

# ECONOMIC WELFARE, PRICE AND PROFIT: THE DETERRENT EFFECT OF ALTERNATIVE ANTITRUST REGIMES

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*This paper critically examines the deterrent effect of price-fixing statutes under alternative antitrust regimes. A regime is defined by the litigation strategy which the antitrust agency employs in detecting cartels and in determining whether prosecution is warranted and by the basis upon which courts estimate damages. The results of the analysis suggest that antitrust policy may actually induce cartels to further restrict output, increasing welfare loss above the level imposed by an unthreatened, perfect monopoly. Litigation strategy and damages should be founded upon consideration of welfare loss measures to avoid this possibility.*

## I. INTRODUCTION

The regulation of economic activity rests upon the premise that it promotes economic and social welfare. Over the past two decades, Averch and Johnson [1962], Stigler [1971], Adams and Yellen [1976], and others have shown that a significant number of regulations and antitrust statutes may reduce economic efficiency. Until very recently, economists continued to treat the prohibition of agreements to raise prices with greater respect, maintaining that the welfare effects of price-fixing statutes are positive. This position was recently challenged by Dewey [1979] who argues that the legal elimination of agreements to stabilize, but not necessarily raise, prices may decrease economic welfare. Dewey's argument depends upon the uncertainty accompanying oligopolistic instability.

The conclusion that price-fixing statutes promote economic efficiency, when the stability argument is set aside, however, remains intact as Bullock and LaCroix [1982], Dewey [1982], Grawe and Overstreet [1982], Koller II [1982], Waldman [1982], and Williams [1982] argue. The purpose of this paper is to demonstrate that this conclusion may, in fact, be incorrect when the economic determinants of antitrust casebringing activity are explicitly considered.

Several studies investigate the question of economic determinants. Long,

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Schramm and Tollison [1973] conclude that excess profits and welfare loss play a minor role in determining antitrust policy and one secondary to industry sales which possesses strong explanatory power throughout their study. Siegfried's [1975] and Asch's [1975] findings suggest that economic variables in general have little influence on the Antitrust Division.

Despite the actual behavior of antitrust agencies, it is frequently asserted that an efficient antitrust policy should be founded upon the use of economic measures to weigh the benefits and costs of casebringing activity. The leading exponents of this view are Bork [1978], Posner [1976] and, more recently, Baxter [1982]. This paper draws upon these normative prescriptions to examine the welfare effects of using economic indices as determinants of antitrust activity. We employ a model which focuses upon one reaction of an ongoing cartel to the possibility of prosecution for a violation of horizontal price-fixing statutes. The analysis is restricted to the impact which the threat of antitrust litigation has upon the cartel's price and output decision. We refer to this effect as deterrence.<sup>1</sup>

The analysis demonstrates that the choices of litigation strategy and the basis for damages are important ones. Under several regimes, antitrust policy has a deleterious effect upon economic welfare. Litigation strategies founded upon gross sales or profit in conjunction with damages awarded on the basis of cartel profit provide just two examples in which antitrust policy exacerbates welfare loss to consumers. In the case of a strategy based on gross sales, economic welfare decreases, output falls and price increases as compared to an unhindered, pure monopoly. Under certain demand and cost conditions, damages based upon monopolistic overcharge also induce cartels to further restrict trade. This perverse potential suggests that more attention needs to be focused upon the role of economic analysis in antitrust policy if a net benefit to economic efficiency is to be assured. In Section II, the basic model is constructed with specific antitrust regimes discussed in Section III. The last section offers brief concluding remarks.

## II. ANALYTICS

The impact of antitrust policy upon illegal cartel behavior can be divided into two basic effects: deterrence and enforcement.<sup>2</sup> The enforcement effect

1. Our analysis is most closely associated with the work of Block, Nold and Sidak [1981] who model and test the deterrent effect of antitrust policy in which the probability of prosecuting a cartel is sensitive to the markup of price over marginal cost. Our paper, however, differs in two important respects. First, rather than assuming one particular antitrust strategy, we compare several competing alternative strategies. Second, the focus of our paper rests upon the impact of competing antitrust strategies upon economic welfare rather than empirical testing. In this latter point, in being theoretical, our paper is more closely associated with the work of Lee [1980; 1982] and Feinberg [1982] who formulate a model in which the antitrust agency and the cartel interact in a game-theoretic context. The present paper differs from their work in that the agency is not assumed *a priori* to produce an unambiguous increase in economic welfare nor are the game-theoretic implications addressed.

2. For an excellent conceptual discussion of the multiple effects of antitrust policy see Mason and Reynolds [1977].

arises from prosecution of cartels and from fines and injunctive measures which accompany legal action. The deterrent effect, in contrast, derives, not from the actual prosecution and subsequent punitive measures, but from the expectation of and threat posed by antitrust litigation. Deterrence is defined as the alteration of economic behavior by the cartel in reaction to the threat posed by detection and prosecution. In this paper, we examine the deterrent effect under alternative antitrust regimes. A particular regime is defined by the perceived economic analysis and policy, or lack thereof, which the cartel believes the antitrust agency and the judiciary employ in determining case-bringing activity and awarding damages.

