Chapter 9

PREDATION, MONOPOLIZATION, AND ANTITRUST

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Contents

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1. Introduction

In this chapter, we shall study a wide range of strategies that can be employed by incumbent firms to either protect or to extend their market shares against competitive attacks by actual and potential entrants. The hallmark of these strategies is that, invariably, they reduce the expected level of profits that incumbent's rivals – present and future – can hope to earn. As such, they differ from those types of conduct whose aim is to implement and enforce collusive arrangements among market participants. Unlike many collusive strategies, these hostile and exclusionary strategies which are the focus here, and which include low prices, output expansions, introductions of new products, redesigns of the existing products, promotions, and so on, are difficult to distinguish from and, in fact, are a part and parcel of market rivalry that economists find salutary for economic welfare, that policy-makers wish to promote, and that business leaders often deplore (but find unavoidable).

We spend most of this chapter surveying descriptive models in which an incumbent firm engages in "battles for market share". With the help of those models, we inquire under what conditions an incumbent can profitably extend its share or protect it against encroachments by actual and potential rivals. The focus is, thus, on those hostile and exclusionary strategies that actually emerge in equilibria of (reasonably) well-specified models of market rivalry. Finally, whenever possible, we explore the welfare properties of these equilibria and inquire whether some restrictions on incumbent firm behavior could have improved the equilibrium outcome, from the social standpoint.

The interest in those questions is not solely academic. In the United States, in the European Community, and in some of the EC member states, diverse laws and public policies restrain market behavior of firms. It is, therefore, important to examine the underpinnings of those policies, study their soundness, and provide suggestions for reforms.

Theoretical models studied here provide a guarded support for the proposition that strategic choices made by dominant firms are not invariably consistent with the objective of welfare-maximization and that some constraints on firm behavior may, in fact, increase welfare. That is, in some reasonably realistic models, constraining the dominant incumbent firm actually improves welfare. These theoretical findings and prescriptions are difficult to translate into workable and enforceable standards that in *actual market settings* would, without fail, promote conduct that enhances social welfare and would discourage conduct that harms welfare. The source of the problem is the strategic setting itself. In the context of strategic interactions, it is difficult to distinguish between those actions which are intended to harm actual (and potential) rivals that stifle competition, and thereby

reduce economic welfare, and those actions which harm present rivals and discourage future entry but which, nevertheless, promote economic welfare. Or, as legal scholars are often fond of saying, actions which are consistent with "competition on the merits".

Here, then, the challenge for industrial organization theory is twofold. The first is to identify circumstances in which single-firm strategies have adverse effects on welfare. The second is to provide workable rules – if such are needed – that could be used as a basis for setting policies that restrain the conduct of dominant incumbent firms. Although some progress has been made on both fronts, it is fair to say that much work is still needed.

The main advance offered by the strategic approach to the analysis of single-firm conduct over the traditional methodology is that it tries to embed the concepts of purpose and intent into sound economic models in which strategy sets and information available to present and future market participants are made explicit. This new "new learning" about dominant firm behavior, which builds on strategic considerations, suggests that welfare-reducing, aggressive and exclusionary conduct is more likely than would be indicated by the old "new learning", which applied static models of competition and monopoly to the analysis of profitability of these types of strategies. At the same time, by pointing out the irrelevance of noncredible threats for market outcomes, the strategic approach more precisely characterizes the set of scenarios in which aggressive and exclusionary conduct can plausibly occur in equilibrium.

In what follows, we review these practices which can be used by an incumbent firm to extend or to protect its market share. In Section 2 we present a fairly general model of strategic conduct. In Section 3 we discuss economic models in which pricing and nonpricing actions may induce the exit of rivals. Section 4 looks at actions that do not necessarily lead to rivals' exit but, instead, place rivals at a competitive disadvantage, in particular by raising their costs. Section 5 considers scenarios in which anticompetitive conduct is facilitated by governmental policies and actions. In Section 6 we review various tests that have been devised to sort out "procompetitive" from "anticompetitive" conduct. Brief conclusions are offered in Section 7.

Note on terminology. In the next four sections, we shall term *anticompetitive* or *predatory* those aggressive and exclusionary business strategies that, when deployed, have the effect of lowering a properly evaluated measure of social welfare. This usage is not entirely consistent with the standard usage in antitrust case law and literature, as is made clear in Section 6.

Note on legal setting. In the United States, single firm conduct is scrutinized primarily under Section 2 of the Sherman Act, which deems it illegal to "monopolize, or attempt to monopolize... any part of the trade or commerce...". In Europe, unilateral conduct is scrutinized under Article 86 of the Treaty of Rome, the treaty for the European Economic Community. The Article prohibits "any

abuse... of a dominant position". Such abuse may consist of, for example, imposing unfair selling prices, limiting production or technical development to the prejudice of consumers, and imposing tie-ins.

In the United States, an important development in the area of Section 2 enforcement has been a growing importance of economic analysis in the process of assessment of firm conduct. This trend is best evidenced in the recent Supreme Court decision in *Japanese Electronics*, a fifteen-year-old predation case. Reasonably sound analyses of various manifestations of foreclosure strategies have been offered by the Supreme Court in *Hyde*, *Northwest Stationers*, and *Aspen Ski*.[1] There is less evidence, on the other hand, that the European Community Court of Justice has been greatly impressed by economic analyses of anticompetitive conduct. At the same time, a recently settled EEC action against IBM implicitly focused on the potential for strategic abuses of technological leadership: a possibility which has not been warmly received in the U.S. courts but which, nevertheless, is quite consistent with the strategic view of dominant firm conduct.

Note on the legal literature. In this chapter we generally refrain from discussion of antitrust cases in the United States or elsewhere. For the analysis of U.S. law, the reader is referred to Sullivan (1977), Areeda and Turner (1978, vol. III), and Areeda (1982). Areeda and Hovenkamp (1986) and Hovenkamp (1985) provide an up-to-date discussion of the cases and legal doctrines from a legal-economic perspective. A more selective discussion can be found in Bork (1978), which contains an influential critique of Section 2 enforcement, in Posner (1976), and in the Posner and Easterbrook (1981) casebook. For the European Community, Fox (1984, 1986) and Hawk (1986) are excellent sources which offer a comparative vantage point. A reader who wishes to stay current with the developments in the law must read court decisions and articles in the law reviews.

2. Framework for economic analysis of dominant firm conduct

Economic and legal assessment of the welfare consequences of strategies that firms use to preserve or enhance market share is difficult for at least the following reasons. First, these business practices and strategies are generally part and parcel of competitive interactions in the marketplace. Thus, price-cutting, introduction of new products, promotional campaigns, etc. all constitute reasonable responses by incumbents to increased actual or potential competition [Porter (1980, 1985)].

[1] *Hyde v. Jefferson Parish Hosp. Dist. No.* 2, 104 S. Ct. 1551 (1984); *Northwest Wholesale Stationers v. Pacific Stationery & Printing Co.*, 105 U.S. 2613 (1985); *Aspen Skiing Co. v. Aspen Highlands Skiing Corp.*, 105 S. Ct. 2847 (1985).

Second, many practices, while not fully consistent with firm behavior in the idealized textbook model of perfect competition, can, nevertheless, often be explained on efficiency grounds. Thus, for example, "technological tie-ins" [Sidak (1983)] which entail bundling of various complementary components of a system, or even refusals to deal with a rival firm, may be justified on the ground that they enable the firm to earn a reasonable rate of return on its investment in R&D or in the creation of new information.

Third, some of these practices, while potentially harmful to consumers, do not harm present or future competition. That is, they do not elevate entry barriers, induce exit of an existing rival, or deter socially desirable entrants from coming into the market. For example, a tie-in designed to facilitate price discrimination can lower consumers' welfare but need not be harmful to competition as it might when it is imposed by a monopolist unthreatened by potential entrants. At the same time, exit-inducing and entry-deterring behavior can improve welfare if it keeps the market from becoming overcrowded.

Fourth, many of these practices that are scrutinized for their effects on competition and welfare are sufficiently unusual to be unfamiliar to jurors, judges, or economists. Consequently, a reasonably reliable assessment of their effects is difficult [see Williamson (1985) for a more complete discussion].

Economic analysis of firm conduct proceeds on the plausible assumption that a firm's decision-makers are motivated in the choice of their actions by the goal of long-run profit maximization[2] and that they have reasonable estimates of how their actions affect their firm's profitability and the profitability of their rivals. As part of profit maximization, a firm's management can engage in potentially *anticompetitive* conduct on three interrelated fronts. First, they can engage in practices designed to deter potential entrants. Such pure deterrence strategies need not harm existing rivals of the dominant firm.[3] Second, they can engage in practices that disadvantage actual rivals, without necessarily causing their exit, but which relax the competitive constraint exercised by them over the dominant firm. Third, they can engage in actions that actually cause the exit of an existing rival or rivals. These types of actions can have a substantial deterrence effect on potential rivals and, in fact, may only be rational if they have this demonstration effect. Similarly, precommitments made purely for deterrence purposes, such as investment in capacity, may harm existing rivals and facilitate aggressive strategies towards actual competitors. Furthermore, actions that disadvantage actual rivals can, in principle, disadvantage potential rivals as well.

[2] This is a significant simplification because it is well established that managers may pursue objectives other than profit maximization. See Chapter 3 by Bengt Holmstrom in this Handbook. Nevertheless, we shall assume that a firm's owners provide incentives for the managers to advance that goal.

[3] These practices, and others, are analyzed by Richard Gilbert in Chapter 8 of this Handbook.

We consider a dominant firm that is facing a rival or a well-defined group of rivals. The subject of the analysis is the response of the dominant incumbent firm to the act of entry and to the strategies adopted by the new rival. We do not focus explicitly here on purely entry-deterring strategies.

We can model strategic interaction between the incumbent and the rival entrant in a variety of ways. Consider the incumbent's profit function:

$$\pi^{\mathrm{I}}(\cdot) = \pi^{0}\left(a_0^{\mathrm{I}}, a_0^{\mathrm{E}}\right) + \pi^{\mathrm{f}}\left(a_1^{\mathrm{I}}\left(a_0^{\mathrm{I}}, a_0^{\mathrm{E}}\right), a_1^{\mathrm{E}}\left(a_0^{\mathrm{I}}, a_0^{\mathrm{E}}\right); a_0^{\mathrm{I}}; a_0^{\mathrm{E}}\right). \tag{2.1}$$

In expression (2.1), superscript I stands for the "incumbent" and E stands for the "entrant". In (2.1), we disaggregate I's profits into current profits, $\pi^0(\cdot)$, and into (appropriately discounted expected) future profits, $\pi^{\mathrm{f}}(\cdot)$. The pair $(a_0^{\mathrm{I}}, a_0^{\mathrm{E}})$ denote the current period actions of I and E. It is important to emphasize here that the a's can represent vectors of complex actions, as will be discussed later. The level of future profits depends on future actions of I and E, namely $a_1^{\mathrm{I}}(\cdot)$ and $a_1^{\mathrm{E}}(\cdot)$, respectively, which are in turn related to the current period actions of the two players. We also posit that $\pi^{\mathrm{f}}(\cdot)$ depends directly on $(a_0^{\mathrm{I}}, a_0^{\mathrm{E}})$.[4]

For the purpose of the analysis, we assume that a_0^{E} is given and focus on the optimal choice of the incumbent's current action, a_0^{I}. We assume that the incumbent dominant firm optimizes against the rival's current action, i.e. acts in response to entry or some market-share-enhancing aggressive action by an existing rival. [Formulation (2.1) also allows for simultaneous moves by the incumbent and the rival, however.] The incumbent also takes into account the future consequences of its current action, with the understanding that the future will evolve optimally. (Here we can point out that in any litigation in which monopolization is alleged, the plaintiff must identify that set of the incumbent's actions which it considers to be anticompetitive. Hence, a_0^{I} is that action which has triggered the antitrust complaint.)

In formulation (2.1), a_0^{I} is not restricted to pricing conduct: it can stand for any form of business strategy including R&D investment, capital expansion, raising rivals' costs by foreclosing access to essential inputs, advertising, rent-seeking in political and legal arenas, or even a choice of managers to run the firm [Fershtman and Judd (1984)]. It is important to recognize that predation can take forms other than price-cutting.[5] The reason for this lies in McGee's (1958) observation that price predation is rarely, if ever, profitable for a dominant firm

[4] We have given (2.1) an intertemporal interpretation. An alternative interpretation treats $\pi^0(\cdot)$ as profits in one market and $\pi^{\mathrm{f}}(\cdot)$ as profits in some other, strategically interrelated, market [see, for example, Bulow, Geanakoplos and Klemperer (1985)]. This interpretation is exploited in various models of reputation-building, as discussed in Subsection 3.1.2 below [see, for example, Easley, Masson and Reynolds (1985)].

[5] Areeda (1982) advances the position that many varieties of nonpricing conduct of dominant firms should be free of scrutiny for their potential anticompetitive effects.

because the costs of a predatory price-cutting strategy tend to increase with the size of the market share of the predator whereas the rival's losses are smaller the smaller is its market share. McGee's assessment of rationality of price predation can be criticized for at least three reasons: first, if the predator can effectively price discriminate across markets or customers then the costs of price predation need not be related to market share; second, price predation in one market can have spill-over effects in other markets – a fact that McGee does not fully appreciate in his cost–benefit calculus; and third, the predator may have no other option but to rely on price as a signal of market conditions that are relevant to rivals' decision whether or not to remain in the market.

Nevertheless, it is correct to conclude that the firm contemplating aggressive market strategy will seek the cheapest strategy that will enable it to accomplish the desired goal of inducing exit and/or discouraging entry. In particular, it may select a strategy whose cost does not increase with market share. For example, per-unit costs of an R&D program decline with the size of the innovator's market. The same may hold for advertising and for raising rivals' costs through manipulation of regulatory policies [Bartel and Thomas (1986) discuss economies of scale in regulatory compliance].

Differentiating expression (2.1) with respect to a_0^{I}, we obtain the first-order necessary condition for the choice of a_0^{I}:

$$\frac{\mathrm{d}\pi^{\mathrm{I}}}{\mathrm{d}a_0^{\mathrm{I}}} = \frac{\mathrm{d}\pi^{0}}{\mathrm{d}a_0^{\mathrm{I}}} + \frac{\partial\pi^{\mathrm{f}}}{\partial a_1^{\mathrm{I}}} \cdot \frac{\mathrm{d}a_1^{\mathrm{I}}}{\mathrm{d}a_0^{\mathrm{I}}} + \frac{\partial\pi^{\mathrm{f}}}{\partial a_1^{\mathrm{E}}} \cdot \frac{\mathrm{d}a_1^{\mathrm{E}}}{\mathrm{d}a_0^{\mathrm{I}}} + \frac{\partial\pi^{\mathrm{f}}}{\partial a_0^{\mathrm{I}}} = 0. \tag{2.2}$$

Consider initially the first and fourth terms in (2.2). The first term captures "innocent" short-term effects of an action on I's profits. In the absence of strategic interactions and direct intertemporal linkages in the profit function, the optimal choice of a_0^{I} would be governed by the direct derivate $\mathrm{d}\pi^{0}/\mathrm{d}a_0^{\mathrm{I}}$. In the presence of direct intertemporal links, the incumbent must also consider the direct consequences of the current action on future profits via the partial derivative $\partial\pi^{\mathrm{f}}/\partial a_0^{\mathrm{I}}$.

Turning now to the second and third terms in (2.2), we note that potentially anticompetitive strategic interactions enter through these components of the expression. For example, the second term can capture the fact that the level of the current action may make future aggressive behavior more profitable. The third term can capture the fact that the choice of the current action can make the entrant less aggressive in the future (in the extreme case, the current choice of a_0^{I} can cause the entrant to exit, i.e. to select $a_1^{\mathrm{E}} = 0$).

Plainly it would be wrong to conclude that a dominant firm behaves anticompetitively when it considers the indirect profit effects of an action in the choice of that action, as displayed in the second and third terms of equation (2.2). Such a

definition of anticompetitive behavior would be most unfortunate: it would frequently condemn as illegal actions those that (a) elevate consumers' welfare and (b) are part of innocent competitive interactions. For example, let a_0^I be the incumbent's investment in R&D. Such an investment will have an impact on I's next-period optimal actions. Thus, successful process R&D may enable I to significantly lower its next period's product price. Similarly, successful R&D effort may cause E to withdraw its product offerings, which, in turn, further elevates I's future profits. Furthermore, it would be unreasonable to expect I to disregard the impact of its R&D program, for example, on the viability of E.

