Lectures 1-2. Sovereign Risk

1. *Theoretical framework*

a. A formal model
b. Borrowing constraints and default

2. *The macroeconomic effects of sovereign risk*

a. Investment distortions and inefficient growth
b. Excess consumption volatility
c. Coordination failures

3. *Reputation, default and retaliation* (read Grossman and van Huyck (1988), Bulow and Rogoff (1999))

a. Reputational equilibria
b. The Bulow-Rogoff result and its limitations

4. *The role of secondary markets* (read Broner, Martin and Ventura (2006))

a. Sovereign risk and secondary markets
b. Transaction costs, large agents and government interference

1. Theoretical framework

We model the interaction between a small country and the international financial market. The country wants to borrow today, but it might be unwilling to pay debts tomorrow. This problem is known as "sovereign risk" and our goal is to understand its origins and consequences.

Assumption 1. (Basic setup) The world lasts two periods, today and tomorrow, indexed by t=0,1. There are many possible states of nature tomorrow, indexed by s=1, …, S. The probability that state s occurs is π_s. There is a single good that can be used for both consumption and investment.

Assumption 2. (The country) The country maximizes $U(c_0, \{c_s\}_{s=1}^{S}) = u_0(c_0) + \sum_s \pi_s \cdot u_s(c_s)$ where $u_0(\cdot)$ and $u_s(\cdot)$ are weakly increasing, twice-differentiable and concave. The country starts with an endowment equal to y_0 and a technology $y_s = f_s(k)$ where k is the capital stock and $f_s(\cdot)$ are also weakly increasing, twice-differentiable and concave.

The autarky benchmark

If the country lived in autarky, it would face these budget or resource constraints:

$$c_0 = y_0 - k \quad \text{and} \quad c_s = f_s(k) \quad \text{for all s}$$

and the optimal consumption and investment would be given by these constraints plus the first-order condition:

$$1 \geq \sum_s \pi_s \cdot \frac{u_s'(c_s)}{u_0'(c_0)} \cdot f_s'(k) \text{ (with equality if k>0)}$$

This condition says that the country should invest until the NPV of an additional unit of capital equals one. The price kernel is $\pi_s \cdot \frac{u_s'(c_s)}{u_0'(c_0)}$ for all s.

If domestic financial markets offer them, the price of an Arrow-Debreu security that pays tomorrow in state s is $\pi_s \cdot \frac{u_s'(c_s)}{u_0'(c_0)}$ while the price of a non-contingent bond with face value equal to p is $\sum_s \pi_s \cdot \frac{u_s'(c_s)}{u_0'(c_0)} \cdot p$.

Assumption 3. (International financial market) The international financial market offers the country a set of securities, N. Each security is defined by a payoff vector that specifies the payments that the security pays tomorrow in each state of nature, i.e. $(p_s)_{s=1}^{S} \in N \in \Re^S$. The international financial market is risk-neutral and discounts future payments with an interest rate equal to r.

Given this assumption, security prices are given by:

$$v\left((p_s)_{s=1}^{S}\right) = \begin{cases} \sum_s \frac{\pi_s}{1+r} \cdot p_s & \text{if } (p_{1s})_{s=1}^{S} \in N \\ +\infty & \text{if } (p_{1s})_{s=1}^{S} \notin N \end{cases}$$

The price kernel is now $\frac{\pi_s}{1+r}$ for all s.

If the international market offers them, the price of an Arrow-Debreu security that pays tomorrow in state s is $\frac{\pi_s}{1+r}$ while the price of a non-contingent bond with face value equal to p is $\frac{p}{1+r}$.

The complete-markets benchmark

If the international financial market offers the country a set of securities $N = \Re^S$, the country would face these budget or resource constraints:

$$c_0 = y_0 - k - \sum_s \frac{\pi_s}{1+r} \cdot p_s \quad \text{and} \quad c_s = f_s(k) + p_s \quad \text{for all s}$$

where the country's foreign debt is: $d = -\sum_s \frac{\pi_s}{1+r} \cdot p_s$, and the optimal consumption, investment and portfolio would be given by these constraints plus the first-order conditions:

$$1 > \sum_s \frac{\pi_s}{1+r} \cdot f_s'(k) \text{ (with equality if k>0)} \quad \text{and} \quad \frac{u_s'(c_s)}{u_0'(c_0)} = \frac{1}{1+r} \quad \text{for all s}$$

Same condition as before for investment, but using market prices. Consumption-smoothing does not affect investment.

Borrowing constraints and default

With sovereign risk, the autarky ($N = \varnothing$) and complete-markets ($N = \Re^S$) benchmarks are both inappropriate because we have endogenous or micro-founded borrowing constraints. How do we determine the latter?