Consider a cartel which maximizes expected profits. In assessing profit expectations, the cartel estimates the probability of the initiation of a successful price-fixing suit and determines the economic data upon which this probability depends. Expected profits are given by

$$(1) \quad \pi_e = p(q)q - c(q) - F$$

where  $c(q)$  is the cartel's production cost function and  $p(q)$  is the inverse market-demand function.<sup>3</sup> The term  $F$  represents the expected financial costs resulting from antitrust activity and is defined by

$$(2) \quad F \equiv s(\theta, \lambda) \tau [\text{damages}]$$

where the specification of the fine function reflects the fact that under current statutes a price-fixing conspiracy is subject to both private and public prosecution.<sup>4</sup> The term  $\tau$  is defined to capture expected public and private financial penalties as a proportion of cartel damages and is referred to as the fine multiple. In the presence of uncertain antitrust enforcement, the cartel must consider not only the magnitude of public and private fines, but also the probability,  $s$ , that a successful suit will be initiated. We assume that this probability increases with  $\theta$ , the data generated by cartel activity and monitored by the agency [ $\partial s(\theta, \lambda)/\partial \theta > 0$ ], and also with the level of agency expenditures,  $\lambda$ , [ $\partial s(\theta, \lambda)/\partial \lambda > 0$ ]. It seems reasonable to argue that increased enforcement expenditure will increase the sensitivity of  $s$  to  $\theta$ , i.e.,  $\partial^2 s / \partial \theta \partial \lambda > 0$ .

It is often, and correctly, stated that the most potent deterrent to price-fixing is the provision that "any person who shall be injured in his business or property by reason of anything forbidden in the antitrust laws . . . shall

3. We assume colluders maximize expected profits. The specification of equation (1) implies that colluders are risk neutral.

4. The model does not imply that all monetary damages will result from a single public action. There is a critical and well established link between public and private antitrust litigation. When a firm loses a public antitrust suit, private litigation is likely to follow because private litigants may use the prior conviction as evidence in their suits. Thus, public action leads, indirectly, to private damages. Also, the fine function does not take account of litigation costs incurred through antitrust action. While private litigation costs incurred are a major component of the resources expended upon antitrust, they are secondary to the focus of our model. The inclusion of litigation cost into our model would entail additional welfare costs from antitrust enforcement.

recover threefold the damages by him sustained."<sup>5</sup> In price-fixing cases the basis for damages is the difference between the price paid by the plaintiffs and the price which would have prevailed in a competitive market.<sup>6</sup> In the case history of antitrust, one finds several alternative methods of appraising damages. In order to focus the immediate analysis upon the impact of alternative antitrust regimes, we initially adopt one of these methods in which damages are awarded on the basis of monopoly profit, that is, damages due to the cartel are equal to  $p(q)q - c(q)$ . At a later juncture, we consider a second specification of damages, monopolistic overcharge, as a fourth regime.

Substitution of (2) into (1) reveals that if  $(1-s\tau) < 0$ , expected profits are negative. In this case, under perfect information and maximization of expected profit, collusion would not be undertaken.<sup>7</sup> If antitrust resources were costless, the agency would clearly seek to establish this level of deterrence, thereby preventing all criminal activity. However, because resources are scarce, total deterrence may not be optimal. In this case, marginal deterrence becomes a viable option and one in which the guiding economic analysis of the agency plays an integral part. The periodic discovery of horizontal price-fixing agreements suggests that marginal deterrence is of more than trivial interest. Assume for the moment, in our model, that  $(1-s\tau) > 0$ , a condition under which a cartel is an ongoing entity and must face the decision of the optimal restriction of output taking agency activity into account. The first-order condition governing this decision is:

$$\begin{aligned} (3) \quad \partial \pi_c / \partial q &= (mr - mc) - s(\theta, \lambda) \tau (mr - mc) \\ &\quad - (\partial s / \partial \theta) (\partial \theta / \partial q) \tau [p(q)q - c(q)] \\ &= 0 \equiv H(q, \lambda, \tau) \end{aligned}$$

where  $mr$  and  $mc$  are respectively marginal revenue and marginal cost of production.<sup>8</sup> The first term on the right-hand-side of (3) is simple marginal profit. The sum of the second,  $s\tau [mr - mc]$ , and third,  $(\partial s / \partial \theta) (\partial \theta / \partial q) \tau [p(q)q - c(q)]$ , terms is the expected marginal fine resulting from antitrust activity. The two components of the expected marginal fine reflect the fact that a change in the cartel's output will affect both the level of profit subject

5. 15 USC § 15.

