ECONOMIC APPROACHES TO ORGANIZATIONS

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Economic Approaches to Organizations

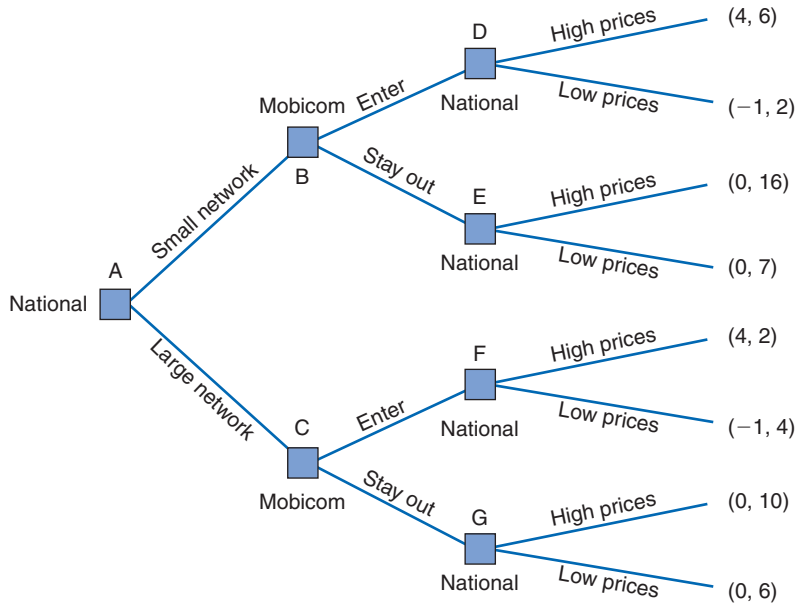

Figure 5.9 An entry game with commitment

to Mobicom's decision? Those three questions can be answered by applying the principle of looking ahead and reasoning backwards through the two stages of the game tree. In nodes D and E, National will choose high prices. So, in node B, Mobicom will decide to enter. In node F, National will choose low prices and, in node G, it will choose high prices. Mobicom knows this, so, in node C, it decides to stay out. Now National knows that, with a small network, Mobicom will enter. The result for National is a profit of 6. It also knows that when it decides to build a large network, Mobicom will not enter. The result is that it will enjoy a profit of 10. So, National decides to build a large network in order to prevent Mobicom's entry.

The point of this example is that, by building a large network, National can commit itself to lower its prices if entry occurs. In the language of game theory, **commitment** is the process whereby a player irreversibly alters the pay-offs in advance so that it will be in his own interest to carry out a threat. In this example, by building a large network, National alters the pay-offs in such a way that, after Mobicom's entry, it is in National's self-interest to carry out the threat of lowering prices. Hence, such commitment makes National's threat credible.

Commitment

From this section you can infer the following:

- In a sequential game, you should anticipate your rival's response. You can do so by applying the principle of looking ahead and reasoning backwards through the game tree.
- A threat can be made credible by showing commitment. By undertaking actions that demonstrate commitment, one player can show another that it is in his own interest to carry out the threat. In order to be effective, commitments must be observable and credible. Box 5.3 illustrates the dangers of making threats that are not credible because they are not backed up by binding commitments.

Box 5.3 Commitment in labour negotiations

Labour negotiations can be viewed from the perspective of game theory as well. In any negotiation, one party may attempt to formulate a 'take it or leave it' offer at a certain stage. In order for such a strategy to be effective, the 'or leave it' part must be credible. If the other party does not believe that is the final offer, the negotiations may be seriously disturbed, as the following story illustrates.

