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MERGERS AND LIMIT PRICING: THE OPTIMAL  
RESPONSE TO POTENTIAL COMPETITION.

The University of Michigan, Ph.D., 1974  
Economics, theory

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MERGERS AND LIMIT PRICING: THE OPTIMAL  
RESPONSE TO POTENTIAL COMPETITION

by

Bruce Rowley Snapp

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy  
(Economics)  
in The University of Michigan  
1974

Doctoral Committee:

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TO JEANNE

In logic, nothing is accidental: if a thing can occur in a state of affairs, the possibility of the state of affairs must be written into the thing itself.

--Wittgenstein--

## ACKNOWLEDGEMENTS

I am grateful for the advice and moral support I have received from many people while I have worked on this project and it is not possible, of course, to thank them all here. I would like to give special thanks to my parents, of course, and to my committee members, who have been generous with their time in times of great need. In particular, I am grateful to my chairman, Peter Steiner, and Michael Klass who helped me over initial rough spots and added much depth and insight to this work.

And most importantly, I thank my wife, Jeanne, who has borne a large burden--financial and emotional--for the last three years. My debt to her is that of a ship in a storm to a sheltering harbor: it can only be acknowledged, but never repaid in full.

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GLOSSARY OF KEY TERMS IN  
ALPHABETICAL ORDER

Roman Letters

|          |   |                                                                                                  |
|----------|---|--------------------------------------------------------------------------------------------------|
| A        | = | level of cartel absolute-cost-advantage entry barrier                                            |
| C        | = | annual cartel policing costs                                                                     |
| $C_n'$   | = | partial derivative of policing costs with respect to the number of firms (n) in the cartel       |
| $D_a^b$  | = | discounting term equal to the integral of $e^{-rt}$ from $t=a$ to $t=b$                          |
| $D(p,t)$ | = | market demand curve                                                                              |
| E        | = | level of economies-of-scale entry barrier                                                        |
| F        | = | annual cartel total fixed production costs                                                       |
| $f(K)$   | = | entry lag function                                                                               |
| g        | = | growth rate of industry demand                                                                   |
| $h_j$    | = | percentage of post-entry profits going to the original cartel members under the <u>j</u> th plan |
| I        | = | implementation costs of the cartel expansion plan                                                |
| $K(t)$   | = | capital stock (output capacity) at time t                                                        |
| $K^a$    | = | capital stock of the merging cartel member                                                       |
| $K^b$    | = | increment in industry capacity under the entry-by-merger plan                                    |
| $K^c$    | = | capital stock (capacity) of the original cartel members                                          |
| $K^e$    | = | desired capacity of entering firm                                                                |
| $K^u(t)$ | = | unutilized cartel capacity at time t                                                             |

|              |   |                                                                                                |
|--------------|---|------------------------------------------------------------------------------------------------|
| $\hat{K}(t)$ | = | capacity (capital stock) required to produce output at time $t$ at minimum average total costs |
| $M$          | = | ratio of market size to the output of a plant of minimum efficient scale                       |
| $n$          | = | number of members in original cartel                                                           |
| $p(t)$       | = | market price at time $t$                                                                       |
| $p_L$        | = | limit price                                                                                    |
| $p_o$        | = | price level equal to long-run average total cost                                               |
| $p^*$        | = | short-run profit-maximizing price                                                              |
| $q(t)$       | = | output at time $t$                                                                             |
| $q_L$        | = | output per unit time at the limit price                                                        |
| $q^*$        | = | output per unit time at the short-run profit-maximizing price                                  |
| $R$          | = | annual cartel revenues                                                                         |
| $r$          | = | rate at which firms discount future profits                                                    |
| $S$          | = | ratio of cartel assets to those of the entrant                                                 |
| $s_i$        | = | output share of the $i$ th cartel member                                                       |
| $T$          | = | implementation cost of the merger plans                                                        |
| $t$          | = | index of time                                                                                  |
| $t_o$        | = | initial date of time index ( $t=0$ )                                                           |
| $\hat{t}$    | = | date at which the cartel's initial capacity is fully utilized under the limit-pricing plan     |
| $V$          | = | cartel's total annual variable production cost                                                 |
| $V_j$        | = | present value of the profits generated by the $j$ th plan                                      |
| $\bar{v}$    | = | level of marginal production cost, assumed to be constant up to full capacity                  |
| $w$          | = | rate of entry of firms                                                                         |
| $x$          | = | entry lag with the entry-by-merger plan                                                        |

|           |   |                                                                                                                            |
|-----------|---|----------------------------------------------------------------------------------------------------------------------------|
| $\hat{x}$ | = | date at which full capacity is reached under the entry-by-merger plan                                                      |
| $y$       | = | annual post-entry profits of the entrant (or annuity equivalent of a lump-sum payment to entrant)                          |
| $z_{j,k}$ | = | difference between the present values of the profit streams generated by the <u>jth</u> and <u>kth</u> plans, respectively |
| $z$       | = | <u>de novo</u> entry lag                                                                                                   |
| $\hat{z}$ | = | date at which full capacity is reached under the cartel-expansion and post-entry merger plans                              |

#### Greek Letters

|          |   |                                                                                                |
|----------|---|------------------------------------------------------------------------------------------------|
| $\gamma$ | = | probability of a merger bid being contested by the owners and/or managers of the entering firm |
| $\delta$ | = | probability of an antitrust challenge of a merger                                              |
| $\eta$   | = | price elasticity of demand                                                                     |
| $\theta$ | = | ratio of $\hat{K}(t)$ to output ( $q(t)$ ) at time $t$                                         |
| $\pi$    | = | annual cartel profits                                                                          |
| $\pi^L$  | = | annual cartel profits when price is at the limit level                                         |
| $\pi^*$  | = | short-run maximum profits                                                                      |
| $\phi$   | = | entrant's share of profits as a percentage of total cartel profits                             |

## CHAPTER I

### INTRODUCTION

Since the end of the Second World War, potential competition has come to occupy a position of importance in the theory of imperfect competition. In many respects, the general question of profit maximization for firms with monopoly power has been recast in terms of their optimal reaction to the threat of entry by new firms. To a large extent, however, theoretical work on the impact of potential competition on the long-run profits of such firms has been dominated by the discussion of the role of optimal pricing policy. Less attention has been devoted to the role of other decision variables open to firms to deal with the problems presented by the threat of entry, and no attempt has been made to integrate optimal pricing policy with the consideration of these other policy tools. Not only does this treatment ignore the full range of possibilities open to real-world monopolists, it fails to capture the possibility of interactions among policy tools which might lead to different predictions about firm behavior than models analyzing the effect of a single choice variable.

In this study, I examine the optimal response of monopolists to potential competition when these firms have a wider scope of action than that afforded by pricing policy

alone. Specifically, I examine the effects on traditional limit-pricing theory of allowing firms the additional option of undertaking mergers with newly entered firms or potential entrants.<sup>1</sup> While the price and merger options are conceptually distinct, they may have similar impacts on the character of competition in a given market by affecting the size and number of firms over the long run, and to this extent the policies may reinforce each other or serve as substitute means to the same end. It is my contention that viewing these alternatives in a common framework adds to one's knowledge both of the motivation for mergers in certain situations and the mechanics of limit pricing in the real world. In particular, this study demonstrates that the inclusion of merger options in a model of optimal entry prevention leads one to predict both higher profits and more entry in some circumstances than would have been true had these alternatives not been considered.

### 1.1 Background

The dominant position of price policy can be explained in large part by the historical development of economists' interest in potential competition as a determinant of the behavior of firms with monopoly power. Entry per se has played an important role in price theory at least since the time of Adam Smith: freedom of entry is the mechanism which equalizes profit rates in the model of pure competition and insures the most efficient allocation of society's scarce resources. This role is essentially passive, however, with

respect to firm behavior: entry or none, firms with monopoly power are assumed to maximize profits by setting price to equate long-run marginal cost and marginal revenue.

The early years of the post-war era witnessed the beginnings of a revision in this theory of how monopolists maximize profits. For some time up to this point, researchers had noted an apparent discrepancy between the actual pricing behavior of firms which were presumed to have monopoly power and that predicted by traditional theory. Empirical studies found that in some industries there was evidence of price being set over the long run in ranges where the industry demand curve was inelastic. Since marginal revenue is negative in these regions and necessarily less than marginal cost, these firms were clearly not following the marginalist rules of traditional theory.<sup>2</sup>

Although attempts were made to reconcile this evidence with traditional theory, the explanation which gained greatest currency was that the theory was inadequate. A number of economists put forward a new theory--which has since come to be known as the limit-pricing hypothesis--that the behavior of the above firms could be explained as a rational response to the threat of entry by new firms.<sup>3</sup> According to this theory, under some circumstances firms might find it more profitable in the long run to set price at a level below the price which equates marginal cost and marginal revenue in order to deter entry by new competitors. Although this policy would sacrifice current profits, for some firms the present value

of these foregone opportunities might be less than the present value of the profits the firms would sacrifice in the future if new firms were to enter and compete with it. In short, some firms might find that following the traditional profit-maximizing rules in the short run would not lead to profit maximization over the long run.

The early work of Bain, Sylos-Labini, and others was primarily concerned with identifying the structural determinants of the limit price--economies of scale, various sources of absolute cost advantages, and so on--and the conditions under which the entry-preventing price policy would be preferable to maximizing short-run profits and allowing entry to take place. In recent years, this initial framework has been extended in a number of directions, especially the dynamics of limit-pricing over time and the implications for optimal pricing when either the amount or timing of entry is assumed to be a function of the extent to which price is raised above the level of long-run average cost.<sup>4</sup> For the most part, however, there has been no attempt to extend the question of optimal entry prevention beyond the choice of pricing policy to include the effects of other factors.<sup>5</sup>

In contrast to the relationship between entry and firm behavior in traditional economic theory, economists have been aware of an interaction between merger possibilities and firm behavior since the first great merger wave engulfed American industries at the end of the previous century. It has been only recently, however, that there has been anything approaching a consensus among economists regarding the impact of

mergers on the character of competition in industries and, by extension, the extent of anticompetitive intent as a motivation for merger behavior.<sup>6</sup> Indeed, it was only in 1950--nearly half a century after the end of the first merger wave--that theorists explored the conditions under which it would be profitable for existing competitors to merge when the benefits resulted from monopoly power alone and found that these conditions might easily be satisfied in many industries.<sup>7</sup>

It has been only in the last decade that potential competition has come to play a role in merger literature. In the late 1950's some economists noted the potential for danger in mergers between firms which were potential competitors, and the Antitrust Division brought suit to prevent several mergers of this type.<sup>8</sup> It was not until the favorable Supreme Court decisions in these latter cases and the rise of conglomerate mergers in the merger waves of the middle sixties, however, that there was widespread interest in exploring the implications of such mergers on the character of competition among established firms in given markets.<sup>9</sup>

In his 1965 analysis of conglomerate mergers, Turner concluded that in two situations mergers between established firms and a firm either recognized as a potential entrant or known to be contemplating entry could have anticompetitive consequences.<sup>10</sup> In the first situation, removing a recognized potential entrant might give established firms greater latitude in setting price without inducing entry, especially if the outsider were the only or most-favored potential entrant. In

the second, established firms might prefer entry by merger since this would leave the number of firms in the industry unchanged and present less difficult problems for oligopolistic coordination than de novo entry.

Thus, Turner's analysis recognized the possibility of a feedback effect between merger activity and the pricing behavior of firms in a given market: in both of the situations where mergers were seen to have potentially harmful effects, the harm arises from the impact of the merger on the pricing activity of established firms. As in the case of the limit-pricing literature, however, Turner eschewed consideration of the question of mergers as an optimal response by established firms given their pricing options. Missing is an exploration of the factors which would determine when merging would be preferable to a limit-pricing (or some other) strategy. It is to these latter questions that the present study is addressed.

## 1.2 Organization of the Study

This study is divided into six chapters. In this first chapter, I have attempted to identify the problem on which I will focus in succeeding chapters and to provide background information about past research in related areas of research. The next chapter is devoted to setting up the basic model employed in this study. I examine there the determinants of the profits of a hypothetical group of profit-maximizing oligopolists and describe both the problems presented by the

threat of entry and the courses of action assumed to be open to these firms to neutralize the threat. In the third chapter I analyze the factors which will determine the ranking of these different strategies under various conditions in the case where established firms are faced by a single potential entrant capable of entering on a large scale.

The material of Chapter IV extends the results of this single-entrant case to that of many potential entrants and examines the sensitivity of the findings of the basic model to a number of restrictive assumptions made in Chapters II and III. Next, in Chapter V, I discuss the implications of the model's results for empirical research and suggest some casual empirical evidence which seems to support my conclusions. Finally, in the last chapter I briefly summarize my findings and discuss directions which future research might take.

### Footnotes

<sup>1</sup>The consideration of other courses of action by which firms could affect potential entrants--such as investment in various kinds of entry barriers--is beyond the scope of the present work.

<sup>2</sup>J. Bain, "A Note on Pricing in Monopoly and Oligopoly," American Economic Review, XXXIX (March, 1949), 448. Bain cites the cigarette and steel industries as "fairly convincing examples."

<sup>3</sup>Important early contributors to the theory of limit-pricing are: Bain, "Conditions of Entry and the Emergence of Monopoly," in Monopoly, Competition and their Regulation, ed. by E. H. Chamberlin (London: MacMillan and Co., 1954), and Barriers to New Competition (Cambridge: Harvard University Press, 1956); Paolo Sylos-Labini, Oligopoly and Technical Progress (Cambridge: Harvard University Press, 1962); and Franco Modigliani, "New Developments on the Oligopoly Front," Journal of Political Economy, LXVI (June, 1958), 215-32. For a recent synthesis of these contributions and those of several British economists, see Jagdish Bhagwati, "Oligopoly Theory, Entry-Prevention, and Growth," Oxford Economic Papers, XXII (November, 1970), 297-310.

<sup>4</sup>B. P. Pashigian, "Limit Price and the Market Share of the Leading Firm," Journal of Industrial Economics, XVI (July, 1968), 165-77; M. Kamien and N. Schwartz, "Limit Pricing and Uncertain Entry," Econometrica, XXXIX (May, 1971), 441-54; D. Gaskins, "Dynamic Limit Pricing," Journal of Economic Theory, III (September, 1971), 306-22; and D. Baron, "Limit Pricing, Entry, and Barriers to Entry," American Economic Review, LXIII (September, 1973), 666-73.

<sup>5</sup>The closest thing to an exception I have found is in Worcester's classic analysis of the dynamics of dominant firm pricing behavior. At one point, he notes that dominant firms might forestall decline over the long run by "aggressive action . . . such as recurrent periods of mergers, building up sales apparatus and other product-differentiating devices that impede entry, and so on." In the next paragraph, however, he dismisses these activities as "short-run efforts to avoid a long-run consequence" and concludes that the "long-run tendency is for the dominant firm to lose out." As a result, he does not deal with these activities further, in spite of an admission that they may be important in the cigarette, steel, and tin-can industries. "Why 'Dominant Firms' Decline," Journal of Political Economy, LXV (August, 1957), 342.

<sup>6</sup>P. O. Steiner, Conglomerate Mergers: Motives, Effects, Policies (Ann Arbor: University of Michigan Press), 1974, Ch. 3.

<sup>7</sup>G. Stigler, "Monopoly and Oligopoly by Merger," American Economic Review, XL (May, 1950), 23-34.

<sup>8</sup>Hines noted this danger in a general discussion of the role of entry by established firms as an effective constraint on the behavior of firms with monopoly power. By and large, however, his analysis of entry by merger emphasizes the beneficial aspects of such entry on the character of competition among established firms. "Effectiveness of 'Entry' by Established Firms," Quarterly Journal of Economics, Vol. LXXI (February, 1957), 143-5. Two important early cases I shall examine later were those against El Paso Natural Gas (1957) and Procter and Gamble (1958). See United States v. El Paso Natural Gas Co., 376 U.S. 651 (1964) and F.T.C. v. Procter and Gamble Co., 386 U.S. 568 (1967).

<sup>9</sup>Mergers between potential competitors are necessarily conglomerate mergers under the F.T.C.'s tripartite division of mergers. For an alternative view of how market-extension mergers should be treated, see Steiner, Mergers, Ch. 1.

<sup>10</sup>D. F. Turner, "Conglomerate Mergers and Section 7 of the Clayton Act," Harvard Law Review, LXXVIII (May, 1965), 1352-86.

## CHAPTER II

### PRELIMINARY THEORETICAL CONSIDERATIONS

In the preceding chapter, I suggested that the traditional emphasis on the importance of pricing in research on entry prevention by established firms with monopoly power understates the range of actual weapons open to such firms in the real world. In particular, I argued that mergers with actual or potential competitors as a response to a threat of entry has been given little attention in the theoretical literature. In this chapter, I examine this question by postulating a model which treats limit-pricing and certain types of mergers within a common framework. Although the options are by no means identical, they may produce similar effects on the size and longevity of monopoly profits and thus have a similar appeal to established firms. The purpose of the model is to demonstrate that in some situations certain merger alternatives will be preferred to limit-pricing strategies by virtue of yielding the monopolist a larger stream of discounted profits over the long run.

My focus is the behavior of a group of oligopolistic firms--which I will call a cartel--acting in concert to maximize the present value of their joint long-run profits.<sup>1</sup> In the first section of this chapter, I examine the determinants of the short-run profits of the cartel. In the second section,

I turn to the question of the impact of the threat of entry on the process of long-run profit maximization and discuss some general alternative price and merger strategies open to the established firms. In the third section, I make specific assumptions about the nature of the entry threat and the strategies open to the cartel and analyze the determinants of the optimal course of action for the group. The model presented in this chapter is highly restrictive in order to make the analysis as simple as possible. In the next chapter, however, I examine the effects of relaxing some of the more important of these restrictions.

## 2.1 Determinants of Cartel Profits

Let us begin by positing an industry consisting of a group of "n" firms which share the same geographical market(s) and sell a single, standardized product<sup>2</sup> at a common market price. Assume further that each firm is of sufficient size to have its output decisions affect the level of that price and that mutual recognition of this fact has led them (either by overt collusion or conscious parallelism) to restrict output and raise market price above the level of long-run average costs. For convenience, I shall assume that the mechanics of the agreement among the members of the cartel call for each firm to produce some fixed share  $s_i$  of total output such that  $\sum_i s_i = 1$  ( $i = 1, \dots, n$ ). These shares are based on the output each firm would produce if market price were at the level of long-run industry average costs,  $p_0$ . The capital stock of

the cartel is  $K^C = \sum^i K^i$ , where the  $K^i$  are such that the *i*th cartel member produces at the minimum point on its short-run average cost curve when price equals long-run average costs. Initially, I shall assume that capital is indestructible and, once installed, has no alternative uses.

The profits the cartel can expect to earn by virtue of its restriction of output will in general depend on a large number of factors. To make matters simpler, I shall abstract from losses associated with periodic breakdowns in the agreement arising from various kinds of disagreements among the members. In particular, I assume that the cartel is free from such sources of instability as differing expectations about future cost or demand, differences in the rate at which members discount the future, excessive suspicion, paranoia, or just plain "cussedness" which would lead one or more firms periodically to perceive a disparity between their own welfare and that of the group as a whole and cause them to adopt an independent course of action.<sup>3</sup> Once the firms agree on a set of market shares, I assume that they are bound by a strong bond of consensus on all issues which confront them and that for all practical purposes, the cartel can be viewed as a single decision-making unit not unlike a multi-plant, single-firm monopoly with similar market control.

Although the cartel may resemble a single-firm monopoly in some respects, it may not always be able to achieve the same level of profits as a single firm with identical

facilities for all possible ranges of output. To begin with, the fixed output-share method of dividing the cartel's profits will not allow it to benefit if a reallocation of output among the plants would lead to lower average total costs for a given level of output. In addition, the assumption of an absence of many sources of instability made in the previous paragraph was not intended to rule out the existence of greed and the possibility that some cartel members might be tempted to cheat on their quotas. On the contrary, I assume that the cartel must undertake certain policing measures to insure that all the members adhere to the terms of the agreement. Such measures would not be needed, however, by a single-firm monopolist.

The profit potential of the cartel can be expressed in functional form as follows. Assume initially that the cartel is the sole supplier in its market and that the market demand curve is stationary over the long run. Under these conditions, I shall assume that the profits of the cartel in year  $t$ ,  $\pi(t)$ , is determined by the function

$$(2.1) \quad \pi(t) = \pi(R, F, V, C, t)$$

where  $R$  is the cartel's revenue;  $F$  and  $V$  the levels of fixed and variable production costs, respectively;  $C$  the level of so-called policing costs; and  $t$  is an index of time. Let us now examine each of the arguments of equation (2.1) separately, since each is a function of other parameters.

The annual revenues of the cartel,  $R(t)$ , can be dealt with easily. Since the cartel is the only supplier in the market, its revenues will be a function of the level of market price,  $p(t)$ , and the quantity demanded of the cartel at that price,  $q(t) = D(p,t)$ . In general, the level of demand will also depend on the prices of other goods and the income levels of consumers. For the purposes at hand, however, I assume that other prices and money income are constant and that the cartel's product does not make up a large enough portion of consumers' budgets for price changes to significantly affect their real incomes. Under these conditions, the cartel's revenue in year  $t$  can be expressed as the following function:

$$(2.2) \quad R(t) = p(t) \quad q(t) = p(t) D(p,t) = R(p,t).$$

The total cartel production costs in time  $t$  are equal to the sum of total fixed ( $F(t)$ ) and variable ( $V(t)$ ) costs. By virtue of the assumption that capital is indestructible, there is no annual depreciation charge and annual fixed cost is equal to the sum of the interest charges on the members' capital stocks:

$$(2.3) \quad F(t) = r \sum_{i=1}^n K^i = rK^C \quad (i = 1, \dots, n).$$

The term " $r$ " is the cartel discount rate, which I assume to be identical for all firms, and  $K^i$  and  $K^C$  are the capital stocks of the  $i$ th firm and the cartel, respectively.

By definition, the cartel's annual total variable costs,  $V_c(t)$ , is the sum of the variable costs of the members,  $V_i(t)$ , which are, in turn, functions of the outputs of each firm,  $s_i q(t)$ --that is,

$$(2.4) \quad V_c(t) = \sum_i V_i(s_i q, t) \quad (i=1, \dots, n).$$

In general, however, it may be the case that the value of total variable costs associated with a given level of car-tel output,  $q(t)$ , could depend on the way in which this output is allocated among the plants controlled by the cartel. If firms have plants with different variable cost functions--that is, if the variable costs for similar outputs are higher and increase more or less rapidly at the margin for some of the firms--it may be possible to produce a given level of cartel output at the lowest possible cost only if output is reallocated from less to more efficient plants, which might even cause some plants to be shut down entirely.<sup>4</sup>

Such a rationalization of production, however, is ruled out by fixed-output-share agreements such as the one postulated for the cartel presently under consideration. It will be possible to construct a single-valued variable-cost function for all cartel output levels, but it might deviate significantly from the minimum variable-cost function the cartel could achieve if it were a single firm monopoly. If so, the cartel's variable cost function will thus be dependent on the set of output shares. If it is, a revision of the quotas could cause shifts in the function which might

either raise or lower the total variable costs associated with a given cartel output, depending on the nature of each firm's function and the change in quotas.

To avoid this complexity, I shall assume that all the firms can produce a given output at the same level of variable costs and that these costs increase proportionately with output up to each firm's full capacity, at which point the costs increase precipitously. This amounts to an assumption of constant marginal costs for all output ranges up to full capacity, an assumption which seems justified by empirical research on short-run cost functions.<sup>5</sup> With the above assumptions, changes in quotas will not lead to changes in the total variable costs associated with a given cartel output, and one can express the level of these costs as a direct function of cartel output alone and ignore its distribution among the members of the cartel. Thus, equation (2.4) can be rewritten as

$$(2.4') \quad V(t) = V(q, t) \text{ with } V'_q = \bar{v} \text{ for } q < q(p_0) \text{ and}$$

$$V'_q > \bar{v} \text{ for } q > q(p_0),$$

where primes denote the first partial derivative of the variable with respect to the argument in the subscript--a convention I employ throughout this work--and  $\bar{v}$  (marginal production cost) is some positive constant.

The final term of equation (2.1),  $C(t)$ , reflects costs incurred by the cartel membership to insure that each adheres to the terms of the agreement and does not succumb

to the temptation to shade price and/or increase output beyond its share of the total. These costs may be of various kinds, and in some cases they could amount to a significant portion of potential cartel profits. First, there may be direct supervisory costs involved arising from open and/or clandestine auditing of members' operations. These activities will probably be supplemented by the publication of a trade journal which lists prices or costs to facilitate coordination and annual conventions at which members are exhorted to act according to the dictates of the interests of the membership as a whole.

The temptation to cheat can be tempered by these supervisory activities if they are highly efficient so that recalcitrants can be quickly detected and punished. All other things being equal, detection should be more difficult--and policing costs correspondingly higher--the larger the cartel membership.<sup>6</sup> Also, one should expect the temptation to cheat to depend on the level of market price: the higher the level of price, ceteris paribus, the greater the gap between price and marginal production costs and the temptation for individual firms to increase output in hopes that the others will keep price at the existing level. The cartel could keep price at a lower level than would otherwise be optimal, but this only substitutes foregone profits for direct supervisory costs. In either case, total policing costs should be higher, the closer price comes to the short-run profit-maximizing level.

Not all policing costs, however, will be direct expenditures on supervisory activities. In addition to these costs, the cartel must include the expected value of any fines and damage to its public image if its coordination efforts require overt and illegal activities which might come to the attention of antitrust authorities. Explicit collusion should be more necessary, all other things equal, the larger the number of firms in the cartel. Still other costs which might be incurred by cartels in the real world have been ruled out by my assumptions about the stability of the cartel.<sup>7</sup>

For present purposes, I shall assume that policing costs are a function of the number of cartel members and the level of market price and that the policing costs in any year are determined by the following expression:

$$(2.5) \quad C(t) = C(n, p, t); \quad C'_n > 0, C'_p > 0, C''_{nn} > 0,$$

where double primes are used to indicate the second partial derivative of a variable with respect to the argument in the subscript. The assumption that policing costs increase more than proportionately as the number of cartel members is consistent with theoretical formulations cited in the previous footnote.

Substituting equations (2.2), (2.3), (2.4'), and (2.5) for the appropriate terms in the general expression for annual cartel profits, I assume that the cartel profit function of equation (2.1) has the following explicit form:

$$(2.1') \quad \pi(t) = R(p,t) - rK^C - V(q,t) - C(n,p,t) \\ = \pi(p,r,K^C,n,t).$$

I assume that the price,  $p^*$ , which maximizes this function in time  $t$ --given the values of the other parameters--is unique. Moreover, I assume the profit function has the following partial derivatives:

$$(2.1'') \quad \pi'_p > 0 \text{ for } 0 < p < p^*; \quad \pi'_r < 0; \quad \pi'_K < 0; \text{ and } \pi'_n < 0.$$

To simplify the notation, I shall denote the short-run maximum-profit level,  $\pi(p^*,r,K^C,n,t)$ , as  $\pi^*(t)$ .

## 2.2 Long-Run Profit Maximization and the Threat of Entry

Up to this point, our discussion has focused on the short-run profit potential of the cartel. I assume, however, that the goal of the cartel is to maximize the present value of its members' joint long-run profits, given the constraints imposed by the terms of the agreement, but that achieving this end is complicated by the possibility of entry by one or more firms in related industries (or markets or stages of production). In general, a threat of entry may cause short-run and long-run profit maximization to diverge if entrants are allowed to capture portions of the cartel's market--and, therefore, its profits--over time. In what follows, I assume that the entry threat can be expressed, following Bain, as a general-condition-of-entry function.<sup>8</sup>

The condition of entry function is a relationship between the amount of entry--usually expressed as a percentage increase in initial industry capacity--which established firms can expect over the long run and the extent to which price is maintained above the level of long-run average cost. The amount of entry is a non-decreasing function of price, and the price intercept of the function is the limit price,  $p_L$ . In general, entry functions may have a variety of forms: the exact shape in any particular case will be determined by the ability of potential competitors to enter and compete at the same minimum cost levels as established firms.<sup>9</sup> In the traditional model of pure competition, potential entrants have the same cost functions as existing sellers, and the limit price is the same as long-run average costs ( $p_0$ ). Any attempt by existing firms to keep price above this level results in a steady stream of entry until price returns to  $p_0$ . In this case, then, the condition of entry function is a horizontal line with its price intercept at  $p_0$ .

If potential entrants cannot compete at the same cost levels as established firms, however,  $p_L$  will be greater than  $p_0$  and the condition of entry function will be everywhere above that of the previous example. If each potential entrant differs in the minimum cost level it could achieve if it entered, entry will be a monotonically increasing function of price above  $p_L$ . If some firms share the same minimum cost levels, the relationship will be a

step function. At any rate, entry will never be a decreasing function of the price-minimum cost gap.

In what follows, I assume that the entry function is well-defined in the sense that the cartel can determine the exact amount of entry--not just a range of possibilities--which will result from setting price at some given level. In addition, I shall assume that neither the timing of entry--the so-called entry lag--nor the scale at which potential entrants desire to enter is affected either by the extent to which price exceeds the level which induces it to enter or by the actions of other potential entrants.<sup>10</sup> Once made, the decision to enter is assumed to be irreversible regardless of later changes in the price level. Finally, I assume that the lag between the decision to enter and the start up of new facilities is an increasing function of the scale of entry: that is,

$$(2.6) \quad t_e - t_o = f(K), \quad f'_K > 0,$$

where  $t_o$  is the date the decision is made and  $t_e$  is the start-up date.

The problem facing the cartel is to choose some course of action which internalizes the entry threat and yields its members the largest long-run stream of discounted profits. Traditional analyses, as we have noted, have focused on the pricing options open to established firms: whether or not to set price at the limit level, and if not, how much entry to allow. If a firm is allowed to enter, however,

the cartel must still decide what attitude it will adopt toward it. I shall assume that established firms either choose to ignore the entrant and maximize cartel profits given a reduced share of total market demand or to admit the new firm to the cartel and maximize profits given the constraints imposed by adjusted quotas, larger industry capacity, and another member.

