Faculty Working Papers

THE ECONOMICS OF PRODUCER DEVELOPED SAFETY STANDARDS

L. G. Thomas, Assistant Professor, Department of
  Economics

#657

THE ECONOMICS OF PRODUCER DEVELOPED SAFETY STANDARDS

L. G. Thomas, Assistant Professor, Department of
 Economics

#657

Summary

Contemporary public policy toward consumer product safety relies increasingly
on industry developed safety standards. These standards prescribe requirements
which effectively set minimum levels for consumer product safety and are developed
directly by industry or indirectly in conjunction with one of several independent
technical organizations. This essay analyzes the economic circumstances under
which producers will, in their self-interest, seek to develop standards, and the
direction of bias (if any) between optimal safety levels and the minimum levels
set by producers. Standard development by both price competitive and collusive
firms are considered, with the most probable outcome being that the minimum safety
level will be set too high.

An increasingly common response to consumer concern over product safety is promulgation of industry developed safety standards. These standards prescribe requirements which effectively set minimum levels for consumer product safety, and are developed directly by industry (through trade associations) or indirectly in conjunction with one of several independent technical organizations (such as the American National Standards Institute (ANSI) or Underwriter's Laboratories (UL)). In theory, individual firms are often free to comply with or to ignore these product guidelines, hence their common designation as "voluntary standards." In actual practice however, there are usually substantial pressures on firms for adoption and the term producer developed standards will thus be used for this essay.

The rationale for these standards is of course some sort of market failure due to the inabilities of consumers to directly monitor safety of complex products. Regardless of the merits of such rationales, basic questions arise as to the economic circumstances under which producers will in their self-interest seek to develop standards, and as to the direction of bias (if any) between optimal safety levels and the minimum levels set by producers. A naive approach to the latter issue is to regard producers as uniformly seeking safety levels that are lower than optimal. It is important to recognize that little support for this approach will be found in this essay. Indeed, the most probable outcome when producers develop binding minimum standards is that the safety level will be set too high.

The structure of this essay is as follows. First the theory of determination of safety levels in competitive markets is outlined. Then

the nature of producer intervention into these markets through establishment of standards is specified. Next, the economic implications of this intervention are considered under two different market structures: a) an industry composed of symmetric, competitive firms, and b) an industry where a dominant cartel establishes price and, now, minimum safety levels while a second set of firms constitutes a competitive fringe. The arguments of the second model are then illustrated by consideration of the architectural glass standard of the U.S. Consumer Product Safety Commission. While this standard is enforced by the U.S. federal government, it was developed by industry representatives and thus provides an exact example of the arguments in the text. Policy recommendations conclude the essay.

II. Competitive Determination of Safety Levels

As background to examination of producer developed standards, it is necessary to review the theory of determination of safety levels by unrestricted competitive markets. After all it is avoidance of competitive outcomes which provide motivations for firms to self-develop safety standards. The development of the theory below draws heavily from Oi (1973), Rosen (1974), and Spence (1978).

For a product which entails risk of accident during consumption, consumer demand is a function of the perceived full price per unit, or the sum of market price and a risk cost per unit. When consumers are fully informed, this full price may be written as:

$$(1) \qquad p^* = p + \frac{K(A(x))}{x} = p + ka$$

where
- p^* = full price
- p = market price
- k = risk cost per expected accident
- a = expected accidents per unit of product
- x = units of product
- K = total risk cost (=kax)
- A = accident level (=ax)

In a more appropriate nonlinear formulation, risk cost is an increasing function of accident risk, with $K_{AA} > 0$, and the expected accident level is an increasing function of units consumed, with $A_{xx} < 0$. The linear formulation in equation (1) simplifies the analysis without altering basic implications or the model. Given symmetry of consumers, the quantity demanded of the risky commodity from (n) symmetric firms of the industry is given by

$$(2) \qquad D(nx) = p^*$$

where the output of each individual firm is denoted by (x).

A perfectly competitive firm will confront a fixed full price in the market (Rosen (1974)). Profits for the firm are therefore:

$$(3) \qquad \pi = (p* - ka)x - C(x,a)$$

where reasonable restrictions on the derivatives of the cost function $C(x,a)$ are:

$$C_x > 0 \qquad\qquad C_a < 0$$
$$C_{xx} \geq 0 \qquad\qquad C_{aa} > 0$$
$$C_{xa} < 0$$

Profit maximizing levels of output and accident rate are respectively given by:

$$(4) \qquad p = C_x$$

$$(5) \qquad -kx = C_a$$

Equation (4), denoted henceforth as the X-equation, provides the familiar equivalence of price and marginal cost under market conditions of perfect competition. The second condition, or the A-equation, provides for minimization of total social costs of the product, given a particular level of output. The perfectly competitive market thus achieves a welfare optimum. This optimum will not occur if firms act to cartilize output or if consumers improperly perceive the accident rate.[1]

---

[1]The effects of monopoly power on product safety (or quality) have been analyzed at length elsewhere (Levhari and Peles (1973), Kihlstrom and Levhari (1977), Schmalensee (1979), and Swan (1971)).

Figures One, Two, and Three graphically present the profit maximizing conditions for a competitive firm facing a given full price. When the following discriminant is negative, Figure One is the correct representation (for a more formal comparative static analysis, see the Appendix):

$$(6) \qquad H = xC_{xa} - C_a$$

When the discriminant is positive Figure Two is correct, and when H is zero Figure Three represents the appropriate diagram. The second order conditions require that the X-curve and the A-curve have the relative positions as shown. Despite the analytical centrality of the discriminant in (6), there is no sensible restriction on the cost function to insure unambiguous sign. For production processes where safety is improved through manufacture of each unit, a cost function of

$$(7) \qquad C(x,a) = g(a)x^{\delta} \qquad\qquad \delta > 1$$

might be appropriate, and here the discriminant is negative. In contrast, for production processes where safety is improved through an exogenous process (such as research), the cost function might be:

$$(8) \qquad C(x,a) = g(a) + h(x)$$

and here the discriminant is positive. One significant empirical implication of the discriminant is that the supply curve of accidents will be upward sloping if H is negative and downward sloping if H is positive. In other words, if a competitive firm with a production process where H is negative experiences an increase in the given full
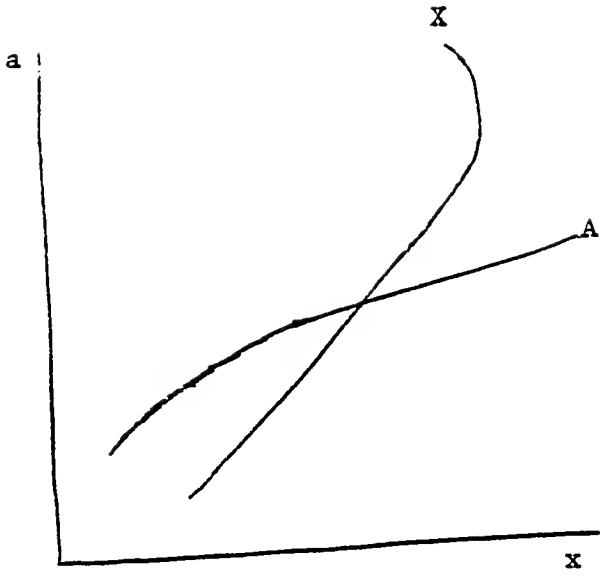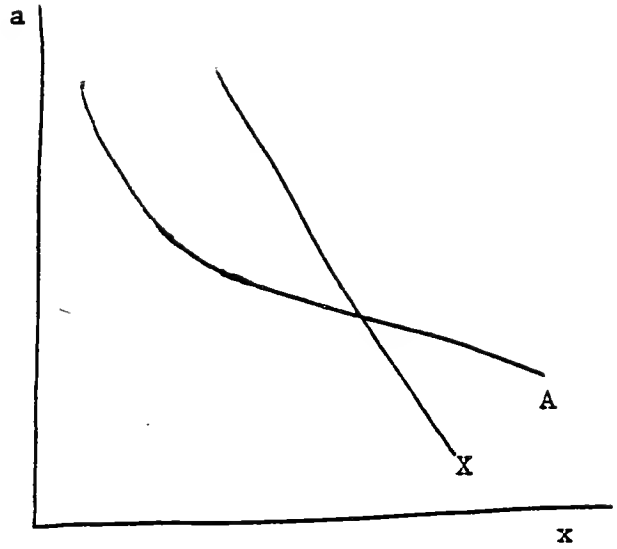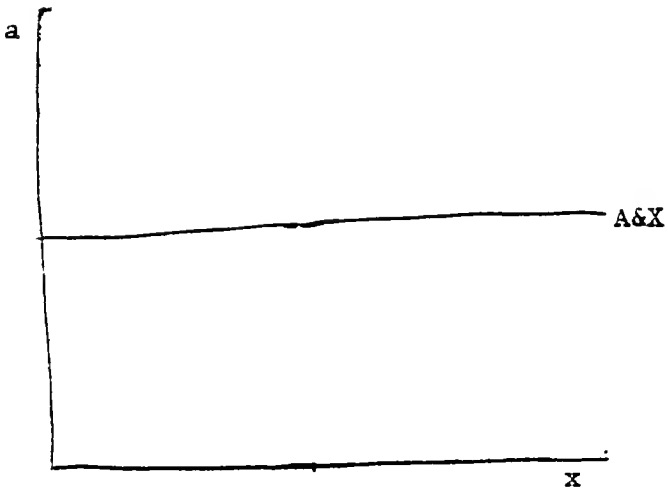
Figure One
(H < 0)

Figure Two
(H > 0)

Figure Three
(H = 0)

price, it will supply more units of less safe equipment. This result (and the converse when H is positive) an be easily seen in Figures One and Two. An exogenous increase in p* shifts the X-curve rightward in both graphs.

An additionally possible, though rather severe restriction on the cost function should be noted. When the production process exhibits constant returns to scale in output (with the accident rate constant), the cost function is:

(9) $C(x,a) = g(a)x$

and H is zero. For this particular circumstance, the supply curve of safety is infinitely elastic, as can be seen in Figure Three.

The above analysis presumes that consumers are precisely informed as to product accident rates. A more general formulation of the nature of consumer demand makes full price a function of the expected accident rate $E(a)$ or:

(10) $\hat{p} = p + kE(a)$

and the profit maximizing conditions for an individual firm become equation (4) and:

(11) $-kxE_a = C_a$

By inspection, competition forces firms in their production decisions to reflect the extent to which consumers tradeoff market price and safety in making their consumption decisions. To the extent that consumers make systematically improper decisions, producer decisions will not be optimal.

III. Elements of Models for Safety Standards

The process for producer development of safety standards will be modeled in this essay as follows.

Minimum Standard. The industry will be regarded as setting a single minimum level for safety, rather than a grading system (such as the USDA system for meat quality). Since grading systems are extremely rare among safety standards, this first specification is most plausible.

Performance Standard. The standard will be regarded as restricting product performance, and not product design. Thus the industry standard will effectively set a minimum level for accident frequency in this essay. Unfortunately, many product hazards are not amendable to prevention through performance standards, as any safety standard must be enforceable through product tests that are inexpensive, reproduceable, and documentable. The epidemological complexity of some hazards prevents useful simulation of product performance and instead militates restrictions on product design. For example, the currently promulgated CPSC standard for blade contact for rotary power mowers is essentially a design requirement for installation of a clutch-brake system. The industry trade association has protested this requirement and instead argued for a true performance standard based on artificial foot and hand probes, an approach that has been rejected by the CPSC primarily because the probes do not appear to simulate true mowing conditions.

Design standards are relatively undesirable because they can be used to restrict both innovation and price competition. A well-known exaple of this phenomenon occurred when the bi-metallic flu damper, the Vent-O-Matic was essentially held off the U.S. market due to lack of

appropriate ANSI standards (U.S. Senate, 1976). A more extreme example occurred with regard to the bicycle standards set by the Consumer Product Safety Commission. The initial version of these standards relied heavily on voluntary standards written by industry which contained requirements that bicycles be shipped preassembled—requirements which would have effectively excluded most foreign-made bicycles from the U.S. market. After strong protests from biking organizations were registered, the proposed standards were rescinded and reworked (Forester, 1973; Cornell, Noll, and Weingast, 1976). A more extensive list of "horror stories" relating to producer development of standards can be found elsewhere (U.S. Department of Commerce, 1977).

Full Compliance. All firms will be regarded as exactly complying with the standard as developed by industry. Again, while this requirement is not fully general there are numerous circumstances which suggest that it adequately represents economic circumstances for safety standards. For while industry developed standards are indeed often voluntarily adopted or rejected by firms, in many cases, there are formidable pressures and even legal constraints on firms to conform with the standard. Some examples of these pressures are that:

a) Major retailing companies will not in general market consumer electrical products which fail to carry certification by Underwriter's Laboratories.

b) Many voluntary standards are incorporated by reference into laws or regulatory acts and thus effectively become mandatory standards. The most famous (or infamous) examples of this practice are local building codes and the mid-1970's wholesale

adoption by OSHA of voluntary workplace safety standards
(Smith, 1976; Hamilton, 1979). Actually incorporation by
reference is quite common, and one ANSI-representative has
estimated that as much as eighty percent of all ANSI-listed
standards have been made mandatory to some extent (Hamilton,
1979).

c) Offeror processes such as those set up by the Consumer Product
Safety Act or the Medical Devices Amendments provide that
mandatory standards be developed by outside parties, rather
than the regulatory agency administering the relevant act.
The proposed or "offered" standards are then subject to
modification by the agency before promulgation as a mandatory
standard. Within the legal framework of these laws, the
agency may ignore prospective offerors and develop the de-
sired standard in-house only under exceptional circumstances.
Given the financial constraints on most non-industry groups,
offeror processes tend to lead to industry self-development
of standards, which are then mandated by the appropriate
government agency (Cornell, Noll, Weingast, 1976).

