Optimal Agency Contracts with Sabotage

Joaquin Poblete, Nicolas Figueroa

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Introduction

- Eddie Cicotte, pitcher of the infamous Black Sox team, was twice benched at the end of a season so that he did not clinch a performance bonus.
- $6.000 salary and $10.000 bonus if he got 30 wins.
- 28 wins in 1917 and benched, bonus was paid in 1918, 29 and benched in 1919.
- Important Features
  - The bonus is big. Incentives to sabotage.
  - Big bonuses were used more than once. Eddie could anticipate.

Introduction

- In general, contracts with discontinuous "bonuses" may induce opportunistic behavior from the principal
- Such behavior should be anticipated by the agent
- More examples
  - Sales contracts
  - What is the rationale? Incentives for effort

Literature

- Concerns over sabotage first introduced by Innes (1990) in contracts with risk neutrality and limited liability.
- He restricted payment to the agent to increase no faster than output to avoid sabotage.
- This approach has been popular in corporate finance and more applied work. Cassamatta (2001), Schmidt (2003).
- Dewatripont Legros and Mathews (2003) state "The "monotonicity" restriction can be derived as an equilibrium outcome from ex post moral hazard considerations. It arises, for example, if the investor can "burn output" in order to make the firm's performance appear lower than it really was. Alternatively, it arises if the entrepreneur can secretly borrow from an outside lender in order to make the firm's performance appear greater than it really was.
- Partly because without some extra restriction optimal contracts fail to exist.

Idea

- We take seriously the idea that the principal can sabotage and introduced a sabotage technology.
- Sharecropping + burning crops.
- Can the principal Sabotage in Equilibrium?
- Will the principal sabotage in Equilibrium? How much?
- For which ouptut levels will the principal sabotage?
- Related to Agency with Limited Liability (Innes (1990), Poblete Spulber (2012)).
- Related to Renegotiation in Agency, Matthews (2001).
- Related to double moral Hazard, Schmidt (2003).

Technology and Timing

- Agent incurs in cost of effort a and generates potential output π.
- Effort increase output in the sense of FOSD $F(\pi, a)$.
- Principal observes π and can burn a fraction s.
- Verifiable output is $\Pi = \pi - s$.
- Contracts are written on Π , payment to the agent must be non-negative and satisfy participation.
- Timing.
  1. Contract $w(\Pi)$ is offered.
  2. Effort a is exerted.
  3. Potential output π is observed by principal and agent only.
  4. Sabotage $s \geq 0$ is chosen.
  5. Π is realized and payments are made.

Renegotiation

- Assumption: Renegotiation takes place after Π is observed, beforse s is chosen.

Proposition (Renegotiation)

Contracts are robust to renegotiation iff $w' \leq 1$. *In equilibrium* $s = 0$.

- If $s > 0$ is anticipated by the agent and there is an excedent from renegotiation.

Commitment

- In organizations or multiple agents, there is commitment.
- Principal may commit to sabotage by choosing a contract that is sufficiently steep in payments to the agent.
- However direct commitment to a sabotage level is not possible