The choice between these strategies will depend in large part on the size of the entrant relative to the output of the cartel. If the entrant is small, it may not have a perceptible impact on the cartel's profits and may be safely ignored.<sup>11</sup> As the entrant approaches the sizes of the existing firms, however, there is a greater chance that ignoring the entrant could lead to a substantial erosion of the cartel's market share over time, which could, in turn, lead to a breakdown of the cartel. Were such a firm admitted into the cartel membership, however, such a situation might be avoided from the start. For the sake of convenience, I will assume that the cartel chooses to expand its membership if it allows large-scale entry to occur. It is assumed to believe the costs of not doing so--a possibly protracted price war followed by some arrangement at a later point in time--would be greater than or equal to the concession<sup>12</sup> the entrant might demand for its cooperation.<sup>13</sup>

Up to this point, the discussion has dealt primarily with options which are consequences of pricing decisions--whether or not to price so as to allow entry to occur in

the first place. I shall assume, however, that the cartel has two other options with respect to actual entrants: first, the cartel can allow de novo entry and then have one of its members merge with the entrant, or second, it can allow entry to take place by having the potential entrant merge with one of the established firms.<sup>14</sup> In this latter case, entry by a potential entrant may or may not result in an expansion of industry capacity. Let us assume that it depends on whether or not the established firm is at least the same scale as that the entrant would desire if it were to construct its facilities from scratch. Specifically, I assume that entry by merger adds facilities of scale  $K^b$  such that  $K^b = K^e - K^a$  if  $K^e > K^a$  and  $K^b = 0$  if  $K^e < K^a$ , where  $K^e$  is the entrant's desired scale of entry and  $K^a$  is the scale of the established firm.

The above formulation of the entry-by-merger option, however, makes certain implicit assumptions about the nature of the industry technology, and these assumptions may not be justified in every case.<sup>15</sup> In particular, it is assumed that existing facilities can be expanded easily to achieve the same results the entrant could have gotten by building its plant from scratch. If firms are multiplant operations and/or the technology is very simple, this assumption may be approximately true. For single-plant firms and/or more complex technologies, however, there may be few ex ante scale options open to firms and ex post modifications of any significant extent may be either impossible or

prohibitively expensive.<sup>16</sup> In addition, existing single-plant facilities may possess locational disadvantages which would in any case cause a larger plant to be built at some other location.<sup>17</sup> For the purposes at hand, I shall assume that if plant and technology are not conveniently malleable, entry by merger involves a cartel member with a plant of at least scale  $K^e$  so that  $K^b$  is equal to zero.

In summary, then, I assume that the cartel has essentially four courses of action it can adopt with respect to any given potential entrant.<sup>18</sup> First, it can bar any entry by setting price at a level just below the amount which will induce that firm to enter. Second, it can set price at some higher level and allow the firm to enter and then either ignore it or admit it to the cartel. Third, it can try to arrange a merger between one of its members and the entrant after entry has occurred. Fourth, it can try to arrange for entry by merger where the newcomer merges with an established firm and adds to its capacity if necessary. In both of the merger cases, I assume that there are no economies of scale or other types of synergistic effects resulting from the mergers other than monopoly power resulting from a continuation of the cartel's complete control over industry demand. In addition, let us assume that anti-trust laws are such that mergers of the sort described above are not subject to attack.<sup>19</sup>

### 2.3 The Cost of Alternative Strategies

As a general matter, one should expect each of the

four courses of action to have a different impact on the present value of the cartel's long-run profits, although it might be possible for two plans to have the same effect and for the cartel to be indifferent between them. I hypothesize that with respect to any given entrant, the cartel will adopt that strategy which causes its profits to diverge least from the level it could have earned had the entry threat not existed in the first place--that is, it will choose the plan which yields the highest present value for its profits. It is useful to think of the impact of each plan as depending on two factors, although in some instances they may be difficult to distinguish: first, the costs involved in implementing a plan once it is chosen, and second, the cost which must be paid either to neutralize or internalize the threat posed by the entrant.

#### Implementation Costs

Let us begin with the first factor, implementation costs. These are costs the cartel incurs in putting a particular strategy into operation in the case of a given entrant. Some of these costs will be common to all plans, while others are specific just to certain plans.

#### Output-Adjustment Costs

An example of the first type of costs--those common to all the plans--are costs the individual cartel members would incur if the adoption of a plan required a change in their level of output per unit of time. Such changes might disrupt

normal operations as new people are hired or fired and machines or entire plants are shut down, started up, or cut back in activity and lead to mistakes or a general decline in efficiency which could raise costs in the short run. On the whole, these costs should vary directly with the amount by which output is changed under each plan and the extent to which the firms can coordinate their adjustment to the new level of cartel output.

The first factor--the size of the change--will depend on the cartel's output level at the time the decision is made. If the cartel is initially producing at full capacity, the plans with the largest adjustment costs will be those that require the cartel to reduce output to the level at which short-run profits are maximized. If the cartel is initially producing this latter level of output, the costliest plans are those requiring increases in output. In addition, the adjustment costs may be of a larger magnitude to the extent that the cartel is characterized by conscious parallelism rather than overt collusion. In the case of conscious parallelism, the communication of the desired level of total output may require a period of iterative adjustment in which some firms may under- or overshoot the amount they should produce before the desired level of cartel output is reached under the old set of output shares for that portion of industry demand supplied by the members of the original cartel. Presumably, the adjustments would be quicker if there were a conscious conspiracy, but in this case one must add to the costs any increment in the

probability that the need for the adjustment will make discovery of the plot more likely by antitrust authorities.

#### Plan-Specific Implementation Costs

If output-adjustment costs are approximately the same for all plans, the plans with the lowest total implementation costs would be the limit-pricing option and the case of entry by a firm too small to be admitted to the cartel. In each of these cases, implementation costs are just output-adjustment costs. There would be additional implementation costs involved in the merger and cartel-expansion plans: these involve a more direct interaction between the cartel and entrant to establish the nature of the latter's involvement in the industry and the price for its cooperation. Both the form and duration of the interaction could differ from plan to plan, with corresponding differences in implementation costs.

Cartel-expansion costs.--In the case of the "cartelization" plan, the interaction entrant's share could take a variety of forms, ranging from covert meetings between the parties to a process of conscious parallelism characterized by "offers" and "counteroffers" in the form of output adjustments which converge over some number of iterations upon some set of output shares acceptable to all concerned.<sup>20</sup> On the whole, one should expect the level of these interaction costs under the cartelization plan to be largely a function of the number--and, possibly, the size distribution--

of firms involved in the interaction. The more firms there are, the more time it will take for the process of conscious parallelism to bring about a convergence to a set of output shares for the members of the expanded cartel. This process could involve substantial foregone profits (in terms of those the cartel could earn if the agreement finally reached could have been implemented from the start) or even losses,<sup>21</sup> so its duration will be of prime importance in determining the present value generated by this strategy.

Indeed, when many firms are involved, the parties may be more likely to resort to overt collusion to speed the implementation of a new agreement. The probability that this collusion will be discovered by anti-trust authorities, however, also increases as the number of conspirators, so there may be a compensating increase in the expected value of costs arising from getting caught. Even if this probability seems relatively low, the absolute size of the damages involved could be very large if the discovery led to the breakup of the cartel, fines and/or imprisonment for the firms' managers, and treble damages by customers. Even for a firm which was not implicated, the cartel and thus that firm might have to lower prices and engage in additional public relations to cleanse its image and keep at bay a more suspicious government.

One could make an even stronger argument in the case of cartel agreements which were susceptible to breakdown from internal stress. The more firms there are, the more

likely it is that some firm will disagree with the other's decision concerning the share allotted to the entrant and adopt an independent course of action or cheat on its new quota.<sup>22</sup> In such situations, implementing the plan could raise the policing costs and/or threaten the very stability of the agreement. I have ruled such cases out by assumption, however, but the previous arguments seem sufficient justification to assume that one may express the total implementation costs,  $I$ , of the cartel-expansion plan as a function of the number of firms involved in the agreement--that is, that

$$(2.7) \quad I = I(n+1) \text{ and } I'_n > 0, I''_n > 0,$$

where  $n$  is the number of firms in the original cartel.

Merger transaction costs.--The two merger plans involve interactions between the cartel and the entrant of a somewhat different nature. To begin with, mergers necessarily involve direct negotiations between the merging parties, and these negotiations per se are legal--even in cases where the merger is later enjoined or found to be in violation of some statute. In addition, the merger must be registered with the Securities and Exchange Commission, and stockholders and the public must be informed of the intended transaction. The cost of these activities and associated legal expenses will probably be small relative to the market value of the firms involved, however, and they will probably be of the same magnitude for a wide range of merger sizes.

Of greater importance will be various financial costs involved in the merger transaction itself. The type and amount of these costs will depend on the method by which the merger is accomplished. If the merger involves an exchange of stock or securities, the transaction will probably involve brokerage fees which could represent a significant percentage of the market values of the firms involved.<sup>23</sup> If cash is involved, the purchasing firm may incur financing costs if it has to raise the money in the market place,<sup>24</sup> and these costs should vary as the firm's credit rating and the amount of cash which must be raised. In addition, all mergers except those accomplished by an exchange of voting stock involve taxes of various sorts which may raise or lower the cost to the firms involved.<sup>25</sup> For convenience, I shall assume that once the cartel and entrant have agreed on the terms of the merger, the former chooses the method of transacting the deal which minimizes these costs.

Another important factor is the amount of managerial effort which must be put into the merger negotiations by the cartel member. Unless there is excess managerial capacity, managers will have to divert their attention from the normal operations of their firm, which may suffer thereby. The burden might be alleviated by hiring consultants who specialize in mergers, but their services are likely to be expensive. Where this factor is of special importance is in cases where a merger attempt is contested by the managers or owners of one of the firms involved or challenged by

antitrust authorities.

In the present context, the first problem is most likely to involve either a disagreement on the terms between the managers and owners of one of the firms or a fear on the part of the managers of one firm that they will be displaced by those of the acquiring firm. To some extent, this issue may not arise at all if the primary purpose of the merger is merely to eliminate the entrant as an independent entity or prevent it from entering on a larger scale. If the former, integration of the merged facilities may take place only in a very general sense and most if not all of the top management may be retained. If the latter, the entrant may wish to displace some of the managers of the existing firm with their own, but this might be avoided if the entrant is primarily interested in the price it might extract from the cartel and not so much the operation of the firm after the merger. In any event, it will behoove both ownership parties to make special deals with unhappy managers if this is the primary stumbling block, since contests may increase the costs significantly.<sup>26</sup>

An antitrust challenge might present the cartel with an even thornier problem. To begin with, antitrust challenges may be hard to anticipate. It was not until 1968 that the Justice Department issued guidelines to help firms decide in advance whether or not a proposed merger would be challenged. It is hard to determine how useful these guidelines have been, however, since they include the influence

of other considerations such as trends in market concentration and "non-market share standards."<sup>27</sup> Moreover, a challenge does not imply a government victory in every instance, and firms may be tempted to try a merger even if the likelihood of a challenge is great if the benefits they perceive are sufficiently large.<sup>28</sup> In any event, the cartel member must include the expected value of these litigation costs in its calculation of implementation costs. If the members must collude to decide which one will make the offer to the entrant, the expected value of the costs of this being discovered must be included as well.

A contested merger or a challenge by antitrust authorities do more, however, than just raise the expected value of implementation costs: they also raise the possibility that the merger bid may not succeed. In this case, the cartel would have to resort to some other plan--cartel-expansion or in the case of the entry-by-merger plan, post-entry merger also--which is presumably less profitable. Considering this possibility complicates the analysis considerably, however, and for the time being I shall assume it away by positing that the cartel is always assured of a success eventually. This does not rule out the possibility of such contests or challenges, it just assumes that their effect is registered through the size of implementation costs.<sup>29</sup>

Finally, there will be certain post-merger costs involved in integrating the operations of the two firms.

Needless to say, the size of these costs will depend on the extent of that integration. If the "merger" essentially just dilutes the ownership of the initial established firm to include the potential competitor, these costs will be minimal. If production facilities are to be coordinated, redundant personnel eliminated and new facilities started up, there may be substantial costs, both in terms of out-of-pocket expenses and in the demands on the time and skills of managers. The less amenable the technology of the industry is to a complete integration of facilities, the more likely it is that the plants of the entrant will be left fairly independent in the case of a post-entry merger, and the less likely it will be that entry by merger results in the construction of new facilities. In either case, the post-merger costs will be less in each case.

Based on the above discussion, I shall assume that the total cost,  $T$ , of implementing the merger strategies is determined by the following function:

$$(2.8) \quad T = T(K^a, K^e, n, \gamma, \delta); \quad T'_K a < 0, \quad T'_K e > 0, \quad T'_n > 0, \\ T'_\gamma > 0, T'_\delta > 0.$$

The variable  $K^a$  is the capital stock of the established firm chosen to merge with entrant, and the Greek letters  $\gamma$  and  $\delta$  are the cartel's evaluation of the probabilities of a contested bid and an antitrust challenge, respectively. All other things equal, one should expect the cartel member to be able to raise capital at lower rates and obtain commission

reductions from brokers the larger its size. Transaction costs should be higher, however, the larger the transaction, for which  $K^e$ --the desired scale of the entrant--is a proxy. In a like manner, the cartel can expect these costs to be higher, the greater the probability of a contest or anti-trust suit. Finally, I have included the number of cartel members,  $n$ , to represent the likelihood that the cartel will have to resort to direct meetings, which raises the specter of discovery and prosecution. This component of implementation costs will rise as the number of members in the cartel.

#### Cost of Neutralizing the Entry Threat

Let us define the cost of neutralizing the threat posed by a given potential entrant as the difference between the profits the cartel could have earned had this threat not existed in the first place and the profits it will earn (net of implementation costs) by adopting a particular strategy. In general, this cost will consist of: (1) direct payments to the entrant to secure its cooperation and any negative feedback effects on the cartel's profit potential resulting from entry in the case where the limit-pricing policy is not chosen, or (2) foregone profit opportunities brought about by the need to accept a lower price than would otherwise have been the case (providing the limit and short-run profit-maximizing prices are not the same) when it is.

Foregone profits.--In the limit-pricing plan, the cartel's profits will be reduced by an amount which varies

directly (although not proportionately<sup>30</sup>) with the difference between the price needed to keep the firm in question from entering--let us call this the firm-specific limit price--and that of the next most-favored firm.<sup>31</sup> In the case of a single potential entrant, there will be only one limit price, and the size of the profits which the cartel must forego by charging it will depend on its height. The latter could be a function of a number of factors, and the literature on limit pricing suggests that the limit price can be viewed as being determined by a function such as the following:

$$(2.9) \quad p_L = p_L(E, A, M, \eta), \quad p'_E > 0, \quad p'_A > 0, \quad p'_M < 0, \quad p'_\eta < 0.$$

The first two arguments,  $E$  and  $A$ , are barriers to entry resulting, respectively, from economies of scale and absolute cost advantages possessed by established firms.  $M$  is a ratio of the size of the market--as measured by cartel output in the region where price equals long-run average costs--to the output of a new plant of minimum optimal scale. The final argument,  $\eta$ , is the price elasticity of demand in the region of competitive outputs. As the partial derivatives show, the limit price is assumed to vary directly as the height of entry barriers and inversely with the elasticity of demand and market size variable.<sup>32</sup>

When there is more than one entrant and the firms are not equally favored (that is, cannot enter and compete at the same minimum average cost level), one can define the

firm-specific limit price for the  $i$ th entrant as

$$(2.9') \quad p_L^i = p_L(E, A^i, M, \eta), \quad i = 1, \dots, m_0$$

Equation (2.9') is identical to (2.9) in all respects but one:  $A^i$  is now the absolute cost advantage of the cartel with respect to the  $i$ th potential entrant. If the entrants are arranged in ascending order according to their inability to compete on equal terms with the cartel, then  $A^i < A^{i+1}$  and  $p_L^i < p_L^{i+1}$  for all  $i$ . According to this taxonomy, the traditional limit price--the immediate condition of entry--is  $p_L = p_L(A^1)$ .

In the cases of the other three strategies, the neutralization cost will be composed of direct payments to the entrant and/or negative feedback effects which reduce the cartel's profit potential. In the case of entry by a firm too small to be admitted to cartel membership, for example, there will be no direct payments to the entrant by the cartel, but the latter's profit potential will be reduced, since it will no longer be the sole supplier in the market and will have its demand curve shift to the left at every level of price by an amount equal to the output of the new firm at that price.<sup>33</sup>

Payments to entrants.--If entry is on a large scale and the entrant can affect the level of market price, the cartel is not likely to ignore the newcomer but rather to seek some means to contain it--cartelization or merger, in the present instance. In either of these cases, the cartel

must obtain the entrant's cooperation by giving it some share of industry profits over the long run, and the size of this share will be an important determinant of the profitability of the three strategies allowing entry to occur. In order to decide its optimal course of action, the cartel will have to make some estimate of the "price" the entrant will demand for its cooperation.

Let us assume that the cartel evaluates the entrant's share of profits,  $y^i$ , in the following way: it assumes that this share is the present value of a stream of equal annual payments,  $y^i$ , made to the  $i$ th entrant. That is,

$$(2.10) \quad y^i = t_e \int_0^{\infty} [e^{-rt} y^i(t)] dt,$$

which I assume can be simplified using the following notation:

$$(2.10') \quad y^i = D_{t_e}^{\infty} y^i.$$

The term " $t_e$ " is the date at which entry occurs and any agreements go into effect, and " $D$ " is a term which reflects the cumulative effect of the discounting process on the constant profit term for the period over which integration proceeds.<sup>34</sup> The annual payment term,  $y^i$ , can have different interpretations. In the case of the cartel-expansion plan, it is the actual profits of the new firm, whereas it will represent the total value to the entrant-stockholder group if a merger takes the form of a combination of two firms. If the merger is a takeover of the entrant by a cartel member, however,  $y^i$  can be viewed as the annuity equivalent of the lump-sum payment to the entrant.

As a general matter, one should expect the cartel's evaluation of  $y^i$  to be different for different potential entrants. Moreover, the cartel may feel that there is a range of possible values of  $y^i$  for a given firm. The amount will never be lower, however, than the entrant's opportunity cost: it would not accept an offer below the present value of the annual profits it could earn in the best alternative activity.<sup>35</sup> The actual price, though, may be quite higher than this minimum value, depending on a variety of factors, such as how strong a competitor the entrant would be if it did not cooperate with the cartel.

For the purposes at hand, I shall assume that the cartel assumes that the annual payments it must make to the  $i$ th entrant is determined by the following function:<sup>36</sup>

$$(2.11) \quad y^i = y(E, A^i, K^e, S^i); \quad y'_E < 0, \quad y'_A < 0, \quad y'_K > 0, \quad y'_S < 0 \quad (i=1, \dots, m).$$

The first two arguments of (2.11) are economies-of-scale and absolute-cost-advantage barriers to entry, respectively, and the third is the desired entry scale of the entrant. The final term,  $S^i$ , is the ratio of the total size of the cartel to that of the entrant (as measured, say, by their assets), which should give some indication of their relative ability to compete on equal terms. As the postulated value for the partial derivative of this variable shows, the entrant is assumed to have less bargaining power over price, all other things being equal, the larger the value

of S. Finally, I shall assume that the price that is finally agreed upon for a given entrant is independent of that for any other, past or present.<sup>37</sup>

Feedback costs.--The final neutralization costs I will examine in this section are different negative feedbacks of the fact of entry on the profits of the cartel after it has reached some sort of agreement with the entrant. In the case of the cartelization plan, for example, an increase in the size of the cartel will increase policing costs and lower the annual profits the new cartel can earn. In all three strategies except entry by merger, entry will increase the amount of capital in the industry and, therefore, the annual fixed costs of the post-merger cartel. This factor will also lower the annual profits of the modified cartel.

## 2.4 Summary

At the beginning of this chapter, I examined the determinants of the short-run profits of a group of firms with monopoly power. In the second section, I introduced the notion that the existence of an entry threat could cause short-run profit maximization to lead to results which diverge from the cartel's goal of maximizing the present value of its profits over the long run. I then examined four courses of action the cartel might take to internalize the threat posed by any given potential competitor and various costs that would be associated with each plan. The next step is to introduce explicit assumptions about the form of

the entry function facing the cartel and to see what the set of all options open to the cartel looks like and which of them generates the largest present value for the members of the original cartel.

## Footnotes

<sup>1</sup>Although I focus on the behavior of a group of firms, the results of this and the following chapters may be applied directly--with the exception of differences noted in the discussion beginning at the bottom of page 12--to the case of a single-firm monopoly or dominant firm. In addition, the term "cartel" is used throughout this work in a very loose sense to designate the firms with monopoly power and is not intended to imply that this group necessarily constitutes a cartel in the strictest sense of that term. The group's decision-making mechanism might be of various types, ranging from the direct--in some cases contractual--association of a classic cartel or trust to the looser relationship characteristic of conscious parallelism. I attempt to note where differences in the mechanism might affect matters under discussion.

<sup>2</sup>Specifically, consumers view the output of different firms as perfect substitutes.

<sup>3</sup>For a more detailed discussion of the sources of cartel instability, see F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McNally, 1970), pp. 160-1 and 183-98 and references cited there.

<sup>4</sup>See W. Fellner, Competition Among the Few (New York: Augustus M. Kelley, 1960), pp. 131-4, and Don Patinkin, "Multi-Plant Firms, Cartels, and Imperfect Competition," Quarterly Journal of Economics, LXI (February, 1947), 173-82.

<sup>5</sup>A survey of the evidence can be found in A. A. Walters, "Production and Cost Functions: An Econometric Survey," Econometrica, XXXI (January-April, 1963), 40-52. Our assumption of identical costs for different firms, of course, is not necessarily justified by this evidence.

<sup>6</sup>If firms' products are highly differentiated, it may be more difficult to detect cheating and there may be a greater temptation for firms to cheat, ceteris paribus. In addition, product differentiation raises the possibility of non-price cheating--by increasing product quality, say, without raising price. Not only will detection be difficult, but retaliation may take longer if other firms must reply in kind rather than by reducing price. Scherer, Industrial Market Structure, pp. 187-90. The group could avoid this problem by eliminating some inter-firm differences, but this could affect profits adversely if it hindered firm's abilities to exploit price discrimination fully and adapt output to the needs of individual customers. Fellner, Competition, pp. 194-5 and Dewey, Monopoly, p. 27. My assumption of product homogeneity avoids these complications without a loss of generality since none affects the model's principal results.

<sup>7</sup>Two deserve special mention: (1) policing costs associated with the retention of obsolete out of a fear that the installation of newer, more productive equipment by some firms could lead to demands for a renegotiation of output shares; and (2) costs and detection difficulties in policing agreements in industries where fashion changes rapidly, as would be true of clothing and shoes. For a thorough treatment of all aspects of policing costs, the reader is referred to the following texts: Fellner, Competition, pp. 198-232; Dewey, Monopoly, pp. 25-30; and Scherer, Industrial Market Structure, pp. 183-212.

<sup>8</sup>Bain, Barriers, pp. 4-11.

<sup>9</sup>In this model I assume that all established firms are equally efficient.

<sup>10</sup>The purpose of this assumption is to allow me to abstract from the problem raised by Sherman and Willett in which potential entrants are dissuaded from entering out of fear that entry by all will lead to losses for all, a state which allows established firms to raise price even higher than if there were only a single entrant (see "Potential Entrants Discourage Entry," Journal of Political Economy, LXXV (August, 1967), pp. 400-3). I shall not address this question, but I discuss the possibility of shifts in the entry function caused by the choice of cartel strategy--a related point--in Chapter IV.

<sup>11</sup>Or it could be chaper for the cartel to ignore rather than bargain with the entrant.

<sup>12</sup>I discuss the nature and determinants of these concessions in the next section.

<sup>13</sup>This assumption is not unreasonable in view of our assumption that capital is indestructible with no alternative uses once installed. In general, the purpose of this assumption about the cartel's intentions is to abstract from the consideration of more complex pricing strategies, such as predatory pricing. Their inclusion would not constitute a very large contribution of the knowledge on that subject within the framework of this study, but the cost of including them would be great in terms of complexity. In the real world, however, predatory pricing may be a powerful tool in the cartel's arsenal, and an incorporation of it into a merger-pricing model should be explored at some time. Now is not that time. For an interesting discussion of possible relationships, the reader is referred to J. McGee, "Predatory Price Cutting," Journal of Law and Economics, I (October, 1958), 137-69; Scherer, Industrial Market Structure, pp. 273-6; L. Telser, "Cutthroat Pricing and the Long Purse," Journal of Law and Economics, IX (October, 1966),

259-77; and B. Yamey, "Predatory Price Cutting: Notes and Comments," Journal of Law and Economics, XV (April, 1972), 129-42.

<sup>14</sup>I assume that either type of merger takes the form either of a combination of the firms or the acquisition of the newcomer by the cartel member. In both cases, the other cartel members share in the payments to the entrant--which may be that firm's share of a combine or a lump sum in cash or securities paid by the acquiring firm--by adjusting the output shares so that the profits going to the original cartel members--including the owners of the merging firm--stand in the same proportion as in the pre-entry period.

<sup>15</sup>I am indebted to Dr. Michael Klass for bringing this point to my attention.

<sup>16</sup>An example of the first case is a potential entrant desiring to enter a retail gasoline market by building 20 stations. A cartel in that market could decide to promote a merger between the potential competitor and an existing firm with 15 stations and allow the construction of five new stations. It would be more difficult, however, for a cartel composed of electrical utilities in the southwestern U. S. to modify the Hoover Dam to suit the desires of an entrant desiring twice the capacity of that facility.

<sup>17</sup>For a more thorough examination of the relationship among plant location, transportation costs, and optimal plant size, see F. M. Scherer, "The Determinants of Industrial Plant Size in Six Nations," Review of Economics and Statistics, LV (May, 1973), 135-45. I shall not deal explicitly with transportation costs in this model.

<sup>18</sup>Note that this discussion is confined to the potential courses of action the cartel can adopt with respect to any individual potential competitor. When there is more than one such firm, the possibilities open to the cartel expand greatly. I address this latter possibility in the next section of this chapter.

<sup>19</sup>This assumption is not intended to rule out the possibility of antitrust restrictions on the market share which any single firm can achieve or massive consolidations such as those which characterized the first great merger wave at the turn of the century. One of my primary concerns is the impact of smaller mergers which seem to have a less obvious impact on concentration but may nonetheless extend or increase existing monopoly power relative to the conditions which would prevail if de novo entry occurred and the firm remained independent.

<sup>20</sup>One might question whether or not such a process would necessarily converge in all cases. Divergence over

the long run seems unlikely, since it would most likely involve increasingly larger losses (direct or in the sense of foregone profits) which would be the disadvantage of all concerned. There might be short-run divergences, however, if one or the other party seeks to "soften up" the other by inflicting losses on it in order to secure more favorable terms. But this is a different matter and is touched upon in the next section. For the purposes at hand, I shall assume that the possibility of long-run instability can be detected by the cartel in advance and avoided if need be.

<sup>21</sup>These losses are to be distinguished from those one party might purposefully inflict on the other to "soften them up" and obtain more favorable terms. These costs are more correctly associated with the determination of the entrant's share of profits and not the mechanics of the implementation of the plan per se. Although the two may be difficult to distinguish in practice--especially in the case of conscious parallelism--they can be distinguished conceptually, and it is the pure implementation costs I wish to examine at this point. The determination of the entrant's price, as noted earlier, will be examined in the following section.

<sup>22</sup>Scherer, Industrial Market Structure, p. 160.

<sup>23</sup>Denis Binder found these fees to range between two and four or five per cent of the market value of acquired bids in tender offers he analyzed. "An Empirical Study of Contested Tender Offers: 1960-1969" (unpublished S.J.D. dissertation, University of Michigan, 1973), pp. 90-1, 123-4.

<sup>24</sup>Even if the firm has sufficient reserves, it may be unwilling to reduce its liquidity or divert the funds in question from other projects.

<sup>25</sup>For a more complete discussion of the effects of tax laws and related topics, the reader is referred to Robert Allan, "Expansion by Merger," in The Corporate Merger, ed. by W. Alberts and J. Segall (Chicago: University of Chicago Press, 1966), pp. 105-6, and Peter O. Steiner, Conglomerate Mergers: Motives, Effects, Policies (Ann Arbor: University of Michigan Press, 1974), Chapters 4 and 5.

<sup>26</sup>Binder, "Contested Tender Offers," pp. 23-6.

<sup>27</sup>U. S. Department of Justice, Merger Guidelines, Washington, May 30, 1968, pp. 55-64. (Mimeographed.) There is evidence that the Justice Department may be relaxing its attempt to challenge every merger which violates these guidelines. See "Antitrust Reorganizes for More Action," Business Week, November 10, 1973, p. 143.

<sup>28</sup>This statement is especially relevant in the present context, where the cartel wishes primarily to control the entrant's output. If the litigation is drawn out over many years as has been typical in many cases, the cartel may be able to benefit even if a challenge and eventual conviction are almost certain from the start.

<sup>29</sup>I examine the effect of relaxing this assumption in Chapter IV.

<sup>30</sup>Although price is lower at the limit level, output will be higher.

<sup>31</sup>Let us assume for the moment that each potential entrant has its own unique limit price. This assumption is relaxed in the next section.

<sup>32</sup>For a more complete analysis, see Ibid, pp. 1-44; Bain, "Conditions of Entry and the Emergence of Monopoly," in Monopoly, Competition and their Regulation, ed. by E. H. Chamberlin (London: MacMillan and Co., 1954); Franco Modigliani, "New Developments on the Oligopoly Front," Journal of Political Economy, LXVI (June, 1958), 215-32; and Paolo Sylos-Labini, Oligopoly and Technical Progress (Cambridge: Harvard University Press, 1969), Part I.

<sup>33</sup>This is essentially the mechanism by which the demand curve of a dominant firm with competitive fringe is determined. See Scherer, Industrial Market Structure, pp. 216-17 and references cited therein, for more details.

<sup>34</sup>Specifically,  $D_{t1}^{t2} = \int_{t1}^{t2} (e^{-rt}) dt$ , where integration starts at  $t1$  and ends at  $t2$ . Use of this shorthand notation is possible because  $y^1$  is a constant and can be factored out of the integral without affecting its value. I shall employ this device wherever conditions permit to simplify the notation.

<sup>35</sup>By prior assumption, I rule out the possibility that the cartel would be willing or able to engage in predatory pricing to drive the entrant out or secure more favorable terms for its cooperation.

<sup>36</sup>This price may also depend on the technological consideration discussed at any earlier point in this chapter. All other things equal, a cartel member might be willing to pay a higher price under the merger strategy if the facilities could be easily integrated and some savings realized by the elimination of duplicated staff. I do not choose to consider this factor explicitly, however, because of constraints on time and space.

