar{\tau}}{1-\lambda}, 2\bar{z}\right) \end{cases} \tag{14}$$

where $\Delta_z \equiv \bar{z} - z^*$ is the length of the interval in which fiscal crises occur. On the other hand, trigger equation 6 becomes

$$x^e = -(b + g + \bar{z}) + \frac{\bar{\tau}}{1-\lambda} + \Delta_z. \tag{15}$$

These equations are illustrated in Figure 3. It is easy to prove that the function labeled CR (for *country-risk*) is positive, decreasing, convex, continuous and differentiable in the interval $(0, 2\bar{z})$. These properties imply that a unique equilibrium exists as long as that CR crosses the vertical axis above the function labeled TR (for *trigger*). This last condition is equivalent to $\bar{\tau} > b + g + c$. This confirms for this example our earlier finding that uniqueness requires that the cost c be sufficiently small.

Using the definition of Δ_z, in equilibrium 15 becomes

$$x^e_{eq} = -(b + g + z^*_{eq}) + \frac{\bar{\tau}}{1-\lambda}. \tag{16}$$

If in addition $\bar{\tau} > b + g + c$ holds, the unique equilibrium threshold is[9]

$$z^*_{eq} = -\bar{z} + \frac{1}{1-\lambda}\left(c + \sqrt{c^2 + 4(1-\lambda)(\bar{\tau} - c - b - g)\bar{z}}\right). \tag{17}$$

5 The effects of policy

Policies affecting λ, c, b, g or $\bar{\tau}$ result in shifts of $E(x|x^e)$ and equilibrium country risk and expected social loss. Next we examine the effects of some of these policies. In this section we assume away the issue of multiplicity of equilibria and focus on cases in which uniqueness obtains.

[9] This is the correct expression if TR cuts CR to the left of $\tau(1-\lambda)^{-1}$. (This requires $4(1-\lambda)(\bar{\tau} - c - b - g) < \bar{z} - 2c$). Alternatively, if TR cuts CR to the right of $\tau(1-\lambda)^{-1}$, the correct equation is

$$z^*_{eq} = -\bar{z} + \frac{1}{1-\lambda}\left(\lambda\bar{\tau} + (1-\lambda)c - \sqrt{(\lambda\bar{\tau} + (1-\lambda)c)^2 - 4\bar{z}(1-\lambda)^2(b + g + \bar{\tau} + c) - \lambda\bar{\tau}^2}\right)$$

5.1 A conservative central banker à la Rogoff

A conservative central banker features a lower α, which is equivalent to a lower λ. The partial derivative of $E(x|x^e)$ with respect to λ is

$$\frac{\partial E(x|x^e)}{\partial \lambda} = E\left[(b+g+z+x^e) \mid \text{ no crisis }\right] p^{nc} - cf(z^*)\frac{\bar{\tau}}{(1-\lambda)^2} \tag{18}$$

For small values of c this derivative is positive, and we have the standard case: a conservative central banker delivers lower country risk.[10] But the opposite case is also possible. If c is large enough, the derivative is negative. That means that a decrease in α, with the consequent decrease in λ, shifts up $E(x|x^e)$ and therefore increases x^{e*}. The appointment of a more conservative policy-maker will reduce country risk if c is small enough, but increase it otherwise.

The intuition is as follows. Comparing two economies under different policy regimes, one with a conservative policy maker (low α) and another with a lax policymaker (high α), we see three possible outcomes depending on the realization of z:

- If the shock z is small enough, neither economy is in a fiscal crisis. In this case, the economy with the more conservative policymaker has less default/devaluation.
- If the shock z is large enough, both economies are in a fiscal crisis. In this case, both economies have the same amount of default/devaluation.
- If the shock is of intermediate size, then the economy with the lax policymaker is not in crisis, but that with the conservative policymaker is. In this case, the latter economy has higher country risk if c is large.

In computing expectations, agents average across these three possible situations. With sufficiently large costs c, the relatively high default/devaluation suffered by conservative policymakers when in the third situation more than offsets the relatively low default/devaluation they enjoy when in the first situation, so that "on average" conservatives engineer more default/devaluation, and this is rationally anticipated by the public. This line of reasoning also makes clear why, if $c = 0$, conservatives always deliver lower country risk.

[10] Note the term $b + g + z + x^e$ is always non-negative by construction, since we are integrating over the interval where $-(b + g + x^e) \leq z \leq z^*$.

This can also be seen by writing the condition for $\frac{\partial E(x|x^e)}{\partial \lambda} < 0$ (condition 18) as

$$E\left[(b+g+z+x^e)\mid \text{ no crisis}\right]p^{nc} < cf(z^*)\frac{\partial z^*}{\partial \lambda} \tag{19}$$

using the fact that, for a given x^e, $\frac{\partial z^*}{\partial \lambda} = \frac{\bar{\tau}}{(1-\lambda)^2}$. The LHS is the marginal effect of λ on country risk when considering no crisis events. It is positive, for more liberal (higher λ) policymakers default more when there is no crisis. On the RHS are the expected costs saved by becoming marginally less conservative. It is also a positive number, since $\frac{\partial z^*}{\partial \lambda} > 0$. In words, less conservative policymakers are in crisis less often. If the latter exceeds the former, then a less conservative policy maker delivers lower country risk.

The upper panels in figures 4 and 5 illustrate both possible cases. Again we use a uniform distribution with support $[-\bar{z}, \bar{z}]$. In 4 we depict a case with relatively high $\bar{\tau}$ and $c = 0$. This means that, for a given $\bar{z}$ (recall the standard deviation of the shock is proportional to $\bar{z}$), crises do not happen often, and when they do they involve zero costs. As the figure shows, country risk is always increasing in α (that is, increasing in λ and in policymaker liberalism).

The example in Figure 5 has the same parameters as Figure 4, except for a lower maximum tax revenue $\bar{\tau}$ and a large c. For small α's the traditional result holds and a more liberal policymaker delivers higher country risk. But for α's larger than 0.59 the opposite happens and more liberal policy maker delivers lower country risk.

What about the consequences for welfare? Recall Rogoff showed that, in the presence of time inconsistency, the policymaker that delivers the highest social welfare is one who has more conservative preferences than society as a whole. That celebrated result need not hold here.

Equilibrium expected social loss is

$$\begin{aligned} E(L) \quad = \quad & \frac{\alpha^s}{2}\int_{-(b+g+x^e)}^{z^*}\left(\frac{\lambda}{\theta}\right)^2\left[b+g+x^e+z\right]^2 f(z)\,dz \\ & +\frac{\alpha^s}{2}\int_{z^*}^{\bar{z}}\frac{1}{\theta^2}\left[b+g+x^e+z+c-\bar{\tau}\right]^2 f(z)\,dz \\ & +\frac{1-\alpha^s}{2}\int_{-(b+g+x^e)}^{z^*}(1-\lambda)^2\left[b+g+x^e+z\right]^2 f(z)\,dz \\ & +\frac{1-\alpha^s}{2}\int_{z^*}^{\bar{z}}\bar{\tau}^2 f(z)\,dz, \end{aligned} \tag{20}$$

which we write more compactly as

$$E(L) = \Lambda(\lambda, z^*, x^e, c) \tag{21}$$

Recall z^* and x^e are also functions of λ, as we have seen above. In words, expected loss depends on what share of the fiscal burden is financed by default/devaluation in non-crisis states, what the threshold is between crisis and non-crisis states, and what the expectation of default/devaluation is across all states.

