ECON 600
Lecture 9: Strategic Commitment

We’ve already discussed strategic commitment in a couple of different contexts, but now we are going to be more specific and rigorous about it. The key point to understand about strategic commitment is this: *it sometimes makes sense to restrict your own choices, because doing so will affect the behavior of others.*

I. Some Prior Examples Revisited

“Market Segmentation” was one example we discussed of a game with multiple equilibria. It looked like this:

<table>
<thead>
<tr>
<th></th>
<th>Crunchy</th>
<th>Creamy</th>
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</thead>
<tbody>
<tr>
<td>Crunchy</td>
<td>3, 3</td>
<td>8, 5</td>
</tr>
<tr>
<td>Creamy</td>
<td>5, 8</td>
<td>2, 2</td>
</tr>
</tbody>
</table>

As represented, this is a simultaneous game. There are two NE: \{Crunchy, Creamy\} and \{Creamy, Crunchy\}. Without having more information about the history of the game, the reputations of the firms, and so on, there’s not much more we can say. But now, let’s suppose one of the firms is able to move first. It can build its peanut-butter factory before the other firm, buying capital equipment and other inputs that are specific to the type of peanut butter it will make. Assume that it is either impossible or very costly to reverse these commitments. Then the game looks like this:

The bold lines designate the subgame perfect equilibrium. In that equilibrium, firm 1 chooses Crunchy, and firm 2 chooses Creamy in response to Crunchy. (It is also part of firm 2’s strategy’s that it would choose Crunchy in response to Creamy, but that aspect of firm 2’s strategy will never be relevant.) In other words, firm 1’s ability to commit gives it a first-mover advantage, allowing it to choose the more favorable of the one-shot game’s two equilibria.
We could apply the same reasoning to show that, in the Battle of the Sexes game, the partner who can move first – and commit to her choice! – can select the equilibrium that is more favorable to her. (The equilibrium that is better for the first mover is the only subgame perfect equilibrium.)

And we could apply the same reasoning once more to get a similar result in the Chicken game. Once again, the first mover gets an advantage if she can commit herself to sticking with her choice. In all of these games, a commitment enables a first-mover to choose one of two possible equilibria.

Now let’s look at the Mad Bomber game again. In the original version of the game, the first choice was yours (pay or not pay) and the second was the bomber’s (bomb or not bomb). Given any choice by you, it was always in his interest not to bomb; that is, he had a dominant strategy of not bombing. But now suppose the bomber has the first move: he can choose to push a button on a robot, irrevocably committing the robot to explode if you don’t pay. What happens then? The game looks like this:

```
   bomber
     /\     /
    /   \   /   
   no robot robot
   pay don't pay pay don't pay
bomber bomb
   -1 mil -100 -1 mil -1 mil
   -1 mil 100 -1 mil 0
```

The bold lines show the subgame perfect equilibrium. [NOTE: To make this game comparable to the simpler version, I have violated the usual convention of having the first payoff in each pair be the payoff of the first player. Here, the first player is the bomber, not you, but I’ve left your payoffs on top and the bomber’s on bottom.]

Notice that new subgame perfect equilibrium involves the bomber choosing to use the robot, thereby tying his own hands – he no longer has the option of not bombing if you don’t pay. He has made his threat credible, thereby improving his position. In contrast to the previous games, in which the commitment merely enabled the first-mover to choose one of two possible equilibria, here the commitment enables the first-mover to make possible an equilibrium that would otherwise have been impossible.

Consider a somewhat different game (equivalent to the game in Besanko, p. 233). In this game, a large firm and a small firm compete in the same market. Each firm has to decide
whether to act aggressively (cutting prices to gain market share, say) or passively. For the large firm, it will generally make sense to be passive, because its larger market share means it stands to lose more as a result of price cuts. Of course, the large firm would prefer that the small firm remain passive as well. But for the small firm, it makes sense to be aggressive if the large firm is passive, because it will benefit from a large number of new customers, and the loss from the cut in price will be relatively small because of its smaller current market share. If the large firm is aggressive, though, the small firm would rather be passive, because it will not get the large increase in buyers after all. The picture looks like this (with large firm choosing the row and small firm choosing the column):

<table>
<thead>
<tr>
<th></th>
<th>Aggressive</th>
<th>Passive</th>
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<tbody>
<tr>
<td>Aggressive</td>
<td>12, 4</td>
<td>17, 5</td>
</tr>
<tr>
<td>Passive</td>
<td>15, 7</td>
<td>18, 6</td>
</tr>
</tbody>
</table>

In this game, there is one NE: the large firm is passive (its dominant strategy) and the small firm is aggressive (best response to passive). Thus, the large firm suffers as the small firm increases its share in the market.

