

Study Guide, Part II (EEB 244, Spring 2002).

8. *Trophic interactions and predation.* Know the classification of pairwise interactions by the direction of effects on Species 1 on Species 2 (trophic, commensalism, mutualism, competition) What is the simplest possible trophic chain? (two species in which one eats the other) Give an example of a trophic chain having three links (plant–herbivore–carnivore) What is a trophic web? (interconnected food chains showing who eats who in the community) What does the Australian example with the sheep fence illustrates? (That predators – dingoes – can have a drastic effect on population density of prey – red kangaroos) What are the four functional classes of consumers? (parasitoid, parasite, predator, grazer). How are they distinguished? (on the basis of *intimacy* and *lethality*) Name some adaptations of prey to reduce predation risk. Give some examples of why it may be advantageous for prey to aggregate in groups (predator confusion, group vigilance, group defense) Explain W.D. Hamilton’s idea of “selfish herd”. Explain P. Errington’s idea of “the doomed surplus”.
9. *Dynamics of predation.* Define predator’s functional response (the dependency between the predation rate – the number of prey killed by an individual predator per unit of time – and population density of prey) What is the Type I functional response? (predation rate increase linearly with prey density) What is the Type II functional response (predation rate saturates – approaches a constant level at high prey densities). Give one possible mechanism that may underlie the S-shaped (Type III) functional response. (switching between prey types or different habitats; formation of a “search image”) Draw Type I, Type II, and Type III functional response curves; label all axes. How does the risk of predation to individual prey depend on prey density in Type I and II functional responses? (Type I: risk stays constant; Type II: declines with prey density) What is the predator numerical response? What components does the death rate of prey due to predation have? (it is the product of the functional and numerical responses). Given equations, explain the biological meaning of the parameters of the Lotka-Volterra predation model (r : prey’s intrinsic rate of population increase, c : predator attack rate, a : conversion factor of consumed prey biomass into new predators, d : predator death rate in the absence of prey).
10. *Dynamics of predation, continued.* What are the population dynamics predicted by the LV predation model? (neutral cycles). What other types of dynamics does one find in nature? (Stable equilibrium, stable cycles, extinction of predators or both species). What additional features were discussed in class that make LV predation model more realistic? (self-limitation in prey and/or predator; Type II functional response in predators). What are the resulting dynamical behaviors possible in this model? (Stable equilibrium or stable limit cycles) If a predator-prey system is characterized by oscillations converging to a stable equilibrium, what does its trajectory look like when plotted in the phase plot? (A spiral leading to the equilibrium) What examples of limit cycles were discussed in lecture? (azuki bean weevil and a wasp parasitoid in the lab; larch budmoth in the Swiss Alps). What were the dynamics of the protozoan predator-prey system studied by Gause in the simplest case – no prey refuge

and no predator immigration? (First, predators drove prey to extinction, then predators starved to death themselves)

11. *Population cycles*. What was the name of the ecologist who started the scientific study of vole and lemming population cycles (Charles Elton) How did Charles Elton find that Canadian lynx populations exhibit cycles? What is the main prey of Canadian lynxes? Why did ecologists dismiss the hypothesis explaining hare-lynx cycles by the effect of sunspot cycles? What is the difference between the specialist and generalist predators of voles? (Specialist predators do not have alternative prey, and therefore must crash if they reduce vole density to near zero; generalist predators survive by switching to alternative kinds of prey). Who are the specialist predators of voles? (weasels) Who are the generalists? (foxes, cats, owls, kestrels) What is the dynamical effect of specialists? (They cause population oscillations in voles). What is the dynamical effect of generalists? (They exert a stabilizing force on vole oscillations). Why are vole dynamics stable in the southern Fennoscandia, but oscillatory in the north? (Numbers of generalist predators decrease from south to north, and so does their ability to stabilize vole dynamics)

Sample problem

(the numerical example worked in lecture)

Given the equation of the Lotka-Volterra predation model:

$$dR/dt = rR - cPR$$

$$dP/dt = caRP - dP$$

and parameters:

$$r = 0.2 \quad c = 0.01$$

$$d = 0.2 \quad a = 0.1$$

calculate the isoclines and plot them in the predator-prey phase plot

If initial densities of prey and predators are $R = 100$, $P = 10$

then what pattern of change does the model predict? (That is, will prey increase, decrease, or stay constant? Will predator increase, decrease, or stay constant?)

IS THE LOSS OF PRAIRIE BIODIVERSITY INFLUENCED BEYOND AN INCREMENTAL LOSS OF HABITAT BY A BREAKDOWN OF ECOSYSTEM PROCESSES?

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A federal list of species at risk in prairie Canada identifies 2 as extirpated, 8 endangered, 4 threatened and 11 vulnerable. To what extent are these declines due to removal of suitable habitat, and/or to a higher level breakdown in life-sustaining ecosystem processes? Among possible processes, we consider the potential impacts of plant succession, predation and dispersal.

Predation by mammals and birds on endangered burrowing owls (*Speotyto cunicularia*) may be elevated. This may be influenced by the invasion of trees and shrubs into the open prairie environment which in the past was maintained near treeless by native grazers and fire. Although the predation rates are low from the predators point of view (1.3%), they are high from the point of view of the declining owls (23-55%).

A loss of genetic diversity could be expected among organisms occupying an ecosystem where habitat loss and fragmentation is high, interrupting normal dispersal. We calculated average heterozygosity and band sharing from DNA fingerprints of ferruginous hawks (*Buteo regalis*), a habitat specialist, and Swainson's hawks (*B. swainsoni*), a habitat generalist. Based on data from seven sites across prairie Canada, there was no evidence that gene flow was disrupted. Genetic diversity of both species was similar to other outbred populations of birds.

A survey of terrestrial and aquatic plants, aquatic insects, birds and mammals was carried out in and around eight ponds (<5 ha) selected in an agroecosystem. The number of species recorded was remarkably high, ranging from 107 to 166.

