

New Technology and Profits

- Another useful comparative statics exercise is to determine how much a firm would pay to reduce its marginal costs to that of its competitor.
- This will simply be the difference between its profits with the new, lower marginal cost and its profits before the investment.
- We would thus have to calculate equilibrium profits in the two equilibria.
- Therefore, this is different than what we did before in the sense that we will start with an asymmetric duopoly and examine a shift to a symmetric one.
- Recall with the differing technologies, we had differing marginal cost values c_1, c_2 , and we solved for aggregate equilibrium output:

$$Q^N = \frac{2a - c_1 - c_2}{3b}$$

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- Which we can sub into the demand function to get equilibrium price:

$$p^N = \frac{a + c_1 + c_2}{3}$$

- With equilibrium price and quantity compute we can calculate equilibrium profits before investing in the new technology.
- Profits are $(p - c_1)q_1$.
- Which after plugging in our previous expression for equilibrium prices and quantities, we get (after some messy algebra):

$$\pi_1 = \frac{1}{b} \left(\frac{a + c_2 - 2c_1}{3} \right)^2$$

- Recall what we are interested in is how much Firm 1 is willing to pay to lower its marginal cost to c_2 .

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- To illustrate how to do this we will set some parameter values and solve for the others.
- Specifically, $p = 16.66$, $Q = 8.33$, $c_1 = 15$, $c_2 = 10$.
- From this, we can solve for the parameters in the demand curve.
- We will get $a = 25$, $b = 1$.
- So this will imply that initial profits are $25/9$;
- Whereas with the new technology profits will be, because now $c_1 = 10$, $225/9$.

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- So the difference, and thus the willingness to pay is 22.22.
- This comparative static exercise is useful to avoid misleading conclusions.
- For example, if we took initial output (before the new technology) as given, and compute the gain from reduced marginal costs, we would get a number small than 22.22.
- That's because by reducing marginal costs, Firm 1 is more competitive and will produce more output in equilibrium.
- We might also think we can compute the gain in investing by the difference in Firm 2 and Firm 1's profits when their costs differed.
- In this case would overestimate the gain from investing.

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- This is because when Firm 1 becomes more aggressive, Firm 2's equilibrium output will be lower, and furthermore, the equilibrium price will be lower as well.
- So in general, taking equilibrium values as constant will lead to incorrect estimation of the effects of exogenous changes.
- Whereas comparative statics takes into account all the equilibrium effects that follow.

Dynamics and Elimination of Dominated Strategies

- While we have motivated Cournot equilibrium by the concept of Nash.
- But in fact Cournot equilibrium can be motivated by iterative elimination of dominated strategies.
- To see this, we can view the game as a dynamic one, in the sense that in the first period, Firm 1 chooses its output. In the second, Firm 2 chooses its optimal output given the period 1 choice.
- And so on, with Firm 1 picking in the odd periods and Firm 2 in the even.
- As we can see graphically, this will eventually converge to the Cournot strategy pair.
- Remarkably, this will happen no matter what the initial output in period 1 is.
- So this motivates us using Cournot equilibrium as a prediction on what will eventually happen when two firms play the game.

Collusion

- What we just concluded was that total profits were lower in oligopolies than monopolies.
- This decrease stemmed from an externality.
- That is, a firm maximized its own profit not taking into account the profits of its competitor.
- So firms will attempt to establish agreements to increase their collective market power.
- As we'll see such agreements can result in all firms being better off.
- This type of behavior will be referred to as collusion.

Collusion

- Cartel agreements are an institutional form of collusion.
- A leading example is OPEC but there are many others.
- More frequently collusion results from secret agreements, mostly because its illegal.
- We will model such agreements with the objective of reducing supply and or increasing prices.
- Though generally, collusion can also refer to advertising expenditures, setting quality standards etc.

Collusion

- To start we will consider a simple duopoly with homogeneous products and constant marginal costs.
- If firms set prices we know this would correspond to the Bertrand model.
- We also know that in equilibrium firms would set price to marginal cost.
- But if prices are allowed to change over time we would want to model this somehow.
- Suppose time is $t = 1, 2, \dots$, and in each period firms simultaneously set prices.
- Firms will play a Bertrand game in each of an infinite series of periods.
- We'll refer to this as a repeated game.