CHAPTER 17

Imperfect Competition

When there are only a handful of firms—as in most industries from which final consumers purchase—the assumptions of perfect competition are unreasonable. But with two or more firms, monopoly isn't a good model either. Imperfect competition refers to the case of firms that individually have some price-setting ability or "market power," but are constrained by rivals. Our analysis starts with one model of imperfect competition formulated over 170 years ago.

1. COURNOT OLIGOPOLY

LEARNING OBJECTIVES

1. How do industries with only a few firms behave?
2. How is their performance measured?

The Cournot[1] oligopoly model is the most popular model of imperfect competition. It is a model in which the number of firms matters, and it represents one way of thinking about what happens when the world is neither perfectly competitive nor a monopoly.

In the **Cournot model**, there are n firms, who simultaneously set quantities. We denote a typical firm as firm i and number the firms from $i = 1$ to $i = n$. Firm i chooses a quantity qi (0 to sell and this quantity costs $ci(qi)$. The sum of the quantities produced is denoted by Q. The price that emerges from the competition among the firms is $p(Q)$, and this is the same price for each firm. It is probably best to think of the quantity as really representing a capacity, and competition in prices by the firms determining a market price given the market capacity.

Cournot model

A model of imperfect competition where firms simultaneously set quantities.

The profit that a firm i obtains is $\pi_i = p(Q)q_i - c_i(q_i)$.

Each firm chooses qi to maximize profit. The first-order conditions[2] give:

$$0 = \frac{\partial \pi_i}{\partial q_i} = p(Q) + p'(Q)q_i - c'_i(q_i)$$

This equation holds with equality provided $qi > 0$. A simple thing that can be done with the first-order conditions is to rewrite them to obtain the average value of the price-cost margin:

$$\frac{p(Q) - c'_i(q_i)}{p(Q)} = -\frac{p'(Q)q_i}{p(Q)} = -\frac{Qp'(Q)}{p(Q)}\frac{q_i}{Q} = \frac{s_i}{\varepsilon}$$

Here $s_i = \frac{q_i}{Q}$ is firm i's market share. Multiplying this equation by the market share and summing over all firms $i = 1, \ldots, n$ yields $\sum_{i=1}^{n} \frac{p(Q) - c'_i(q_i)}{p(Q)} s_i = \frac{1}{\varepsilon}\sum_{i=1}^{n} s_i^2 = \frac{HHI}{\varepsilon}$ where $HHI = \sum_{i=1}^{n} s_i^2$ is the **Hirschman-Herfindahl Index**.[3] The HHI has the property that if the firms are identical, so that $si = 1/n$ for all i, then the HHI is also $1/n$. For this reason, antitrust economists will sometimes use 1/HHI as a proxy for the number of firms, and describe an industry with "2 ½ firms," meaning an HHI of 0.4.[4]

Hirschman-Herfindahl Index (HHI)

The weighted average of the price cost margins of all firms in the market.

We can draw several inferences from these equations. First, larger firms, those with larger market shares, have a larger deviation from competitive behavior (price equal to marginal cost). Small firms are approximately competitive (price nearly equals marginal cost) while large firms reduce output to keep the price higher, and the amount of the reduction, in price/cost terms, is proportional to market share. Second, the HHI reflects the deviation from perfect competition on average; that is, it gives the average proportion by which price equal to marginal cost is violated. Third, the equation generalizes the "inverse elasticity result" proved for monopoly, which showed that the price-cost margin was the inverse of the elasticity of demand. The generalization states that the weighted average of the price-cost margins is the HHI over the elasticity of demand.

Because the price-cost margin reflects the deviation from competition, the HHI provides a measure of how large a deviation from competition is present in an industry. A large HHI means the industry "looks like monopoly." In contrast, a small HHI looks like perfect competition, holding constant the elasticity of demand.

The case of a symmetric (identical cost functions) industry is especially enlightening. In this case, the equation for the first-order condition can be rewritten as $0 = p(Q) + p'(Q)^{Q}/_{n} - c'\left({}^{Q}/_{n}\right)$ or $p(Q) = \frac{\varepsilon n}{\varepsilon n - 1} c'\left({}^{Q}/_{n}\right)$.

Thus, in the symmetric model, competition leads to pricing as if demand was more elastic, and indeed is a substitute for elasticity as a determinant of price.

KEY TAKEAWAYS

- Imperfect competition refers to the case of firms that individually have some price-setting ability or "market power," but are constrained by rivals.
- The Cournot oligopoly model is the most popular model of imperfect competition.
- In the Cournot model, firms choose quantities simultaneously and independently, and industry output determines price through demand. A Cournot equilibrium is a Nash equilibrium to the Cournot model.
- In a Cournot equilibrium, the price-cost margin of each firm is that firm's market share divided by the elasticity of demand. Hence the share-weighted average price-cost margin is the sum of market squared market shares divided by the elasticity of demand.
- The Hirschman-Herfindahl Index (HHI). Is the weighted average of the price-cost margins.
- In the Cournot model, larger firms deviate more from competitive behavior than do small firms.
- The HHI measures the industry deviation from perfect competition.
- The Cournot model generalizes the "inverse elasticity result" proved for monopoly. The HHI is one with monopoly.
- A large value for HHI means the industry "looks like monopoly." In contrast, a small HHI looks like perfect competition, holding constant the elasticity of demand.
- With ***n*** identical firms, a Cournot industry behaves like a monopoly facing a demand that is ***n*** times more elastic.