<sup>37</sup>I wish at this point to avoid the possibility of shifts in the entry function caused by divergences in the actual and expected concessions the cartel grants to early entrants. Some firms in related areas may decide not to consider entry under any circumstances because their expectations of the cartel's behavior lead them to explore what they believe to be more lucrative investments. If the cartel is observed to grant liberal concessions to entrants, however, firms which would not otherwise consider entry may attempt it in hopes of making easy--and in some cases speculative--gains. This phenomenon is potentially of some importance, however, so I examine its effect on the results of the next chapter in Chapter IV.

## CHAPTER III

### OPTIMAL CARTEL STRATEGY FOR THE CASE OF A SINGLE POTENTIAL ENTRANT

In this chapter, I examine the determinants of the optimal course of action for the cartel when it is faced with the threat of entry on a large scale by a single potential entrant. I begin with this specification of the entry function in part because it greatly simplifies the problem and expedites the isolation of the key determinants of optimal cartel behavior. Of equal importance, however, is the fact that the single, large-scale potential-entrant case has been the primary focus of much of the previous work on limit pricing.<sup>1</sup> Thus, the results of this chapter will provide some measure of continuity with previous work. In any event, this case can easily be extended to include more than one large-scale potential competitor, as I shall demonstrate in the next chapter. At that time, I shall also examine the case where industry costs are constant over the long run and the cartel is faced with the possibility of small-scale entry by a large number of firms.

#### 3.1 Preliminary Considerations

In the context of the model of the previous chapter, when the cartel is faced with only a single potential entrant, it has but four possible courses of action: limit

pricing, cartelization, and the two merger plans. Let us simplify matters further by assuming that in the cases where entry occurs, the cartel's arrangement with the entrant goes into effect at the same date at which any new capacity resulting from entry begins operation: that is, the agreement begins at the end of the entry lag. In the case of cartelization and post-entry merger, this date will be the same since both entail entry by the same scale of plant,  $K^e$ . I shall assume that the date for these plans is the year "z," where  $z = f(K^e)$  by equation (2.6) of the previous chapter (time being calculated in years from year zero, the date at which the strategies are being considered). For entry by merger, however, the agreement begins in year  $x = f(K^b)$ , where  $K^b$  is the scale of facilities added to those of an established firm. Since  $K^b$  is always less than  $K^e$ ,  $x$  is an earlier date than  $z$ , but not necessarily by an amount which is proportionate to the difference between  $K^b$  and  $K^e$ .<sup>2</sup> If  $K^b = 0$ , of course, the agreement goes into effect immediately since  $f(0) = 0$ .

Given these assumptions and the definitions, equations, and assumptions introduced in the previous chapter, it is possible to express in functional form the income streams which each of the four strategies would generate over the long run. Designating the present value of the stream yielded by the  $j$ th plan ( $j=1,2,3,4$ ) as  $V_j$ , the long-run profit level for each strategy is as follows:

Strategy 1--limit pricing:

$$(3.1) \quad V1 = D_O^{\infty} \pi(p_L, r, K^C, n) = D_O^{\infty} \pi^L;$$

Strategy 2--entry followed by an expansion of the cartel:

$$(3.2) \quad V2 = D_O^Z \pi(p^*, r, K^C, n) + D_Z^{\infty} h_2 \pi_2(p_2^*, r, K^C + K^E, n+1) \\ = D_O^Z \pi^* + D_Z^{\infty} h_2 \pi_2^*;$$

Strategy 3--entry followed by a merger with a cartel member:

$$(3.3) \quad V3 = D_O^Z \pi(p^*, r, K^C, n) + D_Z^{\infty} h_3 \pi_3(p_3^*, r, K^C + K^E, n) \\ = D_O^Z \pi^* + D_Z^{\infty} h_3 \pi_3^* ;$$

Strategy 4--entry by merging with an established firm:

$$(3.4) \quad V4 = D_O^X \pi(p^*, r, K^C, n) + D_X^{\infty} h_4 \pi_4(p_4^*, r, K^C + K^E, n) \\ + D_O^X \pi^* + D_X^{\infty} h_4 \pi_4^*.$$

Most of the terms in equations (3.1) through (3.4) have already been introduced.  $\pi^*$  and  $\pi^L$  are shorthand notations for the annual level of profits when the market price is equal to the pre-entry short-run profit-maximizing and limit levels, respectively. The " $h_j$ " in the last three equations determine the share of annual post-entry maximum profits ( $\pi_j^*$ ) which goes to the members of the original cartel under each plan,  $p_j^*$  being the post-entry short-run profit-maximizing price in each case. The post-entry profit terms--like  $\pi^*$  and  $\pi^L$ --are assumed to be constant over time, which allows the use of the convenient "D" notation for discounting the profit flows.

In order to examine the factors which determine the

ranking of these strategies by the size of the present values they generate, I shall employ an approach which compares the present values on a two-at-a-time basis. This binary comparison approach utilizes a new variable,  $Z_{j,k}$ , which is defined as follows:

$$(3.5) \quad Z_{j,k} = V_j - V_k \quad (j,k = 1,2,3,4; j \neq k),$$

where the "V" terms are the present values generated by the four strategies. For any two strategies  $j$  and  $k$ , the ranking will depend on the sign of  $Z_{j,k}$ . If  $Z_{j,k}$  is positive, then  $j$  dominates  $k$  because it yields a higher present value, and the converse is true if the sign is negative. If  $Z_{j,k}$  is equal to zero, then the cartel will be indifferent between the two strategies.

Profit maximization for the cartel, therefore, can be characterized as follows in terms of the  $Z$ -variable taxonomy: maximizing the present value of the cartel's profits over time requires that it chooses that strategy (or, possibly, strategies) " $j$ " which maximizes the absolute value of  $Z_{j,k}$  for all  $k$  not equal to  $j$ . The cartel should focus on absolute values since for a given  $j$  and  $k$ ,  $Z_{j,k}$  and  $Z_{k,j}$  are identical except for their signs (unless, of course, both equal zero). Essentially, this reduces the number of comparisons the cartel has to make.

### 3.2 Determinants of Strategy Rankings

Let us now examine the determinants of the strategy

rankings. I shall proceed by examining four different binary comparisons. Since previous work on entry prevention has focused largely on optimal reactions when firms are faced only with strategies similar to the first two above--limit pricing and cartel expansion--I shall examine the trade-offs between these two first. This will have the advantage of demonstrating my method in a familiar case. In addition, the results will provide a test of the model, since one should expect it to yield predictions which are similar to the findings of previous studies. Next, I turn to the determinants of the ranking of the cartel plan with each of the merger plans to see under what conditions--if any--the latter might be preferred options. Finally, after examining the trade-offs between the merger plans themselves, it will be possible to discuss the conditions under which one or both of the merger plans will dominate the other two strategies.

### Cartel Expansion v. Limit Pricing

The choice between the first two strategies can be analyzed by forming the variable  $Z_{2,1}$ , which is the difference between  $V_2$  in equation (3.2) and  $V_1$  in (3.1):

$$(3.6) \quad Z_{2,1} = V_2 - V_1 = \left[ D_O^Z \pi^* + D_Z^\infty h_2 \pi_2^* \right] - \left[ D_O^\infty \pi^L \right] .$$

This equation can be simplified by breaking  $h_2 \pi_2^*$  into its constituent parts. I begin by examining the determinants

of annual profits for the industry after entry has occurred,  $\pi_2^*$ . The size of industry profits in the post-entry period will depend exclusively on the effect of entry on the industry cost structure, since the original and expanded cartel have the same demand curve and, therefore, the same marginal revenue curves. The post-entry cartel, however, will have higher fixed costs equal to the interest payments on the capital stock of the entering firm ( $rK^e$ ).

Since I assumed earlier that the original cartel members had identical marginal cost curves--constant at the same level up to the full capacity of each firm--making room for the entrant will not affect the level of average variable costs associated with the output of the members of the original cartel. If the entrant's plant has the same marginal cost curve as the cartel members, the expanded cartel will be able to produce any given output for the same total variable production costs,  $V(t)$ , as the original cartel. In addition, the marginal cost curve of the cartel will be unchanged except that it will not begin to rise until a much higher level of cartel output than before, which reflects the increase in total capacity.

If, however, the entrant's plant were less efficient than those of established firms, the expanded cartel might produce the same output levels (given the output-share mechanism for assigning production levels of members) at higher total variable costs than before, and the marginal production cost curve in the post-entry period could diverge

from that of the initial period.<sup>3</sup> I shall assume, however, that the facilities added by the entrant have the same variable and marginal production cost structure as that of existing firms. This assumption rules out sources of cost advantages for the cartel which cause entrants to have higher variable costs, but it leaves open those sources of an entrant disadvantage arising from higher fixed costs.<sup>4</sup> Furthermore, I assume that entry does not produce any externalities which might also affect the cartel's cost structure. In short, the new capital is redundant inasmuch as it does not allow the cartel to produce the same output levels at lower average total production costs.

Entry will also have an impact on policing costs. Specifically, an expansion of the size of the cartel will increase supervisory costs and will be higher since there will be one more firm to audit, one more potential cheater. There will not necessarily be an increase, however, in the incentive for individual firms to cheat. At an earlier point I assumed the latter to be a function of the difference between market price and the marginal production costs of individual firms. Since the latter are assumed to be constant over the relevant ranges of output for individual firms, policing costs associated with the intensity of the desire to cheat will rise only if the post-entry cartel price is higher,<sup>5</sup> a possibility I shall confront shortly. If, on the other hand, individual firms' marginal costs were rising or falling as they adjusted to the new output

shares, there might be a rise or fall in the temptation to cheat and the costs necessary to contain it.

Finally, an increase in the number of firms could also increase the likelihood of discovery by antitrust officials to the extent that collusion is an element of the operation of the cartel. In such an instance, there would be an increase in the expected value of antitrust penalties and costs arising from the bad publicity.

The impact of policing costs, therefore, will be entirely associated with the increase in the number of cartel-members--provided, that is, that the cartel does not adjust price in the post-entry period. The amount of the increase associated with the increase in numbers will be equal to  $C'_n$  (which is equal to  $C(p, n+1) - C(p, n)$ ), which--in accordance with the specification of equation (2.5)--is positive. Since this increment is independent of the rate of the cartel output, it is a fixed cost and will not affect the cartel's marginal policing cost structure with respect to output.

Indeed, the impact of entry on cartel profits will only be to increase fixed policing and production costs, leaving marginal cost and marginal revenue unchanged from the pre-entry levels. As a result, the profit-maximizing price and output of the expanded cartel will be the same as for the original cartel, and there will be no change in policing costs associated with a change in market price.

The post-entry industry profits, of course, will be lower than before because of the higher policing costs of

the expanded cartel and the addition to industry capacity. Indeed,  $\pi_2^*$  will be equal to pre-entry profits less these fixed cost additions: specifically,

$$(3.7) \quad \pi_2^* = \pi^* - rK^e - C_n'.$$

The last two terms of equation (3.7) are the negative-feedback cost elements discussed at the end of section 2.3 of the previous chapter.

$\pi_2^*$ , of course, is the level of the post-entry profits for the entire industry, but I am primarily interested in the share going to the members of the original cartel,  $h_2\pi_2^*$ . This share will be determined by two factors. First, after entry occurs, the original members will have to give the entrant some annual amount of profit,  $y(t)$ , the size of which will depend on the factors specified in equation (2.11). Second, the cartel members will have to deduct the cost,  $I(n+1)$ , of implementing the plan from the present value of what is left over after the payment to the entrant. In short, the present value of the original members' share of post-entry profits,  $D_z^\infty h_2\pi_2^*$ , will be equal to the following expression:

$$(3.8) \quad D_z^\infty h_2\pi_2^* = D_z^\infty \left[ \pi_2^* - y \right] - I(n+1).$$

By substituting equation (3.7) for  $\pi_2^*$  in the above equation, one gets the final form for the original members' profits:

$$(3.8') \quad D_z^\infty h_2\pi_2^* = D_z^\infty \left[ \pi^* - rK^e - C_n' - y \right] - I(n+1).$$

Equation (3.8') allows one to simplify the expression for  $Z_{2,1}$  in equation (3.6). Substituting (3.8') into the latter, one gets the following result:

$$\begin{aligned}
 (3.6') \quad Z_{2,1} &= \left[ D_O^Z(\pi^*) + D_Z^\infty(\pi^* - rK^e - C_n' - y) \right. \\
 &\quad \left. - I(n+1) \right] - \left[ D_O^\infty(\pi^L) \right] \\
 (3.6'') \quad &= \left[ D_O^\infty(\pi^* - \pi^L) \right] - \left[ D_Z^\infty(rK^e + C_n' + y) \right. \\
 &\quad \left. + I(n+1) \right].
 \end{aligned}$$

The first bracketed term on the right-hand side of equation (3.6'') is the present value of the difference between the annual level of profits the cartel could earn at  $p^*$  if there were no entry at all and the limit-price profit level, respectively. This term will always be greater than or equal to zero: it will be smaller, the closer the limit price is to the short-run profit-maximizing price, but it will never be negative because the cartel would never charge a price higher than  $p^*$ . The second bracketed term can be interpreted as the profits the original cartel members must sacrifice because the entrant exists and is allowed to enter: the present value of the higher fixed capital and policing costs and annual payment to the entrant plus the cost of implementing the cartel-expansion plan.

The value of  $Z_{2,1}$  will depend on the value of the difference between these two bracketed terms, and this difference will be determined by the values of the various parameters of the variables which constitute these two terms.

The effect of individual key parameters can be examined by differentiating  $Z_{2,1}$  with respect to each of them. Table 3.1 presents  $Z_{2,1}$  with the arguments of all the variables written in and the results of taking the partial derivatives with respect to these parameters.

The first four partial derivatives of Table 3.1 are those of  $Z_{2,1}$  with respect to the four determinants of the value of the limit price,  $p_L$ . A comparison of the signs of these derivatives with those of  $p_L$  in equation (2.9) of the previous chapter with respect to these same parameters shows them to be of opposite signs in each case: values which tend to make the limit price small tend to make  $Z_{2,1}$  positive, making it more likely that the cartel-expansion plan will dominate, all other things being equal.

This result is not surprising. If entry barriers are low (small  $E$  and  $A$ ), the cartel's market large relative to the output of a plant of minimum efficient scale (large  $M$ ), and demand elastic (large  $\eta$ ) in the region of the limit price,  $p_L$ , will be closer to long-run average production costs ( $p_0$ ) rather than  $p^*$  which will increase the value of the (positive) first bracketed term of equation (3.6") and tend to make the entire expression of  $Z_{2,1}$  positive. In the limiting case where  $p_L$  is equal to  $p_0$ , the term  $\pi^L$ --the limit-price profit level--is equal to zero<sup>6</sup> and one should expect the cartelization plan to dominate.<sup>7</sup> Conversely, values of the four parameters which make  $p_L$  large tend to reduce the value of the first bracketed term and

TABLE 3.1

PARTIAL DERIVATIVES OF  $Z_{2,1}$  WITH RESPECT OF KEY PARAMETERS

$$Z_{2,1} = \left\{ D_O^\infty \left[ \pi(\bar{p}^*, r, K^C, n) - \pi(p_L, r, K^C, n) \right] \right\} - \left\{ D_{f(K^e)}^\infty \left[ rK^e + C_n' + Y(E, A, K^e, S) \right] + I(n+1) \right\}$$

$$(1) \quad Z_E' = D_O^\infty(-\pi_p' p_E') - D_Z^\infty(y_E') < 0 \quad (2) \quad Z_A' = D_O^\infty(-\pi_A' p_A') - D_Z^\infty(y_A') < 0$$

$$(3) \quad Z_M' = D_O^\infty(-\pi_p' p_M') > 0 \quad (4) \quad Z_\eta' = D_O^\infty(-\pi_p' p_\eta') > 0$$

$$(5) \quad Z_n' = D_O^\infty(\pi_C' C_n' - \pi_C' C_n' - D_Z^\infty(C_n'') - I_n') = - \left[ D_Z^\infty(C_n'') + I_n' \right] < 0$$

$$(6) \quad Z_{C_n'}' = D_Z^\infty(-1) < 0 \quad (7) \quad Z_I' = D_Z^\infty(-1) < 0$$

$$(8) \quad Z_S' = -D_Z^\infty(y_S') > 0 \quad (9) \quad Z_Y' = D_Z^\infty(-1) < 0$$

$$(10) \quad Z_Z' = e^{-rz} (rK^e + C_n' + Y) > 0$$

$$(11) \quad Z_{K^e}' = D_Z^{z+f} K (rK^e + C_n' + Y) - D_Z^\infty(r + y_K^e) < 0^a$$

<sup>a</sup>See text.

emphasize the negative-valued second term.

It should be noted, however, that the entry barrier terms affect the value of the second bracketed term, as well as the first: entry barriers are arguments of the "y" variable, the annual payment to the entrant. The effect of entry barriers on this latter term, however, is in the opposite direction to their effect on the limit price: when the latter is large, y will tend to be small, in accord with the specifications of y in equation (2.11). On the whole, however, it seems reasonable to assume that the effect of barriers on limit-price profits will outweigh the effect on the entrant's price, so that the sign of the partial derivative of  $Z_{2,1}$  with respect to the economies-of-scale and absolute-cost-advantage barriers is negative overall.

The fifth partial derivative is that of  $Z_{2,1}$  with respect to the number of firms in the original cartel, n. Its sign is negative, which seems to be a reasonable result. One would expect the limit price to be more likely to dominate when n is large, all other things equal, because an expansion of the cartel will involve a large increment to policing costs,  $C'_n$  (since  $C''_n > 0$ ), and large implementation costs (since  $I'_n > 0$  and  $I''_n > 0$ ). In a similar vein, partial derivatives (6) and (7) have negative signs, which means that the cartel-expansion plan is put at a disadvantage the higher the level of policing and implementation costs, respectively, for given values of n. The profitability of the limit-pricing plan, in contrast, is unaffected by any

of these three factors, since this policy does not require a consensus by all the members: if some firms decide to lower price to the limit level and prevent entry, reluctant members must follow suit or lose customers.

The eighth partial derivative has a positive sign: the larger the assets of the cartel relative to those of the entrant (the larger is the variable  $S$ ), the more likely it is that the cartelization plan will be preferred. The reason is that a large value of  $S$  reduces the size of the annual payment to the entrant,  $y$ , all other things equal, which reduces the size of the second bracketed term of the  $Z_{2,1}$  expression. This result is echoed by the next partial derivative, which shows that  $Z_{2,1}$  will tend to be negative, ceteris paribus, the larger the value of these annual payments, given values of its arguments.

The next to the last result shows that  $Z_{2,1}$  will tend to be larger, all other things equal, the longer the entry lag,  $z$  (for a given value of its determinant,  $K^e$ ). When the entry lag is long, the cost elements of the second bracketed term of (3.6") are not incurred until a late date and will be discounted more heavily than if entry occurred earlier. Thus, the negative second term will be smaller and  $Z_{2,1}$  will be more likely to be positive overall. The final parameter,  $K^e$ , will have a more complex effect on the value of  $Z_{2,1}$ . On the one hand, large values of  $K^e$  (the scale of the entrant's facilities) will require a large entry lag, and as we have just seen, this should tend

to favor the cartel-expansion plan. On the other hand, total post-entry interest charges ( $rK^e$ ) and the size of the payments to the entrant,  $y$ , both increase as  $K^e$  gets larger. This will tend to increase the size of the negative second term. On the whole I feel it is reasonable to assume that this latter effect would outweigh the former in most cases, so that on balance the partial derivative of  $Z_{2,1}$  with respect to  $K^e$  is negative.

These results tend to confirm both a priori expectations and the results of previous studies. In particular, the signs of the partial derivatives with respect to entry barriers ( $E$  and  $A$ ), relative market size ( $M$ ), demand elasticity ( $\eta$ ), and the entry lag ( $z$ ) are consistent with the early work of Bain, Modigliani, and Sylos-Labini dealing with limit pricing in a static setting and the more recent work of Gaskins and Baron on dynamic limit pricing over time.<sup>8</sup> Table 3.2 provides a summary of all the above results.

#### Cartel Expansion v. Post-Entry Merger

Let us now examine the determinants of the ranking of the second and third strategies: entry followed in the first case by cartelization and in the second by merger. As before, form the expression  $Z_{2,3}$  such that

$$Z_{2,3} = V_2 - V_3 = D_O^Z(\pi^*) + D_Z^\infty(h_2\pi_2^*) \\ - D_O^Z(\pi^*) + D_Z^\infty(h_3\pi_3^*)$$

TABLE 3.2

SIZE OF PARAMETER VALUES WHICH TEND TO FAVOR LIMIT-PRICING  
AND CARTEL-EXPANSION PLANS, ALL OTHER THINGS EQUAL

| Parameter                        | Favorable Parameter Value |                              |
|----------------------------------|---------------------------|------------------------------|
|                                  | Limit-<br>Pricing<br>Plan | Cartel-<br>Expansion<br>Plan |
| 1. Economies of scale (E)        | High                      | Low                          |
| 2. Cartel cost advantage (A)     | High                      | Low                          |
| 3. Relative market size (M)      | Low                       | High                         |
| 4. Price elasticity ( $\eta$ )   | Low                       | High                         |
| 5. Original cartel size (n)      | High                      | Low                          |
| 6. Police-cost increment $C'_n$  | Low                       | High                         |
| 7. Implementation costs (I)      | High                      | Low                          |
| 8. Cartel/entrant size ratio (S) | Low                       | High                         |
| 9. Entrant profits ( $y$ )       | High                      | Low                          |
| 10. Entry lag (z)                | Low                       | High                         |
| 11. Scale of entry ( $K^e$ )     | High                      | Low                          |

Source: Table 3.1 and text.

$$(3.9) \quad = D_z^\infty(h_2\pi_2^*) - D_z^\infty(h_3\pi_3^*).$$

Since the two plans entail identical profits in the pre-entry period, the ranking of their present values will depend on the profits each plan generates for the members of the original cartel in the period after entry. As was true of the previous binary comparison, the expression for  $Z_{2,3}$  in equation (3.9) can be simplified by breaking the profit-share terms into their constituent parts. Having already dealt with the first term on the right-hand side of (3.9), I need only examine the term for post-entry cartel profits,  $h_3\pi_3^*$ .

As one might expect, the post-entry profit terms under each plan are similar in a number of respects. As under the cartelization plan, a post-entry merger will increase the cartel's fixed production costs by an amount equal to  $rK^e$  per year. In addition, since I assume that the merger does not produce production-related synergistic effects, the cartel's variable cost structure will remain unchanged. Unlike the cartel plan, however, the merger plan will not add to policing costs, since the number of firms in the cartel will be the same before and after the merger. The impact of the merger on the cartel's potential profits will be to raise fixed production costs and leave the profit-maximizing price and output unchanged.

Annual post-merger cartel profits, therefore, will be equal to the following expression:

$$(3.10) \quad \pi_3^* = \pi^* - rK^e.$$

Furthermore, the share of these profits going to the members of the original cartel over the long run--as was true in the cartel-expansion case--will be equal to the present value of the total industry profits after the annual payments to the entrant ( $y$ ) less the total cost of transacting the merger ( $T$ ). That is to say,

$$(3.11) \quad D_z^\infty h_3 \pi_3^* = D_z^\infty (\pi_3^* - y) - T$$

$$(3.11') \quad = D_z^\infty (\pi^* - rK^e - y) - T,$$

by substituting equation (3.10) for  $\pi_3^*$  in (3.11).

Finally, by substituting equations (3.8') and (3.11') for the appropriate post-entry profit terms in (3.9), one gets the resulting expression for  $Z_{2,3}$ :

$$(3.9') \quad Z_{2,3} = \left[ D_z^\infty (\pi^* - rK^e - C_n' - y) - I(n+1) \right] \\ - \left[ D_z^\infty (\pi^* - rK^e - y) - T \right]$$

$$(3.9'') \quad = \left[ T(K^a, K^e, n, \gamma, \delta) \right] - \left[ I(n+1) \right. \\ \left. + D_z^\infty (C_n') \right].$$

The value of  $Z_{2,3}$  is determined, then, by the difference between the two bracketed terms of equation (3.9''). The first is the cost of implementing the merger plan; the second is the sum of the implementation costs of the cartelization plan and the present value of the increment in policing costs under the cartel-expansion plan.

As with the previous binary comparison, I shall analyze the determinants of the ranking of the two strategies by examining the partial derivatives of  $Z_{2,3}$  with respect to the parameters of the variables in equation (3.9"). The results of this differentiation are presented in Table 3.3.

The first four partial derivatives are those of parameters which affect the value of  $Z_{2,3}$  solely by affecting the value of the first bracketed term of equation (3.9"), merger transaction costs (T). The first parameter,  $K^a$ , is the size of the cartel member which merges with the entrant and is used as a proxy for the firm's reserves, ability to get low financing rates and brokerage fees, and capability to handle merger negotiations without severely taxing managerial capacity. All other things equal, the larger the cartel member, the lower is the total cost associated with a given merger. And lower transaction costs, in turn, mean that the first term of (3.9") will be smaller, making it more likely that the second, negative-value term will prevail so that  $Z_{2,3}$  is negative in value. A negative value for  $Z_{2,3}$  means that the merger plan has a higher present value and, therefore, dominates the cartel-expansion plan.

The next two parameters are the probabilities, respectively, of a contested merger bid and of an antitrust action to prevent or dissolve the merger. Both of these factors tend to raise the expected value of merger implementation costs, so the corresponding partial derivatives, (2) and (3), are both positive: the larger the merger transaction

TABLE 3.3  
PARTIAL DERIVATIVES OF  $Z_{2,3}$  WITH RESPECT TO KEY PARAMETERS

| $Z_{2,3} = \left[ T(K^a, K^e, n, \gamma, \delta) \right] - \left[ I(n+1) + D_z^\infty(C_n') \right]$       |                                        |                                     |
|------------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------|
| (1) $Z_K^a = T_K^a < 0$                                                                                    | (2) $Z_\gamma' = T_\gamma' > 0$        | (3) $Z_\delta' = T_\delta' > 0$     |
| (4) $Z_T^a = 1 > 0$                                                                                        | (5) $Z_z' = e^{-rz}(C_n') > 0$         | (6) $Z_{C_n}' = D_z^\infty(-1) < 0$ |
| (7) $Z_I' = (-1) < 0$                                                                                      | (8) $Z_e' = T_K^e + e^{-rz}(C_n') > 0$ |                                     |
| (9) $Z_n' = T_n' - I_n' - D_z^\infty(C_n'') \approx -D_z^\infty(C_n'') < 0$ (since $T_n' \approx I_n'^a$ ) |                                        |                                     |

<sup>a</sup>See text.

costs, the more likely it is that  $Z_{2,3}$  will be positive so that the cartelization plan dominates. This same result is echoed by partial derivate (4), the derivative of  $Z_{2,3}$  with respect to the size of merger implementation costs given the values of all the parameters.

Partial derivatives (5), (6), and (7) of Table 3.3 are with respect to parameters which affect only the second bracketed term of the expression for  $Z_{2,3}$ . The partial derivative with respect to the entry lag,  $z$ , is positive because an increase in this lag, all other things being equal, reduces the present value of the increment in policing costs, which in turn reduces the value of the second bracketed term of equation (3.9"). Thus, the longer the entry lag, the more likely it is that  $Z_{2,3}$  is positive and that, therefore, the cartelization plan ranks higher. The fifth and sixth derivatives in contrast, are negative in value since large levels, respectively, of the policing-cost increment ( $C_n'$ ) and cartelization implementation costs (I), all other things being equal, increase the size of the second bracketed term and make it more likely that  $Z_{2,3}$  is negative in value. High values of these terms favor the merger plan.

The final two partial derivatives involve parameters which affect the size of both bracketed terms of equation  $Z_{2,3}$ . The partial derivative with respect to  $K^e$ , the scale of the entrant's plant, is positive: all other things equal, the larger  $K^e$  is, the more likely it is that the

cartel-expansion plan will dominate the merger plan. The reason is that large values of  $K^e$  will tend to make merger transaction costs larger, all other things equal, to the extent that this increases the value of the transaction and the financing and brokerage costs associated with it. In addition, the entry lag will tend to be larger, the larger the scale of the entrant's facilities, and a longer entry lag reduces the present value of the additional policing costs the cartel would incur under the cartelization plan. Both of these effects, therefore, tend to make  $Z_{2,3}$  positive.

Finally, the partial derivative of  $Z_{2,3}$  with respect to the number of firms in the cartel,  $n$ , is negative--that is to say, large  $n$  values favor the merger plan. Although both merger and cartel transactions costs rise with the size of the membership, in both cases the increase is primarily through the expected-antitrust-cost components: all other things equal, the discovery of collusion becomes more likely the larger the number of firms involved. Thus, the effect on implementation costs should tend to cancel each other out, and the sign of the partial derivative will be determined primarily by the second partial derivative of policing costs with respect to cartel size--which is positive by definition.

As a general matter, the absolute size of the merger transaction costs ( $T$ ) and the size of the original cartel will be the most important determinants of the ranking of the cartel-expansion and post-entry merger plans. If the original cartel is small--a situation which one might

characterize as a "strong" or "tight" oligopoly--policing costs will be low and the community of interest strong and obvious so that the group's profits might well approach those of single-firm monopolist. In such a situation, the addition of another member will not add as much to policing costs--that is,  $C_n'$  will be smaller--as it would if there were more firms, and implementing the plan may involve only minor implementation costs if output adjustments are accomplished through a process of conscious parallelism rather than overt collusion.

In the case of a weak oligopoly, however, the policing and implementation costs of the cartelization plan will be more prominent and make the merger plan relatively more attractive. Needless to say, all of the parameters may play a decisive role in the ranking, especially in cases where the oligopoly is neither obviously weak or strong. If the entry lag is sufficiently small, for example, the present value of even a very small increment in total policing costs may be enough to tip the scale in favor of the merger plan. Table 3.4 provides a summary of the hypothesized impact of high and low values of each parameter on the ranking of the two strategies.