We concluded that ecosystem change on the Canadian prairies is pervasive and much of its impact largely irreversible. Habitat islands (e.g., ponds) scattered in an agricultural landscape can provide important ecosystem services. Biodiversity protection at the species or patch level is likely to be unsatisfying in the long term. We further suggest that prairie settlement is not a historic event, but a continuing episodic event that simply takes different forms. Canadians might anticipate change, rather than merely reacting to it, and define the kind of prairie ecosystem and human existence we might strive for into the future.



X. PRICE DEPRADATION AS A MONOPOLISTIC PRACTICE

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Predation is perhaps the monopolistic practice to have generated the most analyses and it has frequently caused arguments. As will be explained in this paper, the basic problem in analyzing cases lies in distinguishing between a situation of ferocious competition and one of abuse by an agent with substantial power. Predation is usually understood as taking place when a company displaces or significantly harms a competitor by selling its products at below cost in order to eventually impose monopolistic prices — very high prices that are only sustainable because of the absence of competitors.

Some economic agents commonly believe themselves to be victims of predatory attacks when, in their opinion, their competitors' prices are lower than their own costs. However, whether the costs of the suspected predator are lower than their own is frequently not taken into account. In such an instance, as will be seen below, the displacement or harm suffered by the competitor is not undue.

Competition analysis concentrates on business strategies, which involve two complementary elements: legal issues, and economic issues. This paper concentrates on the latter. The basic posit of economic analysis is that agents' behavior is governed by the desire to maximize profits over the company's working life. This does not mean that it is an ideal principle for explaining the whole of human behavior, but it is a powerful and accessible tool and it is of particular use in predicting economic agents' decisions. No discussion of conflicts of interest between owners and managers will be offered, since such conflicts are of no great significance in analyzing predation. It could also be argued that companies' other objectives can include maximizing sales or product growth and increasing market share or stock prices, etc. However, it can be shown that over a sufficiently long period of time, all these goals equate to maximizing profits.

Of the strategies that economic agents can feasibly carry out, competition analysis attempts to identify those that lead to a reduction in social welfare. This means that on occasions, certain restrictions of business activities — to prevent monopolistic practices, for example —

do increase social welfare. Theoretical models are useful for directing these analyses and also for establishing the criteria to be used in distinguishing between pro-competitive and anti-competitive behaviors.

Predation is a strategy for displacing existing competitors and preventing the entry of new ones. As will be seen below, there are many ways of carrying out this practice, and the criteria used to detect its existence are limited. This makes proscribing the practice in legislation particularly complex.

Section 1 deals with legislative issues. Section 2 offers an overview of predatory practices. Section 3 briefly describes the main ideas on predation found in economic literature. The discussion ranges from authors who argue that the practice cannot exist because it is irrational, to others who concentrate on analyzing the conditions under which predation is possible. We will also attempt to describe useful criteria that have been proposed for identifying the existence of predation. The end of this section briefly describes the way in which an empirical foundation has been sought for predation theory. Section 4 describes some of the criteria proposed for analyzing specific cases and emphasizes their strong and weak points. Sections 3 and 4 are largely based on an article by Ordober and Saloner. Section 5 offers some comments on the predation cases handled by Federal Competition Commission, particularly on the one which it used to determine several guidelines for analysis of the practice. Section 6 summarizes the main conclusions.

1. LEGAL BACKGROUND

Article 28 of the Mexican Constitution prohibits monopolies and monopolistic practices. The second paragraph of this article reads as follows:

Consequently, the law shall severely punish and the authorities shall effectively prosecute all concentrations or cornering of essential consumer items by one agent or a reduced number thereof with the aim of securing a price increase; all agreements between, procedures by, or combinations of producers, industrialists, traders, or service providers intended to prevent free market access or

competition among themselves and to force consumers to pay inflated prices; and, in general, all actions that create an undue exclusive advantage for one or several given individuals to the detriment of the general public or any social class.

From this extract it can be deduced that the aim of Article 28 is to prevent the harm to the social welfare caused by the absence of alternatives for consumers and by the displacement of competitors. Obviously, when there is only one supplier, or when suppliers act in concert, the consumer has no option but to accept the price and other conditions imposed by the supplier or suppliers. The existence of a competitive market ensures that the consumer can freely choose the prices and conditions most favorable to him.

The harm to social welfare caused by monopolistic practices can be seen in reduced supply, with higher prices than those that would prevail within a competitive market or even with the supply of an inferior-quality good. The Federal Law of Economic Competition (LFCE) outlines the authorities' power in this regard and specifies when commercial practices are to be considered monopolistic.

The forerunner of the legislation on predation was the Organic Law of Constitutional Article 28 in force prior to the enactment of the LFCE. Article 5, section I, states that articles sold or services provided at prices below production costs are to be considered as tending toward a monopoly, except in the case of new products, products disdained by sellers, and following bankruptcy, liquidation of stock, or other justified reasons. Article 21 states that actions tending toward a monopoly may be punished administratively with 50% of the fines established for monopolies in Article 19.

The Regulations to the Federal Law of Economic Competition, recently published in the Official Journal of the Federation, define one of the basic criteria for demonstrating the existence of predation. Article 7, section 1, stipulates that systematic product sales at prices below average total costs and occasional product sales at prices below average variable costs are to be considered among the practices proscribed in Article 10, section VII, of the LFCE. Below, in the section dealing with criteria, the reasoning behind this cost-based definition will be discussed.

Under the LFCE, monopolistic practices — such as commercial practices that harm social welfare — are punishable. In accordance with Article 9 of the LFCE, absolute monopolistic practices involve the elimination of competition through the concerted action of competing economic agents. Such practices occur when the agreement serves to fix prices, restrict supply, subdivide the market, or to exchange information in order to yield such an effect.

