Highway to Sell

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How to (re-)auction concession contracts? (1)

A TIMELY ISSUE:

- Between 2031 and 2036, 7 existing concessions will be ended. 90% of existing highways network.
- If there is any perspective on "nationalization", it has to be decided 5 years before.

STAKES:

- *Huge needs for new investments:* Renewal of existing assets, environmental transition, connected transit, ...
- *Political sustainability:* Contract length extension often viewed as being undue by the general public.
- *Financial sustainability:* Times of restricted public money, PPPs.

How to (re-)auction concession contracts? (2)

ART REPORT 2023: Auctions may be needed.

- To limit the geographical spans of existing asset ownership (monopoly power)
- To raise entry barriers
- To limit costly renegotiations (credible commitments).

Some Questions

- What are the benefits of competitive bidding at renewal stage?
- What are the consequences on allocative efficiency?
- What are the consequences on prices?
- What are the consequences on investments? What about the transferability of existing assets? What sort of compensation if any?

Asymmetry between incumbent and potential entrants

SOURCES OF ASYMMETRY:

- Costs distributions.
- Earlier investments.
- Access to outside finance to undertake new investments.
- Information on underlying costs and demand.

LITERATURE ON ASYMMETRY IN AUCTIONS: Myerson (1981, MOR); Maskin and Riley (2000a, b, RES).

Model 1: A Simple Model of Dynamic Regulation

- Two periods: $T = 1, 2$, discount factor δ. Prices (tolls)/subsidies (p, p^*)
- CONSUMERS/TAXPAYERS: Discounted net surplus

$$S - p + \delta(S - p^*)$$

- INCUMBENT: Discounted profit

$$p - \theta + \delta(p^* - \theta)$$

Cost parameter= Operator's private information

$$\theta \in \Theta = \left[0, \bar{\theta}\right] \text{ with cdf } F\text{, density } f$$

Virtual cost parameter:

$$h(\theta) \equiv \theta + \frac{F(\theta)}{f(\theta)} \geq \theta$$

Monotone Hazard Rate Property:

$$\frac{F(\theta)}{f(\theta)} \text{ non-decreasing.}$$

Optimal Dynamic Regulation: No Competition (1)

- BREAK-EVEN CONDITION: The most efficient operators are selected

$$p - \theta + \delta(p^* - \theta) \geq 0 \Leftrightarrow \theta \leq \theta^*$$

where

$$\theta^* = \frac{p + \delta p^*}{1 + \delta}$$

- INTERTEMPORAL WELFARE:

$$(S - p + \delta(S - p^*))\, F\left(\frac{p + \delta p^*}{1 + \delta}\right) \equiv (1 + \delta)(S - \theta^*)F(\theta^*)$$

Optimal Dynamic Regulation: No Competition (2)

- THE RENT-EFFICIENCY TRADE-OFF→ Optimal cut-off

$$\underbrace{S}_{\text{Marginal Benefit}} = \underbrace{\theta_m^* + \frac{F(\theta_m^*)}{f(\theta_m^*)}}_{\text{Virtual Cost}}$$

- OPERATOR'S INFORMATION RENT

$$(1+\delta)\max\{\theta_m^* - \theta; 0\}$$

- IMPLEMENTATION

$$\theta_m^* = \frac{p_m + \delta p_m^*}{1+\delta}$$

  - Only the discounted payment $p_m + \delta p_m^*$ is known.
  - Stationary solution (Baron and Besanko, 1984):

$$p_m = p_m^* = \theta_m^*$$

Motivation: Risk-aversion/financial constraints (more on this later):

Principle 1: Stationary regulation

Principle 1

1. *The optimal dynamic regulation reaches a trade-off between rent extraction and allocative efficiency.*

2. *It gives to the operator a stable (stationary) stream of profits.*

Model 2: Bidding for renewal. Based on Laffont-Tirole (88, JPE)

• ENTRANT:

Cost parameter= common knowledge (to start with)

$$c \in \mathcal{C} = [0, \bar{c}] \text{ with cdf } G \text{, density } g$$

• SWITCHING RULE: Choose the entrant for the second period whenever:

$$c \leq \beta(\theta)$$

The switching rule is used as a screening device to extract rent from the incumbent.

$\rightarrow$ The probability of renewal $G(\beta(\theta))$ should depend on θ.