Denote by $\Lambda_y(.)$ the partial derivative of Λ with respect to y. Some tedious computations reveal that

$$\Lambda_\lambda = \frac{1-\alpha^s}{\lambda}\left[1 - \left(\frac{\alpha^s}{1-\alpha^s}\right)\left(\frac{1-\alpha^g}{\alpha^g}\right)\right] E\left[(\delta b)^2 \mid \text{ no crisis}\right] p^{nc} \tag{22}$$

so that $\Lambda_\lambda = 0$ when $\alpha^g = \alpha^s$, as it must be since the chosen λ is, for a given x^e, the optimum for both the government and for society. Clearly Λ_λ is negative (positive) if α is smaller (larger) than α^s.

Finally, it is easy to check that $\Lambda_{x^e} > 0$ everywhere: higher country risk raises the fiscal burden and therefore expected loss.

With this information in hand we can now say something about the effect of policymaker preferences on social welfare. Note that

$$\frac{dE(L)}{d\lambda} = \Lambda_\lambda + \Lambda_{z^*}\frac{\partial z^*}{\partial\lambda} + (\Lambda_{x^e} - \Lambda_{z^*})\frac{dx^e}{d\lambda}, \tag{23}$$

where we have used the fact that $\frac{\partial z^*}{\partial x^e} = -1$. The first term on the RHS of this expression is non-positive for $\alpha \geq \alpha^s$. So is the second term, since $\frac{\partial z^*}{\partial \lambda} = \frac{\bar{\tau}}{(1-\lambda)^2} > 0$. In the third term, the expression in parentheses is always positive, so the sign of the third term depends on whether $\frac{\partial x^e}{\partial \lambda}$ is positive or negative.

To make progress consider a special point along 23, evaluating $\frac{dE(L)}{d\lambda}$ in the neighborhood of $\alpha = \alpha^s$ we have

$$\left.\frac{dE(L)}{d\lambda}\right|_{\alpha=\alpha^s} = \Lambda_{z^*}\left.\frac{\partial z^*}{\partial\lambda}\right|_{\alpha=\alpha^s} + (\Lambda_{x^e} - \Lambda_{z^*})\left.\frac{dx^e}{d\lambda}\right|_{\alpha=\alpha^s}, \tag{24}$$

Note that the celebrated Rogoff result is a special case that holds when $c = 0$. In that situation, $\Lambda_{z^*} = 0$ and $\left.\frac{\partial x^e}{\partial\lambda}\right|_{\alpha=\alpha^s} > 0$, so the RHS of 24 is unambiguously positive. Social loss falls as the policymaker becomes marginally more conservative than society as a whole. This situation is illustrated in the lower panel of Figure 4, where we have assumed $\alpha^s = 0.5$, and where the socially optimal level of α is equal to 0.35.

If $c > 0$ we have two subcases. If $\left.\frac{dx^e}{d\lambda}\right|_{\alpha=\alpha^s} > 0$, so that the conventional link between country risk and policymaker preferences obtains, the RHS has an ambiguous sign. It pays off to be more conservative than society if and only if the cost c is small (so that Λ_{z^*} is close to zero) while $\left.\frac{dx^e}{d\lambda}\right|_{\alpha=\alpha^s}$ is large (a more conservative policymaker sharply reduces country risk).

The other subcase obtains when $\left.\frac{dx^e}{d\lambda}\right|_{\alpha=\alpha^s} < 0$, so that we have the non-conventional result that greater liberalism causes country risk to fall. In that case, the RHS of 24 is unambiguously negative. The social optimum involves a policymaker who is more liberal than society as a whole. This case is illustrated in the lower panel of Figure 5, where we again assumed $\alpha^s = 0.5$, and where the socially optimal level of α is equal to 0.59.

5.2 Dollarization and indexation

We saw above that one interpretation of the parameter θ is the share of debt that is in domestic currency (not indexed). A common policy is to lower θ (i.e. to dollarize debt), so that a devaluation/inflation surprise yields little real revenue. Understanding this, the logic goes, governments will devalue/inflate less in equilibrium.[11] The currently fashionable policy of "dollarization," for instance (applied in Ecuador and El Salvador and hotly discussed in Argentina) consists in this context of driving θ all the way to zero.

What effects does this policy have? Note first that λ is increasing in θ, so the sign of the derivative of $E(x|x^e)$ with respect to θ is the same as that of the derivative with respect to λ. Equation 18 therefore applies, and we see that for c large enough, x^ecan actually increases as public debt becomes more dollarized. But now recall that $x^e \equiv \theta\delta^e b$ is expected revenue from devaluation/default. Redefining country risk as $\delta^e b$— so that it is associated to the rate of default/devaluation— we have that dollarization may increase country risk even when x^e is effectively going down. It follows that

$$\frac{d\left(\delta^e b\right)}{d\theta}\frac{\theta}{\delta^e b} = \frac{dx^e}{d\theta}\frac{\theta}{x^e} - 1 \tag{25}$$

That is, for greater dollarization to reduce expected default/devaluation rate,

[11] See for instance Calvo (1988) and Fischer and Summers (19xx).

the elasticity of x^e with respect to θ must be larger than one. How is this related to the analysis in the previous section? Since $x^e = \theta\delta^e b$, we have

$$\frac{dx^e}{d\theta}\frac{\theta}{x^e} - 1 = \left(\frac{dx^e}{d\lambda}\frac{\lambda}{x^e}\right) 2\left(1-\lambda\right) - 1 \tag{26}$$

Hence, greater dollarization reduces default/devaluation expectations if and only if the elasticity of $x^e$with respect to λ is larger than $0.5\left(1-\lambda\right)^{-1}$. This means that even if c is zero, so that $\frac{\partial x^e}{\partial \lambda}$is unambiguously positive, greater dollarization may increase country risk.

The intuition is that now changing θ not only alters λ, and therefore the share of government obligations that is financed via default. Changing θ also changes the stock of debt that can be defaulted on, so that for every dollar of revenue the government hopes to get from default, higher dollarization (lowering θ) requires a higher default rate.

Figure 6 illustrates the effect of varying dollarization/indexation in the case of $c = 0$. We see that the expected default/devaluation rate is first decreasing and then increasing in θ, the share of nominal debt in the total.

Note that the standard model without crises –for instance Fischer and Summers (1989)– would yield a monotonically increasing relationship between country risk and the share θ of nominal debt. The intuition is that since as θ rises default/devaluation becomes more productive (it yields more revenue for the same default/devaluation rate), it is used more in equilibrium. Algebraically, this is the case in which 5 holds in all states, from which it follows that

$$x^e = \frac{\lambda}{1-\lambda}\left(b+g\right) \tag{27}$$

Hence, using the definitions of λ and of x^e we have

$$\delta^e = \theta\left(\frac{\alpha}{1-\alpha}\right)\left(\frac{b+g}{b}\right), \tag{28}$$

so that δ^e is unambiguously increasing in θ.