#### Post-Entry Merger v. Entry by Merger

I shall next examine the determinants of the ranking of the two merger plans. As before, I begin by forming the variable  $Z_{3,4}$ :

TABLE 3.4

SIZE OF PARAMETER VALUES WHICH TEND TO FAVOR CARTEL-EXPANSION  
AND POST-ENTRY MERGER PLANS, ALL OTHER THINGS EQUAL

| Parameter                                           | Favorable Parameter Value    |                          |
|-----------------------------------------------------|------------------------------|--------------------------|
|                                                     | Cartel-<br>Expansion<br>Plan | Post-<br>Entry<br>Merger |
| 1. Cartel member size ( $K^a$ )                     | Low                          | High                     |
| 2. Probability of contested merger ( $\gamma$ )     | High                         | Low                      |
| 3. Probability of anti-trust challenge ( $\delta$ ) | High                         | Low                      |
| 4. Merger transaction cost (T)                      | High                         | Low                      |
| 5. Entry lag (z)                                    | High                         | Low                      |
| 6. Police-cost increment ( $C'_n$ )                 | Low                          | High                     |
| 7. Cartelization implementation cost (I)            | Low                          | High                     |
| 8. Scale of entry ( $K^e$ )                         | High                         | Low                      |
| 9. Original cartel size (n)                         | Low                          | High                     |

Source: Table 3.3 and text.

$$\begin{aligned}
 z_{3,4} &= V_3 - V_4 = \left[ D_O^Z \pi^* + D_Z^\infty h_3 \pi_3^* \right] - \left[ D_O^X \pi^* + D_X^\infty h_4 \pi_4^* \right] \\
 (3.12) \quad &= \left[ D_X^Z \pi^* + D_Z^\infty h_3 \pi_3^* \right] - \left[ D_X^\infty h_4 \pi_4^* \right].
 \end{aligned}$$

As was true of previous binary comparisons, this equation can be reduced to other variables. In particular, the second bracketed term of equation (3.12) can be shown to be equal to the following expression by an argument similar to that used to analyze post-entry profits in the first merger plan:

$$(3.13) \quad D_X^\infty h_4 \pi_4^* = D_X^\infty (\pi^* - rK^b - y) - T(K^a, K^b, n, \gamma, \delta).$$

Substituting equations (3.13) and 3.11') for the appropriate post-entry profit terms in (3.12) and rearranging the results, one gets the following expression for  $z_{3,4}$ :

$$\begin{aligned}
 z_{3,4} &= \left[ D_X^Z \pi^* + D_Z^\infty (\pi^* - rK^e - y) - T(K^e) \right] \\
 &\quad - \left[ D_X^\infty (\pi^* - rK^b - y) - T(K^b) \right] \\
 (3.12') \quad &= \left[ D_X^Z (rK^b + y) \right] + \left[ D_Z^\infty (rK^b - rK^e) \right] + \left[ T(K^b) - T(K^e) \right],
 \end{aligned}$$

where  $T(K^b)$  and  $T(K^e)$  are the levels of transaction costs for entry by merger and post-entry merger, respectively. The first bracketed term of equation (3.12') is the present value of the extra capital costs and annual payments to the entrant the cartel incurs before year  $z$  because the agreement goes into effect earlier under the entry-by-merger plan. The second term in brackets is the discounted value of the difference in capital costs under each plan after year  $z$ , and the final term is the difference in the level of transaction costs.

The first of these terms will always be positive, of course, and militate against the entry by merger plan. In contrast, the second term will always be negative, since  $K^b$  is less than  $K^e$ , and this will tend to favor entry by merger. The third term should tend to be negative, since  $T_K' > 0$ , but it could be positive or zero if undertaking different plans affects other transaction cost parameters as well. To the extent, however, that both plans involve the same firms, the same sort of negotiations, and the same magnitude of concessions to the entrant, one might reasonably assume that any differences in cost levels would be small and of relatively little influence in the ranking of the plans in many cases.

Let us assume for the time being that differences in transaction costs are insignificant so that the value of  $Z_{3,4}$  depends entirely on the balance between the present value of the payments and capital costs incurred before year  $z$  under the entry-by-merger plan versus the net savings in capital costs under that plan relative to post-entry merger in the period following year  $z$ . That is to say,

$$(3.14) \quad Z_{3,4} \gtrless 0 \quad \text{as} \quad D_x^z(rK^b + y) \gtrless D_z^\infty(rK^e - rK^b)$$

or, equivalently,

$$(3.14') \quad Z_{3,4} \gtrless 0 \quad \text{as} \quad (D_x^z)/(D_z^\infty) \gtrless (rK^e - rK^b)/(rK^b + y).$$

In this latter form, the value of  $Z_{3,4}$  is seen to depend on the balance of two ratios made up of like terms. The left-hand side is the ratio of the total value of the discount

factor for the interval  $t=x$  to  $t=z$  to its total value for the period after year  $z$ . The right-hand side term is the ratio of annual capital cost differences after year  $z$  to the sum of the entrant's annual profits and annual capital costs under the entry-by-merger plan.

The value of  $Z_{3,4}$ , of course, will depend on the values of the different variables in expression (3.14'), and these variables depend in turn on the values of the parameters of the model. The comparative static effects of changes in these parameters on  $Z_{3,4}$  in equation (3.12') are presented in Table 3.5, and the first five seem to be consistent with a priori expectations. For entry by merger to dominate, the right term of expression (3.14') has to be larger than the left, and this condition is more likely to be fulfilled, ceteris paribus, the smaller the value of the entrant's annual profits,  $y$ , since this term appears in the denominator of the right term. The first four derivatives of Table 3.5 are those of  $Z_{3,4}$  with respect to parameters of  $y$ , and they show that parameter values which tend to make  $y$  small--high entry barriers (large  $E$  and  $Z$ ), a high value for the cartel/entrant relative size ratio (large  $S$ ), and low level for  $y$  given values of the parameters--tend to make  $Z_{3,4}$  negative.

Similarly, expression (3.14') would lead one to expect that the entry-by-merger plan would be more likely to dominate, all other things equal, when the entry lag for this plan,  $x$ , is large (relative, of course, to a given value of  $z$ ): large values of  $x$  reduce the numerator of the left term of that

TABLE 3.5  
PARTIAL DERIVATIVES OF  $Z_{3,4}$  WITH RESPECT TO KEY PARAMETERS

$$Z_{3,4} = \left[ D_x^Z(rK^b + y) \right] + \left[ D_z^\infty(rK^b - rK^e) \right] + \left[ T(K^b) - T(K^e) \right]$$

$$(1) \quad Z_E' = D_x^Z(Y_E') < 0 \quad (2) \quad Z_A' = D_x^Z(Y_A') < 0 \quad (3) \quad Z_S' = D_x^Z(Y_S') < 0$$

$$(4) \quad Z_Y' = D_x^Z(1) > 0 \quad (5) \quad Z_x' = -e^{-rx}(rK^b + y) < 0$$

$$(6) \quad Z_z' = e^{-rz}(y - rK^e) = ?^a \quad (7) \quad Z_K^b' = -D_x^{x+f}K(rK^b + y) + D_x^\infty(r) + T_K' = ?^a$$

$$(8) \quad Z_K^e' = D_z^{z+f}K(y - rK^e) + D_x^Z(Y_K^e) - D_z^\infty(r) - T_K' = ?^a$$

<sup>a</sup>See text.

expression, which makes it more likely that the right term is larger and that  $Z_{3,4}$  is negative. By similar reasoning, one should expect small values of  $z$ , the post-entry-merger entry lag, to favor entry by merger, since smaller values both reduce the numerator and increase the denominator of the left term of expression (3.14').

The fifth partial derivative of Table 3.5 tends to confirm the expectation about the size of  $x$ , since it shows that the values of  $Z_{3,4}$  and that variable move in opposite directions. The value of the partial derivative of  $Z_{3,4}$  with respect to  $z$ , however, is not apparent on inspection since it depends on the size of the payment to the entrant ( $y$ ) and yearly interest charge on excess capacity under the post-entry merger plan ( $rK^e$ ). The reason for this dependence is clear upon examining the expression for  $Z_{3,4}$  in equation (3.12'). If  $y > rK^e$ , an increase in  $z$  at the margin increases the positive first bracketed term by more than it decreases the negative second term, which will tend to increase the likelihood that  $Z_{3,4}$  is greater than zero. Conversely, if  $y < rK^e$  increases in  $z$  lessen the value of the expression as a whole and favor entry by merger.

As a result, one might be tempted to conclude on the basis of partial derivative (6) that when  $rK^e$  is larger than  $y$ , entry by merger is favored by large values of  $z$  since  $\dot{z}_z$  is negative in this case. This interpretation is misleading, however, as an inspection of expression (3.14') shows. When  $rK^e$  is less than  $y$ , the right term of (3.14') will be small in

value and it will take a small value of  $z$  to make the left term smaller still so that  $z_{3,4}$  is negative. In this case, conclusions about the value of  $z$  based on the value of the partial derivative--which is negative--are consistent with expectations. Expression (3.14') makes it clear, however, that entry by merger is more likely to dominate when  $z$  is small, all other things being equal, regardless of the values of  $y$  and  $rK^e$ . If  $rK^e$  is larger than  $y$ , a negative  $z_{3,4}$  is more likely than if the opposite were true and there may be a larger range of values within which  $z$  can vary and still have the right term be larger than the left, but one should not conclude that entry by merger is favored by a large entry lag  $z$  because  $z'_z < 0$  in this situation.

The effect of different values of the final two important variables in (3.14'),  $K^e$  and  $K^b$ , are not obvious from examining either that expression or partial derivatives (7) and (8) in Table 3.5 (indeed, the latter are quite complex). An examination of the right term of (3.14') leads one to expect that entry by merger is favored by low values of the variable  $K^b$ : if all other things are equal, lowering  $K^b$  increases the numerator and decreases the denominator, both of which make the whole right term larger. Lowering the size of  $K^b$ , however, does not leave all other things equal. On the contrary, lowering  $K^b$  also lowers the value of  $x$  (since  $x = f(K^b)$  by prior assumption), which increases the numerator of the left side, making that term larger, too. Similarly, a large value of  $K^e$  makes the numerator of the right term larger but also makes the

left term larger if it makes  $z$  larger since this will increase this term's numerator and decrease its denominator.

In short, the impact of different values of  $K^b$  and  $K^e$  on the value of  $Z_{3,4}$  will depend in great part on the relationship between the values of these variables and the size of the respective entry lags--that is to say, it will depend on the exact shape of the entry-lag function,  $f(K)$ . According to expression (3.14'), dominance by the entry-by-merger plan seems to require large values of  $K^e$  associated with low values of  $z$  on the one hand, and small values of  $K^b$  given  $K^e$  (large  $K^e - K^b$ ) associated with large values of  $x$  given  $z$  (small  $z - x$ ). Both of these requirements are satisfied if the entry-lag function has a concave shape (that is,  $f_K'' < 0$ ) such as  $f_I$  or  $f_{II}$  in Figure 3.1 rather than a convex shape such as  $f_{III}$ . In addition, the first condition states that entry by merger is more likely when the function is  $f_I$  than  $f_{II}$ , since for a given value of  $K^e$ ,  $z_{II} > z_I$ .

With a concave entry function, entry by merger would allow the cartel to keep any increases in industry capacity due to entry low while not pushing forward much the date at which the agreement with the entrant goes into effect relative to the post-entry-merger date ( $K^b$  and  $x$  in Figure 3.1 are examples of such a combination of these values). Even if the entry-by-merger plan does not dominate in the polar case of  $K^b = 0$ --that is, where  $D_O^Z/D_Z^\infty$  is greater than  $rK^e/y$ --there may be some  $K^b > 0$  for which  $Z_{3,4}$  is negative and entry by merger is preferred. If, however, the lag function is convex as in the

case of  $f_{III}$  in Figure 3.1, entry by merger might be profitable only for low values of  $K^b$ --if at all--if  $y$  is sufficiently large.<sup>9</sup>

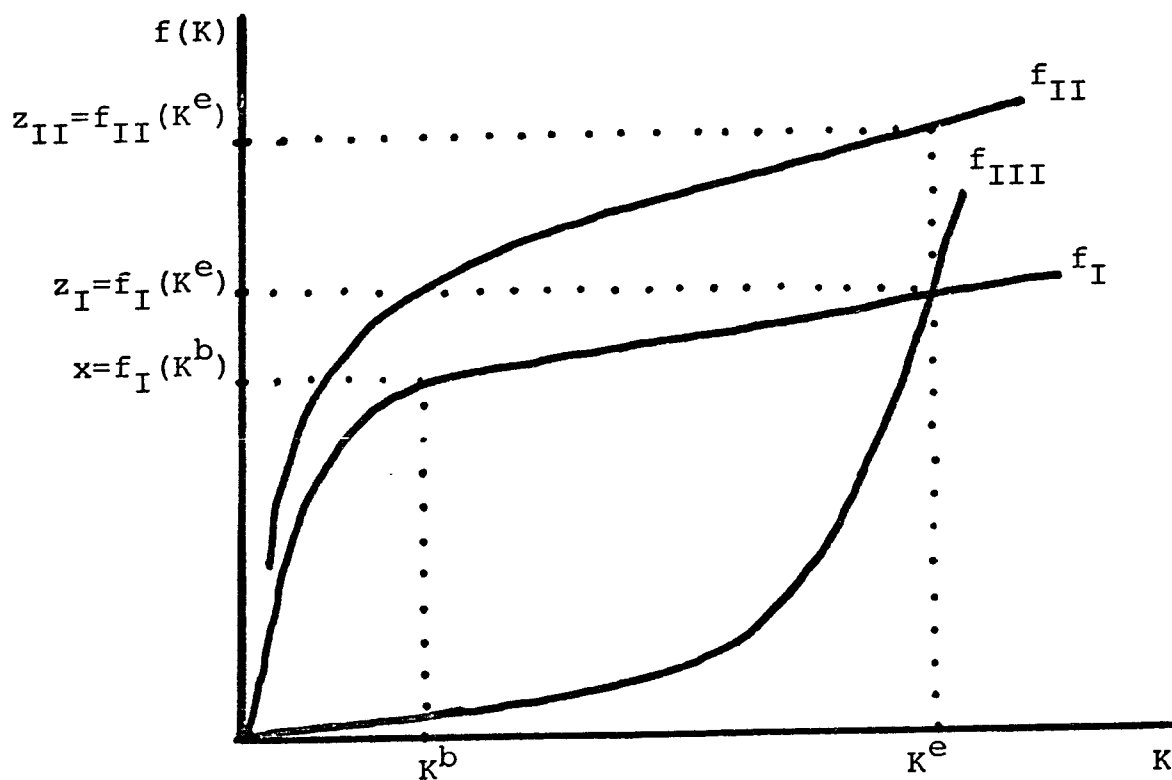


Fig. 3.1.--Possible shapes of the entry-lag function  $f(K)$  and hypothetical values of various related variables.

As a practical matter, the shape of the entry-lag function will be determined by a number of factors besides the scale of entry. It may take time, for example, for the news of profit opportunities to permeate the ranks of potential competitors, and more time still for these firms to investigate the validity of such reports and the possibility of entry before reaching the point where the decision to enter is actually made. Even after the decision is made, there is still a certain amount of planning and preparation which precedes actual construction. These factors will be largely invariant with respect to the scale of entry, and if they form a substantial portion of the lag, the functional relationship between the lag and the scale of entry would tend to have the concave shape. Or they could matter little, in which case the shape would be more convex. In general, the function could have just about any shape, and that for any specific case will most likely be a matter which must be settled empirically rather than by a priori speculation.

Finally, if transaction costs are not approximately equal for each plan, the difference between them could be the deciding factor in the ranking of the two plans. To the extent that  $K^b$  and  $K^e$  are the only parameters which differ, the differences should favor entry by merger by an amount which increases as  $K^b$  decreases in size. To the extent that other parameters vary as well from one case to the next, the difference might favor either plan. If the plans would involve the merging of the entrant with different cartel members under

each plan, all of the parameters save  $n$ , the number of original cartel members, could be different and lead to substantial differences in transaction costs. Moreover, differences could well arise even if the entrant were to merge with the same cartel member in either plan. It might be the case, for example, that the antitrust authorities could be more tolerant of entry by merger than by post-entry merger, which combines firms which are actual competitors. This seems less likely to make a difference today than it would have twenty years ago in this country because of the so-called potential competition doctrine in anti-trust law. A cartel might nonetheless perceive the possibility of a difference which would lead it to expect a difference in treatment and, therefore, evaluate the entry-by-merger transaction costs lower.

In summary, the ranking of the entry-by-merger and post-entry merger plans depends on the level of different variables and the shape of the entry-lag function. All other things being equal, the entry by merger plan is favored by parameter values which lead to small profits for the entrant ( $y$ ), large values of  $K^e$  and  $x$ , small values for  $K^b$  and  $z$ , concavity in the entry-lag function, and small transactions cost relative to that of the other plan. As in previous comparisons, I summarize the hypothesized impact of different parameter values on each plan in Table 3.6.

#### Cartel Expansion v. Entry by Merger

The final comparison I shall examine is that between the

TABLE 3.6

SIZE OF PARAMETER VALUES WHICH TEND TO FAVOR  
POST-ENTRY MERGER AND ENTRY-BY-MERGER  
PLANS, ALL OTHER THINGS BEING EQUAL

| Parameter<br>or<br>Variable             | Favorable Parameter Value |                            |
|-----------------------------------------|---------------------------|----------------------------|
|                                         | Entry by<br>Merger (EBM)  | Post-Entry<br>Merger (PEM) |
| 1. Economies of scale (E)               | Low                       | High                       |
| 2. Cartel cost advantage (A)            | Low                       | High                       |
| 3. Cartel/entrant size ratio (S)        | Low                       | High                       |
| 4. Entrant profits (y)                  | Low                       | High                       |
| 5. EBM entry lag (x)                    | High                      | Low                        |
| 6. PEM entry lag (z)                    | Low                       | High                       |
| 7. EBM entrant scale ( $K^b$ )          | Low                       | High                       |
| 8. PEM entrant scale ( $K^e$ )          | High                      | Low                        |
| 9. EBM transaction cost ( $T(K^b)$ )    | Low                       | High                       |
| 10. PEM transaction cost ( $T(K^e)$ )   | High                      | Low                        |
| 11. Entry-lag function ( $f(K)$ ) shape | Concave                   | Concave                    |

Source: Table 3.5 and text.

cartel-expansion and entry-by-merger plans. Forming the variable  $Z_{2,4}$  as in the other cases, one finds that the ranking of these two strategies depends on the following expression:

$$\begin{aligned} Z_{2,4} &= V_2 - V_4 = D_O^Z \pi^* + D_Z^\infty h_2 \pi_2^* - D_O^X \pi^* + D_X^\infty h_4 \pi_4^* \\ &= D_X^Z \pi^* + D_Z^\infty h_2 \pi_2^* - D_X^\infty h_4 \pi_4^* . \end{aligned}$$

By substituting equation (3.13) for  $D_X^\infty h_4 \pi_4^*$  and (3.8') for  $D_Z^\infty h_2 \pi_2^*$  in the above equation and rearranging the resulting expression, one gets the following form for  $Z_{2,4}$ :

$$\begin{aligned} (3.15') \quad Z_{2,4} &= D_X^Z (rK^b + y) + D_Z^\infty (rK^b - rK^e) + T(K^b) - I \\ &- D_Z^\infty (C_n^') . \end{aligned}$$

Equation (3.15') bears a very strong resemblance to equation (3.12'), the final form of the binary-comparison variable ( $Z_{3,4}$ ) for the case of the two merger plans. These latter equations differ in only two respects. First, cartelization plan implementation costs,  $I$ , replace post-entry-merger transaction costs,  $(T(K^e))$ , in the third bracketed term of equation (3.15'). Second, the equation for  $Z_{2,4}$  includes a fourth term, which is the present value of the increment in policing costs ( $D_Z^\infty C_n^'$ ) under the cartel-expansion plan.

As one might expect, there are strong parallels between the present case and the two immediately preceding it. The comparative static effects of changes the parameters of  $Z_{2,4}$  are reported in Table 3.7, and they are identical to those of

TABLE 3.7  
PARTIAL DERIVATIVES OF  $Z_{2,4}$  WITH RESPECT TO KEY PARAMETERS

|                                                                                            |                                                                           |         |     |                                                |         |
|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------|-----|------------------------------------------------|---------|
| $Z_{2,4} = D_x^z(rK^b + y) + D_z^\infty(rK^b + rK^e) + T(K^b) - I(n+1) - D_z^\infty(C_n')$ |                                                                           |         |     |                                                |         |
| (1)                                                                                        | $Z_E' = D_x^z(Y_E')$                                                      | $< 0$   | (2) | $Z_A' = D_x^z(Y_A')$                           | $< 0$   |
| (4)                                                                                        | $Z_Y' = D_x^z(1)$                                                         | $> 0$   | (5) | $Z_X' = -e^{-rx}(rK^b + y)$                    | $< 0$   |
| (6)                                                                                        | $Z_Z' = e^{-rz}(y - rK^e - C_n')$                                         | $= ?^a$ | (7) | $Z_K^b = -D^{x+f_K}(rK^b + y) + D_x^\infty(r)$ | $= ?^a$ |
| (8)                                                                                        | $Z_{Ke}' = D_z^{z+f_K}(y - rK^e - C_n') + D_x^z(Y_{Ke}') - D_z^\infty(r)$ | $= ?^a$ |     |                                                |         |
| (9)                                                                                        | $Z_n' = - \left[ I_n' + D_z^\infty C_n'' \right]$                         | $< 0$   |     |                                                |         |

<sup>a</sup>See text.

Table 3.5 (the partial derivatives of  $Z_{3,4}$ ) except in two respects. First, the partial derivatives of  $Z_{2,4}$  with respect to  $z$  and  $K^e$  (derivatives (6) and (8), respectively) both contain the incremental policing cost term,  $c_n'$ , and the latter derivative is missing the partial derivative of transaction costs with respect to  $K^e$ ,  $T_K'$ , which appears in Table 3.5. Second, Table 3.7 contains the partial derivative of  $Z_{2,4}$  with respect to  $n$ , the number of original cartel members, which is negative in value.

The parallels also carry over in the values of parameters and variables which determined the ranking of plans in the two previous binary comparisons. As was true in the comparison of the cartelization and post-entry merger plans, entry by merger is more likely to dominate cartel expansion when merger transaction costs are small relative to the implementation costs of cartelization and when the number of firms in the original cartel is large. And as was true of the ranking of the merger strategies, entry by merger is favored by large values of  $K^e$  and small values of  $z$ , and small values of  $K^b$  relative to  $K^e$  and large values of  $x$  given the value of  $z$ . The hypothesized impact of different values of parameters and variables for the specific case of cartel expansion and entry by merger is summarized in Table 3.8.

### 3.3 Synthesis

The results of the binary comparisons of the previous section provide a basis for discussing the conditions under

TABLE 3.8

SIZE OF PARAMETER VALUES WHICH TEND TO FAVOR  
CARTEL-EXPANSION AND ENTRY-BY-MERGER PLANS,  
ALL OTHER THINGS BEING EQUAL

| Parameter<br>or<br>Variable             | Favorable Parameter Value |                           |
|-----------------------------------------|---------------------------|---------------------------|
|                                         | Entry by<br>Merger (EBM)  | Cartel-<br>Expansion (CE) |
| 1. Economies of scale (E)               | Low                       | High                      |
| 2. Cartel cost advantage (A)            | Low                       | High                      |
| 3. Cartel/entrant<br>size (S)           | Low                       | High                      |
| 4. Entrant profits (y)                  | Low                       | High                      |
| 5. EBM entry lag (x)                    | High                      | Low                       |
| 6. CE entry lag (z)                     | Low                       | High                      |
| 7. EBM entrant scale ( $K^b$ )          | Low                       | High                      |
| 8. CE entrant scale ( $K^e$ )           | High                      | Low                       |
| 9. EBM transaction cost<br>( $T(K^b)$ ) | Low                       | High                      |
| 10. CE transaction cost (I)             | High                      | Low                       |
| 11. Size of cartel (n)                  | High                      | Low                       |

Source: Table 3.7 and text.

which each of the four strategies is likely to dominate when all are considered together. Table 3.9 is an attempt to synthesize the results of the preceding discussion into a single guide as to the magnitude of individual parameters of the model which are likely to favor each of the plans. This table is less than perfect in a number of respects. To begin with, it is based ultimately on the results for binary comparisons, and in some cases parameter values have different impacts on the ranking of some plans in the context of different binary comparisons. For example, the cartel-expansion plan is favored by a low value of  $y$ , the entrant's profits, with respect to the limit-pricing plan according to Table 3.2, but Table 3.8 shows that a low level of  $y$  tends to disfavor this same plan with respect to the entry by merger plan. In such cases, the favorable magnitude is designated "medium" to reflect these opposing tendencies. In addition, the table leaves much to be desired, inasmuch as it gives only rough approximations of parameter values and is most useful in determining extreme cases where each plan is likely to dominate taking all the parameter values into consideration.

These considerations notwithstanding, Table 3.9 does give some hint of the conditions under which each plan might dominate, and on the whole, the picture it presents is fairly consistent with a priori expectations. The first four results, for example, show that the limit-pricing plan tends to dominate under a different set of values of the determinants of the limit price (see equation (2.9) above) than is

TABLE 3.9

RELATIVE MAGNITUDES OF PARAMETER VALUES WHICH TEND TO FAVOR EACH STRATEGY, ALL OTHER THINGS BEING EQUAL<sup>a</sup>

| Parameter                                | Favorable Parameter Value |                       |                       |                   |
|------------------------------------------|---------------------------|-----------------------|-----------------------|-------------------|
|                                          | LP Plan                   | CE Plan               | PEM Plan              | EBM Plan          |
| 1. Economies of scale (E)                | H                         | L                     | L                     | L                 |
| 2. Cartel cost advantage (A)             | H                         | L                     | L                     | L                 |
| 3. Relative market size (M)              | L                         | H                     | H                     | H                 |
| 4. Price elasticity ( $\eta$ )           | L                         | H                     | H                     | H                 |
| 5. Original cartel size (n)              | H                         | L                     | H                     | H                 |
| 6. Police-cost increment ( $C'_n$ )      | H                         | L                     | H                     | H                 |
| 7. CE transaction cost (I)               | H                         | L                     | H                     | H                 |
| 8. Cartel/entrant size (S)               | L                         | H                     | H                     | M                 |
| 9. Entrant profits (y)                   | H                         | M                     | M                     | L                 |
| 10. <u>De novo</u> entry lag (z)         | L                         | H                     | H                     | L                 |
| 11. <u>De novo</u> entry scale ( $K^e$ ) | H                         | L                     | L                     | H                 |
| 12. EBM entry lag (x)                    | $\frac{L-M^b}{M-H^C}$     | $\frac{L-M^b}{M-H^C}$ | $\frac{L-M^b}{M-H^C}$ | $\frac{H^b}{L^C}$ |
| 13. PEM transaction cost ( $T(K^e)$ )    | H                         | H                     | L                     | H                 |

Table 3.9.--Continued

| Parameter                                   | Favorable Parameter Value |         |          |          |
|---------------------------------------------|---------------------------|---------|----------|----------|
|                                             | LP Plan                   | CE Plan | PEM Plan | EBM Plan |
| 14. EBM transaction cost ( $T(K^b)$ )       | H                         | H       | H        | L        |
| 15. Contest probability ( $\gamma$ )        | H                         | H       | L        | L        |
| 16. Antitrust suit probability ( $\delta$ ) | H                         | H       | L        | L        |
| 17. Cartel member size ( $K^a$ )            | L                         | L       | H        | H        |
| 18. EBM entry scale ( $K^b$ )               | H                         | H       | H        | L        |

<sup>a</sup>Key: LP = Limit Pricing  
CE = Cartel Expansion  
PEM = Post-Entry Merger  
EBM = Entry by Merger  
H = High  
M = Medium  
L = Low

<sup>b</sup>Entry-lag function concave.

<sup>c</sup>Entry-lag function convex.

Source: Tables 3.2, 3.4, 3.6, 3.8 and text, Section 3.2.

true of the other plans, which seems to be a reasonable prediction. One should expect that the closer the limit price comes to the short-run profit-maximizing price, the more likely it is that an entry-preventing strategy will maximize the cartel's profits over the long run.

Results (5), (6), and (7), on the other hand, demonstrate the sensitivity of the cartel-expansion plan to the size of the original cartel. The larger the initial membership, the less likely it is that this plan will dominate the others because of the problems of policing and coordination, which become even more difficult at the margin by an increase in the cartel size. Similarly, results (13) through (17) show the importance of the size of merger transaction costs on the tradeoff between the merger and non-merger plans.

Rather than describe the relative effects of each parameter size on each plan, however, I shall concentrate instead on the general circumstances under which the two merger plans might provide the cartel with the optimal long-run reaction to the potential entrant. As was pointed out above, the merger strategies will be most likely to prove useful when the limit price is relatively low. That is to say, one should not expect them to be utilized when, in Bain's terms, entry is blockaded. They might prove of use, however, in cases where entry is considered to be just effectively impeded; if merger transaction costs are low, allowing an entrant to enter by merging with an established firm could possibly increase the cartel's profits over those the limit-price strategy would yield. Mergers would probably have their greatest

potential in the case of ineffectively impeded entry, where the limit-pricing plan is presumably not optimal in any event. In this case--where allowing firms to enter is optimal--mergers will be most competitive with the cartel-expansion plan when there are already many firms in the cartel. And their competitive edge will be greater, all other things equal, the lower the level of merger transaction costs relative to those of the expansion plan.

Finally, the tradeoff between the desirability of each of the merger plans with respect to the other will depend in large part on the shape of the entry-lag function and the other factors described in detail in the third part of the previous section. These factors might be of great importance when the merger plans in general generate present values of the same magnitude as those of the other plans. Depending on the values of the parameters which determine the merger plan tradeoffs, it might well be the case that their ranking relative to the other plans differ greatly: the two need not yield similar long-run profits in all situations.

### 3.4 Summary

In this chapter, I have employed a rather restrictive model of an oligopolistic industry to analyze the conditions under which established firms might find it optimal to employ mergers to neutralize the threat of large-scale entry by a single potential competitor. Firms were hypothesized to have but four possible courses of action: (1) setting price

at the limit level to deter entry; (2) admitting the entrant and enlarging the cartel; (3) admitting entry and arranging a merger between the new firm and an established cartel member; and (4) arranging for the firm to enter by merging with an established firm. Binary comparisons of four combinations of the long-run profit streams generated by each plan yielded a fairly clear picture of the conditions under which each plan might dominate the others, and these predictions seemed to be consistent with common-sense expectations.