In fact, it is important that whatever legal restrictions are imposed on single-firm conduct, that they do not prevent the incumbent from exploiting the available intertemporal complementarities on both the demand and cost sides. This admonition is especially relevant for the proper public policy treatment of nonprice strategies such as capacity expansion, advertising, introduction of new products, or even various exclusionary contracts, all of which have intertemporal profit implications. Even current pricing decisions have intertemporal profit implications, as when current prices are used as signaling devices (see Subsection 3.1.3). All this implies that if the dominant firm accounts for the effect $\{(\partial \pi^f/\partial a_1^I)(da_1^I/da_0^I)\}$ in its optimal choice of a_0^I, it is not necessarily behaving in an anticompetitive manner.

Consider next the term $\{(\partial \pi^f/\partial a_1^E)(da_1^E/da_0^I)\}$. As we have already indicated, in a strategic context firms factor in the effects of their actions on their rivals' reactions. For example, any firm is likely to assess the effects of its R&D expenditures on the viability of rival offerings. In particular, a firm's investment program (including capacity expansion, R&D, and advertising) may only be profitable if it actually causes the exit of its rivals and enables the innovator to garner the whole market, or retard entry into an already overcrowded market. Thus, while causing its rivals' exit or retarding entry may be viewed as monopolization par excellence, such actions may, in fact, be conducive to social welfare maximization.

The preceding discussion suggests that it would unduly restrict firms' conduct, and most likely harm social welfare, if incumbent firms were to be forced to select only those actions that are short-run profit maximizing. On the other hand, it does not advance matters to say that incumbent firms should be allowed to maximize long-run profits. Such a posture would allow firms to select a_0^I according to condition (2.2) above. Consequently, it would rule out the possibility of ever finding any firm engaging in anticompetitive behavior precisely because rational anticompetitive behavior maximizes long-run profits, hence is consistent with (2.2). To escape the difficulties inherent in defining anticompetitive behavior in a strategic context, one can take refuge – as we shall in the next sections – in a social welfare criterion and use this criterion to scrutinize firm conduct. From that vantage point, single-firm conduct is anticompetitive if it

affects competition (i.e. actual and potential rivals) and lowers social welfare. However, the welfare criterion cannot be easily implemented in the context of antitrust litigation.[6] Various efforts, discussed in Section 6, have been made to devise tests of anticompetitive conduct which do not rely explicitly on the welfare criterion. As such, these tests cannot always be consistent with the welfare criterion. How well they perform is a matter of debate which will be briefly reviewed in Section 6.

3. Pricing and nonpricing models of anticompetitive behavior

In this section we look at various models of pricing and nonpricing strategies that involve the use of the predator's competitive strengths to muscle, or drive, its rival out of the industry and deter future entry. Subsection 3.1 examines the use of pricing to achieve this end, while Subsection 3.2 examines nonpricing actions.

3.1. Predatory pricing

The prevalence of predatory pricing has been the subject of heated debate that is difficult to resolve on empirical grounds. Various commentators have argued, however, that in several markets pricing has been used to create or maintain high seller concentration. The best-known example is that of the Standard Oil Company which, under the leadership of John D. Rockefeller, attained a 90 percent market share of the U.S. petroleum refining industry between 1870 and 1899. Among the many practices[7] used to attain this position was price warfare practiced openly both by Standard Oil and by "independent" distributors actually under its control. Whether or not this was a shrewd strategy is subject to debate. There is little doubt, however, that Standard Oil at least attempted to use pricing as a weapon to drive its rivals out. In a letter to H.A. Hutchins, an associate, Rockefeller wrote in 1881:

> We want to watch, and when our volume of business is to be cut down by the increase of competition to fifty percent, or less, it may be a very serious question whether we had not better make an important reduction [in price], with a view of taking substantially all the business there is [Scherer (1980, p. 336)].

[6]Scherer (1976) and Comanor and Frech (1984) disagree with this view. Scherer's position is criticized in Areeda and Turner (1975) and Easterbrook (1981a).

[7]Other strategies included securing discriminatory rail freight rates and foreclosing supplies of crude oil. See Scherer (1980, pp. 336–337) for a more detailed discussion and for other references.

The activities of a conference of shipowners in the China–England trade provides a second example. Yamey (1972) reports that, as in the Standard Oil case, the conference used a variety of strategies to keep out new entry. One of these strategies was the undercutting of freight rates when rival vessels were present. In particular, the conference decided that:

> if any non-conference steamer should proceed to Hankow to load, independently any necessary number of conference steamers should be sent at the same time to Hankow, *in order to underbid the freight which the independent shipowners might offer, without any regard to whether the freight they should bid would be remunerative or not* [Yamey (1972, p. 139), emphasis added].

As a result of this decision, when three independent ships were sent to Hankow, the conference responded by sending in their own ships and freight rates fell dramatically. The House of Lords concluded that the rates were "so low that if they [the conference] continued it they themselves could not carry on trade".[8]

The theoretical literature on predatory pricing analyzes three major sets of models: those based on asymmetric financial constraints (the long purse predatory scenarios); those based on reputation; and those based on signaling.[9] Roberts (1985) provides a briefer but more technical review of these models. Virtually all models focus on the case of duopoly in which case, since new entry or re-entry is assumed away or does not occur in equilibrium, the reward to inducing exit is the difference in the present value of the flow of profits from monopoly and duopoly.

The basic idea behind the long purse models is that a firm with greater financial resources can outlast its rival in a "fight to the death" and is, therefore, in a position to drive its rival out. In the signaling models there is some asymmetry of information (usually about the firms' costs or industry demand conditions) and the predator prices low in order to convince its rival that conditions are such that the rival is better off exiting (because the incumbent's costs are low or industry demand is low). The reputation models, by contrast, simply assume that it is feasible to drive the rival out and instead focus on a particular aspect of the profitability of doing so, namely the effect that this might have on future entry.

Although the feasibility and profitability of predatory pricing are necessary conditions for predation to be rational, they are not sufficient. Even if the increase in post-exit profitability is sufficient to compensate the predator for the costs incurred during its predatory episode, the predation will only have been

[8] Other examples of alleged predatory pricing include Borden's price warfare against firms selling reconstituted lemon juice (in competition with its ReaLemon brand) and General Food's response to the entry of Folger's coffee in competition with Maxwell House. For an extensive discussion of this case see Schmalensee (1979) who also offers a plausible rule for testing for predatory conduct. See also Scherer (1980, pp. 335–340) for additional references.

[9] There is also an emerging strand of inquiry which analyzes markets in which there are increasing returns. We make some remarks on this work in our concluding comments to this section.

rational if there were no more profitable strategy at the predator's disposal for achieving the same result. Although this may seem obvious, it was not until the appearance of McGee's (1958) article that the implications of this notion were clearly articulated.

McGee argued that merger is always a preferred alternative to predation. The argument is straightforward. Consider two firms that operate in a single market and suppose that there is no possibility of new entry or of re-entry by a firm that exits. Furthermore, suppose that it is feasible for one of the firms to drive its rival out and that the monopoly profits that would accrue post-exit are sufficient to compensate the predator for its reduction in profits during the predatory episode. Compare that predatory strategy with the alternative strategy of a merger prior to the predatory episode. Clearly the profits of the merged firm would exceed the sum of the profits of the predator and the rival under the predatory scenario. Even if the predator can perform as well as the merged entity post-exit, the merged firm would have earned monopoly profits before the exit instead of the low profits (or losses) that would result from the cut-throat predatory pricing. Absent any asymmetries of information, the firms will both recognize that the outcome from the merger dominates that from predation and thus negotiate merger terms that will make them both better off. Thus, McGee argues, even if it is feasible, predation is irrational.

McGee's argument has been criticized on several grounds. First, the point of the reputation models (which we discuss in greater detail below) is that much of the benefit from an episode of predation is the impact that it has on *future* entry or on entry in other industries. Indeed, if the monopolizing firm shows a willingness to merge with any rival, it may face a stream of entrants who enter just for the possibility of being bought out [see Rasmusen (1985) for a model along these lines]. Thus, the simple single-market calculus above is inappropriate in a multi-market or multi-entrant context. Second, the same externality arises in models of predation based on signaling. A firm that is successful in convincing its current rival that exit is the most profitable strategy, also thereby has an effect on later entry. Third, there are legal constraints on mergers. The elimination of the rival is most advantageous when it results in a large increase in market concentration. However, it is precisely in these circumstances that a proposed merger is likely to violate antimerger legislation. In choosing between two unlawful methods of increasing its market power, Posner (1976) argues that a firm may choose predation since it may be more difficult to detect.[10]

[10]In a more recent article, McGee (1980) counters that these same antimerger laws render predation unattractive as well. Once the predator has successfully driven its rival from the market it may be prevented by anitmerger legislation from buying its rival's assets. Therefore, "physical capital remains, and will be brought back into play by some opportunist once the monopolizer raises prices..." [McGee (1958, pp. 140–141)]. McGee's counterargument assumes that the rival's assets are industry specific. If this is the case, however, his argument is correct only if the "opportunist" who buys up the rival's assets has reason to believe that it will enjoy a more fortunate fate at the hands of the predator. In this regard, see the discussion on reputation for predation below.

Furthermore, in those cases in which a merger is possible, the terms of the merger may themselves depend on the actions the firm can credibly threaten should the merger negotiations fail. Whether or not predatory pricing is a credible threat under those circumstances depends on the rationality and feasibility of such behavior. Thus, even where mergers are possible, an understanding of predatory pricing is required. We therefore turn to an examination of theories of predatory pricing.

3.1.1. The long purse

Many students of predation have suggested that the primary means of inducing exit consists of waging a price war that inflicts losses on the rival until its resources are exhausted. Clearly for this to be a feasible strategy for the predator, unless it has a cost advantage, it must have greater resources to draw on to outlast its foe.[11]

This "deep pocket" or "long purse" predatory scenario was first modeled by Telser (1966). Telser simply assumed that the rival's ability to raise equity and debt financing was limited and that limit was known by the potential predator who was also assumed to have greater resources. Furthermore, the rival was assumed to have to incur some fixed costs to remain in operation. Thus, by driving the market price below the rival's variable costs resulting in a loss at least as large as the fixed costs, the predator exhausts the rival's reserves and drives it out of the market. Provided the monopoly rents the predator receives once exit has occurred are sufficient to compensate it for the reduction in profits during the predatory episode, predation is both feasible and rational.

Notice, however, that in this model predation would never occur in equilibrium. Since all of the relevant parameters (including the firm's resources) are assumed to be common knowledge, the rival would leave at its first opportunity (or the first hint of predation) rather than waste resources on a pointless price war. Indeed, had it envisioned this showdown, it would not have entered in the first place. Thus, Telser's model cannot provide a complete theory of predation. It does, however, demonstrate that having a long purse may provide a *credible threat* of post-entry predation and thus could deter entry.

This point is made more forcefully by Benoit (1984) in the first full game-theoretic treatment of "deep pockets". As in Telser's model, Benoit assumes that the firms have limited financial backing and that the incumbent can survive a greater length of time before it would be forced into bankruptcy. Furthermore, if the incumbent chooses to fight entry, each firm makes a loss. Benoit's result is that

[11] For example, Edwards writes: "An enterprise that is big in this sense obtains from its bigness a special kind of power, based upon the fact that it can spend money in large amounts. If such a concern finds itself matching expenditures or losses, dollar for dollar, with a substantially smaller firm, the length of its purse assures it of a victory" [Edwards (1955, pp. 334–335)].

even if the incumbent firm would only find it profitable to engage in a successful fight for just *one period*, then, no matter how long the entrant could actually withstand a price war, the only perfect equilibrium involves the entrant not entering and the existing firm threatening to fight in every period.

Benoit's argument uses a backward-induction proof. Consider what happens when the entrant has exhausted its resources and cannot fight for one more period without going bankrupt. If the rivalry has reached that stage, it is optimal for the incumbent to fight for one more period and drive the entrant out of the industry (since it prefers a period of fighting followed by monopoly forever to cooperating with the entrant forever). However, then it is optimal for the entrant to leave at the beginning of the period and save itself what is left of its resources. Now consider the period before the last. The incumbent knows that if it fights the entrant will then, at the end of the period, have sufficient resources for no more than one period. But then, by the argument above, the entrant will leave at the end of this second-to-last period if the incumbent fights, and so the incumbent will fight. This argument proceeds all the way back to the first period in the usual way.

While this result is somewhat striking, the assumptions of the model are extremely strong: it is highly unlikely that how long each firm could survive a price war is common knowledge. Even more troubling, perhaps, is the postulated degree of rationality assumed by the players. Not only must both the incumbent and the entrant be able to carry out the above calculations, but it must be common knowledge that they can. When Benoit relaxes this common knowledge assumption, he finds that indeed entry may occur in equilibrium.[12]

A major gap in the theory is the lack of a convincing explanation for the disparity in the stringencies of the financial constraints facing the incumbent and its rival. In Benoit's complete information model, for example, if the entrant could secure a line of credit from a bank that assured it of greater resources than the incumbent, the unique perfect equilibrium would have the entrant driving the incumbent out, and without ever having to suffer a single period of price war. Moreover, the bank should be perfectly willing to participate in this venture. Thus, for any long purse story to be plausible, it is essential that the inability of the target firm to borrow be explained.

Recognizing this, Fudenberg and Tirole (1985, 1986b) have suggested that such an explanation may be provided by recent advances in the theory of financing under asymmetric information. Suppose that a firm's ability to borrow depends on its own net asset value. Then, in a two-period model, a firm that is relatively well endowed may have an incentive to prey on a less financially solid rival in the

[12] Benoit uses the kind of incomplete information repeated game used by Kreps and Wilson (1982) and Milgrom and Roberts (1982b) which we discuss below. Accordingly, we omit a discussion of Benoit's incomplete information model here.

first period. In so doing, the predator may reduce the rival's asset value below the amount it needs in order to be able to borrow in the second period. In that case the rival will be forced out of the market.

What is required for this argument to go through is a theory that shows that a firm may be unable to borrow if its net asset value falls below some critical level. According to Fudenberg and Tirole, the asymmetric information model of Gale and Hellwig (1986) provides this link. Gale and Hellwig consider a one-period model in which a debtor has a potential project with a random payoff whose expectation exceeds the required capital investment. The debtor is assumed to have insufficient funds to finance the project himself. A bank that finances the remainder only observes the actual return on the project if it incurs some auditing cost. They show that the optimal debt contract has the debtor reimburse the bank some predetermined amount if he chooses not to default. If the debtor defaults, the bank audits and confiscates the entire net return.

If the net asset value of the firm is low, however, so that the bank must finance most of the project, then the probability of audit will be quite high (since the firm will choose to default for more moderate realizations of the return on the project). But then if the audit cost is high, the bank may be unwilling to finance the project at an interest rate that is worthwhile to the firm. Thus, a low net asset value for the firm may deprive it of access to financial markets.

The Fudenberg–Tirole insight is a crucial one for the long purse argument: the very handicap that makes the target firm vulnerable to attack may also foreclose it from access to the financial markets. Given the potential importance of their result, additional work is required to relax their assumptions. In particular, their argument rests on the inability of the target firm to borrow in the second period after its resources have been depleted by the first-period predatory episode. However, if the target firm signed a long-term contract at the beginning of the first period that covered the second period as well as the first, and if this long-term access to financing was observable by others, then the incentive for predation may disappear. This important issue awaits further investigation.

3.1.2. Predation for reputation

Critics were quick to point out that McGee's (1958) argument that predation is generally unprofitable assumed that the predator faces only a single rival. If, however, the predator faces rivals in other markets as well, it may be concerned about the effect of its pricing in one market on its rivals in another market. Yamey (1972, p. 131), for example, points out that "the aggressor will, moreover, be looking beyond the immediate problem of dealing with its current rival. Alternative strategies for dealing with that rival may have different effects on the flow of future rivals."

Table 9.1

		Payoffs	
		Incumbent	Entrant
Incumbent's actions	Predatory prices	P^I	P^E
	Accommodated entry	A^I	A^E

When a predator faces a finite number of potential entrants, Selten's (1978) "chain-store paradox" demonstrates, however, that rational strategies in one market cannot be affected by behavior in another market. There is thus no role for a reputation effect.

The "chain-store paradox" considers an incumbent monopolist in N geographically separated markets. The incumbent faces N potential entrants, one in each market. The potential entrants must make their entry decisions sequentially, one potential entrant making its decision each "period". If entry occurs, the incumbent can engage in predatory pricing against the entrant that will be sure to lead to a loss for the latter. Alternatively, the incumbent can behave in a more accommodating manner. For example, the firms could play Cournot or cooperate (implicitly or explicitly) in setting prices. We can summarize the post-entry payoffs in any particular market as shown in Table 9.1. If an entrant chooses not to enter we can normalize its payoffs to 0 and set those for the incumbent to M, the monopoly payoff.

For this model to have the desired interpretation, we need $M > A^I > 0 > P^I$ (so that the incumbent prefers monopoly to accommodating entry which in turn it prefers to predation) and $A^E > 0 > P^E$ (so that an entrant desires to enter if and only if it will not be preyed upon).