Here matters are different because of the possibility of crises. In a crisis the default rate is not for the policymaker to choose, but rather given by revenue needs. It follows that, for a given amount of required revenue, the default rate in crises is higher the lower is the share θ of nominal debt. In addition, a higher θ means that the threshold z^* rises, so that the economy is in crises less often. Either or both of these effects can offset the standard

Fischer-Summers type of result, giving rise to the downward-sloping portion of the schedule in Figure 6 (top panel).[12]

What about the welfare implications of dollarization/indexation of liabilities? The expression in 21 can now be totally differentiated to yield

$$\frac{dE\left(L\right)}{d\theta}=\left\{\Lambda_{\lambda}+\Lambda_{z^{*}}\frac{\partial z^{*}}{\partial\lambda}+\left(\Lambda_{x^{\mathsf{e}}}-\Lambda_{z^{*}}\right)\frac{\partial x^{e}}{\partial\lambda}\right\}\frac{\partial\lambda}{\partial\theta}+\left.\frac{\partial E\left(L\right)}{\partial\theta}\right|_{\lambda\text{ given}} \tag{29}$$

where the last term includes effects on expected loss that do not operate through λ. That term can be easily computed from 20:

$$\left.\frac{\partial E\left(L\right)}{\partial\theta}\right|_{\lambda\text{ given}}=-\frac{\alpha^{s}}{\theta}E\left(\delta b\right)^{2}<0 \tag{30}$$

while

$$\frac{\partial\lambda}{\partial\theta}=2\frac{\lambda}{\theta}\left(1-\lambda\right)>0 \tag{31}$$

It follows that the welfare analysis of indexation/dollarization is the same as the welfare analysis of policymaker conservatism, but with a twist. There is now an additional effect: for a given λ, decreasing θ (indexing/dollarizing more) always increases social loss, since it is the attempted default/devaluation (δb) not its actual yield ($\theta\delta b$) that enters social loss.

Other things equal, then, trying to lower country risk and increase welfare via greater indexation-dollarization is a trickier business than doing so via a more conservative policymaker. Consider for simplicity the case in which $\alpha=\alpha^{s}$. (In that case, as we saw above, $\Lambda_{\lambda}=0$).

$$\left.\frac{dE\left(L\right)}{d\theta}\right|_{\alpha=\alpha^{\mathsf{s}}}=\left\{\Lambda_{z^{*}}\frac{\partial z^{*}}{\partial\lambda}+\left(\Lambda_{x^{\mathsf{e}}}-\Lambda_{z^{*}}\right)\frac{\partial x^{e}}{\partial\lambda}\right\}\frac{2\lambda}{\theta}\left(1-\lambda\right)-\frac{\alpha^{s}}{\theta}E\left(\delta b\right)^{2}, \tag{32}$$

Therefore, whenever country risk is decreasing in λ and therefore in θ, expected social loss is decreasing in θ. In other words, in the range of θ for which $\frac{\partial x^{\mathsf{e}}}{\partial\lambda}$ is negative, it pays off to have as little indexation-dollarization as possible.

Notice that if $c=0$, so that there is no cost of crises, this last expression becomes

$$\left.\frac{dE\left(L\right)}{d\theta}\right|_{\alpha=\alpha^{\mathsf{s}}}=\Lambda_{x^{\mathsf{e}}}\frac{\partial x^{e}}{\partial\lambda}\frac{2\lambda}{\theta}\left(1-\lambda\right)-\frac{\alpha^{s}}{\theta}E\left(\delta b\right)^{2}. \tag{33}$$

[12] Note however that if $c=0$ changing the threshold has no impact on δ^{e}, so that in Figure 6 the downward-sloping portion comes exclusively from the first effect.

We know the first term on the RHS is in this case positive, and the second term on the RHS is always negative. It follows the net effect can have either sign, and greater indexation/dollarization can be bad for welfare even if crises are costless. This case is depicted in the lower panel of Figure 6, in which expected social loss is declining in θ until this share hits 0.55, and increasing thereafter.

6 Endogenizing the cost of default

So far we have treated the cost c of defaulting/devaluing as exogenous. But it can easily be endogenized by appealing to incentive effects.

It is not always feasible to find a tough central banker or finance minister who has a strong dislike of devaluation or default. She may not exist, or she may be inevitably changed once in power. An external agency, such as the IMF, may attempt to commit the government to a low default/devaluation rate by imposing a penalty for c for deviations.[13]

Suppose that the IMF wants to induce the government to follow a given policy rule, characterized by a given α (call it α^f) and its associated λ (call it λ^f). If the government ever deviates from this policy, then it must pay the cost c. Naturally, the IMF will wish to impose the smallest c that ensures the rule is followed as long as possible.[14] The appendix shows that for each chosen λ^f there is a c^* equal to

$$c^* = \bar{\tau}\omega\left(\lambda^f, \lambda\right), \tag{34}$$

where $\omega\left(\lambda^f, \lambda\right) > 0$ is a function of λ^f and λ. As long as the cost of deviating is no smaller than c^*, the government will always attempt to stick to the policy dictated by the IMF. From the definition of $\omega\left(\lambda^f, \lambda\right)$ in the appendix it follows that this function is decreasing in λ^f if and only if $\lambda^f < \lambda$. Hence, if the IMF wants to lower λ^f below λ, it must also increase c^*.

What is the effect of a lower λ^f on expectations of default/devaluation? Consider the total derivative of $E(x|x^e)$ with respect to λ^f, which is now

[13] This is not too far of what the IMF did to Argentina in late 2002.

[14] By as long as possible we mean that if it hits the maximum-tax constraint, the government will have to deviate from the IMF-imposed policy even if it does not want to. The cost c^* below is constructed to reflect this. For details, see the appendix.

$$\frac{dE(x|x^e)}{d\lambda^f} = \frac{\partial E(x|x^e)}{\partial \lambda f} + \frac{\partial E(x|x^e)}{\partial c^*}\frac{\partial c^*}{\partial \lambda^f} \tag{35}$$

$$= E\left[(b+g+z+x^e) \mid \text{ no crisis}\right] p^{nc} - c^* f(z^*)\frac{\bar{\tau}}{(1-\lambda^f)^2} + p^c\bar{\tau}\omega(\lambda^f), \tag{36}$$

The sign of this derivative depends on λ^f itself. A more ambitious target (a lower α^f, meaning a lower λ^f) may cause expectations of default to fall or rise. Evaluating (36) in the extremes ($\lambda^f = \lambda$and $\lambda^f = 0$) one obtains

$$\left.\frac{dE(x|x^e)}{d\lambda^f}\right|_{\lambda^f=\lambda} = E\left[(b+g+z+x^e) \mid \text{ no crisis}\right] p^{nc} \tag{37}$$

$$\left.\frac{dE(x|x^e)}{d\lambda^f}\right|_{\lambda^f=0} = E\left[(b+g+z+x^e) \mid \text{ no crisis}\right] p^{nc} - \bar{\tau}\left[c^* f(z^*) + p^c\right]. \tag{38}$$

The right hand side of 37 is always positive; imposing a tighter policy starting from $\lambda^f = \lambda$ reduces $E(x|x^e)$. This is because the required increase in c^*, starting from $\lambda^f = \lambda$, is zero. But a 'zero tolerance' policy of $\lambda^f = 0$ can backfire: the RHS of (38) may be negative, in which case an *increase* in λ^f is required to reduce expectations of devaluation/default. An example appears in the top panel of Figure 7, where country risk first falls and then rises as α^f (and therefore λ^f) decreases.