Article 10 of the LFCE defines relative monopolistic practices as those carried out in order to unduly displace or harm both real or potential competitors and customers. It should be noted that not all displacements of competitors constitute a monopolistic practice; in other words, not all occurrences of this phenomenon are undue. Hence, when is displacement of competitors or harm to them undue, giving rise to a relative monopolistic practice?

As has already been analyzed, the legislature's intention in prohibiting monopolistic practices was to prevent harm to social welfare. Thus, displacements of competitors are undue when they harm social welfare, and they are not monopolistic practices when social welfare suffers no harm. This harm can be measured in terms of higher prices and/or reduced supply and/or lower good and service quality. In competition analysis it is usual to talk of pro-competitive effects when a commercial practice increases social welfare and of anti-competitive effects when their net effect on welfare is negative.

2. PREDATION: A DESCRIPTION OF THE PRACTICE

Some authors define predation in the following terms:

A firm's deliberate aggression against one or more rivals through the employment of business practices that would not be considered profit maximizing except for the expectation either that (1) rivals will be driven from the market, leaving the predator with a market share sufficient to command monopoly profits, or (2) rivals will be chastened sufficiently to abandon competitive behavior the predator finds inconvenient or threatening. Since these

results are detrimental to consumer welfare, predation is not to be classed as superior efficiency.

It is interesting to note that this definition does not require the existence of sales at less than cost. The key element is that the predator eventually recuperates the profits he missed out on by charging monopolistic prices or, if nothing else, prices that are higher than those of the competition. The problem with using such a definition is that it would require demonstrating that the commission of the monopolistic practice will allow the monopolist to charge monopolistic prices or higher prices than would prevail in a climate of competition. It is probably more difficult to prove this than to show that the predator is selling at below cost.

Another interesting aspect of this definition is its recognition of the fact that the goal of predation is not necessarily to displace the competitor; it can also be intended to punish him for behavior threatening toward the predator.

Analyzing the effects on efficiency is very relevant for proving the existence of the practice. Improvements in the efficiency of the productive apparatus increase social welfare. When production costs fall, articles can be offered at lower prices or product quality can be improved to benefit consumers. Thus, Article 6 of the Regulations stipulates the criterion of improved efficiency for assessing whether behaviors thought to be relative practices are in violation of the law. Predation is an inefficient practice because, in the long term, it implies higher prices than would prevail under competition.

The LFCE is very demanding in the parameters that must be met for a relative monopolistic practice to exist. Section II of Article 11 requires a rigorous definition of the relevant market in accordance with the criteria set forth in Article 12. Section I requires the suspected predator to have substantial power in the relevant market. This latter prerequisite has two important consequences for predation.

Firstly, since the practice involves the undue displacement of economic agents, then the suspected monopolist must have the ability to displace the victim. Article 13 specifies the elements to be considered in ascertaining the suspected monopolist's capacity to displace another

agent. Secondly, in the absence of regulation, substantial power implies the ability to set prices unilaterally, without competing agents being able to counteract that power. This means that the monopolist can recuperate the costs incurred in carrying out the practice.

The following is an example of displacement that is not undue. Assume an efficient producer with lower costs than his competitors who offers a similar quality product to that of his competitors at a lower price. If his competitors are not as efficient, it is likely that they will be displaced from the market. In this example, harm is done to the competitors but the consumer benefits. The net effect is an increase in social welfare, since a good is offered at a lower price, and thus this practice cannot be considered monopolistic.

Now, assume a producer who does not have lower costs than his competitors but who does enjoy substantial power in the market. This means that the producer is able to unilaterally set prices and that his competitors cannot counteract that action. We can imagine him as a very large, well known producer, with smaller competitors who are not as well known. The same thing happens if the market has barriers to entry, requiring high levels of investment to gain consumer recognition and acceptance. We should also consider a situation in which not all agents have the same information about demand levels and other competitors' costs. It could be profitable for the producer with substantial power (henceforth referred to as the dominant producer or the monopolist) to sell at below cost in order to harm or displace a competitor. The dominant producer's rationale for this practice is that the conditions exist for him to recuperate the cost incurred by selling at below his production costs.

For the consumer, it means that the advantages of initially acquiring the good at a very low price will be offset by very high prices once the intended monopolist achieves his goals. The net effect is to reduce social welfare by eliminating competition. In this case, therefore, the displacement of the competitor is undue.

In conclusion, there are two conditions needed for a predatory attack to be effective: first, the predator must be capable of removing his competitor from the market or restricting his growth, which means that he enjoys substantial power; and second, he must be able to reap greater profits than under competition once he has attained his goal.

Individual features of each market give rise to variations in the strategies adopted by economic agents. Consequently, there are several types of predatory practices. In some instances the strategy can involve a substantial increase in output in order to cause a reduction in the market price. In others it can involve the selective placement of the good at predatory prices in certain market segments. This explains the great importance of case-by-case analyses.

3. BRIEF DESCRIPTION OF ECONOMIC MODELS OF PREDATION

Predation has given rise to a large number of studies, which can be divided into two groups: those that focus on analyzing market strategies, and those that are oriented toward the legal treatment of predation, with particular emphasis being placed on the evidence accepted in judicial rulings. This paper focuses on the former group.

Although some authors have deemed predatory practices irrational because they are more costly to the monopolist than to the victim, the development of the strategy analysis approach, through game theory, has shown that when agents have asymmetrical supplies of information — that is, when not all agents share the same information regarding competitors' costs and market conditions — predation is not necessarily irrational, since it can be more profitable to the monopolist than refraining from predatory practices. It should be noted that although some authors consider the existence of predation to be unlikely, they themselves maintain that there should be legislation to prohibit it.