On the whole, the results of this model do seem to suggest that there are situations in which the existence of merger alternatives may increase the long-run profits of established firms over what they would otherwise have earned by employing other responses to potential entrants. To the extent that these results are valid, models of entry prevention which ignore merger options may overstate the usefulness of the limit-pricing strategy and the impact of potential competition as a regulator of economic activity. If mergers may be used to neutralize the effects of potential and actual entry, then the latter are less effective than one might predict on the basis of entry-response models which ignore these options.

In the next chapter, I shall extend the model to include the case of more than one potential entrant and examine the sensitivity of the results derived in this chapter on some of the assumptions which were employed.

### Footnotes

<sup>1</sup>This case is certainly the focus of most of the theoretical work of Bain, Barriers, Ch. 1; Modigliani, "New Developments,"; Sylos-Labini, Oligopoly; and Kamien and Schwartz, "Limit Pricing."

<sup>2</sup>In other words, it need not be that case that facilities of scale  $\frac{1}{2}K^e$  can be constructed in half the time it takes for scale  $K^e$ .

<sup>3</sup>I rule out the possibility that the entrant is more efficient than established firms since this eliminates the limit-pricing strategy as a viable course of action.

<sup>4</sup>It should also be noted that some absolute cost advantages which affect variable and marginal cost--such as patent royalties tied to output levels could well be eliminated by the cartel after entry has occurred.

<sup>5</sup>The amount would be equal to  $C'_p -- C(p^*, n) - C(p^*, n) --$  which might be either positive or negative<sup>2</sup> depending on whether or not  $p^*_2$  is greater or less than  $p^*$ , respectively, for a given value<sup>2</sup> of  $n$ .

<sup>6</sup>That is, the cartel would earn a normal rate of return, which is treated as a cost of production.

<sup>7</sup>Strictly speaking,  $z_{2,1}$  could still be negative if it were the case that  $D'_0(\pi^*) < [D'_z(rK^e + C'_n + y) + I(n+1)]$ . If so, the limit-pricing strategy would dominate since the cartel would prefer no profits--that is, a competitive rate of return--to a negative present value. It seems unlikely, however, that this condition would exist for the case of a single potential entrant unless  $\pi^*$  were very small,  $K^e$ ,  $C'_n$ ,  $y$ , and  $I$  very large (say, because of a large initial value<sup>n</sup> of  $n$ ). Even so, these factors might be counteracted still if  $z$  were also large and the other values correspondingly discounted heavily by being so distant.

<sup>8</sup>Bain, Barriers, Ch. 1 and "Conditions"; Modigliani, "New Developments"; Sylos-Labini, Oligopoly; Gaskins, "Dynamic Limit Pricing"; and Baron, "Limit Pricing."

<sup>9</sup>These considerations aid speculation about the impact of different values of  $K^e$  and  $K^b$  on the ranking of the two plans, but are less helpful in determining what the probable signs of the partial derivatives of  $z_{3,4}$  with respect to each will be in any given circumstance. The signs of derivatives (7) and (8) in Table 3.5 depend on the values of both different variables and, in some cases, their partial derivatives, and the terms in each expression work in opposite directions. One might well be able to find combinations of values which

make the signs either positive or negative for a given ranking of the plans. Since the values of these terms are not crucial to our main argument, I shall not speculate further on them.

## CHAPTER IV

### EXTENSIONS AND SENSITIVITY ANALYSIS

In this chapter, I shall examine the sensitivity of the results of the basic model to some of the assumptions employed in the initial formulation and also extend the model to include the case of potential entry by more than a single firm. I begin by examining the effect of growing demand on the profitability of the different courses of action open to the cartel and the difference this change makes on the ranking of these plans relative to the case where the industry demand curve is assumed to be stationary. Because of its length and complexity, this discussion occupies the entire first section. In the second section, I turn to other assumptions of the basic model which appear at face value to be overly restrictive and potentially capable of vitiating the initial results.

Finally, in the last section, I extend the model to include the possibility of entry by more than one potential competitor. In particular, I focus on two specifications for the general condition-of-entry function: the case where there are many firms capable of entering on a large scale but not necessarily at the same level of minimum average costs, and that where there are many small-scale potential entrants which can compete at the same average cost level.

#### 4.1 Growing Demand

In this section, I examine the effect on the results of the previous chapter of relaxing the assumption that the industry demand curve is stationary over time. Specifically, I shall modify the basic model to include the possibility of growing demand and then examine whether or not this new factor is likely to affect the ranking of the strategies compared to the case where demand is stable.<sup>1</sup> I shall only consider the situation where the cartel faces a single, large-scale potential entrant, but the results can easily be extended to the case of multiple entrants.

##### Modifications and Additional Assumptions

One might make a number of assumptions about the way the industry demand curve shifts out over time. I shall assume that growing demand takes the form of a continuing outward shift of the demand curve parallel to its initial position.<sup>2</sup> Specifically, I assume that industry demand at any point in time,  $q(t)$ , is determined by the following expression:

$$(4.1) \quad q(t) = D(p(t)) + e^{gt} q_0 \quad (t > 0)$$

where  $D(p(t))$  is the initial demand curve;  $g$  is some positive constant growth rate less than the discount rate,  $r$ ;  $q_0$  is the output which would be demanded in the initial period ( $t = 0$ ) if price were set at the level of

long-run average costs,  $p_0$ ; and  $e^{gt}q_0 = 0$  for  $t = 0$ .

For the most part, modifying the basic model is a relatively simple matter since there are only a few elements of it which would be effected by growing demand. I shall begin by modifying the cartel profit function. The cartel's profits at any time,  $t, \pi(t)$ , was assumed in Chapter II to be determined by the following implicit function:

$$(2.1) \quad \pi(t) = \pi(R, F, V, C, t)$$

where the arguments of the function are the annual levels of revenue, fixed costs, variable costs, and policing costs, respectively.

Equation (2.1) can be modified to include increasing demand by substituting expression (4.1) for the original output term in each of the arguments of the profit function. Annual revenue  $R(t)$ , for example, becomes

$$(4.2) \quad R(t) = p(t)q(t) = p(t) \left[ D(p(t)) + e^{gt}q_0 \right],$$

or in implicit form, simply

$$(4.3) \quad R(t) = R(p, g, t).$$

Similarly, annual variable costs,  $V(t)$ , becomes

$$(4.4) \quad V(t) = \bar{v} q(t) = \bar{v} \left[ D(p(t)) + e^{gt}q_0 \right]$$

$$(4.4') \quad = V(D, g, t).$$

The term for policing costs,  $C(t)$ , however, is unchanged by growing demand directly since it assumed to be a function only of the price level ( $p$ ), number of cartel members ( $n$ ), and time ( $t$ ): that is,

$$(4.5) \quad C(t) = C(p, n, t)$$

as before.

As in the case of policing costs, the term for annual fixed costs,  $F(t)$ , does not include the level of output as an argument and will not be directly influenced by growing demand. If demand is growing over time, however, the cartel may find it desirable to increase its capital stock at some point in time. In Chapter II, I assumed that the cartel's initial capital stock,  $K^C$ , was such that the cartel minimized average total costs at  $q_0$ , the output which would be demanded if price were set at  $p_0$ , the level equal to long-run average costs. To the extent that each plan required price to be set at some higher level, the cartel would operate at less than full capacity in the static demand case. In addition, the plans which included the construction of facilities by an entering firm would increase excess capacity even more.

If demand is growing over time, however, the amount of unutilized capacity will decline over time as output expands, and at some point the cartel's facilities will be operating at full capacity. At this point, the cartel must add new facilities or face rising average costs as

its existing plant and equipment are pushed to the limit. The effect of such an expansion on the cartel's profits over the long run will depend on a number of factors, such as the cartel's ability to build new facilities, the scale of new plants, and the date at which they commence operation. These factors will be determined, in turn, by the nature of the industry technology and the timing of the cartel's investment.

For convenience, I shall assume initially that the cartel can expand its facilities either by modifying existing plants or adding new ones at the same rate at which demand is growing so that after its initial excess capacity has been eliminated, the cartel will always be producing at minimum average total costs.<sup>3</sup> Specifically, I assume that there is a relationship between the cartel's output at any time,  $q(t)$ , and the capital stock,  $K(t)$ , needed to produce it at minimum average total costs such that

$$(4.6) \quad \hat{K}(t)/q(t) = \theta$$

where  $\theta$  is some positive constant.<sup>4</sup> When the cartel produces the competitive level of output,  $q_0$ , for example, the cost-minimizing capital stock is  $K^C$ , as assumed earlier. In general, when industry demand is growing and the initial facilities are fully utilized, the capital stock of the cartel at any future date,  $K(t)$ , will be equal to the following:

$$(4.7) \quad K(t) = \hat{K}(t) = \theta q(t) = \theta \left[ D(p(t) + e^{gt} q_0) \right].$$

In addition to allowing one to determine the optimal cartel capital stock after full capacity has been reached, expression (4.6) also allows one to develop an expression for the extent to which capacity is underutilized before this time. As I noted before, if the cartel sets price higher than  $p_0$  (the level of long-run average costs) initially, it will have some unused capacity until some point in time--say, year "b"--when expanding output catches up to original capacity. I shall define the amount of excess or unused capacity,  $K^u(t)$ , for any year before  $b$  to be the difference between the initial cartel capital stock,  $K^C$ , and that stock of capital  $\hat{K}(t)$ , which would allow the cartel to produce its output in that year ( $q(t)$ ) at minimum average total cost. That is to say,

$$(4.8) \quad K^u(t) = K^C - \hat{K}(t) \quad (t < b).$$

By definition,  $K^u(t) = 0$  when  $t = b$ .

The amount of unutilized capacity at any point in time and the date at which full capacity is reached, will vary among the plans open to the cartel. To begin with, the amount of initial excess capacity will depend on the extent to which price is raised above  $p_0$  in the base year ( $t = 0$ ). Except in the case where entry is blockaded, the limit price ( $p_L$ ) will be less than the first period short-run profit-maximizing price ( $p^*(0)$ ) and

the limit-pricing plan will involve a smaller amount of excess capacity in each year than the other three plans. As a result, the cartel will reach full capacity earlier under this plan. In addition, entry may occur before the cartel reaches full capacity under the other three plans, and this will push the date back farther still to the extent that entry leads to the construction of new capacity. Since entry by merger always results in the construction of less capacity than the other entry-inducing plans, the cartel will reach full capacity sooner under this plan than cartel expansion or post-entry merger.

Without a loss of generality, I shall assume that entry does occur before full capacity is reached under the entry-inducing plans. In addition, I assume that the full-capacity date,  $b$ , is uniquely determined for each plan by the following function:

$$(4.9) \quad b = d(p, g, K^j); \quad d'_p > 0, \quad d'_g < 0, \quad d'_{K^j} > 0,$$

where  $K^j$  is the amount of extra capacity added by entry under the  $j$ th plan. Finally, I shall designate the dates for each plan as follows:  $\hat{t}$  for the limit-pricing plan,  $\hat{z}$  for cartel-expansion and post-entry merger, and  $x$  for entry by merger. By definition,  $\hat{t} < x < \hat{z}$ . For the purpose of comparing the present values generated by each plan, I shall make the additional simplifying assumption that  $\hat{t} = z$ , where  $z$  is the date at which entry occurs in the cartelization and post-entry merger plans.<sup>5</sup>

Finally, these different factors can be brought together to form the final expression for annual cartel profits,  $\pi(t)$ , when demand is growing:

$$(4.10) \quad \pi(t) = p(t) D(p(t)) + e^{gt} q_0 - rK(t) - \bar{v}q(t) - C(n,p,t) - rK^u(t)$$

or more simply,

$$(4.10') \quad \pi(t) = (p,r,K,n,g,t) - rK^u(t).$$

As in previous chapters, I shall use the superscripts "\*" and "L" to designate profit levels associated with the short-run profit-maximizing and limit prices, respectively.

Before examining the present values each strategy will generate when demand is growing, it is necessary to examine one other term which will be effected by growing demand: the cartel's payment to the entrant each year,  $y$ . When demand was assumed to be stable, it was reasonable to assume that  $y$  would be a constant amount each year. But if demand is growing, one must assume that the entrant's total annual profits will also grow over time. I shall assume, however, that the entrant's share of profits is constant at some fixed proportion,  $\phi$ , such that:

$$(4.11) \quad y(g,t) = \phi\pi(t).$$

Since it was assumed earlier that the mechanism for shar-

ing profits among members was fixed output shares, this assumption seems quite reasonable.

### Effects on Strategy Rankings

It is now possible to examine the effect of growing demand on the ranking of the four strategies open to the cartel. I begin by presenting the present values that each plan will generate when demand is growing.

#### Strategy 1--limit pricing:

$$(4.12) \quad V1 = D_O^Z \left[ \pi^L(t) - rK^u(t) \right] + D_Z^\infty \pi^L(t)$$

$$(4.12') \quad = D_O^\infty \pi^L(t) - D_O^Z r(K^C - \theta q^L(t));$$

#### Strategy 2--cartel expansion:

$$(4.13) \quad V2 = D_O^Z \left[ \pi^*(t) - rK^u(t) \right] + D_Z^{\hat{Z}} \left[ \pi^*(t) - rK^u(t) - c_n' - y(g, t) \right] + D_Z^{\hat{Z}} \left[ \pi^*(t) - c_n' - y(g, t, ) \right] - I(n+1)$$

$$(4.13') \quad = D_O^\infty \left[ \pi^*(t) \right] - D_Z^\infty \left[ c_n' + \theta \pi^*(t) \right] - D_O^Z \left[ r(K^C - \theta q^*(t)) \right] - D_Z^{\hat{Z}} \left[ r(K^C + K^e - \theta q^*(t)) \right] - I(n+1);$$

Strategy 3--post-entry merger:

$$\begin{aligned}
(4.14) \quad V3 &= D_O^Z \left[ \pi^*(t) - rK^u(t) \right] + D_Z^{\hat{Z}} \left[ \pi^*(t) - rK^u(t) \right. \\
&\quad \left. - y(g, t) \right] \\
&\quad + D_Z^{\infty} \left[ \pi^*(t) - y(g, t) \right] - T(K^e) \\
(4.14') &= D_O^{\infty} \left[ \pi^*(t) \right] - D_Z^{\infty} \left[ \emptyset \pi^*(t) \right] - D_O^Z \left[ r(K^C - \theta q^*(t)) \right] \\
&\quad - D_Z^{\hat{Z}} \left[ r(K^C + K^e - eq^*(t)) \right] - T(K^e);
\end{aligned}$$

Strategy 4--entry by merger:

$$\begin{aligned}
(4.15) \quad V4 &= D_O^X \left[ \pi^*(t) - rK^u(t) \right] + D_X^{\hat{X}} \left[ \pi^*(t) \right. \\
&\quad \left. - rK^u(t) - y(g, t) \right] \\
&\quad + D_X^{\infty} \left[ \pi^*(t) - y(g, t) \right] - T(K^b) \\
(4.15') &= D_O^{\infty} \left[ \pi^*(t) \right] - D_X^{\infty} \left[ \emptyset \pi^*(t) \right] - D_O^X \left[ r(K^C \right. \\
&\quad \left. - \theta q^*(t)) \right] \\
&\quad - D_X^{\hat{X}} \left[ r(K^C + K^b - eq^*(t)) \right] - T(K^b);
\end{aligned}$$

where the only new terms are  $q^*(t)$  and  $q^L(t)$ , which are the annual output levels when price is at the current short-run profit-maximizing price and the limit price, respectively.

I shall now proceed with the binary comparisons of these present values using the " $Z_{j,k}$ " variables employed in Chapter III. Having formed these variables, the effect of growing demand on the strategy rankings can be examined by taking their partial derivatives with respect to the growth parameter,  $g$ .

Limit-pricing v. cartel-expansion.--As in Chapter III, I shall begin with the comparison of the limit-pricing and cartel-expansion plans. The difference between the present values each plan generates,  $Z_{2,1}$ , is equal to the following expression:

$$\begin{aligned}
 (4.16) \quad Z_{2,1} &= V_2 - V_1 = \left[ D_O^\infty \pi^*(t) - D_Z^\infty (\emptyset \pi^* + C_n') \right. \\
 &\quad - D_O^Z r(K^C - \theta q^*(t)) \\
 &\quad \left. - D_Z^{\hat{Z}} r(K^C + K^E - \theta q^*(t)) - ((n+1)) \right] \\
 &\quad - \left[ D_O^\infty \pi^L(t) - D_O^Z r(K^C - \theta q^L(t)) \right] \\
 (4.16') &= \left[ D_O^\infty (\pi^*(t) - \pi^L(t)) \right] - \left[ D_Z^\infty \emptyset \pi^*(t) \right] \\
 &\quad - \left[ D_O^Z r(D(p_L) - D(p^*)) \right] \\
 &\quad - \left[ D_Z^{\hat{Z}} r(K^C + K^E - \theta D(p^*) - \theta e^{gt} q_0) \right] \\
 &\quad - D_Z^\infty (C_n') - I(n+1)
 \end{aligned}$$

Taking the partial derivative of (4.16') with respect to  $g$ , the growth rate, one gets the following equation:

$$\begin{aligned}
(4.17) \quad z'_g = & D_O^\infty \left[ (\pi^*)^L_g - (\pi^L)^L_g \right] - D_Z^\infty \left[ \emptyset(\pi^*)^L_g \right] \\
& + \left[ D_{Z+d}^{\hat{Z}} \frac{1}{g} r(K^C + K^E - \theta q^*(t)) \right. \\
& \left. + D_Z^{\hat{Z}} (r\theta g e^{gt} q_O) \right] > 0.
\end{aligned}$$

This partial derivative is made up of three bracket terms, which I shall examine one at a time. The first is the present value of the difference between the impact of a change in demand on short-run maximum and limit-pricing profits, and I will argue that it is positive in value.

To demonstrate this, it is useful to evaluate the partial derivatives of each profit term with respect to a change in demand. Annual profits under the limit-pricing plan,  $\pi^L(t)$ , are equal to the following.

$$(4.18) \quad \pi^L(t) = p_L q^L(t) - r\theta q^L(t) - \bar{v} q^L(t) - C(p_L, n, t)$$

where  $q^L(t) = D(p_L) + e^{gt} q_O$ . Differentiating this expression with respect to the growth rate,  $g$ , one finds that

$$(4.19) \quad (\pi^L)'_g = g e^{gt} q_O (p_L - r\theta - \bar{v}).$$

The profits the cartel will earn in year  $t$  by charging the short-run profit-maximizing price,  $\pi^*(t)$ , are equal to

$$(4.20) \quad \pi^*(t) = p^*(t) q^*(t) - r\theta q^*(t) - \bar{v} q^*(t) - C(p^*, n, t)$$

where  $q^*(t) = D(p^*(t)) + e^{gt} q_0$ .

Differentiating this equation with respect to  $g$ , one gets a more complex expression than in the case of limit-price profits:

$$(4.21) \quad (\pi^*)'_g = (D'_p(p^*))'_g + g e^{gt} q_0 (p^* - r\theta - \bar{v}) \\ + (p^*)'_g q^*(t) - C'_p(p^*)'_g.$$

Although  $D'_p$  is negative in value, one should expect the first bracketed term of this expression to be positive, especially if  $q_0$  is large initially. Indeed, since  $p^* > p_L$  except in the case of blockaded entry, this first term could be larger than all of equation (4.19), especially in later years, since  $p^*(t)$  will always increase in size relative to  $p_L$ . The second term is definitely positive, and it may be quite large if output ( $q^*$ ) is sufficiently large.

These two terms together could be large enough to make expression (4.21) larger than (4.19), unless the third bracketed term is very large. One can make a reasonable argument, however, that this will not be the case when demand is growing. A key element to the size of this term is the partial derivative of policing costs with respect to price,  $C'_n$ . When demand is stable, one might well expect policing costs to rise at least at the same rate as the level of price, perhaps even faster: the higher price is, the larger the price-marginal cost gap and the incen-

tive to cheat. When demand is growing, however, firms will be less concerned about cheating--as a source of gain for either their competitors or themselves--since they will have enough to do keeping up with demand and capacity. While the need for policing costs may not disappear, growing demand could lead to a reduction in the incentive associated with a given level of price so that overall, policing costs make up a smaller percentage of profits than would be true if demand were stable.

On the balance, then, I would argue that the first bracketed term of equation (4.17) is positive. The third term is also positive. This term is the total effect of an increase in the growth rate on the fixed capital costs associated with the larger excess capacity under the cartel-expansion plan. The faster demand grows over time, the more rapidly this unused capacity is eliminated, and becomes a smaller burden on the profits from the cartelization plan.

The sign of the entire derivative will hinge on the size of the second term, which is negative in value and represents the impact of a change in the growth rate on the entrant's share of profits. There are compelling reasons for believing that this term will be smaller than the other two. To begin with, the effect of the term is diminished by the fact that

its present value is calculated from the date of entry,  $z$ . To the extent that the entry lag is long, the impact from this source will be heavily discounted. In addition, some of the factors which determine the size of  $\emptyset$  are also determinants of  $\pi^L$  but work in opposing directions. If, for example, the cartel has only a small cost advantage, the entrant's profit share will tend to be larger, all other things equal, which will tend to reduce the value of  $Z_g'$  by making  $\emptyset$  and the second bracketed term of (4.17) larger (more negative). At the same time, however, a small cost advantage will reduce the height of the limit price, and, therefore, the value of  $(\pi^L)'_g$  in the first term.

On balance, then, I would conclude that the partial derivative of  $Z_{2,1}'$  with respect to the rate of demand growth,  $g$ , is positive, so that an increase in this rate tends to favor the cartelization plan over the limit-pricing plan. It is always possible, of course, that the values of the parameters investigated above are such that this is not the case. In the case where a cartel is faced by only a single entrant, however, it seems intuitively that in most situations it would be preferable to expand the cartel membership in order to be able to take advantage of the even increasing prices and profits resulting from growing demand.

Cartel-expansion v. post-entry merger.--The case of cartelization and the post-entry merger plans is a great deal less complicated than the previous case. As before, let us form  $z_{2,3}$  such that

$$\begin{aligned}
 (4.22) \quad z_{2,3} = v_2 - v_3 = & \left\{ D_0^\infty \pi^*(t) - D_Z^\infty \left[ C_n' + \emptyset \pi^*(t) \right] \right. \\
 & - D_O^Z \left[ r(K^C + K^E - \emptyset q^*(t)) \right] \\
 & - D_Z^{\hat{Z}} \left[ r(K^C + K^E - \emptyset q^*(t)) - I(n+1) \right] - \left\{ D_0^\infty \pi^*(t) \right. \\
 & - D_Z^\infty \left[ \emptyset \pi^*(t) \right] \\
 & - D_O^Z \left[ r(K^C - \emptyset q^*(t)) \right] - D_Z^{\hat{Z}} \left[ r(K^C + K^E - \emptyset q^*(t)) \right] \\
 & \left. - T(K^E) \right\} \\
 (4.22') \quad = & \left[ T(K^E) \right] - \left[ I(n+1) + D_Z^\infty C_n' \right]
 \end{aligned}$$

Taking the partial derivative of  $z_{2,3}$  with respect to  $g$ , one finds that

$$(4.23) \quad z_g' = 0,$$

which is to say that the ranking of the cartel-expansion and post-entry merger plans relative to one another is unaffected by the rate of growth of demand. As a result, the analysis of the determinants of that ranking is unaffected by one's assumptions about demand conditions.

Post-entry merger v. entry by merger.--I shall next examine the effect of increasing demand on the ranking of the two merger plans relative to one another. The difference between the present value they generate,  $Z_{3,4}$ , is equal to the following expression:

$$\begin{aligned}
 (4.24) \quad Z_{3,4} &= V_3 - V_4 - \left\{ D_O^\infty \left[ \pi^*(t) \right] - D_Z^\infty \left[ \emptyset \pi^*(t) \right] \right. \\
 &\quad - D_O^Z \left[ r(K^C - \theta q^*(t)) \right] \\
 &\quad - \left. D_Z^{\hat{Z}} \left[ r(K^C + K^E - \theta q^*(t)) \right] - T(K^E) \right\} \\
 &\quad - \left\{ D_O^\infty \left[ \pi^*(t) \right] \right. \\
 &\quad - D_X^\infty \left[ \emptyset \pi^*(t) \right] - D_O^X \left[ r(K^C - \theta q^*(t)) \right] \\
 &\quad - \left. D_X^{\hat{X}} \left[ r(K^C + K^b - \theta q^*(t)) \right] - T(K^b) \right\} \\
 (4.24') \quad &= D_X^Z \left[ \emptyset \pi^*(t) + rK^b \right] + D_Z^{\hat{X}} \left[ r(K^b - K^E) \right] \\
 &\quad - D_X^{\hat{Z}} \left[ r(K^C + K^E - \theta q^*(t)) \right] + T(K^b) - T(K^E)
 \end{aligned}$$

Taking the partial derivative of this expression with respect to  $g$ , one gets the following expression:

$$(4.25) \quad z'_g = D_x^z \phi(\pi^*)'_g - D_{x+d}^{\hat{x}}'_g (rK^b - rK^e) \\ + D_{x+d}^{\hat{z}+d}_g'_g r(K^c + K^e - \theta g^*(t)) > 0$$

The first term is the effect of a change in demand on the entrant's profits ( $\phi\pi^*$ ) in the period after the entry-by-merger plan goes into effect but before the post-entry merger plan does. Since a rise in demand will increase the entrant's share, this first term is positive and tends to favor the post-entry merger plan. The second and third terms are the effects of changes in the rate of demand on the higher fixed capital costs under the post-entry merger plan which are related to the higher excess capacity associated with this plan. The value of the second term is negative, that of the third is positive. Since the second term is subtracted from the others, however, both tend to increase the value of  $z'_g$ . This latter effect is consistent with a priori expectations: the faster the growth in demand, all other things equal, the more quickly excess capacity is eliminated and the smaller the post-entry merger plan's disadvantage relative to entry by merger.

On the whole, then, growing demand will tend to favor post-entry merger relative to entry by merger: were the two of equal benefit to the cartel when demand is stationary, post-entry merger would dominate if demand were to start growing.

Cartel expansion v. entry by merger.--The final case I shall consider is that of cartelization and entry by merger. As before, I form the variable  $z_{2,4}$  as follows:

$$(4.26) \quad z_{2,4} = D_x^z \left[ \phi\pi^*(t) + rK^b \right] + D_z^{\hat{x}} \left[ r(K^b - K^e) \right] \\ - D_x^{\hat{z}} \left[ r(K^c + K^e - \theta q^*(t)) \right] \\ + T(K^b) - I(n+1) - D_z^\infty(C_n').$$

Taking the partial derivative, one gets the following expression

$$(4.27) \quad z_g' D_x^z \phi(\pi^*)'_g - D_{\hat{x}+d_g}^{\hat{x}} (rK^b - rK^e) + D_{\hat{x}+d_g}^{\hat{z}+d_g'} r(K^c \\ + K^e - \theta q^*(t)) > 0$$

which is identical to the derivative in the case of the ranking of entry by merger and post-entry merger. One might well have anticipated such a result, given the lack of an effect of demand growth on the cartelization-post-entry merger ranking.

### Summary

Where the cartel is faced by a single potential entrant, the effect of growing demand on the ranking of the strategies open to it seems to be as follows. To begin with, growing demand makes it less likely that the cartel will adopt the limit-pricing plan, all other things equal. The other plans allow the cartel to take advantage of expanding output and rising price over time, and even where

the limit-pricing plan clearly dominates the others when demand is static, this advantage may be eliminated if demand were to grow rapidly over time.

Similarly, growing demand will tend to eliminate any advantage entry by merger might have over the cartelization and post-entry merger plans, all other things equal. This does so by reducing the significance on the profit streams of the larger amounts of initial excess capacity that these latter plans involve when demand is static. Growing demand does not, however, affect the relative ranking of the cartel-expansion and post-entry merger plans as they are specified in this model.

Moreover, these conclusions do not seem to be sensitive to assumptions one makes about the way in which firms grow over time. I assumed initially that internal expansion by firms was a relatively simple matter, that existing facilities could be modified or new plants added to achieve any desired firm size while maintaining the same minimum average-total-cost level and without incurring costs in addition to the costs of the new facilities (that is, without incurring costs associated with growth per se). Alternative assumptions about the malleability of existing plants and economies of scale in new ones can be made, but it is not clear that they would appreciably alter the conclusions presented above. All the strategies would be affected in much the same way by these assumptions--with the exception of the timing of investment--and it seems

doubtful that they would do much except make the analysis even more complex.

Relaxing the assumption that internal growth is costless would actually strengthen the conclusion that growing demand put the limit-pricing plan at a relative disadvantage. In general, one would expect growth--whether by internal expansion or merger--to involve extra costs of several possible kinds--such as the extra drain of planning on managerial resources and disruption of existing operations--and that these costs would be higher, the faster the rate of expansion of the firm. The basic model already takes some growth costs into account for the case of expansion by merger, but not expansion by internal growth. This fact tends to overstate the present value of the cartel's profits under all of the plans, but the limit-pricing plan more than the others since growth in this case begins at an earlier date ( $t = \hat{t}$  as opposed to  $t = \hat{x}$  for entry by merger and  $t = \hat{z}$  for cartel expansion and post-entry merger). Under the assumption that demand growth takes the form of parallel shifts of the demand curve, all of the plans would have the cartel grow at the same rate over the long-run so that these costs would cancel each other out in ranking the plans for the period after  $t = \hat{z}$ .<sup>6</sup> Until that time, however, the limit-pricing plan would involve growth costs the other plans do not, and this would tend to make it relatively less profitable, all other things equal.

Finally, one should expect the results of the single-entrant case to hold for cases where the cartel faces more than one potential entrant. All other things equal, the cartel should find it profitable to allow more entry than it would when demand is static, regardless of whether the entrants are large or small-scale firms. In addition, the entry-by-merger plan will be less advantaged relative to the other plans allowing entry to the extent that its advantage arises from the greater amounts of excess capacity which characterizes the cartel-expansion and post-entry merger plans.

#### 4.2 Other Assumptions

In this section, I shall briefly examine two other assumptions of the basic model to see whether or not they affect the results derived up to this point. First, I shall relax the assumption that the cartel always wins contested mergers and see what effect the possibility of an abortive takeover attempt has on the ranking of the merger strategies. The results of this discussion can also be applied with minor modifications to the effect of the possibility of a successful merger-bid challenge by anti-trust authorities on the ranking of the merger plans. Second, I address the question of the effect of relaxing the restrictive assumptions about capital durability and the lack of alternative uses for existing facilities on the cartel's optimal course of action.