To begin with suppose that $N = 1$. In this setting, if the incumbent is faced with actual entry, it will accommodate it (since $P^I < A^I$). Knowing this, the entrant will enter. Thus, the unique perfect equilibrium is accommodated entry.

Now consider what happens if $N = 2$. Might the incumbent now have an incentive to prey on the first entrant in the hope of scaring the second off? If $P^I + \delta M > (1 + \delta)A^I$, where δ is the discount factor, the incumbent prefers to prey on the first entrant and receive monopoly profits in the second period to accommodating entry in both periods. It seems that in this case the incumbent has an incentive to prey on the first entrant.

The flaw in this logic is what gives rise to the chain-store paradox. When the second period is reached the game looks identical to the incumbent and the (then) single potential entrant, as in the game with $N = 1$. Recall that the unique

equilibrium there entailed accommodation and entry. Thus, the same must be true here. Whether the incumbent practiced predatory pricing in the first period or not is irrelevant to the game that the second potential entrant faces. It is "water under the bridge", and displays of aggressive behavior at that stage will not impress the second potential entrant if it expects rational behavior from the incumbent for the remainder of the game. However, if this is the case, then there is no incentive for predation in the first period. The incumbent realizes that its first-period behavior will not influence the outcome in the second period. Thus, the first-period payoffs are all that are relevant for its first-period decision, and accordingly it will accommodate entry. The unique subgame perfect equilibrium to the game with two potential entrants (or by the same argument, N potential entrants) entails accommodated entry into every market.

This result is counterintuitive. The belief that behavior across markets is related is widespread. For example, Scherer (1980) suggests: "If rivals come to fear from a multimarket seller's actions in Market A that entry or expansion in Markets B and C will be met by sharp price cuts or other rapacious responses, they may be deterred from taking aggressive actions there."

The argument underlying the chain-store paradox relies strongly on backward induction. Indeed, it is readily shown [Milgrom and Roberts (1982b)] that if the incumbent faces an infinite flow of potential entrants (and maximizes the present discounted value of profits) it can use a credible threat of predation to keep out entry.

To see this set $N = \infty$ in the above model. Then the following are equilibrium strategies: the incumbent preys (i.e. prices aggressively and attempts to induce exit) if entry occurs and if it has never accommodated entry; otherwise the incumbent accommodates entry. If entry is ever met by accommodation, every subsequent potential entrant enters; otherwise (if there has been no entry or if all previous entry was met with predation) all potential entrants stay out.

There is no entry along the equilibrium path. The first potential entrant expects to be preyed upon if it enters, and so stays out. The same is then true for all subsequent potential entrants. But why are the first potential entrant's expectations reasonable? If it enters and is preyed upon, the equilibrium strategies of the remaining entrants imply that no further entry will take place. The net present value of the incumbent's profits if it preys is therefore $P^{\mathrm{I}} + \delta M/(1-\delta)$. If it fails to prey on the first entrant, however, it will face entry from all subsequent entrants, irrespective of its future actions. In this situation the incumbent will find it optimal to continue to accommodate all later entry – thus validating the entrants' beliefs – since one period of accommodation rules out any gains from future exit-inducing behavior. Hence, if accommodation occurs in the first period, the net present value of incumbent's profits is $A^{\mathrm{I}}/(1-\delta)$. Thus, predation is worthwhile if $P^{\mathrm{I}} + \delta M/(1-\delta) > A^{\mathrm{I}}/(1-\delta)$ or $A^{\mathrm{I}} - P^{\mathrm{I}} < \delta(M - A^{\mathrm{I}})/(1-\delta)$

(the one-period cost of predation is less than the future benefits from preying this period). This expression holds for δ sufficiently close to 1 since $M > A^{I}$.

This equilibrium embodies extremely simple reputation maintenance. The beliefs of potential entrants that support such an equilibrium are that the incumbent will induce the exit of every entrant. However, if the incumbent ever fails to prey, it loses its predatory reputation (which, notice, at the beginning of the game it has done nothing to earn). Moreover, once it has lost this reputation, it can do nothing to regain it. No matter how many times it later preys on an entrant, if it ever fails to prey it loses its reputation for all time.

Extending the model to an infinite horizon is, for several reasons, an unsatisfactory resolution of the chain-store paradox. First, as is common in infinite-horizon games, this game has many perfect equilibria, one of which is that accommodated entry occurs in every period. Second, the beliefs that sustain the predatory equilibrium are highly implausible. Finally, and most importantly, in many practical situations, such as rivalrous entry into distinct *geographic* markets, the number of potential entrants is finite.

Also, the backward-induction argument of the chain-store paradox is also unsettling, aside from its reliance on the finite horizon, because it attributes an extreme degree of rationality to the players. The pathbreaking work of Kreps and Wilson (1982), Milgrom and Roberts (1982b), and Kreps, Milgrom, Roberts and Wilson (1982), illustrates how important the assumption of rationality is in this setting. Suppose, for example, that instead of the parameter values above, we have $P^{I} > A^{I}$ so that the incumbent actually prefers predation to accommodating entry. In that case, the unique subgame perfect equilibrium is for the entrant to stay out. This is not surprising, of course. If predation is profitable, it will occur. What is surprising is that if there is only a small probability (in a sense about to be made precise) that predation is profitable, it may still occur.

Suppose that it is conceivable that for a particular incumbent it might be the case that $P^{I} > A^{I}$. We will call such an incumbent "tough". There are two possible interpretations of "toughness": either predation is more profitable than accommodation in a single market, or the profitability is lower but the incumbent is "irrational" and prefers to prey even when it is unprofitable to do so. If it is the case for the incumbent that $A^{I} > P^{I}$, we call the incumbent "weak". Finally, suppose that the potential entrant assesses with probability p that the incumbent is tough. One would not want a model of predation to be based on a great deal of irrationality. However, even a small value of p can have dramatic consequences for the willingness of *rational* firms to prey.

To see the effect of the possible presence of a "tough" predator, consider the chain-store model described above, with $N = 2$. Suppose that $(1 - p)A^{E} + pP^{E} > 0$ so that the entrant would enter in a one-period game. There is no pure strategy equilibrium to the game with these parameter values. To see this,

suppose first that there is a pure strategy equilibrium in which the weak incumbent fights entry in the first period. Then the second entrant learns nothing from first-period behavior and enters. But if fighting in the first period does not deter second-period entry, then the weak incumbent has no incentive to fight in the first period. Thus, this cannot be an equilibrium. Now, suppose instead that the weak incumbent does not fight entry in the first-period equilibrium. Then, if the second entrant observes that first-period entry was fought, it will be certain that the incumbent is tough and will stay out. But then even the weak incumbent would want to fight in the first period since it would earn $P^{\mathrm{I}} + \delta M^{\mathrm{I}} > (1 - \delta)A^{\mathrm{I}}$. So there does not exist a pure strategy equilibrium.

The mixed strategies are described by Kreps and Wilson (1982). Here they can be characterized as follows: (i) the first potential entrant enters, (iia) the second potential entrant enters if entry by the first entrant was not fought, and (iib) it randomizes over entering and staying out if entry was fought (the probabilities with which it takes each action are derived below); (iii) the tough incumbent fights entry in both periods; (iv) the weak incumbent randomizes over fighting and accommodating entry in the first period (again, the probabilities with which it takes each action are derived below); (v) if entry occurs in the second period, the weak incumbent accommodates it.

In this equilibrium, the weak incumbent acts as if it is tough in the first period (with some probability) to create a reputation for toughness, i.e. to attempt to persuade future entrants that it is "tough". Obviously, a reputation is more valuable the larger is N.

For these strategies to constitute a perfect Bayesian equilibrium, each action must be optimal at the time it is taken, given the strategies of the other player. Actions (iii) and (v) are clearly optimal. By definition, the tough incumbent prefers to fight entry than to accommodate it. Furthermore, the weak incumbent prefers to accommodate entry in the second period since that is also the last period. Condition (iia) is also satisfied since [from (iii)] only the weak incumbent ever accommodates entry.

We can now turn to condition (iib). Let $\Pr\{f \mid w\}(\Pr\{f \mid t\})$ denote the probability that the weak (tough) incumbent fights in the first period. Then, if the second entrant observes that entry was fought in the first period, it uses Bayes' rule to calculate the probability that the incumbent is tough:

$$\Pr\{t \mid f\} = \Pr\{f \mid t\}\Pr\{t\}/(\Pr\{f \mid t\}\Pr\{t\} + \Pr\{f \mid w\}\Pr\{w\})$$

$$= p/(p + \Pr\{f \mid w\}(1 - p)),$$

where we have used the fact that $\Pr\{f \mid t\} = 1$. If the second potential entrant is to be prepared to randomize [as required in (iib)], it must be indifferent between entering and staying out. This requires that $\Pr\{t \mid f\}P^{\mathrm{E}} + (1 - \Pr\{t \mid f\})A^{\mathrm{E}} = 0$

or $\Pr\{t \mid f\} = A^E/(A^E - P^E)$. Combining this with the expression for $\Pr\{t \mid f\}$ a few lines above (and rearranging), we require that $\Pr\{f \mid w\} = -pP^E/(1-p)A^E$ (which is positive since $P^E < 0$). Thus, if the weak incumbent fights entry in the first period with this probability, the second entrant's posterior estimate that it is facing a tough opponent will be raised by just enough to make it indifferent between entering and staying out. In that case it will be prepared to randomize and condition (iib) will be satisfied.

For the weak incumbent to be prepared to randomize in the first period, i.e. for it to be indifferent between fighting and not, the following must hold:

$$P^I + \delta\big(\Pr\{\text{entry} \mid \text{fights}\}A^I + (1 - \Pr\{\text{entry} \mid \text{fights}\})M\big) = A^I(1+\delta).$$

Rearrangement of this expression shows that the probability with which the second entrant enters, if the first entry was fought, must, therefore, be given by $1 - (A^I - P^I)/\delta(M^I - A^I)$. If the second entrant enters with this probability after the first-period entry was fought, the weak incumbent will be indifferent between fighting and accommodating in the first period and so will be prepared to randomize, satisfying condition (iv).

The remaining condition to be satisfied is (i), that the first potential entrant will enter. This will be true as long as $pP^E + (1-p)(\Pr\{f \mid w\}P^E + (1 - \Pr\{f \mid w\})A^E) \geq 0$.

The above example illustrates the nature of the Kreps–Wilson equilibrium in an extremely simple two-period example. The key point is the following: if the players' prior that the incumbent is tough is only p, in equilibrium entry will actually be fought in the first period with a probability greater than p since, not only does the tough incumbent fight, but also the weak incumbent fights with positive probability. If it fails to fight, it reveals its weakness and faces certain entry in the second period. By fighting, on the other hand, it keeps the entrants in doubt as to its true type, and this may deter second-period entry.

In models with more periods this effect is even more pronounced. Indeed, when there are many periods remaining, the weak incumbent will fight with certainty even if p is very low [see Kreps and Wilson (1982) for the details]. Thus, the firms need only assess a very small probability that the incumbent is of the type that would certainly fight (i.e. that the incumbent is "tough" or "irrational") in order for predation to be rational for "weak" or "rational" incumbents as well.

This example seems somewhat fragile for at least the following reasons: there is incomplete information only about the incumbent's costs, there are only two possible types of incumbent, and the incumbent faces a different potential entrant each period. However, Kreps and Wilson (1982) and Milgrom and Roberts (1982b) show that the reputation effect survives the relaxation of these assumptions.

These models with incomplete information are most powerful when there is long-term, but finite, competition. When the time horizon is infinite, we have seen that equilibrium predation strategies are easy (perhaps too easy) to find without appealing to incomplete information.[13] When the time horizon is short, on the other hand, and if predation is to be a rational strategy, the probability that the incumbent is "tough" can no longer be arbitrarily small.

The focus of the models discussed thus far is on the effect of predation on later entry. In practice, the incumbent may face entry from a number of different potential entrants in each of its geographical markets. Easley, Masson and Reynolds (1985) extend the analysis to this case and Lipman (1985) considers a continuous time version in which the incumbent faces a different potential entrant in each market and where any entrant can enter at any time. A novel feature of these models is that each entrant may decide to delay entry in the hope of learning something about the incumbent from the latter's response to entry by another potential entrant. If that is the case, even if predation does not succeed in deterring entry, it may nonetheless involve a welfare loss by delaying competition. It is not clear how important this effect is likely to be in practice, however, since there is a plethora of other pressures that drive the entrants towards early entry which may well be stronger than the incentive to delay.

3.1.3. Signaling predation

Recently, several models have been proposed that also rely on incomplete information but where, in contrast to the previous subsection, the incumbent's motive is to induce exit rather than to deter entry.

Suppose, for example, that firm 1 (which will emerge as the "predator") has constant marginal costs of production which are either high ($\bar{c}_1$) or low ($\underline{c}_1$). Let the probability that firm 2 assesses that $c_1 = \underline{c}_1$ be given by p. (As usual, p is common knowledge.) Now suppose that firm 2 has constant marginal costs of c_2. Finally, suppose that there are only two periods and that the firms use quantities as their strategic variable.

To make this setting interesting, assume that firm 2 can exit at the end of the first period if it wishes. Furthermore, suppose that it prefers to exit (stay) if it is common knowledge that it is facing the low-cost (high-cost) type of firm 1, i.e. $\pi_2^c(\underline{c}_1, c_2) < 0 < \pi_2^c(\bar{c}_1, c_2)$, where $\pi_2^c(\cdot)$ is firm 2's Cournot profits.

In this setting, firm 1 has an obvious incentive in the first period to convince firm 2 that its costs are low. In that case, firm 2 will leave the market to firm 1 which will then enjoy a monopoly in the final period. This is formally very similar

[13] One should not overstress the importance of the uniqueness of the equilibrium in these models. As Fudenberg and Maskin (1986) have shown, if one varies p (while still keeping it arbitrarily small), one can generate any pair of payoffs for the players that can arise in an infinitely repeated game.

to the limit-pricing model of Milgrom and Roberts (1982a). The only essential difference between the two models is that here firm 2 is already in the market whereas in the limit-pricing model, firm 2 is a potential entrant. In the analogous separating equilibrium, the low-cost firm 1 produces a sufficiently large output that the high-cost type is unwilling to replicate its behavior even if doing so means the difference between monopoly and duopoly in the second period.

In distinguishing itself from the high-cost firm, the low-cost firm produces more than it normally would and causes the first-period price to fall temporarily and results in the exit of firm 2.

Although the model and the equilibrium are closely related to the limit-pricing model, the analysis is somewhat more complicated. Here the amount that each firm of type 1 must produce in a separating equilibrium depends on what firm 2 produces. (When firm 2 is only a potential entrant this complication does not arise.) However, what firm 2 finds optimal to produce in turn depends on what each type of firm 1 produces. To see this, consider a simple example with linear demand, $P = a - bq$, where q is industry output. Let $\underline{q}_1$ and $\bar{q}_1$ denote the output choice of the low and high-cost types of firm 1, respectively.

Firm 2 chooses q_2 to maximize

$$p\{(a - b(\underline{q}_1 + q_2))q_2 - c_2 q_2\} + (1-p)\{(a - b(\bar{q}_1 + q_2))q_2 - c_2 q_2\}. \tag{3.1}$$

Maximizing with respect to q_2 and rearranging gives the best-response function $q_2 = (a - c_2 - b(p\underline{q}_1 + (1-p)\bar{q}_1))/2b$. Thus, q_2 depends on both $\underline{q}_1$ and $\bar{q}_1$. Now, in a separating equilibrium, $\underline{q}_1$ must be sufficiently large so that the high-cost firm prefers to reveal its type rather than to mimic the low-cost type, i.e.

$$\begin{aligned}&(a - b(\bar{q}_1 + q_2) - \bar{c}_1)\bar{q}_1 + \delta\pi_1^{c}(\bar{c}_1, c_2)\\ &\quad > (a - b(\underline{q}_1 + q_2) - \bar{c}_1)\underline{q}_1 + \delta\pi_1^{m}(\bar{c}_1),\end{aligned} \tag{3.2}$$

where $\pi_1^{m}(\bar{c}_1)$ is firm 1's monopoly profits in the second period when it is the high-cost type, and $\bar{q}_1$ is the high-cost type's "regular output". That is simply the output that maximizes $\bar{q}_1(a - b(\bar{q}_1 + q_2) - \bar{c}_1)$, i.e.

$$\bar{q}_1 = (a - bq_2 - \bar{c}_1)/2b. \tag{3.3}$$

In a separating equilibrium, therefore, the low-cost type chooses $\underline{q}_1$ to maximize $(a - b(\underline{q}_1 + q_2) - \underline{c}_1)\underline{q}_1$ subject to (3.2).

