

2. Credible Commitments

2.1 Game Trees and Subgame Perfection

What if one player moves first?

Use a **game tree**, in which the players, their actions, and the timing of their actions are explicit.

Allow three choices for each of the two players, Alpha and Beta: Do Not Expand (DNE), Small, and Large expansions.

The payoff matrix for simultaneous moves is:

The Capacity Game

		<i>Beta</i>		
		DNE	Small	Large
<i>Alpha</i>	DNE	\$18, \$18	\$15, \$20	\$9, \$18
	Small	\$20, \$15	\$16, \$16	\$8, \$12
	Large	\$18, \$9	\$12, \$8	\$0, \$0

TABLE 1. The payoff matrix (Alpha, Beta)

The game tree.

If Alpha preempts Beta, by making its capacity decision before Beta does, then use the **game tree**:

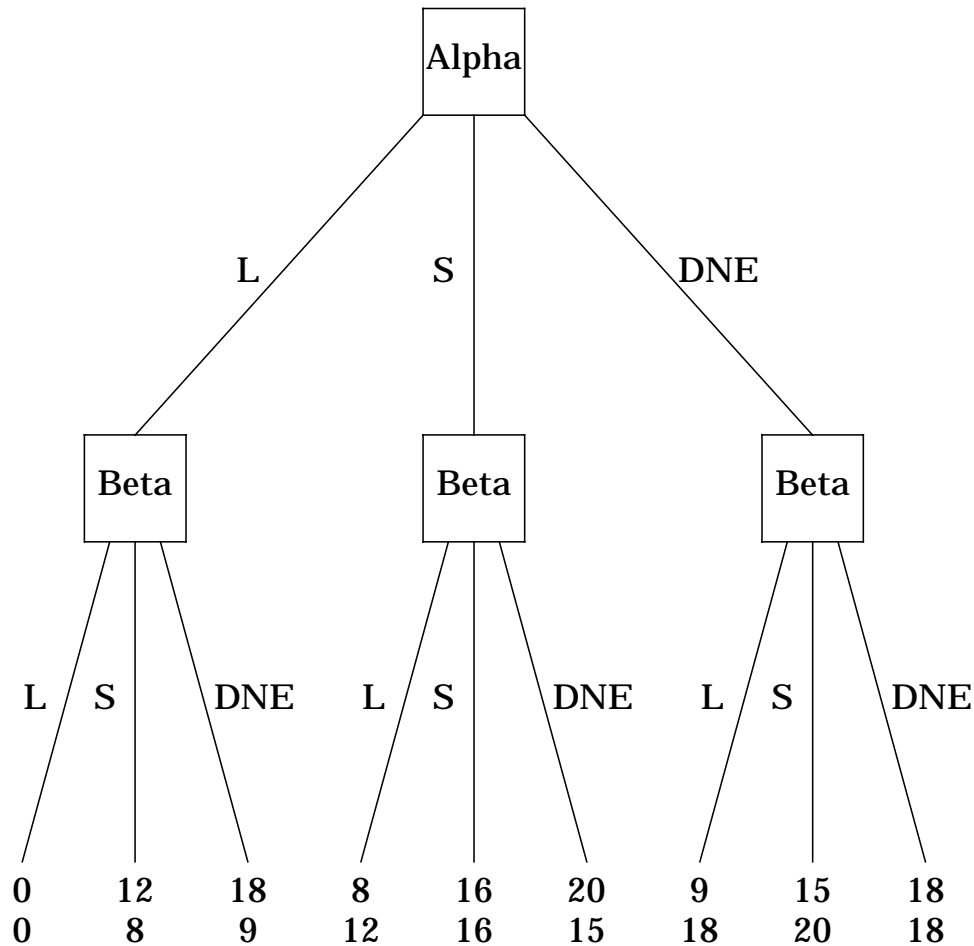


Figure 1. Game Tree, Payoffs: Alpha's, Beta's

Use *subgame perfect Nash equilibrium*, in which each player chooses the best action for itself at each node it might reach, and assumes similar behaviour on the part of the other.

2.1.1 Backward Induction

With complete information (all know what each has done), we can solve this by *backward induction*:

1. From the end (final payoffs), go up the tree to the first parent decision nodes.
2. Identify the best (i.e. the highest payoff) decision for the deciding player at each node. The choice at each node is part of the player's optimal strategy.
3. "Prune" all branches from the decision node in 2. Put payoffs at new end = best decision's payoffs
4. Do higher decision nodes remain?
If "no", then finish.
5. If "yes", then go to step 1.
6. For each player, the collection of best decisions at each decision node of that player
→ best strategies of that player.

