Chapter 12
Market Power

In previous chapters, we discussed the static efficiency of markets from a theoretical perspective. We learned that a market is allocatively efficient when total (consumer plus producer) surplus is maximized and price equals marginal cost. A firm is said to have monopoly or market power when it can profitably maintain price above marginal cost. Theory tells us that market power will be present in unregulated monopoly but not perfectly competitive markets. The extent of market power in oligopoly markets will depend on the specific characteristics of the market.

Chapters 9–11 reveal a wide range of predictions regarding oligopoly and market power. Three classic models of oligopoly provide examples:

1. *Cartel model*. Firms that behave cooperatively and form a perfect cartel exert as much market power as a monopolist. Cartels are more likely to be effective when they are legal, in markets with just a few firms, and when future profits are not heavily discounted.
2. *Cournot model*. In the simple Cournot model with *n* firms, market power diminishes with the number of competitors.
3. *Bertrand model*. In the simple Bertrand model with symmetric firms and homogeneous goods, price equals marginal cost as long as there are two or more competitors in a market.[1]

The extent to which market power is present in the real world is a central policy issue in industrial organization. Market power can substantially harm society and tends to be associated with highly concentrated industries. The main purpose of this chapter is to summarize the empirical evidence regarding this topic. We begin by discussing measurement issues and then review the main determinants of market power.

[1] In the simple Cournot–Bertrand model, price equals marginal cost when there are 1 or more firms.

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12.1 The Measurement of Market Power

In this section, we describe the most common ways to measure market power. The simplest methods ignore scale economies and assume a static setting. When these conditions do not hold, problems arise. For example, it may be suboptimal or impractical to require that price equal marginal cost when there are substantial economies of scale, as in a natural monopoly or natural oligopoly (see Chap. 8). Moreover, in markets where today's research and development produces lower costs and/or better products tomorrow, it may be socially desirable for price to exceed marginal and average cost today.

Even if scale economies and dynamics are unimportant, data limitations and estimation issues can make it difficult to obtain a precise estimate of exerted market power. In this section, we discuss common measures of static market power and only briefly discuss measurement issues in dynamic markets.[2] Discussion of more complex theoretical and policy issues involving dynamic markets is postponed to later chapters.

12.1.1 The Lerner Index in a Static Setting

As we saw in Chap. 6, the Lerner index provides a precise measure of the degree of allocative inefficiency or monopoly power in a static setting. For a monopolist, recall from Chap. 6 that the Lerner index is defined as $\mathcal{L} = (p - \text{MC})/p = 1/\eta$, where p is price, MC is long-run marginal cost, and η is the absolute value of price elasticity of demand. The Lerner index is frequently referred to as an index of monopoly power. More generally, $\mathcal{L}$ is an index of market power, as it can be used to measure the degree of allocative inefficiency in any market structure. When firm demand is perfectly elastic, as in perfect competition, price equals marginal cost and $\mathcal{L} = 0$. With fewer substitutes, the price elasticity of demand falls and the degree of market power increases. Thus, the Lerner index ranges from 0 to 1, with a higher value indicating greater market power.

It is important to realize that market power depends on technology as well as the price elasticity of demand. To see this point, consider a monopolist that has linear demand and cost functions. Inverse demand is $p = a - q$, and total cost is $\text{TC} = \text{MC} \cdot q$, where q is quantity. In this model, $\text{d}p/\text{d}q = -1$ and the profit maximizing output and price levels are $q^* = (a - \text{MC})/2$ and $p^* = (a + \text{MC})/2$. At the equilibrium,

$$\mathcal{L} = \frac{1}{\eta} = -\frac{\partial p}{\partial q}\frac{q^*}{p^*} = \frac{a - \text{MC}}{a + \text{MC}}. \tag{12.1}$$

[2] The threat of government regulation and antitrust enforcement may induce firms to limit their prices below simple profit-maximizing levels, which reduces exerted market power below its potential level. This is an unseen benefit of government regulation and antitrust enforcement.

This equation implies that market power diminishes as marginal cost increases.[3] The reason for this relationship is that when the demand function has a negative slope, the demand elasticity is not a constant; η increases as q^* declines. Thus, an increase in MC lowers q^*, which raises η and lessens market power. Thus, both the nature of demand and technology determine market power.[4]

We can also derive the Lerner index in an oligopoly market with n firms. Consider a general first-order condition for firm i, which is similar to the first-order condition for a monopolist (see Chap. 6):[5]

$$p_i + \theta \frac{\partial p_i}{\partial q_i} q_i - \mathrm{MC} = 0. \tag{12.2}$$

The only difference is that it includes θ, a behavioral parameter of market power, or simply the **behavioral parameter**.[6] We will see subsequently that choosing particular values of θ will produce a first-order condition that is identical to that of a monopolist, a perfectly competitive firm, or an oligopoly firm that competes in a Bertrand- or a Cournot-typesetting as described in Chap. 10. Assuming that firms produce homogeneous goods, $p_i = p$ and $\partial p_i/\partial q_i = \partial p/\partial Q$, where Q is the industry level of output. Under these conditions, (12.2) can be rewritten as

$$\mathcal{L} \equiv \frac{p - \mathrm{MC}}{p} = -\theta \frac{\partial p}{\partial Q} \frac{Q}{p} \frac{q_i}{Q} = \frac{\mathrm{ms}_i \theta}{\eta} = \frac{\theta}{n \cdot \eta}, \tag{12.3}$$

where ms_i is the market share of firm i, which equals $1/n$ because of symmetry.[7] The advantage of this specification is that it describes the Lerner index for a variety of possible cooperative and noncooperative equilibria. For example,

- In a competitive or Bertrand equilibrium with homogeneous goods, $p = \mathrm{MC}$ which implies that $\theta = 0$ and $\mathcal{L} = 0$.Rauchen.
- In the Cournot equilibrium, $\theta = 1$ and $\mathcal{L} = \mathrm{ms}_i/\eta = 1/(n \cdot \eta)$.[8] Notice that when $n = 1$, $\mathcal{L} = 1/\eta$ which is the simple monopoly outcome.

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[3] That is, $\partial \mathcal{L}/\partial \mathrm{MC} = (-2a)/(a + \mathrm{MC})^2 < 0$.

[4] For further discussion on this topic, see Färe et al. (2012).

[5] This equation is frequently derived from a "conjectural variation" model (Bowley 1924), where θ reflects the firm's conjecture or expectation about the change in industry output (Q) with respect to a change in the firm's own output (q_i). See Bresnahan (1989) for a discussion of the conjectural variation interpretation of this equation. In our representation, θ can be thought of as a reduced form parameter (Schmalensee 1988), where (12.2) is used as a device for describing possible oligopoly outcomes and for estimating market power when the choice variable is output or price (Slade 1995).

[6] Note that the term "behavioral" in this context is distinct from the meaning of the behavioral economics concepts discussed in Chap. 4 and throughout the book.

[7] That is, $\mathrm{ms}_i \equiv q_i/Q = 1/n$ because all firms produce the same level of output in equilibrium.

[8] From (10.1) and (10.2), a Cournot firm's first-order condition is $p + (\partial p/\partial Q)q_i - \mathrm{MC} = 0$. This implies that for (12.2) to hold, θ must equal 1 in the Cournot model.

Table 12.1 Market structure, the behavioral parameter (θ), and the Lerner index ($\mathcal{L}$) of market power

Market structure	θ	$\mathcal{L}$
Perfect competition	0	0
Bertrand oligopoly	0	0
Cournot oligopoly	1	$1/(n \cdot \eta)$
Cartel	n	$1/\eta$
Monopoly	1	$1/\eta$

Note: η is the absolute value of the price elasticity of demand, n is the number of firms, and products are perfectly homogeneous.

- For a monopolist, $\theta = n = 1$ and $\mathcal{L} = 1/\eta$.
- In a perfect cartel, $\theta = n$ and $\mathcal{L} = 1/\eta$.

Given that the market outcome will range from competitive to cartel, $0 \leq \theta \leq n$ and $0 \leq \mathcal{L} \leq 1/\eta$. Thus, we can think of θ as an indicator of the "toughness of competition" found in Sutton's (1991) model of market structure (see Chap. 8). The degree of competition increases as θ decreases. The relationship between θ and $\mathcal{L}$ in different market settings is summarized in Table 12.1. It shows that a higher value of θ implies greater market power.

Equation (12.3) can be modified further to provide a summary of the main forces that influence market power. Recall from Chap. 8 that the Herfindahl–Hirschman index of industry concentration (HHI) equals $1/n$ in a symmetric oligopoly. In this case, the Lerner index becomes

$$\mathcal{L} \equiv \frac{p - \text{MC}}{p} = \frac{\theta \cdot \text{HHI}}{\eta}. \tag{12.4}$$

This simple framework implies that market power increases when:

- Concentration increases (HHI increases)
- Demand becomes less price elastic (η decreases)
- Competition diminishes (θ increases)

Of course, products may not be homogeneous and firms may not be symmetric. When products are differentiated, firms will sell their products at different prices. Even with homogeneous goods, firms may have different costs. Under these conditions, we could calculate the average Lerner index for all firms in the market. One method is to use a weighted average, with market shares used as weights. In this case, the Lerner index becomes

$$\mathcal{L} \equiv \sum_{i=1}^{n} \text{ms}_i \frac{p_i - \text{MC}_i}{p_i}. \tag{12.5}$$

Data limitations frequently make it difficult to estimate a Lerner index in (12.5). First, we need data from every firm in the industry. Second, marginal cost is not observable unless marginal cost equals average cost (i.e., there are constant returns to scale). Thus, economists have developed indirect methods of estimating market power, topics we will take up in Sect. 12.2.

