The Effect of Exit Rights on Cost-based Procurement Contracts[1]

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[1]The findings, interpretations, and conclusions expressed in this presentation and paper do not necessarily represent the views of the World Bank.

Procurement and exit-rights

- Principal hires a firm to complete a project at the lowest possible cost
- Information about a project's cost arrives over time
- Suppliers often have exit rights
  - Limited liability protection
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- How to design procurement contracts that assure the project completion?

What we do:

- Two-period model:
  1. Firm privately observes a signal about the expected intrinsic costs
  2. Firm learns actual intrinsic cost
- Firm has exit-rights at any point in time

Related literature

- **Optimal procurement contracts:** Baron and Besanko (1984), Laffont and Tirole (1986, 1987, 1990), Calveras et al. (2004), Guasch (2004), Krämer and Strausz (2011)...
- **Dynamic mechanism design** Freixas et al. (1985), Myerson (1986), Courty and Li (2000), Pavan et al. (2014), Bergemann and Välimäki (2019), Gerardi and Maestri (2020)...
- **Mech design with ex-post participation constraints:** Ollier and Thomas (2013), Krämer and Strausz (2015, 2016), Bergemann et al. (2021), Moreira and Gottlieb (2021)...
- **Our main contributions:**
    - Effect of exit-rights on procurement contracts
    - Relation between competition and ex-post participation

Canonical procurement model

- Project's cost: $C = \beta - e$
- Firm's type: $\beta \in \{\beta_L, \beta_H\}$
- C is verifiable but not effort nor β
- Firm's utility:
$$U(T, C, e) = T - C - \psi(e)$$
- $\psi : \mathbb{R}_+ \to \mathbb{R}_+$ strictly increasing, strictly convex, twice continuous differentiable
- Firm's outside option normalized to 0
- Direct Mechanism: $(e_H, T_H), (e_L, T_L)$

Dynamic procurement model

- Period 1:
  - Firm privately observes signal $s \sim F \in \Delta\Big((0,1)\Big)$
    - ★ $Pr(\beta = \beta_H) = s$
  - Principal offers a menu of contracts
  - Firm chooses a contract or the ex-ante outside option
- Period 2:
  - Firm learns β
  - Firm decides whether to exit (ex-post outside option value $\bar{u} \in \mathbb{R}$)
  - Firm chooses effort
  - Payments are realized

Principal's problem

$$\mathcal{P}: \quad \min_{\{T_i(\cdot),e_i(\cdot)\}_{i\in\{L,H\}}} \quad \int_{\underline{s}}^{\overline{s}} \{(1-s)T_L(s) + sT_H(s)\} dF(s)$$

subject to (IC-1),(IC-2),(IR-1),(IR-2)

- T and e might depend on s and β.

Link

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$$\mathcal{P}: \quad \min_{\{e_i(\cdot),u_i(\cdot)\}_{i\in\{L,H\}}} \int_{\underline{s}}^{\overline{s}} \{(1-s)\left[u_L(s)+\beta_L-e_L(s)+\psi(e_L(s))\right]$$
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Link

Main Result

Theorem

There exists $\bar{u}_3 < \bar{u}_2 < \bar{u}_1 < 0$ *such that*

- *If* $\bar{u} > \bar{u}_1$*: no first-period screening, (IR-1) is slack, and (IR-2) binds*
- *If* $\bar{u} \in (\bar{u}_2, \bar{u}_1]$*: no first-period screening, (IR-1) binds, and (IR-2) binds*
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- High $\bar{u}$ ($> \bar{u}_2$): cost-plus contracts — payments only depend on realized costs.
- Low $\bar{u}$ ($< \bar{u}_3$): payments depend on self reported estimated costs.

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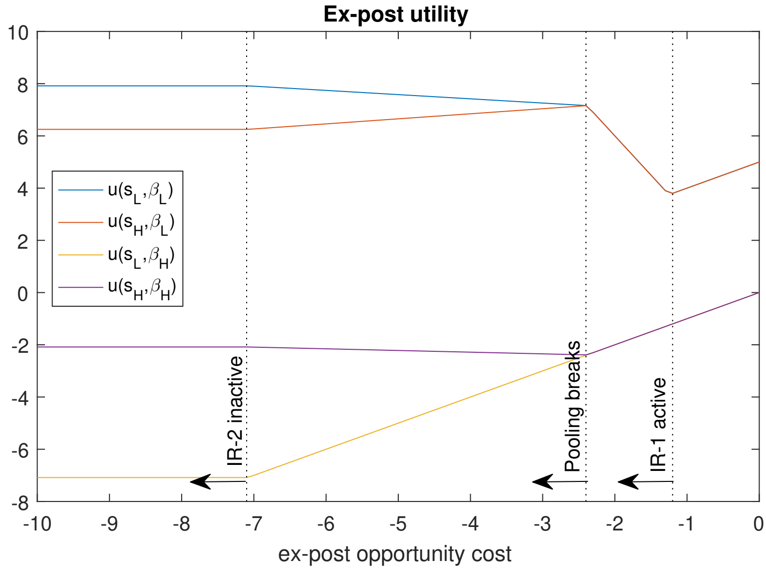
  - Absence of non-reponsiveness: screening is optimal.