In the interesting case where (3.2) is a binding constraint, the equilibrium levels of $\bar{q}_1$, $\underline{q}_1$, and q_2 are obtained by solving (3.1), (3.2), and (3.3) simulta-

neously. In equilibrium, q_1 is often higher than it would be in a simple one-period game since the low-cost type is prepared to produce more than it otherwise would in order to credibly signal its type. But since q_2 is decreasing in q_1 from (3.1), this means that holding $\bar{q}_1$ constant, firm 2 will produce less. But this in turn means that the high-cost firm will produce more than it otherwise would since $\bar{q}_1$ is increasing in q_2 from (3.3).

The first-period separating equilibrium is therefore richer than in the Milgrom–Roberts limit-pricing model. There, the high-cost firm produces its usual one-period output and only the low-cost firm limits prices. Here, both types of firm 1 produce more than their one-period outputs (even though the high-cost firm is not signaling) and firm 2 produces less. The possibility that it is facing a low-cost firm and that such a firm would engage in a predatory expansion of output for signaling purposes intimidates firm 2 into reducing its output. This in turn provides an incentive to the nonsignaling high-cost firm to increase its output.

This formulation of the problem is adapted from Saloner (1987). However, several other papers demonstrate the same idea in different settings. The earliest model is probably due to Salop and Shapiro (1980).[14] They suppose that an entrant can enter a "test market" before committing itself to a national market. This provides the incumbent with an opportunity to demonstrate that it is the kind (low-cost) of firm that is not worth entering against in the national market. Their focus is on the pooling equilibrium. As discussed below, their formulation of "test-market predation" is used by Scharfstein (1984) to develop policy guidelines to prevent test-market predation. Finally, Roberts (1986) formulates an analogous model to the one analyzed above but where the incomplete information is about demand rather than costs. In that model, firm 2 observes only the industry price and not the output of firm 1. Firm 2 is unsure whether demand is high or low and attempts to infer this from the price it observes. For simplicity, Roberts assumes that the level of demand is the same in both periods. In equilibrium, a low price signals that demand is low and firm 2 chooses to exit.

In these models, even if exit is never optimal for firm 2, firm 1 may nonetheless have an incentive for output expansion. The reason is this: even if firm 2 does not leave, firm 1 would prefer firm 2 to believe that it is the low-cost rather than the high-cost firm. This is immediate from (3.1), which shows that q_2 is strictly decreasing in the probability that firm 2 assigns to firm 1 being low cost. If, ceteris paribus, the low-cost firm produces more than the high-cost firm, firm 2 in turn produces less if it believes it is facing a low-cost firm. This idea is originally

[14] In an early paper, Masson and Eisenstat (1975) suggest that asymmetric information may provide an incentive for predation in order to signal that costs are low. They do not present, however, an equilibrium model.

due to Mailath (1984) who derives the separating equilibrium for a continuum of types and also provides conditions for uniqueness of the equilibrium.

The above models typically use a two-period discrete time formulation. Also, one of the firms is typically assumed to be the "natural" predator. The symmetric case in which both firms may be unsure as to whether they can survive against their rival in the long run is examined by Fudenberg and Tirole (1986a). In their formulation, each firm knows its own costs but not those of the rival. In their model, pricing and output decisions are suppressed. Rather, the value of remaining in the industry if the rival has not exited is a general function of time. Thus, the only strategic decision is the exit decision.[15] The model is therefore a game of timing, with each firm deciding when to quit. In equilibrium, exit times are decreasing in the firm's true cost so that each firm becomes increasingly pessimistic about the prospects for driving its rival out as time progresses. An attractive feature of the model is that there is no artificial designation of the predator firm. Unfortunately, since pricing is suppressed, predatory pricing issues cannot be analyzed.

In the signaling models, the presence of incomplete information provides firm 1 with two incentives to increase output. The first is to induce exit, and the second is to induce the rival to curtail its production if it does not leave. These dual incentives have in common that they reduce the firm's perception of the profitability of remaining in the industry. This suggests a third incentive for predation in the first period and one that calls into question McGee's critique of predation: predation *in anticipation of merger* to "soften up" the rival and improve the takeover terms.

This incentive is explored by Saloner (1987). Formally, the above two-stage model is expanded to three. In the first period firms 1 and 2 choose outputs. At the end of the first period, firm 1 makes a take-it-or-leave-it takeover offer to firm 2. If firm 2 accepts the offer, firm 1 has a monopoly for the final period. If firm 2 rejects the offer, the firms again choose outputs in the final period (after firm 2 updates its assessment of the costs of firm 1 using the inferences it makes from firm 1's first-period output choice and its takeover offer price). Here, firm 1 has two incentives to convince firm 2 that its costs are low. If firm 2 believes it is facing a low-cost firm its expected profits in the second period are low and hence it will accept a low takeover price. Furthermore, if firm 2 rejects firm 1's offer (which it would never do in this equilibrium model but which it might do in a richer model with two-sided uncertainty), then firm 2 will produce less in the second period thereby increasing firm 1's profits. Thus, in this model, contrary to

[15] Exit decisions by firms have not been rigorously analyzed in a strategic context until recently. See for example, Ghemawat and Nalebuff (1985, 1987), Londregan (1986), and Whinston (1987).

McGee's claim, even if a merger is possible, strategic pricing is nonetheless likely to occur in order to improve the terms of an acquisition.

In this version of the model a merger is inevitable. Thus, the strategic pricing does not affect the ultimate industry structure, merely the terms at which the monopolization is achieved. Therefore, strategic pricing would not be considered "predatory" under most definitions,[16] since the acquirer's pricing strategy is not responsible for the elimination of the target. However, if there is the possibility of entry in the final period, then the merger is not necessarily inevitable. For example, suppose that the entrant will enter only if the existing firms merge and the entrant believes that firm 1 is the high-cost firm. In that case, the merger will not occur unless the potential entrant has been convinced that firm 1 has low costs. Then, an expansion of output by firm 1 in the first period can achieve several objectives: it can convince the potential entrant to stay out if a merger occurs, it can thereby convince firm 2 to merge, and, finally, it can convince firm 2 to sell out on favorable terms. In this model, the output expansion serves both a limit-pricing function [à la Milgrom and Roberts (1982a)] and a predation function.

A recent study of the activities of American Tobacco from 1891 to 1906 by Burns (1986) lends considerable support to the contention that predatory pricing can improve the terms of a takeover. During that period, American Tobacco acquired some 43 rival firms. Burns estimates that the alleged predation is associated with up to a 60 percent reduction in the acquisition costs of American Tobacco. The benefits of the predation are estimated to have more than offset the reduction of profits during the predatory episodes.

The above signaling models have in common that firm 1 is better informed about some payoff-relevant variable (costs or demand) than is firm 2, and increases its output to signal to firm 2 that conditions are, in fact, not amenable to its continued presence. Much of the same behavior can, however, be derived even when there is no incomplete information but rather uncertainty and imperfect observability. Models of this type have been developed by Riordan (1985) and Fudenberg and Tirole (1986b).

The focus of Riordan's paper is the relationship between a firm's output choice and its rival's past actions, rather than on predation. However, his model is easily adapted to consider predatory pricing. He studies a two-period model like those considered above. In his model, however, demand is uncertain each period and, in contrast to Roberts' model, neither firm has superior information about the level of demand. In addition, neither firm observes the other's output (even ex post). Furthermore, exit is assumed not to be possible. The key assumption is that demand is intertemporally positively correlated. Thus, in the first period, each firm would like to convince its rival that demand is low since the latter will

[16]See the discussion in Section 6 below on formal definitions of predation.

then produce a low output the following period. Since only price is observable, the firm accomplishes this by producing more in the first period than it otherwise would. The observed price is then low leading to the inference that demand is low. Even though the rival firm is not fooled in equilibrium, the firm must still expand output since, otherwise, a high price will result which will lead the rival to make an inference that demand is higher than it actually is. If, in addition, exit were possible, however, a firm that could convince its rival that demand was sufficiently weak might be able to induce the latter to leave the market.

The Fudenberg and Tirole model is similar except that they assume that the uncertainty is about firm 2's fixed costs rather than about demand and the firms have price as the choice variable. Thus, firm 2 observes its profits net of fixed costs but not the fixed costs themselves nor firm 1's price. Firm 1 now has an incentive to engage in secret price-cutting since in so doing it lowers firm 2's net profits. Firm 2 then infers that its fixed costs are relatively high and may exit. The purpose of firm 1's action is to make it harder for firm 2 to infer what its true fixed costs are. Fudenberg and Tirole refer to this attempted tampering with the signal that firm 2 receives from the market about its fixed costs as "signal jamming". This is a good label for the behavior but not for the outcome since, in equilibrium, firm 2 is not fooled and makes the appropriate inferences despite firm 1's attempt to mislead it.

As suggested by the work of Fudenberg and Tirole (1984) and Bulow, Geanakoplos and Klemperer (1985), the conclusions of many of the above models are reversed if the decision variable is changed from outputs to prices with differentiated products or vice versa. For example, in the Roberts or Riordan models, if price were the strategic variable, then firm 1 would want to convince firm 2 that (current) demand is high which would entail charging a higher-than-usual price. The Fudenberg and Tirole model is immune to this criticism since firm 1 wants to convince firm 2 that its profits are low. To do this, it must "attack" firm 2's first-period profits, which it can do either by lowering its price secretly or by expanding output. Similarly, in the Saloner model, firm 1 needs to convince its rival that its profits would be low if it stayed. Since it is signaling that it has low costs, it could do this either by expanding output or by lowering price in a differentiated products model.

3.1.4. Concluding remarks on theories of predatory pricing

The image that populist stories of predatory pricing conjure up are of weak rivals being driven into bankruptcy by the industry giant. Yet the strand of work that has received the most attention, namely the signaling models, is of the gentle persuasion variety. The "predator", with a moderate show of strength, persuades the rival that its resources would be better spent elsewhere. And the reputation models are silent on the question of how the exit is achieved. While there is

nothing to say that the populist view is the correct one, it is nonetheless probably true that the most fruitful avenue for further work is in developing models in which the financial constraints are carefully modeled.

While the long purse story may be able to claim an older ancestry, the signaling models have the edge in their handling of entry. Whereas the long purse story must appeal to the reputations models for its explanation of why the incumbent is not faced with new entry when it attempts to raise its price post-exit, the signaling models have no such problems. The very signaling that induces the entrant to leave the market also persuades others not to enter.

As a final comment, it is worth noting that with the exception of the infinite horizon reputations model, every formal model we have discussed relies on some form of asymmetric information.[17] It is, however, possible to develop other models in which predation is feasible and rational but where all firms are perfectly informed. In industries which are subject to increasing returns, perhaps because of the benefits from compatibility, entrants may only have a small "window of opportunity" for successful entry. If the entry is sufficiently delayed, then the incumbent may be able to close the window of opportunity by pricing aggressively until its secure position has been achieved. Models in which strategic/predatory pricing emerges as a result of the presence of compatibility benefits have been analyzed by Farrell and Saloner (1986a), Hanson (1985), and Katz and Shapiro (1986).

3.2. Nonprice conduct aimed at eliminating competitors

In the previous subsection we examined how a firm could use price as a weapon to drive a rival out of the market and discourage future entry. In this subsection we describe some nonprice mechanisms for achieving the same ends. Unfortunately, the scenarios reviewed below have not attracted the same amount of rigorous analysis as the pricing games.

3.2.1. Predatory product innovation

Recall that we have identified two conditions that are necessary for predatory pricing to be effective, namely that the predator must be capable of driving the rival out of the market, and that it must be able to enjoy a higher level of profitability once that has been achieved. The first condition may be substantially easier to achieve through new product innovation than through a price reduction. Consider the simplest case examined by Ordover and Willig (1981). Suppose that

[17]See Milgrom and Roberts (1987) for a critique of asymmetric information games.

the predator and the rival are producing identical products at marginal costs of c per unit and are competing in prices. Suppose, furthermore, that the predator introduces a new product which it can produce at constant marginal cost of $c + d$ per unit and which consumers value some amount, $e > d$, more than the old product. The equilibrium when the two firms remain active in the market is for the predator to price the new product at a little less than $c + e$. In that case it earns profits while the rival makes no sales. If the rival has even small fixed costs, it will then choose to exit. If there are re-entry barriers, defined as the cost that a firm that has exited a market must incur to resume production, the predator will then be able to raise its price.

Notice that so long as the rival remains viable (so that the price cannot exceed $c + e$), the innovation increases welfare. Yet, if the innovator can raise the price to the monopoly level, there may well be a welfare loss even though the quality of the product has been increased. Schwartz (1985) has demonstrated, however, that the Ordover–Willig characterization of anticompetitive, exit-inducing innovations is unsatisfactory. He shows in a simple model of pre-innovation duopoly that there exist socially valuable innovations which are profitable only due to the monopolist profits forthcoming from the induced exit of the competing duopolist. Schwartz's results are not surprising, given the well-known disparities between social and private incentives to innovate. Consequently, the rationality of anti-competitive product introductions remains unexplored despite its obvious policy relevance. This is unfortunate because, intuitively, such strategies are not subject to the McGee–Easterbrook objection that they impose a higher cost on a predator than on the prey. This point is elaborated in a recent paper by Campbell (1986) that shows in the context of location models that product *redesign*, which makes the incumbent's product more like the entrant's product, can impose greater costs on an entrant than on the incumbent.[18] However, Campbell does not show that the incumbent would so redesign its product in a perfect equilibrium. Indeed, Judd's (1985) analysis shows that the incumbent may have an incentive to redesign its product to accommodate an entrant's new offering.

3.2.2. Predatory compatibility changes

A special case of predatory product innovation, and one which has been the subject of a great deal of antitrust litigation in the United States, occurs when the dominant manufacturer of a system redesigns the system so as to render the components incompatible with those of its rival's components. Even if the old system can still be offered, if the new system is superior, as we discussed above, it

[18] In his attempt to define anticompetitive product innovations, Campbell (1986) makes a distinction between product changes that are designed to increase the firm's own area of consumer interest and those that are designed to diminish the consumer area of a firm's rival. Such a distinction seems spurious since most desirable (and welfare-reducing) design changes have both effects.

can be priced in such a way as to eliminate the sales of the old system. If entry to the new system is foreclosed to the rival and re-entry with the old system is difficult, the predator will be able to raise prices to the monopoly level. Even if the rival is able to compete in the market for the new system, if redesigning its components is time-consuming, the predator will at least be able to enjoy a temporary price increase. [See Ordover and Willig (1981, 1982) for a more detailed discussion of this phenomenon, Farrell and Saloner (1986b) for a general discussion of competitive compatibility issues, and Besen and Saloner (1987) for an exhaustive review of the theoretical literature and its application to policy in the market for telecommunications services.]

3.2.3. Predatory vertical restraints

Ordover, Sykes and Willig (1985) have argued that a firm which has a dominant market position may have an incentive to extend that dominance by integrating forward into its downstream market. This, of course, does not occur if the other firm has an uncontested monopoly position upstream and sells to identical downstream buyers who use the input in fixed proportions and employ a CRS production technology. In that case, the firm is able to appropriate all the potential gains to monopoly power by means of a "perfect price squeeze". If either of the "ifs" fails to hold, however, it may be possible for the firm to extend its monopoly power. The possibility for anticompetitive conduct arises when such leveraging requires that the dominant firm induces the exit of an efficient (or even more efficient) downstream supplier.

Suppose, for example, that there are two groups of final consumers. One group has a higher willingness to pay for either the good produced by the upstream firm alone, or for the system consisting of one unit of the good produced by the upstream firm and one unit of the good produced by the downstream firm. In such situations, the profit-maximizing pricing scheme may involve a low price for the upstream good (which is then purchased only by the low valuation consumers) and a relatively high price for the bundled system (which is purchased by the high valuation consumers). In the presence of competing downstream firms, however, this price discrimination scheme cannot be effectively carried out since the high valuation users will be able to put together a low-priced good from the upstream firm with a low-priced good from the rival downstream manufacturers.

A variety of strategies may enable the upstream firm to extend its market power in these circumstances. For example, where the downstream good must be used with the upstream good as part of a system, the upstream firm can attempt to condition the sale of the upstream good on the purchase of its brand of downstream good; or it can make the warranty of the upstream good conditional on the use of its brand of downstream good. Alternatively, where the upstream and downstream goods must be physically interconnected, the up-

stream firm can offer its component to rival sellers at a disadvantageous price. All of these strategies which disadvantage downstream rivals may raise welfare, if price discrimination is desirable, for example. And they frequently have a sound business rationale as when informational imperfections require tying of components in the market. In limited circumstances, the exclusionary strategies mentioned above result in undue restrictions on the scope of choices open to consumers and may harm welfare.