In a similar way, we can derive an index of market power in an input market. For example, a firm that is a single buyer of an input has market power, because it can pay a lower price for the input without completely eliminating the quantity supplied of that input. In other words, the firm is an input price maker, not an input price taker. A firm of this type is called a monopsonist and will gain greater profit by lowering the input price below its perfectly competitive level. Given our interest in output markets and the fact that the derivation is similar to that of the Lerner index, we leave the issue of monopsony power to Appendix 12.A.

12.1.2 The Lerner Index in a Dynamic Setting

As we said previously, it is more difficult to measure market power in a dynamic market. This is an advanced topic, and we do not derive the Lerner index for a dynamic market here. You should be aware, though, that the static Lerner index provides a biased estimate of market power in a dynamic setting. In a dynamic market, production and sales today affects future profits. This can occur for addictive commodities, as greater consumption today leads to more serious addiction and increased demand (and profits) tomorrow. Another example occurs with learning-by-doing, where greater production today leads to learning, more adept workers, and lower costs tomorrow.

How would a dynamic setting affect the measurement of market power? Consider the case of cigarettes. When starting a business it may be profit maximizing to give away cigarettes (i.e., set the price to zero) today to hook new consumers and intensify preexisting addiction. The firm can then hike the price tomorrow, a strategy that can boost overall profit. In essence, market power today is reflected in the firm's ability to raise price tomorrow. Thus, even though price is below marginal cost today, market power is still present because this strategy allows the firm to raise price substantially in the future. Although somewhat more complicated, a similar problem exists when learning-by-doing is present (Pindyck, 1985). These issues are taken up more formally in Appendix 12.B.

12.1.3 Other Measures of Market Power and Industry Performance

Given the difficulty of measuring the Lerner index, other measures have been proposed to estimate the degree of market power. One such measure is **Tobin's *q***, which is defined as the market value of the firm divided by the replacement value of the firm's assets. In a perfectly competitive industry that is in long-run equilibrium, Tobin's q will equal 1 because potential investors will value a firm at its replacement cost. If a firm is expected to earn positive economic profits, Tobin's q will exceed 1 because the firm is now more valuable than its replacement cost.

Other measures of market power are based on profitability. One example is a firm's profit rate or **rate of return** (r), defined as the ratio of the amount earned per dollar invested in the company for a given time period. To illustrate, assume a firm uses three inputs, labor (L), materials (M), and physical capital (K). The owner of the firm invests $p_K K$ in the company, where p_K is the price (or rental rate) of capital. The rate of return on the owner's investment (r) is

$$r \equiv \frac{\text{TR} - T - p_L L - p_M M - \delta p_K K}{p_K K}, \tag{12.6}$$

where TR is total revenue, T is the tax on profits, p_L is the price of labor, p_M is the price of materials, and δ is the depreciation rate of capital. When long-run economic profits are zero, the owner will earn a normal rate of return, r^*. If $r^* = 10\%$, for instance, the rate the owner could earn from alternative competitive investments is 10%. With positive economic profit, however, r will exceed r^*. Thus, a rate of return above normal implies positive economic profit.

Another profitability measure is the **profit-to-sales ratio**, defined as profit (π) divided by total revenue (sales). That is,

$$\frac{\pi}{\text{TR}} \equiv \frac{\text{TR} - \text{TC}}{\text{TR}}, \tag{12.7}$$

where TC is total cost. Because it is easy to measure, it is frequently used in the business literature. It is also identical to the Lerner index when the industry is in long-run equilibrium and firms operate in the region of constant returns to scale. In this case, MC equals long-run average cost (AC), and the profit-to-sales ratio becomes

$$\frac{\pi}{\text{TR}} \equiv \frac{p \cdot q - \text{AC} \cdot q}{p \cdot q} = \frac{p - \text{AC}}{p} = \frac{p - \text{MC}}{p}. \tag{12.8}$$

Although these profitability measures are used in applied studies, they suffer from three main weaknesses when employed to identify market power. First, market power is normally associated with positive long-run economic profit but can exist even though long-run profits are zero. We saw this in the model of monopolistic competition in Chap. 6. Second, most firms are diversified, and it is difficult to identify the portion of revenues, costs, and assets that are associated with a particular product or market. Third, we are interested in economic profits, but only accounting profits are reported by firms.

Accounting profits can be a poor proxy for economic profits. For example, physical capital is typically valued incorrectly at its historical cost rather than at its opportunity cost. In addition, investments that provide future benefits (such as physical capital, advertising and research and development) may be incorrectly treated as a current expense. As Fisher and McGowan (1983) and Fisher (1987) point out, it is nearly impossible to get an accurate estimate of the economically relevant depreciation rate for each of these expenditures. Thus, dynamic effects create measurement problems here too. We conclude that profitability serves as a weak proxy measure of market power and should be used with caution.[9]

More recently, Boone (2008) developed an index of competition that circumvents these accounting problems, the **index of relative profit differences** (RPD). To use RPD to determine the degree of competition, two conditions must hold. First, firms within the same industry must have different levels of efficiency.[10] Second, an increase in competition must punish inefficient firms more harshly than it punishes efficient firms. To illustrate, consider a duopoly case where firms compete in a Cournot-type game and produce homogeneous goods. Firm 1 has lower costs than firm 2. As we saw in Chap. 10, both firms earn positive profits. Now assume that the degree of competition intensifies, with firms now competing in a Bertrand-type game. With an increase in competition, firm 2's profits fall to zero while firm 1's profits remain positive. Firm 2 is harmed relatively more by the increase in competition.

RPD compares the variable profits of different firms. Let $\pi_i^{\mathrm{v}}(E_i, \theta)$ equal firm i's variable profit, which is a function of its efficiency level E_i and the behavioral parameter (θ). Variable profit equals total revenue minus total variable cost. Suppose there are three firms in a market where firm 1 is most efficient and firm 3 is least efficient, such that $E_1 > E_2 > E_3$. Recall that θ ranges from 0 (in homogeneous Bertrand) to n (in a cartel), where the degree of competition increases as θ falls. In this case,

$$\mathrm{RPD} \equiv \frac{\pi_1^{\mathrm{v}} - \pi_3^{\mathrm{v}}}{\pi_2^{\mathrm{v}} - \pi_3^{\mathrm{v}}}. \tag{12.9}$$

Under these conditions, more rigorous competition (i.e., a decrease in θ) will lead to an increase in RPD, $\partial \mathrm{RPD}/\partial \theta < 0$. Thus, if RPD falls over time, we can conclude that market power has diminished.

Boone's index has several desirable qualities. First, variable profit data are readily available for publicly owned firms. Boone (2008, 1255) shows that variable profit is approximately equal to "gross operating profit" found in a company's income statement. Second, using variable profits circumvents the measurement problems associated with accounting profits.[11] Third, data are needed for at least three firms in the industry but are not required for every firm. The only difficulty

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[9] For a more complete discussion of the problems associated with measuring profitability and the pros and cons of using profitability to measure market power, see Fisher and McGowan (1983), Martin (1984, 2000), Fisher (1987), and Carlton and Perloff (2005). Fisher (1987) takes the strongest position, arguing that because these problems are insurmountable, accounting profit should not be used for empirical research in industrial organization.

[10] This seems reasonable, because in the real world, firms in the same industry are rarely symmetric (unless the market is perfectly competitive, or nearly so).

[11] For example, one does not need to estimate the appropriate depreciation rate of durable assets that is needed to convert accounting profits to economic profits.

is that firms must be ranked in terms of their relative efficiency. Fortunately, Färe et al. (1985, 2008) identify several methods for estimating firm efficiency. A simple alternative is to use average variable cost (i.e., total variable cost divided by output) to measure firm efficiency, where the firm with lower average variable costs is more efficient. Given its advantages, we expect Boone's method to become a common way of determining the extent to which industry competition has changed.

12.2 Estimating Market Power

In this section, we summarize several methods for estimating static market power in a particular industry.[12] Early studies in the structure–conduct–performance tradition used measures of profitability to estimate market power. The weakness of this approach is that price may exceed marginal cost even though profits are zero. More modern approaches make use of information about costs and the price elasticity of demand to estimate market power. The empirical evidence is extensive, and we provide a summary of market power estimates for only a select group of industries.