Contested merger bids.--The basic model of Chapter II recognized the possibility that merger bids by the cartel might be contested by either the owners or managers of an entering firm, but I assumed at that point that the only effect of such contests was to raise the level of the transactions costs incurred by the cartel member making the bid. It is unrealistic, however, to assume that the cartel would always be successful in winning such contests. Indeed, in a study of 145 contested tender offers between 1960 and 1969, Binder found that only 46 of them--somewhat less than one-third--were successful.<sup>7</sup> Of course, these cases represented only a small proportion of the total number of mergers consummated during that period of time, but it does appear to be true that once a contest is initiated, there is a significant chance that a merger bid will fail.

Both the possibility of a contest and a failure of the bid, therefore, must be taken into account by the cartel in evaluating its optimal course of action. If the merger attempt should fail, the cartel would have to resort to one of the other strategies allowing entry. In the case of pre-entry merger (that is, trying to get the potential competitor to enter by merging with an existing firm), the cartel would be able to try another bid later, after entry has taken place, as well as cartelization. If a post-entry merger bid fails, however, only the cartelization plan is left. When to the cartel, then, the

possibility of a merger-bid failure will not affect the ranking of the strategies. If they are less profitable than another option which would be ruled out by undertaking a merger bid, however, the cartel would be faced with a dilemma.

Suppose, for example, that the strategies ranked in descending order as follows: post-entry merger, limit-pricing, entry by merger, and cartel expansion. Suppose further that the present values of the first three plans were fairly close to one another, whereas the cartelization plan was far down the list. In this circumstance, the ranking of the plans could change if the original ordering did not take into account the possibility of a merger-bid failure. If there were a high probability that the post-entry merger attempt would fail, the expected value of adopting this strategy could be smaller than that of either the limit-pricing or entry-by-merger plans: whereas the cartel could get the long-run profits of the limit-pricing plan with certainty, there might be only a slight chance of getting the larger profits of the merger plan and a very great probability of getting the smaller profits of the cartel-expansion plan. In sort, where there is a possibility of a merger bid failing, the cartel must calculate the expected value of the merger strategies before making the irreversible decision to allow entry to take place.<sup>8</sup>

Capital stock assumptions.--In this paragraph, I wish

to examine briefly the effect of relaxing the assumption of the basic model that once capital is invested in the cartel's industry, the resulting facilities and equipment are indestructible with no alternative uses. The analysis of this case is relatively simple, since relaxing the assumption has much the same effect as assuming that demand is growing: the cartelization and post-entry merger plans have a smaller disadvantage relative to entry by merger, and all three relative to the limit-pricing plan, because the cartel can withdraw excess investment over time. If plants wear out and need to be replaced or if they can be scrapped or converted to other uses, the cartel will no longer be stuck with permanent excess capacity--and in one case, the possibility of permanent losses--if demand is not growing. Although there will still be some adjustment period over which excess capacity will entail higher fixed costs, they will be limited. As a result, there will be a narrowing of the advantage the limit-pricing plan might have, all other things equal.

#### 4.3 Extension to Many Potential Entrants

##### Threat of Large-Scale Entry

In principle, the preceding framework can be extended to include cases where the cartel faces more than one

large-scale potential entrant, but doing so introduces a number of complexities missing from the single-entrant case. To begin with, the evaluation of the determinants of the cartel's optimal course of action becomes a cumbersome process since the number of plans--combinations of decisions with respect to each entrant--increases rapidly as the number of potential entrants increases. If the cartel may adopt any of the four plans with respect to each of  $m$  potential competitors, it will have to evaluate  $4^m$  courses of action or plans to determine which yields the highest present value.<sup>9</sup> Just increasing the number of entrants from one to three increases the number of plans from four to sixty-four!

In addition, the case of multiple potential entrants raises the possibility of various interactions between the cartel's decisions with respect to different entrants. One example is the case where one or more firms share a common firm-specific limit price: the cartel's decision whether or not to admit one such firm will not be independent of the decision to admit the others. Another example is where negotiations over the concessions the cartel must grant a particular entrant are influenced by the concessions it has or is planning to grant some other entrant. The experience of one set of negotiations could affect the expectations of other entrants in ways that are either beneficial or harmful for the cartel, but in either case taking these feedback effects into account will com-

plicate matters for the cartel. Similarly, if entry lags vary among potential competitors, the cartel must deal with additional dynamic complications missing from the single entrant case.

Nevertheless, there are some situations in which the cartel's determination of its optimal course of action will be a relatively simple matter. The most obvious case, of course, is that in which the firm-specific limit price of every entrant lies above the price at which the cartel equates its marginal revenue and marginal cost. In this case, entry is blockaded and the limit-pricing plan dominates all other combinations of plans the cartel might undertake with respect to each entrant.

Another simple case would be that of the threat of simultaneous entry by a finite number of potential entrants which were identical in every respect except the price which induced them to enter and which could be isolated from one another if the need arose to insure that negotiations with one firm did not affect that with any other. Under these conditions, the general condition-of-entry function would be a step function, with the height of each step representing the difference between the firm-specific limit prices of successively disfavored entrants, and the cartel's decision with each potential competitor would be independent of that arrived at for the others. As a result, the cartel could employ a simple sequential rule to maximize its long-run profits.

This decision rule can be characterized as a search by the cartel for both the optimal response to individual potential entrants and the optimal price over the long run. The first step of the algorithm requires the cartel to calculate the present values of the four courses of action with respect to the most-favored potential entrant using the firm-specific limit price of the second most-favored firm in the profit calculations. Doing so yields four present values, and as in the case of a single potential entrant, the cartel should adopt that plan which yields the largest present value. If the limit-pricing plan dominates, then it is the optimal course of action with respect to all potential entrants.

If, however, one of the three entry-inducing plans should dominate, the cartel must repeat this process for the second most-favored firm, this time employing the firm-specific limit price of the third most-favored firm to calculate profit levels. Again, the cartel need examine no more possibilities if the limit-pricing plan dominates the others with respect to the second firm. If not, the process should be repeated *seriatim* for the other potential entrants until either the limit-pricing plan dominates or there are no other potential entrants.

Since at each step the cartel makes an optimal response to each potential entrant, this algorithm will produce the same overall course of action for the cartel that it would choose were it to calculate the present values of

each of the  $4^m$  possible combinations of plans and choose the one with the greatest value.<sup>10</sup> It seems likely, however, that the decision rule described above would offer substantial savings to the cartel in terms of both time and complexity.

The success of this algorithm, however, hinges on at least two conditions. First, the potential entrants must be essentially identical (the same size, for example) except for their differing cost disadvantages. Second, the cartel's decision with respect to each firm must be independent of the others. The importance of the first condition can be illustrated with the following example. Suppose that the cartel were faced with two potential entrants of different sizes, with the more-favored firm being larger. Furthermore, assume that the algorithm would lead the cartel to add the first, large firm to the cartel membership to take advantage of a low increment in policing cost but that a large jump in the latter costs at the margin--combined with the large increase in redundant capacity from admitting the first entrant--would lead it to adopt the entry-by-merger plan with respect to the second, smaller entrant.

Were the cartel to examine other courses of action with respect to these two firms, however, it might find that the above sequence was not in fact the most profitable one. Since marginal policing costs are a function of the number of firms in the cartel and not their size,

the cartel would not care which of the two firms it admitted to the group as far as this factor alone is concerned. By admitting the smaller firm, however, the cartel would have less redundant capacity and a smaller increase in annual fixed costs. Assuming that the cost to the cartel of merging with either of the two potential entrants is approximately the same, the cartel might find it more profitable to adopt the combination of decisions with respect to the two firms which is just the reverse of that suggested by the algorithm. In such cases, the algorithm might miss possible sources of profits for the cartel arising from the order in which entrants are accommodated.

The second condition concerns the possibility that the decision the cartel makes with respect to one entrant might influence its decision with respect to some of the others. If entrants do not enter simultaneously but have different entry lags, for example, it might be difficult for the cartel to keep its concessions with early entrants from influencing the expectations of future entrants. An early reputation for making lucrative settlements or undertaking mergers at set intervals could come back to haunt the cartel in future negotiations, just as a reputation for hard bargaining might help it. If entry tended to occur at intervals, however, and the intervals were sufficiently far apart, these intertemporal interactions might be kept at a minimum. The simplest such case would be that of a succession of infrequent entry threats by single potential entrants.<sup>11</sup>

In addition to the above factors, the choice of the optimal course of action may be complicated by yet another problem. Up to this point I have assumed that both the number and scale of potential entrants remained constant over the long run, regardless of the actions of the cartel. It may be the case, however, that the strategy chosen by the cartel has a feedback effect on these factors to the detriment of the cartel. Essentially, I have assumed that the general condition-of-entry function reflects the intentions of firms for which entry into the cartel's industry at some level of market price is their most profitable course of action. There will probably be other firms capable of entering at the same price level in the cartel's market but which would not actually do so because they had more profitable opportunities elsewhere. Thus, the entry function represents potential entrants in a more limited sense: those with no larger opportunity cost.

For the entry function to remain stable over time, however, it must be true that the perceptions of the profitability of entry by potential entrants in the broader sense remain unchanged over time. If these expectations are based on the returns the firms expect to earn by entering and competing with the cartel members--the sequence discussed in Section 2.2 of Chapter II which determines the minimum price the entrant would accept for cooperating with the cartel's plans--there may be an in-

crease in the number of entrants over time of the cartel adopts any plan except the limit-pricing strategy. If the other strategies involve the payment of some premium in excess of the minimum profits entrants expect to earn, some firms which were not "active" potential entrants may find that this premium makes entry into the cartel's industry relatively more attractive than their previously best alternative.

The price the cartel pays for the cooperation of entrants, therefore, may cause the entry function to shift outward over time: in addition to the firms originally attracted by what one might term business motives, the cartel will also face the possibility of entry by firms attracted as well by the premiums it may be offering to the initial entrants. One should expect this shift to be greater, all other things equal, the larger the premiums. In addition, the shift might be relatively larger in the case of the merger strategies, since merger negotiations are overt transactions that often receive publicity in the news media. The problem, however, is the establishment in the minds of firms the expectation of extra gains, and this is possible with any of the three entry-inducing plans. As a result, the cartel could find it necessary to abandon its use of these plans or employ them only at infrequent intervals to avoid shifts in the entry function.

These examples demonstrate the nature of some of the complexities introduced by extending the basic model to

include the possibility of entry by many large-scale firms. The determinants of the optimal course of action for the cartel will be a function not only of the original parameters but also by the specific form of the entry function and the nature of interactions between decisions concerning different firms in the same or different time periods. I shall not attempt, however, to evaluate these determinants for specific cases. Although doing so would have its benefits in terms of greater reality and applicability for the model in various special circumstances, the task would be formidable and require greater time and space than is appropriate at this point. My primary concern has been to suggest how such an extension might be made and some of the difficulties which would be involved.

These complications, however, do not vitiate the fundamental conclusion of the basic model that mergers will, in some circumstances, allow the cartel to earn higher profits than otherwise would have been possible.

#### Threat of Small-Scale Entry

Up to this point I have dealt explicitly only with entry threats from potential competitors capable of entering on a large scale and having a significant impact on the level of market price by dint of their size. The primary reason for this emphasis is that large-scale entry threats have been the main focus of the limit-pricing literature. Some studies, however, have dealt

either wholly or in part with entry threats from potential competitors which could enter on a scale too small to have their individual output decisions noticeably affect the level of market price.<sup>12</sup>

The final form of the entry function I wish to consider, therefore, is one which incorporates the possibility of small-scale entry. In particular, I wish to consider a variant of the case of so-called "easy" entry where the industry is characterized by constant long-run average total costs and by an absence of any cost advantages for established firms over entrants. I wish to examine this form for the entry function because in the limit-pricing literature this condition is recognized as presenting established firms with the dimmest long-run profit prospects. These prospects would be even less bright in an environment such as that created by the restrictive assumptions of my basic model, and it seems appropriate to determine what role, if any, mergers might plan in such an extreme case.

In addition to the assumptions about long-run average cost and the absence of any cost advantage for cartel members, I shall make the following assumptions about the specific form of the entry function. To begin with, I assume that the cartel faces a large number of potential competitors, each of which is capable of entering only at the same small scale,  $K^e$ , which is an insignificant percentage of initial industry capacity.<sup>13</sup> Not all of these

firms, however, enter at the same time if price is raised above the level of long-run average costs: I assume that after some initial lag, new competitors enter at some constant rate of  $w$  firms per year as long as price is kept above the limit level.

It is instructive to begin, I feel, by examining the cartel's profit prospects in the absence of any merger possibilities. Doing so gives one a feeling for the dynamics of this case and the nature of the optimization problem facing the cartel. One becomes quickly convinced that the cartel's prospects are dim indeed in contrast to the large-scale, single-entrant case. Consider, for example, the limit-pricing option: this plan would yield the cartel only a competitive rate of return (that is to say, a present value of zero) since the limit price is equal to long-run average total costs.

It may be the case, however, that the cartel can do no better by choosing instead to restrict output and maximize short-run profits. If--as I assumed in Chapter II-- it is infeasible to expand the cartel to include such entrants, raising price above the level of long-run average costs would invite a flood of entry which would erode the cartel's control over demand over the long run. The entry would cause the cartel's demand curve to shift to the left, and as more entry occurred, the level of market price and the cartel's profits would fall as more and more of the market comes to be supplied by the fringe group of small

entrants.<sup>14</sup> If the cartel were to try to stop this erosion, however, by allowing price to fall back to the limit level, it would cease to earn any profits at all: since (by prior assumption) capital is indestructible and has no alternative uses, the expansion of industry capacity would impose losses on all firms.

To raise price above the level of long-run average costs, then, is to invite a continuing stream of entry as long as price remains above that level and permanent losses once price returns to the competitive level--as it must do eventually if demand is not growing. These considerations notwithstanding, it is possible that the present value of these profits and losses is positive overall--depending on the rate of entry ( $w$ ), entry lag, and so on--so that this plan dominates limit pricing. Even so, the cartel members must pay a price in the sense that they must liquidate their dominant position over time. In the case of dominance by either plan, the easy entry conditions insure that monopoly power will be at most a passing problem for society.<sup>15</sup>

The primary concern of the present study, of course, is the potential value of the merger alternatives to the cartel under the conditions of easy entry. I shall not attempt, however, to isolate the determinants of the cartel's optimal course of action: doing so presents the same sort of difficulties as the solution in the case of many large-scale entrants. Once again, I shall use the

excuse of inadequate time and space to avoid an explicit determination since this would require a rather extensive reconstruction of the basic model. While valuable in its own right, such a task is inappropriate in the present context.

I do feel it is possible, however, to discuss some of the factors which will determine the general usefulness of mergers to the cartel by referring to the results of the previous chapter. I shall begin by assuming that the simple output-restriction plan--the easy entry equivalent of the cartel-expansion plan of the large-scale entry case--dominates the limit-pricing plan so that the cartel can realize a positive present value by raising price, allowing entry, and thus liquidating its market share over time. The question that needs to be answered, then, is whether or not the cartel can do better still by engaging in mergers with entrants and/or potential competitors. Let us begin by examining whether or not mergers offer the cartel any potential benefits.

#### Benefits of mergers

Undertaking mergers may present the cartel with a possible source of profits because of their effect on the level of market price and, thus, the cartel's revenues. By merging with entrants rather than competing with them, the cartel can affect the rate at which its control over demand declines over time, a possibility not open to it under the simple output-restriction plan since collusion

with so many entrants is assumed to be out of the question. By merging with an entrant, the cartel reduces by one the number of firms that form the fringe group of entrants. As a result, its control over demand is greater than would otherwise have been the case both in the period in which the merger is consummated and for every period thereafter. The larger the number of mergers, the smaller the decline in the cartel's control over demand and the longer price can be maintained at high levels.

In the limiting case, the cartel's demand curve and, therefore, its revenue potential, would remain unchanged if it were to merge with every firm that entered. If the entry of new firms did not affect the cartel's marginal cost structure, price would remain at the same level while entry took place. (I do not mean to suggest, of course, that the cartel would actually find it optimal to merge with every firm that entered, only to demonstrate the nature of the potential benefits involved.) Extending the cartel's control over demand and raising its long-run revenues above the level they would otherwise be is a necessary condition for mergers to lead to higher profits for the cartel. But these factors alone are not sufficient to insure that mergers will increase profits: so far I have examined only the potential benefits to the cartel of undertaking mergers. The profitability of doing so will also depend on the costs the cartel must incur.

Cost of mergers

The profitability of undertaking mergers will be influenced by three basic types of costs: increments in the cartel's fixed capital costs which result from mergers with existing firms; the transaction costs of actually undertaking the mergers; and the share of any increase in revenues which the cartel must share with entrants to induce them to merge with cartel members. Let us examine each of these factors.

Fixed capital costs.--If the cartel undertakes post-entry mergers, it will increase its capital stock as well as its control over demand. Assuming as in Chapter II that the mergers do not affect the cartel's marginal cost curve, the cartel's revenues will not be affected by those firms it merges with but it will not have the same level of profits associated with this level of revenue because of its higher fixed costs. As in the case of the entry threat by a single firm, the cartel can avoid this problem by encouraging entrants to enter by merging with established firms without adding any new capacity. Whether or not this would be more profitable than post-entry merger can be examined by referring to condition (3.14) and (3.14') of the previous chapter.

These conditions demonstrated that entry by merger would be preferable to post-entry merger if the present value of the extra annual profits ( $y$ ) the cartel must share with the entrant under the former plan because of

of its earlier starting date is less than the present value of the annual fixed capital costs ( $rK^e$ ) added by the new capacity built under the latter plan. That is to say, entry by merger is preferred if

$$(4.1) \quad D_a^b(y) < D_b^\infty(rK^e), \text{ or, equivalently, if}$$

$$(4.1') \quad (D_a^b)/(D_b^\infty) < (rK^e)/(y)$$

where  $a$  is the date the agreement starts under entry by merger,  $b$  the (later) date at which the entrant's plant would go into operation if it entered de novo, and the entrant is assumed to construct no new capacity if it enters by merging.<sup>16</sup>

In the case of large-scale entry,  $a$  and  $b$  may be sufficiently removed from one another so that  $D_a^b$  is large and consequently (4.1') is not fulfilled for given values of  $y$ ,  $r$ , and  $K^e$ . In the case of small-scale entry, however, the entry lag ( $b - a$ ) is likely to be very small. If so,  $D_a^b$  will also be small and entry by merger may dominate post-entry merger, especially in the period near the initial year when  $b$  is near and  $D_b^\infty$  at its largest values. Even if there are potential savings from the entry by merger plan, however, there are practical difficulties involved in implementing it. With so many entrants of such a small size, it may be very difficult if not virtually impossible for the cartel to discover who they are and contact them in time to prevent a large number from entering de novo. In addition, a concerted

program of searching out entrants could backfire if it led these firms to demand a larger share of profits for their cooperation. I shall examine the possibility of feedback effects of this sort in greater detail below.

Merger transaction costs.--As in the case of large-scale entry, merger transaction costs should be an important determinant of the profitability of employing these options. In the case of small-scale entry, however, this element may be even more important. All mergers have certain common features which do not vary much with the size of the merger: all require a certain amount of negotiations and contact between the merging parties, all must be registered with the SEC and in some cases state authorities, and there is a certain amount of managerial effort which must go into the planning and coordinating of each merger. To the extent that these activities involve a fixed element, the costs associated with them will also be invariant of the size of the merging firms and the transaction costs involved in small-scale mergers will constitute a larger percentage of the expected benefits. In some cases, transaction costs could be high enough to absorb enough of these benefits so that undertaking individual mergers with each entrant is infeasible.

It may be possible, however, for the cartel to realize some savings in transaction costs by promoting large mergers involving many entrants simultaneously, such as the combinations which characterized the first merger wave and

created firms such as U.S. Steel. The larger these combinations must be, however, the more likely it is that they will be attacked by antitrust authorities, and the cost of litigating such mergers if they were challenged might more than compensate for any savings from other sources. In addition, the more firms there are in any proposed combination, the more likely it is that a contest might arise which would not only raise total transaction costs but perhaps even endanger the entire enterprise were it to lead other interested parties to have second thoughts as well.

Finally, even if the cartel were able to undertake mergers on an individual basis with entering firms, it might still encounter antitrust problems if authorities became worried that there were far too many mergers being undertaken by the cartel and that they must be impeding the socially beneficial effects of entry. This would most certainly have happened in the antitrust climate of the past two decades, but it is unclear that it would have presented a problem to firms in the years before the passage of the Celler-Kefauver Act. In any event, if antitrust action does loom on the horizon, merger transaction costs could rise for the cartel and make further merging unprofitable.

Entrants' profits.--The final "cost" element I wish to examine is the sum of the payments the cartel must make to the entrants with which it merges. Were the car-

tel to approach but a single entrant and offer to merge with it, one would expect it to be able to do so at a modest price, perhaps only slightly more than the book value of the entrant ( $K^e$ ). Since entrants are so small, it is reasonable to assume that they have few opportunities to realize more than a competitive rate of return on their investments, and even though they are attached to the cartel's market by high initial prices and profits, they may not expect to do much better than a normal rate of return in the long run. Although a firm might be tempted to try to get as high a price as possible, it would undoubtedly be restrained by the fear that the cartel would turn instead to one of the other entrants. If the entrant viewed the offer as a once-and-for-all-time offer, it would probably accept on the belief that some gain is preferable to none.

Assuming that transaction costs and prospective increases in fixed costs (in the case of post-entry merger) were low relative to the benefits from mergers, the cartel might still not profit from merger activity if entrants demands for profits are too high. Initially, the cartel might be able to acquire entrants at low prices. There are at least two reasons, however, why any attempts at an extensive merger program might drive up acquisition prices and reduce the effectiveness of mergers as a source of further profit for the cartel.

First, while the cartel may be able to isolate the

first group of entrants and keep secret its intentions to engage in as many mergers as possible, these intentions will become clear over time as the cartel continues to engage in merger activity. As a result, individual firms may become less likely to view an offer as a once-in-a-lifetime proposition and this may make them more willing to risk asking a higher price, especially if they feel that there is a good chance that they can always sell out for some price which is better than the profits they could make if they did not merge at all.

In addition, this willingness to hold out will be reinforced by the fact that as the cartel undertakes mergers, its control over demand will be greater than would otherwise have been the case and both existing and potential entrants will find market price at higher levels than they anticipated. This fact will most likely lead them to adjust upward their expectations of the profits they can make by remaining independent and, therefore, the price they should ask of the cartel. The more extensive the cartel's current merger activity, the more likely it is that entrants may expect this to continue into the future and have high expectations of the profits they will make if they remain independent. Obviously, these expectations will not be fulfilled if they are widely held and cause prices to rise above the point where it is profitable for the cartel to undertake mergers. At this point, merger activity will cease until

entrant's expectations adjust to this new development.

Finally, the whole situation could be made even more complex if the cartel's merger activity were to cause an outward shift of the entry function so that there were even more firms threatening entry at every point in time. Since entry conditions are so easy, such shifts would be a likely consequence of an active merger policy.

In short, merging may present a fairly complex problem for both cartel members and entrants. The cartel must take care to take into account the possibility of feedback effects of its merger activity on the demands of current and future merger prospects or it may not get maximum benefit from merging. Similarly, entrants have to balance possible gains and lost opportunities and decide both when to merge and how much to ask in return. It is difficult to say what the exact optimal cartel strategy would look like without recasting the model in dynamic terms, but it does seem safe to conclude that the cartel might find it profitable at best to merge with only a portion of the firms which face it as entrants and potential competitors.

On the whole, the above discussion seems to indicate that the cartel will probably be even more constrained in its use of mergers in the case of small-scale, easy entry than that of large-scale entry. Many factors, especially the greater number of possible entrants due to the ease of entry, seem likely to increase the costs relative to the

benefits. This case may be one where the cartel may find it relatively more lucrative to rely on other alternatives I have explicitly eschewed--predatory pricing, investments in entry barriers such as advertising, product differentiation, and so on. This is not to say, however, that mergers will not provide opportunities for the cartel to raise its profits above what they would otherwise have been without this option. A too active merger policy would be self-defeating, but used judiciously, mergers might provide the cartel with larger long-run profits. And the possibilities are greatly improved if one relaxes the assumption that all the potential entrants are essentially identical: if some are larger and/or more aggressive than others, mergers with these firms might well provide the means of eliminating the most troublesome firms and buy extra time to develop alternative strategies.

#### 4.4 Summary

In this chapter, I have demonstrated ways in which the basic model of the second chapter can be extended to include the case of more than one potential entrant and growing demand and have examined a number of crucial assumptions. Although these things have modified the initial results in a variety of ways, they have by no means vitiated the main result that mergers might, under certain circumstances, offer existing firms faced with the threat of entry higher profits over the long run than they might have earned if the merger alternatives were not available.

In the next chapter, I shall try to see the extent to which this conclusion is justified by existing research on both mergers and limit-pricing behavior.

### Footnotes

<sup>1</sup>I do not consider the case of declining demand explicitly.

<sup>2</sup>A specification which is widely employed in limit-pricing models is the assumption that the demand curve shifts outward at every point at an exponential rate such as in the following example:  $q(t) = e^{gt}D(p(t))$ . This specification has the disadvantage that the price intercept of the initial demand curve stays the same over time so that the demand curve becomes increasingly horizontal. The specification I employ, however, assumes that demand grows at the same rate at every level of price, whereas one might expect there to be proportionately greater growth at lower price levels. Incorporating the best aspects of both forms would make the analysis more complicated, and I doubt whether it matters much in terms of the basic results which specification one chooses. As a result, I have chosen the one I feel is most convenient.

<sup>3</sup>This statement implicitly assumes that there are no additional costs involved in the process of growth per se. At this end of this section, I relax this assumption, and I also examine the effect of making alternative assumptions about industry technology and the ease with which the cartel can expand its facilities.

<sup>4</sup>This assumption is consistent with a number of linearly homogeneous production functions which might characterize cartel production techniques: a Leontieff fixed-factor function with only one method and either a Cobb-Douglas or CES function in the presence of fixed factor prices.

<sup>5</sup>As a general matter,  $\hat{t}$  might be either earlier or later than  $z$ , depending on the height of the limit price,  $p_L$ . In comparing the present values, however, the assumption that  $\hat{t}$  equals  $z$  will simplify matters greatly without greatly affecting the results.

<sup>6</sup>If demand growth were of the type often specified in limit-pricing models--an exponential growth at every level of price, such as  $q(t) = e^{gt}D(p(t))$ --the limit-price plan would fare even worse in most cases if it required price to be maintained at a level below that of the short-run profit-maximizing level. The lower price is kept in this case, the larger absolute amount of growth in output--all other things equal--and the faster the firm must grow. Under the other plans, price would be rising

over time and output would grow by smaller absolute amounts over time so that over the long-run, they would involve lower growth costs from internal expansion.

<sup>7</sup>"Contested Tender Offers," p. 8a.

<sup>8</sup>These results can be extended directly to the case where the cartel faces the possibility of an antitrust suit.

<sup>9</sup>This number represents the maximum number of possible combinations of decisions, but the actual number of plans might be smaller if the cartel cannot undertake all of the plans with respect to some firms. For example, if two firms share the same firm-specific limit price, the cartel would not have to consider the case where one is admitted and the other kept out. While this might reduce the number of actual plans some, this number may still be large. In the case of three entrants, even if all have the same limit price the cartel would still have twenty-eight combinations of decisions to choose from.

<sup>10</sup>As in the case where all  $4^m$  possibilities are considered, firms are not induced to enter as calculations proceed but rather simultaneously once the optimal strategy has been formulated ex ante.

<sup>11</sup>This specification is similar to that adopted by Kamien and Schwartz in extending their limit-pricing model to the case of many potential entrants. "Limit Pricing," 450-1.

<sup>12</sup>Gaskins ("Dynamic Limit Pricing") considers only small-scale entry, whereas Bain ("Conditions" and Barriers) and Worcester ("Dominant Firms"), consider both this case and that of large-scale entry.

<sup>13</sup>Strictly speaking, the case of easy entry does not rule out the possibility of entry on a larger scale. I choose to ignore this possibility, however, because it has already been examined in detail above and would serve primarily to make the analysis more complex without significantly affecting the nature of the results.

<sup>14</sup>The cartel's situation is identical to that of the classic case of a declining dominant firm with competitive fringe. See Worcester, "Dominant Firms," 339-42.

<sup>15</sup>The analysis of this and the previous paragraph is similar to that employed by Stigler in a different context to determine the conditions under which it would be profitable for firms to merge to form monopolies when entry is easy. "Monopoly and Oligopoly," 23-7.

<sup>16</sup>By prior assumption, the entrant's addition to industry capacity,  $K^b$ , is zero if the established firm is larger than the entrant's desired size,  $K^e$ . This condition will most certainly be fulfilled in the case of small-scale entry considered in this section.

## CHAPTER V

### MERGER RESPONSES: SOME EVIDENCE

Up to this point, the focus of this study has been the behavior of hypothetical firms operating in the restrictive environment of my theoretical framework. In this chapter, I turn to examples of the behavior of actual firms which provide a casual test for some of the predictions of the model. This chapter is not intended to be a thorough empirical investigation. Such an undertaking would require a great deal more time and space than can be afforded at this point: indeed, an adequate test of the hypotheses generated in previous chapters would present enough problems and require sufficient original research to constitute a dissertation in its own right. The following material does seem to indicate, however, that focusing on the role of pricing policy alone neglects important options which firms can employ to combat entry threats and suggests that further research is justified.

This chapter is divided into four sections. In the first three I examine two cases of mergers between established firms and firms recognized by them as potential competitors and one example of a firm which employed both mergers with potential competitors and newly entered firms. The former examples are fairly recent mergers

which were successfully challenged by the Justice Department: El Paso Natural Gas' 1957 acquisition of Pacific Northwest Pipeline Corporation, and Schlitz's 1964 merger with John Labatt, Ltd. The remaining example, in contrast, covers a number of mergers made by the Standard Oil Trust in the last two decades of the nineteenth century. In conjunction with this example, I also examine very briefly some characteristics of mergers in the British cement industry which provide an interesting contrast to the Standard Oil experience.

Finally, in the last section I briefly comment on the usefulness of these examples as a test of the relevance of the theoretical model developed in the earlier chapters of this thesis.

