Lecture 23

Qian and Roland (1998)
Cai and Treisman (2005)

Qian and Roland (1998)

1. Introduction

   (a) Governments in developing countries and transition economies tend to bail out failing state enterprises.

   Bailouts are expensive and take resources away from other worthwhile activities.

   (b) Failure and bailout are interdependent.

   The promise of bailout erodes effort, which encourages failure.

   The threat of termination encourages effort, which reduces failure.

   (c) They define a "hard budget constraint" equilibrium as a subgame prefect equilibrium with high effort and no bailouts. In this case there are also plentiful government resources for other activities.

   They define a "soft budget constraint" equilibrium as a subgame perfect equilibrium with low effort and bailout.

   (d) The authors are interested in why we may have one equilibrium and not the other. In particular, they focus on the *degree of centralization* as a central factor.

   Specifically, the central government has lower opportunity cost for bailouts than do the regional governments in a federation.

   Fiscal externalities make the opportunity cost of funds higher for local governments than for the central government. This reduces the incentive to keep subsidizing inefficient enterprises.

   They show that if equilibria exist and certain conditions hold then equilibria under centralization all have soft budget constraints and equilibria under federalism all have hard budget constraints.

   The outcome is better than under centralization, but there are still distortions: overprovision of infrastructure and underprovision of local public goods.

   (e) They also show that if local governments have easy access to credit, or they can print money, then the budget constraints will tend to soften.

   This gives an efficiency rationale for the assignment of different functions to different tiers of government (they call this "checks and balances," but that is a very general concept).

2. There are N identical regions. The focus will be on symmetric equilibria.

   In each region there is a government with a social welfare function:

   $$W_i$$

   The regional social welfare function depends on the income of workers in state owned firms, the income of workers in non-state firms, and local public goods.

   (a) Income of workers in state owned firms: y_i.

   A critical assumption is that the only way the government can support workers in state owned firms is to prop up those firms.

   The government lacks an efficient way of making direct transfer payments to these workers. This is critical!

   (b) Income of workers in non-state firms: x_i.

   Workers in non-state firms are paid their marginal product. This in turn depends on public infrastructure, I_i. Given constant returns to scale:

   $$x(K_i, I_i) = f(K_i, I_i) - K_i f_K(K_i, I_i)$$

   In general then:

   $$W_i = x(K_i, I_i) + y_i + u(z_i)$$

3. There is also a central government. Its social welfare function is just the sum of the regional social welfare functions:

   $$W = \sum_i W_i$$

4. Overall, we are interested in comparing the outcomes of two games.

   (a) In one, the central government makes all decision.

   (b) In the other the central government does not act and the regional governments make all the decisions.

5. In both games, the basic order of play is the same.

   (a) In each region there are n state enterprises (n large) and some non-state enterprises.

   (b) At date 0, nature tells state enterprises ("workers") which of their projects are type-1 ("good") and which are type-2 ("bad").

   $$\Pr(\text{good project}) = \alpha$$

   $$\Pr(\text{bad project}) = 1 - \alpha$$

   (c) Between date 0 and date 1, the state owned firms with bad projects make a decision about whether to work hard at bad projects ("high effort") or whether to give up ("low effort").

   (d) At date 1, the game ends for state owned firms with good projects and for firms with bad projects and high effort.

   The incomes to the workers (net of effort) are assumed to be the same in both cases. A worker is indifferent between having a good project and having a bad project and putting in high effort.

   The revenue to the state is also the same in both cases.

   (e) A lot happens between date 1 and 2.

      i. The government decides whether to "bail out" or "terminate" the firms with bad projects and low effort.

      ii. Simultaneously, it chooses how much local public good to provide and how much public infrastructure to provide.
      (It also makes a decision about direct transfers to state employees, but this instrument is assumed inefficient and is never used.)

      iii. Non-state firms act. They hire capital and labor.
      Wages depend on public infrastructure.

      iv. The game ends with capital locating in each region, production taking place, and payoffs.
      Capital is freely mobile and must earn the same net return in all regions.