6. The specification of the model places primary emphasis upon the damages incurred by consumers because damages to suppliers are only loosely tied to cartel profits. See Page [1980].

7. The condition  $(1-s\tau) > 0$  is a sufficient condition for the cartel to engage in illegal price-fixing provided firms earn zero measured profits under competition, that is, only if there are no rents earned on specialized factors of production owned by the firms. If these rents exist, then the antitrust agency would have to distinguish between competitive and non-competitive rents. We assume that the agency never brings suit against noncolluding firms. If the agency is fallible, then the deterrent effect of antitrust would decline. See Becker [1968] on "mistaken enforcement." We are indebted to Rod Smith for pointing this out to us.

8. The second-order condition (satisfied by assumption) is

$$\begin{aligned} \partial^2 \pi_c / \partial q^2 &= -2(\partial s / \partial \theta) (\partial \theta / \partial q) \tau [mr - mc] + (1-s(\theta, \lambda) \tau) (mr' - mc') \\ &\quad - [(\partial^2 s / \partial \theta^2) (\partial \theta / \partial q)^2 + (\partial s / \partial \theta) (\partial^2 \theta / \partial q^2)] [\tau [p(q)q - c(q)]] = H_q < 0. \end{aligned}$$

to the anticipated damage multiple ( $\tau$ ) and the probability that the cartel will be detected and prosecuted. The third term is important for our results and arises because changes in output affect the economic data which the agency monitors which in turn affect the probability of prosecution. The change in probability alters the expected fine. We refer to this term as marginal detection and denote it by  $md$ . The term's importance is most easily seen by rewriting (3) as:

$$(4) \quad (1-s\tau)mr = (1-s\tau)mc + (\partial s/\partial \theta)(\partial \theta/\partial q)\tau\pi.$$

In the absence of  $md$ , the antitrust agency's existence would not alter the output of an ongoing cartel from the level established by an unthreatened, perfect monopoly. This follows from the relationship of  $(1-s\tau)mc$  to  $(1-s\tau)mr$ . To the left of the simple monopoly output ( $q_m$ ),  $(1-s\tau)mr$  must exceed  $(1-s\tau)mc$  and to the right it must lie below it. At  $q_m$ ,  $(1-s\tau)mr$  equals  $(1-s\tau)mc$ . The reason for this is straightforward. At any output, the marginal revenue and marginal cost curves ( $mr$  and  $mc$ ) are simply reduced by the same proportion,  $(1-s\tau)$ . It follows, in this simplest model, that the *sine qua non* of marginal deterrence is the marginal detection effect.

One result of our paper can be simply stated: when damages are defined as cartel profit, economic welfare decreases, increases, or remains unchanged as  $md$  is positive, negative, or zero at the simple monopoly output, with the caveat that the opportunity costs of agency resources must be taken into account. The veracity of this statement follows directly from (4) by noting that if  $md$  is positive, expected marginal cost [defined as the right-hand-side of (4)] is increased and output, as a consequence, is decreased. If the marginal detection effect is negative, expected marginal cost is reduced and output is increased. The thrust of antitrust activity on marginal deterrence thus rests upon the sign of  $(\partial s/\partial \theta)(\partial \theta/\partial q)[\tau\pi]$  and, this sign is solely dependent upon the sign of  $\partial \theta/\partial q$ , that is, the relationship of  $\theta$  to output. This fact suggests that the choice of economic data which the antitrust agency monitors is critical in evaluating marginal deterrence of antitrust activity, a fact best illustrated in the context of specific regimes.

### III. IMPLICATIONS OF ALTERNATIVE ANTITRUST REGIMES

The antitrust agency is assumed to monitor economic data which are sensitive to the presence of cartel activity and changes in which are indicative of movements toward furthering societal goals.<sup>9</sup> As Stigler [1970, 531] points out, "a law is enforced, not by society, but by an agency instructed to that

9. Various antitrust goals have been advocated by economists and policy administrators. A number of leading economists argue that consideration of economic welfare should guide antitrust policy. Expositors of this view include Posner [1976], Bork [1978] and Baxter [1982]. Bork and Posner also argue, rather strongly, that the legislative intent of antitrust laws was to advance the goal of consumer welfare. For a recent contrasting view which takes the position that distributive justice was the goal of the framers of antitrust law see Lande [1982]. Lande also provides an excellent survey of other views regarding legislative intent, obviating discussion of this issue here.

task." In carrying out this task, the agency must employ some rationale for determining whether a case should be brought. This stratagem may, or may not, produce results which are economically efficient.

We examine three specific antitrust regimes because they are those investigated by recent empirical studies of antitrust activity under which  $s$  is a function of the level of profit, the cartel's size as captured by gross sales or revenue, and the welfare loss imposed on society by its existence.<sup>10</sup> These regimes differ in the strategy which the antitrust agency employs in detecting cartels and in deciding whether litigation is warranted. We also examine a fourth regime to consider an alternative definition of antitrust damages advocated by the law and economics literature.