3.2.4. Predatory product preannouncements

Farrell and Saloner (1986a) show that an action as seemingly benign as a firm (truthfully) announcing in advance that it will introduce a new product at some future date can eliminate competition and reduce welfare. In markets characterized by demand-side economies of scale, consumers may become "locked-in" to a technology that achieves a sufficiently large "installed base" of users (once the installed base is large enough, the benefits of "going along with the crowd" may outweigh the benefits from the new technology). In such a setting, a firm that has new technology may be able to prevent the lock-in by announcing its product in advance and giving consumers that have not yet purchased the old technology the opportunity of waiting for the new technology. In this way the new technology may be adopted, whereas it would not have been adopted before. If the new technology is proprietary, the rivals may be eliminated by this strategy. Moreover, even though the new technology is preferred by new consumers, the consumers who have already purchased the old technology are "stranded". Overall, welfare may be reduced.

4. Putting rivals at a disadvantage

Most of the attention in the literature has been devoted to attempts by incumbents to reduce competition by eliminating their competitors. In contrast to attempts by incumbents to "muscle out" their rival, in this section we turn to actions which involve the use of "sabotage" by the incumbent to put the *rival* at a competitive disadvantage.

This goal can be accomplished by raising the rival's costs or by impairing its ability to generate demand for its product.[19] The line of work addressing these

[19]In a way, a low price (a predatory price) impairs a rival's ability to generate demand for its product as will redesign of needed components, as in Subsection 3.2.2 above. From this perspective many anticompetitive strategies put a rival at a disadvantage in the sense in this section [see also Campbell (1986)].

issues was initiated by Salop and his co-authors Krattenmaker, Scheffman, and Schwartz under the general rubric of "raising rivals' costs".[20]

An example of a cost-raising tactic is the signing of an exclusive dealing contract in which the supplier of an input agrees not to supply the rival firms. Another example, which falls short of outright exclusion, is taking actions that raise the price at which the rival can obtain the resources. Notice that it may be worthwhile for the firm to raise its own costs in order to raise those of the rival. This is important since the firm engaging in this exclusionary tactic may, for instance, have to pay a premium for an exclusive dealing arrangement. An example of a demand-impairing action is signing customers up to long-term contracts or refusing to participate in a joint-marketing arrangement with the rival (as occurred, for example, in the *Aspen* case). The rationale for categorizing both types of actions as "raising rivals' costs" is that in the case of a demand-impairing action the rival must incur additional promotional costs if it wants to restore its competitive position. However, since the rival need not necessarily respond by increasing its promotional effort, we prefer to use the broader (but less catchy) phrase "putting the rival at a disadvantage". In what follows we concentrate on cost-raising activities.

In any model, a firm's competitive position is improved if its rival is placed at a cost disadvantage. For example, consider two firms competing in Cournot fashion. Suppose they face constant marginal costs c_1 and c_2 and that the inverse demand function is linear, $P = a - b(q_1 + q_2)$. At the Cournot equilibrium, firm i's output is $q_i^c = (a - 2c_i + c_j)/3b$ and its profit is $\pi^i = (a - 2c_i + c_j)^2/9b$. Not surprisingly, in equilibrium firm i's profits are increasing in c_j so that firm i is always better off the higher its rival's costs.

Simply asserting that a firm would prefer its rival to be at a cost disadvantage does not, however, mean that it is feasible and profitable for the firm to place its rival at such a disadvantage. In particular, there are three issues that need to be addressed. First, when the firm raises the rival's costs by excluding its rival from access to some scarce resource, the current owner of the resource, understanding the value of its resource to the rival, ought not to give up its right to supply the rival for less than that value. Thus, the value of the exclusion to the firm engineering the exclusion must be greater than the value to the rival. Second, when its current suppliers are removed from the market or raise their prices, the rival must not be able to enter into a mutually profitable arrangement with substitute suppliers which would restore its competitiveness.[21] Third, the excluding firm must have some market power if it is to exploit the rival's disadvantage.

To see how the first of these conditions can be satisfied, consider the above Cournot example and examine the effect of an increase of c_j on the

[20]See Salop and Scheffman (1983, 1984, 1987), Krattenmaker and Salop (1986a, 1986b) and Salop, Scheffman and Schwartz (1984).

[21]That is, the rival cannot have available to it credible counterstrategies in the sense of Easterbrook (1981a).

profits of firm i and on those of the rival, firm j, itself. Differentiating we have $\partial\pi^i/\partial c_j = 2(a - 2c_i + c_j)/9b = 2q_i^c/3$ and $\partial\pi^j/\partial c_j = 2(a - 2c_j + c_i)(-2)/9b = -4q_j^c/3$. Therefore, the gain to firm i from an increase in c_j is (locally) greater than the loss to firm j from that increase provided $q_i^c > 2q_j^c$. Thus, in a Cournot model, provided firm i is more than twice the size of its rival, it would be willing to expend greater resources to raise its rival's costs than the rival would be willing to expend in an attempt to keep them down. This result follows from the fact that the large firm benefits more from a price increase than does its smaller rival.[22]

The second condition might be trivially satisfied. For example, the exclusive dealing contract may remove the low-cost suppliers of the input from the market leaving only the high-cost suppliers. However, the situation is not always as clear cut. For purposes of illustration, consider the case where all suppliers of an input have access to the same technology but where after some of them are removed from the market by an exclusive dealing arrangement, the remaining suppliers are able to increase the price they charge because of the more concentrated market structure that they now enjoy.

This case is less straightforward. The reason is that the pricing arrangement between the rival and the remaining firms is inefficient. Thus, the rival may be able to reach an agreement with the suppliers whereby suppliers reduce their prices to what they were before, in return for an appropriate side payment. In other words, the rival may have an effective *counterstrategy* to the firm that masterminded the foreclosure.

To see how this works, consider the following simple example. Suppose that two Cournot competitors use an input in fixed proportions that is supplied by either of two Bertrand suppliers. Suppose that demand for the finished good is given by $P = a - Q$ and that all costs are marginal costs which we set equal to zero for simplicity.[23] In that case, the Bertrand input suppliers charge zero for the input and the equilibrium in the finished goods market has $P = a/3$, $q_1 = q_2 = a/3$. The downstream firms' profits are $\pi^1 = \pi^2 = a^2/9$.

Now suppose that one of the downstream firms, say firm 1, purchases one of the input suppliers. The remaining input supplier becomes a monopolistic supplier to the rival. It sets its price, taking into account the effect on the demand of the rival. If the rival faces costs of $\underline{c}$ per unit, its equilibrium output is $q_2 = (a - 2\underline{c})/3$. The supplier therefore chooses $\underline{c}$ to maximize $\underline{c}(a - 2\underline{c})/3$, so it sets $\underline{c} = a/4$. The firms' profits are then $\pi^1 = (5a/4)^2/9$ and $\pi^2 = (a/2)^2/9 = a^2/36$.

[22] See Salop and Scheffman (1983) for the comparable analysis of a dominant firm facing a competitive fringe which we present in Section 6, below.

[23] This is a particularly simple form of the vertical structure. Greenhut and Ohta (1979) analyze the richer case where both tiers of the market are characterized by oligopoly.

It therefore seems as though this method of raising its rival's costs is profitable for firm 1.[24] But notice that firm 2 has an effective counterstrategy. Its input supplier is earning $((a - 2\underline{c})/3)(9/4) = a^2/24$. The combined profit of firm 2 and its supplier is therefore $a^2/36 + a^2/24 = 5a^2/72$. If these two firms were to enter into an agreement reducing $\underline{c}$ to zero, the situation would be restored to what it was before firm 1 had purchased its supplier. Then the combined profits of firm 2 and its supplier would be $a^2/9 > 5a^2/72$. There are thus gains to such an agreement. There are two main ways to obtain these gains: the firms could merge, or firm 2 could be charged a two-part tariff for the input (for example, it could be charged marginal cost plus a fixed fee to compensate its supplier for its lost profits).

It thus appears that firm 2 has an effective counterstrategy to firm 1's purchase of a supplier. This result depends, however, on the assumed quantity competition in the downstream market. In particular, it may not hold in the more realistic case where the firms produce differentiated products and use prices as the strategic variable.[25]

This can be seen from Figure 9.1. The firms' best-response functions prior to firm 1's merger with one of the input suppliers are given by BR_1 and BR_2. Firm 2's equilibrium level of profitability is illustrated by the isoprofit curve P. After the merger, however, firm 2's costs increase and its best-response function moves outwards since for any price of firm 1, firm 2 wants to charge a higher price than it did when it faced the lower pre-merger prices. We label the new best-response function BR_2' and the resulting equilibrium N'.[26] A particularly illustrative case is where N' is on P, as drawn.

The key question is what can be said about the firms' profitability at N' compared to that at N. Clearly, firm 1 is better off since its costs have not changed and both firms are charging higher prices. More importantly, the sum of the profits of firm 2 and its supplier are the same as at N. To see this notice that P represents firm 2's profits when it faces input prices of zero, which is equal to the input supplier's costs. Therefore, P also represents the sum of the profits of firm 2 and its input supplier for any price charged by the input supplier (and, in particular, for the price charged by the input supplier after the merger has taken

[24] In this simple example firm 2's loss exceeds firm 1's gain so that it would be surprising to see firm 1 outbid firm 2 for the input supplier. However, as we saw above, this would not be the case if firm 1 was significantly larger than firm 2. In any case, this is tangental to the point we are making here.

[25] The details of this analysis are being pursued by us in collaboration with Steven Salop.

[26] Notice that total output decreases in equilibrium. This is in contrast to the successive oligopoly models of Greenhut and Ohta (1979) and Salinger (1984). The outcome differs from those models because here the input suppliers are originally perfectly competitive. The merger does not produce any efficiency gains since there is no "double marginalization" to be avoided. If, in our example, there had been three input suppliers and the two remaining suppliers continue to compete in Bertrand style after the merger of the third supplier, then there would be no effect on output or price. If, on the other hand, the two remaining suppliers were now able to achieve some degree of implicit collusion and raise their prices, the conclusions derived above would go through as before.

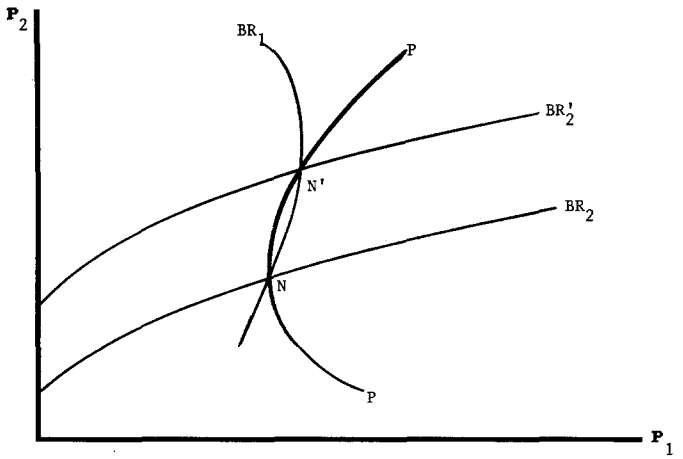

Figure 9.1

place). Thus, firm 2 and its supplier taken as a unit are indifferent between the new and the old equilibria (N vs. N'). Of course, firm 2's supplier is better off since it is now receiving a positive price. Therefore, firm 2 must be worse off.

The upshot of this is that firm 2 does not have an effective counterstrategy here: by merging with its supplier and restoring the equilibrium to N, the increase in firm 2's profits would be insufficient to compensate its supplier for the latter's loss in profits.

The net effect of firm 1's action is that it is better off, firm 2 is worse off, and firm 2's supplier is better off. The prices of both firms have increased and since they were too high to start with (from a social welfare point of view), social welfare has decreased.[27] This result holds not just for increases at N' but also in a neighborhood of that point.

Thus, raising rivals' costs may be achieved through excluding the rival from the low-cost suppliers of an input or by removing some of the potential suppliers from the market place. In the *Alcoa* case, for example, Judge Learned Hand reported that at one time Alcoa purchased from power companies the promise that they would not sell electricity to other aluminum producers and that Alcoa did not itself purchase electricity from them.

[27]In the case presented here, the firm is able to achieve an increase in the rival's costs by merging with just one upstream supplier. In general, it may have to merge with several. In that case, suppliers purchasing later will generally have more leverage and will demand a higher price. Of course, farsighted early firms will realize the benefits they confer on later target firms and will attempt to appropriate some of these gains. These issues are discussed by Mackay (1984).

Raising rivals' costs through exclusionary practices comes in a variety of guises. For example, an extreme case is where the firm forecloses access to *all* suppliers of an essential input: as in the essential facilities problem. Another example is where a purchase contract between the firm and a supplier contains a restrictive covenant in which the latter agrees to sell to the rival only at unfavorable terms. This kind of restriction, litigated in the *Klor's* case, for example, is much more common than the naked restraint exemplified by the exclusionary rights in the *Alcoa* case.

In these cases, the effect of the increase in the rival's cost is to reduce its market share. A more extreme case is where the increase in costs renders future participation unprofitable for the rival so that it leaves the market. Clearly, if this is the case, the incentives for a firm to raise its rival's costs are even greater than otherwise. Williamson (1968) discusses how this strategy might have been employed in the *Pennington* case, where the defendant was accused of attempting to drive rival companies out of coal mining by securing an increase in industry-wide wages through negotiations with the union. [See also Maloney, McCormick and Tollison (1979) on the effects of unionization on industry profits.]

A great virtue of this general approach is that it encompasses a wide range of potentially anticompetitive practices. Unfortunately, the development of the theory lags somewhat behind the potential applications. The ability of a firm to outbid its rival for access to the resource as well as the rival's ability to respond to the increase in its costs depends on the exact nature of the foreclosure. As we saw above, it is also sensitive to the model formulation. Additional theoretical work seems warranted. Furthermore, virtually all the work in this area has focused on cost-raising techniques. Demand-impairing actions have not received much attention.

5. Government facilitation of anticompetitive behavior

In the preceding sections we surveyed the conduct of dominant firms in laissez-faire markets. In this section we focus on incentives for anticompetitive behavior in scenarios in which "government" plays an explicit role. These scenarios are of interest for at least the following three reasons. First, novel incentives for anticompetitive behavior may arise in such situations (Subsection 5.1). Second, the misuse of governmental powers may provide an extremely effective anticompetitive tool, as when it leads to the exclusion from the market of new firms which may be more efficient than the incumbent. In particular, manipulation of the political process may be an effective method of raising rivals' costs (Subsection 5.2). Third, in the international context, predatory activity can be under-

taken by governments on behalf of home firms or facilitated by various industrial policies of the home government (Subsection 5.3).[28]

5.1. Anticompetitive practices and a regulated firm

Rate of return (ROR) regulation can provide a dominant firm with novel incentives for engaging in behavior that excludes from the market an equally (or more) efficient rival. To see how this occurs, assume that the allowed rate of return, s, exceeds the true cost of capital to a firm, r. This implies that the potential flow of profits to the ROR regulated firm reflects the margin, $s - r$, applied to the firm's total capital stock, K. Consequently, the firm has an incentive to take actions to increase its capital stock even if such actions are not otherwise profitable or efficient. Thus, we are dealing here with yet another perverse effect of ROR regulation, some of which have been noted by Averch and Johnson (1962) and Wellisz (1963) [Ordover, Sykes and Willig (1985)]. Here, it is important to realize that a ROR regulated firm that engages in an Averch–Johnson (A–J) type of anticompetitive activity does not require a period of recoupment during which the profits dissipated by the anticompetitive activity are made up and more. In fact, the regulated firm may maintain its inefficient (exclusionary) activity forever, or until it is sued by its rivals, and finance the losses with inefficiently high prices in other markets in which it does not face competition. Consequently, predatory activity by an inefficiently regulated firm is not subject to the usual criticism that it will never be undertaken by a rational firm because recoupment may be impossible [Brennan (1986a)].

To see how A–J predation works, consider the following scenario which is explored by Ordover, Sykes and Willig (1985, section 3). The regulated firm, firm A, offers two complementary or vertically integrated services, 1 and 2. There are Q identical consumers who are willing to pay b for a system comprising one unit of each service. The regulated firm has a protected monopoly in the provision of service 1. Service 2 is, however, open to competition. Production costs for the regulated firm are as follows:[29]

$$\text{Service 1:} \quad C_{A1} = V_1 Q + rK_1,$$

$$\text{Service 2:} \quad C_{A2} = V_{A2} Q + rk_{A2} Q,$$

[28] Strategic trade policies are reviewed more extensively in Dixit (1985). See also Chapter 20 by Paul Krugman in this Handbook.

[29] We assume that capital is used in fixed proportions here so that the usual A–J input distortion does not arise.

where, V_1 and V_{A2} are unit variable costs, K_1 is capital used in service 1, and k_{A2} is the capital–output ratio in service 2. For the rival firm, firm B, the unit cost is c_{B2}.