12.2.1 Estimating Marginal Cost

The most direct method of estimating a Lerner index is to estimate a total cost function and use it to derive marginal cost. Suppose there is a simple production process that employs a single input to produce a single output. For simplicity, assume that the total cost (TC) function that represents this technology is

$$\mathrm{TC} = \left(c_0 q + c_1 q^2 + c_2 q^3\right) w, \tag{12.10}$$

where w is the price of the input and c_0, c_1, and c_2 are cost parameters. With appropriate data and the proper estimation technique, parameter values can be estimated with regression analysis. Given these estimates, marginal cost can be calculated as

$$\mathrm{MC} \equiv \frac{\partial \mathrm{TC}}{\partial q} = \left(c_0 + 2c_1 q + 3c_2 q^2\right) w. \tag{12.11}$$

This estimate of MC can then be applied, along with output price data, to calculate a Lerner index.[13] The main weakness with this approach is that accounting cost data are substituted for economic cost data. Thus, this technique suffers from similar drawbacks as those that use profitability to measure market power.

[12] For a review of the extensive literature on the relationship between profitability, concentration, and entry barriers, see Weiss (1974), Schmalensee (1989), Scherer and Ross (1990), Carlton and Perloff (2005), Waldman and Jensen (2006), and Perloff et al. (2007).

[13] Studies that have used this technique include Friedlaender and Spady (1981), Keeler (1983), Wolfram (1999), and Weiher et al. (2002).

12.2.2 The Price Response to a Change in Costs

When it is impossible or impractical to estimate marginal cost, we can still take advantage of average cost data to estimate the degree of competition in a market. If markets are perfectly competitive, any cost hike will be passed on fully to consumers. The pass-through rate equals 1. As we saw in Chap. 6, the pass-through rate will generally not equal 1 for firms with market power. Thus, the extent to which price responds to cost changes can be exploited to assess the extent of market power. Sumner (1981) applied this technique to the US cigarette industry.[14] By comparing tax and price data across states, he rejected the hypothesis that the industry was perfectly competitive.

Hall (1988) compared the change in total revenue with the change in total cost that resulted from demand shocks in 26 manufacturing industries, 1953–1984. Assuming constant returns to scale, he showed that if an increase in demand raises total revenue by the same amount that it raises total cost, the industry is competitive. His evidence rejects the hypothesis that these industries behaved competitively. Applying Hall's method to data from Belgium, Dobbelaere (2004) also found that markets are generally imperfectly competitive.[15]

12.2.3 The New Empirical Industrial Organization Technique

Investigating the effect of a change in the price elasticity of demand on price can also be used to estimate the degree of competition in a market. In a perfectly competitive market, price will be unaffected by a change in elasticity because price always equals marginal cost. On the other hand, when market power is present, the Lerner index indicates that a reduction in the price elasticity of demand will generally lead to a higher price. Thus, whether or not price changes with the demand elasticity is an indicator of market power. Many of the econometric techniques summarized below require a change in the slope or elasticity of demand to identify market power.

One common method that has been used in the past is called the **new empirical industrial organization** (NEIO) approach, to distinguish it from earlier studies of

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[14] Bulow and Pfleiderer (1983) criticized Sumner's work by showing that the pass-through rate can equal 1 for a monopolist under certain demand conditions. Nevertheless, Sumner's conclusion is confirmed by Sullivan (1985) using a different method.

[15] Panzar and Ross (1987) provide another method that is based on the effect of costs on prices.

the 1960s and 1970s that used profitability to measure market power.[16] Because it has been so widely used, we investigate this technique in some detail.

We demonstrate the main idea by assuming a simple structural model of firm demand and costs.[17] Firms are assumed to compete in a static oligopoly setting with homogeneous goods,[18] and all relevant data are available. Firm i's inverse demand function is

$$p = a + bQ + d_1 Q \cdot y_1 + d_2 y_1 + d_3 y_2, \tag{12.12}$$

where Q is the industry level of output, $b < 0$, and y_1 and y_2 are exogenous variables such as consumer income and the price of a substitute good. We will see that this method of identifying market power requires demand to rotate with y_1. Assume that firm i's marginal cost function takes the following form

$$\text{MC} = c_0 + c_1 w \cdot q_i. \tag{12.13}$$

Returning to the firm's general first-order condition (12.2) and solving for price produces an equation called optimal price equation (supply relation or markup equation)

$$p = \text{MC} - \theta \frac{\partial p}{\partial Q} q_i. \tag{12.14}$$

It indicates that price will depend on marginal cost, the behavioral parameter (which is assumed to be constant), the slope of the inverse demand function, and output. The slope of the inverse demand function in (12.12) is $\partial p/\partial Q = b + d_1 y$. Substituting this partial derivative and the marginal cost function into the supply relation yields

$$\begin{aligned} p &= (c_0 + c_1 w q_i) - \theta(b + d_1 y_1) q_i \\ &= c_0 + c_1 w q_i - \theta b q_i - \theta d_1 y_1 q_i. \end{aligned} \tag{12.15}$$

We can rewrite this as

$$p = \alpha_0 + \alpha_1 w q_i + \alpha_2 q_i + \alpha_3 y_1 q_i, \tag{12.16}$$

where $\alpha_0 \equiv c_0$, $\alpha_1 \equiv c_1$, $\alpha_2 \equiv -\theta b$, and $\alpha_3 \equiv -\theta d_1$.

[16] Early studies include Rosse (1970), Iwata (1974), Gollop and Roberts (1979), Appelbaum (1979, 1982), and Bresnahan (1981). For a review of this approach and its applications, see Bresnahan and Schmalensee (1987), Bresnahan (1989), Slade (1995), and Baker and Bresnahan (2008).

[17] This model is designed to illustrate the main idea and may not be appropriate for a number of reasons, as discussed below.

[18] Although more complex, a similar approach is used to estimate market power when products are differentiated. For example, see Nevo (1998, 2001).

Regression analysis is used to estimate (12.12) and (12.16) jointly as a system of equations. This requires firm level data on p, q_i, Q, y_1, y_2, and w, but not on MC. The regression results produce estimates of the parameters a, b, d_1, d_2, d_3, α_0, α_1, α_2, and α_3. With these estimates, the behavioral parameter is identified if one of the following conditions holds:

- α_2 and b do not equal zero. If α_2 and b are not zero, then $\theta = -\alpha_2/b$.
- α_3 and d_1 do not equal zero. If α_3 and d_1 are not zero, then $\theta = -\alpha_3/d_1$.[19]

This makes it clear why it may be possible to estimate market power when a change in one variable causes demand to rotate ($d_1 \neq 0$). It also begs the question, what variables may cause a change in the slope or elasticity of demand. Porter (1983) found that weather conditions influenced the demand elasticity in his study of market power in the railroad industry. Berry et al. (1995) used product entry and exit as elasticity determining variables.

The NEIO technique can also be used to estimate market power with industry data. In this case, we are estimating the average behavior of firms in the industry. To derive the empirical model, we sum up both sides of (12.14) over all firms.

$$\sum_{i=1}^{n} p_i = \sum_{i=1}^{n} \mathrm{MC}_i - \sum_{i=1}^{n} \theta_i \frac{\partial p}{\partial Q} Q \cdot \mathrm{ms}_i, \tag{12.17}$$

where $q_i = Q \cdot \mathrm{ms}_i$. For homogeneous goods and symmetric firms, $p_i = p_j = p$, $\mathrm{MC}_i = \mathrm{MC}_j = \mathrm{MC}$, and $\theta_i = \theta_j = \theta$ for all firms i and j. Dividing (12.17) by n gives

[19] Notice that if both b and d_1 are zero, the demand function is horizontal because the slope is $\partial p/\partial Q = b + d_1 y_1$. For a discussion of identification issues, see Bresnahan (1982) and Lau (1982). To illustrate the NEIO method, Bresnahan (1989) assumed linear demand and cost functions. A linear cost function is not homogeneous of degree 1 in input prices, a property of a true cost function (Varian, 1992). If we were to assume linearity, the marginal cost function becomes

$$\mathrm{MC} = c_0 + c_1 q_i + c_2 w.$$

In this case, substitution produces the following supply relation

$$p = (c_0 + c_1 q_i + c_2 w) - \theta(b + d_1 y) q_i = c_0 + c_2 w + (c_1 - b\theta) q_i - d_1 \theta y q_i.$$

We can rewrite this as

$$p = \alpha_0 + \alpha_1 w + \alpha_2 q_i + \alpha_3 y q_i,$$

where $\alpha_0 \equiv c_0$, $\alpha_1 \equiv c_2$, $\alpha_2 \equiv c_1 - b\theta$, and $\alpha_3 \equiv -d_1\theta$. In this model, the behavioral parameter is identified if one or both of the following conditions hold:

- $c_1 = 0$, which implies that $\alpha_2 = -b\theta$ or that $\theta = -\alpha_2/b$
- $d_1 \neq 0$, which implies that $\alpha_3 = -d_1\theta$ or $\theta = -\alpha_3/d_1$

That is, the market power parameter is identified if there are constant returns to scale ($c_1 = 0$) or if y interacts with output in the demand function. However, Perloff and Shen (2012) demonstrate that this specification suffers from a collinearity problem and cannot be accurately estimated.