Irrelevance of Due Process. Requirements of due process in stan-
dards activities will not be regarded as hampering industry achievement
of goals. At first glance, this aspect of the model would appear in-
appropriate due to the fact that a large portion of American standards
are developed outside trade associations and through standards organi-
zations under the famous "consensus process." The principal aspects
of this process have been sketched as follows:

a) Reasonable notice that a proposed standard is being considered should be given to persons or interests which may be materially affected by it.

b) Potentially affected persons or interests should have an opportunity to participate in the deliberations, discussions, and decisions relating to the standard.

c) Careful consideration should be given to minority points of view.

d) Standards should be approved by considerably more than a majority of the affected interests, although unanimity is not necessarily required.

e) Minorities should have the right of appeal to assure that their procedural rights were protected and their views were given full consideration.

f) Adequate records should be maintained to document that the required decisional process was actually followed and the views of minorities duly considered.

g) The entire process should be open to public scrutiny and review.

In point of fact, however, while most standards development procedures incorporate aspects of the "consensus process," the political economy of standards organizations is such that industry views dominate. Despite occasional efforts at "balance" for standards committees, in most of these institutions industry is financially and in membership terms preponderant. When the vastly greater technical expertise of corporate participants is considered, the constraints on industry and

particularly on large corporations, imposed by the consensus process do not appear generally binding (Hemenway, 1975).

Symmetry. All consumers will be modeled as having the same risk cost (k). All firms will be modeled as facing the same cost function, although this latter specification is not an essential element of the analysis.

IV. Standards Development By Competitive Firms

The first model of producer development of safety standards will examine the case of (n) symmetric competitive firms. Standards development under less competitive conditions will be considered in the next section. An essential element of the model will be allowance for asymmetry of information on safety levels between consumers and producers. The analysis will trace first the implication of this asymmetry for producer incentives to develop standards, and secondly will consider the direction and magnitude of bias away from optimal safety levels that would result if a quasi-cartel of otherwise competitive producers were to set a minimum safety standard.

Because safety levels of products are not directly observable, consumers generally cannot directly determine the associated risk of death or injury for a particular unit when making purchase. On the basis of past experiences and reports from other consumers, however, each consumer may well properly assess the safety level for products of the industry as a whole. Akerlof (1970) offers the market for used cars as one where this asymmetry of information between buyers and sellers holds true. The welfare problem with this type of market is that producers have strong incentives to undercut the quality or safety average for the market as a whole. Such producer adulteration lowers production costs and enables the adulterating firm to underprice competitors. As all firms to some extent face these incentives, the resulting Cournot-like equilibrium involves lower safety, and in some cases lower profits as well.

More exactly, consumer demand becomes a function of the expected accident rate as in equation (10), where now

$$(12) \qquad E(a) = \sum_J m_j a_j$$

where J denotes the set of firms and m_j and a_j denote respectively the market share and the accident rate for the jth firm. Under conditions of symmetry, $m_j = 1/n$ and $a_j = a$ for all firms. Profits for each firm become:

$$(13) \qquad \pi = (p* - \frac{k}{n} \sum_J a_j)x - C(x,a)$$

with profit maximizing conditions:

$$(14) \qquad p = C_x$$

$$(15) \qquad -zkx = C_a \qquad\qquad z = 1/n$$

which are represented in Figures Four, Five, and Six. The dotted line in each figure represents the A-curve corresponding to the socially optimal equation (5).

Define the discriminant G as

$$(16) \qquad \begin{aligned} G &= zxC_{xa} - C_a \\ &= H + (z-1)xC_{xa} \end{aligned}$$

where $0 < z < 1$, H is the discriminant in equation (6), and the appropriate derivatives are all evaluated at the Akerlof equilibrium in equations (14) and (15). Note that if H is positive then G is necessarily positive. Figure Four illustrates the Akerlof equilibrium when the industry technology exhibits a negative discriminant G, Figure Five
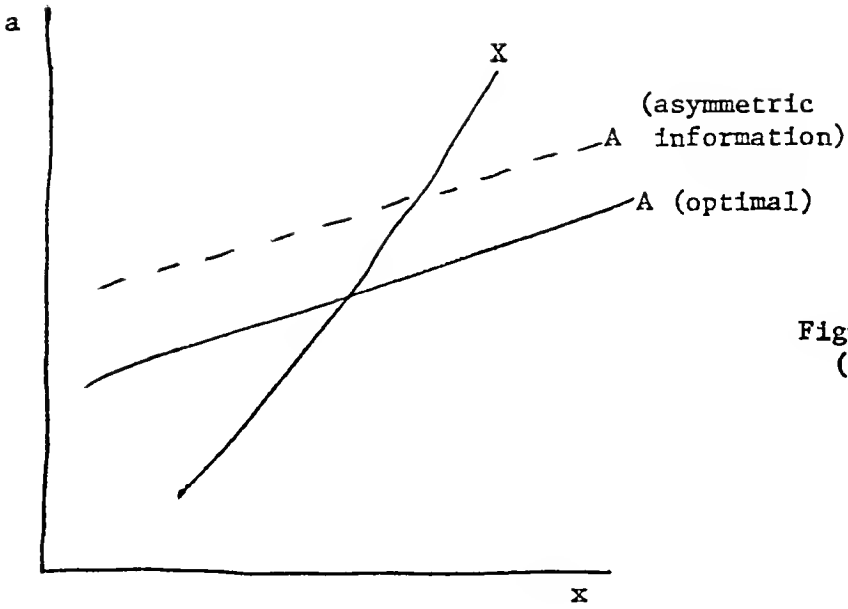
Figure Four
(H < 0)