For a time, General Electric in its labour negotiations used a strategy known as Boulwarism (named after Lemuel R. Boulware, the GE vice-president of employee and public relations who introduced it in the 1950s), under which its initial offer, chosen after careful research into wages and working conditions in GE and its competitors, was its final offer. Although this take-it-or-leave-it offer was intended to be fair and acceptable to the workers, the union strongly opposed this technique – understandably, given . . . the amount of bargaining power to be gained from commitment. One union response was likewise to present a set of demands and announce they were inflexible. Another was to behave disruptively during negotiations. Another was to strike. Yet another was to complain to the National Labour Relations Board, which found that GE was guilty of an unfair labour practice; the adjudicator considered the lack of real concessions by GE during negotiations as evidence that GE was not bargaining in good faith. By 1970, the union's opposition had induced GE to cease using the commitment strategy.

Source: McMillan (1991)

5.5 The iterated prisoner's dilemma

In Section 5.2 we discussed the prisoner's dilemma. If two rational and selfish players play this game only once the outcome can be predicted (defect, defect): the game has a dominant strategy equilibrium.

Iterated prisoner's dilemma

In the **iterated prisoner's dilemma** two players play the game many times. In each round each player has to choose to either co-operate or defect. In making that choice, each player can take into account what the other player did in previous rounds. In the repeated game, a strategy is defined as a set of rules that specify what action to take given the history of the game so far. To illustrate the concept of a strategy for an iterated game, we give a few examples.

Tit-for-tat

- ***Tit-for-tat*** is the strategy consisting of the following decision rules: in the first round, choose cooperate, in the following rounds choose whatever the other player did in the previous round.
- *Permanent retaliation*: in the first round, choose cooperate; if the other player defects in any round, choose defect in all subsequent rounds.
- *All D*: always choose defect no matter what the other player does.
- *All C*: always choose cooperate no matter what the other player does.
- *Random*: choose randomly (by tossing a coin) between cooperate and defect.
- *Tit-for-tat plus*: in the first round, choose cooperate; in the following rounds, if the other player cooperated in the previous round, choose cooperate with probability $1-\varepsilon$ and defect with probability ε if the other player defected in the previous round, choose defect.

- *Tit-for-two-tats*: in the first two rounds, choose cooperate; in the following rounds, choose defect if the other player defected in the last two rounds, otherwise choose cooperate.
- *Uneven*: in the first round and in all subsequent uneven rounds, cooperate; in the second and in all subsequent even rounds, defect.

Now suppose that you play the game many times against the same player. What is your best strategy? The answer depends on the strategy of your opponent: tit-for-tat will perform very nicely against tit-for-tat, tit-for-two-tats, permanent retaliation, and All C, but not All D.

It also depends on the pay-offs – if T (the temptation to defect in Figure 5.3) is very large, then an occasional unexpected defection could be part of your best strategy so tit-for-tat plus will perform very well against tit-for-tat and tit-for two-tats, but not against permanent retaliation.

The iterated prisoner's dilemma has been investigated by Axelrod (1984). Axelrod invited scientists from several disciplines, from mathematics to psychology, to submit strategies for the prisoner's dilemma with pay-offs given in Figure 5.1. Note that with these pay-offs permanent mutual cooperation is better than taking turns at exploiting each other (permanent mutual cooperation gives each player 3 in each round; taking turns at exploiting each other means receiving 5 and 0 in two consecutive rounds, an average of 2.5). In most real-world situations it is better to cooperate than take turns at exploiting each other. If R is the reward for mutual cooperation, N the pay-off for being naïve and T the temptation to defect (as in Figure 5.3), that is equivalent to assuming that $0.5(N + T) < R$.

With the pay-offs given in Figure 5.1 and no discounting, Axelrod organized two computer tournaments between the strategies he had received. In each tournament, each strategy was paired with each other strategy, with itself and with random. Both tournaments were won by tit-for-tat.

Tit-for-tat has several characteristics that may explain its success. First, tit-for-tat is nice. That means it is never the first to defect. If tit-for-tat is paired with itself, with tit-for-two-tats, permanent retaliation or all C, then it will receive 3 in each round.

Second, tit-for-tat is forgiving. That means, if the other player defects once but then starts to cooperate again, tit-for-tat will punish him only once. Thus, unlike permanent retaliation, tit-for-tat is able to restore cooperation after a single defection.