1. Assume that, in the event of default, the international financial market cannot retaliate against the country. Then, $N = \left\{ (p_s)_{s=1}^S \middle| p_s \geq 0 \text{ for all } s \right\}$ is feasible and constrained-efficient.

2. Assume that, in the event of default, the international financial market can costlessly impose penalties on the country worth ϕ_s tomorrow in state s. Then, $N = \left\{ (p_s)_{s=1}^S \middle| p_s \geq -\phi_s \text{ for all } s \right\}$ is feasible and constrained-efficient.

Is the "default and penalty" game well defined? (What are these penalties? Who decides them? When?)

From "off-equilibrium" to "equilibrium" default and penalties (What frictions do we need?)

Example

Assume $u_0(\cdot) = u_s(\cdot)$ for s=1,2; $y_0 = 0$ and $y_s = 2 \cdot y$ for s=1,2; and r=0.

1. Let $\phi_s = +\infty$ for s=1,2. Then, we can implement $c_0 = c_1 = c_2 = y$.

2. Now let $\phi_2 = \lambda \cdot 2 \cdot y$ ($\lambda < 0.5$). Then, we can only implement $c_0 = c_1 = \frac{1+\lambda}{3} \cdot 2 \cdot y$ and $c_2 = (1-\lambda) \cdot 2 \cdot y$ without equilibrium default nor penalties.

3. Now assume that there is only a non-contingent loan. Then, we can still implement $c_0 = c_1 = \frac{1+\lambda}{3} \cdot 2 \cdot y$ and $c_2 = (1-\lambda) \cdot 2 \cdot y$ but now this requires default in state 2. No penalties are imposed ("excusable" default).

4. Now assume the the international financial market does not observe the state (moreover penalties are small and/or utilities very concave). Then, we can only implement $c_0 = c_1 = \frac{1}{3} \cdot 2 \cdot y$ and $c_2 = (1-\lambda) \cdot 2 \cdot y$. This requires both default and penalties being imposed in state 2. ("excusable" and "non-excusable" default).

2. The macroeconomic effects of sovereign risk

We next use the theoretical framework developed to study the macroeconomic effects of sovereign risk. The presence of borrowing constraints prevents beneficial trade across dates (borrowing and lending) and across states of nature (risk sharing) and lowers welfare.

We next focus on the following macroeconomic manifestations of this problem:

1. Investment distortions and inefficient growth.

2. Excess consumption volatility.

3. Cordination failures.

Investment distortions and inefficient growth

To simplify the exposition, we assume that there is no uncertainty, i.e. s=1; and preferences exhibit exponential discounting, i.e. $u_0(\cdot) = u(\cdot)$ and $u_1(\cdot) = \beta \cdot u(\cdot)$.

We also assume that penalties are proportional to output, i.e. $\phi = \lambda \cdot f(k)$. Therefore, the budget or resource constraints simplify to:

$$c_0 = y_0 - k + d \quad \text{and} \quad c_1 = f(k) - \max\{(1+r) \cdot d, \lambda \cdot f(k)\}$$

If λ is high enough, the country is not constrained and:

$$1 = \frac{f'(k)}{1+r} \quad \text{and} \quad u'(c_0) = (1+r) \cdot \beta \cdot u'(c_1)$$

But what happens if λ is small?

Case I: Investing after borrowing

Assume the country can decide investment after borrowing. Then, the equilibrium is as follows:

1. The international financial market sets a borrowing constraint, $d \leq \bar{d}$, that ensures repayment. That is, $(1+r)\cdot\bar{d} \leq \lambda \cdot f(k^*)$ when k^* is optimal investment.

2. The country maximizes utility subject to the budget constraints and the borrowing constraint. When λ is small and the borrowing constraint is binding, the FOCs say:

$$u'(c_0) = f'(k)\cdot\beta\cdot u'(c_1) \quad \text{and} \quad u'(c_0) > (1+r)\cdot\beta\cdot u'(c_1)$$

Sovereign risk constraints foreign borowing and generates:

- Underinvestment and low growth.
- High domestic interest rate and low consumption today.

Case II: Investing before borrowing

Assume instead that the country can decide investment before borrowing. Then, the equilibrium is as follows:

1. The international financial market sets a borrowing constraint $d \leq \frac{\lambda \cdot f(k)}{1+r}$ after it observes the level of investment k.

2. The country maximizes utility subject to the budget constraints and the borrowing constraint. When λ is small and the borrowing constraint is binding, the FOCs say

$$u'(c_0) > f'(k) \cdot \beta \cdot u'(c_1) \quad \text{and} \quad u'(c_0) > (1+r) \cdot \beta \cdot u'(c_1)$$

Sovereign risk induces actions that relax the borrowing constraint and generates:

- Overinvestment and high growth.
- High domestic interest rate and low consumption today.