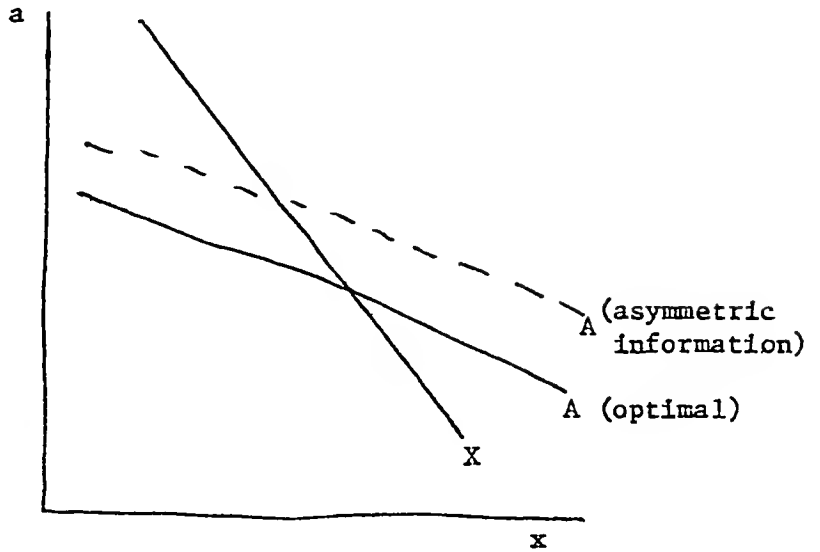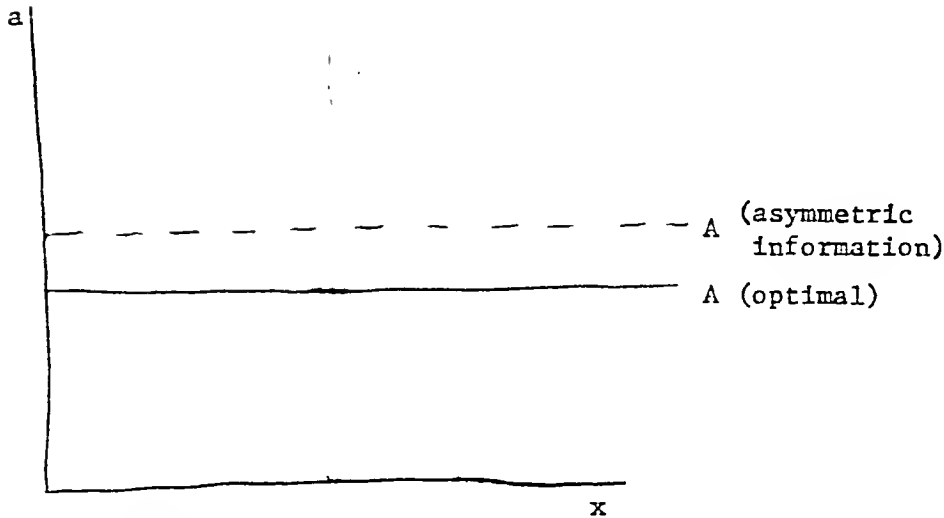Figure Five
(H > 0)

Figure Six
(H = 0)

the case where G is positive, and Figure Six the case when G is zero.
By inspection, regardless of the nature of the cost function, each firm
and thus the industry as a whole, produce products with higher than
optimal accident rates, where optimal rates can be identified by the
intersection of the X-curve and the dotted, socially optimal A-curve.
Several historical examples of this product adulteration can be offered.
In the early part of this century, shoe manufacturers used progressively
inferior leather (incorporating into the leather water soluble substances
such as glucose or Epsom salt) for soles (Alsberg, 1931). During a
later period, producers of mayonnaise began to laden their product with
gum arabic, so much so that the proportion of gum arabic rose to 50 per-
cent of mayonnaise content. Further addition of gum arabic would have
led to probable separation of the product into its components (Chamberlin,
1953).[2]

The effects of consumer misperception on other market variables
are not so unambiguous. When G is negative (as in Figure Four) the
equilibrium output is increased due to consumer misperception and due
to the nature of demand the full price must necessarily fall. In con-
trast, when G is positive (as in Figure Five) the equilibrium output
is lower with misperception, thus the full price is increased. Note
that in the former case, interestingly enough, consumers are made better
off by their own misperception.

To illustrate the impact on industry profits, let the (z) variable
in equation (15) vary continuously in the open interval between zero

---

[2]Both these examples are cited in Hemingway, 1975.

and unity, where a decline in (z) indicates greater misperception. Then the effects of misperception on the profits of an individual firm are:

$$(17) \qquad \frac{d}{dz} = x \frac{dp^*}{dz} + (p^* - ka - C_x) \frac{dp^*}{dz} - (kx + C_a) \frac{da}{dz}$$

$$= x \frac{dp^*}{dz} + (z - 1)x \frac{da}{dz}$$

where the first order conditions of the Akerlof equilibrium are used to simplify the derivative. The second term is clearly positive, while as discussed above the first term is of ambiguous sign. When the discriminant G is nonpositive, then greater misperception (z declines) explicitly implies lower profits. Otherwise, the effect on profits is unclear.

By way of summary, comparative statics based on the three exemplary cost functions in equations (7), (8), and (9) are given in Table One. Examination of the table suggests that there are indeed circumstances under which mutual producer adulteration of product leads to lower industry profits, and hence to economic motivation for industry self-development of standards, though these circumstances are by no means inevitable.[3] Actually, it is striking that many (possibly most) complex consumer products introduced during this century were subjected to limited producer adulteration which eventually led to some form of standardization or certification. Particular examples include tractors (Kudrle, 1975), room air conditioners (Hunt, 1975), and more recently solar heating equipment (Business Week, 1979), and home insulation.

---

[3]Clearly, there are additional factors such as imperfect liability requirements or the threat of government regulation which may propel producers to develop standards.

Table One

Comparison of Market Equilibria Under Perfect
Competition and Asymmetric Information

Cost Function in Equation	Discriminant		Change in Listed Variable When (z) Decreases			
	H	G	a	x	p*	π
7	negative	negative[a]	increase	increase	decrease	decrease
		positive[b]	increase	decrease	increase	decrease
8	positive	positive	increase	decrease	increase	increase
9	zero	positive	increase	decrease	increase	no change

a) For this result to hold, the δ term in equation (7) must satisfy: $z\delta > 1$.

b) For this result to hold, the δ term in equation (7) must satisfy: $z\delta < 1$.

Under those economic conditions where producers elect to develop
safety standards, a natural issue arises as to how high or low the
minimum standard will be set. When producers of a competitive industry
congregate to set a binding minimum safety standard, but are unable to
effectively collude on other restrictions of product attributes, there
are two important limits on industry profit maximization. First, there
exists an asymmetry in the direction which safety may be changed: mini-
mum standards only set a lower bound for the safety level and in other-
wise competitive markets do not enable forced diminution of safety below
levels which competitive firms would set. Secondly, market pressures
on output in the absence of collusion must force price to equal marginal
cost. There are thus two constraints on producer behavior in the stan-
dards development process:

(18) $$p - C_x = 0$$

(19) $$-zkx - C_a \geq 0 \qquad \text{where } 0 < z < 1$$

where (19) simply requires that it is never profitable for a competitive
firm to raise safety (lower the accident rate) over prevailing market
levels. Should this latter constraint be violated, competitive firms
would "cheat" against the standard, raising safety until (19) held as
an exact equality.