As a prelude to evaluating the economic consequences of these regimes, a consideration of importance is the effect which increased resources allocated to the agency and stricter fines have upon cartel price, output, profit and welfare loss imposed upon society by the cartel's existence where welfare loss is defined by

$$(5) \quad WL \equiv \int_q^{q_c} (p(x) - mc(x)) dx + \lambda$$

and  $q_c$  is the competitive output, a constant once the demand and cost functions are specified. In order to assess these effects, we define  $\partial \pi_e / \partial q \equiv H(q, \lambda, \tau)$ . The following comparative static derivatives are calculated by totally differentiating (3) and solving:

$$(6) \quad \partial q^* / \partial \lambda = -H_\lambda / H_q = \{(\partial s / \partial \lambda) \tau (mr - mc) + (\partial^2 s / \partial \theta \partial \lambda) (\partial \theta / \partial q) [\tau (p(q)q - c(q))] / \partial^2 \pi_e / \partial q^2\}$$

$$(7) \quad \partial q^* / \partial \tau = -H_\tau / H_q = \{s[mr - mc] + (\partial s / \partial \theta) (\partial \theta / \partial q) [p(q)q - c(q)]\} / \partial^2 \pi_e / \partial q^2$$

where  $*$  denotes optimal value and subscripts partial derivatives. The impact on any other variable of interest is given by

$$(8) \quad \partial \phi / \partial i = (\partial \phi / \partial q) (\partial q^* / \partial i)$$

where  $\phi$  denotes the variable ( $\phi = \pi \equiv p(q)q - c(q)$ ,  $R \equiv p(q)q$ ,  $WL$ , etc.) and  $i$  the policy instrument ( $i = \lambda, \tau$ ). Examination of (6), (7) and (8) reveals that the economic impact of antitrust policy is easily determined once the sign of  $\partial \theta / \partial q$  is established.

Consider the regime in which profit ( $\theta \equiv \pi$ ) is perceived by the cartel as the datum employed in determining casebringing activity. In this instance,  $\partial \theta / \partial q = \partial \pi / \partial q = mr - mc$ . The marginal detection effect takes its sign from simple monopoly profit (zero at  $q_m$ , negative for outputs greater than  $q_m$

10. The model is general enough however that other regimes can be analyzed by specifying alternative definitions of  $\theta$ .

and positive for outputs less than  $q_{sm}$ ). The result, as shown in Figure 1, is the rotation of expected marginal cost from  $(1-s\tau)mc$  to  $(1-s\tau)mc+md$  as indicated by arrows. For a profitable gamble at the margin, the cartel is not deterred from producing the simple monopoly output.<sup>11</sup> In Figure 1, the output determined by the intersection of  $(1-s\tau)mr$  and  $(1-s\tau)mc+md$  is the same as the output for which  $mc = mr$ .

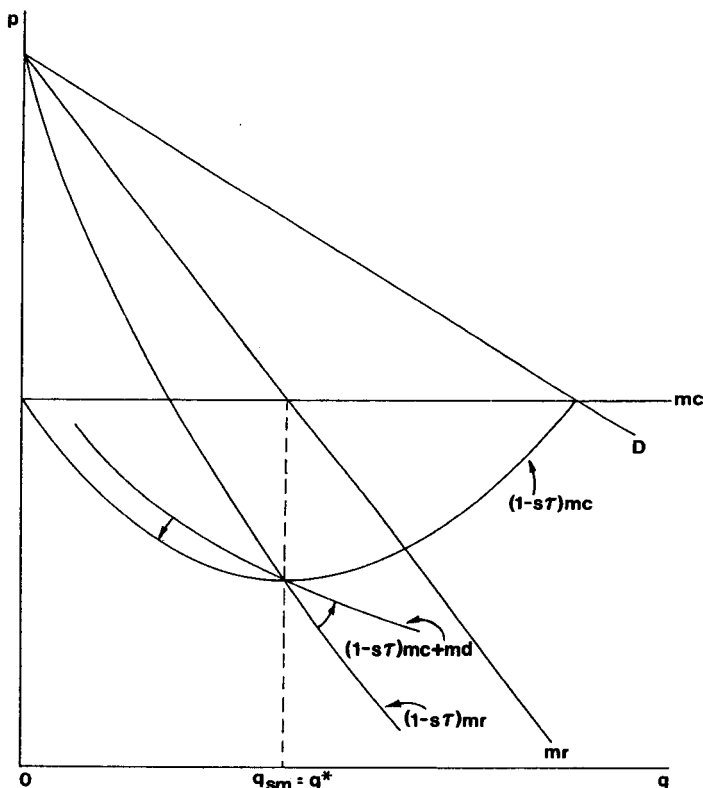


FIGURE 1

Under a profit regime, increases in the level of antitrust expenditure ( $\lambda$ ) and the anticipated damage multiple ( $\tau$ ) in their role of marginal deterrence

