Flexibility versus security in agency contracts with moral hazard

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Motivation

Over the course of a contractual relationship, **new outside opportunities** may arise.

Early termination clauses can help parties to seize them.

But may also **weaken the strength** of the initial agreement.

- **Labor contracts** (employer, employee).
- **Joint ventures** (partnerships between firms).
- **Business relocation** (public-private partnerships).

Motivation

The **trade-off** we have in mind is that between:

- Guaranteeing some **security** for encouraging relation-specific investment;
- Providing some **flexibility** to allow for early termination.

Several approaches are possible and usually relies on **incomplete contracting** or **limited commitment** assumptions.

Instead we tackle the problem in a full commitment environment and exhibit 'incomplete contracting' as an endogenous choice.

Overview of the framework

Standard principal-agent with **moral hazard** and **limited liability.**

Augmented with a stochastic and **privately observed outside option** for the principal.

- The value of outside option realizes **after the agent effort is sunk and before output is produced**.

The principal can design her own **exit rights** from the contract and commit to a **liquidation fee**.

Framework: Setup

Principal hires an agent to work on a **project** with outcome $\pi \in \{\underline{\pi}, \overline{\pi}\}$.

Success depends on **effort** $e \in \{L, H\}$.

- $\mathbb{P}(\pi = \overline{\pi}) =: p_e$, where $p_H > p_L$.
- Cost of effort: $\psi_H > \psi_L = 0$.

Principal's **outside option:** $x \in X$, where $x \sim F$, and $Q := F^{-1}$.

- Realizes only **after** effort is sunk.
- But **before** the project's outcome realizes.

We focus on contracts inducing **high effort.**

Framework: Contract and Timing

We consider **contracts with exit rights** $\mathcal{C} := \left\{(\bar{t}, \underline{t}), z\right\}$.

- Project contract: $(\bar{t}, \underline{t}) \in \mathbb{R}_+^2$;
- Liquidation fee: $z \in \mathbb{R}_+ \cup +\infty$.

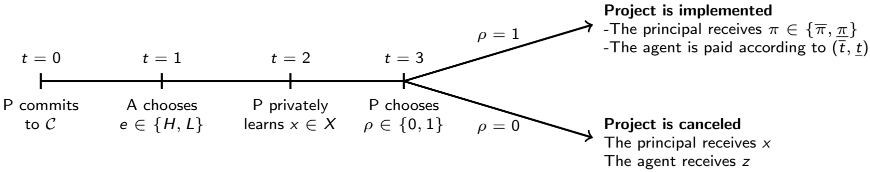


Figure: Timing of the game.

Generality of Contracts with Exit Rights

Our definition of contracts with exit rights **is minimal.**

General approach: $\left\{(\bar{t}, \underline{t}), z, \rho\right\} : X \to [0, \infty)^3 \times [0, 1]$.

- All payments can be **contingent** on the reported value of the outside option.
- The principal **can commit to an implementation rule:** $\rho(x) \in [0, 1]$.

The principal can commit ex ante but must report the value of the outside option at the interim stage.

- Adverse selection problem with her future self.

Generality of Contracts with Exit Rights

We show that our approach is **without loss of generality.**

- The adverse selection problem the principal faces with her future self renders conditioning on x irrelevant.

The implementation rule is a **threshold rule:** $\rho(x) = \mathbb{1}\{x \leq \tilde{x}\}$.

- It is enough to consider a unique liquidation fee z.
- We use $z = +\infty$ to represent the case $\rho(x) = 1$ for all $x \in X$.

Implementation Probability

Define $\phi := F(\tilde{x})$, the **implementation probability of the project** when the threshold rule is $\tilde{x}$.

For convenience, we let the principal choose $\phi \in (0, 1]$ together with a contract with exit rights $\mathcal{C}$.