The market equilibrium with binding minimum safety standards de-
veloped to maximize firm profits (or the standards equilibrium, for short)
is derived as a solution to the following constrained optimization prob-
lem:

(20) $L = [p*(nx) - ka]x - C(x,a) + \lambda[p*(x) - ka - C_x] - \omega(zkx + C_a)$

where (λ) and (ω) are Lagrange multipliers. The Kuhn-Tucker conditions
for the constrained optimum are:

(21) $L_x(a,x,\lambda,\omega) = 0$

(22) $L_a(a,x,\lambda,\omega) = 0$

(23) $p - C_x = 0$

(24) $\omega(zxk + C_a) = 0$ $\omega \geq 0$ $zxk + C_a \leq 0$

The conditions for the standards equilibrium are thus (23), (24), and
the following equation, obtained by solving (21) and (22) for (λ):

(25) $\dfrac{n}{C_{xx}} \dfrac{dp*}{dx} (xC_{xa} - C_a) + (kx + C_a) + \dfrac{\omega}{C_{xx}} M = 0$

where M is the following term:

(26) $-(zk + C_{xa})(k + C_{xa}) - C_{aa}(\dfrac{dp}{dx} n - C_{xx})$

The output condition or X-curve for the standards equilibrium is, as re-
quired, identical to that for the competitive equilibrium. So the
standards equilibrium will be optimal and equal to the competitive
equilibrium only if the safety conditions (24) and (25) are equal to
(5).

These safety conditions separate potential standards equilibria
into three categories. The discriminant for each of these categories
is H of equation (6), which appears again in the first term of equation
(25). In other words, the safety conditions for the SE fall into one

of the following three cases as the discriminant H is respectively

negative, positive, or zero. (Note that M is positive as part of the

sufficiency conditions for a maximum.)

A. $H < 0$ $\omega = 0$ $zkx + C_a < 0$

In this first case, the inequality in (19) is strict so that this con-

straint is not binding on producer decisions. Under these circumstances,

the standards equilibrium is characterized by equation (23) and the

following safety condition:

$$(27) \qquad n \frac{dp^*}{dx} \left(\frac{C_a - xC_{xa}}{C_{xx}} \right) = kx + C_a$$

This first case presents a downward shift of the A-curve, as by inspec-

tion both sides of (27) are negative given the sign of H and the usual

sign for (dp^*/dx). Figure Seven graphically presents the argument.

When H is negative, then, the accident level is set too low resulting

in lower equilibrium output, hence a higher full price.

B. $H > 0$ either $\omega = 0$ and $zkx + C_a < 0$

                or $\omega > 0$ and $zkx + C_a = 0$

In the second case, the equilibrium accident rate is set too high, to

the extent that producer adulteration exists. As suggested by earlier

analysis, this adulteration is profitable under certain cost conditions.

When H is positive then, firms either leave the accident rate at the

high level set due to adulteration or lower this level towards, though

not to, the optimal value. In the former circumstance, (19) holds as

an exact equality as the safety condition. In the latter circumstance,

equation (27) provides the safety condition as (ω) is zero. Both circumstances indicate an upward shift in the A-curve, as illustrated in Figure Five for the Akerlof equilibrium. When the standards equilibrium is characterized by equation (27) with H positive, the A-curve lies between the two curves shown in Figure Five, or above the optimal A-curve and below the curve representing equation (15).

C. $H = 0$ $\omega = 0$ $zkx + C_a < 0$

In this final case, inspection of equation (25) using the above listed information demonstrates that (25) reduces to equation (5). Thus only in this last case is the standards equilibrium optimal.

While the three cases discussed above seem at first to suggest no expected direction of bias in safety levels when competitive producers self-develop safety standards, this agnostic conclusion would seem inappropriate. It is important to recognize that the class of cost functions discussed in case B above do not seem plausible for products that are candidates for standardization. Minimum standards, especially minimum performance standards, by their very nature require alterations of the product itself and not of the manufacturing process. Cost functions such as equation (8) where safety is improved through a separate, research-like process and where H is positive do not seem appropriate in this context. This argument suggests that the basic tendency of the discriminant H is to be negative or at least nonpositive in relevant industries. As argued above, a nonpositive sign for H implies that the bias for safety levels of products covered by producer developed safety standards is towards too much rather than too little safety.

V. Standards Development by Collusive Firms

It is important to consider the implications of the previous section in the context of a less competitive market structure. For this second model the Akerlof-type specifications for consumer expectations of accident rates add complication without insight. Thus for this section of the essay, consumers will be regarded as fully informed about the safety attributes of products they purchase. Generalization of the analysis to condition of asymmetric information is straightforward.

The industry structure will now consist of a cartel of (n) symmetric firms along with a competitive fring composed of (m) symmetric firms. Basic variables for the cartel and fringe are given in Table Two.

As in traditional models of dominant firms, the cartel will set full price for the entire industry. While this full price will not necessarily be identical for all firms, it does not follow that the market or exchange price will be uniformly the same for all firms. The cartel may well produce a safer product which sells at a higher price as compared to output of the competitive fringe. Thus equivalent full prices for all firms does not preclude differing proportion of market price and risk cost between cartel and fringe.

Table Two

Basic Variables for Second Model

Variable	Cartel	Fringe
number of firms	n	m
firm output	x	z
accident rate	a	b
market price	p	q

The chosen full price will maximize profits for the cartel subject to the supply function of output for the competitive firm. The basic optimization problem is thus:

(28) $\max_{a,x,z}$ $px - C(x,a)$

       subject to $D(xn + zm) = p* = p + ka$

                      $D(xn + zm) = p* = q + kb$

                              $q = C_z(z,b)$

or by substitution to eliminate market prices:

(29) $\max_{a,x,z}$ $[D(xn + zm) - ka]x - C(x,a)$

        subject to $D(xn + xm) - kb = C_z$

First order conditions for the dominant cartel after elimination of the Lagrange multipliers are:

(30) $p + nxD'[1 + \dfrac{mD'}{C_{zz} - mD'}] - C_x = 0$

(31) $-kx - C_a = 0$

Note that the term in brackets in equation (30) is strictly less than unity and weakly greater than zero. Further note that when costs are linear in output $(C_{zz} = 0)$ that the bracketed term equals zero and thus the "cartel" optimum reduces to the competitive equilibrium discussed earlier. Under these circumstances, the supply curve of the competitive fringe is infinitely elastic.

First order conditions for the competitive fringe, given the full price set by the dominant cartel are:

(32) $D(xm + zm) - kb - C_z = 0$

(33) $-kz - C_b = 0$

It should be noted that the safety condition, or A-curve, is identical
for both sets of firms and precisely the socially optimal condition for
the accident rate (given the output levels).

The basic market equilibrium before standards development is il-
lustrated in Figures Eight and Nine. Figure Eight applies when the
familiar discriminant H in equation (6) is negative--Figure Nine when
H is positive. The dotted X-curve represents the optimal values asso-
ciated with equation (4) of the competitive equilibrium. Equations (5),
(31), and (33) are all represented as the A-curve. For each member of
the dominant cartel, the profit-maximizing X-curve or equation (31) lies
to the left of the optimal X-curve. As would be expected, each firm in
the cartel offers on the market a smaller than optimal output level.
This restriction in output forces an increase in the prevailing full
price, which as argued in the second section causes a rightward shift
of the profit-maximizing X-curve for competitive firms. At the equil-
ibrium established by equations (30) through (33) each firm in the com-
petitive fringe will produce an output level that is larger than optimal.
The greater output of the fringe however will not fully compensate for
the reduction of output by the cartel.