For the authorities, the main problem lies in distinguishing aggressive competition with pro-competitive effects from monopolistic practices, particularly given the absence of a clear and direct scale for measuring the impact on welfare. A legal analysis of predation cases, mainly in the USA, points to three basic conditions that indicate the possible existence of predation: that the predator is a dominant company; that the market structure and its barriers to entry make it possible for the suspected perpetrator to recoup the costs incurred in carrying out the practice; and that the predator invested resources in causing his competitor harm.

Predation as an Irrational Act

The authors who propose this idea are thinking of a world of perfect information. To make the reasoning more accessible, assume a situation with two companies that have similar costs: one is large, with substantial market power, and the other is a smaller competitor in the same market. If the large company, which we shall henceforth call the monopolist, wished to eliminate its competitor, it basically has two alternatives: it can purchase the competitor, or it can remove it from the market by offering the product at a below-cost price for as long as it takes to bankrupt the competitor.

From the victim's point of view it is obvious that, faced with certain displacement through bankruptcy, he would prefer to be bought out before his assets lose all their value. He would therefore be willing to accept a price for his company that would discourage predation. Thus, in accordance with this line of thought, a merger would be a better option than predation. Moreover, in that the predator holds a significant share of the market, he incurs in major current costs in the hope of a not entirely certain recuperation. The conclusion, therefore, is that this would be an irrational act.

This reasoning suffers from some limitations. One is that it relies on the assumption that both economic agents enjoy full information. Since the merger would be aimed at eliminating the competition without any social benefit to offset it, it would most probably be questioned by the competition authorities. In fact, the monopolist might well prefer predation, given the problems inherent in detecting it, than to have the merger blocked by the competition authorities.

Theories Based on Asymmetries in Companies' Finances

Some authors have centered on the limitations facing certain companies for obtaining capital. The suspected predator, in addition to having greater resources, knows his victim's limits. If the predator sells at below average costs, the victim will eventually exhaust his resources and be forced out of the market. Then, the monopolist can recuperate the costs he incurred during the predation.

However, the above example is not an equilibrium situation — in other words, there is a better option for both parties. Since the resources of both companies are known to all the participants, the victim of predation

would withdraw from the market at the first credible threat of a predatory attack and would thereby avoid wasting resources on a futile struggle. In fact, knowing the predator's capabilities and incentives, the victim would not have entered the market in the first place. Thus, the above reasoning is not useful in explaining the displacement of the competitor.

The Chain-Store Paradox

The reasoning in the previous section suffers from serious limitations: What would happen if the monopolist were faced with the entry of several competitors? Are there any effects on competitors in other markets close to where the predator carries out his attacks?

The "chain-store paradox" assumes a monopolist who serves "n" markets. Each of these markets has one potential competitor, and these competitors make the decision to enter or not sequentially. Information on strategies is shared by all the agents.

When a competitor enters a market, the monopolist can either pursue predatory tactics and sell at below cost, or he can adapt to the new competitive situation. Obviously, he enjoys higher profits by working alone than by adapting to competition. If he chooses predation, he will face losses in that period. For the new entrant, there are two options: loss if he falls victim to a predatory attack, or profit if the monopolist chooses to adapt.

If we restrict the analysis to a single period, the monopolist will prefer to adapt and the new competitor, aware of the monopolist's options, will enter the market. If the analysis is extended to two periods, even assuming that the monopolist's profits from operating the second period alone are enough to make predation viable, he will adapt to the new competitor.

To understand why the monopolist's best strategy in this model is to adapt, we should begin by analyzing the second period. The situation is very similar to when there is only a single period. The monopolist in this period would prefer to adapt in the second market, because if a second competitor were to enter he would be unable to obtain monopolistic rent

in the subsequent periods. The second competitor, aware of the monopolist's options, will enter the market. The monopolist, predicting the result in the second period, will prefer to adapt in the first period. The reasoning is similar in the subsequent "n" periods. Up to this point, the model indicates that predation will not take place. The solution described in this model is known as "backwards induction" — that is, it begins analyzing strategies in the final phase in order to discover the best strategy.

This model, however, depends heavily on its assumptions, which are unrealistic: information is shared; both the monopolist and the potential competitors have the same information; they are fully aware of competitors' costs; there is no uncertainty regarding demand levels. In addition, cost differentials between companies are irrelevant in this model.

But it is interesting to see what happens in this model if we increase the number of periods N to infinity. If the monopolist refrains from predation in any period and instead adapts to the competitor, he will always have competition in the subsequent periods and, in that situation, it would not be in his interest to have ever adopted predatory tactics. If he always displaces the competitors through predation, no potential competitor would want to be the victim. This result can be seen as a simple example of maintaining a predatory reputation.

Hence, when N equals infinity, if the losses in the first period plus the current value of the monopolistic income expected in the future are greater than the current value of his income in a competitive market, the monopolist will prefer predation over adaptation. Conversely, if the current value of income in a competitive market is greater than the initial predation plus the future monopolistic income, then the monopolist will choose to adapt. Since in this model this information is known to the potential competitors, if they find themselves in the situation where the monopolist will follow predatory tactics, none of them will enter, since they know that any competitor who dares to enter the market will lose.

It is interesting to note that, on account of the model's features, if the monopolist faces an infinite number of potential competitors, N equals infinity, then the threat of predation can be credible; that is, it prevents the entry of competitors. In this situation there are two possible solutions: first, the monopolist adapts in all periods and, second, the monopolist always adopts predatory tactics and hence prevents the

entry of competitors. Extending the model to an infinite number of periods does not, however, make it more realistic. In addition, for an economic model to be useful it must offer a single solution; this model offers several solutions and is therefore less useful.

Theories of Predatory Reputation

One important factor for companies' decision-makers is the amount of relevant information available. In the real world, information is a scarce good and is therefore expensive. It is not unusual for some economic agents to have more information than others. For example, it is only to be expected that a potential competitor will have less information regarding a market than an established, experienced economic agent. It is also to be expected that agents will be lacking a clear idea of their competitors' costs.