Principal's **expected payoff** writes:

$$V := \phi \underbrace{\left(Y_H - T_H\right)}_{\substack{\text{Expected return} \\ \text{of the project}}} + (1-\phi) \underbrace{\left(\hat{x}(\phi) - z\right)}_{\substack{\text{Net value of the} \\ \text{outside option}}},$$

where $Y_H := p_H\overline{\pi} + (1-p_H)\underline{\pi}$, $T_H := p_H\overline{t} + (1-p_H)\underline{t}$, and $\hat{x}(\phi) := \mathbb{E}[x \mid x \geq Q(\phi)]$.

Consistency Constraint

Of course, ϕ must be **consistent** with the principal's interim decision to exit.

For a given contract with exit rights $\mathcal{C}$, it must satisfy $\phi = \mathbb{P}(x - z \leq Y_H - T_H) = F(Y_H - T_H + z)$, or simply,

$$Y_H - T_H = Q(\phi) - z. \qquad (PIC)$$

ϕ is entirely determined by $\mathcal{C}$ but it is useful to use it explicitely.

Agent and Incentive Compatibility

The **expected payoff** of the agent writes:

$$U := \phi T_H + (1-\phi)z - \psi_H.$$

Provided that $\mathcal{C}$ **induces high effort:** $U \geq \phi T_L + (1-\phi)z$.

Agent's incentive compatibility rewrites as:

$$\bar{t} - \underline{t} \geq \frac{C_H}{\phi p_H}, \qquad (AIC)$$

where $C_H := \frac{p_H \psi_H}{p_H - p_L}$ is the standard **agency cost.**

Trade-offs

Increasing ϕ:

- **Lowers** the cost of incentives;
- **Decreases** flexibility.

For an increase of ϕ to be *consistent*, P may have to increase the liquidation fee z.

Benchmark 1: Social Optimum

Consider a **social planner** who observes the realization of the outside option but not the effort level.

They choose $\mathcal{C}$ and ϕ to **maximize**

$$U + V = \phi Y_H + (1 - \phi)\hat{x}(\phi) - \psi_H,$$

subject to AIC, $U \geq 0$, $V \geq \mathbb{E}[x]$ and limited liability constraints on $\overline{t}$, $\underline{t}$, and z.

Benchmark 1: Social Optimum

Proposition

The **socially optimal** *implementation policy is such that* $Q(\phi^{FB}) = Y_H$.

In other words, the project is implemented if and only if $Y_H > x$.

- **Agency costs are sunk** at the interim stage: irrelevant.

The liquidation fee z plays no role in achieving the social optimum.

- It only affects **distribution of surplus.**

Benchmark 2: Verifiable outside option

Assume the outside option is **verifiable.**

- The principal can make the contract contingent on the **realized value** of the outside option (instead of **reported**).

Proposition

Assume the outside option is **verifiable.** *The principal chooses* $\phi^* = \phi^{FB}$ *and the equilibrium contract is such that* $\overline{t}^* = \frac{C_H}{\phi^{FB} p_H}$, $\underline{t}^* = 0$, *and* $z^* = 0$.

Benchmark 2: Verifiable outside option

With verifiability, the principal **implements the social optimum.**

The problems of providing effort incentives and efficiently terminating the project can be **separated.**

Full commitment is crucial here:

- At the interim stage, implementing the project when $Y_H \geq x$ is not **sequentially rational.**
- The project is worth only $Y_H - p_H t^*$ at the interim stage.
- The principal would like to implement the project *less often.*
- But it is **ex ante efficient.**

The principal's problem

Coming back to the **privately** observed outside option.