But what if the large firm can commit to a strategy before the small firm makes its choice of strategy? Then the game looks like this:

Once again, the bold lines show the subgame perfect equilibrium. Notice that the large firm can make itself better off by committing to an aggressive strategy first. Given that, the smaller firm will respond by being passive. Thus, the large firm improves its own payoff relative to what it would have gotten in the one-shot game. Moreover, the commitment allowed the firm to make possible an outcome that was not an equilibrium in the one-stage game.

Notice, however, that the large firm might wish to change its strategy once the small firm has made its move. Once the small firm has chosen to be passive, the large firm’s best response is also to be passive. If the large firm still had that option, we might expect it to
use it – and so might its small competitor. Foreseeing that the large firm won’t follow through on its aggressive position, the small firm might choose to be aggressive after all. (To see this, imagine we add another stage to the game, in which the large firm can change its strategy back. The outcome of that game would be the same as the one-shot game.) What all this emphasizes is that the commitment must really be a commitment, not just an idle promise. To put it another way, a commitment must be credible.

II. The Elements of an Effective Commitment

What does it take to make a commitment work? There are two main factors.

1. The commitment must be visible to others, so they know you’ve made it. Otherwise, it cannot change their behavior. As a corollary, it must be understandable; otherwise, they’ll know you’ve done something, but they won’t realize its significance. (For example, a change in product characteristics designed to attract more customers won’t necessarily be recognized as such.)

2. The commitment must be credible: observers must believe you’ll follow through on it. The most effective way to make a commitment is to make it irreversible. But it’s not always easy to make a totally irreversible decision, so often reversal is simply made very costly – just costly enough that it’s sensible to follow through on the commitment.

What are some devices that can be used to establish a credible commitment?

- Investing in strategy-specific assets, such as a new plant or capital equipment. It’s not enough just to make an investment in any plant or equipment, though, because it may be possible to sell assets back or convert them to other purposes. That’s why the investments need to be strategy-specific: they cannot easily be converted to some other strategy.
- A short time period during which one could switch back. Even if it’s relatively low in cost to switch back, you can’t do it quickly enough. For instance, if a television network promises to air a certain show on Thursday night, it could not switch to Wednesday without enough time to alert its viewers to the change.
- Staking your reputation on the correspondence between your promises and your actions. If a firm promises that it will produce a particular variety of product, or sell at a particular price, it could incur ill will by breaking its promise.
- Making binding contracts with buyers or suppliers. For instance, Airbus committed itself to building jumbo jets by making advance contracts with several major airlines.

III. Strategic Complements and Strategic Substitutes

In some situations, more aggressive behavior by one firm will induce less aggressive behavior by the other party; faced with aggressive behavior, the other firm will back off. In a situation like this, we say the firms’ choices are strategic substitutes.
One well-known example of strategic substitutes is firms’ quantity choices under Cournot competition. In the example used in a previous lecture, we found that firm 1’s best response function looked like this:

\[ q^R_1 = 60 - q_2/2 \]

Notice that as firm 2’s quantity increases, firm 1 responds by decreasing its own quantity. And since firm 2’s response function is the same (with \( q_1 \) and \( q_2 \) reversed), the same goes for firm 2: it will respond to an increase in firm 1’s quantity by decreasing its own quantity.

