Financing Infrastructure in the Shadow of Expropriation

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- Large upfront investment and long-term revenue inflow
  - Highways, Railways, Water and Sanitation Systems
- Infrastructure projects work as public-private partnerships
  - **Investors**
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- Main differentiating feature: Investors face *double moral hazard*
- Existing papers focus on PPP and privatization
- **This paper:** Optimal infrastructure financing under double moral hazard

Government's Expropriation

Example: India's National Highways Authority of India (NHAI)

- NHAI is involved in $\sim 40\%$ of litigation cases that the Union Government is party
- Over 60% of these cases are in the post-award face of the highway project
- Two main reasons for litigation in post-award phase
  - payment related
  - wrongful termination/debarment of contractors
- Not unique to India!

Main Results

- The double moral hazard creates *inefficiencies*
  - Extensive margin: fewer projects financed
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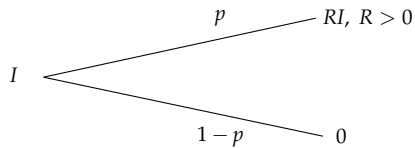
  2. **Co-investment between government and private investors**
     - *Increases scale only when double moral hazard is not too severe*
  3. **Sharing the project's return**
     - *Mitigates moral hazard and incentivizes investor participation*

Benchmark Model

Risky infrastructure project



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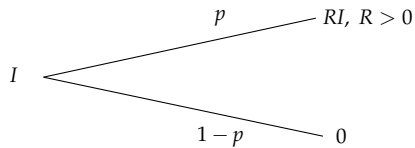

Moral Hazard I

$$p = \begin{cases} p_h & \text{if private operator exerts effort} \\ p_l & \text{if operator shirks (private benefit B)} \end{cases}$$

$p_h > p_l$, only p_h NPV> 0

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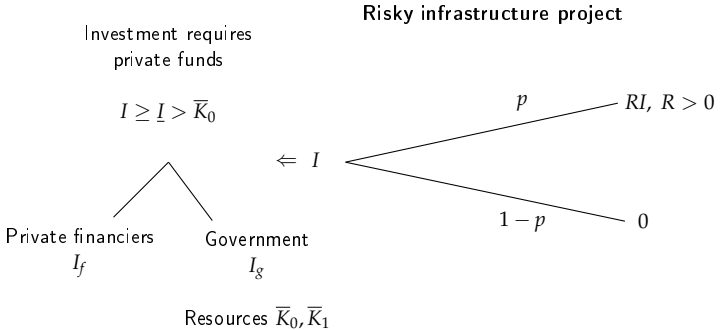

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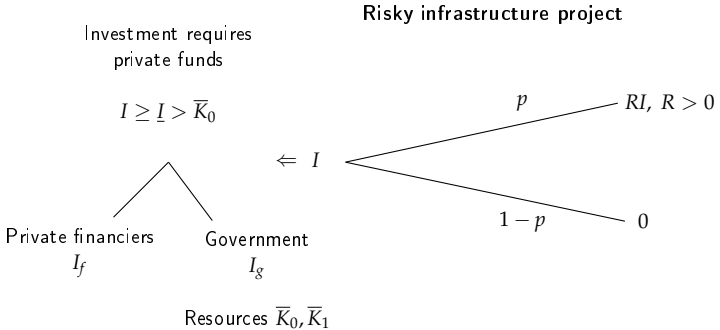

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Financiers

Government

Operator

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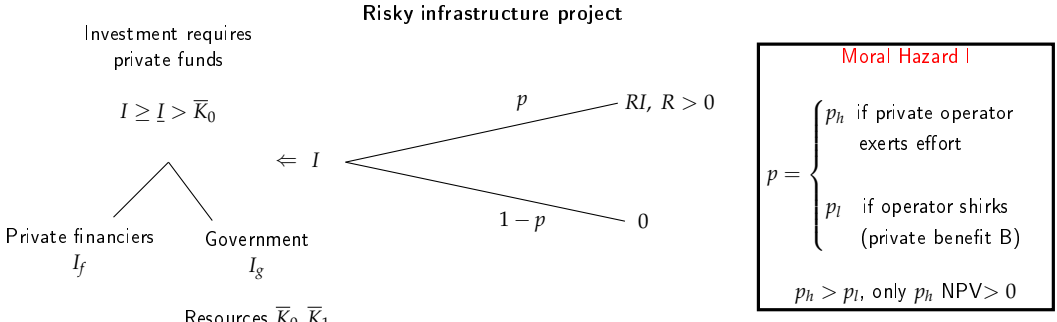