Table 12.2 Lerner index estimates from selected industries

Study	Industry	Lerner index
Hyde and Perloff (1998)	Retail meat (Australia)	0.00
V. Tremblay and C. Tremblay (2005)	Brewing	0.01
Genesove and Mullin (1998)	Sugar refining (1880–1914)	0.05
Gollop and Roberts (1979)	Coffee roasting (dominant firm)	0.06
Appelbaum (1982)	Textiles	0.07
Slade (1987)	Retail gasoline	0.10
Karp and Perloff (1989)	Rice exports	0.11
Appelbaum (1982)	Electrical machinery	0.20
Porter (1983)	Railroads (with collusion)	0.40
Spiller and Favaro (1984)	Banking (dominant firms)	0.40
Nevo (2001)	Breakfast cereal	0.45
Wolfram (1999)	Electric power (Brittan)	0.48
Suslow (1986)	Aluminum	0.59
Kadiyali (1996)	Photographic film (Kodak and Fuji)	0.65
Appelbaum (1982)	Tobacco	0.67
Taylor and Zona (1997)	Long-distance phone service (AT&T)	0.88

$$p = \mathrm{MC} - \frac{\theta}{n}\frac{\partial p}{\partial Q}Q. \tag{12.18}$$

Thus, given a marginal cost specification we are able to estimate this equation and the market demand function simultaneously, as we did using firm data. With an estimate of θ, assuming it is identified, we can calculate the Lerner index from (12.3).

The NEIO technique has been applied to a variety of industries. The results from several studies are summarized in Table 12.2. Given that these industries have very different structural and institutional characteristics, it is not surprising that their market power estimates vary widely. As one might expect, the results generally indicate that market power in agricultural and food industries is relatively low, while market power is relatively high in manufacturing and service industries.

The main advantage of the NEIO approach is it allows us to obtain an estimate of the Lerner index without a direct measure of marginal cost. One limitation of the NEIO approach is that it tells us the degree of market power but not its cause. Another concern is that the behavioral parameter is assumed to be a continuous variable when the outcome from static games implies that it is a discrete variable.[20] Recall that $\theta = 0$ in a Bertrand game, $\theta = 1$ in a Cournot game, and $\theta = n$ in a monopoly or perfect cartel. We take up these issues in the next section.

[20] In a dynamic setting, however, the "folk theorem" indicates that an appropriately defined trigger strategy can support any noncompetitive outcome, implying that θ is continuous and ranges from 0 to n (Friedman 1971). It is called a folk theorem because it was understood by game theorists long before it was published (Gibbons 1992, 89). For further discussion of the strengths and weaknesses of the NEIO approach, see Bresnahan (1989), Slade (1995), Genesove and Mullin (1998), Corts (1999), and Perloff et al. (2007).

12.2.4 The Stochastic Frontier Method of Estimating Market Power

Kumbhakar et al. (2012) developed an alternative method for estimating market power that is based on the stochastic frontier estimation technique. This method is considerably more flexible than the NEIO technique. Not only can it control for technology using a marginal cost function, as is required with the NEIO technique, but it can also control for technology using an input distance function, which requires data on input quantities but not input prices. In some applications, cost data are more difficult to obtain than input data. In addition, market power can be estimated whether there are constant returns or variable returns to scale. Kumbhakar et al. apply their technique to the Norwegian sawmilling industry and find that the markup of price over marginal cost is approximately 8% to 11%.

12.2.5 Estimating Game Theoretic Strategies or Behavior

One weakness with the NEIO and stochastic frontier approaches is that they assume that any type of firm behavior is possible. Another way to approach the market power question is to test to see whether firm behavior is consistent with a specific game. Gasmi and Vuong (1991) and Gasmi et al. (1992) developed an approach based on this idea, which they used to determine which oligopoly model is most consistent with the data: static Nash, Stackelberg, or cartel. Thus, both static and dynamic games are considered. Because the empirical model is rather complex, we describe it in Appendix 12.C.

Gasmi et al. (1992) apply this technique to the market for premium cola, where Coke and Pepsi compete in price and advertising. They use quarterly data, 1968–1986, to estimate demand, cost, and best-reply functions in price and advertising for both Coke and Pepsi. The model that outperformed all others[21] indicates that Coke was a Stackelberg leader in price over the entire sample period, Coke was a Stackelberg leader in advertising from 1968 through 1976, and Coke and Pepsi colluded on advertising from 1977 to 1986.

Gasmi et al. (1992) then estimated the Lerner index for each firm based on the parameter estimates from their best model. Their results are summarized in Table 12.3 and show that market power has increased over time and that Coke has maintained a strategic advantage over Pepsi. Comparing these estimates with those found in Table 12.2, Coke and Pepsi have a level of market power that exceeds that of the banking industry and is similar to that of the electric power and photographic firm industries.

[21] This is based on goodness of fit, as determined by the mean square error criterion using a likelihood ratio test as discussed in Greene (2000).

Table 12.3 Lerner index estimates for Coke and Pepsi

Firm	1968–1976	1977–1986
Coke	0.59	0.64
Pepsi	0.45	0.56

Source: Gasmi et al. (1992)

As with all approaches to estimating market power, this technique has weaknesses. First, like the NEIO approach, it does not tell us the cause of market power. A more important weakness from a practical standpoint is that it requires a great deal of data. With more than two firms, there may not be enough data to estimate parameters accurately without a sufficient number of simplifying assumptions.

12.2.6 Estimating the Overall Efficiency Loss Due to Market Power

How large is the aggregate efficiency loss due to noncompetitive pricing in the US economy as a whole? If inconsequential, market power is not a policy concern and enforcement of our antitrust laws and regulations may be an unnecessary expense (assuming that prices will not rise if antitrust enforcement were abolished). Nonetheless, given the potential importance of this issue, a number of economists have estimated the total deadweight loss due to market power for the US economy as a whole.

In his classic study, Harberger (1954) showed that the deadweight loss (DWL) can be represented by a simple equation. To start, consider a homogeneous goods market with a linear demand function (D) and a technology that exhibits constant returns to scale, implying that long-run marginal cost equals long-run average cost. Market power exists when the equilibrium price (p^*) exceeds long-run marginal cost. This produces a DWL equal to the shaded area ABC in Fig. 12.1, where Q^* is the equilibrium output in the presence of market power, $p_{PC} = \text{MC}$ is the perfectly competitive price, and Q_{PC} is the perfectly competitive level of output. Let $\Delta p \equiv (p^* - p_{PC})$ and $\Delta Q \equiv (Q_{PC} - Q^*)$. If we consider small changes, then

$$\begin{aligned}
\text{DWL} &= \left(\frac{1}{2}\right)\Delta p \cdot \Delta Q \\
&= \left(\frac{1}{2}\right)(\Delta p)^2\left(\frac{\Delta Q}{\Delta p}\right) \\
&= \left(\frac{1}{2}\right)\left(\frac{p^* - \text{MC}}{p^*}\right)^2\left(\frac{\Delta Q}{\Delta p}\frac{p^*}{Q^*}\right)p^*Q^* \\
&= \left(\frac{1}{2}\right)\left(\frac{p^*Q^* - \text{AC}\cdot Q^*}{p^*Q^*}\right)^2\eta\cdot\text{TR} \\
&= \left(\frac{1}{2}\right)\left(\frac{\text{TR} - \text{TC}}{\text{TR}}\right)^2\eta\cdot\text{TR} \\
&= \left(\frac{1}{2}\right)x^2\cdot\eta\cdot\text{TR},
\end{aligned} \tag{12.19}$$

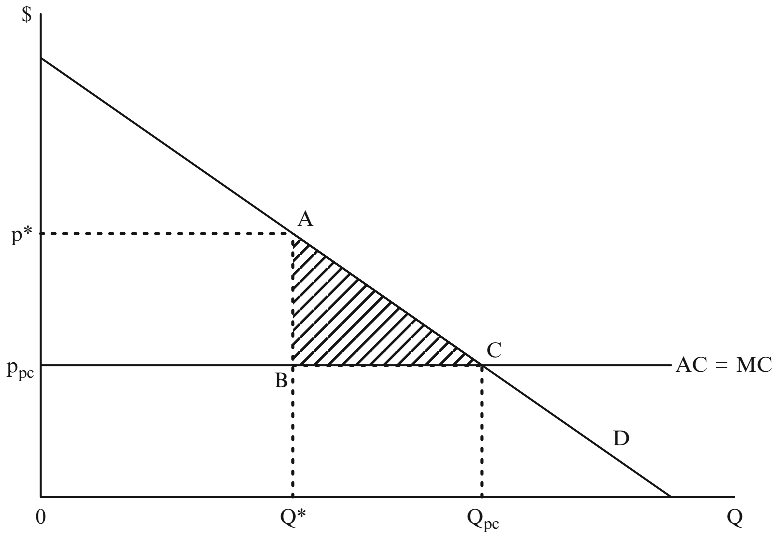

Fig. 12.1 The deadweight loss due to market power

where η is the absolute value of the price elasticity of demand, TR is total industry revenue (or sales), TC is total industry cost, and x is the value of the profit-to-sales ratio for the industry [(TR $-$ TC)/TR]. Because the elasticity of demand is difficult to estimate, Harberger assumed that $\eta = 1$. Given that only accounting data were available, he defined excess profits as profits above average profits for the industries in his sample.