11. We assume a unique expected profit maximum. Analytically uniqueness requires  $(1-s\tau) > (\partial s/\partial \pi)(\tau\pi)$  where the left-hand-side is the portion of profit which the cartel expects to retain and the right-hand-side is the additional fine which the cartel expects to incur due to the increased probability of detection and prosecution. If this assumption and/or the assumption that  $(1-s\tau) > 0$  is relaxed, multiple profit equilibria become a distinct possibility under the profit and revenue regimes. The welfare effects, whether positive or negative, of antitrust policy become uncertain. Uncertain outcomes do not provide a foundation for a rational antitrust policy and do not lend support to adoption of either regime. This is not the case under the welfare loss regime. Multiple equilibria, however, are possible and at times likely even when not considering expected profits as recently pointed out by Formby, Layson and Smith [1982].

do not change the level of output, price or profit as equations (6) and (7) reveal. Society's economic welfare, however, is reduced as resources devoted to antitrust activity have alternative uses. In sum, with reference to the profit regime, the deterrent effect is less than ineffectual because, in the absence of an enforcement effect, the cartel produces an output identical to that of a pure monopoly but economic welfare decreases.

In terms of economic welfare, the sales regime produces worse results. When the cartel perceives that the probability of a successful antitrust suit is affected by sales volume (gross revenue),  $\partial\theta/\partial q = mr$ . The marginal detection effect possesses the same sign as marginal revenue and is positive over the relevant range. The result in this case is the shift of expected marginal cost from  $(1-sr)mc$  to  $(1-sr)mc+md$  as indicated by arrows in Figure 2. The effect of this antitrust regime is an unambiguous decrease in economic welfare, decrease in output and an increase in price. By equations (6) and (7), increases in the levels of antitrust expenditure and the anticipated damage multiple compound this perverse effect.

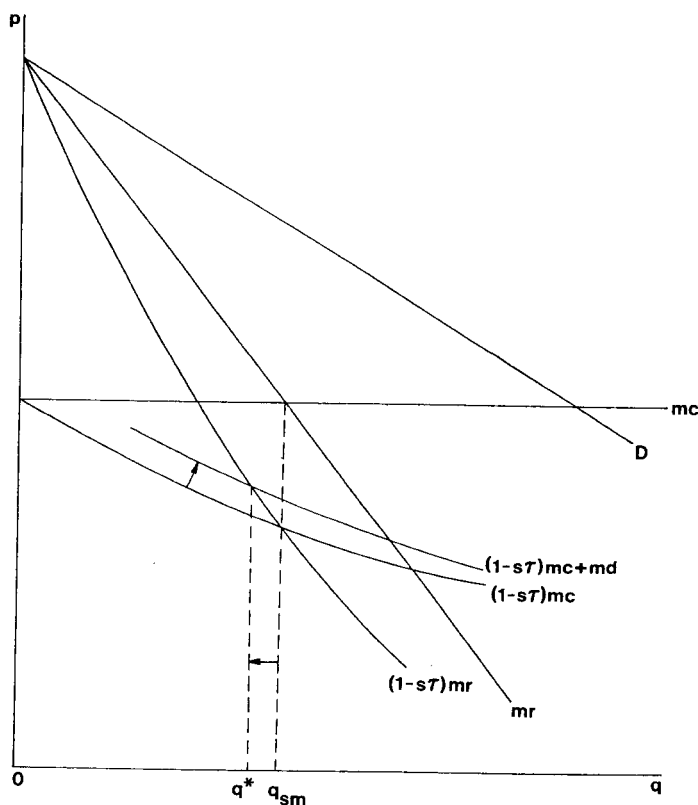


FIGURE 2

In marked contrast, when the cartel believes that the probability of successful antitrust litigation is related to the welfare loss, the marginal detection



effect results in increased economic welfare and output, and decreased price and cartel profit. Formally,  $\partial\theta/\partial q = \partial WL/\partial q = -p(q) + mc < 0$  for relevant levels of output implying that  $md$  is negative for  $q < q_c$ . The marginal detection effect reduces expected marginal cost as shown in Figure 3. Output increases to  $q^*$ , price is lowered and economic welfare increases. Increased fines and agency expenditures are frequently advocated as a means of reducing welfare loss. Under the welfare-loss regime, this contention is supported by our comparative static results, a markedly different result to those of the previous regimes.<sup>12</sup>