What are the implications for welfare? Should the IMF force the local policymaker to act more conservatively than the policymaker naturally would? We can use the same technique as in earlier sections, calculating

$$\frac{dE(L)}{d\lambda^f} = \Lambda_{\lambda^f} + \Lambda_{z^*}\frac{\partial z^*}{\partial \lambda^f} + (\Lambda_{x^e} - \Lambda_{z^*})\frac{\partial x^e}{\partial \lambda^f} + \Lambda_c \frac{\partial c}{\partial \lambda^f} \tag{39}$$

where it is easy to check from 20 that

$$\Lambda_c = \frac{\alpha^s}{\theta^2} E(x \mid \text{crisis})\, p^c > 0 \tag{40}$$

Focus first on the case with $\alpha = \alpha^s$, so that the government has the same preferences as society. Given that the marginal increase in the cost needed to implement a slightly higher λ is zero, 39 becomes

$$\left.\frac{dE(L)}{d\lambda^f}\right|_{\alpha^f=\alpha=\alpha^s} = \Lambda_{x^e}\frac{\partial x^e}{\partial \lambda^f}, \tag{41}$$

which is positive since $\frac{\partial x^e}{\partial \lambda^f} > 0$ for $c = 0$. Therefore, having the IMF induce a policy that is more conservative than both society and the government is optimal. That is, if $\alpha = \alpha^s$, the best α^f is $\alpha^f < \alpha$. The intuition is that raising the policymakers α to $\alpha^f < \alpha$ has marginal benefits and costs. The marginal benefit is that in non-crisis situations, a more conservative policymaker ameliorates the time inconsistency problem.[15] The marginal cost is that in crisis situations a cost c has to be paid, and the more conservative the policymaker is, the more often crises happen. But starting at $\alpha^f = \alpha$ this marginal cost is zero, since the marginal increase in c required to make that α^f sustainable is zero.[16] This case appears in the lower panel of Figure 7.

If the government is naturally more liberal than society, so that $\alpha < \alpha^s$, then we have

$$\left.\frac{dE(L)}{d\lambda^f}\right|_{\alpha^f = \alpha^s < \alpha} = \Lambda_{z^*}\frac{\partial z^*}{\partial \lambda^f} + (\Lambda_{x^e} - \Lambda_{z^*})\frac{\partial x^e}{\partial \lambda^f} + \Lambda_c \frac{\partial c}{\partial \lambda^f}, \tag{42}$$

which may be positive or negative, since the sum of the first two terms, as we know, is of ambiguous sign, and $\Lambda_c > 0$. That is, having the IMF induce a policy that is more conservative than society could be welfare decreasing if the government is sufficiently liberal, so that the c needed to sustain the IMF policy is large.

What is the connection between how tough an IMF program is and uniqueness of equilibria? It turns out that a sufficiently tough or ambitious program –that is, one with a low α^f– can cause multiple equilibria. The intuition is that forcing a government to behave much more conservatively than it would if left to its own devices calls for a large cost c. And, as we saw in sections 2 and 3 above, a large enough c can generate multiple equilibria. As in those sections, the intuition is that expectations of high default/devaluation raise the fiscal burden, shifting the threshold between crisis and non crisis states. A large c is then paid with higher probability, worsening the expected fiscal burden and potentially rendering the pessimistic expectations self-confirming.

[15] And starting from $\alpha^s = \alpha^g$, making the policy maker marginally more conservative increases welfare, as Rogoff proved, since the gain from enhanced credibility more than offsets the loss from less flexibility in responding to shocks.

[16] That is, $\left.\frac{\partial \omega(\lambda^f, \lambda^g)}{\partial \lambda^f}\right|_{\lambda^f = \lambda^g} = 0$.

This result stands in contrast with those of Obstfeld (1997). In that paper, escape clauses with exogenous costs can involve self-fulfilling attacks on fixed exchange rates if those costs are sufficiently small. In Obstfeld's paper escape costs are non-pecuniary and affect the policymaker's utility only. The higher the cost, the less willing is the policymaker to validate high devaluation expectations. Here escape costs are pecuniary and they affect the government's budget constraint. This is precisely why high such costs allow pessimistic expectations to be self-validating.

An example of this phenomenon appears in Figure 8. As α^f (and therefore λ^f) falls country risk decreases, but for very low α^f (very conservative IMF programs) the equilibrium is no longer unique. There is an alternative outcome that yields higher country risk and expected social loss. In that range, which equilibrium obtains depends exclusively on animal spirits. By being more ambitious, the IMF may end up increasing the very country risk it was attempting to reduce.

7 Conclusions

Do tougher policies induce higher credibility, lower expectations of devaluation and default, and possibly higher welfare? Conventional wisdom typically says yes. The model in this paper suggests otherwise. In an uncertain environment in which fiscal crises are both possible and costly, tough policies such as greater policymaker conservatism and rising dollarization/indexation of government debt can easily backfire, causing higher country risk and lower welfare.

This does not mean that any toughening of policies is counterproductive. On the contrary, we have shown that the relationship between country risk and expected social loss, on the one hand, and the "toughness" of policies, on the other, can be non-monotonic and quite sensitive to changes in underlying economic conditions. But our results do suggest that toughness beyond a certain point may be welfare reducing, and that this *certain point may* other than what conventional theory suggests. For instance, the well-known result that it is welfare-improving to appoint a conservative policy-maker often does not hold here.

Not all tough policies are created equal. The paper also suggests that indexing or dollarizing public debt may be particularly dangerous. Appointing a conservative policymaker may cause crises to occur more often, but has no implications for the ability of the government to default/devalue as needed in times of crisis. That is why conservatism may be welfare-improving if the fiscal costs of crisis are small, as we say in sections 4 and 5. Dollarization of debts, on the other hand, or measures such as facilitating the imposition of sanctions or penalties on defaulting nations, reduce the revenue collected by governments for every possible default/devaluation rate. This means that, other things equal, default rates are higher at times of crisis, and country risk and expected social loss may well be higher.[17]

We have developed the argument in terms of a fiscal problem, but the same logic could be applied more broadly. For instance, it could be applied to the inflation-unemployment trade-off for which the idea of time inconsistency was originally developed. If the expectations-augmented Phillips curve is subject to shocks and if there is a politically-dictated upper bound to the rate of unemployment (as their arguably is in the real world), then a very similar story applies. Often-advocated policies, such as indexing wages to insulate them from inflation, thereby making inflation surprises useless in terms of employment, could also have counter-productive effects.

[17] Fischer and Summers (1989) make a related point, arguing that what they term policies of "inflation protection," may be welfare improving when inflation is imperfectly controlled by the policymaker.