One way of representing the uncertainty caused by incomplete information is to classify economic agents with substantial power as either aggressive or adaptable. The aim is not to introduce subjective variables into the analysis, but rather to represent the absence of information regarding, for example, competitors' costs. In this way it is more easily taken into account when defining strategies. Thus, a monopolist may be more aggressive when he believes his costs are lower than or equal to those of his potential competitors, and he will lean toward adaptation if he thinks his costs are higher than or equal to those of his competitors. It should be noted that it is in the monopolist's interest to earn a reputation for aggressiveness.

We shall now define, in the simplified two-period world, the following possible strategies: (a) the first potential competitor enters the market; (b1) the second potential competitor enters if the first was not met by a predatory attack; (b2) if the first potential competitor suffered a predatory attack he will decide at random whether or not to enter; (c) the aggressive monopolist will adopt predatory tactics in both periods; (d) the adaptable monopolist in the first period will decide at random whether to choose predation or adaptation; (e) if the potential competitor enters in the first period, the adaptable monopolist will adapt.

Any of the described strategies can constitute an optimal solution for the agents involved — that is, they maximize their profits, given the other agent's decisions. The key point is how new competitors, in deciding whether or not to enter market, estimate the chances of the monopolist they will face being aggressive (a probability we shall call "p"). In conditions of equilibrium, the natural calculation could be the number of aggressive monopolists divided by the total number of possible monopolists. However, the probability will be higher in this case, because the probability of meeting an adaptable monopolist who prefers to attack must also be taken into account. If he fails to do so, he shows weakness and a competitor will enter in the second period. By attacking he, if nothing else, maintains doubt about whether he is aggressive, thereby reducing the entry of competitors in the second period. As the periods increase, the effect of this reputation is heightened. The number of periods does not need to reach infinity for there to be the certainty of a predatory attack; even with very low values of "p", predation is viable.

Different studies have shown that the results still come out the same, even if some of the assumptions are relaxed — such as the incomplete information referring only to the predator's costs, or there being only two types of behavior for the monopolist and there being different potential competitors in each period.

Theories on Signaling a Predatory Attitude

Some authors have concentrated on explaining the strategy of displacing current competitors through predation on the basis of incomplete information, in contrast to the previous examples, where the analysis was focused on preventing their entry.

These models assume a single market in which two producers compete. The producer with substantial power can have one of two types of costs: high or low. Each producer knows his own costs, but the weaker producer, the potential victim of a predatory attack, only knows that there is a probability "p" that the suspected monopolist has low costs. This probability is known to both agents. The weak producer can withdraw at the end of the first period, and he will prefer to do so if he knows his competitor has low costs. This means that his profits will be negative if his competitor has low costs.

In this model, the monopolist obviously has incentives for making his smaller competitor believe his costs are low. To give this impression, the monopolist produces more than he would produce in a normal situation, creating a drop in the market price during the first period.

In this period, the smaller competitor will reduce his output, and there is a range of probabilities "p" where the effect will be for him to withdraw, leaving the larger producer to obtain extraordinary profits by setting a monopolistic price in the second period. If the producer with substantial power really does have lower costs, then, from the point of view of the LFCE, the displacement of the smaller competitor is not undue. Allowing an efficient producer — one with lower costs — to operate increases social welfare. Therefore, no predatory practice is involved.

However, if the larger producer does not have lower costs but is rather trying to make it appear that he is more efficient than he really is, then the asymmetries in information allow the predation to displace efficient producers and enable the predator to remain in the market, with an overall negative impact on welfare.

One interesting conclusion from these signaling models is that the existence of incomplete information gives the monopolist two incentives for increasing production. The first is the removal of his competitor from the market, and the second is a reduction in the competitor's output. Even if he is unsuccessful in removing the competitor, he will have an impact on perceptions of the market's profitability.

Predation can therefore be used to prepare for a concentration, artificially lowering the price of the company that is to be bought out by artificially reducing its profitability. In the USA between 1891 and 1906, *American Tobacco* purchased 43 of its competitors. It apparently followed predatory tactics prior to those acquisitions. It has been estimated that those tactics saved *American Tobacco* 60% of its purchase costs.

Other Forms of Predation

The previous section offered an overview of monopolistic practices in which the predatory instrument is the monopolist's pricing policy. However, the full range of strategies for displacing or preventing the entry of competitors is very broad and can include instruments of other kinds.

In certain conditions, the displacement of competitors can be made relatively easy through the introduction of new products. However, the positive effects such an innovation has on welfare makes it difficult to classify it as undue displacement. One derivation of this kind of practice, which has given rise to many lawsuits in the USA, is when the innovation is aimed at rendering competitors' products incompatible.

Another practice frequently involved in litigation in the USA is to cause increases in competitors' costs. On certain occasions, a predator is able to increase his competitor's costs by controlling some irreplaceable component. In this instance, unlike classic predation, the suspected perpetrator does not necessarily sacrifice short-term profits in order to harm his victim.

One obvious case is that of the vertically integrated producer where the predator controls a product that is a vital component for his competitors in the markets located further down the production chain. It can also occur in industries that are not vertically integrated but in which the predator, with substantial power, signs an exclusivity contract with the supplier of an irreplaceable component. This kind of arrangement is feasible if, to the monopolist, the value of displacing the competitor is higher than the value of the component to his competitor; otherwise, the supplier of the component would be unwilling to sign the exclusivity agreement.

In general, for this kind of practice to occur, three conditions are needed: (1) the predator must be able to increase his competitors' costs enough so that the marginal cost in the relevant market increases; (2) demand in the market must be sufficiently inelastic; and (3) the increase in the predator's average cost as a result of the practice must be no greater than that of the victim's.