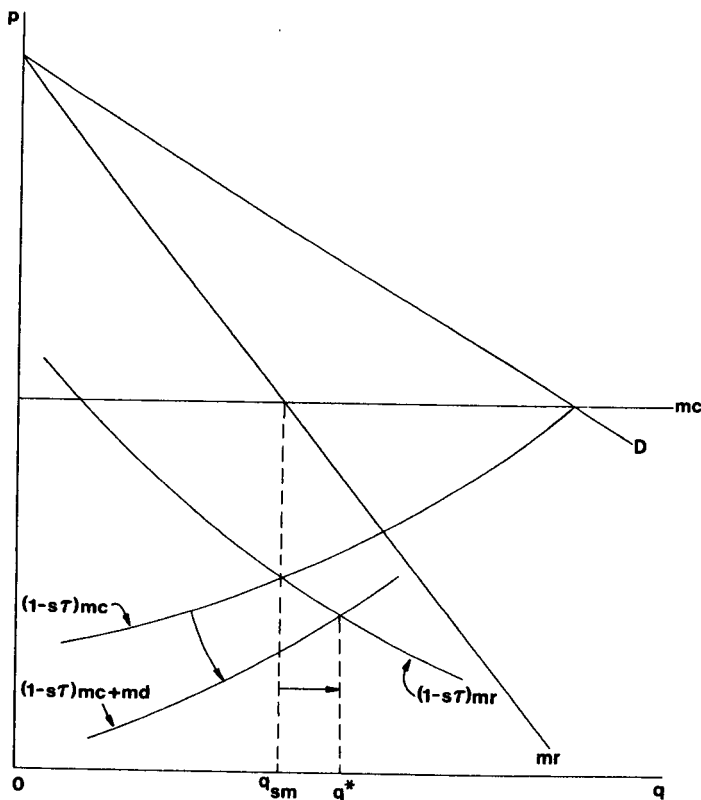


FIGURE 3

These results are not surprising when one reflects upon the fact that the threat or expectation of a fine creates the same type of economic incentives as a tax on profit in which the tax rate varies either with the level of profit, revenue or welfare loss. To draw the analogy, consider the case in which the

12. This raises the issue of what index of monopoly power would be most appropriate for the agency to employ. Two primary contenders are the Harberger index and the Lerner index. As Formby and Layson [forthcoming] show, the Lerner index can move in an opposite direction to the Harberger index under shifts and rotations of the demand schedule. Because the Harberger index is a direct measure of welfare loss, we prefer its adoption.

tax rate varies with the level of profit. As is well-known a monopolist will not change output in response to the imposition of such a tax because if he is permitted to retain a portion of any increase of pre-tax profit (as marginal tax rates of less than 100 percent imply), then, after-tax profit will be maximized at the same output as pre-tax profit. The same holds true for our profit regime except the threat of prosecution replaces the certainty of taxation. This statement becomes more convincing when we write expected profit as  $(1-s\tau)\pi$  and note that  $s\tau$  plays the same role as a tax rate and that  $(1-s\tau)$  represents the portion of pre-litigation profit which the cartel expects to retain. As long as the expected fine rate, in total or at the margin, does not exceed one-hundred percent (the condition for consideration of marginal deterrence in the first place), the cartel will maximize expected profit at the simple monopoly output. There is simply no incentive for the cartel to change output.

In contrast, the agency's use of total revenue as a trigger for litigation would provide an incentive for output to change, albeit a perverse one. It should be amply clear to the cartel that it can reduce the chances of prosecution by lowering total revenue through a further restriction in output. The benefit to the cartel of this action is a lower expected fine. The cost to the cartel is a lower pre-litigation profit. Around simple monopoly output, the expected fine falls more rapidly than does pre-litigation profit, providing an increase in what really matters to the cartel, expected profit.<sup>13</sup> The analysis of the welfare loss regime follows by very similar intuitive reasoning except that, in order to maximize expected profit, the cartel must reduce welfare loss by increasing output.

In sum, the fundamental issue is whether the participants of a cartel will find it optimal to produce less, the same, or more output when antitrust litigation is a possibility. The analysis demonstrates that the answer hinges upon the marginal incentives created by the way in which antitrust prosecution is applied. How is it applied? Empirical work on this subject is suggestive.

Long, Schramm, and Tollison's [1973, 361] analysis, although somewhat controversial, indicates that "the welfare loss triangle alone or together with excess profits appear to play a minor role in explaining antitrust activity. However, . . . industry sales appear as a strong variable throughout."<sup>14</sup> In this

13. The proof of this is straightforward. Letting  $s\tau \equiv t$  to continue the analogy that  $s\tau$  is similar to a tax rate,  $t$ , we can write expected profit as  $\pi_e = (1-t(R))\pi$ . Taking the derivative of expected profit with respect to output we have  $d\pi_e/dq = -dt/dR \cdot mr \cdot \pi + (1-t)(mr-mc)$ . The first term is the reduction in total tax resulting from a decline in the tax rate. The second term is the amount of retained marginal profit foregone when output is changed away from simple monopoly output. At  $q = q_{sm}$ ,  $mr = mc$  and, therefore,  $d\pi_e/dq < 0$ .