The principal solves:

$$
\begin{aligned}
\max_{(\phi,\overline{t},\underline{t},z)} \quad & \phi(Y_H - T_H) + (1-\phi)(\hat{x}(\phi) - z) \\
\text{s.t.} \quad & \phi T_H + (1-\phi)z - \psi_H \geq 0 && (IR) \\
& \overline{t} - \underline{t} \geq \frac{C_H}{\phi p_H} && (AIC) \\
& Y_H - T_H = Q(\phi) - z && (PIC) \\
& z \geq 0,\ \overline{t} \geq 0,\ \underline{t} \geq 0, && ((LL_z),\ (LL_{\overline{t}}),\ (LL_{\underline{t}}))
\end{aligned}
$$

Simplifying the problem

From **standard arguments:**

- IR is slack.
- AIC binds: $\overline{t} = \frac{C_H}{\phi p_H} + \underline{t}$.
- $LL_{\underline{t}}$ binds?

Using AIC, PIC rewrites as:

$$Y_H - \frac{C_H}{\phi} - \underline{t} = Q(\phi) - z. \qquad (PIC)$$

Both sides are increasing in ϕ.

- Potentially multiple solutions.

A reformulation

Define $\zeta(\phi) := Q(\phi) - Y_H + \frac{c_H}{\phi}$.

- Can be loosely interpreted as the "cost" of satisfying PIC.
- From PIC, $\underline{t} = z - \zeta(\phi)$.

The principal's problem can be reformulated as:

$$\max_{\phi,z} \quad \phi Q(\phi) + (1-\phi)\hat{x}(\phi) - z$$
$$\text{s.t.} \quad z \geq \max\{0, \zeta(\phi)\}$$

Can be interpreted as

- the expected value of an **option-to-sell** the outside option at strike price $Q(\phi)$,
- while paying an **upfront price** z.

Solution(s)

Proposition (Informal)

Any solution ϕ^* *must belong to* $[\underline{\phi}, 1]$, *where*

$$\underline{\phi} := \sup\{\phi \in [0,1] \mid \zeta(\phi) = 0\}$$

and $z^* = \zeta(\phi^*) \geq 0$ *for all* $\phi \in [\underline{\phi}, 1]$.

It implies:

- $\underline{t}^* = z^* - \zeta(\phi^*) = 0$.
- $z^* > 0$ may be optimal for the principal.
- The "price" $\zeta(\phi^*)$ is always in its positive part.

Solution(s)

To obtain a clear-cut characterization, we assume the following.

Assumption (Single-crossing)

For any C_H, there exists at most one $\tilde{\phi} \in (0,1]$ such that $I(Q(\tilde{\phi})) = \frac{C_H}{\tilde{\phi}^2}$, where $I(x) = \frac{1-F(x)}{f(x)}$ is the inverse hazard rate.

Satisfied by all F with nondecreasing inverse hazard rate (exp, Pareto, ...) and under some conditions when decreasing.

It ensures the **strict quasi-concavity** of the principal's problem.

Characterization

Proposition (Informal)

Under the single crossing condition, the equilibrium contract is unique and takes one of the three following contractual forms.

- **Lock-in contract:** $\phi^* = 1$, $z^* = +\infty$;
- **Partially-secured contract:** $\phi^* < 1$, $z^* \in (0, \infty)$;
- **At-will contract:** $\phi^* < 1$, $z^* = 0$.

Lock-in contracts correspond to the **standard solution.**

Partially-secured and at-will contracts both **allow the principal to terminate the project** at the interim stage.

- With or without **consequences** (z).

Focus on Partially-Secured Contracts

The equilibrium ϕ is defined by:

$$\underbrace{I(Q(\phi^*))}_{\substack{\text{Virtual marginal} \\ \text{cost of type } Q(\phi^*)}} = \underbrace{\frac{C_H}{(\phi^*)^2}}_{\substack{\text{Marginal benefit} \\ \text{on agency costs}}} .$$