Commitment.

In the simultaneous game (see the payoff matrix above) the equilibrium outcome is Alpha: Small; Beta: Small.

In the sequential game (see the game tree above) the equilibrium outcome is Alpha: Large; Beta: Do Not Expand.

In the sequential game, Alpha's capacity choice has **commitment value**: it gives Alpha (in this case) **first-mover advantage**.

2.2 Threats and Credible Threats, or Why Commitment Is Important

Two firms, Able and Baker, are competing in an oligopolistic industry (an industry with few sellers who are engaged in a strategic “dance”).

Able, the dominant firm, is contemplating its capacity strategy, with two options:

- “Aggressive,” a large and rapid increase in capacity aimed at increasing its market share, and
- “Soft,” no change in the firm’s capacity.

Baker, a smaller competitor, faces a similar choice.

Payoffs.

The table shows the NPV (net present value) associated with each combination of strategies:

		<i>Baker</i>	
		Aggressive	Soft
<i>Able</i>	Aggressive	12.5, 4.5	16.5, 5
	Soft	15, 6.5	18, 6

TABLE 2. Simultaneous Payoffs (Able, Baker)

Using arrows, we easily see that Able has a dominant strategy of S.

Equilibrium.

There is a unique Nash equilibrium: Able chooses Soft and Baker chooses Aggressive, to give a payoff to Able of 15.

But from Able's point of view, this combination is not as good as if both Able and Baker chose Soft → Able's payoff of 18.

But without Baker's cooperation, this outcome will not be reached.

What if Able committed to choose Aggressive whatever Baker chose? If this were **credible**, then Baker would choose Soft (for a higher payoff of 5, over 4.5), which in turn would give Able a payoff of 16.5, instead of 15 in the N.E.

How to commit to Aggressive on Able's part?

Credible threats.

It's not enough to announce it or even to promise¹ it: not a *credible* move, since Baker knows that Soft is a *dominant strategy* for Able: no matter what Baker does, Able's payoff is higher if it's Soft.

One way is for Able to make a preemptive move, by accelerating its decision process and aggressively expanding its capacity before Baker decides what to do: turns a *simultaneous* interaction into a *sequential* game:

1. Talk is cheap ... because supply exceeds demand.

A sequential tree.

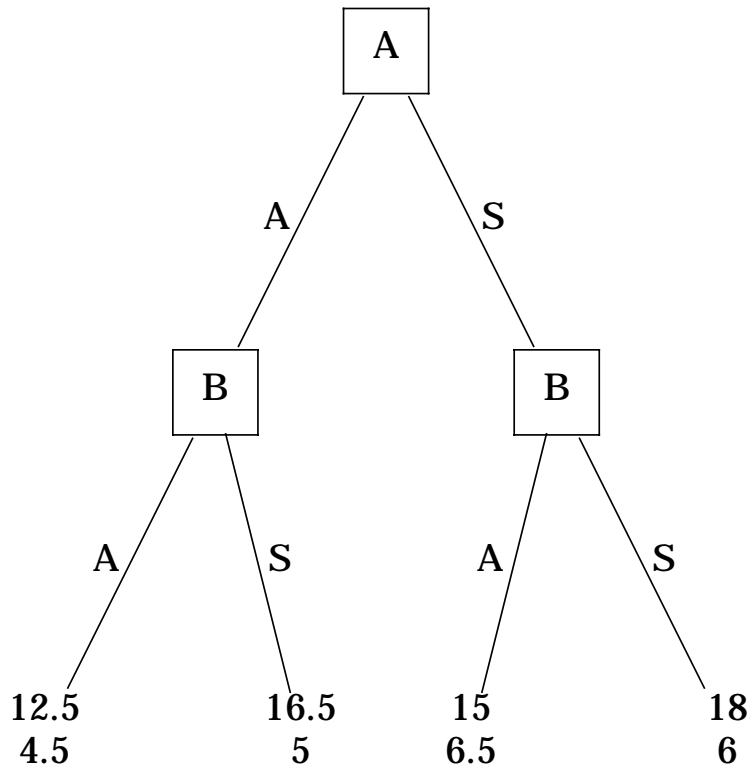


Figure 2. Sequential Payoffs (Able, Baker)

{Able: Aggressive, Baker: Soft} is a subgame perfect Nash equilibrium of the sequential game.