Sabotage must be incentive compatible

Definition

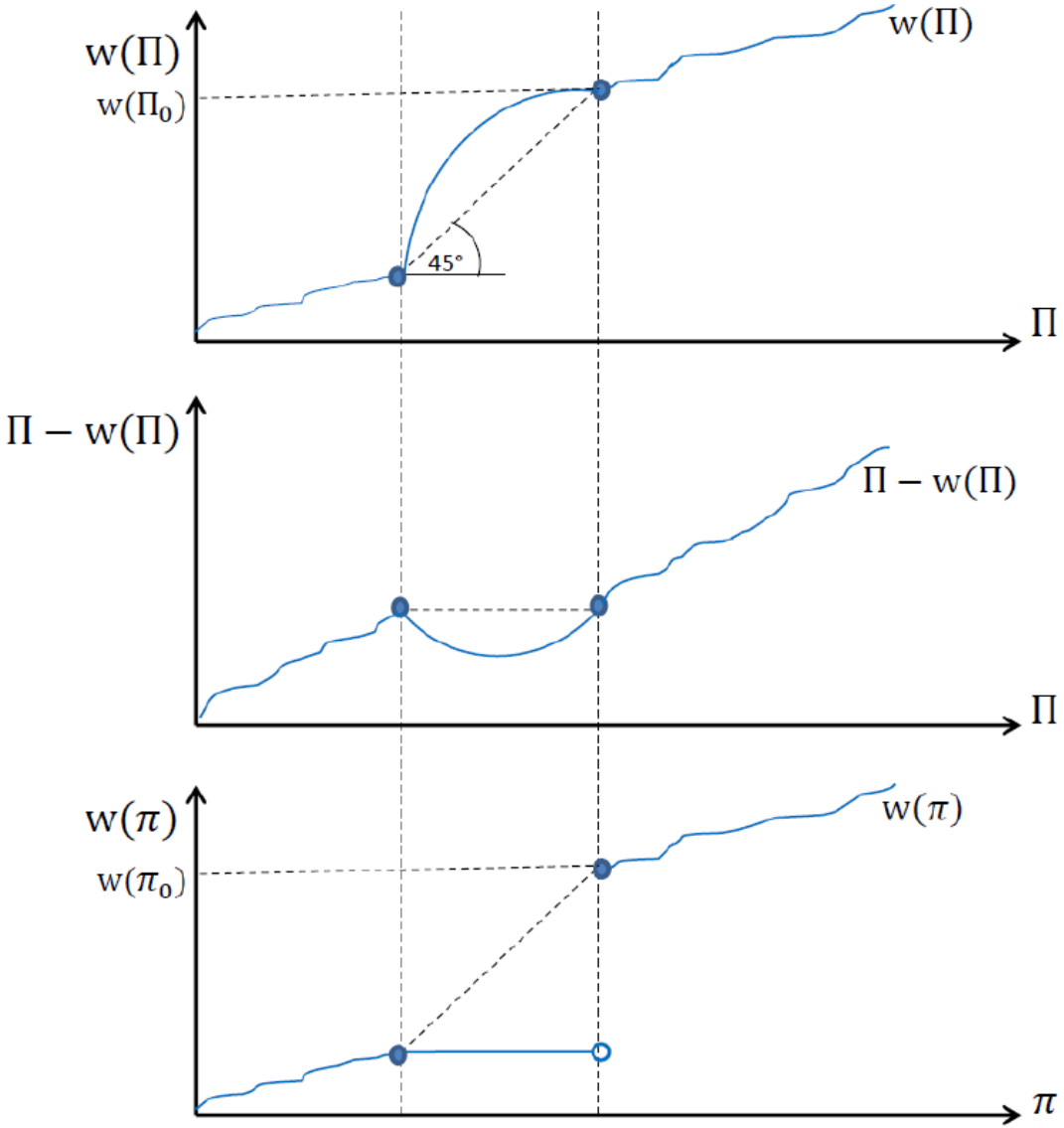
A sabotage profile $s(\pi)$ is incentive compatible under a contract $w(\Pi)$ if

$$s(\pi) \in arg \max_{x} \pi - s(\pi) - w(\pi - s(\pi))$$

A contract $w(\Pi)$ induces a contract $w(\pi)$ through

$$w(\pi) = w(\Pi) - s(\pi = \Pi)$$

- Principal can only commit to a sabotage profile if it is incentive compatible.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Results

- Formally.....

Lemma

$w(\Pi)$ and $s(\Pi)$ are differentiable a.e. Moreover, they are substitutes: $w'(\Pi)z(\Pi) = 0$ whenever w' exists.

Lemma

Sabotage decreases abruptly. If $z(\Pi) > z(\Pi + \varepsilon)$, then there exists $\Pi' \in (\Pi, \Pi + \varepsilon)$ with $z(\Pi') = 0$.

Lemma

WLOO we can restrict attention to contracts with $w' \leq 1 +$ sabotage.

- Observe that sabotage can exist and be optimal in equilibrium.