Excess consumption volatility

We have already seen an example of this problem earlier, when we studied the case in which $u_0(\cdot) = u_s(\cdot)$ for s=1,2; $y_0 = 0$ and $y_s = 2 \cdot y$ for s=1,2; and r=0. We found that:

1. Without sovreign risk, consumption is smooth: $c_0 = c_1 = c_2 = y$. Thus, $c_0 = E(c_s)$ and $Var(c_s) = 0$.

2. With sovereign risk and perfect information, consumption is no longer smooth and varies over time and states of nature: $c_0 = c_1 = \frac{1+\lambda}{3} \cdot 2 \cdot y < (1-\lambda) \cdot 2 \cdot y = c_2$. Thus, $c_0 < E(c_s)$ and $Var(c_s) > 0$.

3. With sovereign risk and asymmetric information, consumption also varies over time and states of nature: $c_0 = c_1 = \frac{1}{3} \cdot 2 \cdot y < (1-\lambda) \cdot 2 \cdot y = c_2$. Thus, $c_0 < E(c_s)$ and $Var(c_s) > 0$.

Coordination failures

We have assumed throughout that the country is being led by a smart social planner and the international financial market acts as a non-strategic single agent. What happens if we instead recognize that the behavior of both country and international financial market are the sum of many uncoordinated decisions by small individuals as well as financial and non-financial firms?

1. (Strategic complementarities) Domestic and foreign private agents'actions today depend on government behavior tomorrow, and viceversa. For instance, there might be multiple equilibria in investment:
    a. If domestic investors expect low taxes and invest a lot, the tax required to pay the debt is small and this validates their expectations.
    b. If domestic investors expect high taxes and invest little, the tax required to pay the debt is large and this also validates their expectations.

2. (Borrowing or trading externalities) Domestic and foreign borrowers (lenders) do not take into consideration how their actions affect the government decision to default. Typically this leads to inefficiently tight borrowing constraints.

3. Reputation, default and retaliation

We have assumed so far that the interaction between the country and the international financial market is sporadic. If instead the interaction is repeated over time the number of equilibria increases dramatically. In fact, it might be even possible to replicate the complete-markets allocation even if there are no conventional penalties. Do these equilibria provide a better description of the real world?

We first show how to construct these equilibria and then analyze a powerful argument, due to Bulow and Rogoff (1989) to rule them out:

1. Reputational equilibria

2. The Bulow-Rogoff result and its limitations

Reputational equilibria

(*One-shot risk sharing problem*) Assume $u_0(c_0) = 0$ and $u_s(c_s) = u(c_s)$, and normalize such that $u(0) = 0$. There are two states of nature, s=1,2. In state 1, $y_1 = y$ and in state 2 $y_2 = 0$. There are no conventional penalties: $\phi_1 = \phi_2 = 0$. Then, insurance is not possible and $c_1 = y$ and $c_2 = 0$.

(*Repeated risk-sharing problem*) Assume this interaction is repeated infinitely many times. The future is discounted at rate β. Then, there are additional equilibria based on trigger strategies. For instance, assume that defaulting leads to permanent exclusion from the international financial market. Is the complete-markets allocation sustainable?

Benefit from default: $u(y) - u(0.5 \cdot y) \geq 0$

Cost from default: $\frac{\beta}{1-\beta} \cdot [u(0.5 \cdot y) - 0.5 \cdot u(y)] \geq 0$

Define $\beta^* = 2 - \frac{u(0.5 \cdot y)}{0.5 \cdot u(y)} \in [0,1]$. If $\beta < \beta^*$, the answer is negative. If $\beta > \beta^*$, the answer is positive.

Extensions/comments:

1. Partial risk sharing is possible if $\beta \in (\beta^*, 1]$.

2. Permanent exclusion from financial markets is the worse possible threat and therefore sustains the maximum amount of insurance.

3. There are many alternative threats and therefore equilibria. How do we rule these out and obtain empirical predictions of the theory?

4. Infinite vs. finite horizons.

The Bulow-Rogoff result and its limitations

Bulow and Rogoff (1989) argue that even the worst possible threat in a reputational equilibria is not realistic. Even if a country defaults, there is no reason why it should not be able to purchase insurance if it provides enough collateral. But if this is is the case, the country will always prefer to default on any debt and, since the international financial market knows this, the country cannot borrow.

Limits to the Bulow-Rogoff argument:

1. International financial market:
    a. Lack of commitment
    b. Imperfect competition
    c. Asset bubbles
2. Reputational spillovers
    a. Other interactions
    b. Signaling
3. Political economy problems