Figure 1

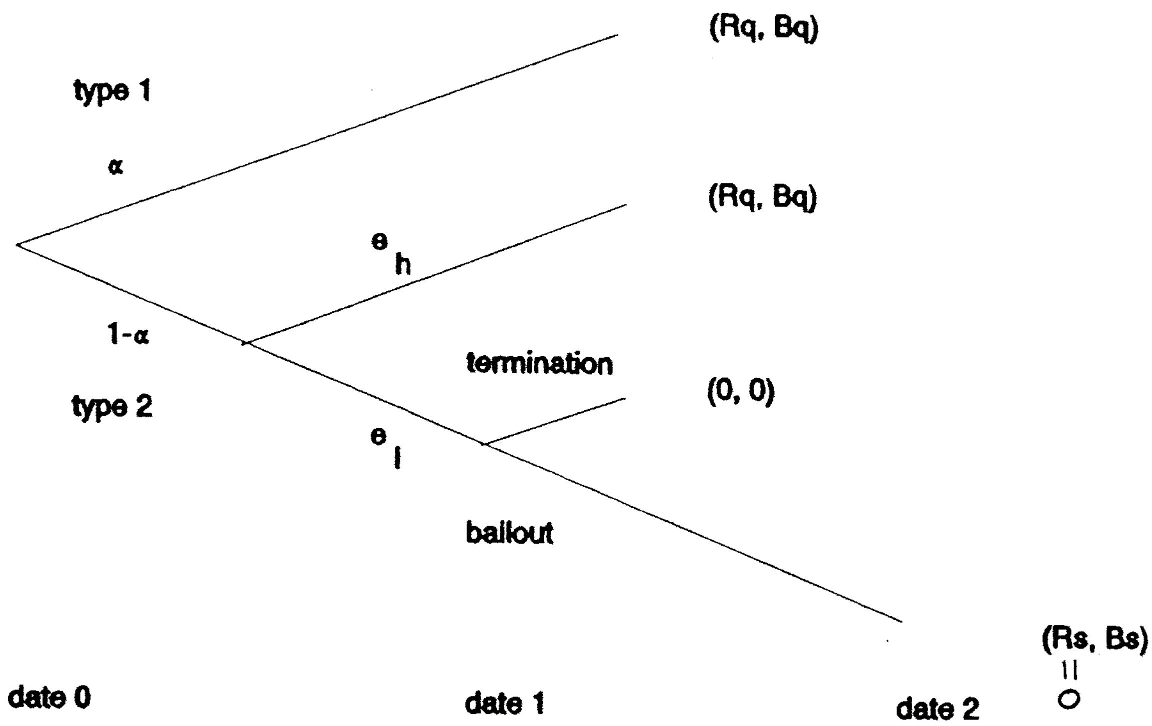


FIGURE 1. THE MECHANISM OF THE SOFT AND HARD BUDGET CONSTRAINT

Figure 1

6. Subgame Perfect Nash Equilibrium

   (a) A strategy for a worker is a single decision, whether to put in high or low effort after a bad project.

   A strategy for the government has a discrete part ("bailout" or "terminate") and a continuous part. Both are chosen simultaneously and after the worker moves.

   (b) Look at Figure 2.

Figure 2

   Whether the government prefers "bailout" (and other variables optimal) or "terminate" (and other variables optimal) is going to depend on a parameter condition specified later.

   At the moment we cannot say whether $\delta > \epsilon$ or $\epsilon > \delta$.

   (c) On the other hand, we can state what the worker must do in SPNE. This follows from $B_s > B_q > 0$.

   If the government's strategy includes "terminate" then the worker must play "high effort" in any SPNE, since $B_q > 0$.

   If the government's strategy includes "bailout" then the worker must play "low effort" in any SPNE, since $B_s > B_q$.

   Define a "hard budget constraint equilibrium" as a SPNE with "high effort" and "terminate."

   Define a "soft budget constraint equilibrium" as a SPNE with "low effort" and "bailout.

   By the previous argument, these are the only possible SPNE.

7. **Note!**

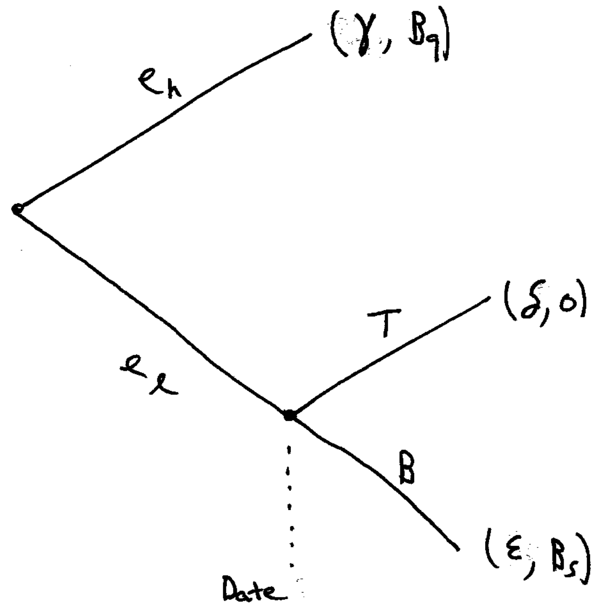
   Notwithstanding the previous analysis, "high effort" and "terminate" is always Nash!