Characterization Results

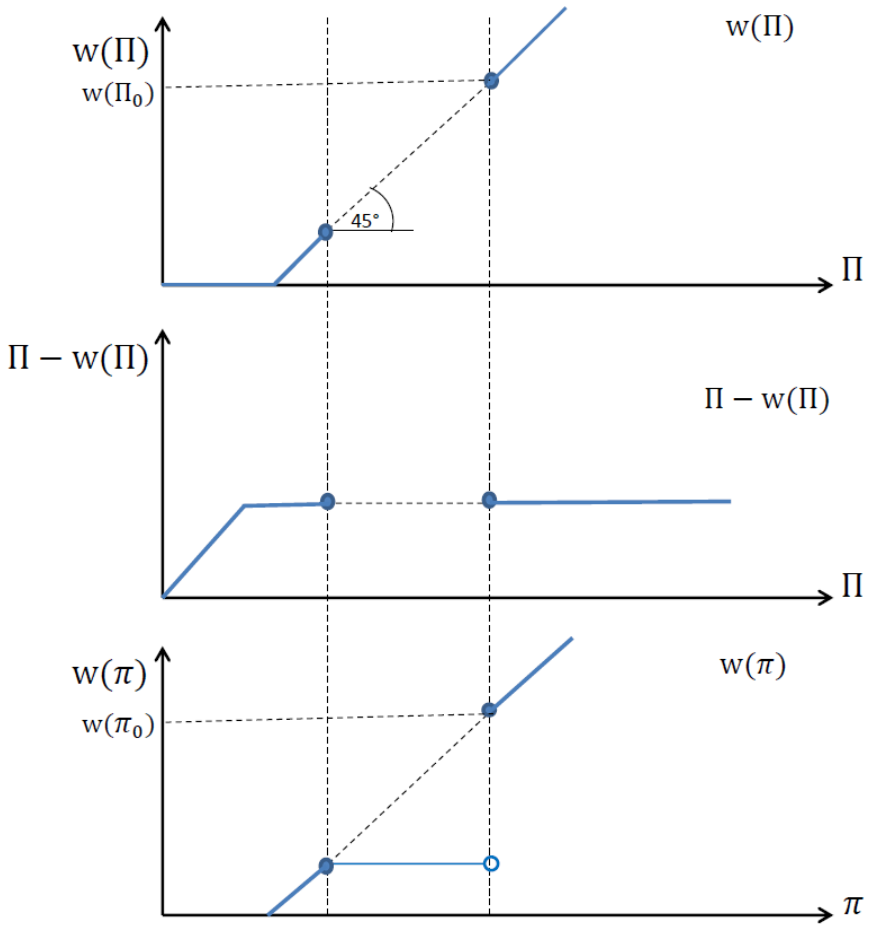
- What we knew without sabotage and $w'(\Pi) \leq 1$
- Agent's payment: $\int w dF = \int w'(1-F)$
- Marginal benefit of effort: $\int w'(-F_a)$.
- Benefit of increasing w' : $-F_a$. Cost of increasing w' : $1-F$.

$\frac{\partial}{\partial \Pi} \frac{-F_a}{1-F} > 0 \Longleftrightarrow \frac{\partial}{\partial a} \frac{f}{1-F} < 0$

- Under HRSD, the optimal contract is $\max\{\Pi - k, 0\}$

Characterization Results

- Sabotage + HRSD
- Optimal contract is $\max\{\Pi - k, 0\}$ + sabotage
- Can't say how much or where, yet.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How much sabotage?

Proposition (How much s)

If $-F_a$ is increasing in π, the agent's participation constraint is binding.

- Consider contract w without sabotage and $\widehat{w}$ with sabotage on $[\pi_1, \pi_2]$.

$$\frac{\partial}{\partial a}\left[\int \widehat{w}(\pi)dF(\pi,a) - \int w(\pi)dF(\pi,a)\right]$$

$$= \int_{\Pi_1}^{\Pi_2}(-F_a(\pi_2,a))d\pi - \int_{\Pi_1}^{\Pi_2}(-F_a(\pi,a)))d\pi$$

- This contrast with standard agency models with limited liability.
- Principal sabotage at least untill participation constraint is binding.
- The strike price might be different.