### 5.1 El Paso Natural Gas Company

The first case I wish to examine is the 1957 acquisition of the Pacific Northwest Pipeline Corporation by El Paso Natural Gas. My discussion is divided into three parts. In the first, I present a short narrative of the circumstances surrounding the merger to provide a background for the discussion. The second section presents values for various parameters of the theoretical model of earlier chapters and discusses how these values were obtained. Finally, in the last section I compare the parameter values for the El Paso case with those predicted by the model to favor the different courses of action and see to what extent this case lends support to the model.

## Background

The facts of the case, briefly, are as follows: The El Paso Natural Gas Company is a large interstate supplier of natural gas in the southwestern United States. In the early 1950's, El Paso was the only out-of-state supplier in the California market and was the leading firm there, as affirmed by its market share of fifty percent in 1956.<sup>1</sup> In this same period, the Pacific Northwest Pipeline Corporation became a major interstate gas supplier and potential competitor of El Paso. Pacific Northwest constructed a pipeline network connecting natural gas fields in New Mexico, Colorado and Canada to its markets in Washington and Oregon.

Concurrent with this expansion of its reserves and pipeline, Pacific Northwest also attempted to enter the California market. In 1954, the company was in the process of negotiating to deliver Canadian gas to one of the largest California distributors, Pacific Gas and Electric (PGE). At this time, however, it entered into certain gas exchange contracts with El Paso which caused it to interrupt these negotiations. The contract involved gas deliveries in Idaho and a joint extraction program in New Mexico fields, but the real purpose of the agreement was apparently to keep Pacific Northwest out of the California market. Such, at any rate, was the interpretation of the Pacific Northwest management, which sent stockholders a letter which said in part that the agreement

"means that El Paso's California market will be protected against future competition [by Pacific Northwest], and further it results in all parties now working together for a common end rather than fighting each other."<sup>2</sup>

The agreement failed to go into effect, however, because of certain complications, and Pacific Northwest resumed its negotiations with PGE. In addition, it entered into negotiations with Southern California Edison Company (Edison), the single largest industrial user of natural gas in southern California. At the time, Edison was being supplied by El Paso through a distributor, but its service was of low priority and subject to interruption at times of peak load demand from domestic users. Edison attempted to obtain a higher priority, even approaching El Paso directly, but was refused. It then turned to Pacific Northwest, and in the summer of 1956 the two companies negotiated a tentative agreement for Pacific Northwest to deliver gas to Edison at the California-Oregon border, which gas would then be distributed by Edison through a proposed new system.

In the words of the Court, "El Paso decided to fight the plan to the last ditch . . . ."<sup>3</sup> Whereas El Paso had previously been unwilling to make concessions to Edison, it now approached the latter through a distributor with an offer for the desired high priority contract. In addition, it also made substantial price reductions. El Paso's initial offer was for 40¢ per thousand cubic

feet (mcf), but this dropped during the negotiations to 38¢ and then 34¢ per mcf, and the final terms called for a price of only 30¢ per mcf.<sup>4</sup> Edison accepted the offer and terminated its tentative agreement with Pacific Northwest.

In the meantime, Pacific Northwest continued to approach PGE about the possibility of a deal. El Paso had decided, however, that outbidding Pacific Northwest was not its best course of action. Indeed, the company apparently had been interested in acquiring Pacific Northwest since 1954<sup>5</sup>--the year it had instead initiated the gas exchange contracts designed to keep Pacific Northwest out of California. When this "treaty" fell through, El Paso made an attempt to acquire Pacific Northwest. The first offer was made in late 1955, while Pacific was resuming its efforts with PGE, but the offer was refused. Merger negotiations were resumed in the summer of 1956, at approximately the same date as the tentative agreement between Pacific Northwest and Edison.

Finally, El Paso made Pacific an offer which its board of directors apparently could not refuse; for in November, 1956, the latter approved a merger with El Paso. Within a short time, the Justice Department challenged the combination on the grounds that Pacific Northwest exerted a positive competitive influence in the California market even though it did not actually sell gas there. Initially, the merger was approved by the Federal Power Commission

(1959) and District Court (1962), but in 1964 the Supreme Court reversed the lower court and ordered the merger dissolved.

#### Parameter Values

Table 5.1 lists the main parameters of the theoretical model developed in the earlier chapters of this thesis: all of the parameters of Table 3.9 plus the demand growth parameter (g). The first column of this table contains estimates of the magnitudes (relative to the values one might find in other industries) of the values of each of these parameters for the El Paso-Pacific Northwest example. The remaining columns present the results of comparing these case values with the magnitudes which the model predicts will favor each of the plans. If the case value of a particular parameter agrees with the value predicted to favor a given plan, a plus sign (+) appears in that plan's column. If the values are different, a negative sign (-) appears instead. Finally, the total number of agreements and differences is presented in the last two rows of the table.

Economics of scale.--Economics of scale are very important in the natural gas industry. Both production and distribution require huge investments before any gas can be transmitted at all, but once facilities have been constructed, a large volume of gas can be supplied at relatively low marginal cost up to the capacity of the

TABLE 5.1

COMPARISON OF PARAMETER VALUES OF THE EL PASO EXAMPLE  
WITH VALUES PREDICTED TO FAVOR THE DIFFERENT PLANS

| Parameter                             | Case Value | LP Plan | CE Plan | PEM Plan | EBM Plan |
|---------------------------------------|------------|---------|---------|----------|----------|
| 1. Economies of scale (E)             | H          | +       | -       | -        | -        |
| 2. Cartel cost advantage (A)          | M          | +       | -       | -        | -        |
| 3. Relative market size (M)           | L-M        | +       | -       | -        | -        |
| 4. Price elasticity ( $\eta$ )        | L          | +       | -       | -        | -        |
| 5. Original cartel size (n)           | L          | -       | +       | -        | -        |
| 6. Police-cost increment ( $C'_n$ )   | L          | -       | +       | -        | -        |
| 7. CE transaction costs (I)           | H          | +       | -       | +        | +        |
| 8. Cartel/entrant size (S)            | M          | -       | -       | -        | +        |
| 9. Entrant profits ( $y$ )            | H          | +       | -       | -        | -        |
| 10. <u>De novo</u> entry lag (z)      | H          | -       | +       | +        | -        |
| 11. De novo entry scale ( $K^e$ )     | H          | +       | -       | -        | +        |
| 12. EBM entry lag (x)                 | L          | +       | +       | +        | -        |
| 13. PEM transaction cost ( $T(K^e)$ ) | M-H        | +       | +       | -        | +        |
| 14. EBM transaction cost ( $T(K^b)$ ) | L          | -       | -       | -        | +        |
| 15. Contest probability ( $\gamma$ )  | L          | -       | -       | +        | +        |

TABLE 5.1--Continued

| Parameter                                       | Case Value | LP Plan | CE Plan | PEM Plan | EBM Plan |
|-------------------------------------------------|------------|---------|---------|----------|----------|
| 16. PEM antitrust suit probability ( $\delta$ ) | H          | +       | +       | -        | +        |
| 17. EBM antitrust suit probability ( $\delta$ ) | L          | -       | -       | -        | +        |
| 18. Cartel member size ( $K^a$ )                | H          | -       | -       | +        | +        |
| 19. EBM entry scale ( $K^b$ )                   | L          | -       | -       | -        | +        |
| 20. Demand growth rate ( $g$ )                  | H          | -       | +       | +        | +        |
| TOTALS: Values agree (+)                        |            | 10      | 7       | 6        | 11       |
| Values disagree (-)                             |            | 10      | 13      | 14       | 9        |

Key: LP = Limit-pricing  
 CE = Cartel-expansion  
 PEM = Post-entry merger  
 EBM = Entry-by-merger  
 H = High  
 M = Medium  
 L = Low

+ = Case and predicted values are the same  
 - = Case and predicted values are different

pipelines. The existence of these economies in production is supported by econometric studies of the gas industry in Britain which found the long-run average cost function to be declining over all relevant levels of output.<sup>6</sup>

Absolute cost advantage.--The enormous capital investment required to enter this industry may give established firms an absolute cost advantage over potential entrants by screening some out altogether or imposing heavy capital costs which make it harder for them to achieve the same level of average costs as existing firms.<sup>7</sup>

Relative market size.--No estimates of minimum efficient scale for gas firms are available, but the extensive economies of scale must make it fairly large--possibly on the order of a natural monopoly for most market sizes. For this reason, one might be tempted to rate the value of the ratio of market size to the output of an efficient firm as low, but regulation by state and federal agencies might prevent this from being true in all but local markets. Nonetheless, for the California market the value of the parameter would still be smaller than for most industries.

Price elasticity.--The consumers of natural gas can be divided more or less into two groups. The first are residential and commercial users who use gas essentially for cooking, water heating, and space heating. The second is industrial customers who use gas as a fuel to generate

electricity, as an input in industrial processes, and as a source of heating. Demand for the former group is generally inelastic since changing to substitutes is expensive once the facilities are installed. In the long-run, however, demand is somewhat more elastic since facilities may wear out and new construction can choose less costly substitutes. Industrial users, on the other hand, are often on an "interruptible" basis--that is, their gas may be shut off to meet peak demands of residential and commercial users--and are equipped to shift to substitute fuels on short notice. As a result, these users' demand tends to be more price elastic, with changes in relative fuel prices leading to large shifts in the consumption of different fuels. The overall elasticity is generally considered to be low to moderately inelastic relative to other goods.<sup>8</sup>

Number of firms in the industry.--Prior to the El Paso-Pacific Northwest merger, there were few firms supplying the California market, and El Paso was far and away the dominant firm, as is testified to by its market share of 58.1 percent in 1957.<sup>9</sup>

Policing cost increment.--One would expect this increment to be low because of the small number of firms and the equally small number of customers, both of which would make price shading difficult to hide. In addition, regulatory agencies require that rates be published and

and open to public scrutiny before they are approved.

Cartel-expansion plan transaction costs.--These costs could be quite large to the extent that the entry of Pacific Northwest into the California market touched off a period of price competition. It could take some time to restore pricing discipline, and the size and long-term nature of the contracts could make the losses (foregone profits) quite large.

Cartel/entrant size.--Relative to many industries, Pacific Northwest was a relatively large potential competitor: it had approximately one-fourth El Paso's assets and one-third its reserves.<sup>10</sup> In some cases (such as Procter and Gamble's entry into the bleach industry), however, this variable might be quite small, so I have assigned it a "medium" value in this case.

Entrant's profits.--With its size and reserves, Pacific Northwest could probably have anticipated cornering a fairly large portion of the California market and a correspondingly large share of industry profits.

De novo entry lag.--Both the regulatory process-- which requires firms to compete for and obtain approval for contracts before pipeline construction can begin-- and the time required to construct the pipeline combine to make the lag longer than in most industries.

De novo entry scale.--The large capital investment would have made the de novo entry scale large.

Entry-by-merger (EBM)/entry lag.--In the present example, entry-by-merger did not involve the construction of any new facilities, so there was no lag.

Post-entry-merger (PEM)/transaction costs.--These costs would be medium to high to the extent that El Paso anticipated a Justice Department challenge to any merger after Pacific Northwest already entered the California market. (See "Probability of antitrust challenge" below.)

Entry-by-merger transaction costs.--Low to the extent that El Paso did not anticipate that a market-extension merger would be challenged by the antitrust authorities. (See "Probability of antitrust challenge" below.)

Probability of a contested merger bid.--It seem unlikely that there was any anticipation of a challenge by stockholders to a merger bid as long as management went along with it, which they were quite happy to do in November of 1956.

Probability of an antitrust challenge (PEM and EBM).--El Paso's decision to merge with Pacific Northwest was probably influenced by two factors. To begin with, although natural gas industry mergers are not exempted from the antitrust laws, El Paso probably thought the Federal Power Commission had primary jurisdiction and that they would

probably be sympathetic--or at least more so than the Justice Department--to its merger plans, which did, in fact, prove to be true. Under the doctrine of primary jurisdiction, a court would have had to have given the Commission findings extra weight.<sup>11</sup> In addition, by 1956 the Justice Department's policy on horizontal mergers was fairly well established for one to assume that it would feel a merger with Pacific after it had entered would be sure to be attacked. The doctrine of potential competition, however, was yet to be confirmed by the Supreme Court, and El Paso may have anticipated little chance of a challenge in a merger involving firms which were not actual competitors.

Size of merging cartel member.--In both absolute and relative terms, El Paso was a large firm at the time of the acquisition.

Entry-by-merger entry scale.--The value of this variable is low since no new facilities were anticipated as a part of the merger.

Growth rate of demand.--The value for this variable is very high. Experts for the State of California estimated that the rate was only slightly below ten percent per year in 1962.<sup>12</sup>

### Analysis

The final row of Table 5.1 shows the total number

of times that the parameters of the El Paso example agree (+) or disagree (-) with the values predicted by the model for each of the four plans. Happily, the entry-by-merger plan has the highest number of pluses, followed closely by the limit-pricing plan. The cartel-expansion and post-entry-merger plans come in third and fourth respectively, somewhat behind the other two.

Although it happens to be true in this case that the plan which was chosen has the highest number of agreements, it is not the total number of agreements per se which determines the ranking of the plans. To begin with, in some cases a given parameter value may be favorable to the dominance of more than one plan. The long de novo entry lag, for example, favors both the cartel-expansion and post-entry-merger plans. Indeed, the parameter values for the El Paso case favor a single plan in only ten out of the twenty instances: four each for limit-pricing and entry-by-merger, and two for cartel-expansion.<sup>13</sup> The other ten parameters diffuse their influence (as it were) and counter-balance the effects of other variables.

Even more important, the totals may be misleading to the extent that the parameters do not have equal weight in determining the profits which flow from the adoption of each plan (and, therefore, the ranking of the four courses of action). The post-entry-merger plan, for example, may be favored by a majority of the parameters but not dominate because it is highly probable that the merger bid would be

contested and reversed.<sup>14</sup> In short, in certain cases some parameters may have a more important role in determining which of the plans dominates.

One cannot, therefore, explain the dominance of entry-by-merger by the fact that it received the highest score. Indeed, in this particular example one might have expected the limit-pricing plan to dominate. It has nearly the same number of pluses, and some of these are with parameters which one would expect to be of great importance in determining the ranking of the plans. In particular, the first four parameters indicate that the limit-price should be high relative to the short-run profit-maximizing price, and one should expect this to greatly favor the limit-pricing plan.

There are a number of reasons, however, why limit-pricing may not have been preferable to entry-by-merger. To begin with, demand in the California market was expanding at a rapid rate in the middle 1950's--nearly ten percent per year. In the first section of Chapter IV we found that growing demand tended to disfavor limit-pricing relative to the other plans, all other things being equal. One reason is that when demand is growing, profits grow less rapidly when price is kept at some constant level--as would be true if price were set to equate marginal revenue and marginal cost. Moreover, growing demand might inflate potential entrants' profit expectations so that established firms would have to set price at an even lower level to

achieve the same deterrent effect.

The limit-pricing policy may also have been rendered less viable by certain other factors peculiar to the natural gas industry. First, the gas industry is regulated by state and federal agencies which require firms to seek their approval before charging customers any given price. Not only does this regulatory process impart a certain rigidity to prices because of the extra time required to get rates approved, it also makes it possible for one firm's rivals and/or customers to challenge the proposed rates and possibly have them disallowed. Were it the case that the limit-price were near or below the average cost of a competitor, a firm which tried to adopt a limit-pricing strategy against potential entrants might find its rates being challenged by existing rivals as being discriminatorily low. Even were the rates to be allowed at some point, the delay involved in resolving the conflict might alone prove fatal in terms of deterring potential entrants.

Yet another consideration is the long-term nature of gas contracts. To justify the heavy investment pipeline construction involves, gas companies need long-term contracts to insure that the demand for the gas will be there for a period sufficient to allow investors to recover their investment. Contracts for periods as long as twenty years are quite common. In such cases, one might imagine that firms might be reluctant to set price at a level too close to average costs if the decision were incapable of

being reversed for such a long period of time.

For the reasons listed above, then, limit-pricing may not have been a very lucrative--or even possible--course of action for El Paso to take. Of the remaining plans, entry-by-merger seems to be the most favored. Few important factors favor cartel-expansion or post-entry-merger, and several important factors weigh against them. The cartel-expansion plan, for example, is disfavored by the large implementation costs that plan would entail if Pacific Northwest proved to be an aggressive competitor. Similarly, the high likelihood that a post-entry-merger would be successfully challenged by the Justice Department undoubtedly weighed heavily against that plan.

Entry-by-merger, on the other hand, allowed El Paso to neutralize the threat posed by Pacific Northwest at a relatively low transaction cost without sacrificing its dominant position in the California market. El Paso probably did not expect a market-extension merger to be challenged or believed that if it were attacked, the case would not stand if the merger had Federal Power Commission approval. In addition, even if the merger was not eventually consummated, starting with this type of merger still left the firm room to fall back on any of the three remaining plans.

## 5.2 The Standard Oil Trust

The next example I wish to consider is the merger

activity of the Standard Oil Trust after it attained its near monopoly in oil refining in the late 1870's. Unlike the previous case, I shall not focus on just a single instance of the Trust's reaction to a potential entrant but rather the strategy of reactions which emerged out of Standard Oil's experience with many firms in the last quarter of the nineteenth century. As before, I shall divide my discussion into three parts: background information, a presentation of the data, and an analysis of that data.

### Background

Starting with a modest Cleveland refinery, John D. Rockefeller and some associates began an acquisition program in 1871 in the Cleveland area, and by 1879 a company spokesman claimed that Standard accounted for 90 percent of all oil refined in the United States, although the actual figure was probably closer to 80 percent.<sup>15</sup> Rockefeller contended that his motive in creating the Trust was to restore health to the refining industry, which was severely plagued by excess demand and low prices in the period immediately following the Civil War. He believed he had brought order and profit where there had been only chaos and losses before, and as a result he tended to view entrants and potential competitors as undeserving beneficiaries of his efforts and possible seeds of a return to unbridled competition.

For these reasons, Rockefeller undertook mergers with new firms as they entered and made attempts to dissuade others from doing so. The Rockefeller papers contain numerous examples of men being offered lucrative settlements and, in some cases, positions with the Trust for not entering into competition with it.<sup>16</sup> Some who did enter--as in the case of some firms which were longstanding competitors--were bought out on what appeared to be generous terms.

This policy of generosity, however, was a two edged sword. Rockefeller soon began to realize that while his merger policy initially allowed him to increase its market share and eliminate some potential competitors, by the end of the 1870's--about the time Standard reached its largest market share--an increasingly large number of the firms which were entering or planning to enter were doing so for the sole reason of being bought out by the Trust. In short, the merger policy itself was attracting entry. As a result, Standard reduced its merger pace in the 1880's and adopted a new strategy for dealing with potential competition.

The strategy Standard Oil finally adopted was a complex combination of mergers, limit-pricing, and investment in entry barriers.<sup>17</sup> The Trust continued to undertake some mergers with potential competition.<sup>18</sup> If a new firm entered a regional market, price was cut to allow the Trust to hold its market share unless the firm were

perceived to be a real threat, in which case prices were cut to the bone. Standard executives kept close watch on competitors' prices and crude oil supplies. Standard raised price only if the latter were low and there was little prospect of new ones arriving quickly.<sup>19</sup> Finally, Standard exploited its size to reduce costs in order to make its pricing policy profitable. Investment in research and development was encouraged in hopes of both reducing costs and improving product quality.<sup>20</sup>

#### Parameter Values

Table 5.2 is similar to Table 5.1 in as much as it presents parameter values for the Standard Oil example and compares them with the predictions of the theoretical model for each of the courses of action. Since this example involves not one potential entrant but many, some of the parameter values presented below are designed to be representative of the majority of firms Standard has to deal with. As before, I shall discuss the parameter values before analyzing the results of the comparison.

Economies of scale.--In the nineteenth century, oil refining presented few opportunities to exploit economies of scale. That minimum efficient scale was small is suggested by the fact that one of Standard's most persistent and successful rivals had a plant representing an investment of only \$65,000. One refiner of the day estimated that a plant with a capacity of 3,000 barrels

TABLE 5.2

COMPARISON OF PARAMETER VALUES OF THE STANDARD OIL EXAMPLE  
WITH VALUES PREDICTED TO FAVOR THE DIFFERENT PLANS

| Parameter                             | Case Value | LP Plan | CE Plan | PEM Plan | EBM Plan |
|---------------------------------------|------------|---------|---------|----------|----------|
| 1. Economies of scale (E)             | L          | -       | +       | +        | +        |
| 2. Cartel cost advantage (A)          | L-M        | +       | -       | -        | -        |
| 3. Relative market size (M)           | H          | -       | +       | +        | +        |
| 4. Price elasticity ( $\eta$ )        | M-H        | -       | +       | +        | +        |
| 5. Original cartel size ( $n$ )       | H          | +       | -       | +        | +        |
| 6. Police-cost increment ( $C'_n$ )   | H          | +       | -       | +        | +        |
| 7. CE transaction costs (I)           | H          | +       | -       | +        | +        |
| 8. Cartel/entrant size (S)            | H          | -       | +       | +        | -        |
| 9. Entrant profits ( $y$ )            | L          | -       | -       | -        | +        |
| 10. <u>De novo</u> entry lag ( $z$ )  | L          | +       | -       | -        | +        |
| 11. De novo entry scale ( $K^e$ )     | L          | -       | +       | +        | -        |
| 12. EBM entry lag ( $x$ )             | L          | +       | +       | +        | -        |
| 13. PEM transaction cost ( $T(K^e)$ ) | L          | -       | -       | +        | -        |
| 14. EBM transaction cost ( $T(K^b)$ ) | L          | -       | -       | -        | +        |
| 15. Contest probability ( $\gamma$ )  | L          | -       | -       | +        | +        |

TABLE 5.2--Continued

| Parameter                                       | Case Value | LP Plan | CE Plan | PEM Plan | EBM Plan |
|-------------------------------------------------|------------|---------|---------|----------|----------|
| 16. PEM antitrust suit probability ( $\delta$ ) | L          | -       | -       | +        | -        |
| 17. EBM antitrust suit probability ( $\delta$ ) | L          | -       | -       | -        | +        |
| 18. Cartel member size ( $K^a$ )                | H          | -       | -       | +        | +        |
| 19. EBM entry scale ( $K^b$ )                   | L          | -       | -       | -        | +        |
| 20. Demand growth rate ( $g$ )                  | L-M        | +       | -       | -        | -        |
| TOTALS: Values agree (+)                        |            | 7       | 6       | 13       | 13       |
| Values disagree (-)                             |            | 13      | 14      | 7        | 7        |

Key: LP = Limit-pricing  
CE = Cartel-expansion  
PEM = Post-entry merger  
EBM = Entry-by-merger  
H = High  
M = Medium  
L = Low

+ = Case and predicted values are the same  
- = Case and predicted values are different

per day could be built for from thirty to fifty thousand dollars, and another testified at the 1911 antitrust trial that he had purchased a refinery of 1,500 barrels per day in 1889 for only \$5,000.<sup>21</sup>

Absolute cost advantage.--Because of its size, Standard was able to use bulk purchasing to obtain quantity discounts on almost all of its inputs. Eventually, the Trust internalized the production of many of its inputs such as cans, barrels, and boxes. It also integrated into pipelines and other transportation media which produced further savings by insuring a steady supply of crude oil. On the whole, these savings gave Standard a modest cost advantage over many rivals and potential entrants.<sup>22</sup>

Relative market size.--Even though markets were regional in scope, they were still large relative to the output of a plant of minimum efficient scale.

Price elasticity.--The demand for oil in the nineteenth century was probably highly elastic due to the availability of substitutes for most of its uses. In lighting it competed with--among other products--whale oil, coal gas, candles, and even wood fires.

Original cartel size.--While the Trust itself is best regarded as a single firm, Standard always attempted to encourage competitors to follow its lead in pricing decisions. In many cases, prices were set in concert by

a number of firms, although agreements were often subject to frequent breakdowns.

Police-cost increment.--This cost element was probably large because of the number of existing firms.

Cartel-expansion transaction costs.--Like the police-cost increment, cartel-expansion costs will be larger, the larger the number of firms in the cartel.

Cartel/entrant size.--In most cases, entrants were small in comparison to Standard Oil and its cooperating rivals.

Entrant profits.--Most entrants were too small relative to Standard Oil to capture a very significant share of industry profits.

De novo entry lag.--Although estimates of the entry lag are unavailable, one would expect it to be short because of the relatively small investment and the simple technology embodied in a plant of reasonably efficient size.

De novo entry scale.--For refining alone, minimum efficient scale was relatively small. (See "Economies of scale" above.)

Entry-by-merger entry lag.--Entry-by-merger in this context usually involved no new construction: indeed, one of the purposes of the merger strategy was to prevent the industry from having excess capacity.

Post-entry-merger and entry-by-merger transaction costs.--In the absence of possible antitrust action, merger transaction costs were probably relatively low. In most cases, there were few owners to deal with and thus no need to involve brokers.

Probability of a contested merger bid.--The likelihood of a contest was probably not much of a problem since most firms were owner-operated, representing the entrepreneurship of a few individuals.

Probability of antitrust action.--In the nineteenth century mergers did not present antitrust problems for firms.

Cartel member size.--The value of this parameter is "high."

Entry-by-merger entry scale.--In all cases, this merger plan involved the construction of no new facilities.

Demand growth.--The demand for oil products grew more or less steadily in the late nineteenth century, although not nearly so rapidly as the supply of new crude. The big surge in demand did not come until the widespread use of the gasoline engine in the twentieth century.<sup>23</sup>

### Analysis

As in the previous example, the last two rows of Table 5.2 show the total number of times the parameter

values of the example correspond with or diverge from the values predicted to favor each of the different plans. Taking these totals by themselves, one can understand why mergers played such an important role in Standard's initial strategy against potential competitors: both merger plans come out far ahead of limit-pricing and cartel-expansion in terms of correspondences.

An examination of the individual parameters, however, provides even more compelling reasons why mergers were favored. Three of the first four parameters, for example, have values which suggest that the limit-price was low relative to the short-run profit-maximizing price. As a result, limit-pricing must not have appeared to be a very lucrative method of maintaining Standard's dominance. Similarly, the next three parameter values tend to make the cartel-expansion plan a relatively unprofitable alternative. In contrast, only one parameter value--that for demand growth--does not favor at least one of the merger plans. There were no antitrust laws to threaten acquisitions of either actual or potential competitors, and the small size of most firms allowed the purchases to be made without the expense of brokers. In short, mergers afforded Standard a cheap, effective means of eliminating new and potential competition.

The effectiveness of Standard's merger policy, however, was soon dulled by the tendency of some men to enter in hopes of being bought out.

That a number of designing men set up refineries, pressed their competition in the markets, and appealed to public opinion for support, hoping to compel the Standard to buy them out at high prices, is incontestable. Early in 1878, for example, . . . [Rockefeller] inveighed against a man at Rouseville, Pennsylvania, who had been "systematically blackmailing" the Standard, who boasted of building seven refineries, and who was asking [the Standard] for money.<sup>24</sup>

Letters from men offering not to enter oil refining became a common occurrence.<sup>25</sup>

The appearance of these "blackmailers," of course, was the manifestation of a phenomenon discussed in Section 4.3 of Chapter IV: a shift in the industry entry function. Standard's extensive merger program and well-publicized generosity made entry attractive to firms which otherwise would not have been tempted to enter. Thus, while reducing the number of competitors and potential entrants initially, the long-run effect of the acquisition program was to enlarge rather than reduce the pool of potential entrants.

As a result, Standard was forced to reduce the pace of its acquisitions and shift to an alternative policy. The policy which was chosen was essentially that of limit-pricing. There were undoubtedly a number of reasons why cartel-expansion was not chosen, but one of the most important undoubtedly was the prejudiced attitude with which Rockefeller and his associates regarded competitors and competition. They developed this attitude in the early years of the refining industry when an abundance of crude

oil supplies and refining capacity kept prices too low for anyone to earn a profit. These men always claimed that the primary motivation of the Trust was to remove this excess capacity and stabilize price at a higher level.

In spite of its rather poor showing in terms of the parameters of Table 5.2, then, limit-pricing nonetheless came to be Standard Oil's primary means for dealing with the threat of new competition. Although the Trust's cost advantage was somewhat modest, limit-pricing allowed Standard to maintain its dominant position and still earn substantial profits.<sup>26</sup> Some of these profits were re-invested in projects designed to make the cost advantage even larger. Mergers were still employed to deal with some firms which appeared to constitute especially dangerous threats, but the long-run effectiveness of mergers as the primary policy was vitiated by the tendency for later entrants to demand acquisition prices in excess of their worth to the Trust and for the number of entrants to increase instead of get smaller.

#### Addendum

At this point I wish to examine in somewhat less detail an example which presents an interesting contrast to that of Standard Oil. The example is the response of the British cement industry to new competition in the early twentieth century. As was true for Standard Oil, entry barriers were low for the industry in this period.<sup>27</sup>

Indeed, before 1900, the structure of the industry was essentially competitive. In 1900, however, a number of firms combined to form Associated Portland Cement Manufacturers, Ltd. (APCM), with a market share of fifty per cent. This firm proceeded to raise price and invite entry, for by 1907 its share of the market had fallen to less than a third. In 1911 prices had fallen so low that another group of firms was motivated to form British Portland Cement Manufacturers, Ltd. (BPCM), which joined in an alliance with APCM and some other firms. This group--referred to as the Associated Group--controlled seventy-five percent of industry output at that time.

The Associated Group has continued to maintain a dominant position in the British cement industry since 1911. As Table 5.3 demonstrates, however, the Group's control has been far from stable. Over the years, its share has fluctuated over a wide range, falling from its initial high value to a low one only to be raised again to a high value. These fluctuations contrast sharply with the more or less constant nature of Standard Oil's market share, and the difference derives from the Associated Group's different pricing and merger policies.

As with Standard Oil, the Associated Group used its dominant position to keep prices high over the long-run, which encouraged existing firms to expand and new firms to enter. In contrast to Standard Oil, however, the Group did not attempt to stabilize its market share by merging

with new competitors and potential entrants. Instead, the Group allowed its share to decline by a substantial amount first before undertaking mergers which returned its share to a high value.

TABLE 5.3  
MARKET SHARE OF ASSOCIATED GROUP FOR VARIOUS YEARS<sup>a</sup>

| Year | Market Share (%) |
|------|------------------|
| 1911 | 75               |
| 1921 | 69               |
| 1930 | 57               |
| 1934 | 70               |
| 1938 | 55               |
| 1952 | 67               |

<sup>a</sup>Source: P. Leslie Cook, *Effects of Mergers* (London: George Allen & Unwin, Ltd., 1958), pp. 41,59,78,92,106,117.