We now analyze the incentives for firm A to gain control over service 2 in a variety of scenarios. Assume first that firm B supplies service 2. Then, A's prices are

$$P_1^* = b - c_{B2}, \qquad \text{if ROR constraint is not binding}$$

and

$$P_1^* = V_1 + sK_1/Q, \quad \text{if ROR constraint is binding.}$$

Here, as before, s is the allowed rate of return. Thus, by producing service 1 alone, firm A can earn a profit equal to

$$\min\{(s - r) \cdot K_1, Q[b - c_{B2} - V_1] - rK_1\}.$$

Next, assume that A has a monopoly over the provision of services 1 and 2. Firm A's prices are now

$$P_{12}^* = b, \qquad \text{if ROR is not binding,}$$

and

$$P_{12}^* = V_1 + V_{A2} + sk_{A2} + sK_1/Q, \quad \text{if ROR is binding.}$$

Thus, the firm can earn profits equal to

$$\min\{(s - r) \cdot (K_1 + k_{A2}Q), Q[b - V_{A2} - V_1 - rk_{A2}] - rK_1\}.$$

To ascertain A's incentives to exclude firm B from the provision of service 2, we must consider the maximum profits A can earn in various possible scenarios. These scenarios differ according to how efficient A is in the provision of the service in question and whether the rate of return constraint is binding or not. Plainly, iff the constraint is never binding (because b is low, for example) then A will monopolize 2 iff $V_{A2} + rk_{A2} < c_{B2}$. However, if the constraint binds even when A provides only service 1, then it can earn $(s - r)Qk_{A2}$ in additional profits regardless of which firm is the lowest cost supplier. If $c_{A2} = V_{A2} + rk_{A2} > c_{B2}$, then A can monopolize service 2 only if it engages in anticompetitive activities such as tying the sale of service 2 to the sale of service 1, redesigning service 1 to make it incompatible with the variants of service 2 produced by rivals

and so on. (Note that if $c_{A2} < c_{B2}$, all the standard tests would detect predatory pricing of service 2 by firm A.)[30]

Brock (1983) doubts whether rate-of-return regulation provides strong incentives to engage in predatory cross-subsidy. He points out that "because a rate-of-return regulated firm uses an inefficient input mix, it has a higher actual cost.... As a result [it] tends to produce at least one product at a lower level than any reasonable social benchmark." For example, one such benchmark could be the vector of output produced by the firm in the partially regulated second-best (or Ramsey) optimum. Brock shows that in a two-product case, the welfare effects of a dominant firm aggressively displacing the fringe's output are ambiguous. Brock agrees, however, that even though cross-subsidy may be a "poor investment" for the regulated firm, the "gain to predation... through the indirect effect of rate base augmentation" cannot be entirely disregarded, as we have shown in the beginning of this section. Brock also points out that if regulation is likely to be looser in the future, then the likelihood of price predation as compared to the no-regulation case is increased, ceteris paribus. As Brock also observes, the regulation also opens up the possibility of anticompetitive activity through investment in *barrier-to-entry capital of a political form*. Such an investment makes sense if the regulated firm wants to protect its rate base or if it must raise entry barriers in order to ensure sustainability. We take up these and related matters in the next subsection.

5.2. Anticompetitive uses of the political and legal process

Perhaps one of the most efficient methods for disadvantaging existing and prospective competitors that is available to an incumbent firm is through the strategic use (or abuse) of the political and legal process. Disadvantages inflicted upon the existing rival and the entry barriers created by means of such strategies are frequently more permanent than those that could be generated through more standard means. In addition, because they often constitute an exercise of other important rights, such as the First Amendment and due process rights in the United States, these strategies are generally more difficult to detect or control [Bork (1978), Brock (1983), Baumol and Ordover (1985)].[31] Indeed, in the United States, the courts have formulated an exception to the Sherman Act, the *Noerr–Pennington* doctrine, according to which concerted action consisting solely of activities aimed at influencing public officials does not violate the Sherman Act. Thus, the Noerr–Pennington doctrine leaves a great deal of room for an

[30] For the analysis of other possible cases, see Ordover, Sykes and Willig (1985).

[31] Brock (1981) provides an extensive, if somewhat tendentious, history of AT&T's uses and abuses of the regulatory process to control competitive entry into the provision of long-distance telephone services and terminal equipment.

active use of the governmental process with the purpose of disadvantaging established rivals and deterring future entry.

The courts also constitute an arena in which anticompetitive strategies can be implemented. [See Baumol and Ordover (1985) for some examples.] There, however, unlike in the political arena, it is frequently the weaker or smaller firms rather than the dominant firms that are more likely to take an activist role. Indeed, the data base developed by the Georgetown Project on Private Antitrust Litigation[32] indicates that plaintiffs tended to be much smaller than the defendants, that many of the allegedly anticompetitive practices are not likely to have anticompetitive effects [Salop and White (1985, table 5)], and that many of the plaintiffs were dealers of the defendant's products [Salop and White (1985, table 6)] who most likely employed the antitrust law opportunistically.

Despite the importance of these issues, their analytic treatment in the economic literature is not entirely satisfactory probably because of the difficulty in modeling the political process itself. Brock (1983) argues that the dominant firm's activity in the regulatory arena can be modeled as an investment in barrier-to-entry capital of a political form.

The fringe firm solves the standard static profit maximization problem:

$$\max_{\{q\}} pq - q^2/2L(k),$$

where, $L(0)$ and $L(\infty) > 0$, $L' < 0$. As modeled, the fringe firm's unit production cost depends on the stock of barrier-to-entry capital accumulated by the dominant firm. Fringe firms are assumed not to have any direct regulatory costs, although $L(k)$ can be interpreted as reflecting the optimal level of regulatory expenditures by a representative fringe firm.

The dominant firm maximizes the discounted present value of profits by selecting the path of investments in regulatory activity:

$$\max_{\{I(t)\}} \int_0^\infty e^{-rt}(p - c) \cdot \{(\bar{y} - q) - p_I I\} dt$$

$$\text{s.t.} \quad \dot{k} = I - \delta k,$$

$$k(0) = k_0, \quad 0 \leq I \leq \overline{M},$$

where $\bar{y}$ is the fixed market demand, q is the fringe's supply, p_I is the price of the unit of investment in political barrier-to-entry capital whose stock is denoted by k, and whose flow is I.

[32] Salop and White (1985, 1986) describe the data base and the key findings.

Now assume that $L'' < 0$ if $k < \tilde{k}$ and $L'' > 0$ if $k \geq \tilde{k}$. These conditions ensure that near $\tilde{k}$, a small investment in political/regulatory activity significantly deters entry. However, at small values of k_0, the efficacy of such investment is low. Brock shows that if a dominant firm starts with a low level of the relevant capital (say a small legal staff and a small stable of economists), it may choose not to invest in political/regulatory entry-deterring activities. If, however, k_0 exceeds some critical level the dominant firm will make such an investment. From this exercise, Brock concludes that "the formation of k should be discouraged with as much vigor as possible". Whether such a policy prescription is sound and whether it can be implemented is more problematic. First, much of the predatory activity of this type can be performed using variable inputs such as outside counsel and economists. Consequently, discouragement of the accumulation of k need not yield desirable results. More efficacious may be disadvantageous tax treatment of legal and related expenses. Second, Brock's suggestion seems to imply that firms should be discouraged from developing the capability to react skillfully to their regulators. This may have highly undesirable welfare consequences, if the regulatory process is not perfect.[33]

Salop, Scheffman and Schwartz (1984) also treat investment in political activity as a method of raising rivals' costs. They construct a model which enables the analyst to sort out market failure rationales for a particular regulation from rent-seeking, special interest rationales. Indeed, the Salop–Scheffman–Schwartz model does not admit market failure. Instead, it identifies the industry characteristics and those aspects of the regulatory process that are conducive to rent-seeking, special interest, or competition-disadvantaging regulatory activities by firms.

The set-up is a standard extension of the raising rivals' cost approach [see Salop and Scheffman (1983, 1984)]. The dominant firm's costs, $A(x, r)$, and rivals' costs, $B(x, r)$, depend on output, x, and on the value of the regulatory parameter, r. If B_r and $B_{rx} > 0$, then the dominant firm will profit from an increase in r, as long as the impact of an increase on its own cost is moderate, in a sense that can be made rigorous within the model. When both A and B do not collude after the regulation is imposed, then firm A benefits from more stringent regulation if

$$\partial p^s/\partial r \geq (\partial A/\partial r)/x,$$

where Q is total output and $p^s(Q, r)$ is the supply price function. Hence, the impact on profits is $\partial \pi^A/\partial r \geq 0$, if and only if the market supply curve shifts up by more than the dominant firm's average cost. A sufficient condition is that the common increase in marginal cost, ΔMC, exceeds $\partial(A/x)/\partial r$. Most interestingly, the authors demonstrate that whereas $\partial Q/\partial r < 0$, we cannot deduce from

[33] This has been pointed out to us by Richard Schmalensee.

changes in the individual firm's output whether this firm has benefited or not from a more stringent regulation [Salop, Scheffman and Schwartz (1984, result 4)]. This is an important finding because antitrust analysts often look to output effects of a practice as indicators of underlying incentives and overall welfare effects. In any case, the analysis shows that, ceteris paribus, the larger are the partial derivatives, $\partial A/\partial r$, $\partial B/\partial r$, $\partial(A/x)/\partial r$, $\partial(B/x)/\partial r$, and the demand and supply elasticities, ε^D, ε^S, the stronger are the incentives for pursuing anticompetitive strategies in the political/regulatory marketplace.

As stated, the model is not closed because the supply side of regulatory actions has been left unspecified. The supply side must reflect the reality of the political process. What that reality consists of depends on the specifics of the situation. For example, the political process may be willing to "supply" the regulation only if both A and B gain, or A gains more than B loses, or A gains [Salop, Scheffman and Schwartz (1984), Ordover and Schotter (1981)]. Of course, A is more likely to abuse the political/regulatory process under the third of these regimes. The second regime is interesting because it suggests a possibility of competition for the regulators' favors. How costly it will be for A to obtain them depends again on details of political process.

The Salop–Scheffman–Schwartz analysis greatly clarifies the linkages between the individual incentives of firms to engage in rent-seeking activities that disadvantage rivals and the actual mechanics of the supply of regulation. It is thus a significant advance over much of the rent-seeking literature.

There is some, albeit scant, empirical evidence on the strategic abuses of the regulatory process. For example, Bartel and Thomas (1986) demonstrate that U.S. work safety regulations (OSHA) and environmental protection regulations (EPA) have differentially disadvantaged small and large firms and firms located in diverse geographic regions of the United States. Thus, Bartel and Thomas show that OSHA and EPA regulations might have increased profits of large firms by as much as 3 percent and those located in the northern states by as much as 9 percent. They also show that unionized workers have been able to capture a significant portion of the rents generated by predatory regulatory activity. Similar findings of strategic abuses of the regulatory process can be found in Marvel (1977) and Oster (1982) [see also, Pashigian (1984, 1986) and Evans (1986)].

An important extension of the rent-seeking, responsive-protectionism literature would be to examine the incentives of management-operated firms to influence the political process. The extensive protectionist lobbying by major U.S. corporations indicates that senior management of these firms expect to benefit from protectionist regulations which hobble and restrain competitors. But what about the owners of these firms? The issue does not arise when owners are also managers or when owners have all the relevant information so that they can induce the first-best supply of effort and optimal choice of investments from the managers. When information is asymmetric, moral hazard problems intrude. In

the presence of moral hazard, a reduction in market competition can exacerbate the principal–agent conflict, leading to inefficiencies in firms' operations.

This can be demonstrated in a simple model [Willig (1985)] of a managerial firm in which the owner's payoff is some function $V(c, b)$, $V_c > 0$, where c is an observable measure of cost and b is a statistic that reflects the intensity of market competition; $c = \theta/e$, where θ is a random variable $\theta \in [\theta_0, \theta_1]$; and e is the manager's effort. Manager's utility is $U(R, e) = R - \alpha e$, where $R(\cdot)$ is the compensation schedule. The manager reports θ which elicits $R(\theta)$, his payment, $c(\theta)$, the cost target, and $\phi(\theta)$, the probability that the firm will be operated. Then, unless $\theta = \theta_0$, the firm's costs are higher than they would be if the owner knew the realization of θ. Changes in market conditions, operating through the parameter b, affect managerial utility and profits. For example, if an increase in b implies an increase in the elasticity of demand at the initial equilibrium level of output, then this form of increased competitive pressure benefits management while maintaining profits at the original level [Willig (1985)]. Other forms of increased competition may, however, lower managerial utility.

These findings are important because they suggest that the economic consequences of increased protectionist activity may depend on how the activity affects the product market interactions among rival firms. Furthermore, in the principal–agent context, the owners must simultaneously choose compensation schedules that provide managers with the correct incentives to invest in cost-reduction and rent-seeking (protection-generating) activities. Given the maintained assumption of asymmetric information, the key analytic question is whether managers will overinvest resources in protectionist activities as compared to the amount that would have been expended by the owners. Briefly, then, modeling rent-seeking activities must reflect the potential conflict of interest between managers and owners.

5.3. Anticompetitive practices in an open economy

In many domestic industries, import competition substantially reduces the sales of domestic producers. In principle, such competition is highly desirable from the social welfare standpoint. Occasionally, however, import competition may reduce nationalistic social welfare or may have otherwise unfair economic and social consequences. In this subsection we briefly survey some novel policy considerations that arise when assessing anticompetitive conduct in international trade. In particular, these special considerations relate directly or indirectly to the policies of foreign governments [Ordover, Sykes and Willig (1983)]. In fact, were it not for the potential role that a foreign government can play in determining the outcome of competitive interactions in the international market place, the analyses

of various anticompetitive practices presented earlier in this chapter would carry over without any significant modifications.[34]

When a foreign government precommits to a strategic subsidy or tariff, it can move the equilibrium of a game played by its firms against firms which are domiciled elsewhere. We refer to the latter as domestic firms. When the nonintervention equilibrium entails rents, by acting as a Stackelberg leader, the foreign government can redistribute the potentially available rents in favor of *its* home firms. This is, perhaps, the key insight yielded by the application of strategic industrial organization models to international trade.[35] From the standpoint of domestic welfare, the consequences can be mixed: domestic consumers are likely to benefit from the strategic actions of the foreign government while domestic firms lose. The losses to firms, in terms of diverted profits, can, in principle, outweigh gains in consumers' surplus causing domestic social welfare to fall. This would render the actions of the foreign government anticompetitive, if anticompetitive practices were to be defined as any practice which lowers domestic social welfare. Yet, there is no persuasive reason why the foreign government should be kept to the same standards of conduct as that which applies to domestic and foreign *firms*. In particular, the notion that the foreign government should pursue (innocent) profit-maximizing strategies is not compelling. On the other hand, foreign firms which can be presumed to be profit maximizing and which are direct beneficiaries of their home government's actions need not have themselves engaged in actions that would violate the test for anticompetitive conduct offered in Section 2 of this chapter.[36]

One way out of this policy conundrum is to confine antitrust scrutiny of behavior to conduct of firms and leave the scrutiny of governmental policies to international trade authorities. A difficult middle ground arises when the foreign government merely acts to facilitate anticompetitive behavior by coordinating export policy. The *Japanese Electronics* case presents a market scenario which has not been fully explored in the economics literature. In that case, the plaintiffs alleged that Japanese exporters of television sets engaged in predatory cartel behavior designed to eliminate American manufacturers of television sets. They also alleged that predatory conduct was facilitated by the Japanese government's export policies, which required each Japanese exporter to sell only to assigned U.S. accounts, as well as by maintained and condoned collusion among Japanese

[34] It may be more difficult, however, to actually carry out the tests of anticompetitive conduct. For example, cost calculations relevant for cost-based tests of predatory pricing are made even more complicated than they usually are because of fluctuations in the exchange rates. Some additional difficulties are discussed in Ordover, Sykes and Willig (1983a) and Ordover (1987).

[35] The relevant literature is surveyed by Paul Krugman in Chapter 20 of this Handbook and Dixit (1985). See also the volume edited by Krugman (1986b).

[36] In the famous *Polish Golfcart* case, the District Court noted that passing on the benefits of a subsidy to consumers in terms of lower prices constitutes a normal response to market opportunities, *Outboard Marine Co. v. Pezetel*, 461 F. Supp. 384 (D. Del. 1978).

firms in their home market, which had the effect of increasing incentives to export into the lucrative U.S. market. The analytically interesting problem raised by the *Japanese Electronics* case is whether or not collusive predation is ever possible and how the incentives to predate are related to the home market structure of the foreign firms.[37]

6. Tests of anticompetitive behavior

In the preceding sections we surveyed many different aspects of strategic marketplace competition. We have shown that in some instances such strategic business conduct not only harms competitors but also augments the ability of the dominant firm to maintain, or even increase, a supracompetitive rate of return on its investments. In other words, by its tactics, a dominant incumbent can harm the competitive process and lower long-run social welfare. This observation suggests a deceptively simple test, or definition, of anticompetitive conduct in the context of strategic interactions surveyed in this chapter. According to this definition, *business conduct would be deemed anticompetitive if it were to injure competitors and reduce the level of long-run social welfare relative to the level that would be attained in the absence of the complained-of conduct or business tactic.*

There are many problems with this definition-cum-test of anticompetitive behavior. Perhaps the most severe is its implementability in the adversarial setting of antitrust litigation. Such an open-ended inquiry into the welfare effects of business conduct would not only consume significant resources but, more importantly, because of its complexity, would frequently lead to erroneous results. Furthermore, by its very nature, such an open-ended test of anticompetitive conduct would complicate business planning and might increase incentives for anticompetitive abuse of antitrust laws [Baumol and Ordover (1985)].