With these assumptions and (12.19), Harberger used data from 73 manufacturing industries for the period 1924–1928 to estimate the aggregate DWL in the US economy. He found that the DWL was less than 0.1% of GNP (gross national product, defined as the dollar value of all goods and services produced in the economy).

If correct, Harberger's estimate suggests that market power was insufficient to warrant much policy concern. As one might expect, this led to a flurry of studies designed to verify or disprove his estimate. Critics claimed that Harberger's measure of economic profit was too low[22] and that η is greater than one, both of

[22] Using average profit in manufacturing to identify a normal rate of return produced estimates of economic profit that were too low. A more accurate estimate of normal profit rates can be found in the agricultural and service sectors, as they tend to be more competitive and have lower profit rates than in manufacturing. Harberger defined the economic profit rate as the accounting profit rate in manufacturing minus the average profit rate in manufacturing. Because the average in manufacturing is higher than "normal," his estimate of the economic profit rate is too low.

which biased downward his estimate of DWL.[23] Subsequent studies estimate aggregate DWL in the US economy to range from 0.4% to 6.0% of GNP. After making appropriate corrections for the main problems associated with Harberger's work, Masson and Shaanan (1984) estimated DWL to equal 2.9%. This is almost 30 times Harberger's estimate.

More recent estimates are unavailable, which is unfortunate because increased globalization over the last several decades may have reduced this deadweight loss. Caves and Barton (1990) argue that greater foreign competition leads to greater domestic cost efficiency. Furthermore, Salvo (2011) found that the mere threat of imports reduced domestic market power in his empirical study of the Brazilian cement market.

Other factors, such as rent seeking and X-inefficiency, can push up the social cost of market power. We take up these issues in Chap. 19.

12.3 Determinants of Market Power

Previous sections of the chapter have focused on estimating market power. In this section, we discuss the main causes of market power.

12.3.1 Theory

The most striking determinant of market power is market structure. Predictions from the four traditional models of market structure that we discussed in previous chapters are summarized in Table 12.4. In a perfectly competitive industry, price equals marginal cost because: (1) profit maximization requires that marginal cost equal marginal revenue and (2) price and marginal revenue are identical for

Table 12.4 Model predictions of market power

Market structure	$p - \text{MC}$	π_{LR}
Perfect competition	0	0
Monopoly	>0	≥0
Monopolistic competition	>0	0
Oligopoly	≥0	≥0

Note: p is price, MC is marginal cost, and π_{LR} is long-run profit

[23] For example, a profit maximizing monopolist will produce in the elastic region of demand (i.e., $\eta > 1$). This is also true in a cartel but need not be true in competitive markets or in oligopoly markets. Consider the n-firm Cournot model described in Chap. 9 where the inverse demand function is $p = a - bQ$ and c is marginal cost. At the Cournot–Nash equilibrium, $\eta = (a + cn)/(an - cn)$ which is less than 1 when $n > a/(a - 2c)$. Thus, $\eta < 1$ when c is sufficiently low and n is sufficiently high.

perfectly competitive firms. In addition, long-run profits (π_{LR}) are zero because of free entry and exit. Recall that zero economic profit implies that entrepreneurs receive a normal rate of return on their financial investments in the firm, giving them no incentive to move resources in or out of the industry. Thus, there is no market power in perfect competition.

In contrast, a monopoly firm has market power and may earn positive profits in the long run. The profit maximizing monopolist produces output where marginal cost equals marginal revenue, but price exceeds marginal revenue and therefore marginal cost since firm (market) demand has a negative slope. In addition, positive profits may persist in the long run because of barriers to entry.[24]

Monopolistic competition has qualities of both competition and monopoly. Like monopoly, price exceeds marginal cost because the firm faces a negatively sloped demand function. Yet, each firm faces considerable competition from products that are close (although not perfect) substitutes. Thus, firm demand is relatively elastic, and the equilibrium price tends to be relatively close to marginal cost. In addition, long-run profits are zero because entry is free, as in perfect competition. One can conclude that a monopolistically competitive firm has little market power and that the absence of long-run economic profit does not preclude the possibility of market power.

The degree of market power in an oligopoly setting is less clear. In a static Cournot model with n firms, the Cournot Limit Theorem states that market power diminishes with more competitors. This theorem suggests that entry barriers that reduce the number of competitors will increase market power, as predicted by the structure–conduct–performance paradigm that we discussed in Chap. 1. This is an intuitively appealing result, but it is not true in other models of oligopoly. In a static Bertrand model with homogeneous goods, for example, market power is zero with two or more competitors. At the other extreme, market power can match that of a monopolist when firms form a perfect cartel. Thus, economic theory demonstrates that there is no simple relationship between market structure and market power. In an oligopoly setting in particular, the degree of market power depends upon the degree of price competition, which in turn depends upon the specifics of the game being played, not just the number of competitors.

From previous discussion, we know that several other factors besides the number of competitors influence price competition in a static oligopoly setting. First, we saw in Chap. 10 that product differentiation tends to dampen price competition. Second, price competition is weaker when firms compete in output (i.e., Cournot) rather than price (i.e., Bertrand). Third, the ability of firms to form an effective and stable cartel will diminish price competition. Cartel viability will depend, in part, on the effectiveness of antitrust laws to limit collusive behavior. Thus, government can have considerable effect on exerted market power.

The degree of price competition also depends on the presence of potential competition. For instance, we saw in Chap. 10 that in the Cournot–Bertrand model with

[24] Recall from Chap. 6, however, that even a monopolist may earn zero profit in the long run, depending on demand and cost conditions.

homogeneous goods, a Bertrand-type potential entrant can induce a competitive outcome even in the case of monopoly. Although reality may not be this extreme, the model demonstrates how important potential entry can be to price competition.[25]

Analyzing market power becomes even more complicated in a dynamic setting. We saw in Chap. 11 that firms may make strategic investments today in order to enhance market power in later periods. In markets for addictive commodities, a firm may cut price today, which increases the degree of addiction and enables the firm to charge a higher price tomorrow. In addition, a firm may invest in research and development to lower future marginal cost. These investments can give a firm a strategic advantage, which in turn can increase concentration and profit. Although strategies such as these can boost market power, albeit for different reasons, actions that lower costs and raise firm profits can produce a net benefit to society. These issues will be discussed in Chaps. 14–17.

From this discussion, we can conclude that a number of factors influence market power. To summarize, market power tends to be higher when:

- Entry barriers are present, resulting in high industry concentration.
- There are no potential entrants.
- Products are differentiated.
- Firms compete in output rather than price.
- Firms form an effective cartel.
- Firms make strategic investments today in order to reduce costs and/or raise prices tomorrow.

Because real-world industries vary considerably along these dimensions, it is not surprising that market power varies significantly across industries as we saw in Tables 12.2 and 12.3.

12.3.2 Empirical Evidence

Early empirical studies in the structure–conduct–performance tradition used a cross-section data set from many industries to identify the causes of high industrial profits. Profits were modeled as a function of industry concentration and barriers to entry, with entry barriers typically defined as the capital requirements needed to do business (the value of physical capital divided by total revenue or sales), advertising (advertising expenditures divided by sales), and research and development (research and development expenditures divided by sales).

As we discussed in Chap. 1, this line of research suffers from a number of problems. First, it is difficult to measure economic profit accurately. In addition, many of the variables listed above are endogenous. That is, concentration may affect profits, but high profits can also attract entry and affect concentration.

[25] This is similar to the outcome of a "contestable market," as discussed in Chap. 5. For further discussion, see C. Tremblay and V. Tremblay (2011a).

Similarly, advertising may increase barriers to entry and lead to higher profits, but a decline in profits may induce firms to cut advertising spending. The presence of endogeneity makes empirical estimation more difficult.

In spite of these weaknesses, hundreds of empirical studies were conducted during the 1960s through the 1980s to identify the relationship between profits and concentration. In the most reliable studies, adjustments were made to correct for the measurement problem associated with accounting profits. To address the endogeneity problem, by the late 1970s researchers began to estimate systems of equations, such as the following:

$$\begin{aligned}\pi &= a_0 + a_1\mathrm{CR} + a_2A/S + a_3K/S + a_4X_1,\\ A/S &= b_0 + b_1\pi + b_2\mathrm{CR} + b_3X_2,\\ \mathrm{CR} &= d_0 + d_1\pi + d_2A/S + d_3K/S + a_4X_3,\end{aligned} \tag{12.20}$$

where π is a measure of the profit rate of an industry, CR is concentration, A/S is advertising divided by sales, K/S is capital expenditures divided by sales, and the variables X_1–X_3 represented other exogenous variables.