14. Long, Schramm and Tollison found that a trillion dollar increase in the sales of a two-digit SIC industry resulted in between 3.1 and 9.7 additional antitrust cases in that industry. This impact is of considerable significance since food and kindred products and transportation equipment had industry sales which exceeded one quadrillion dollars. Nellor and Laband's [1984] recent empirical reexamination and extension of Long, Schramm and Tollison's work again suggests that welfare loss is not an important explanatory variable in agency decision making.

case the deterrent effect of antitrust policy may lead to a reduction rather than an increase in economic welfare. This conclusion depends, in part, upon awarding damages on the basis of cartel profit, a basis which, in fact, is to be found in antitrust case history. A second basis for awarding damages is also to be found in the history of antitrust litigation. We consider this second basis as a fourth regime.

The fundamental antitrust tradition in private price-fixing cases is to award damages on the basis of the difference between the price paid by the plaintiffs and the price which would have prevailed in a competitive market.<sup>15</sup> The fine function in this case is given by:

$$(9) \quad F = s(\theta, \lambda) \tau [p(q) - p_c] q$$

where the price under competitive conditions ( $p_c$ ) must equal marginal cost at the competitive output ( $\bar{mc}$ ), that is,  $p_c = \bar{mc}$ . The first-order condition for maximization of expected profit under this specification is:

$$(10) \quad \partial \pi_c / \partial q = (mr - mc) - md - s\tau(mr - p_c) = 0$$

where the last term on the right-hand side of (10) is the rate of change of the expected fine with respect to output.

Interpretation is facilitated by substituting  $p_c = \bar{mc}$  and rewriting (10) as

$$(11) \quad \partial \pi_c / \partial q = (1 - s\tau)(mr - mc) - md - s\tau(mc - \bar{mc}).$$

Two points are worthy of comment. First, the economic incentives created by the marginal detection effect are unaltered because  $md$  enters (11) as an additive term.<sup>16</sup> This simply means that the effect of overcharge-based damages on output is imposed upon that of marginal detection to obtain their combined effect. Second, comparison of (3) and (11) demonstrates that the only difference between this regime and the previous three is the last term on the right-hand side of (11). In the absence of marginal detection ( $md = 0$ ), this term represents the rate at which expected profit is changing around the simple monopoly output. As the cartel increases output, expected profit will increase, decrease or remain unchanged as marginal cost at the competitive output is greater than, less than or equal to marginal cost at the simple monopoly output.

In the empirically important case of constant marginal cost,  $mc = \bar{mc}$ ,  $s\tau(mc - \bar{mc}) = 0$  and (11) reduces to (4) for all levels of output. Damages

15. Plaintiffs in private treble actions are not required to establish the exact amount of this disparity (*Bigelow v. RKO Pictures, Inc.*, 327 U.S. 251, 265 1946). Rather, courts have approved three basic methods of estimating damages resulting from a price-fixing conspiracy. The "before and after" technique compares the price paid before the cartel's existence with the price established by the cartel. The "yardstick" method compares the price paid by the plaintiff with that paid by similar firms purchasing outside the sphere of the cartel. The third technique uses the testimony of experts to estimate the amount of damages. The precise determination of the overcharge may, therefore, vary a great deal.

16. This implies, of course, that total deterrence is not achieved, and marginal deterrence remains the objective of the antitrust agency.

based on overcharge yield the same results as damages based on profit, and our previous conclusions and analysis remain unaltered. This becomes obvious upon noting that  $(p - mc)q$  equals profit (excluding fixed costs) because marginal cost equals average variable cost for all  $q$ . The specification of damages as monopolistic overcharge yields different results only when marginal cost at the competitive output is greater or less than marginal cost at the monopoly output.

In the case of monotonically increasing marginal cost, an overcharge-based fine provides an incentive for the cartel to increase output. The positive incentive results from the fact that, by expanding output around the simple monopoly output, the cartel can reduce the level of damages and the expected fine at a more rapid rate than pre-litigation profit falls, thereby increasing expected profit in a manner similar to that explained in previous regimes. When marginal cost monotonically declines, it might appear that an opposite output effect would result. However, intuitive relection allows us to dismiss this case. Declining marginal cost over the relevant range of output is a sufficient condition for the existence of no more than one seller in the market. Our model analyzes the output decision of a cartel which, by definition, consists of two or more producers.

Importantly, however, we cannot rule out the possibility of a perverse incentive under monopolistic overcharge because the competitive price can be less than marginal cost at the monopoly output level when the marginal cost curve is U-shaped. This is easily demonstrated by specifying a demand schedule, fixing the intersection of the marginal cost curve and the demand curve, and changing the simple monopoly output by altering the intersection of marginal cost and marginal revenue until the desired result is obtained. As the reader can easily verify, marginal cost at the simple monopoly output can be greater, less than or equal to the competitive price and any qualitative output effect is possible with the set of U-shaped cost curves. As a result, we cannot unequivocally recommend an overcharge-based fine over a profit-based fine.