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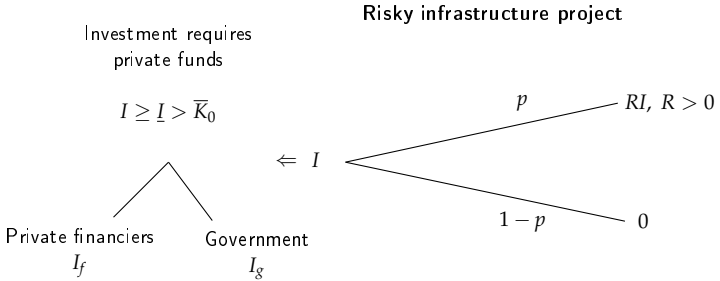

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Moral Hazard II

Government can expropriate from private operator (privatizations, fix user fees)

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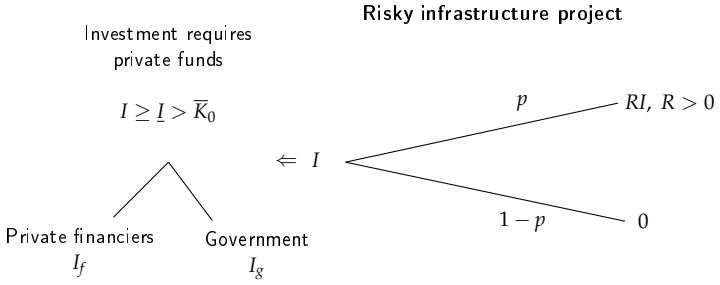

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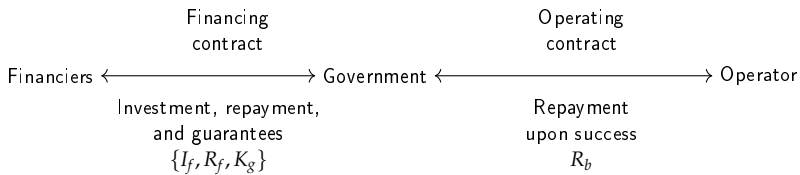


Moral Hazard II

Government can expropriate from private operator (privatizations, fix user fees)

Government's limited commitment Default penalty Φ on operational contract

Timing and Contracts

Investment Stage

Government and financiers enter into a financial contract

$\Downarrow$

Investment, repayment and guarantees (I_f, R_f, K_g)

Government and private financiers invest $I = I_g + I_f$

Gestation Stage

Private sector operator is appointed

Government and operator enter into an operational contract (determines expropriation)

$\Downarrow$

Repayment R_b

Operating Stage (Moral Hazard)

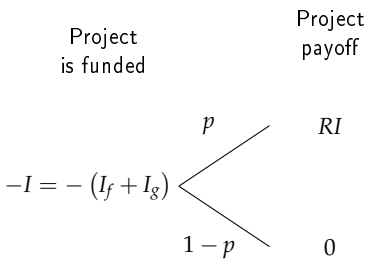
Private sector operator undertakes project development (Effort choice)

Payoff Stage

Project's payoffs are realized & distributed

Govt. makes repayment decision

Payoff Structure



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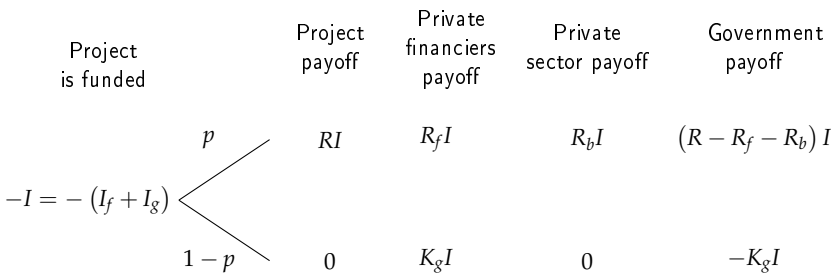