Schmalensee (1989) and Caves (2007) reviewed the evidence and found that these studies produced a number of relationships that hold with some regularity. Schmalensee (1989, 952) concludes that in spite of the weaknesses with this line of research, it "can produce useful stylized facts to guide theory construction and analysis of particular industries." Regarding profits, he concludes that the following stylized facts hold generally:

- The effect of concentration on industry profits is small and statistically weak.
- Individual firm characteristics, such as a relative cost advantage, have a substantial effect on industry profits.
- Advertising spending and capital requirements tend to be positively correlated with industry profits.
- Expenditures on research and development tend to be positively correlated with industry profits when concentration is low, but the relationship may be weak or change sign when concentration is high.
- Regarding firm profits, the effect of concentration is generally negative or insignificant, but the effect of the firm's market share on profits is positive in some industries.

Schmalensee's summary lends credence to studies that focus on individual industries and firms, as the forces that influence profitability tend to be industry and firm specific.[26]

Iwasaki et al. (2008) applied the approach of estimating a system of equations similar to those in (12.20) but for a single industry, the US brewing industry.

[26] In imperfectly competitive markets, there is also evidence that unions are able to capture some of the excess profit generated by market power (Domowitz et al. 1988; Dobbelaere 2004).

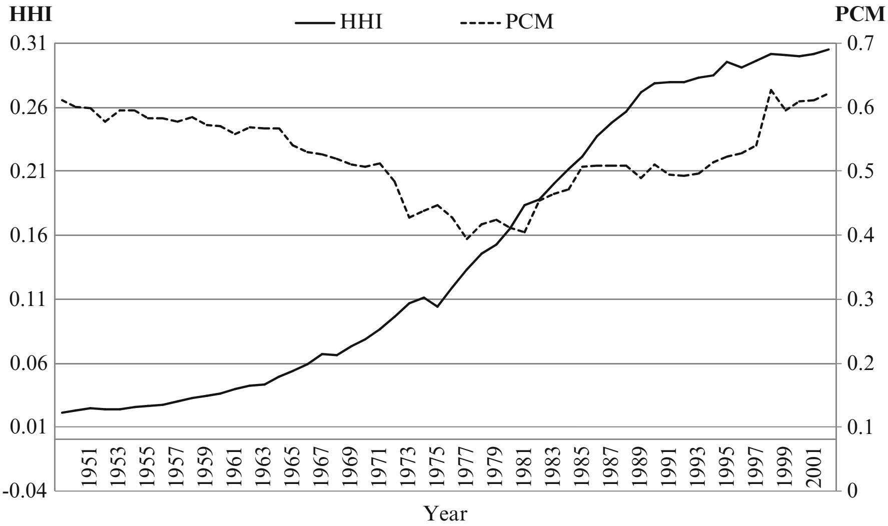

Fig. 12.2 The Herfindahl–Hirschman index (HHI) and the price-cost margin (PCM) for the US brewing industry, 1950–2003

An interesting characteristic of the industry is that industry profits remained low during the 1970s and 1980s in spite of the fact that industry concentration was rising rapidly. These trends can be seen in Fig. 12.2, which plots the Herfindahl–Hirschman index and the price-cost margin (PCM). The Iwasaki et al. empirical results showed that concentration had a significant but small positive effect on profits. The evidence also showed that technological change increased optimal firm size by enlarging the minimum efficient scale needed to take advantage of scale economies in production and advertising.[27] In their race to reach minimum efficient scale, firms engaged in fierce price and advertising competition that took place during the 1970s and 1980s, which explains the low profits during the period. Their study illustrates how the intensity of competition, as well as concentration and barriers to entry, can be an important determinant of industry profits. The so-called "beer wars" are discussed in more detail in Chap. 21.

One needs to be cautious when interpreting profit studies, however, as they need not imply that an increase in concentration is inefficient. As we saw in Chap. 1,

[27] The evidence of V. Tremblay and C. Tremblay (2005) and Iwasaki et al. (2008) also shows that brewers were forced into a preemption race in advertising, which caused unsuccessful advertisers to fail. In such a race, Doraszelski and Markovich (2007) show that firms with a string of successful advertising campaigns will replace those with unsuccessful campaigns, a process that leads to a higher level of concentration.

Demsetz (1973) argues that a positive profit–concentration relationship is also consistent with the superior efficiency hypothesis.[28] According to Demsetz, a firm may develop a cost-reducing (or quality improving) innovation that is difficult to imitate. This, in turn, allows the firm to earn higher profits and gain market share and a dominant position in the industry. Thus, a third cause, the superior efficiency of dominant firms, increases profits and fosters high concentration. We take up this dynamic issue more fully in later chapters.

Given Demsetz's argument and the measurement problems associated with profitability, an alternative way to investigate this issue is to look directly at the effect of concentration on price. One approach is intertemporal: determine the effect of entry on prices for a short enough period so that marginal cost is stable. Goolsbee and Syverson (2008) took this approach and found that entry by Southwest Airlines caused airfares to drop by up to 29%. Noether (1988) conducted a similar study in the market for hospital services and found greater price and quality competition with less concentration. The positive price–concentration relationship is further supported by Gilbert (1984), Bailey et al. (1985), and Koller and Weiss (1989) for the banking, airline, and cement industries, respectively. Barton and Sherman (1984) found that a horizontal merger in the microfilm industry led to a significant price increase.

Another approach is intermarket. This requires a comparison of price–concentration pairs in different geographic markets where marginal cost is likely to be the same. Busse and Rysman (2005) provide an excellent example. They analyzed the relationship between price and the number of competitors in the US market for telephone books that contain yellow page advertisements. These markets are local, and generally have one to five competitors selling ad space in books with yellow pages to local businesses. This is nearly an ideal experiment because costs and other factors are likely to be similar across regions; all that differs is the number of competitors. Results showed that one additional competitor caused the median price to fall by 7.2%. Although the evidence that concentration leads to a higher price cannot rule out the superior efficiency hypothesis (i.e., that costs fall as well), it is clearly consistent with the hypothesis that price competition diminishes with concentration.

The Busse and Rysman results provide convincing support for the hypothesis that a reduction in the number of competitors leads to higher prices, *ceteris paribus*. Nevertheless, given that market power can increase when price increases and when marginal cost decreases, appropriate policy analysis will depend on the sources of market power. We will take up this issue further in Chaps. 19 and 20.

Finally, Kwoka and Shumilkina (2010) conduct a case study on the influence of potential competition on airline prices. They investigate the price effect of the 1987 merger between US Air and Piedmont Airlines. In markets with one or more potential

[28] Others who have expressed similar views include Brozen (1971) and McGee (1971). Alternatively, Mancke (1974) argued that this strategic advantage can be driven by luck rather than superiority.

competitors,[29] Kwoka and Shumilkina found that the presence of a potential entrant led to significantly lower fares. When a merger eliminated a potential competitor, air fares rose 5 to 6 percent. This provided clear evidence that the presence of a potential competitor can contribute to greater price competition.

12.4 Summary

1. When a firm has the power to profitably maintain price above marginal cost, allocative inefficiency results and the firm is said to have **market power**.
2. The Lerner index in a static setting, defined as $\mathcal{L} \equiv (p - \text{MC})/p$, provides one measure of market power. There is no market power when $\mathcal{L} = 0$. Exerted market power is greater for higher values of $\mathcal{L}$.
3. For homogeneous goods and symmetric firms, the Lerner index for firm i equals $(\text{ms}_i \cdot \theta)/\eta = \theta/(n \cdot \eta) = (\theta \cdot \text{HHI})/\eta$, where ms_i is market share, η is the absolute value of the price elasticity of demand, n is the number of firms, HHI is the Herfindahl–Hirschman index of concentration, and θ is the **behavioral parameter** of market power. The behavioral parameter characterizes a variety of models of cooperative and non-cooperative behaviors. In a Bertrand or competitive setting, $\theta = 0$ and $\mathcal{L} = 0$. In Cournot, $\theta = 1$ and $\mathcal{L} = \text{ms}_i/\eta = 1/(n \cdot \eta) = \text{HHI}/\eta$. In monopoly or a perfect cartel, $\theta = n$ and $\mathcal{L} = 1/\eta$.
4. In a dynamic setting, firm profits are interdependent over time. In this case, market power may still be present even though price equals marginal cost. For example, a firm may price an addictive commodity below marginal cost today substantially boost price above marginal cost tomorrow. The Lerner index in a dynamic setting requires an adjustment factor for the effect that a change in current production has on future profits, as discussed in Appendix 12.B.
5. One measure of market power is **Tobin's *q***, which is defined as a firm's market value divided by its replacement value. Market power pushes up the profitability of a firm, which raises its market value above its replacement value. Thus, market power exists when Tobin's q is greater than 1.
6. Because the data are readily available, a measure of accounting **profitability** is sometimes used to identify market power or measure industry performance. Examples include the **rate of return** (the amount earned per dollar invested in the firm) and the **profit-to-sales ratio** (profits divided by total sales). There are two main problems with these measures. First, market power can exist even when long-run profits are zero. Second, accounting profits can be a poor proxy for economic profits.