Less (resp. more) renewal for low-cost (resp. high-cost) incumbent.

Bidding for renewal (2): What is the optimal switching rule?

- Intertemporal consumers net surplus:

$$\int_0^{\theta^*} \left(S - h(\theta) + \delta \left((S - h(\theta))(1 - G(\beta(\theta))) + \int_0^{\beta(\theta)} (S - c) dG(c) \right) \right) dF(\theta)$$

- Optimal Switching Rule:

$$\beta(\theta) \equiv h(\theta)$$

→ Comparison of the incubent's virtual cost with the cost of competitor. Myerson (1981) revisited in a dynamic context.

→ Switching more often than under complete information on the incumbent's cost. Efficiency would indeed require

$$\beta(\theta) \equiv \theta$$

Bidding for renewal (3)

- OPTIMAL CUT-OFF:

$$S + \underbrace{\frac{\delta}{1+\delta}\int_0^{h(\theta_c^*)} G(c)dc}_{\text{Efficiency gains from entry}} = h(\theta_c^*)$$

→ More likely that the incumbent operates: *Rent-efficiency trade-off tilted towards efficiency*

- INFORMATION RENT: Lower than in the absence of competition: *Sampling effect*

$$\theta_c^* - \theta + \delta \int_\theta^{\theta_c^*} (1 - G(h(\tilde{\theta})))d\tilde{\theta} < (1+\delta)(\theta_c^* - \theta)$$

- IMPLEMENTATION: Second-period contingent prices (transfer of assets, penalty for breach)

$$p^* = \theta_c^*; \quad p(\theta) = \theta(1 - G(h(\theta))) + \int_\theta^{\theta_c^*} (1 - G(h(\tilde{\theta})))d\tilde{\theta}$$

Entrant with Private Information

Replace c with the entrant's *virtual cost*

$$\varphi(c) = c + \frac{G(c)}{g(c)}$$

Define the distribution of the entrant's virtual costs

$$\tilde{G}(\varphi(c)) \equiv G(c)$$

- Optimal Switching Rule:

$$\beta(\theta) \equiv h(\theta) \Leftrightarrow \text{Switch whenever } \varphi(c) \leq h(\theta)$$

$\rightarrow$ Switch less often towards the entrant

Principle 2: Benefits of bidding procedures

Principle 2

1. EFFICIENCY GAINS. *The incumbent stands ready to operate more often*
$$\theta_m^* \leq \theta_c^*. \tag{0.1}$$

2. BETTER RENT EXTRACTION. *The incumbent gets less information rent*
$$\max\left\{\theta_c^* - \theta + \delta \int_{\theta}^{\theta_c^*} (1 - G(h(\tilde{\theta})))d\tilde{\theta}; 0\right\} \leq (1+\delta) \max\left\{\theta_c^* - \theta; 0\right\}. \tag{0.2}$$

Model 3: The Costs and Benefits of Nationalization

- Sappington and Stigliz (1988), Martimort (2006): On the *Neutrality Theorem*.
- Williamson (1985) on *selective intervention*. Public authority cannot commit not to intervene ex post. Detrimental impact on incentives from an ex ante viewpoint.
- Riordan (1990) on *vertical integration (public ownership)*:

  A trade-off between the benefits of giving to the operator some incentives to invest (under private ownership) and better extracting information rent (under public ownership) .

The Costs and Benefits of Nationalization (2)

SKETCH:

$$c \sim G(\cdot|i_e)$$

i_e improves costs in *FOSD*; namely $G_{i_e}(\cdot|i_e) \geq 0$

- *Public ownership.* c is known by the public authority $\Rightarrow$ No information rent for the entrant; no investment.
- *Private ownership.* c is private information for the operator $\Rightarrow$ Information rent=Engine for investment

$$\int_0^{\bar{c}} G(c|i_e) \left(\int_\Theta Proba\{\varphi(c, i_e^*) \leq h(\theta)\} dF(\theta) \right) dc > 0$$

Incentives to invest do exist!

$$\max_{i_e} -i_e + \int_0^{\bar{c}} G(c|i_e) \left(\int_\Theta Proba\{\varphi(c, i_e^*) \leq h(\theta)\} dF(\theta) \right) dc \Rightarrow i_e > 0$$

Principle 3: Public versus private ownership

Principle 3

Public ownership at the renewal stage biases renewal towards the public entrant but reduces non-verifiable investment by the incumbent in comparison with private ownership.