When H is positive, the cartel will offer a product version which
is less safe but also cheaper in terms of market price than the product
version offered by the competitive fringe (see Figure Nine). Under
these circumstances, there is clearly no incentive for the cartel to
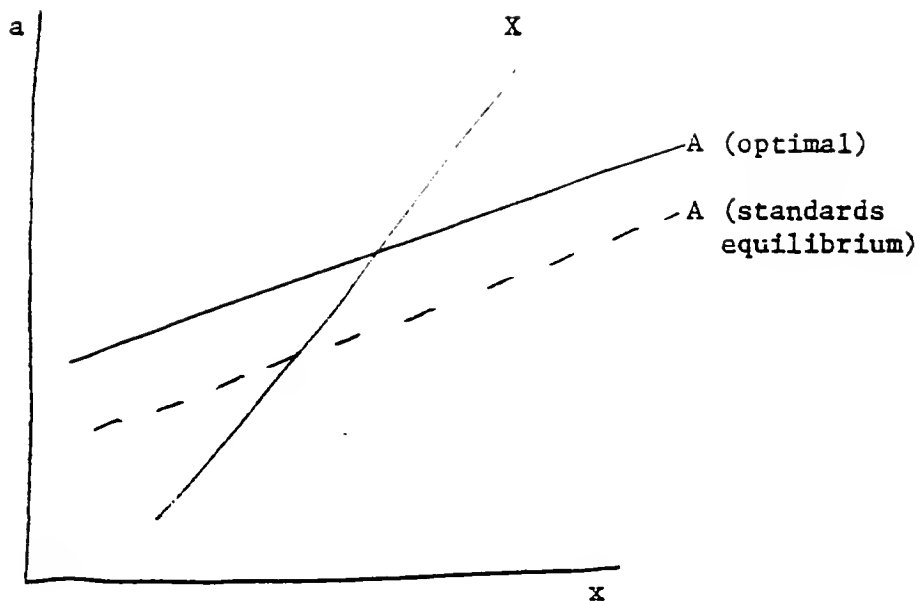
Figure Seven
(H < 0)

a

X

A (optimal)

A (standards
equilibrium)

x

Figure Eight (H < 0)

X   X   X
(cartel) (optimal) (fringe)

a

A

x

Figure Nine (H > 0)

X   X   X
(cartel) (optimal) (fringe)
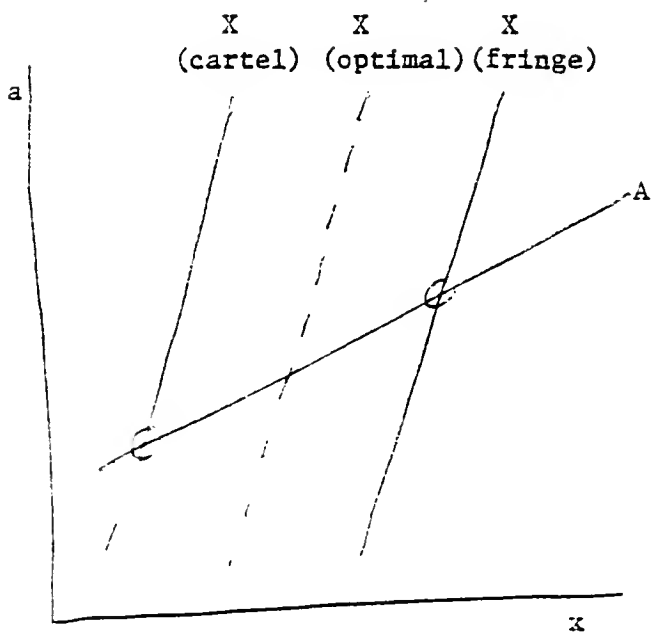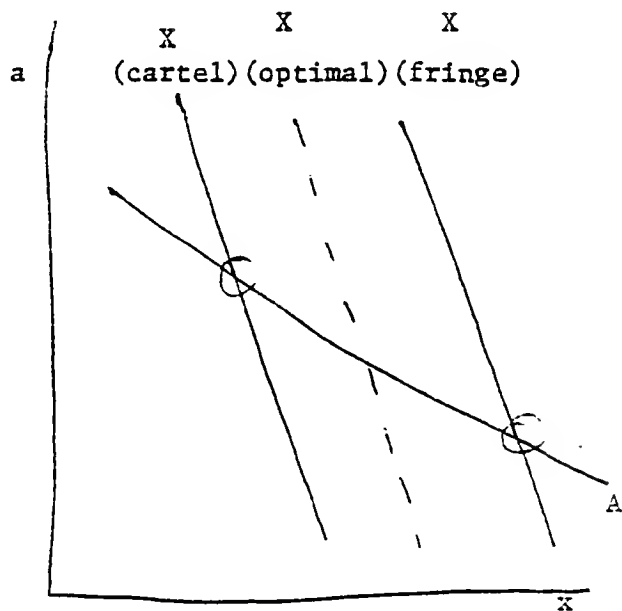
a

A

x

develop and seek to enforce a ceiling on the accident rate. Such a minimum safety standard would, for small changes in the accident rate, force alteration only of the product version produced by the cartel. Since the competitive fringe produces a safer version anyway, these firms would not be directly affected by small changes in allowed maximum accident rates. Any efforts by the cartel to lower the maximum accident rate under the circumstances of this second model would only lower profits and therefore would not be attempted.

When H is negative however, the market situation is very different. As Figure Eight confirms, the cartel now offers the safer, more expensive product version while it is the competitive fringe that produces the version with higher expected accident rate. Clearly there is now indeed an incentive for the cartel to forcibly lower the maximum accident rate prevailing in the market. A binding minimum safety standard could reduce the (b) variable for the competitive finge, and as inspection of both Figure Eight and equation (32) indicates, thereby reduce the output of each competitive firm. The reduction of competitive output enables an increase in the common full price, hence an increase in the market price of cartel output, hence an increase in cartel profits.

The ability of the cartel to reduce competitive output through safety standards causes the profit-maximizing A-curve to diverge from the optimal A-curve. Mathematically, the optimization problem for the cartel becomes:

$$(34) \quad \max_{a,x,z} \; [D(xn + zm) - ka]x - C(x,a)$$

$$\text{subject to} \quad D(xn + zm) - ka = C_z$$

The accident rate for the competitive fringe (b) is now forced to equal that of the cartel (a). First order conditions for each firm of the cartel after elimination of the Lagrange multiplier are equation (30) and the following condition:

$$(35) \qquad kx + C_a(x,a) = \frac{-mD'}{C_{zz}} [xC_{za}(z,a) - C_a(x,a)]$$

It should be noted that since H is negative the following inequalities hold (given the derivative restrictions on the cost function and the fact that x < z):

$$(36) \qquad xC_{za}(z,a) - C_a(x,a) < xC_{xa}(x,a) - C_a(x,a) = H < 0$$

Both sides of equation (35) are thus negative which indicates that the profit-maximizing A-curve for the cartel lies below the optimal A-curve.