   Just look at the normal form in Figure 2.

   This is an important point not mentioned by Qian-Roland. While there isn't always a hard budget constraint equilibrium (because that must be subgame perfect), there is always a Nash equilibrium in which the workers play "high effort" and the government plays "terminate."

   Subgame perfection comes if and only if $\delta > \epsilon$.

The Relationship Between "Effort" and "Bailout" in SPNE



$B_s > B_q > 0$

	e_l	e_h
B	(ε, B_s)	(γ, B_q)
T	$(\delta, 0)$	(γ, B_q)

Figure 2

8. Regional government budget constraints.

   (a) Regional government revenue comes entirely from taxing (a) state owned firms with good projects and (b) state owned firms with bad projects and high effort.

       Government revenue from these firms is $R_q > 0$.

       Government revenue from all other firms is zero.

   (b) Suppose the regional government plays "terminate."

       Then in any SPNE the workers choose "high effort," so the regional governments choose transfers, public goods and infrastructure subject to the constraint:

       $$E^H \equiv nR_q = \tau_i + I_i + z_i$$

       The workers in the state enterprises have incomes:

       $$y^H \equiv nB_q + \tau_i$$

   (c) Suppose the regional government plays "bailout" (at a cost of 1 unit for each firm).

       Then in any SPNE the workers choose "low effort," so the regional governments choose transfers, public goods and infrastructure subject to the constraint:

       $$\begin{aligned} E^S &\equiv \alpha n R_q + (1-\alpha) n R_s - (1-\alpha) n \\ &= \alpha n R_q - (1-\alpha) n \\ &= \tau_i + I_i + z_i \end{aligned}$$

       The workers in the state enterprises have incomes:

       $$y^S \equiv \alpha n B_q + (1-\alpha) n B_s + \tau_i$$

       Notice that:

       $$E^H > E^S$$

9. First Best.

   By this they mean, not efficient in the purely technical sense, but maximizes the nation's objective function $W = \sum_i W_i$.

   The social planner (unlike the government) can precommit to terminate all projects. One can show that t he planner wants to do this because giving workers in state owned firms "great" incomes (R_s) at the cost of bailouts is worse overall than giving them less income (R_q) at the benefit of more infrastructure and public goods.

The planner chooses:

$$(\tau_1, ..., \tau_N), \quad (I_1, ..., I_N), \quad (z_1, ..., z_N)$$

to find the stationary points of:

$$\mathcal{L} = \sum_i [x(K_i, I_i) + nB_q + \tau_i + u(z_i)] + \lambda \left\{ \sum_i [nR_q - \tau_i - I_i - z_i] \right\}$$

$$\frac{\partial \mathcal{L}}{\partial \tau_i} = 1 - \lambda$$

$$\frac{\partial \mathcal{L}}{\partial I_i} = \frac{\partial x(K_i, I_i)}{\partial I_i} - \lambda$$

$$\frac{\partial \mathcal{L}}{\partial z_i} = u' - \lambda$$

They assume $\lambda > 1$ at the solution so (think "Kuhn-Tucker") this implies:

$$\tau_i^{FB} = 0$$

10. Fiscal Centralization.

The claim in Proposition 1 is that, if the following condition holds:

$$B_s > \frac{\partial x(K_i, I_i^C)}{\partial I_i}$$

then there is only a soft budget constraint equilibrium.

In terms of Figure 1, this ensures $\epsilon > \delta$. The pair "high effort" and "terminate" remains Nash (recall the normal form) but it is not subgame perfect.

The argument in Qian-Roland is very brief. It isn't clear if they recognize that one must allow the government to reset *all* of its controls in showing $\epsilon > \delta$.