This leads us, by the process of elimination, to consider damages based on welfare loss. The analysis is perfectly symmetrical to the welfare-loss-litigation regime and therefore will not be undertaken here except to state that welfare-loss damages provide a positive incentive for output expansion under all cost conditions.<sup>17</sup> The policy recommendation which emerges, then, is for both litigation strategy and fines to be founded upon welfare loss.

17. This recommendation is bolstered by the fact that a number of legal scholars analyze the definition of damages in private antitrust litigation in recent articles and court decisions and find that profit-based damages are inferior to welfare-loss based damages. Our simple analysis does not allow us to appraise the difficulties, particularly, those related to standing, of implementing a welfare-based fine because the legal issues surrounding the use of welfare measures to calculate damages are complex. We do refer the interested reader to an excellent overview of this issue by Page [1980]. Our recommendation rests entirely upon and is restricted to the marginal incentives involved in various damage systems.

## IV. CONCLUSION

Antitrust possesses the potential for exacerbating the welfare loss which a cartel imposes upon society as well as the potential for reducing that loss. The structure of litigation strategy and the specific basis for awarding damages are critical in determining which outcome will prevail. The approach of this paper is to determine whether the participants in a cartel, facing the always present threat of antitrust litigation, will, at the margin, find it in their best interest to produce less, more or the same output as an unhindered, simple monopolist operating in the absence of any potential sanctions. The answer, we find, hinges upon the marginal incentives created by the way in which antitrust policy is implemented. If the antitrust agency employs size (total revenue) in deciding whether or not to bring suit and the courts award damages on the basis of cartel profit, then, the deterrent effect will be perverse. The cartel, in response to the threat of litigation, will find that it is in its best interest to raise price, lower output and impose a greater welfare loss upon society than if antitrust did not exist at all. If the probability of prosecuting a cartel is dependent upon cartel profit and damages are awarded on the same basis, the cartel will not be deterred from engaging in the same level of restraint of trade as does a simple monopolist. Antitrust in the role of marginal deterrence will be impotent. In contrast, if the antitrust agency adopts a litigation strategy founded upon the consideration of economic measures to weigh the costs and benefits of casebringing activity, the cartel will be induced to increase output and lower price. Economic efficiency will be served.

Two alternative bases upon which damages have been awarded in the case history of antitrust, namely, cartel profit and monopolistic overcharge, are considered. Damages awarded on the basis of cartel profit have no effect in terms of marginal deterrence nor, if marginal cost is constant, do damages awarded on the basis of monopolistic overcharge. Under an overcharge basis, however, the cartel will find it in its best interest to further restrict output if the competitive price is less than marginal cost at the simple monopoly output. Because of this possibility, we cannot recommend damages based on overcharge. Nor can we recommend damages based on profit because they have no effect. We prefer damages awarded on the basis of welfare loss which avoids both shortcomings. From the perspective of marginal deterrence, our policy recommendation then is for both litigation strategy and damages to be based on consideration of welfare loss.

The agency's failure to explicitly choose an index related to any economic variable does not suggest a neutral deterrent effect on economic welfare, price, and profit. It is unclear whether the agency's reliance upon hot tips, monitoring of the mail, or the practice of pork barrel antitrust administration produces a positive, negative, or zero marginal detection effect. Complaints may be generated by the presence of excess profit or mere size. With the current absence of a clearly defined strategy based on economic analysis, it

appears unlikely that welfare loss serves as a foundation for antitrust strategy. Further, the failure to clearly communicate strategy to ongoing, but as yet undetected, cartels may preclude a reaction on their part which is potentially beneficial to society. Even antitrust scholars are uncertain of the economic determinants of antitrust casebringing activity. Aforementioned empirical studies are suggestive but shed little definitive light on the question. Uncertainty as to welfare effects, whether positive or negative, however, is not a quality to recommend the present policy.

Lest our results be carried beyond the intent of the paper, qualification is in order. Drawing policy recommendations from a simple model is inherently hazardous. It is useful to keep Coase's [1960, 43-44] criticism of Pigou and Schumpeter's [1954, 472-73] critique of Ricardo in mind when dealing with a model of considerable abstraction for policy implications as does this paper. The model does not take up the weighty questions inherent in interactions between violators and the antitrust agency. In examining the effects of a proposed policy change, these considerations may have considerable import which this paper does not take account of. The intent of the paper is to point out an important possibility in deterrence and to call for further analysis to relax restrictive assumptions with the aim, in Coase's [1960, 44] terms, of "devising and choosing between social arrangements [with] regard to the total effect."

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