

Game Theory at the Movies 4: *Sequential Games and Commitment*

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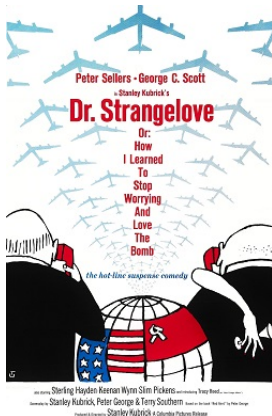
Outline

- Backward induction and subgame perfect equilibrium (SPE).
- *Dr. Strangelove* (1964): a commitment no one was told about.
- *The Good, the Bad and the Ugly* (1966): the truel.
- *Ransom* (1996): changing the kidnappers' payoffs.

Credible and Non-Credible Threats

- In a sequential game, solve from the last mover up: **backward induction**.
- A **subgame perfect equilibrium** (SPE) requires a best response in every subgame.
- A threat matters only if, when the time comes, the player would actually carry it out.

Dr. Strangelove (1964)



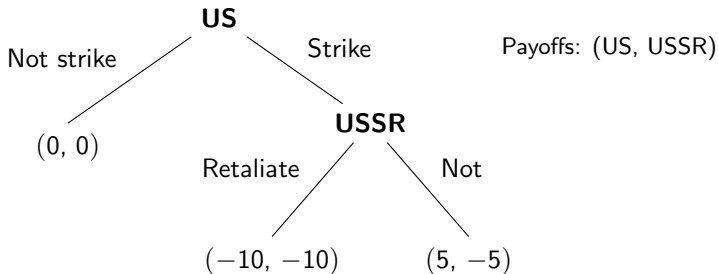
Theatrical release poster.

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The Doomsday Machine

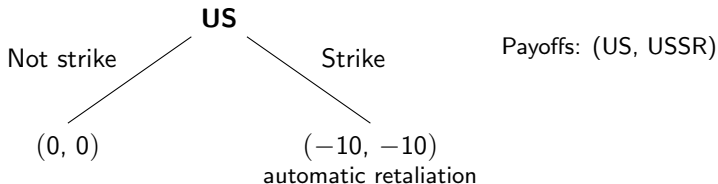
- Cold War deterrence: each superpower threatens to retaliate against a first strike.
- But once your cities are destroyed, retaliation is pure loss.
- The Soviets build a doomsday machine: retaliation becomes automatic.
- They plan to announce it on Monday. A rogue US general attacks first.

Without the Machine



- After a strike, the USSR compares -10 with -5 : it does not retaliate.
- Anticipating this, the US strikes. SPE: (Strike, Not retaliate).

With the Machine



- The machine deletes the USSR's choice. The US compares 0 with -10 : it does not strike.
- **Commitment:** by deleting an option, the USSR makes its threat credible (Schelling, 1960).

Why the Secret Ruins the Machine

- A commitment works only by changing what the rival *expects*.
- Not knowing about the machine, the US still believes the tree without it.
- So the machine deters no one, and when the strike comes it destroys everyone.
- **Lesson:** a commitment that is not communicated only traps its owner.

The Good, the Bad and the Ugly (1966)



Theatrical release poster.

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A Duel Among Three

- Three men stand in a circle in a graveyard, each with a pistol.
- A contest among three is a **truel**.
- Label them by skill: A is the deadliest, B middling, C the poorest shot.
- Who is most likely to survive?

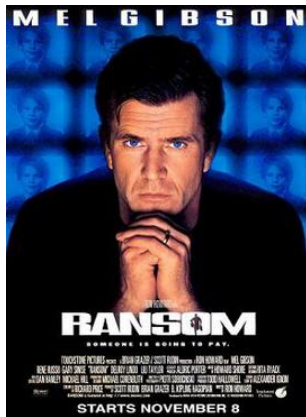
Backward Induction in the Truel

- **Last stage:** if two remain, the better shot is more likely to win the duel.
- **Earlier stage:** A would rather face C than B , so A shoots at B .
- Likewise, B would rather face C than A , so B shoots at A .
- No one spends a first shot on C .

Why the Weakest Can Survive

- The strong shooters thin each other out.
- C then faces a single, weakened rival.
- A rational weak player may even fire wide on purpose, so as to be no one's target.
- Kilgour and Brams (1997): survival odds can run in the reverse order of skill.

Ransom (1996)



Theatrical release poster.

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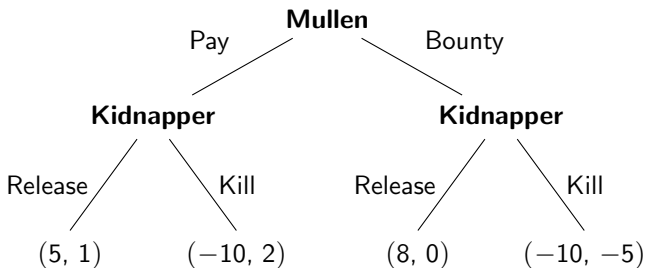
Ransom or Bounty?

- Kidnappers take the son of Tom Mullen, a wealthy airline owner, and demand \$2 million.
- Mullen realizes that paying buys nothing certain: the boy can identify his captors.
- He goes on television and turns the \$2 million into a bounty on the kidnappers.
- He will withdraw it only if his son is returned alive.

The Ransom Game

- Selten (1977): the family pays, then the kidnapper releases or kills the hostage.
- If the hostage can identify the kidnapper, killing lowers the risk of capture.
- *Ransom* breaks Selten's assumption: payment no longer secures release.

Pay or Bounty?



Payoffs (Mullen, kidnapper), illustrative.

Solving the Game Backward

- After Pay: the kidnapper kills, since $2 > 1$. Paying is useless.
- After Bounty: holding the boy makes the kidnappers hunted men, so the kidnapper releases, since $0 > -5$.
- Mullen compares -10 (pay) with 8 (bounty): the SPE is to offer the bounty.
- **Lesson:** instead of bargaining within the game, change its payoffs.

A Prisoner's Dilemma Among the Kidnappers

- The bounty also pays any kidnapper who betrays the others.
- Each knows that the others are tempted to defect first.
- In the film, the ringleader turns on his own accomplices to claim the bounty.
- Mullen cannot make the gang trustworthy, so he makes the partnership unstable.

Summary

- Solve sequential games backward; keep only credible threats.
- *Dr. Strangelove*: commitment makes a threat credible, but only if announced.
- *The Good, the Bad and the Ugly*: in a truel, strength attracts fire.
- *Ransom*: changing the payoffs changes the equilibrium.