More generally, it can be shown that under Cournot competition, with demand curve \( P = a - bQ \) and marginal costs of \( c_1 \) and \( c_2 \) for the two firms, the firms’ response functions are as follows:

\[ q^R_1 = \left[ (a - c_1)/2b \right] - q_2/2 \]
\[ q^R_2 = \left[ (a - c_2)/2b \right] - q_1/2 \]

Notice that each response function is a decreasing function of the other firm’s quantity. We could show the equilibrium of the two functions as their intersection on a graph:

Notice that the final equilibrium will depend, in part, on the firm’s marginal costs, because a change in a firm’s marginal cost will change its reaction function. Specifically, a decrease in cost will move the firm’s reaction function outward, as shown below:
Thus, when firm 1’s cost decreases, it will induce an equilibrium in which firm 1 produces more and firm 2 produce less output.

How does this relate to the issue of commitment? Many times, a credible commitment will involve some investment that a firm could make, such as in a new plant or new technology, to lower its production costs. If the firm is not thinking strategically, it might make the decision considering only the up-front investment cost and the reduction in production costs that will follow, on the assumption that firm 2’s behavior remains fixed. The reduction in costs is the “direct effect” of the investment. But there is also an indirect “strategic effect” as well, which is that firm 2 will respond by decreasing its own quantity, thereby lowering the output price. The strategic effect will make firm 1 more inclined to make the investment than if it considered only the direct effect. By making a “tough” commitment – that is, a commitment to be more aggressive – the firm pushes its competitor into a more passive posture. The text, following Fudenberg and Tirole, call this the “top dog” strategy.

It is also possible to make a “soft” commitment – a commitment to behave more passively. For example, firm 1 could take an opportunity to expand into another market (not occupied by firm 2), thereby increasing its marginal costs in the present market because of diseconomies of scale or scope. Doing so would induce firm 2 to be more aggressive by producing more output, and firm 1 would end up producing less. This negative strategic effect will make firm 1 less inclined to make the “soft” commitment. When a firm refrains from making an investment (or reduces the size of the investment) in order to avoid incurring aggressive acts by competitors, the text (following Fudenberg and Tirole) calls this the “lean and hungry look” strategy.

Choices are not always strategic substitutes. Sometimes, they are strategic complements, meaning that more aggressive behavior by one firm will be met with more aggressive behavior by the other firm. Bertrand competition provides an example of strategic complements.
In the case of homogeneous products, it’s clear that a higher price by one firm allows the other firm to raise its price as well, since the best response is always to set a price just below the other firm’s price (unless it’s equal to marginal cost already). But more interesting is the case of differentiated products. In this case, there is an equilibrium in which both firms price above marginal cost; in that respect, the outcome is similar to Cournot. However, as with homogeneous goods, a higher price for one firm enables a higher price for the other. When one firm raises its price, the other firm will be able to raise its own price more without losing as many customers.

Although we didn’t work out the math for Bertrand competition with heterogeneous goods, we can show the result graphically. Each firm’s reaction function is upward-sloping, as shown below, because each firm’s best response to a higher price is a higher price (and a lower price in response to a lower price).

Suppose that firm 1 makes a “tough” commitment, meaning one that commits the firm to choosing lower (more aggressive) prices. It might do this by investing in a new technology to lower its marginal cost. This will cause its reaction function to move left, indicating a lower price for firm 1 in response to every possible price of firm 2.
Notice that in the new equilibrium, both firms charge lower prices. As before, the question is how this affects a firm’s decision about whether to make certain kinds of investments. The investment has a positive direct effect, because it reduces the firm’s cost, but it has a negative strategic effect, because it causes firm 2 to lower its price (thus reducing firm 1’s sales relative to what they would have been if firm 2 did not respond). As a result, firm 1 will be less inclined to make the investment than it would have been if it considered only the direct effect. Note that this is opposite of the result under Cournot competition, where the strategic effect was positive and made the firm more inclined to make the investment. When a firm avoids making an investment (or reduces the size of an investment) in order to avoid stoking competition, the text, again following Fudenberg and Tirole, calls it the “puppy dog ploy.”