First, optimizing conditional on "bailout":

$$\begin{aligned} \mathcal{L} &= \sum_i [x(K_i, I_i) + \alpha nB_q + (1-\alpha)nB_s + \tau_i + u(z_i)] \\ &+ \lambda \left\{ \sum_i [\alpha nR_q - (1-\alpha)n - \tau_i - I_i - z_i] \right\} \end{aligned}$$

$$\frac{\partial \mathcal{L}}{\partial \tau_i} = 1 - \lambda$$

$$\frac{\partial \mathcal{L}}{\partial I_i} = \frac{\partial x(K_i, I_i)}{\partial I_i} - \lambda$$

$$\frac{\partial \mathcal{L}}{\partial z_i} = u' - \lambda$$

As above, they assume $\lambda > 1$ so $\tau_i^C = 0$. The solution here is I_i^C and z_i^C.

Compare this with the optimum conditional on "terminate." We lose $(1-\alpha)nB_s$ from the objective function but there are extra resources equal to $(1-\alpha)n$ in the constraint (i.e., there is now E^H to allocate). Formally:

$$\mathcal{L} = \sum_i \left[x(K_i, I_i) + \alpha n B_q + \tau_i + u(z_i)\right] + \lambda \left\{ \sum_i \left[nR_q - \tau_i - I_i - z_i\right] \right\}$$

Call the solution here I_i^* and z_i^*. Note that K_i is the same in all cases, since regions are identical and we are examining the symmetric equilibrium. The extra resources will be split between the two controls so $I_i^* > I_i^C$ and $z_i^* > z_i^C$. The mean value theorem ensures that:

$$[x(K_i, I_i^*) - x(K_i, I_i^C)] = \frac{\partial x(K_i, \hat{I}_i)}{\partial I_i}[I_i^* - I_i^C]$$

$$[u(z_i^*) - u(z_i^C)] = u'(\hat{z}_i)[z_i^* - z_i^C]$$

Concavity then gives:

$$[x(K_i, I_i^*) - x(K_i, I_i^C)] < \frac{\partial x(K_i, I_i^C)}{\partial I_i}[I_i^* - I_i^C]$$

$$[u(z_i^*) - u(z_i^C)] < u'(z_i^C)[z_i^* - z_i^C]$$

Adding up gives the gain in the social welfare function from the new resources:

$$\begin{aligned}
[x(K_i, I_i^*) - x(K_i, I_i^C)] + [u(z_i^*) - u(z_i^C)] &< \frac{\partial x(K_i, I_i^C)}{\partial I_i}[I_i^* - I_i^C] + u'(z_i^C)[z_i^* - z_i^C] \\
&= \frac{\partial x(K_i, I_i^C)}{\partial I_i}[I_i^* - I_i^C + z_i^* - z_i^C] \\
&= \frac{\partial x(K_i, I_i^C)}{\partial I_i}(1-\alpha)n
\end{aligned}$$

Given the inequality in the premise, we conclude:

$$\text{SWF Loss} \;=\; (1-\alpha)nB_s > (1-\alpha)n\frac{\partial x(K_i, I_i^C)}{\partial I_i} \;=\; \text{Maximum SWF Gain}$$

The comparison with the first best is similar to the above, except the workers have chosen "high effort" instead of "low effort." This just adds a constant to the objective function compared to the centralization case and there are more resources to allocate. Thus $z_i^{FB} > z_i^C$ and $I_i^{FB} > I_i^C$.

The argument that there is no hard budget constraint equilibrium follows immediately from $\epsilon > \delta$. Remember, this incorporates the requirement of subgame perfection.

Remember too (for what it's worth) that the Nash equilibrium ("high effort" and "terminate") remains.

11. Centralization versus Decentralization.

    The claim in Proposition 2 is that, if the following condition holds:

$$\frac{\partial x(K_i, I_i^D)}{\partial I_i} + \frac{\partial x(K_i, I_i^D)}{\partial K_i}\frac{\partial K_i}{\partial I_i} > B_s > \frac{\partial x(K_i, I_i^C)}{\partial I_i}$$

    then centralization has only a soft budget constraint equilibrium and decentralization has only a hard budget constraint equilibrium.

    The former follows from the previous arguments. The latter follows from a similar analysis as the one above, except now we are showing that $\delta > \epsilon$.

Cai and Treisman

1. This paper makes a nice contrast to Brueckner's.

   His tradeoff was "good" Tiebout matching versus "bad" race-to-the-bottom in tax competition for mobile capital.

   This paper considers a tradeoff within tax competition itself: the race-to-the-bottom versus the benefits of disciplining governments to behave well.