Recognition of the difficulty in formulating legal rules for determining anticompetitive conduct in strategic environments has provoked at least three different responses. The first response has been to urge removal of virtually all constraints on single firm behavior, including the behavior of dominant firms. The rationale for this position is that firms reach a dominant position by virtue of

[37]The key issue here is whether predatory firms can effectively free-ride on each others' investments in anticompetitive activities. Plainly, to the extent that anticompetitive conduct entails sacrifice of current profits for future increments in market power, each firm would prefer others to make that sacrifice. Hence, predatory firms must evolve some mechanism for effecting collusion and for punishing those who deviate from the collusive strategy. What this punishment amounts to is not obvious: predation already involves pricing low which clearly rules out low prices as the appropriate punishment. Hence, in the predatory context, punishments must involve reverting to high prices (or low levels of output). A related problem of collusive entry-deterrence has been explored by Harrington (1984). Parenthetically, we may add that the Supreme Court found the plaintiffs' contentions factually absurd.

business acumen, or luck, and to restrain their behavior penalizes bigness and creates discincentives to aggressive competition. Furthermore, proponents of this view perceive markets to be quickly self-correcting so that any marketplace advantages which are not related to superior skill and efficiency are quickly eroded. Consequently, anticompetitive conduct is, in general, unprofitable.[38]

The second response has been to propose a narrowing down of possible scenarios in which a firm's conduct could be scrutinized for its possible anticompetitive effects. This would be accomplished by postulating a set of "filters" designed to screen out potentially meritorious claims of anticompetitive conduct from those that are most likely without merit [Joskow and Klevorick (1979), Easterbrook (1984)]. Claims which have passed through these filters could then be assessed by means of simple, well-defined standards, such as the Areeda–Turner (1975) standard for predatory pricing which compares price to the appropriate marginal cost. The rationale for this public policy response is that anticompetitive behavior is rare, but it cannot be ruled out completely. The two-stage procedure of filtering out claims and then applying simple rules to assess conduct effectively reduces the risk of labeling vigorous procompetitive conduct as anticompetitive. Avoiding this type of error is conceivably more important, from a public policy standpoint, than committing the converse error of labeling conduct as procompetitive which, in fact, is anticompetitive.

The third response posed by the conundrum of analyzing competitive behavior in strategic settings calls for open-ended rules. This position is expounded by Scherer (1976), for example. According to Comanor and Frech (1984), who also adopt this view, a strategic perspective demands "a detailed investigation of the purpose and effects of specific acts under the Rule of Reason". As such, this approach harks back to the more traditional antitrust methodology which focused on purpose and intent and eschewed simple rules.[39]

In our view, simpler, more explicit tests of anticompetitive behavior are likely to be preferable, even if in some circumstances these tests would produce type I and type II errors. In the rest of this section, we review some of these tests, examine their welfare properties, and conclude that additional research is needed

[38]This position is well articulated by McGee (1958, 1980). See also Easterbrook (1984). The recent U.S. Supreme Court decision in the *Japanese Electronics* case [*Zenith Radio Corp. v. Matsushita Elec. Indus. Co.*, 494 F. Supp. 1190 (E.D. Pa. 1980); *Matsushita Elec. Indus. Co. v. Zenith Radio Corp.*, 106 S. Ct. 1348 (1986)], has fully accepted the view that rational anticompetitive behavior is likely only if the firm can expect to recoup the upfront costs of its anticompetitive campaign. Schmalensee (1987) reviews the literature on the causes and persistence of dominant market positions and develops the point that workable, welfare-enhancing rules for single-firm conduct are difficult to devise when competition is imperfect. See also Mueller (1986) and Encaoua, Geroski and Jacquemin (1986).

[39]Sullivan (1977) provides an excellent exposition of the "traditional" approach to the analysis of anticompetitive conduct.

to determine how well these tests perform in a wide variety of realistic market scenarios.

Much of the extensive relevant literature has concerned itself with deriving tests of predatory pricing. This is so for two reasons. First, the classic form of predation allegedly entails a dominant firm selectively cutting its prices, driving a smaller rival out of the market, and then raising its price, being no longer constrained by the forced-out rival. The second reason is that much of the modern legal-economic scholarship on predation grew out of the response to the article by Areeda and Turner (1975), which developed a cost-based test of predatory pricing.

(1) *The Areeda and Turner rule* (1975, 1978). Areeda and Turner (A–T) have proposed that any price above reasonably anticipated short-run marginal cost should be lawful. Conversely, a price below short-run marginal cost should be deemed unlawful. Turning to the actual application of their standard, they note that calculations of marginal costs may be difficult. Consequently, A–T propose that the average variable cost be used as a workable surrogate for marginal cost. Thus, under a modified A–T test, a price below a reasonably anticipated average variable cost is presumptively unlawful. The rationale for the A–T cost-based test is obvious: a perfectly competitive firm sets its profit-maximizing output at the level at which $p = MC$. Any price lower is not short-run profit-maximizing, hence must involve sacrifice of profits, which is the first prerequisite for predatory conduct.

The A–T test has been embraced by U.S. Courts in many antitrust cases. Some courts have, however, opted for different, and potentially more stringent, cost-based price tests entailing, for example, average total cost floors. Areeda (1982), Hurwitz and Kovacic (1982), Hovenkamp (1985), and Areeda and Hovenkamp (1986) provide summaries of the pertinent case law and the emerging trends in judicial analysis of predation. The test itself has been scrutinized by Scherer (1976), Brodley and Hay (1981), Hay (1981), Zerbe and Cooper (undated), as well as others.

Two main criticisms have been levied against the A–T test for predatory pricing. The first is technical and pertains to the use of AVC as a surrogate for MC. Here the basic point is that in some instances MC can be significantly above the AVC, which makes it easier for a dominant firm to engage in predatory price-cutting without violating the standard. In other instances, when there is substantial excess capacity, AVC can be significantly below MC. To suggest, as A–T have done, that AVC can be used as a surrogate only when it does not significantly differ from MC, defeats the whole purpose of using this surrogate cost measure in the first place. Indeed, A–T's analysis of the appropriate measures of AVC is rather inadequate. It does not derive the correct cost concepts from the analysis of the predatory conduct itself and, consequently, does not provide clear guidance of how to treat such important components of

total cost as capital and advertising expenses. Ordover and Willig (1981) provide an extensive discussion of the cost concepts pertinent for the analysis of predatory conduct using cost-based price floors.[40]

The second, most important criticism of the A–T test goes to the core of the test itself. It questions whether MC is the correct price floor: whether some potentially higher price floor would not be more appropriate from the welfare standpoint given the strategic nature of predatory conduct. Inasmuch as the welfare properties of marginal cost pricing are based on static considerations, these are not necessarily the relevant ones for the analysis of inherently strategic interactions between the dominant incumbent firm and its actual and prospective rivals. As we have shown in equations (2.1) and (2.2) in Section 2, in a strategic context the firm must account for the effects of its actions on rivals and for rivals' reactions to its actions. Consequently, the selection of a behavioral rule that is totally divorced from strategic interactions seems to beg the question of how anticompetitive conduct is to be handled in a strategic context.[41] The essence of these strategic interactions is in the consequences of the alleged predator's conduct on the viability and profitability of its rivals, actual and potential. From that vantage point, the relationship between the predator's marginal cost and price loses much of its probative value. For example, in fully specified models of reputational and signaling predation, such as those reviewed in Subsections 3.1.2 and 3.1.3, successful predation does not necessarily require prices below MC or AVC. It requires, however, prices that convey to the rival the signal that it should not enter or remain in the market. Such prices bear no systematic relation to the incumbent's AVC. Similarly, in models in which an entrant has only a small "window of opportunity", as when there are significant externalities related to the size of the installed base of the product, a temporary price reduction can deny the entrant the only chance to introduce its product. In this scenario, the level of price is chosen with an eye towards attracting the newly arriving customers to the installed base and away from the entrant's product. Such a level of price is obviously related to the relative benefits of the two competing products (plus whatever externalities flow from the installed base). Production costs themselves are less pertinent.

Yet, the rationale for using MC as the appropriate price floor is quite appealing. It stems from the fact that uninhibited competitive interactions, say à la Bertrand, can drive the price down to the level of marginal cost. Hence, an imposition of a cost-floor test more stringent than the MC will constrict the scope of competitive interactions in the marketplace. At the same time, restrain-

[40]See also Areeda (1982).

[41]Ordover and Willig (1981) show that the Areeda–Turner test can be derived from a fully strategic analysis but only under very restrictive assumptions.

ing an incumbent's responses to competitive entry may facilitate socially desirable entry. This is emphasized by Williamson (1977) in his critique of the Areeda–Turner test. This point can be made more rigorous by means of a simple example [Dasgupta and Stiglitz (1985)]. Assume a market for a homogeneous product with $D'(p) < 0$. Every potential firm has constant production costs of $\underline{c}$. Bertrand competition leads to $p^* = c$ and zero profits for all participating firms. Assume that there are two potential competitors, I and E. Firm I is already in the market. Firm E can either enter or stay out. To enter it must incur K in sunk costs. If entry occurs, I and E select prices simultaneously. Finally, let $\bar{\pi}$ denote monopoly profits exclusive of entry costs. Then Dasgupta and Stiglitz (1985) show that if $0 < K < \bar{\pi}$, there is a unique (subgame) perfect equilibrium in which firm E does not enter and I earns $\bar{\pi} - K$.

Now assume that the predation rule prohibits prices at or below average long-run cost. In the example at hand, $p_{\min} = c + K/\bar{q}(p_{\min})$, where $\bar{q}(p_{\min})$ is the volume of sales per firm if both firms are in the market and both charge $p_{\min}$. Hence, $\bar{q}(p_{\min}) = 1/2D(p_{\min})$. Let $p_{\min} + \delta$, δ arbitrarily small, be the minimum nonpredatory price, then there is a unique subgame perfect equilibrium in which both firms enter and charge the minimum nonpredatory price [Dasgupta and Stiglitz (1985)]. If K is small, $p_{\min} + \delta \approx c$, hence the average cost rule induces an approximately welfare optimal outcome. However, as K gets higher, the inefficiency from having two firms in the market begins to weigh heavier and may even exceed the inefficiency from monopolistic pricing in the presence of scale economies which would be sustained by the A–T rule.

(2) *The Joskow and Klevoric rule* (1979). The test developed by J–K to test for predation attempts to capture the strategic aspects of conduct alluded to above. J–K advocate a two-tier approach to testing for predatory pricing. The first tier examines the *structural* preconditions for the likelihood of successful and rational predation. These structural preconditions include (a) the dominant firm's market share; (b) the size of other firms in the market; (c) the stability of market shares over time; (d) the dominant firm's profit history; (e) residual elasticities of demand; and (f) the conditions of entry. The first-tier tests are designed to filter out allegations of predatory conduct which are likely to be proved baseless.

In those markets in which preconditions for rational successful price predation are satisfied, J–K impose a stricter cost-based price floor than proposed by A–T. J–K first argue that MC is not the appropriate floor. Instead, they note that prices below AVC are presumptively illegal because at such prices the predator is not even covering avoidable costs. More importantly, they argue that any price below the average *total* cost should be presumptively illegal. This is because in a competitive market, the equilibrium price will equal ATC and, furthermore, it is highly unlikely that a post-entry price in a market predisposed to predation would be so low as to impose losses on the incumbent dominant firm. The J–K

test does allow for this latter possibility, however, by permitting an affirmative defense demonstrating that the price below ATC is short-run profit-maximizing.[42]

J–K also consider the possibility that temporary price cuts to a level above ATC could be predatory. According to J–K, a price cut to a level above ATC would be predatory if it were reversed within a reasonable period of time, say two years. In this, they follow Baumol (1979) whose predation rule is discussed below.

(3) *The Posner rule* (1976). Posner's test substitutes long-run MC for the cost floors in the A–T test. Posner recognizes that predation is a strategic, long-term phenomenon and hence must be assessed using long-run cost standards. According to Posner, a price below $LRMC$ is presumptively predatory when coupled with the intent to exclude an equally or more efficient competitor. How to determine intent is not fully explained by Posner.

(4) *The Williamson rule* (1977). Williamson develops a rule for predation which aims to capture the strategic aspects of anticompetitive conduct. The novelty of Williamson's approach is that it does not focus directly on cost–price comparisons in testing for predation against a new entrant. Instead, Williamson's rule would deem as predatory any "demand adjusted" output expansion in response to new entry. Conversely, if the incumbent maintains or constricts its output following entry, it behaves in a nonpredatory manner, according to Williamson's rule. However, the incumbent's output level, whether higher or lower than the pre-entry level, would be deemed predatory if following entry the market price for its product were to fall below AVC.

Whereas the theoretical underpinnings for the A–T test were provided by the standard model of short-term profit maximization in a competitive market, Williamson's rule builds on a model of limit pricing and entry deterrence. Williamson's scenario is that of an incumbent firm prepositioning itself to combat a potential entrant, in the event that the potential entrant actually comes in. To that extent, the Williamson scenario appears more relevant to the problem of designing rules that would curb socially undesirable entry-deterring strategies.

Regarding welfare properties of his rule, Williamson argues that the incumbent subject to the no-expansion rule chooses a pre-entry level of output which is higher than the level that it would select if it were constrained by A–T's MC [or AVC rule]. Insofar as higher output implies a higher level of welfare, Williamson's rule is superior to the A–T rule. However, other considerations intrude. If the incumbent is more constrained under the Williamson rule than it would be under the A–T rule, it may find it more difficult to deter entry. Consequently, an incumbent constrained by the nonexpansion rule may choose accommodation, while the incumbent constrained by the MC price floor may select deterrence. To the extent that in some circumstances entry deterrence leads to higher social

[42] Williamson (1977) adopts both $SRAC$ and $LRAC$ floors for predatory prices against established rivals; his "loose oligopoly" case.

welfare than does accommodation, Williamson's rule is welfare-inferior to the A–T rule. Thus, Williamson's demonstration that the output restriction rule is welfare-superior to the marginal cost rule is not uniformly valid. This issue is extensively discussed by Reynolds and Lewis (undated). [See also Easley, Masson and Reynolds (1985).]

(5) *The Baumol rule* (1979). Contestability theory provides the theoretical underpinnings for the predation rule developed by Baumol. Baumol's rule would prohibit a dominant firm from cutting its price(s) in response to entry and then reversing the price cut once the entrant has left the market. That is, Baumol would permit the incumbent firm to react aggressively to entry provided that it then maintains the level of price for a prespecified period of time. In essence, Baumol's rule is concerned less with price cuts than with reversals of price reductions, although Baumol introduces a side constraint that the price cannot fall below the average incremental cost (AIC).[43]

In support of the rule, Baumol reasons that an incumbent firm subjected to his rule would select the pre-entry price which yields it the maximum available rate of return, consistent with the existing entry barriers. In particular, if these entry barriers are minimal or nonexistent, the incumbent's pre-entry price would generate approximately a normal (competitive) rate of return. There is no reason, however, for this claim. As long as entry is not instantaneous, an incumbent may initially maintain a supracompetitive price and then, following entry, lower it to a level determined by the post-entry game between itself and the entrant. Indeed, the incumbent may find it optimal to set the pre-entry price at the unconstrained monopoly level. Furthermore, if the incumbent can credibly threaten with an output expansion and a low price following entry, as it can under the Baumol rule, it may thereby deter an equally efficient entrant [Dasgupta and Stiglitz (1985)]. This means that the Baumol rule does not invariably lead to a socially optimal outcome. The difference between the contestability result and the outcome in the predatory setting considered by Baumol lies precisely in the fact that contestability analysis assumes that the incumbent cannot respond to the lower price offered by the entrant.

The preceding tests or rules for defining predatory behavior focused on pricing. In particular, they have focused on price responses by a single-product firm to entry or a threat thereof.[44] Surely, potentially anticompetitive conduct encompasses a richer class of business strategies than product pricing. And within the

[43] AIC of product i is defined as

$$AIC_i(y) = [C(y_1, \ldots, y_i, \ldots, y_n) - C(y_1, \ldots, y_{i-1}, 0, y_{i+1}, \ldots, y_n)]/y_i,$$

where $C(\cdot)$ is the total cost function. AIC is, therefore, a generalization of an average cost for multi-product cost functions.