When to Sabotage

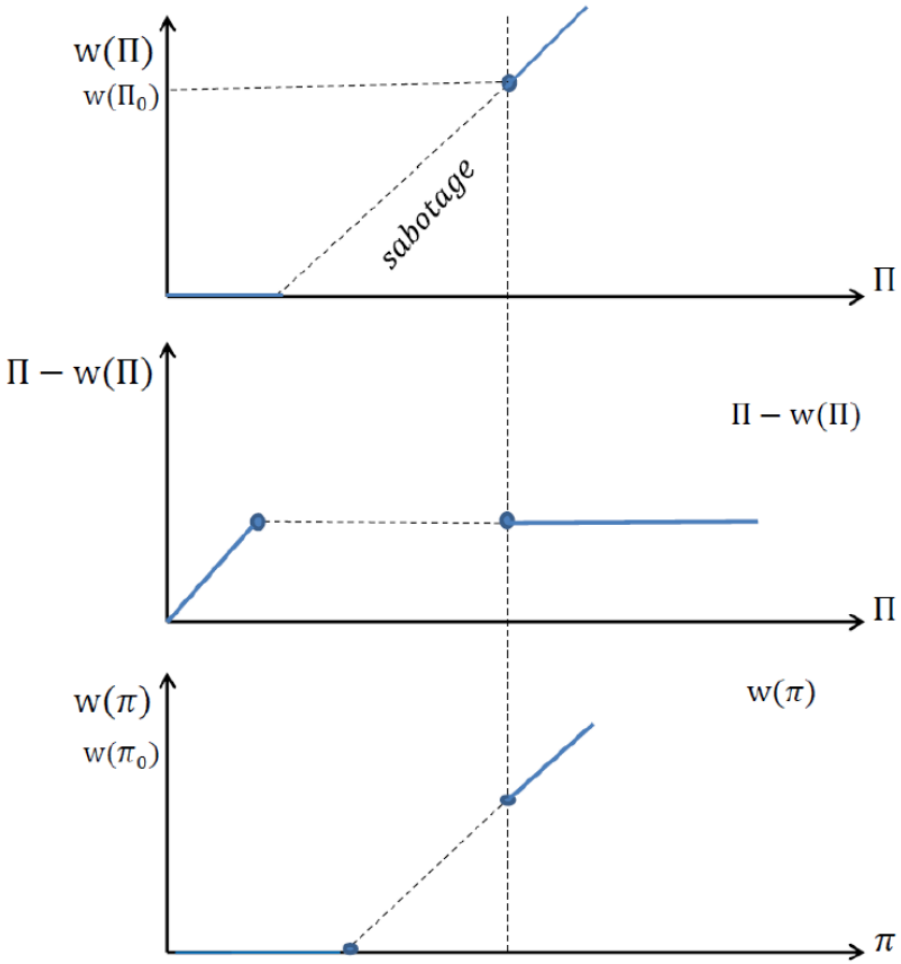
- Intuition, remember that

$$\frac{\partial}{\partial a}\left[\int \widehat{w}(\pi)dF(\pi,a) - \int w(\Pi)dF(\Pi,a)\right]$$
$$= \int_{\Pi_1}^{\Pi_2}(-F_a(\pi_2,a))d\pi - \int_{\Pi_1}^{\Pi_2}(-F_a(\pi,a)))d\pi$$

- Sabotage where $-F_a(\Pi,a)$ is changing fastest in Π.

Proposition (Where)

If $-F_a$ is concave in Π, then there exist levels Π_0, Π_1 such that. For $\Pi < \Pi_0$, $w(\Pi) = w'(\Pi) = z(\Pi) = 0$. For $\Pi \in [\Pi_0, \Pi_1]$, there is sabotage $s(\Pi) = \Pi - \Pi_0$ and $w(\Pi) = 0$.For $\Pi > \Pi_1$, $\omega(\Pi) = \Pi - \Pi_0$ and $z(\Pi) = 0$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Final Remarks

- Bonus style contracts may be optimal without renegotiation.
- These contracts are a commitment to Sabotage.
- Sabotage takes to increase incentives.
- If higher states have a larger marginal return to effort, contracts with LL have a binding participation constraint.
- Sabotage happens where marginal returm to effort change fastest.