Three Frictions

- Private Operator Moral Hazard
- Government Moral Hazard

- Government's limited commitment

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Three Frictions

- Private Operator Moral Hazard $\Rightarrow$ Incentive compatibility of operator
- Government Moral Hazard$\Rightarrow$ Incentive compatibility of government
  - Double Moral Hazard limits feasibility and scale
- Government's limited commitment $\Rightarrow$ Default decision of government
  - Limits the maximum scale of the project

Incentive Compatibility Constraints

- Moral Hazard I: Private sector needs incentives to supply high effort
- Private sector will supply high effort if

$$\underbrace{p_h R_b I}_{\text{expected payoff from high effort}} \geq \underbrace{p_l R_b I + BI}_{\text{expected payoff from low effort}} \iff R_b \geq \frac{B}{\Delta p}$$

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- Moral Hazard II: Government needs incentives not to expropriate from operator
- Government will choose to induce high effort if

$$\underbrace{p_h \left(R - R_b - R_f\right) - \left(1 - p_h\right) K_g}_{\text{expected payoff from inducing } p_h} \geq \underbrace{p_l \left(R - R_f\right) - \left(1 - p_l\right) K_g}_{\text{expected payoff from expropriating } R_b}$$

  - Trade-off: Higher return vs. lower probability of success

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$$K_g - R_f \geq \frac{p_h}{\Delta p} R_b - R$$

  - Trade-off: Higher return vs. lower probability of success
    - Guarantee K_g increases the cost of failure and extorting⇒Ameliorates MH
    - Higher shared return R_f decreases the benefit of inducing high effort ⇒Exacerbates MH

Double Moral Hazard

- MH1: Governments optimal expropriation decision implies ICP always binds

$$R_b = \frac{B}{\Delta p} \iff R_g = R - \frac{B}{\Delta p} - R_f$$

- MH2: ICG becomes

$$K_g - R_f \geq p_l \frac{B}{\Delta p} - \left(R - \frac{B}{\Delta p} \right)$$

- Both moral hazard problems are intertwined
  - Severity of moral hazard of the private sector determines the incentives of the government to expropriate everything

No Default and Feasibility Constraints

- Government needs incentives and resources to honor contracts

$$R_f I \leq \min\left\{ \Phi, \quad \left(R - \frac{B}{\Delta p}\right) I + \overline{K}_0 + \overline{K}_1 - I_g \right\} \text{ (NDR)}$$

$$K_g I \leq \min\left\{ \Phi, \quad \left(R - \frac{B}{\Delta p}\right) I + \overline{K}_0 + \overline{K}_1 - I_g \right\} \text{ (NDK)}$$

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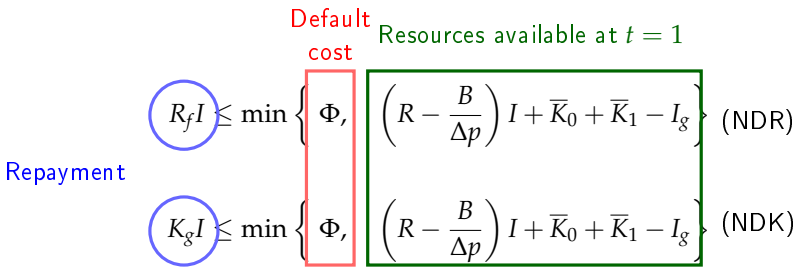

Participation Constraints

- Operator will participate if $R_b \geq 0$ (IRO)
- Financiers will provide financing if

$$\underbrace{p_h R_f I}_{\text{expected payoff from project}} + \underbrace{(1-p_h)\,K_g I}_{\text{expected guarantee}} \geq \underbrace{r I_f}_{\text{outside option}} \qquad \text{(IRP)}$$