A Appendix

For any given λ^f, if there is no fiscal crisis the instantaneous loss is

$$L^f = \left(\frac{1-\alpha^g}{2}\right)\left[\left(\frac{1-\lambda}{\lambda}\right)\left(\lambda^f\right)^2 + \left(1-\lambda^f\right)^2\right](b+g+z+x^e)^2 \tag{43}$$

But if against the maximum tax constraint, the government has to deviate from the IMF policy even if it does not want to. This means that the worst realization of z for which 43 is relevant turn out to be z^*, which is given here by $(b+g+z^*+x^e) = \left(1-\lambda^f\right)\bar{\tau}$. In that case 43 can be written as

$$L^f = \left(\frac{1-\alpha}{2}\right)\left[1+\left(\frac{1-\lambda}{\lambda}\right)\left(\frac{\lambda^f}{1-\lambda^f}\right)^2\right]\bar{\tau}^2 \tag{44}$$

By contrast, if the government deviates from the IMF prescription and applies its preferred rule λ, the resulting loss is

$$L^g = \left(\frac{1-\alpha}{2}\right)(1-\lambda)\,(b+g+z+x^e+c)^2\,, \tag{45}$$

which evaluated at the same z^* as above equals

$$L^g = \left(\frac{1-\alpha}{2}\right)\left(\frac{1-\lambda}{(1-\lambda^f)^2}\right)\left[\bar{\tau}+\left(1-\lambda^f\right)c\right]^2. \tag{46}$$

The government will not deviate for any $z \leq z^*$ as long as 43 is no larger than 45, implying

$$c \geq \bar{\tau}\left(\frac{\psi-1}{1-\lambda^f}\right) \equiv \bar{\tau}\omega\left(\lambda^f,\lambda\right) \tag{47}$$

where

$$\psi \equiv \sqrt{\frac{(\lambda^f)^2}{\lambda}+\frac{(1-\lambda^f)^2}{1-\lambda}} \geq 1$$

Equation 47 defines the lowest feasible c, which we call c^*. Note that if $\lambda^f = \lambda$, $\psi = 1$, so deviation is never preferred (given that c is non-negative). It is straightforward to show that, given the definition of ψ, the function $\omega\left(\lambda^f,\lambda\right)$ is decreasing in λ^f if and only if $\lambda^f < \lambda$.

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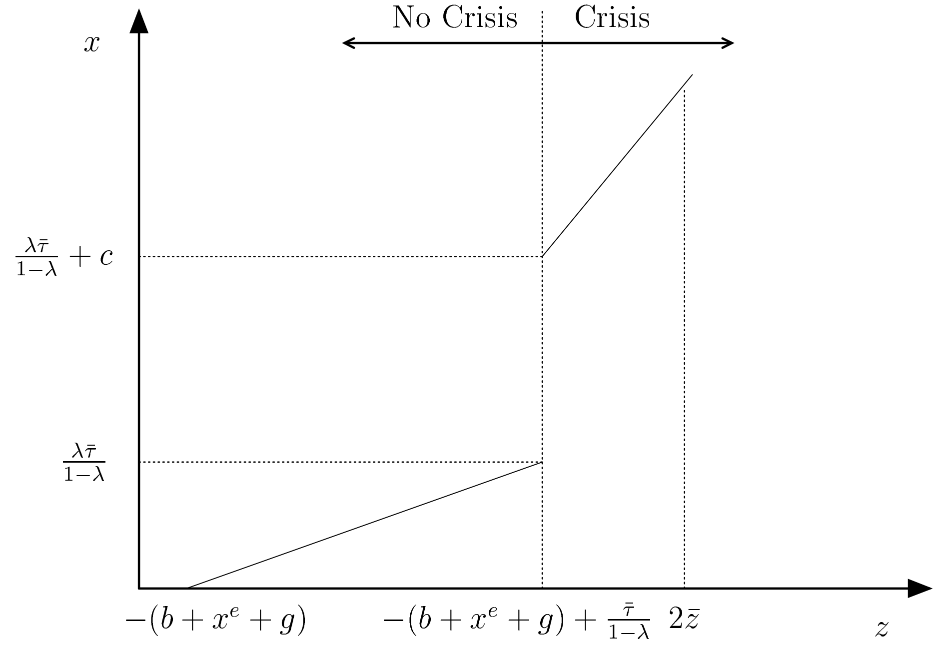