On the other hand, it turns out that a “soft” commitment has a positive strategic effect under Bertrand competition. A soft commitment is one that commits the firm to charging higher (less aggressive) prices. An example would be changing the products characteristics to target a small niche market. The resulting equilibrium will involve both firms charging higher prices. The fact that firm 2 will respond with a higher price makes the commitment appear more attractive to firm 1 than it would if firm 1 considered the direct effect alone. For example, the newly targeted niche market might not be large enough to justify such a specific product design, but if firm 2 responds with a higher price, the reduced competition can make the targeting beneficial all things considered. The text, with Fudenberg and Tirole, calls this the “fat-cat effect.”
We can summarize the four cases discussed as follows:

<table>
<thead>
<tr>
<th>Strategic Substitutes</th>
<th>Tough Commitment</th>
<th>Soft Commitment</th>
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<tbody>
<tr>
<td>(Cournot)</td>
<td>Top Dog</td>
<td>Lean and Hungry Look</td>
</tr>
<tr>
<td>Strategic Complements</td>
<td>Puppy Dog Ploy</td>
<td>Fat Cat</td>
</tr>
<tr>
<td>(Bertrand)</td>
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### IV. Entry Games

Consider again the market entry game introduced in a previous lecture.

You should recall that the subgame perfect equilibrium of this game has the entrant choosing to enter and the incumbent choosing to accommodate. His threat to fight is not credible. Here’s another way to think about it: Once the entrant has paid his fixed cost and entered the market, the game is just a Cournot duopoly. We already know what the equilibrium of a Cournot duopoly looks like, and that’s where the “accommodate” payoffs come from.

But we assumed here that there would only be one play of the game after entry. What if they play repeatedly? In that case, the post-entry game is a repeated game, much like the repeated prisoners’ dilemma discussed earlier. There are many possible equilibria in that game. One possible equilibrium is the standard Cournot outcome played every period. Another possible equilibrium cooperation (cartel behavior), which is possible if the firms are sufficiently far-sighted and they use “trigger strategies” or a similar mechanism.

Another possible outcome of the post-entry game is that the firms will engage in a war of attrition, each of them trying to drive out the other firm. However, the incumbent firm doesn’t necessarily have any advantage in the war of attrition as a result of the entrant’s fixed cost of entry. Why? Once that entrance fee is paid, it is sunk and thus irrelevant. The incumbent could leave the market as easily as could the entrant, and the entrant
could make similar threats. For the entry cost to make a difference to the entrant's initial choice of whether to enter, it would have to be the case that (a) the expected present value of payoffs from the post-entry repeated game is positive, but (b) that same expected present value is less than the fixed cost of entry, so that the present value of entering is actually negative. The outcome of a war of attrition really depends primarily on the cost structures of the firms (because the firm with higher costs will generally suffer larger losses), and also the two firms’ relative access to capital.

The bottom line is this: In order for entry deterrence to be effective, the incumbent must do something that affects the entrant’s expectations about post-entry competition. Making a threat is not enough, because talk is cheap. So how can the incumbent change expectations?

1. The incumbent firm commits itself in some concrete way. Suppose, for instance, that the incumbent firm can build a factory that will drive its marginal cost down. Under normal circumstances (no threat of entry), the cost of this investment is too great to justify the benefits in terms of future profits. Building the factory will thus lower the incumbent’s monopoly profits. But it may also deter the entrant by credibly committing the incumbent to produce larger quantities (or set lower prices) than it would without the factory.

2. Another possibility is playing on the uncertainty of the entrant about the incumbent’s costs. By setting a low price now, the incumbent could send an implicit message that it has low costs, so the entrant can predict that post-entry competition won’t go well for it. The problem with this approach is that the entry is not usually a one-time threat. The incumbent would have to keep its price low for a long time. Raising its price at any point could reveal that its costs aren’t so low after all. That doesn’t make this strategy impossible, but it limits its usefulness. For it to make sense for the incumbent, the price he charges must be below the monopoly price that corresponds to its actual cost, but it must be high enough that it’s still better than having a competitor. That could be a narrow range.

3. Another possibility is establishing a reputation for toughness. Suppose there’s some small chance that the owner or manager of a firm doesn’t care so much about profits, but about winning. Call this person “irrational” (a slight misuse of the term, since it really just refers to unusual preferences). Such a firm might fight even when that’s not in its best interests profit-wise. And the existence of such firms could give rational firms an incentive to establish a reputation as irrational. The more often the incumbent faces down rivals even at the expense of profits, the greater likelihood potential rivals will assign to the possibility of this being an irrational incumbent.