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- Government needs incentives to participate and provide guarantees

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Optimal Financing Contract

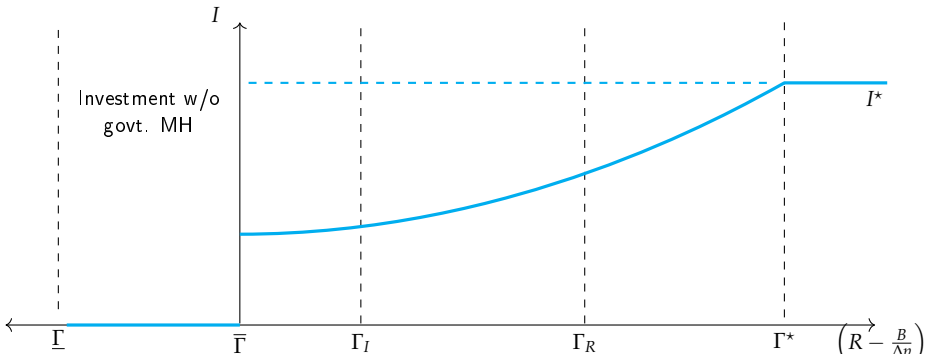
- Socially optimal financing contract solves

$$\max_{I_g, I_f, K_g, R_f, R_b} (p_h R - r) I$$

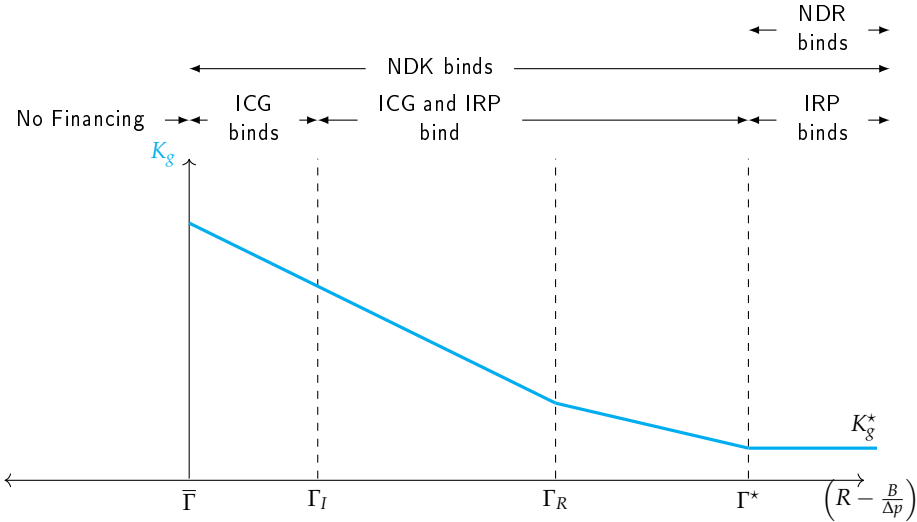
subject to:

- Incentive compatibility constraints for operator and government (ICP & ICG)
- No default and feasibility constraints (NDR & NDK)
- Participation constraints for financiers, operator, and government (IRO, IRP& IRG)

Proposition 1: Inefficiencies of Double Moral Hazard



Proposition 2: Pecking Order



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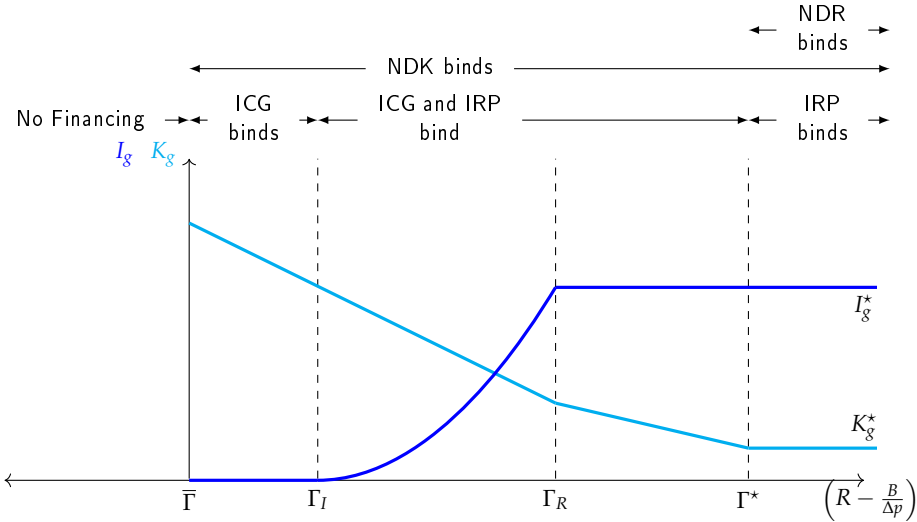