Model 4: Securing Incumbent's Investment

Demsetz (1968) and the Chicago School on the key role of franchising versus Williamson (1985) and the non(limited)-transferability of assets.

Contract renewal: Transfer of physical assets, human capital, worker force.

Investment can be verifiable (book accounts, financial costs) or not (learning-by doing, know-how, moral hazard).

$$\text{First-period cost } \frac{i^2}{2} \Rightarrow \text{Second-period benefit } \begin{cases} i & \text{for incumbent ,} \\ si & \text{with } s \in (0,1) \text{ for entrant.} \end{cases}$$

Verifiable Investment

- INTERTEMPORAL WELFARE:

$$\int_0^{\theta^*} \Bigg(S - h(\theta) - \frac{i^2}{2}$$

$$+\delta \left((S - h(\theta) + i)(1 - G(\beta(\theta))) + \int_0^{\beta(\theta)} (S - c + si) dG(c)) \right) \Bigg) dF(\theta)$$

- OPTIMAL SWITCHING RULE: Now biased towards incumbent

$$\beta(\theta) \equiv h(\theta) - (1 - s)i$$

$\rightarrow$ Comparison of the incubent's virtual cost with the cost of competitor *including opportunity cost of lost investment*.

$\rightarrow$ Switching less often when investment imperfectly transferable

Verifiable Investment (2)

- INVESTMENT RULE:

$$i^* = \delta \mathbb{E}_\theta \left(1 - \underbrace{(1-s)G(h(\theta) - (1-s)i^*)}_{\text{Transfer loss}} | \theta \leq \theta^* \right) < \delta$$

- OPTIMAL CUT-OFF:

$$\underbrace{S - \frac{(i^*)^2}{2(1+\delta)} + \frac{\delta}{1+\delta} \left(1 - (1-s)G(h(\theta_c^*) - (1-s)i^*)\right) i^*}_{\text{Net value of investment}}$$

$$+ \underbrace{\frac{\delta}{1+\delta} \int_0^{h(\theta_c^*) - (1-s)i^*} G(c)dc}_{\text{Efficiency gains from entry}} = h(\theta_c^*)$$

Non-Verifiable Investment

Non-commitment on the buyer's side ⇒ hold-up on investment.

$$i^* = \arg\max_i -\frac{i^2}{2} + i\delta\mathbb{E}_\theta \left(1 - G(h(\theta) - (1-s)i^*)|\theta \leq \theta^*\right)$$

or

$$i^* = \delta\mathbb{E}_\theta \left(1 - G(h(\theta) - (1-s)i^*)|\theta \leq \theta^*\right)$$

Making switching towards the entrant less attractive boosts the incumbent's incentives to invest.

Principle 4: Imperfect transferability of assets

Principle 4

1. *Imperfect transferability leads to bias renewal towards the incumbent.*
2. *Non-verifiability of investments leads incumbents to underinvest.*
3. *Switching towards the entrant is more likely with non-verifiability.*

Model 5: Add-Ons and Ex Post Monopoly: Arve and Martimort (2024, RES)

SCENARIO. An auction took place in the first-period and selected one firm.

No ex post competition.

An add-on (additional work/innovation) must now be completed by the incumbent.

- *Requires investment i.* Public money is costly ($\lambda > 0$). The incumbent needs outside finance. Competitive financiers.
- *Innovation* has value γ that realizes with probability e. A non-verifiable effort e is undertaken by the firm; costly with $\psi(e)$ ($\psi(0) = 0$, $\psi' > 0$, $\psi'' > 0$)

Costly Finance

Non-verifiability of effort $\Rightarrow$ *Agency costs* perceived by outside financiers, investment maybe eschewed.