Credible commitment?

Able may be able to credibly commit by demonstrating that it was rewarding its managers on market share rather than the NPV profit of the payoffs: more profitable for the managers to go for capacity aggressively, even if the company's payoff appears lower.

Paradoxically, Able's position is strengthened if it can reduce its options and tie itself to Aggressive.

Inflexibility can have value: strategic commitments or moves that limit choices can actually improve one's position.

How?

By altering one's rivals' expectations of about how one will compete, and so altering their decisions, and so your outcomes.

By committing to what seems an inferior decision (Aggression), Able alters Baker's expectations and its action, to Able's advantage.

Credible, communicated commitments.

Commitments must be credible and communicated and understandable to be of value.

- By their nature, strategic commitments (threats or promises) are intended to change others' expectations and behaviour; others must wonder whether the committed player mightn't fall back on the uncommitted best action: it's nothing but a bluff.
- The movie *Dr Strangelove* describes a Russian commitment — The Doomsday Machine — to respond to any incursion into Soviet airspace with an attack of nuclear missiles on the U.S. Unfortunately, the Russian have overlooked telling the Americans about it ...
- The rivals' managers must understand the implications for their own firms' payoffs of Able's ability to price low with its excess capacity.

To be truly credible, the commitment must be *irreversible*: very costly to stop or reverse (i.e. sunk).

Non-credible threats are ignored.

2.3 A Menu of Strategic Moves

2.3.1 Threats and Promises

- An *unconditional move* may give a strategic advantage to a player able to seize the initiative and move first.
- Possible for a second mover to gain similar strategic advantage by commitment to a *response rule*: “If you do/don’t act like this, then I’ll do/not act like that.” The rule must be in place and *clearly communicated beforehand*.
- Two sorts of response rules: *threats* and *promises*.

Threats and promises.

- A *threat* is a response rule that punishes others who fail to cooperate with you.
 - *Compellent threats* to induce action (hijacker).
 - *Deterrent threats* to deter action (NATO).
 - Both sorts: both sides will suffer if the threat has to be carried out.
- A *promise* is a rule that rewards others who cooperate with you.
 - Again, both *compellent* (“Clean up your room”) and *deterrent* (“Don’t be nasty to your sister”).
 - Both share a common feature: once the action is taken (or not taken), there is an *incentive to renege*.
- What about:
Mugger: If you “lend” me \$20, then I promise I won’t hurt you. Implicit threat overshadows the explicit promise. What is the status quo ante?

2.3.2 Warnings and Assurances

- Warnings and assurance are non-strategic: there is *no temptation to renege*, since they are Nash equilibrium actions.
- Threats and promises: the response rule commits you to actions you wouldn't take in its absence, i.e. strategic.
- If the rule says merely that you will do what is best at the time, then there is no change in others' expectations, and hence no influence.
- But there may still be an informational role for stating what will happen without a response rule: *warnings* and *assurances*.
- A *warning*: it's in your interests to carry out a "threat". A warning is used to inform others of the effects of their actions.
- When it's in your interest to carry out a "promise": an *assurance*.
- Warnings & assurances: equilibrium actions with no incentive to renege.

Informational, not strategic.

- Threats and promises are truly strategic moves, but warnings and assurances are more informational;
 - they don't change your response rule in order to influence another player,
 - instead you are merely informing them of your response to their actions.
or altering the other player's information set
 - You aren't manipulating them by altering your response rule from what will be best at the time.
 - There is no issue of credibility with warnings and assurances, since there is no incentive problem for you.
 - Hence warnings and assurances don't require commitment.

2.3.3 Summary of Strategic Moves

- An *unconditional* move is a (response) rule in which you move first and your action is fixed.
- *threats* and *promises* occur when you move second: they are conditional because the response dictated by the rule depends on what the other side does.
- A strategic move is a preemptive action, and the response rule must be in place *and communicated* before the other side moves.
- Hence the game should be analysed as a sequential move game, which may dramatically alter the outcomes, even though the payoffs remain unchanged, due to the different rules of play.

2.4 Strategic Moves

(See Dixit & Nalebuff, Chapter 5.)