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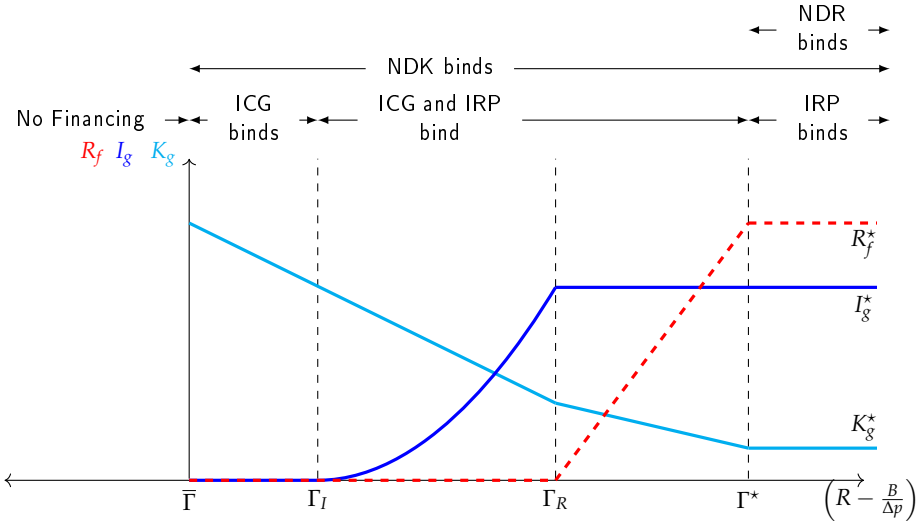

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Conclusion

- Classic moral hazard: limits feasibility but not scale
- Government expropriation risk also present in many infrastructure projects
  - further limits feasibility and scale
- Optimal infrastructure financing in the shadow of expropriation features
  - Government guarantees
  - Co-Investment between financiers and government if MH not too severe
  - Bundling of development rights and tax subsidies (in paper)
- All these features are observed in practice

Characteristics of Infrastructure Projects

- Large upfront investment and long-term revenue inflow
  - Highways, Railways, Water and Sanitation Systems
- Long gestational periods over which return uncertainty is revealed
- Multiple stages:
  1. Financing (private and/or public)
  2. Gestational period (Government development)
  3. Private development after bid submissions
- Government participation through
  - Financial guarantees, tax treatment of bonds for infrastructure financing
  - Direct investment (Co-investment)
  - Acquisition of land
  - Offering reasonable user-fees and tolls (credibly?)

Related Literature

- Perotti (1995): Partial privatization by govt as commitment to not extort
- Martimort and Sand-Zantman (2006): Government retains good projects to signal quality
- Medda (2007): Guarantees to private sector exacerbates moral hazard
- Engel, Fischer, and Galetovic (2013): Risk sharing in PPP model with and without govt subsidies
- Banerjee, Gucbilmez and Pawlina (2014): Real option exercise in timing of infrastructure projects
- Andonov, Kraussl and Rauh (2020): Parallels between infrastructure financing and PE investments

Infrastructure in the U.S.