Figure 1: Crisis and no-crisis regions

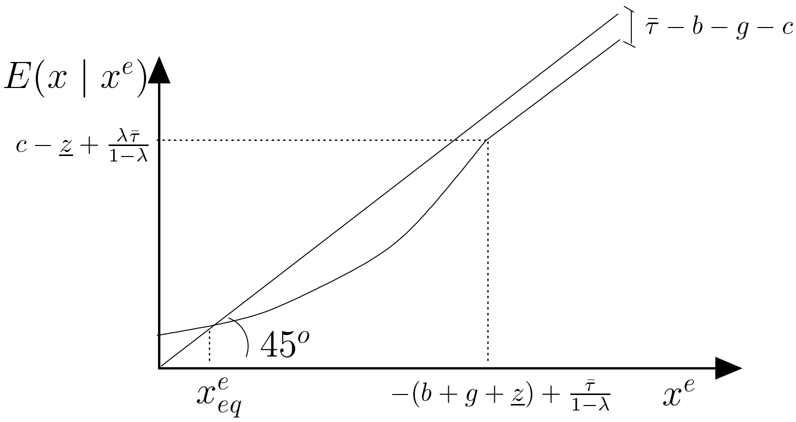

Figure 2.1

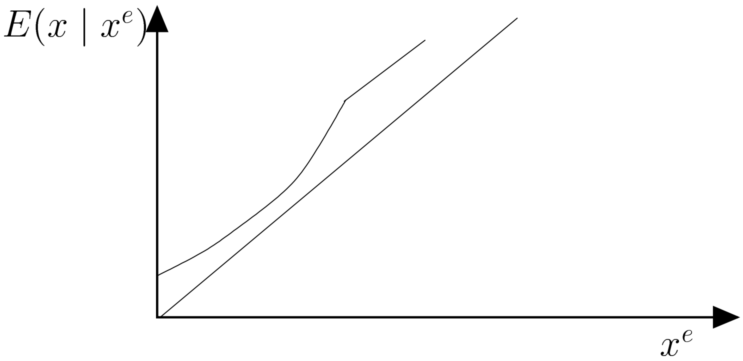

Figure 2.2

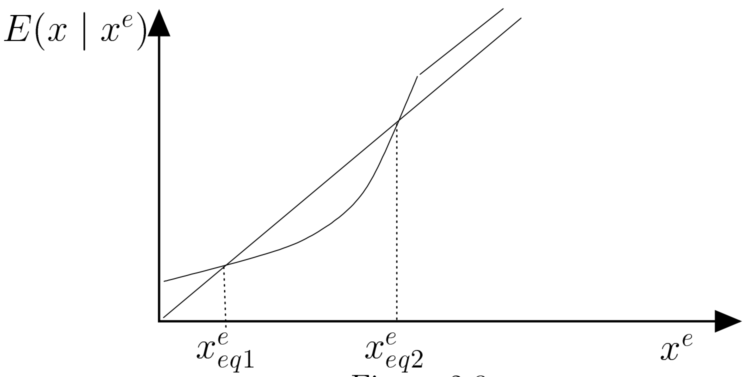

Figure 2.3

Figure 2: Equilibria

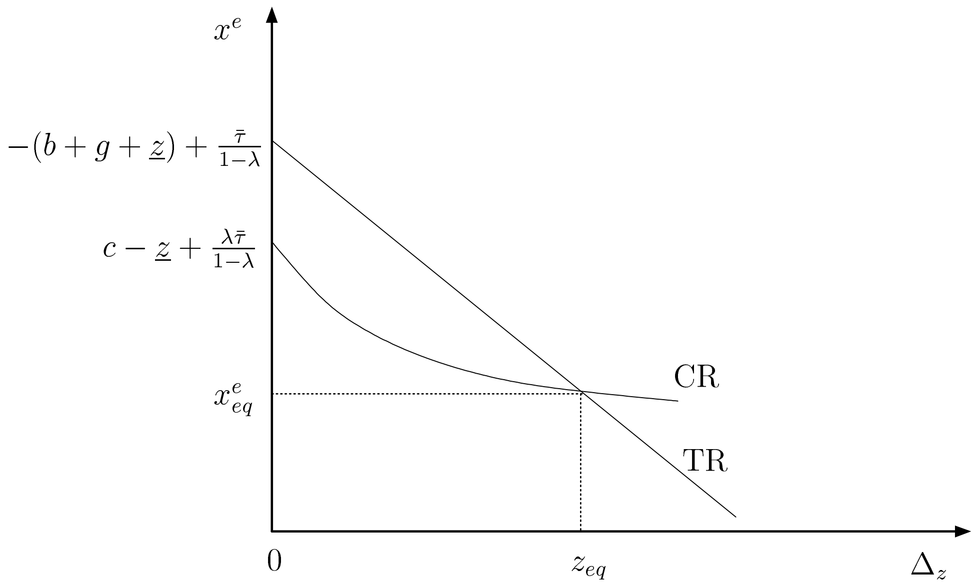

Figure 3: Equilibrium with uniform distribution

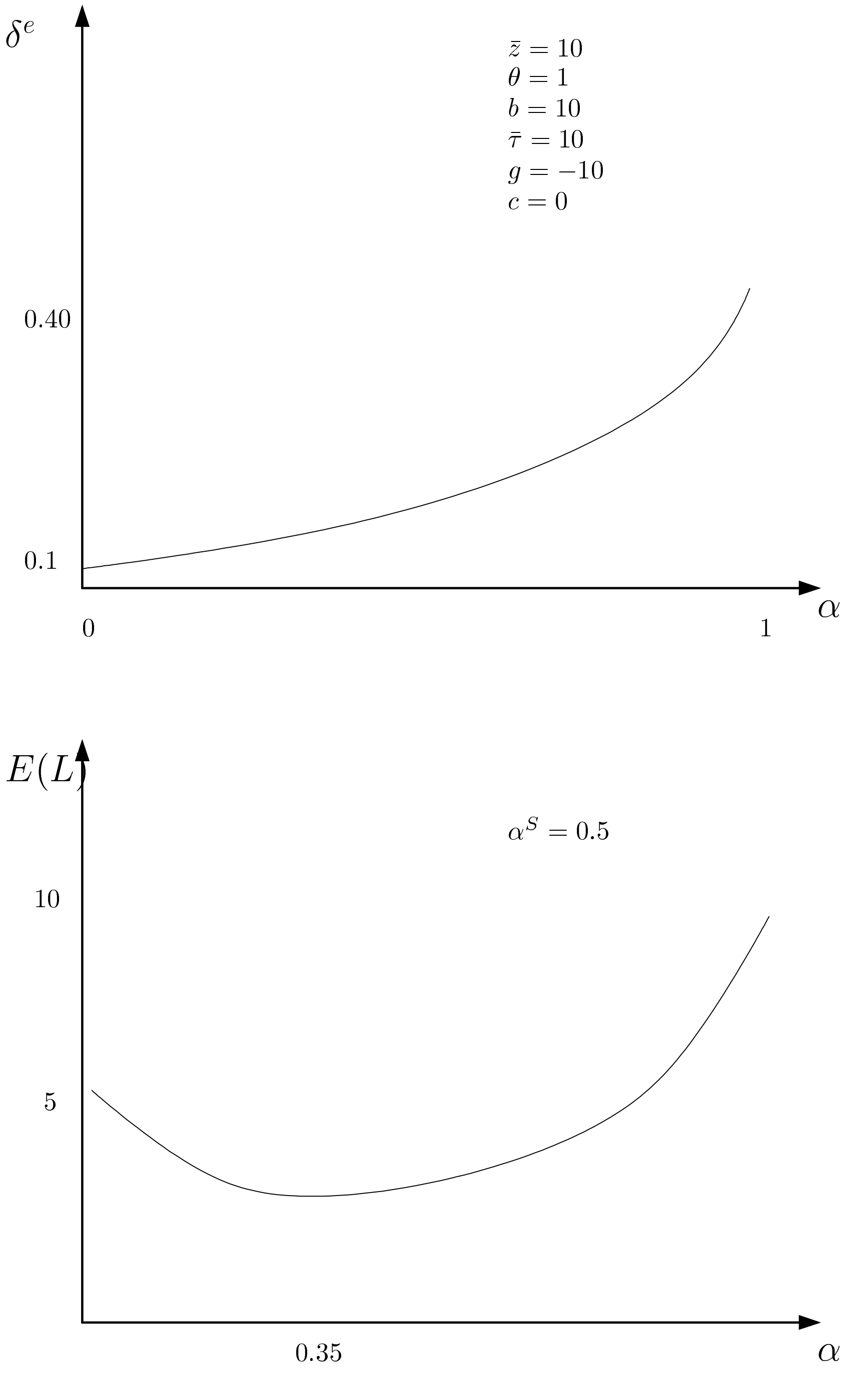

Figure 4: Equilibrium country risk and expected social loss with costs $c = 0$.