- For the scorched earth policy strategy to be effective, you must destroy what the invader (raider) wants, which may not coincide with what you want.
- An example of a *strategic move*: designed to alter the beliefs and therefore the actions of others in a direction favourable to yourself.
- distinguishing feature is that the move purposefully limits your freedom of action, unconditionally or conditionally.
- Leaving your options open is not always preferable in strategic interactions: your lack of freedom has strategic value, by changing other players' expectations about your future responses.

They know that when you have the freedom to act, you also have the freedom to give up.

So by reducing your freedom to give up, you strengthen your position.

2.5 Unconditional Moves

Consider rivalry between the US and Japan to develop High Definition TV (HDTV):

- The US has the technological edge (for now), but has more limited resources because of accumulated budget deficits.
 - The Japanese can win, but so can the US with a strategic move.
 - The payoff matrix:
 - Hi,Hi is the worst for both: the US is more likely to win, but at a higher cost.
 - Lo,Hi (Hi,Lo) is next worse for the US (Japan) because Japan (the US) is likely to win.
 - The Japanese prefer Lo,Hi: their chances of winning are high and they care less about the resource cost.
 - The US prefers Lo,Lo: they are likely to win at low cost.
- ∴ Rank the four combinations for each player.

The HDTV Race

		<i>Japan's effort</i>	
		Lo	Hi
<i>US effort</i>	Lo	4, 3	2, 4
	Hi	3, 2	1, 1

TABLE 3. The payoff matrix (US, Japan)

A non-cooperative, positive-sum game.
(One Nash equilibrium.)

Lo,Lo → US wins
 Lo,Hi → J wins
 Hi,Lo → US wins
 Hi,Hi → standoff or US wins

Thinking through the options.

- US has a dominant strategy, Lo, but the Japanese can anticipate this.
- Japanese best response is Hi.
- (Lo,Hi) is an equilibrium, but it's the US's second worst payoff. This calls for a strategic move by the US.
- If the US moves first by announcing its unconditional effort level before the Japanese reach their decision, the game becomes sequential-move, with the following tree:

The HDTV game tree.

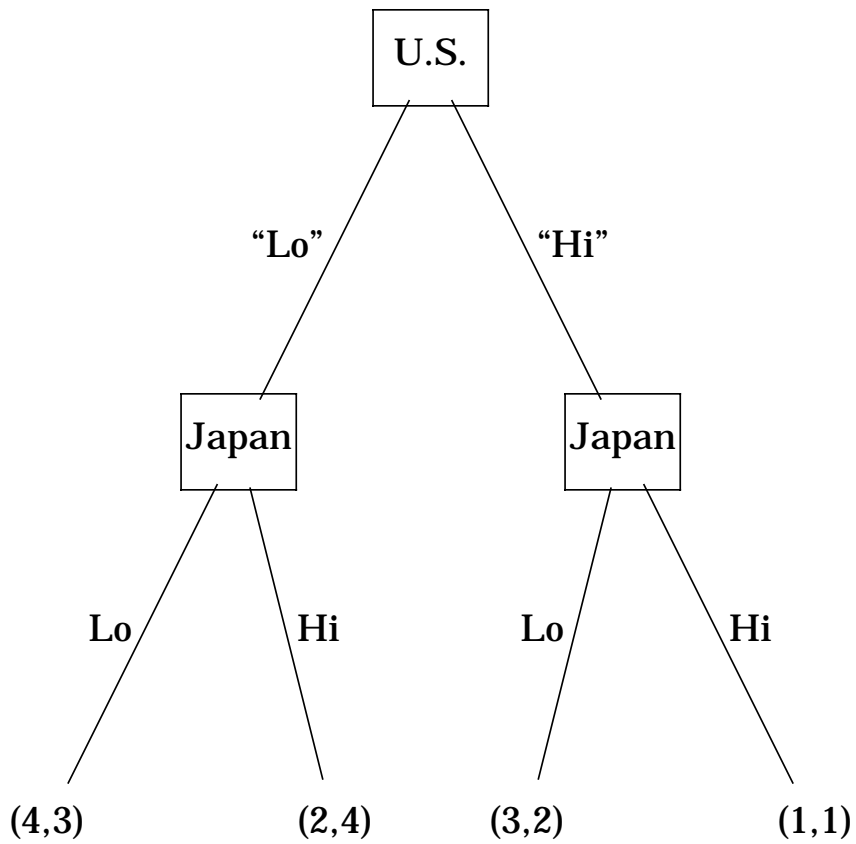


Figure 3. Tree and Payoffs in Sequential-Move Game (U.S., Japan)

Look forward and reason backward.