In both cases, a firm or group of firms with a dominant market position and easy entry conditions has failed to follow the precepts of traditional dominant firm pricing theory--namely, to allow its market share to decline gradually over the long-run.<sup>28</sup> Standard Oil attempted to maintain its dominance using a continuing merger policy but was forced to abandon the attempt when it caused the industry entry-function to shift outward. Associated, however, undertook mergers infrequently and was able to avoid the entry-function shift. It is not clear that

Associated consciously spaced their merging to avoid Standard's dilemma, but it is clear that they did not have one of the options open to Rockefeller: it seems unlikely that Associated had or could have developed a cost advantage sufficient to allow limit-pricing to yield it any more than just a competitive rate of return.

On the whole, Standard and the Associated Group were both able to earn profits in excess of a competitive rate of return but using much different methods. Had Standard not implanted the expectation of capital gains in entrants' heads by its aggressive merger policy, perhaps it might also have used Associated's phoenix-like merger behavior to earn essentially the same profits over the long-run.

### 5.3 The Schlitz-Labatt Merger

The final example I wish to consider is the 1964 acquisition of controlling interest in John Labatt, Ltd., of Canada by the Joseph Schlitz Brewing Company. This merger was successfully challenged by the Justice Department and involved horizontal as well as conglomerate aspects because of Labatt's controlling interest in one of Schlitz's regional competitors. One of my purposes in including this example is to demonstrate how considerations other than potential competition can influence an established firm's strategy toward a potential entrant.

#### Background

During the 1950's Schlitz--the nation's second

largest brewer and one of only three firms operating in all fifty states--made an attempt to increase its share of sales in the Eight Western States,<sup>29</sup> especially California. At that time, Schlitz marketed only its premium-priced beer, Schlitz, and had only a small market share--only four percent in California. For the most part, however, its attempts met with little success and its market share remained stable. Finally, Schlitz decided that in order to improve its position it had to introduce a so-called popular-priced brand or acquire an existing producer of one in that area. It chose the latter route, acquiring the stock and assets of Burgermeister Brewing Corporation in 1961. The merger advanced Schlitz from tenth to third in the California market, with 12.3 percent of sales.<sup>30</sup>

In 1964, Schlitz acquired controlling interest in Labatt's, which was the third largest brewer in Canada. Labatt, in turn, controlled 63.5 percent of the stock of General Brewing Corporation, a firm operating exclusively in the West but ranked twelfth in terms of sales nationally. General's popular-priced beer Lucky Lager had 18.4 percent of the California market, making it that state's second largest brewer. Schlitz's control over General by way of its control over Labatt gave it a market share of 26.8 percent in California and 23.0 percent in the Eight Western States, making it the leading firm in both areas.<sup>31</sup>

Although it may appear that the merger was primarily motivated by a desire on Schlitz's part to gain control

over General Brewing, one can argue that this was not the only or even the primary motivation. At the time of the merger, Labatt and General Brewing were undertaking a two-staged expansion program. The first stage involved the introduction of General Brewing's popular-priced beer (Lucky Lager) into other areas of the country with the ultimate goal of becoming a national brewer. The second stage consisted of a plan to use General Brewing's facilities to introduce Labatt's beer as a premium brand in the West, moving into the rest of the country with Lucky Lager if the latter's expansion were successful.<sup>32</sup>

In addition, the success of the Labatt-General Brewing expansion program depended heavily on the participation of both firms. On the one hand, General Brewing relied heavily on Labatt for financing and technical assistance. Labatt, on the other hand, needed General Brewing's established position to circumvent various entry barriers which would have made de novo entry more expensive. Since the end of World War II, only four firms have attempted de novo entry, and only one--Carlings--was successful.<sup>33</sup>

It is perhaps not surprising, then, that neither the Justice Department nor the District Court were impressed by Schlitz's contention--first announced right after the case was filed and reiterated at the trial--that it had always intended to have Labatt divest itself of General Brewing and that once this was done there would be no grounds for

nullifying the Schlitz-Labatt merger. Not only is it hard to believe that Schlitz would not actually like to keep control over General Brewing, it is clear that Schlitz would still gain substantially by splitting up the two firms. Without Labatt's help, General Brewing would have a much harder time expanding its markets to the rest of the country.

In short, it seem likely that Schlitz's main motivation in acquiring Labatt was to eliminate the competitive threat posed by the Labatt-General Brewing expansion plans. It is clear that Schlitz would have derived benefits from merging with General Brewing alone, but it is difficult to believe that Schlitz would think that the Justice Department would stand by idly while two of the largest firms in the nation, let alone the West, merged. The precedents in horizontal merger cases were will established in 1964 that Schlitz must have felt there was a high probability that the merger would be challenged. If it desired to expand by merging, there were many other firms it could have acquired which would have attracted much less attention. More likely, Schlitz probably felt that it had a small chance to get both Labatt and General Brewing but a much larger chance at least to keep Labatt by offering to spin off General Brewing.

#### Parameter Values

Table 5.4 is identical in form with Tables 5.1 and

TABLE 5.4

COMPARISON OF PARAMETER VALUES OF THE SCHLITZ-LABATT EXAMPLE  
WITH VALUES PREDICTED TO FAVOR THE DIFFERENT PLANS

| Parameter                             | Case Value | LP Plan | CE Plan | PEM Plan | EBM Plan |
|---------------------------------------|------------|---------|---------|----------|----------|
| 1. Economies of scale (E)             | L          | -       | +       | +        | +        |
| 2. Cartel cost advantage (A)          | M-H        | +       | -       | -        | -        |
| 3. Relative market size (M)           | M          | +       | -       | -        | -        |
| 4. Price elasticity ( $\eta$ )        | L          | +       | -       | -        | -        |
| 5. Original cartel size (n)           | M-H        | +       | -       | +        | +        |
| 6. Police-cost increment ( $C'_n$ )   | H          | +       | -       | +        | +        |
| 7. CE transaction costs (I)           | H          | +       | -       | +        | +        |
| 8. Cartel/entrant size (S)            | M          | -       | -       | -        | +        |
| 9. Entrant profits ( $y$ )            | M          | -       | +       | +        | -        |
| 10. <u>De novo</u> entry lag (z)      | M-H        | -       | +       | +        | -        |
| 11. De novo entry scale ( $K^e$ )     | H          | +       | -       | -        | +        |
| 12. EBM entry lag (x)                 | L          | +       | +       | +        | -        |
| 13. PEM transaction cost ( $T(K^e)$ ) | H          | +       | +       | -        | +        |
| 14. EBM transaction cost ( $T(K^b)$ ) | L          | -       | -       | -        | +        |
| 15. Contest probability ( $\gamma$ )  | L          | -       | -       | +        | +        |

TABLE 5.4--Continued

| Parameter                                       | Case Value | LP Plan | CE Plan | PEM Plan | EBM Plan |
|-------------------------------------------------|------------|---------|---------|----------|----------|
| 16. PEM antitrust suit probability ( $\delta$ ) | H          | +       | +       | -        | +        |
| 17. EBM antitrust suit probability ( $\delta$ ) | L          | -       | -       | -        | +        |
| 18. Cartel member size ( $K^a$ )                | H          | -       | -       | +        | +        |
| 19. EBM entry scale ( $K^b$ )                   | L          | -       | -       | -        | +        |
| 20. Demand growth rate ( $g$ )                  | L          | +       | -       | -        | -        |
| TOTALS: Values agree (+)                        |            | 11      | 6       | 9        | 13       |
| Values disagree (-)                             |            | 9       | 14      | 11       | 7        |

Key: LP = Limit-pricing  
 CE = Cartel-expansion  
 PEM = Post-entry merger  
 EBM = Entry-by-merger  
 H = High  
 M = Medium  
 L = Low

+ = Case and predicted values are the same  
 - = Case and predicted values are different

5.2 and contains the parameter values for the Schlitz-Labatt merger. As before, I shall discuss the derivation of the parameter values before discussing them in terms of the model predictions.

Economies of scale.--Estimates of minimum efficient scale in the brewing industry range from 100,000 to a million barrels per year. It seems likely that the scale curve does not decline rapidly toward either of these figures, however, since the vast majority of brewers are of much smaller scale than 100,000 barrels.<sup>35</sup> As a result, I would judge that the value of this parameter should be "low."

Cartel cost advantage.--Advertising is effective for national brewers in establishing consumer preferences for their products. One of the largest brewers, Anheuser-Busch, conducted a survey and found that it was able to maintain on the average a five cent per can or 12 ounce bottle over so-called popular-price brands.<sup>36</sup> In addition, entry into the industry is hampered by large capital costs (a new million-barrel capacity costing from \$30 to \$40 million).<sup>37</sup> Both of these factors should impart a medium to high absolute costs advantage to establish firms, especially the large nationally advertised brands.

Relative market size.--The value of this parameter depends on the value assigned to minimum efficient scale,

which is estimated by different sources to be between 100,000 and one million barrels. The former represents 0.7 percent of 1963 scales in the Eight Western States, while the latter represents 7.0 percent.<sup>38</sup> Since most experts tend to think that the higher estimates of minimum efficient scale are closer to being correct, I shall accept the latter figure, which is "medium" in relative magnitude.

Price elasticity.--Although the demand for individual brands is price elastic, that for beer in general is price inelastic.<sup>39</sup>

Original industry size.--Although there is a trend toward increasing concentration, there are still a large number of brewers both on the national level and in the Eight Western States. In 1963, there were nine firms in the West with 4.5 percent of the market or more, their combined share being 83 percent.<sup>40</sup> On the whole, I feel that this parameter is best valued "medium to high."

Policing-cost increment.--This parameter is valued as high to reflect the difficulties involved in policing a large number of firms.

Cartel-expansion transaction costs.--This parameter is also assigned a high value because of the number of firms involved.

Cartel/entrant size.--In 1963, Labatt was Canada's third largest brewer with sales of \$108.5 million, about one-third that of Schlitz.<sup>41</sup> Relative to the firms just in the Eight Western States, one would have to judge Labatt's relative size as approximately medium--not so large as in the case of Procter & Gamble's proposed entry into the bleach industry, but more than entry in the case of the Standard Oil example.

Entrant profits.--With its size and past experience, Labatt probably anticipated capturing at least a moderately large share of industry profits relative to those of established firms.

De novo entry lag.--The size of new facilities and the time required to develop distribution and supply networks should tend to make the entry lag fairly large.<sup>42</sup>

De novo entry scale.--The large investment would make the entry scale relatively large.

Entry-by-merger entry lag.--In this case, the lag was very short.

Post-entry-merger transaction cost.--To the extent an antitrust challenge was expected, these costs would be high. (See below, "Probability of antitrust action.")

Entry-by-merger transaction cost.--To the extent Schlitz anticipated that an agreement to divest Labatt of

General Brewing would satisfy antitrust authorities, the expected value of these costs would be relatively low.

Probability of a contested merger bid.--Although Labatt warned Schlitz that its acquisition would meet with an adverse reaction from the Canadian public, there is no evidence that Schlitz expected any hostility from Labatt stockholders.<sup>43</sup>

Post-entry-merger antitrust probability.--It seems likely that Schlitz did not think it could avoid an anti-trust suit if it attempted to merge with Labatt after it introduced its beer into the West.

Entry-by-merger antitrust probability. There is no direct observation on the value of this parameter, but the following scenario seems to fit some of the facts of this case. Schlitz may have thought it could get away with a market extension merger--that is, a merger involving Labatt alone. The potential competition doctrine had not been developed by the Supreme Court when the merger idea was conceived, and although similar mergers had been challenged, many had won in the District and Appeals Courts. Schlitz probably anticipated the possibility of a challenge, however, because of Labatt's control over General Brewing. But Schlitz may have believed that if it were challenged on this point, the antitrust authorities could be placated if it agreed to divest Labatt of General

after the merger. In short, it may have anticipated at most a challenge of only the horizontal elements of the merger.

Cartel member size.--Schlitz must be considered a large firm: its 1963 sales made it the second largest brewer nationally and the fourth largest in the Eight Western States.<sup>44</sup>

Entry-by-merger entry scale.--No additional capacity was anticipated as a part of the Labatt-Schlitz merger, so the value of this parameter is low.

Demand growth rate.--For the most part, the demand for beer has been stagnant for many years. Per capita consumption actually fell from 18.5 to 15.0 gallons per year from 1947 to 1958, and while it rose somewhat thereafter, per capita consumption is still below the 1947 figure (in 1968, the figure was 16.7 gallons per year).<sup>45</sup>

### Analysis

The last two rows of Table 5.4 show that the entry-by-merger and limit-pricing plans have the largest number of correspondences between the case parameter values and those predicted to favor each plan with thirteen and eleven, respectively. As in previous examples, of course, it is not the totals but rather the values of individual parameters which determine which of the plans will dominate. Even so, the ranking of the plans according to the total

number of parameter correspondences does seem to indicate a tendency for plans which involve the construction of new facilities (cartel-expansion and post-entry merger) to be disfavored relative to those which do not (limit-pricing and entry-by-merger).

An examination of the individual parameters for the cartel-expansion plan reinforces the impression given by the totals that this plan should not dominate. Table 5.4 shows that three key parameters for this plan (original cartel size, police-cost increment, and cartel-expansion transaction costs) all have values which tend to reduce its profitability relative to the other courses of action. In addition, those parameter values which are favorable to this plan also favor at least one other plan as well.

Much the same can also be said of the post-entry-merger plan. In this case, the antitrust-probability parameter militates heavily against this plan by raising the possibility that this plan might be reversed by the courts if adopted. Were that to happen, Schlitz would find its options severely reduced since Labatt would already be established as an actual competitor, rendering limit-pricing and entry-by-merger inoperative.

The totals for the limit-pricing plan, however, are fairly close to that for entry-by-merger, and one might be tempted to think that this course of action would be an effective weapon to combat the threat of new competition. Furthermore, some of the parameter values reinforce this

feeling. As I noted in the previous section, both the absolute capital requirements of entry and the expense and difficulty of eroding consumers' preferences gives established firms an absolute cost advantage over firms which acts as a barrier to new entry. Moreover, established firms are relatively large compared to the sales in regional markets and demand is inelastic, both of which favor limit-pricing. And finally, demand has been relatively stagnant in the brewing industry for years, which militates against de novo entry because new entry tends to create excess capacity.

Some of these considerations, however, do not apply with full force in the case of the threat posed by Labatt-General Brewing. To begin with, Labatt did not have to build new facilities in order to introduce its beer to the West: it was intending from the outset to use General Brewing's existing facilities. In addition, the experience of other firms suggests that Labatt and General Brewing could have accomplished their proposed expansion into the rest of the country by acquiring local and regional brewers at prices below the cost of constructing new facilities.<sup>46</sup> Finally, Labatt was a sufficiently large firm to overcome the promotional-cost entry barrier without great difficulty. For these reasons, then, using the limit-pricing plan to deter the threat posed by the combined forces of Labatt and General Brewing would require a larger price reduction, all other things equal, than if those firms were attempting de novo entry.

As in the case of limit-pricing, the entry-by-merger plan was different than those of the other examples examined above. The difference lies in the fact that General Brewing was an actual as well as potential competitor of Schlitz's so that the expected benefits included an element deriving from the lessening of competition in the Eight Western States. These benefits undoubtedly increased the profitability of the merger plans, but it may not have been by much. The exact amount depends on the probability Schlitz attached to a challenge of this part of the merger by the Justice Department. Even if Schlitz assigned a low value to the probability that there would be no challenge, the expected value of these purely "horizontal" benefits (total horizontal benefits times the probability of the merger not being challenged) could have seemed large, perhaps large enough at the margin to make this strategy dominate.

Even though Schlitz may have felt that there was a high probability that the horizontal element of the merger would invite attack, it might not have anticipated any trouble with the purely market-extension aspects of the merger--that is, the acquisition of Labatt alone. While this did not, in fact, prove to be the case, one can make a fairly convincing argument that Schlitz perceived this probability to be low at the time of the merger. The potential competition doctrine had not yet been announced by the Supreme Court, and although some such cases had

been brought, some had won at the District Court and Appeals Court levels.<sup>47</sup>

Schlitz's actions certainly would lead one to believe that it did not take the threat of a challenge of the "pure" market-extension aspects very seriously. Its offer to divest Labatt of General Brewing is clearly an attempt by Schlitz to cut its losses, but it may well have felt that this would be enough to either get the Justice Department to drop any suit or convince a court that the merger should be allowed. While Schlitz would have undoubtedly preferred to keep General Brewing, it still would have gained from getting only Labatt since it was the combination of Labatt and General Brewing which constituted the greatest threat. Even if it only acquired Labatt, Schlitz would rob General Brewing of the financial and technical assistance its expansion plan required and eliminated Labatt as an instigator of expansion with other firms.

In short, entry-by-merger may have appeared to be a cheap, effective way either to eliminate or greatly weaken an imposing potential entrant. Like limit-pricing, this plan allowed Schlitz to do so without increasing the number of firms in the Western market. Moreover, it still left Schlitz with the three other alternatives if the Justice Department did sue and win.

#### 5.4 Conclusion

In this chapter I have examined three examples where

established firms have used mergers to deal with the threat posed by potential competition. These examples do not, of course, constitute a very thorough empirical investigation of the usefulness of the theoretical model developed in the first part of this thesis. For one thing, data was not available for all the parameters and inferences had to be substituted for them. Even more important, a more thorough examination would also have to examine cases in which other strategies dominated to test whether or not the model worked for those cases as well.

On the whole, however, the examples examined in the previous sections were useful in a number of ways. To begin with, they do not reveal any major inconsistencies in the model. In all three instances, the parameter values of the cases tend to be in agreement with the values predicted by the model to favor the merger plan which did, in fact, dominate. In addition, these examples demonstrate that individual parameters vary in their importance from case to case, making it difficult to determine their importance a priori.

Finally, these examples also demonstrate the difficulty involved in empirical research in this area. To begin with, the El Paso case shows how institutional features of a firm's environment can affect the decisions open to it. In that case, the presence of regulatory agencies may have impeded the ability of that firm to employ the limit-pricing strategy. Similarly, the model

developed in earlier chapters assumed that firms' decisions were motivated only by the benefits they expected to receive by eliminating another firm as a potential competitor. In the Schlitz example, however, the decision to merge with Labatt may well have been influenced by the possibility that Schlitz might also be able to eliminate one of its major rivals in the West as well. As a general matter, mergers might involve a number of so-called synergistic effects which provide benefits to one or both merging firms. If so, it might be very difficult to separate out the influences of the different factors and determine which was most important.

For the most part, then, these examples do seem to indicate that further research in this area is justified. At the very least, they lend support to the fundamental theoretical conclusion of this study that an examination of the response of firms to the threat posed by potential competition should not focus on pricing policy alone. In particular, these cases do suggest that mergers are important alternative options open to established firms.

Footnotes

<sup>1</sup>United States v. El Paso Natural Gas Co., 376 U.S. 651, 652 (1964).

<sup>2</sup>Id. at 654.

<sup>3</sup>Id. at 655.

<sup>4</sup>Ibid.

<sup>5</sup>Ibid.

<sup>6</sup>Table VIII in Walters, "Production and Cost Functions," p. 50.

<sup>7</sup>Bain, "Conditions," 226.

<sup>8</sup>M. Farris, and R. Sampson, Public Utilities, (Boston: Houghton-Mifflin Co., 1973), pp. 18-19, 193-195.

<sup>9</sup>United States v. El Paso Natural Gas Co., CCH Trade Reg. Rep., (District Court Decisions), ¶70,571 at 77,299 (D. Utah, November 20, 1962).

<sup>10</sup>"New Frontier," pp. 81-82.

<sup>11</sup>After the Justice Department filed its suit, El Paso made application for approval of the merger with the FPC and tried to get the antitrust suit dismissed or delayed until after the Commission acted. The District Court did delay its proceedings in deference to the Commission, which ruled that the merger should be permitted since there would be little harm to competition but numerous benefits. The Supreme Court, however, ruled that the FPC did not have primary jurisdiction since the merger was a stock acquisition and since the Justice Department suit was pending when El Paso filed for FPC approval. See California v. Federal Power Commission, 369 U.S. 482 (1962).

<sup>12</sup>376 U.S. at 658.

<sup>13</sup>The parameters are as follows: Limit-pricing--economies of scale, absolute cost advantage, relative market size, and price elasticity; entry-by-merger--

cartel/entrant size, probability of antitrust action, entry-by-merger entry scale, and entry-by-merger transaction costs; and cartel-expansion--original cartel size and policing-cost increment. No parameter values favor post-entry merger alone.

<sup>14</sup>This effect is examined in Section 4.2 of Chapter IV.

<sup>15</sup>Nevins, Allan, Study in Power: John D. Rockefeller (New York: Charles Scribner's Sons, 1953), II, pp. 54,76.

<sup>16</sup>See Ibid., pp. 56-57 for two examples and McGee, "Predatory Pricing," pp. 147-148 for another.

<sup>17</sup>The theoretical model developed in the preceding chapters abstracts from the consideration of investment in entry barriers as a course of action open to established firms.

<sup>18</sup>For a time, Standard executives hoped that predatory pricing might be an effective means to drive out the Trust's remaining competitors and prevent the entry of new firms. These men soon found, however, that "price-cutting meant profit-cutting" and that "the Standard gained or lost on a titan's scale while its opponents did so on a pygmy's." Independents only had to suspend operations and let Standard supply the whole market at a price below cost until "the titan tired of this expensive experiment"--which it must do at some point. Nevins, Rockefeller, II, pp. 65-66. For additional references concerning Standard's use of predatory pricing, see footnote 13 in Chapter II above.

<sup>19</sup>Nevins, Rockefeller, II, p. 66.

<sup>20</sup>Hidy, R., and Hidy, M., Pioneering in Big Business, 1882-1911: History of Standard Oil Company (New Jersey), (New York: Harper & Brothers, 1955), p. 34.

<sup>21</sup>Nevins, Rockefeller, II, p. 54.

<sup>22</sup>Ibid., pp. 13-15.

<sup>23</sup>Ibid., p. 96.

<sup>24</sup>Ibid., pp. 55-56.

<sup>25</sup>For an example of these letters, see Ibid., p. 56 n.

<sup>26</sup>The figures used to calculate these averages are from the Brief for the Defendant in the 1911 dissolution case and are reproduced as Appendix III in Ibid., p. 478. It would be interesting to calculate Standard's market share for the period after 1896 to see if it declined, as one might expect if the earlier profit figures represent the return from a limit-pricing policy. Rockefeller was a firm believer in low prices, but his successor may have decided upon a policy of cartel-expansion. Unfortunately, market share figures for this period are not available on a year-by-year basis.

<sup>27</sup>Low entry barriers characterize the American cement industry and one should expect this also to be true in the case of Britain. Bain, Barriers, Tables XIV and XV, pp. 169-170.

<sup>28</sup>Worcester, "Dominant Firms," pp. 339-342.

<sup>29</sup>These states are California, Oregon, Washington, Arizona, Nevada, Idaho, Utah, and Montana.

<sup>30</sup>United States v. Joseph Schlitz Brewing Co., 253 F. Supp. 129, 140, 141, (N. D. Cal., 1966).

<sup>31</sup>Id. at 136-137.

<sup>32</sup>Id. at 137-138

<sup>33</sup>Elzinga, Kenneth, "The Beer Industry," in The Structure of American Industry, edited by Walter Adams (New York: MacMillan Co., 1971), pp. 201-202.

<sup>34</sup>Bowen, William, "How They Put 'Gusto' into Schlitz," Fortune, LXXX (October, 1964), p. 226.

<sup>35</sup>Elzinga, "Beer," pp. 199-200.

<sup>36</sup>Ibid., p. 206.

<sup>37</sup>Ibid., p. 201.

<sup>38</sup>Ibid., p. 192, and United States v. Joseph Schlitz Brewing Co., 253 F. Supp. at 159.

<sup>39</sup>Horowitz, I., and Horowitz, A., "Firms in a Declining Market: The Brewing Case," Journal of Industrial Economics, XIII (March, 1965), p. 138.

<sup>40</sup>253 F. Supp. at 159.

<sup>41</sup>Id. at 136.

<sup>42</sup>Horowitz and Horowitz, "Brewing," 132.

<sup>43</sup>253 F. Supp. at 138.

<sup>44</sup>Id. at 136, 159.

<sup>45</sup>Elzinga, "Beer," 192.

<sup>46</sup>According to Scherer, the Falstaff Brewing Co. was able to acquire a large amount of capacity in different parts of the country for about one half the per barrel cost of constructing new capacity. Industrial Market Structure, p. 119.

<sup>47</sup>The El Paso case is an example of the former.

## CHAPTER VI

### CONCLUSION

I began this study with the observation that the theoretical literature dealing with the impact of potential competition on the behavior of firms in threatened markets was inadequate because it concentrated almost exclusively on the role of pricing policy as the primary decision tool with which these firms could deal with the entry threat. Specifically, I felt that merger activity afforded firms the opportunity to accomplish some of the same ends as limit pricing, and in subsequent chapters I developed a model which integrated both pricing policy and mergers into a single framework.

#### 6.1 Recapitulation

In the initial chapters of this thesis, I developed a simple model of the behavior of a group of oligopolistic firms trying to maximize the present value of their joint long-run profits given the constraint of potential entry on a large scale by a single firm. I assumed that in addition to the traditional policies of limit pricing and expanding the size of the group, the firms also had the option of merging with the potential entrant either before or after de novo entry would otherwise take place if the

limit-pricing plan were not chosen.

The most important result of the model is that there are conditions under which one or both of the merger plans might dominate the other two responses. In particular, the merger plans are favored by factors which result in a relatively low limit price (low entry barriers, elastic demand, and a large market relative to the output of a plant of minimum efficient scale) and those which tend to make an expansion of the group size expensive in terms of coordinating and/or policing the group's activities (an initially large membership). Other favorable conditions are low merger transaction costs relative to the benefits involved and low probabilities of either a contested merger bid or an antitrust challenge.

An examination of the sensitivity of these results to some of the model's more restrictive assumptions did not find that the fundamental conclusion that merger options might still dominate was affected, but some of the individual results were altered. If demand is growing rather than stagnant, for example, the three entry-inducing policies are more likely to dominate limit pricing, all other things being equal. In addition, entry by merger would be somewhat less likely than post-entry merger or cartel expansion, the trade-off between the latter two being unaffected. Also, relaxing the assumption that capital is indestructible with no alternative uses once it is installed tended to favor carteli-

zation and post-entry merger relative to the two other plans in much the same way as growing demand does. Finally, the possibility of a successful antitrust challenge or of losing a merger-bid contest tend, as one might expect, to put the two merger plans at a disadvantage relative to limit pricing and cartel expansion.

After the sensitivity analysis, I briefly addressed the question of how one might extend the basic model to include the possibility of entry by more than one potential entrant. This discussion demonstrated some of the complexities such a task might encounter--especially from various forms of interdependence among the decisions the group might make with respect to different entrants--as well as some rather simple cases. No attempt was made, however, to examine the impact of such an extension on the comparative static results of earlier chapters.

Finally, in Chapter V I sketched the details of a number of examples of the behavior of actual firms which tended to be consistent with some of the model's predictions. While not constituting a very thorough empirical investigation of those predictions, the examples at least suggest that mergers have been used by established firms in preference to limit pricing or cartel expansion to deal with the threat posed by a potential or newly entered competitor.

## 6.2 Further Extensions

There are, it seems to me, a number of directions in

which research can proceed from this point. To begin with, the model used in this study is somewhat cumbersome and would be of greater value if translated into a more dynamic form, one more akin to the more recent limit-pricing models. Such a change might be of use in undertaking a more complete analysis of the multiple-entrant cases, both when entry is on a large and small scale. Such a recasting might also be able to encompass the possibility of additional decision variables, such as advertising expenditures levels and investment in research and development.

In addition, greater attention should be devoted to the role of the entrant in developing the basic model. In this study, the entrant was assigned an essentially passive role, with the choice of strategies being determined solely by the cartel's evaluations of the different parameters. In the real world, of course, the entrant and established firms might interact in a number of ways, and the entrant might have strategies of its own which would influence the established firms' choice of responses.<sup>1</sup>

Finally, there is definitely room for much empirical work, both to test the implications of this model and to provide a better understanding of specific instances of past or present firm behavior. For example, a study of the growth of the major steel companies in the first half of this century suggests that the elimination of a future competitor may have motivated U.S. Steel's 1907 acquisition

of the Tennessee Coal, Iron, and Railroad Company, a merger which caused some controversy at the time.<sup>2</sup> This model might well provide insight into this question and the more general topic of the development of the steel industry after the formation of U.S. Steel. On the whole, a review of past market and product-extension and vertical mergers might produce a large number of examples which would provide useful data for empirical research within the framework of this model.

### 6.3 Conclusion

For the most part, I do not feel that this thesis generates any significant policy implications for anti-trust authorities in the United States: the danger of mergers between established firms and/or firms which are potential competitors has long been recognized by both economists and the courts.<sup>3</sup> Indeed, as I pointed out in the first chapter, the so-called potential competition doctrine has been a primary weapon with which antitrust authorities have attacked conglomerate mergers since the late 1950's.

The importance of this work lies not in the addition of yet another item to the laundry list of merger abuses but rather in the theoretical understanding of firm behavior regarding potential entry. At present, economic theory recognizes that potential entry is a regulator of firm behavior and may lead firms to keep prices lower than

they would otherwise wish and that some firms are motivated to merge with potential entrants to remove this threat. But theory has failed to ask why some firms should choose one response while another chooses the other. Both are alternative means of preventing the establishment of an independent firm as a direct competitor in the existing firm's market, and not viewing the two in a common framework not only fails to capture some of the freedom of action actually open to real firms but may also lead one to incorrect predictions about market behavior. Specifically, this thesis demonstrates that in some cases traditional limit-pricing models can lead one to predict lower prices and profit rates for established firms over the long run than would a model which includes the merger option as well.

On the whole, then, the value of this work lies in pointing out the complexity of firm behavior in response to the threat of entry and the danger of ignoring this complexity. I have extended the basic limit-pricing model by adding one more decision variable, merger. The next step is to examine the effect of including the many other such variables as well.

Footnotes

<sup>1</sup>It might be noted that this rather wooden handling of potential entrants is also a characteristic of most limit-pricing models.

<sup>2</sup>Gertrude Schroeder, The Growth of Major Steel Companies: 1900-1950 (Baltimore: Johns Hopkins Press, 1953,) p. 130.

<sup>3</sup>The model may, however, have applications in countries where merger policies are more lax.

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