13.3 Entry Deterrence

In our discussion of the Stackelberg game, we implicitly assumed that firm 1 would accommodate entry by firm 2. Accommodation means that firm 1 chooses its optimal duopoly output. However, if firm 1 can commit to its output level, there is another alternative. It may be able to *deter* the entry of firm 2. Entry is deterred if firm 2 expects that postentry its profits will be nonpositive. The minimum level of output for firm 1 that deters entry by firm 2 is called the **limit output.** Denote the limit output by q_1^l.

The limit output is implicitly defined by the following equation:

$$\pi_2\left(R_2\left(q_1^l\right), q_1^l\right) = 0. \tag{13.15}$$

That is, when firm 2 takes the output of firm 1 (q_1^l) as given, its profit-maximizing choice—as given by its best-response function, $q_2^l = R_2(q_1^l)$—yields profits of zero. When it acts optimally—given the output of firm 1—the best it can do is earn zero profits, in which case we assume that it does not enter. Of course output levels greater than q_1^l will also deter entry. If $q_1^l > q_1^m$, the monopoly output for firm 1, then the profit-maximizing choice for firm 1 if it wants to deter entry is q_1^l. While larger outputs also deter entry, they move firm 1 farther away from its profit-maximizing monopoly output, reducing profits unnecessarily. If $q_1^l < q^m$, then firm 1 can produce the monopoly output and still deter entry.

13.3.1 Constant Returns to Scale

Suppose that output is homogeneous and the firms have identical cost functions given by $C_i = cq_i$. This cost specification corresponds to a technology characterized by constant returns to scale since marginal cost—equals average cost—is a constant equal to c. Moreover, there are no fixed costs—all costs are variable and the costs of entry are zero. The question of interest is, Can firm 1 deter entry of an equally efficient rival and still exercise market power?

What is the limit output for firm 1? Consider point B in Figure 13.3. At this level of output for firm 1, q_1^l, the optimal response for firm 2 is not to produce. For any output less than q_1^l, firm 2 would produce a positive amount, since entering and producing put it on an iso-profit contour with positive profits. In order for firm 2 not to have an incentive to produce it must be the case that any output by the entrant would reduce price below average cost and result in negative profits. Firm 1's limit output is such that price equals average and marginal cost, c.

This is illustrated in Figure 13.4. If firm 1 were to produce any amount less than q_1^l, the remaining or residual market would be large enough that firm 2 could profitably enter. The residual demand curve faced by firm 2 would be such that there would be a number of output levels for which price exceeded average cost. In Figure 13.4 if firm 1 were to produce q_1, any output level between 0 and q_2^{max} would yield firm 2 positive profits.[10] The optimal output for firm 2 is q_2^* and its maximum profits are indicated by the shaded rectangle.

With constant returns to scale, it is not possible for firm 1 to deter entry of firm 2, exercise market power, and earn profits. With constant returns to scale, there is no cost disadvantage associated with small-scale production. Provided price exceeds average cost, firm 2 can always enter, perhaps on a very small scale, and earn positive profits. Entry deterrence requires that the price at the limit output equal average cost. Of course since by producing q_1^l firm 1 has driven price down to average

[10] Recall that firm 2's residual demand curve is found by shifting the market demand curve to the left. The intercept of the residual demand curve is the price that would prevail in the market if firm 2 produced no output. This is $P(q_1)$.

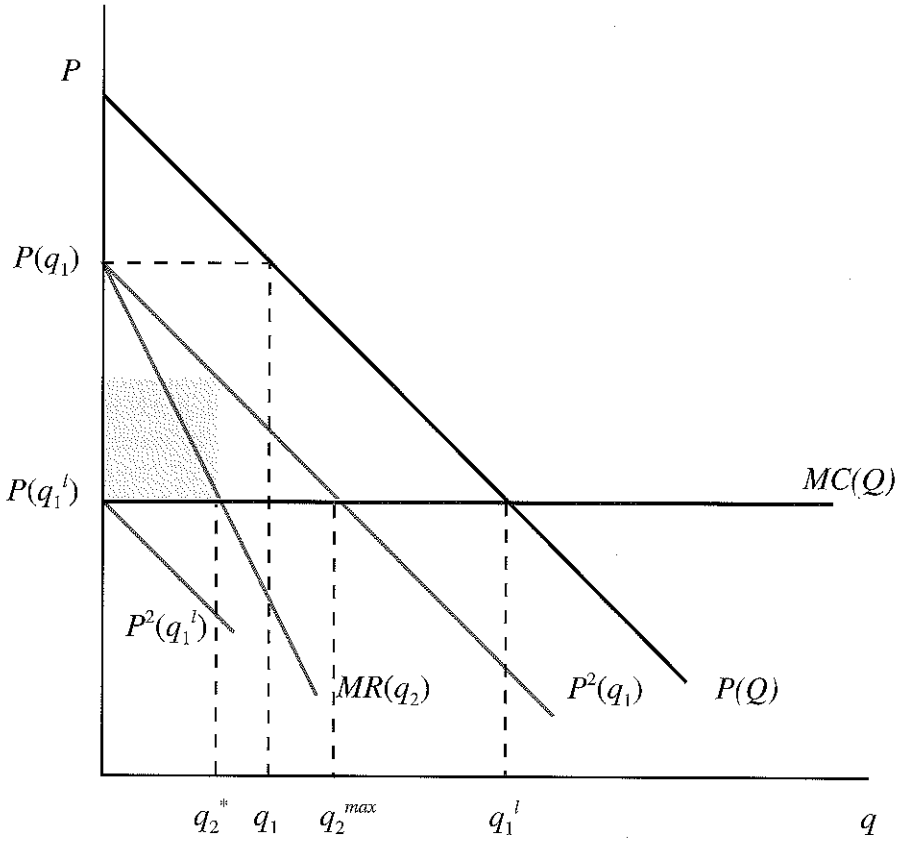

Figure 13.4 Limit Output under Constant Returns to Scale: Successful Entry

cost, its own profits are zero. Firm 1 will compare the profitability of its two options: deterring entry and optimally accommodating entry. The latter option is simply the Stackelberg equilibrium. In the constant returns case the choice for firm 1 is easy: entry deterrence is not profitable, but the Stackelberg solution is, so the latter will be chosen.