Conditions 1 and 2 guarantee that the practice causes an increase in the market price. Condition 3 requires that the increase in the market price

be higher than the increase in costs caused by the practice. Thus, the predator will obtain profits in the short term, but there will be a negative impact on social welfare as the predation causes prices to rise.

Empirical Analysis in Laboratory Experiments

The reputation and signaling theories are pending empirical verification. The game theory content of these theories makes it difficult to use traditional tools such as econometrics. Instead, the method which has been used is to simulate the situations in a laboratory and to contrast the theories' predictions with a laboratory simulation of a market.

One study simulated two monopolists — one with a tendency toward adaptation, and the other aggressive. For the former, predation was not a dominant strategy. This means that in his profit calculations, predatory tactics were not always in his interest, while for the latter monopolist it was a dominant strategy. In the sessions, those who were playing the monopolists knew what type they were, whereas those playing the potential competitors could not distinguish between the types of monopolist until the end of the game. For the potential competitors, there was a 0.33 probability of encountering an aggressive monopolist. The monopolists' profits depended on their type: in a given period, the adaptable monopolist obtained greater profit by adapting to the entry of the competitor than by using predatory tactics, while the aggressive monopolist always earned more through predation.

The rules of the game were known to all participants. The instructions were given as neutrally as possible in order to avoid possible inferences on the "correct" way to play. The participants were kept from seeing or talking to the others; thus, they did not know the other players' identities.

In each game, the monopolist received eight threats of entry from the competitor; in this way, he had incentives for building up a reputation. At the end of each game, the monopolists were changed to minimize incentives for developing a reputation between games. Competitors only played for two periods and they entered randomly to minimize the chances of their developing reputations.

In the game, the adaptable monopolists consistently sought to appear aggressive. The proportion of adaptable monopolists who did not adopt predatory tactics decreased as experience with the game rose. The entry of competitors was influenced by predatory attacks. To some extent, inexperienced competitors entered in order to compete but, as they developed game experience, their entry rates fell substantially. The results of the experiment confirmed the hypothesis that with asymmetrical information, predation can be the best strategy for monopolists.

4. CRITERIA FOR DETERMINING THE EXISTENCE OF PREDATION

As seen above, the main problem with predatory practices is the difficulty in distinguishing them from a situation of competition. Section 1 maintained that the decision on whether the displacement of a competitor is undue is based on its effect on social welfare. The main criteria proposed by competition analysts are described below. First, however, we will introduce some economic concepts that are central to discussing these criteria.

[gráfica]

Precio, Costo Unitario → Price, Unit Cost

Demanda → Demand

Cantidad → Quantity

Predictions regarding the behavior of companies are based on the idea that the main goal of entrepreneurs is to maximize profits. Thus, decisions on the number of units to produce and the price at which they are to be sold depend on the relationship between the company's income and costs. One concept which is frequently used in economic analysis is marginal cost, defined as the increase in total costs caused by an increase of one unit of output. In theory it is very powerful and easy to use; it is shown on Graph 1 as curve CMg.

At low levels of output (i.e., with idle productive capacity), when one unit of the product is added, income increases more than costs. Thus, the entrepreneur will have an incentive to increase output until the point

where adding another unit would cause a greater increase in costs than in income. The decision of not producing more will therefore be taken when the increases in cost and in income are equal.

As has already been defined, the marginal cost is the increase in total cost caused by an increase of one unit in output, and the marginal income is the increase in a company's total income caused derived from one extra unit of output. Thus, for the entrepreneur the optimal amount to produce is that at which his marginal cost equals his marginal income. In a highly competitive market, with well informed agents and without transaction costs, a producer cannot affect the market price. In such a case, the producer's marginal income remains constant with and equal to the market sale price (P_c) and the quantity supplied will be Q_c . Again, if agents in the market are perfectly well informed and there are no transaction costs but there is only one supplier — a textbook monopoly — price (P_m on Graph 1) will be higher than the marginal cost (C_g on Graph 1) that corresponds to quantity Q_m . In this market, monopolistic rent is calculated by multiplying the quantity sold (Q_m) by the difference between price and marginal cost ($P_m - C_g$). The problem with using marginal cost as an indicator is that in empirical terms, it is very difficult to determine.

According to the Areeda-Turner criterion, a price higher than short-term marginal cost should not be considered predatory. If the price is lower than the short-term marginal cost, it should be treated as a predatory price. The rationale for this argument is that if price is equal to marginal cost in a competitive situation, then any price below that cost implies a loss of earnings for the company. That is one of the prerequisites of predation. Given the difficulty inherent in estimating marginal cost, Areeda and Turner proposed using the average variable cost as an acceptable approximation.

There are several major inaccuracies in the Areeda-Turner reasoning, and these should be addressed. Producers will make profit if they systematically cover their total costs and, in certain conditions, for very short periods they will minimize losses if they cover at least their variable costs. Making price equal to marginal cost does not necessarily mean that the company will make profit at any level of output. To illustrate this, note first that having price equal to marginal cost will yield positive profit if it is greater than average total costs (C_{meT} on Graph 2). On the graph, this is shown by the section of the marginal cost curve that is above point B.

[gráfica]

If the point where price and marginal cost meet is on the section where the average total cost curve is decreasing (the section between points A and B on the graph), it means that at that level of output the company would be making a loss, because in that range marginal cost is always lower than average total cost. In this case, the decision to set the threshold at marginal cost would facilitate predation. On the rising section of the average total cost curve (the section between points B and C on the graph), variable costs are lower than the marginal cost.

Furthermore, using variable cost as an approximation of marginal cost is an error. First, it is important to note that the increase in variable cost due to a one-unit increase in output is equal to the increase in total marginal costs. It does not follow from this that average variable cost is similar to marginal cost. For example, with rising variable costs, as shown in Graph 2, average variable cost (shown on Graph 3 as CMeVar) will always be lower than marginal cost. This marginal cost is shown by line Cmg on Graph 3. This means that under the Areeda-Turner criterion, if average variable costs were used as an approximation to marginal cost, the true value of marginal cost is always underestimated.