- Transportation Infrastructure Finance and Innovation Act (TIFIA, 1998) established federal credit program for transportation project of national and regional significance
  - *Secured direct loans* to sponsors of projects
  - *Loan guarantees* to institutional investors
  - *Long-term standby lines of credit* that can be drawn by project sponsors
  - TIFIA facilities have relatively low cost (tied to 10-yr treasury rates)
  - Since 1998, TIFIA has provided over $\$8bn$ in credit for highways and other projects, mainly backed by user-fees and tolls

Go back

Infrastructure in France

- Two-pronged approach with Public-Private Partnerships
- First, French government has provided EUR $8bn$ guarantees to bank loans directed towards infrastructure projects
  - This allows commercial banks to finance private sector sponsors
- Second, government established EUR $10bn$ guarantee program to promote debt financing. These guarantees:
  - promote liquidity of the market for bank loans and bonds
  - allow infrastructure projects to be financed at relatively low costs

Go back

Revenue vs General Obligation Financing

- Financing raised at project-level (RO) or general-level (GO)

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- Two ex-ante identical, independent projects $i \in \{a, b\}$
- Double moral hazard in both projects
- Separate government guarantees K_g^a and K_g^b
- Cross-guarantees to project i from the return of project j, K^i.
  - $K^i > 0 \Rightarrow$GO and $K^i = 0 \Rightarrow$ RO

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  - $K^i > 0 \Rightarrow$GO and $K^i = 0 \Rightarrow$ RO
- Cross-guarantee has opposing effects on extortion incentives.
  - Subsidizing a when a fails and b succeeds
    - *decreases* incentives to extort from project a to avoid failure
    - *increases* incentive to extort from project b since expected payoff from b falls
  - Overall effect depends on success probability

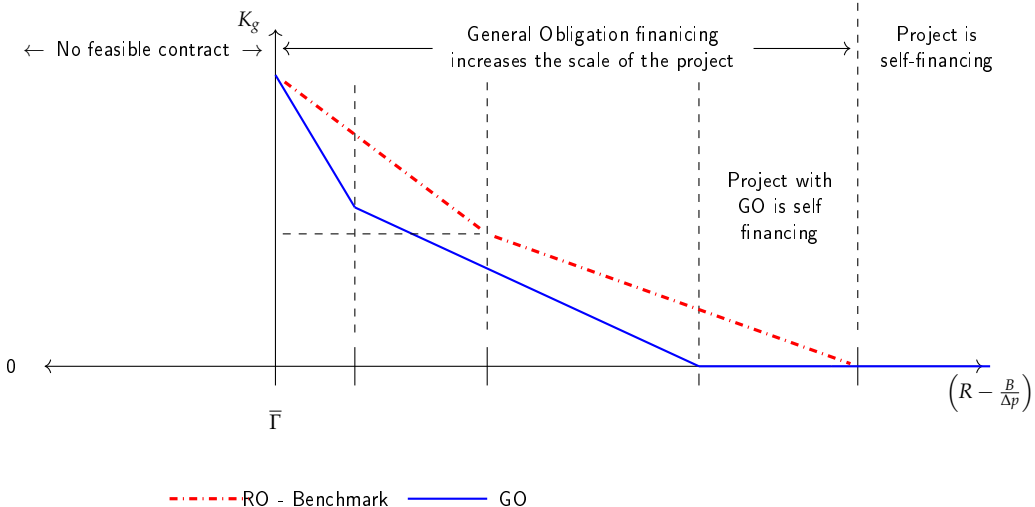
Revenue Only vs General Obligation Financing

Proposition

1. If $\left(R - \frac{B}{\Delta p}\right) < \underline{\Gamma}$ the project is never funded
2. If $\underline{\Gamma} \leq \left(R - \frac{B}{\Delta p}\right) < \overline{\Gamma}$ the project is not funded in the presence of government moral hazard
3. If the project is funded
   - If $2p_h \geq 1$, GO financing is preferred ($K^a = K^b > 0$)
   - If $2p_h < 1$,
     - GO financing is preferred ($K^a = K^b > 0$) if the project's return is high enough
     - RO financing is preferred ($K^a = K^b = 0$) otherwise

- Cross guarantees can create or destroy value depending on severity of moral hazard and the probability of success of the project.