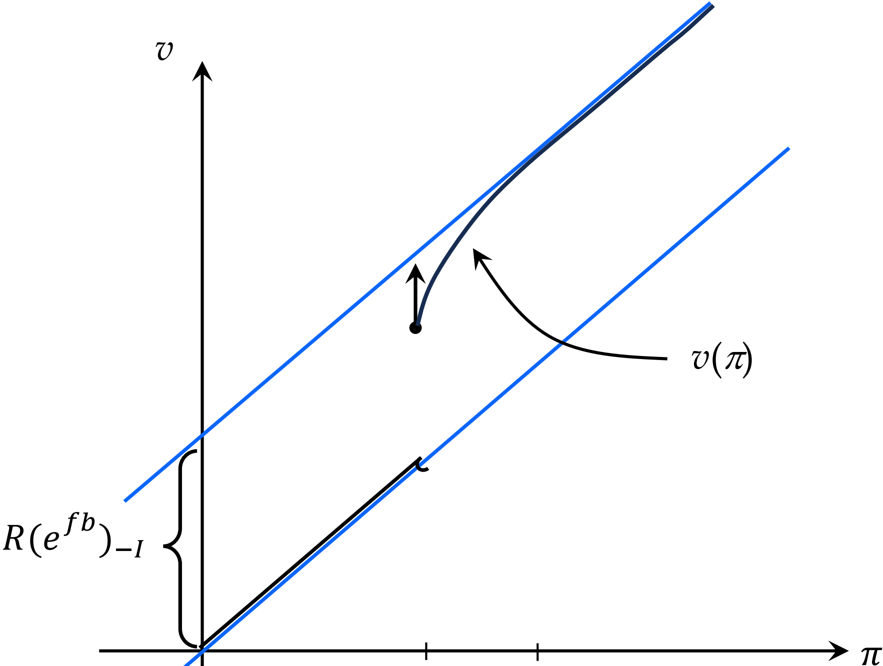
The operator's payoff function v induced by this agency problem:

$$v(\pi) = \begin{cases} \pi & \text{for } \pi \in [0, \hat{\pi}), \\ \pi - I + \gamma e^{sb}(\pi) - \psi(e^{sb}(\pi)) = R(e^{sb}(\pi)) & \text{for } \pi \in [\hat{\pi}, I), \\ \pi - I + R(e^{fb}) & \text{for } \pi \geq I. \end{cases}$$

where $R(e) = e\psi'(e) - \psi(e)$= *liability rent*,

$e^{sb}(\pi) \leq e^{fb}$ stands for the second-best effort over the range of values of π where the innovation is financed by outside financiers.

$\hat{\pi}$ minimum scale to *bring in* outside financiers.



v
$v(\pi)$
$R(e^{fb})_{-I}$
π

Optimal Dynamic Regulation (1)

- Break-even condition: The most efficient operators are now selected when

$$p - \theta + \delta v(p^* - \theta) \geq 0 \Leftrightarrow \theta \leq \theta^*$$

where the cut-off θ^*

$$p - \theta^* + \delta v(p^* - \theta^*) = 0 \text{ (Lagrange multiplier } \mu)$$

- Intertemporal welfare:

$$\left(S - p + \delta(S - \underbrace{(1+\lambda)}_{\text{Cost of public funds}} p^*) \right) F(\theta^*)$$

$\rightarrow$ *Warning:* Non-concave optimization problem....

Optimal Dynamic Regulation (2)

$$\underbrace{v'(p_m^* - \theta^*)}_{\text{Marginal cost private money}} = \underbrace{1 + \lambda > 1}_{\text{Marginal cost public money}}$$

$$\Rightarrow \underbrace{p_m^* - \theta^*}_{\text{Promised Gains}} > 0 > \underbrace{p_m - \theta^*}_{\text{Earlier losses}}.$$

More uncertainty on second-period (cost/demand)$\Rightarrow v$ becomes "more" concave over the relevant range. *Extra precautionary gains are needed in the second period*.

Back on First-Period/First-Price Auction

Suppose $n+1$ bidders in the first period.