[44] Ordover and Willig (1981) discuss the modifications in the cost-based price floors for multi-product firms. Areeda (1982) argues that no modifications are necessary. Baumol (1986) provides an interesting critique of Areeda's position.

category of predatory pricing itself, various forms of anticompetitive conduct can also be distinguished, as we have demonstrated in Section 3 [see also Salop and Shapiro (1980)]. Rules for defining predatory conduct that apply to a wide range of business practices have been developed by Ordover and Willig (1981) and by Salop et al. [Salop and Scheffman (1983), Salop, Scheffman and Schwartz (1984), and Krattenmaker and Salop (1986b)].[45] Whereas Ordover and Willig attempt to provide a general standard for judging predation, Salop et al. focus explicitly on business strategies that raise rivals' costs.

(6) *The Ordover and Willig rule* (1981). The approach adopted by O–W is to begin with a general definition of predatory conduct and to then derive specific tests of predation from the rule itself. They define predation as "... a response to a rival that sacrifices part of the profit that could be earned, under competitive circumstances, were the rival to remain viable, in order to induce exit and gain consequent additional monopoly profits". In other words, a particular response to entry violates the O–W standard if (i) the incumbent had available another response to entry that would have been less harmful to the rival; (ii) when viewed ex ante, the incumbent's chosen action must have been more profitable, given the rival's exit, than the less harmful alternative action; and (iii) assuming that the rival remains a viable potential competitor in the market, the incumbent's chosen response, when viewed ex ante, is less profitable than the alternative less harmful action.

The O–W definition, and the tests derived from it, can be best interpreted as an attempt to reinterpret expression (2.2) in Section 2, which we repeat here:

$$\frac{\mathrm{d}\pi^{\mathrm{I}}}{\mathrm{d}a_0^{\mathrm{I}}} = \frac{\mathrm{d}\pi_0^{\mathrm{I}}}{\mathrm{d}a_0^{\mathrm{I}}} + \frac{\partial\pi^{\mathrm{f}}}{\partial a_1^{\mathrm{I}}} \cdot \frac{\mathrm{d}a_1^{\mathrm{I}}}{\mathrm{d}a_0^{\mathrm{I}}} + \frac{\partial\pi^{\mathrm{f}}}{\partial a_1^{\mathrm{E}}} \cdot \frac{\mathrm{d}a_1^{\mathrm{E}}}{\mathrm{d}a_0^{\mathrm{I}}} + \frac{\partial\pi^{\mathrm{f}}}{\partial a_0^{\mathrm{I}}}.$$

According to O–W, the choice of a_0^{I} is not anticompetitive as long as the derivative $\mathrm{d}a_1^{\mathrm{E}}/\mathrm{d}a_0^{\mathrm{I}}$ is reinterpreted as reflecting a counterfactual state-of-the-world in which an entrant remains viable despite the incumbent's chosen action. Viability simply means that an entrant who has been induced to exit can costlessly reenter the market. A viable entrant exercises a competitive constraint equal in its effectiveness to that of a dormant firm that has merely shut down its operation without dispersing productive assets while waiting out the predatory campaign.

This can be restated more precisely. Let $\underline{a}_0^{\mathrm{I}}$ and $\underline{a}_0'$ be two alternative current actions that the incumbent can take in response to entry. Action $\underline{a}_0^{\mathrm{I}}$ induces exit, hence is potentially anticompetitive, but $\underline{a}_0'$ need not. Let a_1^{E} take one of three "values", depending on whether the entrant is "in", whether it is "out", and whether it is "viable". Again, being "viable" is a counterfactual action or state of

[45]Areeda (1982) provides some arguments why nonpricing conduct should be excluded from the purview of predatory analysis.

the entrant. Then action $\underline{a}_0^{\mathrm{I}}$ is predatory if:

$$\text{(i)}\quad \pi_0^{\mathrm{I}}\left(\underline{a}_0^{\mathrm{I}}\right) + \pi^{\mathrm{f}}\left(a_1^{\mathrm{I}} | \underline{a}_0^{\mathrm{I}}, \text{entrant "out"}\right)$$

$$> \pi_0^{\mathrm{I}}\left(\underline{a}_0'\right) + \pi^{\mathrm{f}}\left(a_1^{\mathrm{I}} | \underline{a}_0', \text{entrant "in"}\right),$$

$$\text{(ii)}\quad \pi_0^{\mathrm{I}}\left(\underline{a}_0^{\mathrm{I}}\right) + \pi^{\mathrm{f}}\left(a_1^{\mathrm{I}} | \underline{a}_0^{\mathrm{I}}, \text{entrant "viable"}\right)$$

$$< \pi_0^{\mathrm{I}}\left(\underline{a}_0'\right) + \pi^{\mathrm{f}}\left(a_1^{\mathrm{I}} | \underline{a}_0', \text{entrant "in"}\right).$$

Condition (i) says that action $\underline{a}_0^{\mathrm{I}}$ is more profitable than the alternative action $\underline{a}_0'$ if $\underline{a}_0^{\mathrm{I}}$ induces exit and $\underline{a}_0'$ does not. Condition (ii) says that assuming counterfactually that under $\underline{a}_0^{\mathrm{I}}$ the entrant remains viable, then $\underline{a}_0'$ is more profitable with the entrant remaining in the market. In the nonstochastic setting, an entrant's viability is coextensive with being in the market, albeit not necessarily producing.

Both conditions are needed for a test of predation. If (ii) were not present, (i) would require, for example, that the incumbent has a duty to ensure the rival's survival in the market. Condition (ii) alone would mandate that the incumbent selects that action that maximizes its discounted present value of profits on the condition that the entrant is in the market. This is undesirable: an entrant could claim predation if the incumbent refused to play a Cournot strategy instead of engaging in Bertrand competition, for example. Viewed another way, condition (ii) captures the profit sacrifice entailed by the choice of action $\underline{a}_0^{\mathrm{I}}$, were the entrant to remain viable. Condition (i) shows the profit motive behind the actual choice; the choice of $\underline{a}_0^{\mathrm{I}}$ yields higher *actual* discounted profits. The expression also shows that predation is not a rational strategy if the rival's exit does not yield any additional profit relative to the situation in which it remains a viable competitor.

For each category of conduct, a different test of predation is needed precisely because in every case the alternative less harmful response will be different. For example, when the alleged predatory action involves a price cut that induces a rival's exit, a less harmful response would entail the incumbent charging a higher price and selling less of its product. In fact, the application of the O–W standard to price cuts yields the familiar cost-based tests of predatory pricing in some market scenarios. The standard also yields tests for predatory product innovations, as we have discussed in Subsection 3.2. The application of the standard to product innovations suggests that (i) raising the price of some system components needed by a rival supplier may be a useful predatory strategy; (ii) market acceptance is not conclusive evidence of the economic superiority of a new

product;[46] and (iii) predation may be a successful strategy when a vertical price squeeze cannot be effectively implemented [Ordover, Sykes and Willig (1985)].

The O–W standard has been criticized for being difficult to implement, for being opaque, for being divorced from standards of economic efficiency, and for being potentially harmful to dynamic efficiency by virtue of discouraging product innovations. These criticisms can be found in Easterbrook (1981b, 1984), Scheffman (1981), Sidak (1983) and Schmalensee (1985). A more positive assessment can be found in Fudenberg and Tirole (1986b) and Williamson (1982) [see also, Ordover, Sykes and Willig (1983b) for a partial response to the critics].

(7) *The Salop et al. rule* [Krattenmaker and Salop (1986b)].[47] Salop et al. have analyzed business strategies designed to elevate rivals' costs. In Section 4 we have discussed these strategies at some length. According to the S–S–K standard, a practice, such as an acquisition of an exclusionary right, is anticompetitive if (i) it significantly raises rivals' marginal costs; and (ii) the firm that has implemented the cost-increasing strategy can increase its price after its rivals' costs have been increased, i.e. the strategy incremented the firm's control over price, hence its market power. According to S–S–K, the firm engaged in allegedly anticompetitive cost-raising conduct would have two affirmative defenses against the allegation of exclusionary conduct. First, it could demonstrate that its rivals have available to them effective counterstrategies which would shield them from the adverse effects of the initial strategy and which could actually render the initial strategy unprofitable. Second, the firm could demonstrate that the practice, while harmful to consumers, nevertheless yields such efficiencies that, on balance, aggregate social welfare is increased.

The appeal of the S–S–K approach is that it focuses on those types of business conduct which, while potentially anticompetitive, do not necessarily require the incumbent to sacrifice current profits for the sake of future gain. In the S–S–K model, anticompetitive behavior need not entail intertemporal profit sacrifice, it does not require the rival's exit, and it does not require any pre-entry positioning moves. Anticompetitive behavior consists of strategic conduct that raises rivals' costs. Once this conduct is adopted, harmed rivals instantaneously cut back on output. The dominant firm can then immediately increase its market share or raise price or both. Hence, the risks associated with standard predatory strategies are reduced because higher profits accrue instantaneously. Consequently, this type of anticompetitive conduct is feasible even if the dominant firm does not have a deeper pocket or superior access to financial resources.

The classic scenario for the Salop–Scheffman type of anticompetitive conduct involves a dominant firm facing a price-taking fringe. The dominant firm selects

[46] For a judicial discussion of the issue, see *Berkey Photo. Inc. v. Eastman Kodak Co.*, 603 F. 2d 263 (2d Cir. 1979).

[47] Theoretical underpinnings of the rule are presented in Salop and Scheffman (1983, 1986) and Salop, Scheffman and Schwartz (1984).

action a which elevates costs. The dominant firm's problem is to select market price, p, and the level of the action variable, a, which maximizes its short-run profit, namely

$$\max_{\{p,\, a\}} p \cdot x - C(x, a)$$

$$\text{s.t. } x = D(p) - S(p, a): \quad a \geq 0.$$

To make the problem interesting, we assume that $C_a > 0$ and $S_a < 0$. A sufficient condition for the optimal value of a to be positive is[48]

$$1/\left[1 + s \cdot \varepsilon^{D}/(1 - s)\varepsilon_s^{F}\right] > \Delta AC_D/\Delta MC_F, \tag{6.1}$$

where ε^D and ε_s^F are the elasticities of market demand and fringe supply, respectively; $s = x/D(p)$; ΔAC_D and ΔMC_F represent, respectively, the strategy-induced *changes* in the dominant firm's average cost (C_a/x) and the representative fringe firm's marginal cost (which equals $-S_a/S_p$). The policy question is whether *any* choice of a that satisfies (6.1) is to be regarded as anticompetitive.

Thus, from the policy standpoint, the S–S–K approach invites inquiry into the likelihood that a particular exclusionary strategy (such as boycott, refusal-to-deal, tie-in, or vertical merger) will have anticompetitive effects. The inquiry proceeds in two stages. First, it must be determined whether the strategy will significantly elevate rivals' costs, as captured in expression (6.1) above. To this end, S–S–K suggest an approach related to the methodology in the U.S. Department of Justice Merger Guidelines where the likelihood of the anticompetitive effects of a merger is gauged, at the preliminary level, by calculating the Herfindhal–Hirschman Index (HHI) of concentration for the relevant market and then comparing it to the appropriate benchmark [Krattenmaker and Salop (1986b)]. Krattenmaker and Salop then develop additional "objective" criteria, such as "cost share" and "net foreclosure rate", which are needed to evaluate the likelihood of anticompetitive effects from an exclusionary strategy in various strategic contexts.

The second stage of the appropriate inquiry involves determining whether the cost-raising strategy increased the firm's ability to raise price. Here, again, S–S–K would rely on structural characteristics of the relevant market. However, they caution that standards for horizontal mergers should not be adopted without modifications which are appropriate to the "vertical" nature of many of the exclusionary strategies.

[48] This is a correct version of equation (2) in Salop and Scheffman (1983).

The S–S–K approach is subject to at least two criticisms.[49] First, it leaves open the question under what conditions rivals cannot render unprofitable the exclusionary strategy pursued by a firm which is determined to harm them. If any exclusionary strategy can be met with an effective counterstrategy, then rivals have little to fear from cost-raising tactics. We have demonstrated that whether a rival has access to an effective counterstrategy depends on the details of the analyzed situation. Second, the S–S–K rule may potentially stymie competitive interactions among rival firms. This is because in some instances such interactions do raise rivals' costs and enable one firm to subsequently increase market price. For example, rendering a complementary component incompatible with a rival's components may be an inevitable outcome of R&D rivalry among firms. Yet, such redesigns could raise a rival's costs and increase the innovator's market power. Nevertheless, the methodology developed by S–S–K puts some coherence and rigor into the analysis of exclusionary strategies.

7. Conclusions

The discussion in the preceding section suggests that none of the rules, standards, and tests of predatory conduct invariably leads to higher social welfare in the long run when applied to realistic market situations. This is not surprising. Anticompetitive behavior can manifest itself in many different ways. It is unreasonable to expect, therefore, that one rule will be equally applicable to all types of conduct in all possible market situations. However, the problem is even worse than that. When perfect competition is not attainable, and the market is not fully contestable, there is no presumption that more firms in the market is preferable to fewer firms. Consequently, rules which restrict the ability of firms to deter entry in the first place may stimulate undesirable entry.[50] And, conversely, this means that rules regulating the strategic conduct by dominant firms must carefully weigh the considerations of salutary effects of entry and of unrestricted competition among incumbent firms. This is not an easy balance to strike. On this score, as of this writing, theoretical industrial organization economics provides only limited guidance for policy-makers.

Nevertheless, some important policy lessons have been generated by the strategic models of single-firm conduct. First and foremost, the strategic approach has been effective in debunking the comfortable proposition that predatory conduct is more costly to the predator than to the prey and, hence, is irrational and not likely to occur. It has been demonstrated in Section 3, that in a

[49] Brennan (1986b) provides an extensive critique of the S–S–K approach.

[50] The social desirability of entry is analyzed in a number of papers. For more recent contributions, see Bernheim (1984) and Mankiw and Whinston (1986).

variety of realistic market settings, anticompetitive conduct is feasible and profitable. The old "new learning" derived its key proposition about the profitability of anticompetitive conduct by focusing on price predation rather than on the richer set of business strategies. Furthermore, the implicit models which underpinned the key conclusions of the old "new learning" did not fully reflect the nature of strategic market interactions. The "new learning" does not lend a credence to the populist view that dominant incumbent firms have almost unbridled power to control the behavior of rivals and to deter entry.

Second, this insight has also brought the recognition that no single "bright-line" standard for defining predation can be expected to correctly proscribe any behavior which reduces welfare and to promote procompetitive conduct. This is because the market settings in which predation is rational deviate along many dimensions from the perfectly competitive ideal. Markets in which predatory conduct is rational are characterized by imperfect and asymmetric information, scale economies, intertemporal and intermarket cost and revenue linkages, barriers to entry and reentry, etc. As Ordover and Willig noted, "... it is unreasonable to expect workable tests for predatory conduct to accomplish more than the cure of the social ills from predation" [Ordover and Willig (1981)]. Yet in markets in which predatory conduct is likely and profitable, more far-reaching competition policy may be desirable.

Third, much of the policy debate over standards for predatory pricing has not been properly grounded in sound economic models in which price predation is rational. As the models of Subsection 3.1 indicate, price predation is most likely to be effective in markets in which entrants are significantly less informed than are the incumbent firms. This means that the analysis of informational asymmetries characterizing a particular market may be of significant importance for testing the claim that rational predation has occurred. We do not know of a single antitrust case in which this issue has been explicitly raised.

Fourth, the focus on price predation seems misplaced given the richness of strategies employed by firms in their battles for market share [Porter (1980, 1985)]. In fact, many of these strategies are more likely to be successful than would be price predation, given the reversibility of price commitments. Regarding nonprice and cost-raising predation, simple cost-based rules are often inadequate for discerning predatory from nonpredatory conduct. However, standards for nonprice and cost-raising predation are not as fully developed and their welfare properties less fully scrutinized than one would wish for final policy recommendations.

Even though great strides have been made, the strategic approach to antitrust is not yet fully developed. There has been little work testing the empirical content of various strategic models of firm behavior. In this regard, the work of Burns (1986) and West and von Hohenbalken (1986) is especially valuable. Experimental work by Harrison (1985), Isaac and Smith (1985a, 1985b), not reviewed here,

is also valuable for testing the predictive power of various models of anticompetitive conduct. On the theoretical side of the enterprise, additional work on nonprice and cost-raising, rival-disadvantaging predation is clearly warranted. Finally, a better understanding of how the sophisticated strategic analyses can be translated into workable standards, which can be applied in the context of antitrust litigation and business counselling, is needed.

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