Third, tit-for-tat is retaliatory. If the other player defects, he is punished immediately. For that reason, it is difficult to exploit tit-for-tat.

Axelrod's results show quite nicely how two selfish and rational players in the iterated prisoner's dilemma can achieve cooperation even if they cannot make binding commitments (they cannot trust each other not to break promises). That has important consequences for the way members of an organization cooperate. Suppose the two players are Arabia and Russia and each country can choose its production level each week. The two countries then play the iterated prisoner's dilemma. Suppose, further, that they agree to have production levels observed. That mutual cooperation can arise, based on such an agreement, is not surprising. Now suppose the two players are two large firms that have formed a joint venture. To cooperate means giving your partner full access to all relevant know-how;

Box 5.4 Reputation as commitment

Dixit and Nalebuff (1991) explain the building of reputation as being a form of commitment as follows:

> If you try a strategic move in a game and then back off, you may lose your reputation for credibility. In a once-in-a-lifetime situation, reputation may be unimportant and therefore of little commitment value. But, you typically play several games with different rivals at the same time, or the same rivals at different times. Then you have an incentive to establish a reputation, and this serves as a commitment that makes your strategic moves credible.
>
> During the Berlin crisis in 1961, John F. Kennedy explained the importance of the US reputation: 'If we do not meet our commitments in Berlin, where will we later stand? If we are not true to our word there, all that we have achieved in collective security, which relies on these words, will mean nothing.'

Source: Dixit and Nalebuff (1991)

to defect means giving away as little knowledge as possible. If both firms expect to set up similar joint ventures in the future, cooperation is likely to arise. For those firms, it now pays to invest in their reputation as trustworthy partners. Building a reputation is one way to show a commitment (see Box 5.4). In single-stage games it is not possible to build a reputation as the game is over after the first move. In repeated games, however, players may invest in building reputations. Reputations for trustworthiness and cooperativeness help to establish cooperation even in the adverse conditions of a prisoner's dilemma.

Similar situations arise when two people have to work together to accomplish a task. They can both choose between a high level of effort (which is equivalent to cooperating) and a low level of effort (defecting). If they have to work together many times, cooperation is more likely to arise than if they work together only once. If the players meet only once, then we predict mutual defection.

What happens if they know that they will meet each other 1000 times? In the last round they will surely both defect as there is no future from there on in which the other player can punish defection. In round number 999, they will also both defect as they know they are both going to defect in the last round anyway. That logic, taken to the extreme, leads inevitably to the conclusion that both players will defect in the first round. Of course, instead of 1000, any other finite number will yield the same result. Only if both players are to meet an infinite number of times or they do not know how often they will meet can we expect mutual cooperation.

5.6 Auctions

We now turn to a situation involving more than two players in a single-stage game. A prototypical example is the auction.

Open auction

Auctions come in various shapes and forms. An important distinction is between the **open auction**, in which the bids of all parties are observable, and

Sealed-bid auction

the **sealed-bid auction**, in which that is not the case. Again, we shall see that the observability of information plays a crucial role.

Imagine that, as a manager, you are attending the open auction of a piece of land that is adjacent to your factory. As you are contemplating an expansion that exceeds the boundaries of your current acreage, you are strongly interested in this additional piece of land. You think the land should be worth more to you than to competing bidders, but are not sure. Several people you do not know are attending the auction. What should your bidding strategy be? How should the seller set up the auction in order to extract the highest possible price from the audience? As we shall see, the answers to those questions are not unrelated.

If the seller sets up the auction as an 'increasing bid' competition, the optimal strategy for you as a potential buyer is straightforward. It is to remain in the bidding competition until the price rises to your own valuation of the land and drop out of the competition as soon as the price moves beyond your own valuation. If all bidders are rational and execute the same strategy, the land will be transferred to the buyer with the highest private valuation of the land. Note that during the bidding process you will also thus be informed of the other players' private valuations of the land. As the bidding process unfolds, you are able to observe what those private valuations are by noticing who remains in the competition and who drops out. The bidding process forces the players to reveal their preferences.