Bidding strategies in the first-price auction: $\left\{p(\hat{\theta})\right\}_{\hat{\theta}\in\Theta}$

$$\theta = \arg\max_{\hat{\theta}\in\Theta}(p(\hat{\theta}) - \theta + \delta v(\theta^* - \theta + v'^{-1}(1+\lambda)))(1-F(\hat{\theta}))^n$$

From there, we deduce

$$p(\theta) - \theta + \underbrace{\delta v(\theta^* - \theta + v'^{-1}(1+\lambda))}_{\text{premium}}$$

$$= \frac{1}{(1-F(\theta))^n}\int_{\theta}^{\theta^*}(1+\delta v'(\theta^* - \tilde{\theta} + v'^{-1}(1+\lambda))))(1-F(\tilde{\theta}))^n d\tilde{\theta}$$

Principle 5: Financial constraints and add-ons

Principle 5

1. *Additional investments are jointly covered by stable financial revenus on base service and access to financial markets. Marginal agency costs= cost of public funds.*

2. *Operator in charge runs losses on base service and gains on add-ons. Those gains are necessary to attract outside finance.*

Model 6: Maybe Informed Entrant. Bontems, Calmette, Martimort (2024)

SCENARIO. A bidder, the entrant, might not be yet be informed on its cost of providing the service (probability q).

One shot auction (no discount).

CONTRACTS:

- Uninformed operator:

$$\Big(\underbrace{p_0^u}_{\text{Before knowing}}, \underbrace{p^u}_{\text{After}} \Big)$$

- Informed operator:

$$p^*$$

The case of a single may-be informed bidder, $q = 1$

- BREAK-EVEN CONDITION:

$$p^0 + \int_0^{\bar{\theta}} \max\{p^u - \theta; 0\} dF(\theta) \geq 0 \text{ (PC)}$$

- EXPECTED WELFARE:

$$-p^0 + (S - p^u)F(p^u) \equiv (S - p^u)F(p^u) + \int_0^{p^u} (p^u - \theta) dF(\theta)$$

- OPTIMAL CONTRACT: *"Making the operator residual claimant"*
  - Right decision to operate or not, ex post:

$$p_m^u = S$$

  - Surplus extraction, ex ante:

$$p_0^m = -\int_0^S F(\theta) d\theta$$

Incentive Constraint

Suppose now that the operator may already know its cost parameter (with probability $q < 1$). He might adopt the behavior of a not yet informed operator $\Rightarrow$ Another *truthfulness* incentive constraint:

$$\max\{p - \theta; 0\} \geq p^0 + \max\{p^u - \theta; 0\}$$

Which simplifies for those firms which operate as

$$p \geq p^0 + p^u \text{ (IC)}$$

EXPECTED WELFARE:

$$q\left(-p^0 + (S - p^u)F(p^u)\right) + (1 - q)(S - p)F(p)$$

subject to (PC) and (IC)

Optimal Contract

Suppose now that

$$p_m^* < p_m^0 + p_m^u$$

Both (PC) and (IC) are then binding. Let us aggregate those constraints as:

$$p \geq p^u + \int_0^{p^u} F(\theta) d\theta \text{ (Lagrange multiplier, } \mu\text{)}$$

SOLUTION:

- Higher price for informed operators:

$$S = p_m + \frac{F(p_m) - \frac{\mu}{1-q}}{f(p_m)} \Rightarrow p_m > p_m^*$$

- Lower price for informed operators:

$$S = p_m^u + \frac{\mu(1 - F(p_m^u))}{qf(p_m^u)} \Rightarrow p_m^u < S$$

Impact of Competition

Incentive constraint of an informed operator becomes

$$(p-\theta)(1-G(p)) \geq \left(p^u - \theta + \int_0^{p^u} F(\theta)d\theta\right)(1-G(p^u)) \quad \forall \theta \leq p$$

In particular, take $\theta = p$ to get again!

$$p \geq p^u + \int_0^{p^u} F(\theta)d\theta \text{ (IC2) (Lagrange multiplier, } \mu\text{)}$$

Impact of Competition (2)

SOLUTION: Threat of competition only on informed operators

- Lower price distortion for informed operators:
- Some price distortion for informed operators:

Principle 6: Maybe Informed Operator

Principle 6

1. *A menu of prices must be offered to elicit whether operators are informed or not on their costs. Informed operators must be induced to reveal this information with a higher payment. Not yet informed operator are paid less.*

2. *Competition erodes rents of informed operators but has no impact on uninformed operators who break even anyway.*

Wrapping up: “The Principles of the Principles”..Competition....

- requires asymmetric treatment between incumbents (better informed, having invested) and potential entrants (less well informed, having not yet invested)
- better extracts rent from informed operators,
- requires compensations for incumbents to protect investments,
- requires compensations for incumbents to relax financial constraints in view of further investment,