   "Competition for capital is believed to shift government priorities away from nonproductive public spending and toward business-friendly investments." (p. 817)

2. They argue that the "disciplining effect" is driven by the assumption of identical regions.

   Without this (and the focus on symmetric equilibria), there may be no disciplining effect, just a race-to-the-bottom.

   In particular, the worse-endowed regions will have worse policies given capital mobility than if the were isolated.

3. Thus, this paper focuses on comparing the choice of infrastructure investment when each region is isolated and when there is a common market for capital.

   In other words, the benchmark here isn't some efficient allocation of infrastructure. It is the amount of infrastructure investment that occurs when each region is isolated. The comparison is with the amount of infrastructure investment when there is a common market.

4. Two types of regions, N that are well endowed and M that are poorly endowed.

   Capital is more productive in regions that are well endowed.

   Exogenous endowments:

   > [Exogenous endowments are] any inherited features that affect the marginal productivity of capital locally invested. Endowments may include stocks of natural resources, human capital, or infrastructure.

   ("Infrastructure" is different from "infrastructure investment" in this paper!)

5. Capital is also more productive in regions with more "infrastructure investment."

   Infrastructure investment:

   > Infrastructure investment should be interpreted broadly as any costly action governments take to increase the productivity of capital in their

units. Thus, 'infrastructure' includes physical infrastructure (transportation, telecommunications, etc.), education, public health, and a system of well-enforced property rights and legal protections.

6. Production Function:

   $$F_i = f(I_i, k_i, A_i)$$

   with

   $$A_n > A_m$$

   Note that infrastructure and exogenous endowments increase output. They also increase the productivity of capital.

7. The government's objective function:

   $$U_i = (1 - t_i)F_i + \lambda c_i$$

   c_i is public spending, so λ measures the government's preference for public spending.

   c_i could be "good things" or "bad things."

8. The government's objective is to maximize the objective function subject to the constraint:

   $$I_i + c_i = S + t_i F_i$$

   (assume $t_i = t$ for all i).

   This leads to an optimal choice of infrastructure with closed capital markets, I^*, and open capital markets, I^{**}.

9. The game has the usual two stages.

   In the first stage the government chooses infrastructure and consumption.

   In the second stage, capital appears in each region and production/payoffs take place.

   The government anticipates the equilibrium allocation of capital when it chooses infrastructure.

10. The central claim is that it is possible to have:

$$I_m^{**} < I_m^*$$

The poorly endowed region may spend more on infrastructure when capital markets are closed than when they are open.

This could not occur in a symmetric equilibrium.

11. Optimal infrastructure investment depends upon the relationship:

$$\frac{\partial F_i}{\partial I_i} + \frac{\partial F_i}{\partial k_i}\frac{\partial k_i}{\partial I_i} = \tau$$

This equates the marginal cost of extra infrastructure with the extra benefits.

If all regions are symmetric, then k_i does not change with the shift from closed to open markets. $\frac{\partial F_i}{\partial I_i}$ is unchanged and the next terms are positive. This unambiguously leads to more infrastructure. Formally, if $A_m = A_n$, then we must have $I^{**} > I^*$ for both regions.

The intuition is as follows: when regions are isolated, extra infrastructure increases the productivity of existing capital; when there is a common market for capital, extra infrastructure causes both a tendency for in-migration of capital plus greater productivity of existing capital. No capital actually migrates in equilibrium, but the incentives to invest in infrastructure are enhanced.

12. If regions differ, however, then it is possible that capital leaves the region.

This reduces the productivity of infrastructure. That is to say, $\frac{\partial F_i}{\partial I_i}$ falls, and the incentive to invest in infrastructure falls with it. Better-endowed units invest more in infrastructure than under isolation. Worse-endowed units invest less in infrastructure than under isolation.

They essentially "give up" on competing for mobile capital. They focus on either predation or satisfying the demands of local citizens.

13. Formally, they establish:

$$\frac{I_n^{**}}{I_m^{**}} = \frac{k_n^{**}}{k_m^{**}} = \left(\frac{A_n}{A_m}\right)^{1/(1-\alpha-\beta)}$$

Since the total capital stock is fixed, an increase in the ratio of endowments increases k_n^{**} and decreases k_m^{**}. The level of infrastructure in each region moves the same way.

For a sufficiently skewed ratio of endowments, it is possible to generate an inversion in the infrastructure levels in the poorly endowed region:

$$I_m^{**} < I_m^*$$