[29] An airline is defined as a potential competitor on a particular route when it serves one or both endpoints of a route but not the route itself.

7. A measure of market competitiveness is the **index of relative profit differences** (RPD). In a market with three firms (1, 2, and 3) where firm 1 is most efficient and firm 3 is least efficient, RPD $= (\pi_1 - \pi_3)/(\pi_2 - \pi_3)$, where π_i is firm i's variable profit. An increase in market competitiveness will lead to an increase in RPD.
8. There are several other ways to estimate market power. First, a cost function could be estimated and used to derive marginal cost and calculate a Lerner estimate (when price data are available). Another example is the **new empirical industrial organization (NEIO)** technique which empirically estimates the behavioral parameter of market power. In addition, Gasmi et al. (1992) developed a technique for identifying firm strategies. Evidence from these and other techniques show that the degree of market power varies considerably from industry to industry and can be high enough to be a policy concern.
9. According to economic theory, many factors influence market power. These include exogenous entry barriers that increase industry concentration, the presence of potential competitors, product differentiation, the choice of strategic variable (output v. price), the ability to maintain an effective cartel, and strategic investments today that affect future costs and competition.
10. There are hundreds of empirical studies that have attempted to determine the main causes of market power. Early studies generally confirm economic theory. In particular, they show that higher concentration leads to higher profits. Some economists question this conclusion, because of various theoretical, methodological, and measurement concerns. For example, the superior efficiency hypothesis, which states that high profits may be due to lower costs rather than higher prices, undermines the conclusion that a positive correlation between concentration and profits is due to collusion. More recent studies that address the criticisms of early work confirm, however, that an increase in concentration does lead to higher prices. These studies also demonstrate that industry-specific characteristics and the presence of a potential competitor can have an important effect on industry performance.

12.5 Review Questions

1. Derive the static Lerner index ($\mathcal{L}$) for a monopoly firm. Explain the properties of $\mathcal{L}$, that is, identify its minimum and maximum values and explain how it changes with the price elasticity of demand.
2. Show that the general first-order condition in (12.2) can be consistent with the first-order condition for a Cournot-type firm and a Bertrand-type firm with homogeneous goods.
3. Explain how a firm can have market power but earn zero economic profits in the long run.

4. Assume that an entrepreneur has invested \$1,000 in a company, and this investment will earn a long-run accounting profit of \$200 per year. Assume further that a normal profit on such an investment is \$100. That is, by earning an accounting profit of \$200, the owner earns an economic profit of \$100.

   A. Based on accounting profit, what is the owner's rate of return? What is the normal rate of return? Does this company have market power?
   B. If the owner were to sell the company at a competitive auction, at what price would the company be sold? Would the company with a new owner earn positive economic profits? Evaluate.

5. Define Tobin's q and explain why a value greater than 1 indicates the presence of market power.
6. Assume a market with three firms (1, 2, and 3), where firm 1 is most efficient and firm 3 is least efficient. Each firm's variable profit is $\pi_1^v = 6$, $\pi_2^v = 2$, and $\pi_3^v = 1$. A change in market conditions causes variable profits to become $\pi_1^v = 5.5$, $\pi_2^v = 1$, and $\pi_3^v = 0$. Explain how this change has affected the index of relative profit differences. Has this change in market conditions led to an increase or decrease in market competitiveness?
7. Describe two common measures of market power or industry performance. What are their main strengths and weaknesses?
8. Assume a market with two firms, 1 and 2, with multicharacteristic product differentiation. Respective demand and cost functions for firm i are $p_i = a - q_i - dq_j$ and $\text{TC}_i = cq_i$.
   Assume that $a = 12$ and $c < 12$.

   A. If $d = 0$, what is the Lerner index?
   B. If $0 < d < 1$ and firms behave as Cournot competitors, what is the Lerner index?
   C. If $d = 1$ (i.e., homogeneous goods) and firms behave as Stackelberg competitors (i.e., firm 1 is the leader and firm 2 is the follower), what is the value of the Lerner index?
   D. If $d = 1$, will market power be greater in the Cournot model or the Stackelberg model?

9. Consider a market where there is an increase in marginal cost.

   A. Assuming linear demand and supply (or cost) functions and a constant cost industry that is perfectly competitive, prove that a unit increase in marginal cost will lead to a unit increase in the long-run equilibrium price.
   B. Assuming a monopoly market with linear demand and cost conditions, prove that a unit increase in marginal cost will cause the equilibrium price to rise by less than one.
   C. Can the difference in the price response to an increase in marginal cost provide a test for monopoly power?

10. Outline the main determinants of market power. Why is it true that an increase in industry concentration need not lead to an increase in market power?
11. If an increase in concentration leads to an increase in economic profit, society need not be worse off. Evaluate.
12. Explain how you could use data from a single industry to demonstrate that concentration does or does not lead to higher prices.
13. (Advanced) Assume that a monopolist produces a single durable good. In this dynamic case, Appendix 12.B shows that the Lerner index equals $\mathcal{L} = (p_t - \text{MC}_t + \alpha)/p_t$, where α measures the effect that an increase in durability has on future profits. Without durability, $\alpha = 0$ and $\mathcal{L} = (p_t - \text{MC}_t)/\text{p}_t$. Explain how an increase in durability affects $\mathcal{L}$.
14. (Advanced) Assume that two firms (1 and 2) compete in the strategic variable, $\mathcal{S}$. Firms are symmetric and face the following profit equation:

$$\pi_i = \mathcal{S}_i - b\mathcal{S}_i^2 + d\mathcal{S}_j\mathcal{S}_i$$

Assume that you have all of the data you need and that firms are either (1) colluding or (2) behaving as static Nash competitors. Show how you would use the Gasmi et al. (1991, 1992) method to empirically test which behavioral assumption is correct (see Appendix 12.C).
15. Suppose that the CEO of a monopoly firm suffers from overconfidence and is interested in empire building over profits. Explain how this will affect market power.

Appendix A: Monopsony Power

As we saw in Sect. 12.1.1, there is a single buyer of an input in a monopsony market. Lack of competition for an input enables the firm to lower the price of the input without completely eliminating supply. Instead of being an input price taker, where the input supply function is perfectly elastic, the firm is an input price maker. Similar to a monopolist that earns greater profit by raising the output price above its competitive level, a monopsonist earns greater profit by lowering the input price below the competitive level.[30]

In this case, the index of input market power for input x is $I_x \equiv (\text{VMP} - w)/\text{VMP}$, where VMP is the value of the marginal product of input x[31] and w is the price of the input. When the input market is perfectly competitive, $w = \text{VMP}$ and the

[30] For a more complete discussion of a monopsonist, see Pindyck and Rubenfield (2009, Chap. 10), Varian (2010, Chap. 26), and Nicholson and Snyder (2012, Chap. 16).

[31] The value of the marginal product is defined as the marginal product of the input times the output price, which is the added revenue the firm receives from employing one more unit of the input. For further discussion, see any introductory or intermediate microeconomics textbook, such as Frank and Bernanke (2008), Mankiw (2011), Bernheim and Whinston (2008), Pindyck and Rubenfield (2009), and Varian (2010).

index equals 0. Market power is present when $I_x > 0$. A "bilateral monopoly" exists when there is a monopoly supplier and a monopoly buyer.[32] In this case, Chang and Tremblay (1991) showed that under certain conditions $I_x = (1/\varepsilon_S + 1/\eta)/(1 + 1/\varepsilon_S)$, where ε_S is the price elasticity of supply of input x and η is the absolute value of the price elasticity of demand. In this case, input market power increases as output demand becomes more inelastic (i.e., η falls) and input supply becomes more inelastic (i.e., ε_S falls). Notice that $I_x = 1/\eta$, the Lerner index, when the firm is an input price taker (i.e., the input supply elasticity is infinite).

Azzam (1997) uses an approach that is similar to the NEIO method to estimate the degree of monopsony power in the US beef packing industry. The empirical specification derives from the first-order condition of profit maximization for the beef packing input. He found that higher concentration in beef packing led to greater monopsony power. He also found support for the hypothesis that higher concentration led to greater cost efficiency, with the cost-efficiency effect outweighing the market-power effect.

Appendix B: The Lerner Index in a Dynamic Setting

Here, we formalize our discussion of the measurement of market power in a dynamic market from Sect. 12.1.2. Assume that firm i competes in an oligopoly market where production today affects future profit, as with addictive commodities, learning-by-doing, or a durable good.

Problems such as these can be solved using dynamic programming methods, where the goal of the firm is to choose the level of output in each period that maximizes the present value of the stream of profits now and into the future, V.[33] In essence, this represents the market value of the firm. The firm's problem can be described in period t by a Bellman equation

$$V_t = \max[p_t(Q_t)q_t - \text{TC}_t(q_t) + D \cdot V_{t+1}], \tag{B.1}$$

where V_t is the value function in period t, D is the discount factor as discussed in Chap. 2, and subscript i is suppressed for notational convenience. The goal is to choose q_t to maximize V_t. The general first-order condition that includes the behavioral parameter θ is

$$\frac{\partial V_t}{\partial q_t} = p_t + \theta \frac{\partial p_t}{\partial Q_t} q_t - \text{MC}_t + \alpha = 0. \tag{B.2}$$

[32] One way to solve the bilateral bargaining problem is to use Rubenstein's (1982) approach, as discussed in Chap. 3.