The market equilibrium after cartel determination of a minimum safety standard is shown graphically in Figure Ten. Note that both output and accident rate for firms in both the cartel and the competitive fringe are lower after imposition of the standard than the respective values would be without industry developed restrictions on product safety. Further note that the accident rate as set is too low relative to the optimal value.
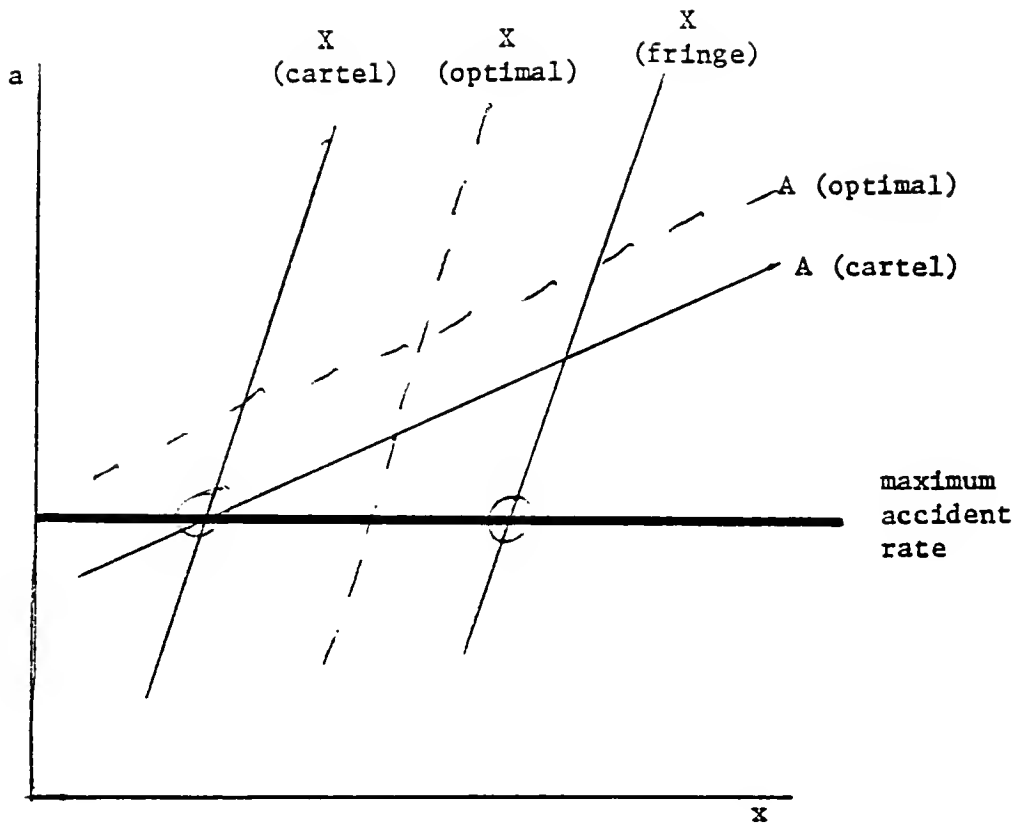
Figure Ten (H < 0)

VI. The CPSC Architectural Glazing Standard

In January of 1976 the Consumer Product Safety Commission (CPSC) announced a mandatory standard for architectural glass (used in sliding glass doors, storm doors, shower doors, etc.). The standard effectively requires that all such glass be safety glazed, though technically the regulation consists of performance (impact) requirements. These requirements are quite expensive, costing American consumers an estimated 45 to 60 million dollars a year to cover glazing costs (CPSC estimates). Nonetheless, this standard has been the least controversial of all those issued thus far by the CPSC, and is generally regarded as one of the few CPSC "success stories." The standard is expected to reduce injuries associated with breakage of architectural glass.

The standard was developed under the CPSC offeror process, by the "Consumer Safety Glazing Committee" (CSGC). Examination of the nature of the offeror provides a basis for insight into the nature of the standard. The CSGC was formed in 1969 by industry to lobby, at both state and federal levels, for more stringent standards towards architectural glass. Membership of the CSGC is listed in Table Three and reads like a cartel roster for the architectural glass industry. Meetings of the CSGC from 1969 on took place at PPG Industries (Pittsburgh Plate Glass) facilities; the initial chairman's background included long service at PPG Industries in marketing and research; financing for CSGC activities was entirely provided by industry; etc. From 1969 to 1973, the CSGC was successful in convincing 32 state legislators (covering some 86 percent of the relevant market) to adopt some version of a "model" standard—truly an impressive achievement. The CSGC effort was

Table Three

National Glass Dealers Association, (NGDA)
PPG Industries, Inc.
Architectural Aluminum Manufacuters Association, (AAMA)
Glass Tempering Association, (GTA)
National Safety Council - Home Conference
National Woodwork Manufacturers Association, Inc., (NWMA)
ASG Industries, Inc.
Libbey-Owens-Ford Company
Rohm and Haas Company
C-E Glass Company
Globe Amerada Glass Company
Mobay Chemical Company
National Sash and Door Jobbers Association, (NSDJA)
Fourco Glass Company
Rowland Products, Inc.
Safety Glazing Certification Council
Sealed Insulating Glass Manufacturers Association, (SIGMA)
General Electric Company, Plastics Department
U. S. Plywood - Champion Papers
Solar Control Products Corporation
J. W. Carroll and Sons
B. F. Goodrich Chemical Company
Doorlite Producers Association, (DPA)
International Brotherhood of Painters and Allied Trades, AFL-CIO

capped by CPSC adoption in 1976 of the industry sponsored standard, which preempted the essentially similar state standards and established for the first time a national building standard.

Unfortunately, while the CSGC effort was presumably to industry benefit, the effects on consumers are neither clear nor encouraging. The Council on Wage and Price Stability (COWPS) in 1976 issued a critique of the CPSC-CSGC standard arguing that safety benefits of the glazing requirements (when properly discounted) were at best only 5 million dollars per year—in other words that costs were ten times benefits for the standard. CPSC response to the COWPS statement failed to dispute the five million dollar calculation directly, but rather argued that reduced breakage of glass (thus reduced costs) actually accounted for the largest portion of total benefits. The CPSC arguments are not documented and further would seem to establish, if anything, that the architectural glazing standard is predominantly a standard for product quality and not for product safety. When it is recognized that the CPSC and COWPS estimates apply only to the 14 percent of the market not already affected by CSCG state-level activities, and that the total national effects would be seven times these estimates, the desirability of such glazing standards becomes distinctly questionable.

The above arguments suggest that the CSGC and its associated standards represent an interesting phenomena: that of an industry which succeeds in deliberately and sharply raising safety standards for its products, even to levels above that which would be cost-beneficial for consumers. The models of this essay are offered as basis for analysis of this behavior.