[gráfica]

Costo → Cost

Cantidad → Quantity

So, to build up a predatory reputation in order to discourage the entry of new competitors, selling below variable costs is not necessary; it is enough for them to be below average total costs for a sufficiently long period of time for them to serve to prevent the entry of new competitors. Predation is not as costly to the predator, as long as he covers at least his variable costs. However, it is of course difficult to believe that a new investor would be willing to risk his capital if he is not sufficiently sure that he will be able to recuperate the investment made.

From this discussion it follows that for a company to make profit, it must systematically produce at above average total cost. However, it is important to note that with sunken costs, such as advertising

expenditure, and as a result of unpredictable fluctuations in demand, it may well be that it is in the producer's interest to sell temporarily at below his average total costs but above his average variable costs. Were the market price to fall below average total costs, then the best option for the economic agent would be to suspend production in order to minimize losses.

In accordance with this analysis, Article 7 of the Regulations gives the systematic sale of products at prices below average total costs or their occasional sale at below average variable costs as criteria for predation.

The Joskow-Klevorick criterion attempts to include the strategic aspects of predatory behavior. It suggests submitting the case to a first filter that examines structural conditions which make predation possible. These conditions are: (a) the shares of the suspected predator's market; (b) the size of the other companies in the market; (c) the stability of market shares over time; (d) the results history of the suspected predator; (e) the residual elasticities of demand; and (f) the presence of barriers to market entry.

If the case warrants passage to the next stage, the next analysis is whether sales were made at below cost. The proposed threshold is that if the price is lower than average total cost, then predation is deemed to be taking place. The problem with this cost definition is that it ignores the effect of erratic fluctuations in the market in the short term. As previously analyzed, if demand falls for a time, companies cannot adjust all their costs in the short term. They can therefore operate by selling at below their average total costs. Joskow and Klevorick suggest allowing sales at less than average total costs if it can be shown to be consistent with the short-term maximization of profit, but go into no greater detail. Perhaps the most controversial part of their proposal is that they consider price reductions predatory, even when the reduced prices are above average total costs, provided that the price reduction is temporary and subsequently returns to its original position.

Posner's criterion maintains that predation is a long-term strategy and, as such, that the criteria should be equally long-term. It suggests that sales prices below long-term marginal costs are predatory. However, it does not discuss the best way to measure long-term marginal costs.

Williamson's criterion is different in that to prove the existence of predation, no comparisons between price and production costs are required. His approach attempts to pin down the strategic aspects of a monopolistic practice. Of the suspected predator's increases in output, he proposes separating those that are in response to changes in demand from those that coincide with the entry of new competitors. These latter increases are considered part of a predatory strategy. He accepts that if sales are made at less than average variable costs, then predation is taking place regardless of whether output increases or not.

Williamson's criterion focuses on the design of rules to prevent the adoption of anti-competitive strategies. The basic idea is that increases in output to satisfy expanding demand are desirable from the social perspective. However, temporary increases in output for sustaining the substantial power of a monopolist by displacing competitors or preventing the entry of new economic agents are not beneficial. One practical problem with this criterion is the separation of fluctuations in demand. There is no direct measure for demand, and the probability of making mistakes can be significant.

According to Baumol's criterion, the fundamental element in a predatory practice is the predator's ability to increase prices to recuperate the funds invested in the predatory attack. The origin of this idea lies in models of disputable markets.

5. CASES OF PREDATION IN MEXICO

Distribution of Pharmaceuticals in Cuernavaca

A significant proportion of the predatory pricing complaints filed with the Commission do not contain the elements needed to prove the existence of the practice. For example, one complaint submitted by *Asociación Civil de Propietarios de Farmacias de Cuernavaca, Mor.*, a drugstore owners' association in Cuernavaca, Morelos, alleged that large chain-stores in their area were selling pharmaceutical products at below purchase cost.

In this case, the relevant market was that of retail sales of pharmaceutical products in the city of Cuernavaca. However, the investigation carried out by the Commission failed to find any indication

that the chain-stores were selling the products at less than their purchase costs. What it did reveal was that they operate with lower margins than smaller drugstores, and with greater turnover. Although small retailers in general cannot secure the same terms from suppliers on account of their low operating volumes, the investigation showed that several drugstores belonging to the association were capable of competing against the chain-stores against which the complaint was made.

The Plenary of the Commission concluded that there were insufficient grounds to indicate that the accused were guilty of predatory pricing. The prices these agents offer are the result of their efficient handling of their businesses and are not intended to unduly displace other economic agents.

Unfair Competition Between Ferry Companies

In this case, *Naviera Turística de Quintana Roo* filed a complaint against another ferry company for "unfair competitive practices." The alleged predation consisted of, *inter alia*, its failure to observe the fees set forth in an agreement entered into by the Ministry of Communications and Transport and the two companies.

However, the Commission's investigation revealed that the Ministry had annulled the fee agreement almost a year after it had been signed. The Plenary of the Commission therefore decided that there was insufficient evidence of a relative practice.

The Bottle War

A soft-drink bottling company in the state of Sonora filed a complaint against its main competitor for stealing its returnable bottles with a view toward destroying them. Such a practice would cause harm to the competitor by forcing costs up.

The investigation revealed that: (a) competitors commonly collect each other's bottles and, from time to time, effect exchanges; (b) both companies collected and stored their competitor's bottles; (c) no evidence was found of the destruction or sale of the complainant's bottles; (d) the alleged perpetrator lacked substantial power.

The alleged perpetrator held a 54% share of the regional market, compared with the complainant's 46%. In such a market, with such similar shares, it would be highly difficult for a competitor not to be able to counteract an increase in the larger company's price. It was therefore decided that the alleged perpetrator could not have substantial power in the relevant market, which is an indispensable factor in proving the commission of a relative practice.