RO vs GO Financing ($p_h > 0.5$)



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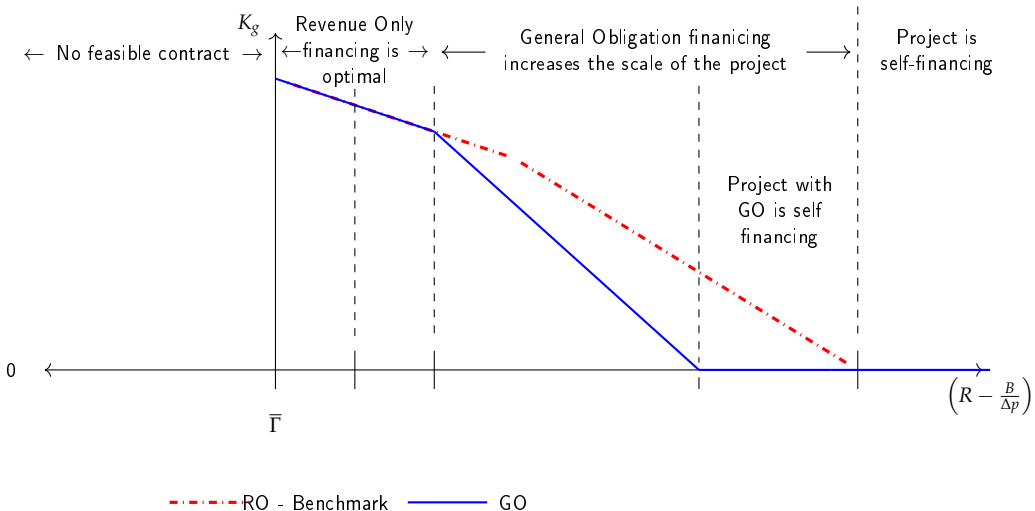
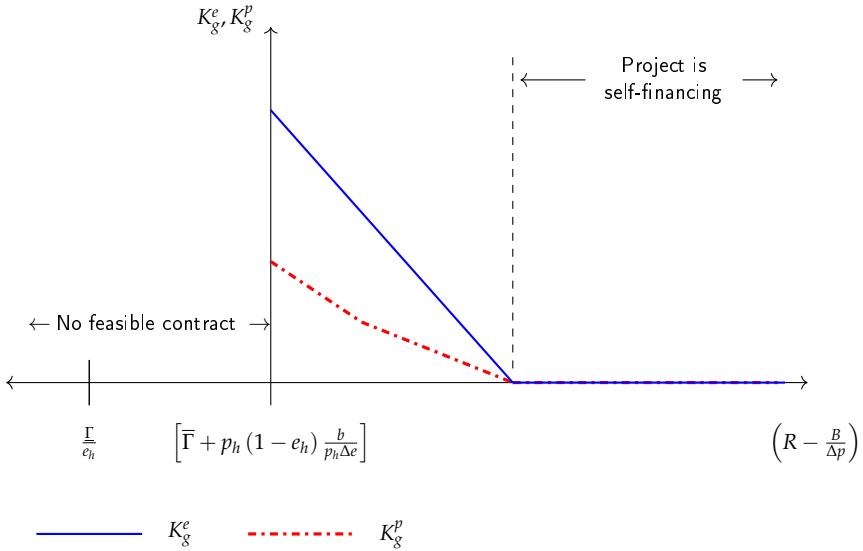


Early-stage moral hazard

- Project requires government input in the first stage
  - land acquisition, clearances, provision of public utilities, etc.
- Second stage same as benchmark model
- First stage outcome depends on government effort
  - high effort, high prob. of success e_h; low effort, low prob. of success e_l + benefit b
- Two instances for project failure (i) government input and (ii) private sector input
- Government can offer guarantees in each stage
- **Result:** First stage moral hazard *reduces* project feasibility further
  - Guarantees for first-stage failure are *higher* if

$$\underbrace{\frac{b}{p_h \Delta e}}_{\text{first stage MH severity}} > \underbrace{\frac{p_l B}{(\Delta p)^2}}_{\text{second stage MH severity}}$$

Decreasing guarantee structure



Increasing guarantee structure