VII. Conclusion

The general conclusion to be drawn from the analysis of this study is that while there is in theory no systematic bias in product safety when industry self-develops binding minimum safety standards, the most likely direction of bias is for safety levels to be set too high. This analytical result sharply differs from the apparently common though naive view that industry maximizes its profits by seeking inadequate safety for consumer goods. While this conclusion applies directly to industry developed standards, the analysis here has potential implications for producer derivation of standards as well. One does not have to regard so-called "capture" theories of regulation as completely valid to accept the notion that producer pressures and interests strongly affect the nature of regulatory outcomes. Understanding of the nature of producer interests in consumer standards therefore sheds light on regulatory development of such standards as well. Indeed, the basic arguments of this essay suggest an outline of how a "captured" safety agency might administer its mandate.

The prevalent notion that industry seeks to underproduce safety seems based on the documented abuses of the voluntary standards system in the 1960s (National Commission on Product Safety, 1970). Yet review of these incidents suggests that the deficiencies of these standards actually arose due to the substantial possibility of noncompliance, particularly by smaller firms. The nonbinding nature of these early safety standards enabled noncomplying firms to sell cheaper though less safe products in competition with complying firms and thus substantially constrained standard development by those firms which intended to comply.

The spread of product liability suits and the emergence of safety regulation for almost all consumer products bring an increased likelihood of industrial compliance to contemporary standards. Critics of industry developed standards thus confuse the quite distinct incentives of firms setting voluntary floors for accident rates which will be ignored by significant industry segments and the incentives of firms (such as those participating in the CPSC offeror process) setting mandatory minimum safety requirements.

On the basis of this argument, most of the 1960s abuses could be eliminated by insuring mandation of standards developed by industry. Yet this tactic would only exacerbate the danger that standards will be used for anticompetitive purposes. While this danger is quite real, it must however be recognized that virtually any response to market failure as regards consumer product safety involves the creation of market power. Alternatives to industry standards, such as market signaling (brand names) or bureaucratic determination of product requirements hardly are free of the anticompetitive implications, or other drawbacks. In the end, the appropriate role for industry standards remains to be determined on the basis of detailed understanding of the relative strength and weaknesses of policy options for product safety.

Appendix

This Appendix presents basic comparative statics analyses as basis for the verbal arguments of the text.

I. Competitive Equilibrium

First order conditions are given as equations (4) and (5) of the text. The second order condition is that:

$$(A1) \qquad C_{xx}C_{aa} - (k + C_{xa})^2 > 0$$

or equivalently by rearrangement:

$$(A2) \qquad \left| \frac{C_{xx}}{k + C_{xa}} \right| > \left| \frac{k + C_{xa}}{C_{aa}} \right|$$

Total differentiation of equations (4) and (5) gives the slope of each equation as:

$$(A3) \qquad \frac{da}{dx} = \frac{-C_{xx}}{k + C_{xa}} \qquad \text{for equation (4)}$$

$$(A4) \qquad \frac{da}{dx} = \frac{k + C_{xa}}{-C_{aa}} \qquad \text{for equation (5)}$$

Note that due to equation (5),

$$(A5) \qquad x(k + C_{xa}) = xC_{xa} - C_a = H$$

where H is the discriminant in (6). Inspection of these results proves Figures One through Three to be correct representations of the competitive equilibrium.

II. Akerlof Equilibrium

The market equilibrium with asymmetric information is characterized by

(A6) $p^* - D(xn) = 0$

(A7) $p^* - ka - C_x = 0$

(A8) $-zkx - C_a = 0$ $0 < z < 1$

Basic comparative statics analysis yields:

(A9) $\dfrac{\partial a}{\partial z} = \dfrac{kx}{E} (nD' - C_{xx}) < 0$

(A10) $\dfrac{\partial x}{\partial z} = \dfrac{kx}{E} (k + C_{xa})$

(A11) $\dfrac{\partial p^*}{\partial z} = \dfrac{kxn\ D'}{E} (k + C_{xa})$

$$E = C_{xx}C_{aa} - (zk + C_{xa})(k + C_{xa}) - nD'C_{aa} > 0$$

Second order conditions for (A7) and (A8) to maximize profits of each firm insure that E is positive. The following equation provides sign for (A10) and (A11) (using (A8)):

(A12) $zx(k + C_{xa}) = zxC_{xa} - C_a = G$

where G is the discriminant in equation (16).

References

Akerlof, G. "The Market for Lemons: Quality Uncertainty, and the Market Mechanism," Quarterly Journal of Economics (August, 1970).

Alsberg, C. "Economic Aspects of Adulteration and Imitation," Quarterly Journal of Economics (November, 1931).

Caves, R. E. and M. J. Roberts. Regulating the Product: Quality and Variety, Cambridge, Mass., Ballinger, 1975.

Chamberlain, E. H. "The Product as an Economic Variable," Quarterly Journal of Economics (February, 1953).

Cornell, N., R. Noll, and B. Weingast. "Safety Regulation," in Setting National Priorities, The Next Ten Years, Washington, D. C., Brookings, 1976.

Forester, John. "Toy Bike Syndrome," Bike World (October, 1973).

Hamilton, R. W. Role of Nongovernmental Standards in the Development of Mandatory Standards, in process.

Hemenway, D. Industrywide Voluntary Product Standards, Cambridge, Mass., Ballinger, 1975.

Hunt, M. "Trade Associations and Self-Regulation: Major Home Appliances," in Caves and Roberts, op. cit.

Khilstrom, R. and D. Levhari. "Quality, Regulation, and Efficiency," Kyklos, Fasc. 2, 1977.

Kudrle, R. T. "Regulation and Self-Regulation in the Farm Machinery Industry," in Caves and Roberts, op. cit.

Levhari, D. and Y. Peles. "Market Structure, Quality, and Durability," Bell Journal of Economics (Spring, 1973).

Oi, W. "Economics of Product Safety," Bell Journal of Economics (Spring, 1973).

Rosen, S. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," Journal of Political Economy (January/February, 1974).

Smith, R. S. The Occupational Safety and Health Act, Washington, D. C., American Enterprise Institute, 1976.

Spence, A. M. "Consumer Misperception, Product Failure, and Producer Liability," Review of Economic Studies, 1978.

Spence, A. M. Market Signaling: Information Transfer in Hiring and
    Related Screening Processes, Cambridge, Mass., Harvard University
    Press, 1974.

Swan, P. "The Durability of Goods and Regulation of Monopoly," Bell
    Journal of Economics (Spring, 1971).

U. S. Department of Commerce, Voluntary Standards and Testing Laboratory
    Accreditation: An Analysis of Problems, Issues and Alternatives
    for Federal Action, Washington, D. C., July, 1977.

U. S. Congress, Senate Subcommittee on Antitrust and Monopoly, Voluntary
    Industrial Standards—1976 Hearings, 94th Congress, 2nd Session,
    March 1976 and August 1976.