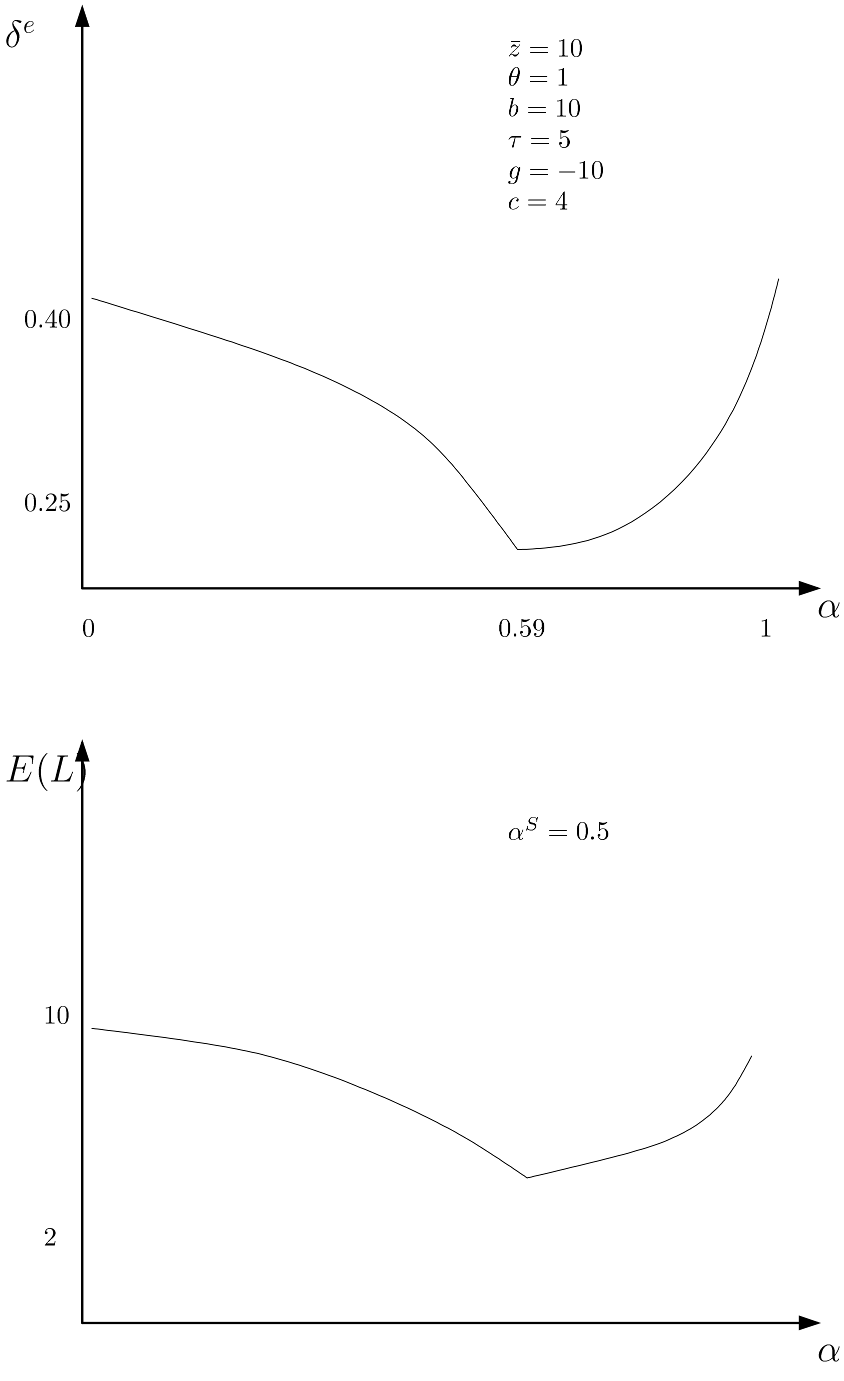

Figure 5: Equilibrium country risk and expected social loss with costs $c = 4$.

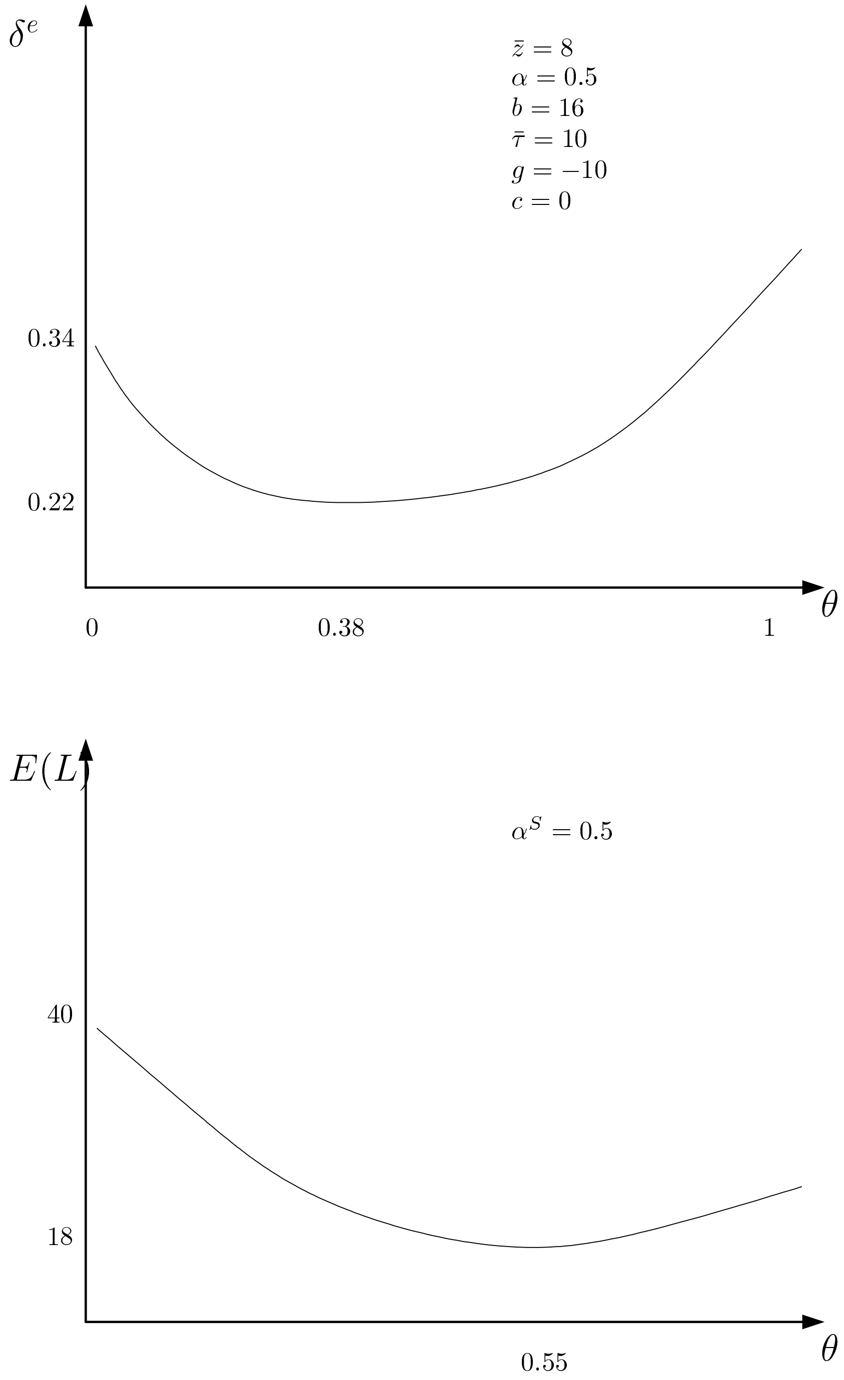

Figure 6: Equilibrium country risk and expected social loss with costs $c = 0$.