Such an increasing bid competition is, however, not entirely optimal from the seller's point of view. In order to grasp this point, imagine that you are among the last two bidders for the property. One of the two must have the highest private valuation – say it is you. However, the other player will then be the first to drop out of the competition. He drops out as soon as the price rises just beyond his own private valuation. That may still be far below your own private valuation, however. Hence, there is good news for you: you acquire the land at a price substantially below the level you were willing to pay. Conversely, it is bad news for the seller: her land could have fetched far more than it did.

There are several strategies the seller could employ to counter that risk. One of

Dutch auction

the most interesting is to use a **Dutch auction** instead of an increasing bid competition. In a Dutch auction, the auctioneer starts with a very high price (a price that is, in the auctioneer's opinion, well above the highest private value of all bidders). The auctioneer cries out loudly prices that slowly decrease. This process stops when one of the bidders cries out 'mine'.

In a Dutch auction you have to make your bid (that is, you have to cry out 'mine') without knowing what other bidders might be willing to bid. So, if the piece of land is worth $1 million to you and you estimate that it is worth $700 000 to the second highest bidder, then your best strategy would seem to be to cry out 'mine' when the price is $701 000. That, however, is risky because your estimate may be too low. If you think that the private value of the second highest bidder is somewhere between $650 000 and $750 000 with an expected value of $700 000 your best strategy is probably to cry out 'mine' at a price level somewhere between $751 000 and $701 000.

In a Dutch auction, the seller probably receives at least a part of the difference between the private values of the highest and the second highest bidders. For the

seller there is also a risk, however. In an increasing bid auction, the auctioneer can start with a minimum price. In a Dutch auction there is no such minimum.

In order to establish a minimum, the seller can convert the auction from a one-stage to a two-stage game. In the first stage, the game is played as an increasing bid competition. The winner of the first stage gets a financial reward (a fixed fee or a small percentage of his bid), but not the land. The land is subsequently auctioned in a second stage, which takes the form of a Dutch auction. If, in the second stage, no one cries out 'mine' before the first-stage price is reached, the winner of the first stage has to buy the land for the first-stage price. The bidders in the first stage are usually professional bidders who bid in order to obtain the fee for winning the first stage. They usually do not want the land for themselves.

Notice several interesting features of the open auction game:

- it is a game with private information: each bidder's valuation of the land is his own private information;
- in the increasing bid case most of this private information is revealed as the game is played: only the winner's private information can ultimately remain private;
- the design of the game determines the incentives for players to reveal their private information; by adding a second-stage Dutch auction, the seller attempts to induce the bidder with the highest private valuation to reveal her private information;
- the private information is valuable – the seller is prepared to pay the first-stage winner a price (the fee or percentage) in order to participate in this design.

Sealed-bid (one-stage) auction

In a **sealed-bid (one-stage) auction**, all bidders have to submit their bids in a sealed envelope at the same time. The most striking difference between it and the open auction is that you do not learn about the private information of the other bidders during the auction process. You get only one chance to place your bid under conditions of uncertainty about the other players' private valuations.

What is a good strategy for bidders when sellers design the game as a sealed-bid, one-stage auction? To derive the answer, first consider the case where you, as a bidder, have full information on all the other bidders' valuations. If your valuation is the highest, what should you bid? It seems clear that you should bid just above the second highest valuation. If you bid lower than that, you risk losing the competition. However, bidding much higher makes no sense as you would pay more than needed (colloquially, you would leave money on the table).

The full information case gives a clue as to how to proceed in the more realistic case in which none of the bidders knows the competitors' valuations. Say you are contemplating submitting a bid for a business unit that is divested by its parent company. The parent has solicited the help of an investment banker to set up a one-stage sealed-bid auction.

First, you have to determine the likely competition. Which other companies may be interested in acquiring that particular business unit? Which companies are bidding only because they think that they can run the business unit better (financial bidders)? Which other companies, in addition, believe that they could realize synergies by combining the business unit with their current operations (strategic bidders)?