Solve by looking forward and reasoning back:

- If U.S. Lo, then Japanese Hi, and U.S. gets 2.
- If U.S. Hi, then Japanese Lo, and U.S. gets 3.
- So U.S. should announce Hi, and expect the Japanese to respond Lo.
- Equilibrium of sequential-move game, and results in a payoff of 3 for the U.S., higher than the 2 it got in the simultaneous game.
 - The U.S. strategic move is its unilateral and unconditional declaration of its choice, *not* the choice it would have made in a simultaneous-play game:
 - U.S. has nothing to gain by declaring Lo, which is what the Japanese expect anyway.
 - Strategic moves: commit to *not* follow the equilibrium move of the simultaneous-play game.
 - The strategic move alters the Japanese beliefs and so their move. (If the U.S. could then change its move from Hi to Lo, it should do so.) But ...

Questions:

Why should the Japanese believe the U.S. declaration?

Wouldn't they expect a change of mind?

If they do, wouldn't they choose Hi?

- The *credibility* of the U.S. declaration is suspect. Without credibility, the U.S. move has no effect.
- Most strategic moves must face the issue of credibility. (Consider the possible preemptive moves in Chicken!)
- To make a strategic move credible, you have to take some other supporting action that makes reversing the move too costly or even impossible: *commitment*.
- Strategic moves (which always have an incentive to renege) contain two elements:
 1. the planned course of action and
 2. the commitment that makes this action credible.
- Visibility?

2.6 More Strategic Moves

- More complicated options than above. Instead of establishing a response rule directly, you could allow someone else to take advantage of one of these options:
 - Allow someone else to make an unconditional move before you respond, *or*
 - Wait for a threat before taking any action, *or*
 - Wait for a promise before taking any action
- Cases in which someone who could move first does even better by allowing the other side to make an unconditional move first: sometimes it is better to follow than to lead.

Leave your opponent an escape.

- But sometimes your goal: to prevent your opponent from making an unconditional commitment:
 - “When you surround an enemy, leave an outlet free.” Deny the enemy the credible commitment of fighting to the death.
- It’s never advantageous to allow others to threaten you:
 - you could always do what they wanted you to do without the threat;
 - the fact that they can make you worse off if you do not cooperate is bad, because it only limits your available options.
- *But if the other side can make both threats and promises, then you can both be better off.*

2.7 The Appropriate Threat

- Why do trade disagreements (Australia v. the USA, or the USA v. the EC, or the USA v. Japan) seldom lead to (threats of) armed conflict or seizure of other's goods or citizens?
- Excessive threats have problems:
 1. Lack of credibility.
 2. If it worked, it might result in a further questioning of the relationship.
 - 3(a) If it didn't work (because of lack of credibility, say), and the threat was carried out, then the punisher may be seen as uncivilised.
 - 3(b) If it didn't work, and the threat wasn't carried out, then the threatener's reputation may be damaged — future credibility.
 4. An excessive threat muddies the water.

Summary of threats.

So we note:

- Threats may be costly.
- Excessive threats may be counterproductive.
- A successful threat need never be carried out, so long as there are no mistakes. e.g.. *Dr. Strangelove, or How I Stopped Worrying and Loved the Bomb*
- Too large a threat may lose credibility.

e.g.. Boeing v. Airbus.

Getting the threat right ...

The Piranha Brothers

— *Monty Python's Flying Circus ...*

The Operation: **X**

1. Select a victim.
2. Threaten to beat him up if he paid the “protection” money.

The Other Operation: **X**

1. Select a victim.
2. Threaten not to beat him up if he didn't pay the “protection” money.

The Other Other Operation **✓**

1. Select a victim.
2. Threaten to beat him up if he didn't pay the “protection” money.

2.8 Credible Commitments

Consider the following statements from the media:

- “Continental Airlines said yesterday that it would raise airfares on about two-thirds of its routes ... to take effect September 5.”
New York Times, August 29, 1992.
- “Continental Airlines has dropped its plan to raise domestic airfares by 5%.”
USA-Today, 1992.
- “Microsoft officials won’t confirm or deny that its commitment to ACE with OS/2 3.0 was a bluff, but the [previous] announcement bought them about six months.”
UnixWorld, February 1992.
- “On January 5, Boeing, the world’s top aircraft maker, announced it was building a plane with 600 to 800 seats, the biggest and most expensive airliner ever. Some in the industry suggest Boeing’s move is a bluff to preempt Airbus from forging ahead with a similar plane.”
Business Week, 1993.