The Chewing Gum Decision

The complaint made by *Chicles Canel's* against *Warner Lambert*, the maker of *Chicles Adams*, and the *ex officio* investigation of *Warner Lambert* have been the only opportunities for a detailed analysis of predation in Mexico. In this case, the Commission defined a series of criteria to assess the presence of predatory practices. This section briefly describes some aspects of the case.

To define the relevant market, we first identify the need that the product satisfies, why it is demanded, and what makes producing it good business. Then, considering the product which is the instrument of the monopolistic practice, the close substitutes that satisfy the same need are identified.

In its decision, the Commission identified the need satisfied by chewing gum as that of having something to chew. The starting point was *Clarks* brand coated chewing gum. One close substitute was *Canel's* coated chewing gum. The design of the *Clarks* product had many similarities with *Canel's*, both in its name and, at least initially, in its presentation. This design was later changed following a suit brought before the Mexican Industrial Property Institute. Thus, both products are in the same relevant market.

Another close substitute is the *Chiclets* product. The technology used to produce *Warner Lambert* coated gum and *Canel's* coated gum is the same, and their cost structures are therefore very similar. Thus, *Chiclets* was also in the same relevant market. American-style chewing gum, while it is not coated, satisfies the same need to chew and is therefore also part of the relevant market. To summarize, all chewing gums satisfy the same need. Sweets and candies of other kinds were not included in the definition of the relevant market, because they do not satisfy the same need to chew.

Once it has been defined, it could very well be that the entire market does not have all the important characteristics needed to demonstrate the practice's existence. The market can then be divided into segments, according to some particular feature. Such segmentation is not unusual in antitrust cases in the United States: in cases such as *Brown Shoe Co. vs. US* and *Aluminium Co. vs. US*, the markets were segmented.

In the case at hand, the market for chewing gum comprises two segments: the formal, where barriers to entry exist, and the informal. In the former, the suspected predator, *Chicles Adams*, is the basic participant, while the latter involves products from both gum manufacturers. The formal segment comprises a distribution network with large warehouses and shops where the barriers to entry are significant: barriers created over years by factors such as exposure of the brand to consumers, advertising expenditure, and other marketing strategies.

The attractiveness of the formal segment is that it has higher prices and more stable demand than the informal. However, direct entry to that segment can be excessively expensive. One natural entry route into the chewing gum market is through the informal segment, where the entry costs are much lower and which can serve as a platform for eventually entering the formal segment. Selling a product at below cost in the informal segment would make entry into the formal market through the informal segment impossible.

Warner Lambert's substantial power was built on three key facts shown in the file: *Warner Lambert's* 53% share of the chewing gum market; its ability to increase the relative price of *Chiclets* and other brands (e.g., the relative price of *Chiclets* was calculated as the price of *Chiclets* divided by the price of its main competitor, *Canel's*) without losing market share; and the inability of other producers, such as *Wrigleys*, to

increase their shares to counteract the increase in the price of *Warner Lambert's* products.

Above, predation and purchase of competitors were analyzed as options open to monopolists. It is interesting to note that in the complaint filed by *Chicles Canel's* against *Chicles Adams*, the records show that *Warner Lambert* showed interest in purchasing its competitor. This was prior to the enactment of the Federal Law of Economic Competition.

According to the Commission's Decisions, the elements that indicated a predatory strategy were the introduction of the *Clarks* brand product, which in both its design and marketing strategy was not consistent with the principle of maximizing profits through increases in product sales, but rather through the displacement of the competitor in the informal market and preventing the entry of other potential competitors. This allowed the agent with substantial power to sustain a higher price than that of the competition in the formal segment.

In accordance with this, selling *Clarks* at below average cost over a sufficiently long period could eventually decapitalize the close competitor and discourage the entry or development of other competitors.

The Plenary's Decision established that in cost analyses, historical and not standard costs would be used. The prorating of indirect expenditure should preferably be done using the structure of sales cost instead of the net sales. This is particularly importance since if the product is being sold at below cost, then prorating on the basis of sales would tend to underestimate the proportion of indirect expenditure in the cost of the good in question.

One important criterion was defined in the February 8 decision, when the Commission ruled that one of the prerequisites for the existence of a predatory practice was the harm suffered by the alleged victim. If the suspected predator is incapable of making the victim of predation suffer losses, then he will be unable to displace him and there will therefore be no reduction in social welfare.

6. CONCLUSION

In this paper, predation has been described as a strategy for displacing competitors and preventing the entry of new ones, carried out by an economic agent with substantial power, which causes harm to social welfare. The legal background was reviewed, and a series of predatory strategies were described.

The individual characteristics of each market give rise to variations in the strategies adopted by economic agents. Consequently, there can be many types of predatory practices. This large number of predatory strategies makes it difficult to define criteria broad enough to be easily applicable to every case.

This explains the importance of a rigorous case-by-case analysis. It also illustrates the importance of Section VII of Article 10. Restricting the terms of the law to certain specific strategies would encourage entrepreneurs whose companies enjoy substantial power to design other strategies for securing monopolistic profit — strategies which would also harm social welfare but which would not be exactly covered by the legislation in force at the time.

Emphasis was placed on three conditions for establishing the existence of predation: the predator must be a company with substantial power; the structure of the market and its barriers to access must permit the recuperation of the costs incurred by the suspected monopolist in carrying out the practice; and the predator must have invested resources in harming his competitor.

Of the main arguments regarding predation, a review was offered of those that maintain that the practice is not very feasible and of those who have incorporated in it elements to make it more realistic, such as the economic agents having asymmetrical information. The main criteria that have been proposed for analyzing the possible presence of predation were also discussed.

This issue is far from fully explored, and many points are still open to debate. However, every new case is a great opportunity for thought and analysis regarding monopolistic practices.