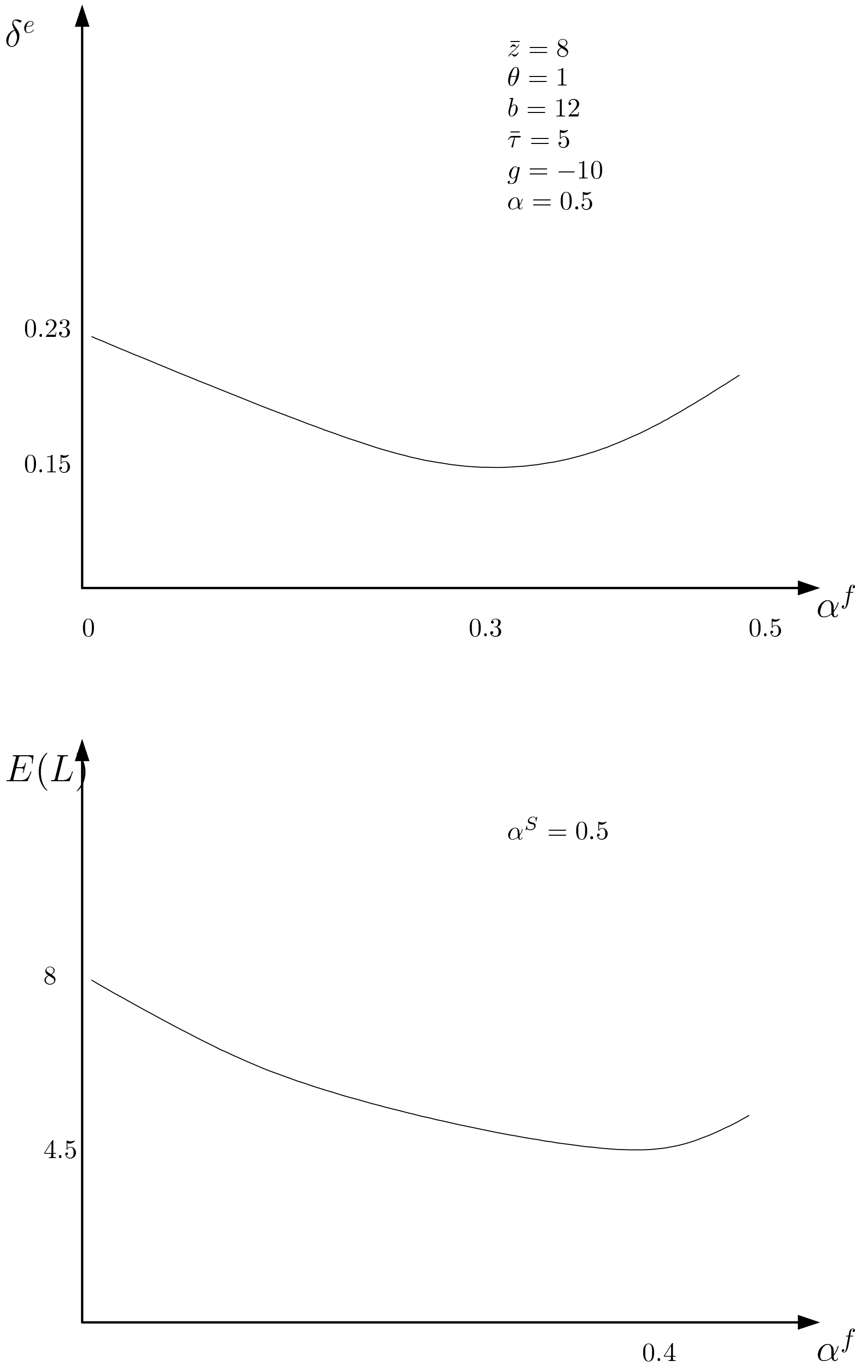

Figure 7: Equilibrium country risk and expected social loss with endogenous costs.

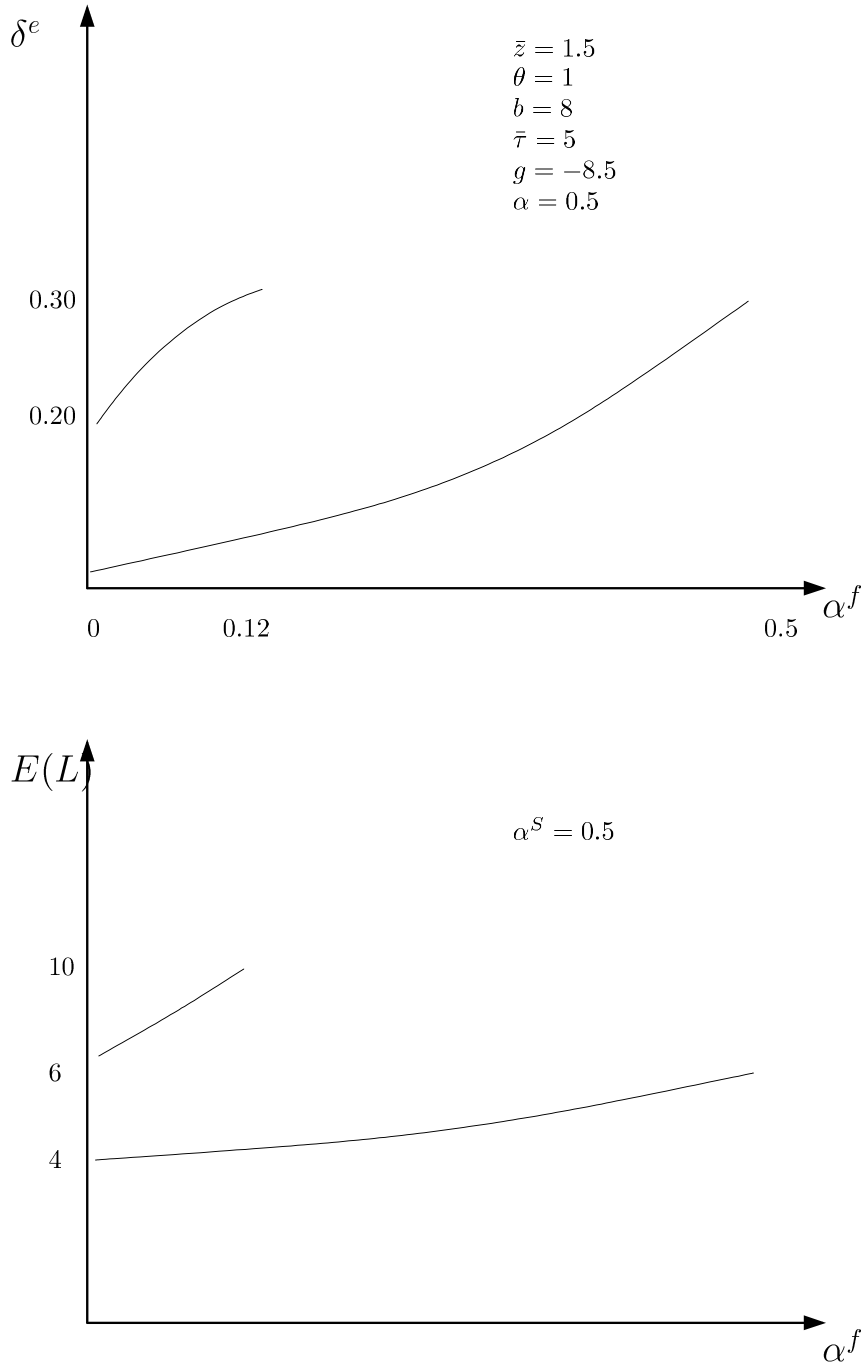

Figure 8: Equilibrium country risk and expected social loss with endogenous costs.