[33] For a review of dynamic programming techniques, see the Mathematics and Econometrics Appendix at the end of the book.

Note that $\alpha \equiv D \cdot \partial V_{t+1}/\partial q_t$ is an adjustment factor that represents the effect of a change in q_t on the present value of the stream of future profits beginning in period $t + 1$. In a static market with no future effects, $\alpha = 0$ and (B.1) reduces to the first-order condition found in the static model found in (12.2). With addiction and learning-by-doing, this term will be positive. An increase in production today increases future demand with addiction and lowers future costs with learning-by-doing. In a durable goods problem, this term will be negative because an increase in sales today will lower future demand.

The α parameter plays a key role in identifying the degree of market power. After rearranging terms in (B.2), a dynamic Lerner index is defined as

$$\mathcal{L} \equiv \frac{p_t - \mathrm{MC}_t + \alpha}{p_t} = -\theta \frac{\partial p_t}{\partial Q_t} \frac{Q_t}{p_t} \frac{q_t}{Q_t} = \frac{\mathrm{ms}_t \theta}{\eta}. \tag{B.3}$$

In this case, there is no market power when $\mathcal{L} = 0$, but $\mathcal{L}$ need not equal 0 when price equals marginal cost. In a dynamic setting where $\alpha > 0$, as with addiction, market power is present ($\mathcal{L} > 0$) even when price equals marginal cost.

The issue is even more complicated in a model with learning-by-doing (Pindyck 1985). For example, consider a monopolist whose marginal cost in period t is a negative function of learning and where learning is a positive function of the firm's cumulative past production ($\Sigma Q^{\mathrm{M}}_{t-1}$). Correctly estimating $\mathcal{L}$ not only requires information on price and α but also requires an estimate of the marginal cost that would result if the industry had been perfectly competitive all along. Note that because cumulative output will be greater under competition ($\Sigma Q^{\mathrm{PC}}_{t-1}$) than under monopoly, $\mathrm{MC}(\Sigma Q^{\mathrm{M}}_{t-1}) > \mathrm{MC}(\Sigma Q^{\mathrm{PC}}_{t-1})$. From society's perspective, the correct measure of the Lerner index is

$$\mathcal{L} \equiv \frac{p_t - \mathrm{MC}_t\left(\Sigma Q^{\mathrm{PC}}_{t-1}\right) + \alpha}{p_t}. \tag{B.4}$$

Note that only $\mathrm{MC}(\Sigma Q^{\mathrm{M}}_{t-1})$ is observable from firm data, however. If $\mathrm{MC}(\Sigma Q^{\mathrm{M}}_{t-1})$ is used instead of $\mathrm{MC}(\Sigma Q^{\mathrm{PC}}_{t-1})$ to estimate $\mathcal{L}$, this will underestimate the degree of market power. This illustrates how difficult it can be to accurately estimate market power in the presence of learning-by-doing.

Appendix C: Estimating Game Theoretic Strategies

In this appendix, we provide an overview of the Gasmi and Vuong (1991) and Gasmi et al. (1992) method of estimating market power and the particular game being played by firms. Because applying this technique is complicated when there are many strategic possibilities, we illustrate the main idea by considering only nested games of output or price competition and ignore advertising. We consider differentiated Bertrand, Cournot, and cartel games only. The goal is to find a first-order condition that is general enough to nest each of these three possible outcomes. This is different from the NEIO approach, because this technique constrains the market-power parameter to take a discrete value that corresponds to Bertrand, Cournot, or cartel behavior.

We begin with Cournot. Assume that two firms, Coke and Pespi, compete in a static game where the choice variable is output and products are differentiated. Inverse demand, cost, and profit equations are the same as those found in Chap. 10, Sect. 10.2.1:

$$\begin{aligned} p_i &= a - q_i - dq_j, \\ \mathrm{TC}_i &= cq_i, \\ \pi_i &= \mathrm{TR}_i - \mathrm{TC}_i = \left(aq_i - q_i^2 - dq_jq_i\right) - cq_i, \end{aligned} \tag{C.1}$$

where subscript i represents Coke or Pepsi and subscript j refers to the other firm. The first-order condition for firm i is

$$\begin{aligned} \frac{\partial \pi_i}{\partial q_i} &= \mathrm{MR}_i - \mathrm{MC}_i, \\ &= \left(a - 2q_i - dq_j\right) - (c) = 0, \end{aligned} \tag{C.2}$$

where MR_i is marginal revenue and MC_i is marginal cost.

Next, we consider the case where Coke and Pepsi form an effective cartel. The goal now is to maximize joint profits (Π), which is

$$\begin{aligned} \Pi &= \pi_i + \pi_j \\ &= \left(aq_i - q_i^2 - dq_jq_i - cq_i\right) + \left(aq_j - q_j^2 - dq_iq_j - cq_j\right). \end{aligned} \tag{C.3}$$

The first-order condition for firm i is

$$\begin{aligned} \frac{\partial \Pi}{\partial q_i} &= \left(a - 2q_i - dq_j - c\right) + \left(dq_j\right) \\ &= a - c - 2q_i - 2dq_j = 0. \end{aligned} \tag{C.4}$$

In the Bertrand case, recall that we must reorganize demand so that quantity is a function of the choice variables, p_i and p_j. From (10.35) and (10.36), we saw that the demand structure from the Cournot game above produces the following demand function in prices:

$$q_i = \alpha - \beta p_i + \delta p_j, \tag{C.5}$$

where $\alpha \equiv a(1 - d)/x$, $\beta \equiv 1/x$, $\delta \equiv d/x$, and $x \equiv (1 - d^2)$. This yields the following profit equation for firm *i:*

$$\begin{aligned}\pi_i &= \mathrm{TR}_i - \mathrm{TC}_i = p_i(\alpha - \beta p_i + \delta p_j) - c(\alpha + \beta p_i - \delta p_j) \\ &= \alpha p_i - \beta p_i^2 + \delta p_j p_i - \alpha c + \beta p_i c - \delta p_j c. \end{aligned} \tag{C.6}$$

The first-order condition for firm *i* is

$$\begin{aligned}\frac{\partial \pi_i}{\partial p_i} &= \mathrm{MR}p_i - \mathrm{MC}p_i \\ &= \alpha - 2\beta p_i + \delta p_j + \beta c = 0. \end{aligned} \tag{C.7}$$

where $\mathrm{MR}p_i$ is firm *i*'s marginal revenue with respect to a change in p_i and $\mathrm{MC}p_i$ is firm *i*'s marginal cost with respect to a change in p_i.

The next step is to solve the first-order conditions in each of the three cases for q_i. This produces firm *i*'s best-reply function in q_i for the Cournot, cartel, and Bertrand cases.[34]

$$\begin{aligned}\text{Cournot}: q_i &= +\frac{a}{2} - \frac{1}{2}c - \frac{d}{2}q_j, \\ \text{Cartel}: q_i &= +\frac{a}{2} - \frac{1}{2}c - dq_j, \\ \text{Bertrand}: q_i &= -\frac{\alpha}{2} + \frac{\beta}{2}c - \frac{\delta}{2}p_j. \end{aligned} \tag{C.8}$$

The following equation nests each of these best-reply functions.

$$q_i = \psi_0 + \psi_1 q_j + \psi_2 p_j, \tag{C.9}$$

where ψ_0 through ψ_2 are parameters that take on different values for each of the three different models. That is,

[34] To derive this equation in the Bertrand case, we first solve firm *i*'s demand function for p_i, which we then substitute into the firm's first-order condition (12.27) and solve for q_i.

$$\begin{aligned} \text{Cournot}: \psi_0 &= \frac{a}{2} - \frac{1}{2}c, \quad \psi_1 = -\frac{d}{2}, \ \psi_2 = 0; \\ \text{Cartel}: \psi_0 &= \frac{a}{2} - \frac{1}{2}c, \quad \psi_1 = -d, \quad \psi_2 = 0; \\ \text{Bertrand}: \psi_0 &= -\frac{\alpha}{2} + \frac{\beta}{2}c, \ \psi_1 = 0, \quad \psi_2 = -\frac{\delta}{2}. \end{aligned} \tag{C.10}$$

The regression model to be estimated includes the system of demand, cost, and best-reply functions for each firm that are found in (C.1) and (C.9). The demand and cost regressions give estimates of parameters a, d, and c which relate directly to the parameters in (C.9). From the estimates of parameters and standard errors, hypothesis tests are conducted to determine which model is most consistent with the data. For example, the data support the Cournot model if the estimates indicate that $\psi_0 = [(a/2) - (1/2)c]$, $\psi_1 = -d/2$, and $\psi_2 = 0$.