13.3.2 Economies of Scale

If there are economies of scale then profitable entry deterrence will be possible for the incumbent. The simplest case to consider is when the cost function of both firms is $C_i = cq_i + f$ where $i = 1, 2$. The fixed cost (f) might correspond to setup or entry costs. The greater f the greater the extent of economies of scale. When firm 2 considers entering it will compare its postentry profits or quasi-rents ($(P - c)q_2$) with the cost of entering (f). The effect of adding fixed costs to the model is to move the limit output point (B) in Figure 13.3 upward and to the left along firm 2's best-response function. Why? The addition of the fixed cost simply results in a relabeling of firm 2's iso-profit contours. The zero-profit contour when there was only a per unit cost of c corresponds now to profits of $-f$. The iso-profit contour that corresponds to profits of f when there is no fixed costs is the zero-profit contour when the firm must pay f to enter. Firm 2 must anticipate some

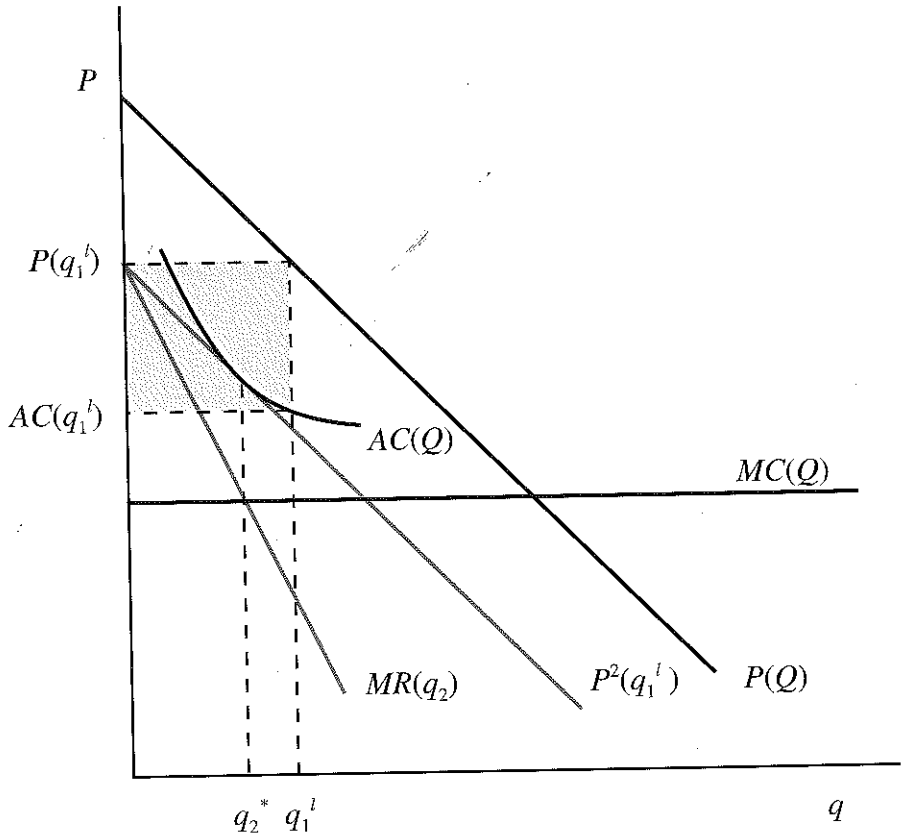

Figure 13.5 Limit Output and Residual Demand in the BSM Limit Output Model

minimum market share and quasi-rents in order to cover f or it will not enter. The larger f the greater its quasi-rents and hence its output must be in order to earn nonnegative net profits, so the larger f the closer B is to firm 2's monopoly point on its best-response function. The limit output therefore decreases as f increases—q_1^l is inversely related to f and the extent of economies of scale.

Figure 13.5 illustrates the derivation of the limit output when there are economies of scale. As firm 1 increases its output, the residual demand curve for firm 2 shifts in and down. When the profit-maximizing choice for firm 2 yields zero profits—the residual demand curve is tangent to the average cost curve ($AC(q_2)$)—at the profit-maximizing output q_2^*, firm 1 is producing the limit output. The shaded area is the profit of firm 1 from deterring entry by producing q_1^l. Entry deterrence is profitable when there are economies of scale, since the entrant encounters the following problem when the incumbent produces the limit output. If it enters and tries to realize economies of scale, it must produce a substantial amount of output, the effect of which is to reduce price sufficiently that it falls below its average cost. Notice that in Figure 13.5 for output levels greater than q_2^*, the average cost curve is above the residual demand curve for firm 2. However, if it enters on a small scale to avoid depressing the price, its costs are too high. Notice that in Figure 13.5 for output levels less than q_2^* the average cost curve is above the residual demand curve for firm 2.