Tactical bluffing.

(From Dixit & Nalebuff, Chapter 6.)

All strategic moves court lack of *credibility*.

- If it is not in your interest to carry out a strategic move (unconditional move, threat, or promise), then your opponents will look forward and reason back to realise that you have *no incentive* to follow through.
- If your strategic move is not a credible commitment, then it will be ineffective in altering your opponents' behaviour by changing their expectations about your responses to their actions.

Are you engaging in *tactical bluffing*?

If the opposition decides you are, then your efforts to convince otherwise will be in vain.

e.g. Rothschild's selling on the London Exchange.

2.8.1 Eight-Fold Path to Credibility

Three underlying principles:

- I. to *change the payoffs* of the game (Items 1, 2, 6 below) — to make it in your interest to follow through on your commitment:
 - turn a threat \Rightarrow a warning,
 - turn a promise \Rightarrow an assurance.
- II. to *limit your ability* to back out of a commitment (3, 4, 5, 6) — three possibilities: deny yourself any opportunity to back down,
 - by cutting yourself off from the situation, or
 - by destroying any avenues of retreat, or even
 - by removing yourself from the decision-making position and leaving the outcome to chance.
- III. to *use others to help you maintain commitment* (7, 8) — a team may achieve credibility more easily than an individual.
 1. Reputation
 2. Contracts
 3. Cutting off communication
 4. Burning your bridges
 5. Leaving outcome beyond your control
 6. Moving in steps
 7. Teamwork
 8. Mandated negotiating agents

2.8.1.1 Reputation:

- In a once-in-a-lifetime situation, reputation may not matter (tourists, beware!)
- but in a repeated interaction with one player or parallel games with several players reputation may be valuable. (“Never negotiate with terrorists/Hamas/the IRA/etc.”)
 - Why?
 - Costly?
 - Alternatives?)
- Sometimes *destroying* your reputation can create the possibility for a commitment, by committing you *not* to take actions in the future that you can predict will not be in your best interests.
 - Despite a commitment never to negotiate with hijackers, what if the government reaches a negotiated settlement and then breaks this new commitment by attacking the hijackers?
 - with this action the government denies itself the ability to negotiate with hijackers in the future: how could hijackers ever be able to believe the government’s future promises?

Let's destroy our credibility!

- The destruction of the credibility of a promise makes credible the threat never to negotiate.
(Tax/immigration amnesties and perverse incentives, and side effects.)
- The player cultivates a reputation with the aim of creating credibility for her future unconditional commitments, threats, and promises.
- Pride in our word, our promises, is taught as an end in itself, but it also improves the credibility of our daily commitments.
- *Irrationality* may make credible the player's threats, however outrageous — Ghaddafi, Saddam Hossein, the Ayatolah Khomeini — what wouldn't an irrational player do if he were convinced in his own cause.

So, it may be rational to be irrational!

2.8.1.2 Contracts:

- Agreeing to punishment if you fail to follow through will make your commitments credible.
 - Pay the programmer a lump sum because it's the end of the financial year, even though the promised program is three months late?
 - No. The contract is the commitment device.
- But beware, contracts can be *renegotiated*,
- *so for the contracting approach to be successful, the party who enforces the action or collects the penalty must have some independent incentive to do so.*
- If breaking a contract produces damages, then renegotiating the contract is a less attractive option mutually, and may no longer be mutually attractive at all.
- Possible to write contracts with neutral parties as enforcers, who must be made to care about whether the commitment is kept.
- Contracts alone cannot overcome the credibility problem.

2.8.1.3 *Cutting Off Communication*

- Can make a decision truly irreversible.
 - Extreme form: last will and testament.
 - Posting a letter/receiving a letter.
 - Other examples?
- Problem: absence may reduce enforceability of the contract: trustees.