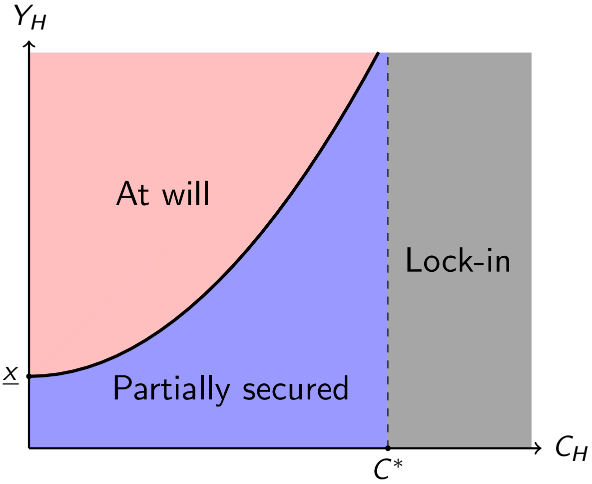
The principal solves the **trade-off** between

- the cost of incentivizing her future self to implement the project;
- the benefit of decreasing the cost of effort incentives.

This intermediary case happens when LL_z is **not binding.**

- z is used **as a tool** to satisfy PIC at ϕ^*.

Type of Contract: Project Value and Agency Costs



Type of Contract: Project Value and Agency Costs

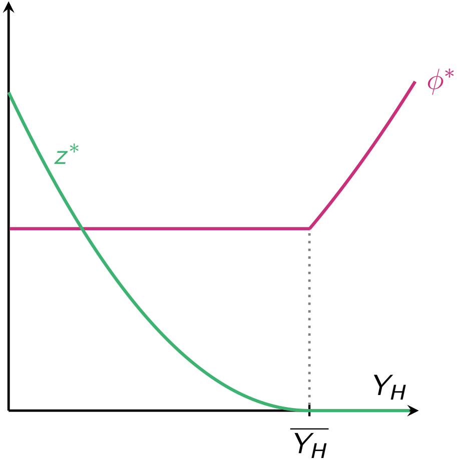
Lock-in contracts occur only when $C^* = \lim_{x \to +\infty} I(x)$ is **finite.**

- Distribution of the outside option has a **thin upper tail.**

For thicker upper tail, expected **project value is key.**

- Liquidation fee is positive only for low enough Y_H.

Security and liquidation fee



Security and liquidation fee

For **low** project value:

- Constant security level.
- Liquidation fee decreasing in Y_H.

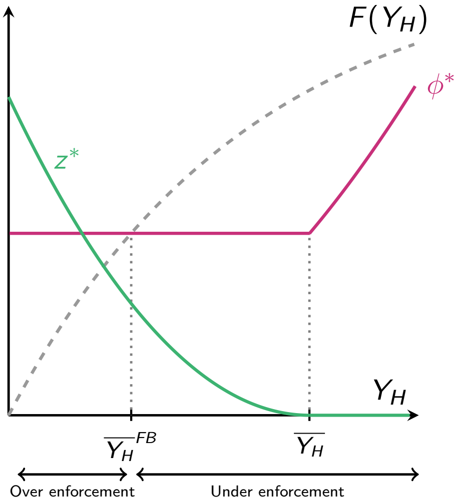
For **high** project value:

- Increasing security.
- No liquidation fee.

Careful: Agents with weak projects seem to be less secured than those with strong project.

- Socially optimal security depends on Y_H.

Over and under enforcement



Over and under enforcement

In general, both **under and over enforcement** can occur.

The principal

- Overenforces very weak projects;
- Undenforces the others.

The larger Y_H the more the project *self-enforced* itself.

- Hence the less z is needed.

Statutory liquidation fee

Assume that a social planner can only impose a minimum level of liquidation fee.

The optimal choice is $z = \zeta(\phi^{FB})$

- Achieves the first-best when there is underenforcement;
- Does nothing when there is overenforcement.

Provides a rational for **banning at-will contracts**

- Not based on equity concerns or risk aversion
- Only based on efficiency.

Conclusions

We exhibit some **endogenous incomplete contracting** and characterize the three types of contracts that emerge.

The key element is the **adverse selection** problem the principal faces with her future self.

All contractual forms involve some **distortion** of implementation but both over and under enforcement are possible.

Banning at-will contracts is optimal.