Optimal ex-post profits in response to $\bar{u}$



Multiple Firms

1. Period 1:
   - Each of n firms privately observes signal $s_i \in [\underline{s}, \overline{s}] \subset (0, 1)$
     - $Pr(\beta_i = \beta_H) = s_i$
     - Signals and types are iid across firms
   - Principal selects one firm to execute the project

2. Period 2:
   - The selected firm:
     - Learns its β_i
     - Decides whether to exit (ex-post outside option value $\bar{u} \leq 0$)
     - Chooses effort
   - Payments are realized

link

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Principal directly observes s but not β.

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Suppose $\bar{u}$ is sufficiently low. As the number of firms increase, the principal's expected cost of implementing the second-best allocation converges to the cost when the she directly observes the first-period signals.

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Proposition 2

Suppose $\bar{u} = 0$. Then, the principal's expected cost of implementing the second-best allocation diverges to infinity when the number of firms increase.

Contrasting Propositions 1 and 2

- High ex-post outside option:
  - Reporting the lowest $\underline{s}$:
    - ⋆ Firm is selected with probability 1
    - ⋆ $u_L(\underline{s}) > u_H(\underline{s}) \geq 0$ implies rents bounded away from 0
    - ⋆ Increasing number of firms $\Rightarrow$ information rents explodes

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    - $u_L(\underline{s}) > u_H(\underline{s}) \geq 0$ implies rents bounded away from 0
    - Increasing number of firms $\Rightarrow$ information rents explodes
- Low ex-post outside option:
  - Under-reporting s:
    - $\uparrow$ probability of being selected
    - $\downarrow u_H(s) \times \uparrow u_L(s)$
    - Firm gains if β_L but loses if β_H
  - Rents needed to prevent under-reporting go to 0 as n increases.

Summary

- Dynamic procurement model: gradual information arrival and ex-post exit rights
- Optimal contracts as a function of ex-post reservation utility:
  - High: no first-period screening, (IR-1) is slack, and (IR-2) binds
  - Intermediary: no first-period screening, (IR-1) binds, and (IR-2) binds
  - Low: full first-period screening, (IR-1) binds, and (IR-2) is slack
- Competition achieves the second-best only for low ex-post reservation utilities

Thank you!

Revelation principle

- Direct mechanisms:
  - Recommended efforts: $e_{\beta}(s)$
  - Transfers: $T_{\beta}(s)$
- Satisfying incentive compatibility and participation in both periods

IC's and IR's

- Ex-post incentive compatibility:

$$\begin{aligned} u_L(s) &\geq T_H(s) - C_H(s) - \psi(e_H - \Delta\beta) \\ u_H(s) &\geq T_L(s) - C_L(s) - \psi(e_L + \Delta\beta) \end{aligned} \tag{IC-2_s}$$

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- Ex-ante incentive compatibility:

$$(1-s)u_L(s) + su_H(s) \geq (1-s)u_L(\hat{s}) + su_H(\hat{s}), \quad \forall \hat{s}, s \tag{IC-$1_{s,\hat{s}}$}$$

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- Ex-ante and ex-post participation:

$$U(s) := (1-s)u_L(s) + su_H(s) \geq 0, \quad \forall s \tag{IR-1}$$

$$u_H(s) \geq \bar{u}, \quad \forall s \tag{IR-2}$$

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Revelation principle with multiple firms

- Direct mechanisms:
  - Firm selection:

    $$x : [\underline{s}, \overline{s}]^n \to \Delta\Big(\{1, ..., N\}\Big)$$

  - Recommended effort for the selected firm:

    $$e^i : [\underline{s}, \overline{s}]^n \times \{\beta_L, \beta_H\} \to \mathbb{R}^n_+$$

  - Transfers:

    $$T^i : \{\beta_L, \beta_H\} \times [\underline{s}, \overline{s}]^n \to \mathbb{R}^n_+$$

- Satisfying incentive compatibility and participation in both periods

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