2.8.1.4 *Burning Your Bridges (or Sinking Your Ships)*

- Cortés' burnt ships had two effects:
 - his soldiers had no alternative but to fight,
 - the opposition could see that there was no easy out for the would-be conquistadores, while they could retreat inland, which they did. Importance of all participants seeing the bridges being burnt.
- Polaroid's undiversified business: instant photography. Successfully defended itself in court against Kodak's instant film and camera, but latterly has diversified as its competitive advantage is whittled away.
- Figuratively burning one's bridges with a particular group may increase one's credibility with other groups.
- Pulling down the Berlin Wall as a burnt bridge for Eastern Germany's "reformist" government.
- Other examples?

2.8.1.5 *Leaving the Outcome beyond Your Control*

- Dr Strangelove's doomsday device;
 - its automatic trigger was essential;
 - it made a good deterrent because it made aggressive action tantamount to suicide.
 - But a cost: what if the aggression is based on a mistake?
 - Cannot turn off the doomsday device's automatic retaliation.
- Want a threat no stronger than necessary to deter the rival.
- Schelling's *brinkmanship*:
 - establish a *risk*, but not a certainty, that retaliation will occur.
 - A risk cannot be ignored, even if it seems very unlikely. (U.S. versus the USSR in Europe, Cuban missile crisis.)

2.8.1.6 *Moving in Steps*

- Break the threat or promise into many, small pieces, and then each is dealt with separately, one after the other.
- Establishment of trust? Convert a once-off into a repeated game, in which reputation is important.
- Paying the builder.
- End-game strategies? (such as Always Defect)

2.8.1.7 *Teamwork*

- Peer pressure in AA. Pride and self-respect are lost when commitments are broken — enough to drive one to drink?
- As well as social pressure, the army uses coercive desertion penalties as well as inculcation of love of country and loyalty to one's mates to induce commitment.
- Honour code at Stanford makes not only cheating an offence but also failing to report others who you know to have cheated; exams are not monitored.
- Accessories after the fact (=deed).

2.8.1.8 Mandated Negotiating Agents

- Buying a new car — “I’m on your side and I want the sale, let me ask the boss about the trade-in price”.
- One’s bargaining situation can be improved if one has an agent to negotiate on one’s behalf.
- A union leader may be less flexible because of his reputation. Or an agent may not have authority to compromise
- Should voluntary commitments subsequently abandoned be more severely regarded than abandonment of externally imposed commitments by the agent?

Using an agent, however, can raise problems of divergence of interests — the Principal-Agent problem — which raises the issue of the appropriate *contract* between the principal and her agent.

This is addressed with Game Theory in Contracting Theory.

2.8.2 Saint Crispin's Day

*O God of battles! steel my soldiers' hearts;
Possess them not with fear; take from them now
The sense of reckoning, if th'opposed numbers
Pluck their hearts from them ...*

*We few, we happy few, we band of brothers;
For he to-day that sheds his blood with me
Shall be my brother ...
And gentlemen in England now a-bed
Shall think themselves accurs'd they were not here
And hold their manhoods cheap whiles any speaks
That fought with us upon Saint Crispin's day.*

*That he which hath no stomach to this fight,
Let him depart; his passport shall be made,
And crowns for convoy put into his purse:
We would not die in that man's company
That fears his fellowship to die with us.*

Henry V, [IV, i and iii]

2.8.3 An Offer You Can't Refuse

- At the end of what appeared to be a successful job interview, Larry was asked where the firm ranked in his list of potential employers.
 - Before answering, he was told that the firm only hired those applicants who ranked it first.
 - If the firm was in fact his first choice, then they wanted him to accept in advance a job offer, should one be made.
 - With this prospect of an “offer you can't refuse” (because if you do then it's gone), what should Larry have done?
 - “We want you to work for us. If you rank us first, then we know we'll get you.”
 - “But if you rank us second, we might lose you.”
 - “To get you, even if we are not your first choice as an employer, we want you to agree in advance to accept our offer or you will get none at all.”
 - Credible?
- Committee decision making and take-it-or-leave-it credible threats.

2.8.4 Firms Compete Against Themselves?

- IBM emphasised short-term leases, rather than selling its mainframes.
 - In the customer's interests?
 - Well, obsolescence, flexibility, maintenance, financing.
 - But, otherwise computer prices fall over time — a durable good — and
 - IBM's customers wait to buy at lower prices, accelerating pressure for IBM to compete with itself by lowering prices faster.
 - Leasing commits IBM to keep prices high, since lowering its prices is much more costly since all will renegotiate lower leasing prices.
- Textbooks?
- Computer companies?
- Others?

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