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MINIMUM QUALITY STANDARDS AND LICENSING IN MARKETS WITH ASYMMETRIC INFORMATION

by

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Hayne E. Leland

I. Introduction

The hand of the government in economic affairs is rarely more visible than in regulating quality. Safety standards have been imposed on drugs, automobiles, microwave ovens, and a host of other products. Bank and insurance portfolios must satisfy soundness criteria. Restaurants are required to meet cleanliness standards, commercial aircraft must conform to maintenance standards, etc., etc., etc.

Minimum quality standards are not limited to products alone. To enter a number of professions, one must pass state-administered tests believed to insure at least a minimum level of competence. Doctors, lawyers, and contractors, to name but a few, must pass such tests. In many professions where the state does not impose requirements, professional groups themselves set standards which are claimed to improve quality. And there is continual agitation to extend standards to other professions, from automobile repair to investment counseling.

Traditional economic theory has given little guidance on the desirability of such standards. A number of economists have held such standards to be misguided paternalism at best, or an outright grab for monopoly profits at worst. And it seems clear that, in many cases, licensing
standards are written more to protect current practitioners from competition than to protect the public from incompetence.\textsuperscript{1} As several papers in this volume bear witness, the current attitude of economists seems to be moving toward eliminating many if not all licensing requirements.

In the analysis developed here, and in Leland [1979], we reach somewhat different conclusions. We show that certain types of markets may benefit from minimum quality standards. Even random licensing or entry restriction, which arbitrarily excludes a certain fraction of potential sellers from the market, may be socially beneficial. We characterize the nature of markets for which standards are desirable.

We also examine the standard that might prevail if a profession or industry were empowered to regulate itself. In most cases, we confirm a popular suspicion: self-regulation results in too high standards. While quality regulation may be misused, this does not alter our contention that it can have beneficial effects.

To reach these conclusions, it is clear that our model of markets must diverge from that suggested by traditional theory. The key difference is characteristic of many quality-regulated markets: asymmetric information. By this, we mean that the seller has a more accurate perception of true product quality than the buyer. Examples tend to come from markets that have quality regulation. Automobile purchasers have difficulty in assessing the safety merits of alternative gas tank locations. A depositor finds it difficult to assess the risk of his bank's portfolio of assets. And the user of a drug or of a doctor's services may not be in a position to judge its efficacy at the time of purchase.\textsuperscript{2}
Of course, buyers usually have some information about the quality of their purchases. The quality of some products (e.g., bananas) can be observed prior to sale. Even if direct observation of quality is not possible prior to sale, experience from prior purchases or friends' suggestions may reduce uncertainty. Consumer information services scrutinize a few major products. And "signals" such as guarantees offered or diplomas displayed may provide further insights into product quality. In a number of markets, nonetheless, substantial asymmetries tend to remain. These are the markets on which we focus.

In a seminal article, George Akerlof [1970] pointed out that problems can arise in markets characterized by asymmetric information. He considered the market for used cars, where quality was assumed to vary from high to low ("lemons"). Akerlof assumed that potential sellers know the quality of their own cars. And higher-quality cars have higher use value to their owners if they are not sold. Buyers, on the other hand, have difficulty distinguishing good cars from bad. Since no one will pay more for a car that looks identical to all others, all cars have the same price. Akerlof assumed this price reflected the average quality of all cars offered for sale—a form of rational expectations on the part of buyers, who know the general quality level offered by the market but not the quality of any specific unit.

Problems begin to occur in the used car market because owners of the highest-quality cars do not find it advantageous to sell at the market price, which reflects the lower average quality. When these sellers withdraw, average quality and price fall further, inducing owners
of the next best quality cars to withdraw from the market. Price and quality spiral downward; in equilibrium, Akerlof suggests that only "lemons" will be offered for sale. The steep discount of slightly used car prices from new car prices would seem to add casual empiricism to Akerlof's point.

Akerlof's model is formalized in Leland [1979]. It is shown that although markets with asymmetric information do not always degenerate to the lowest quality level, there will always be an inefficiency in competitive equilibrium: quality levels will be too low.

The market failure can be explained as follows. In equilibrium, the marginal seller will find market price just equal to his opportunity cost. When opportunity costs rise with quality, the marginal seller will always be of the highest quality level actually selling. The social value of a unit of the highest quality exceeds the social value of a unit of the average quality level. Yet the price received by the seller of the highest quality level is the same as the price received by all other sellers, and equals the average value in equilibrium. Thus the market failure can be cast in terms of a simple externality. When a high-quality seller offers his good or service to the market, the average quality rises and buyers are willing to pay more. But the high-quality seller must split the benefits with all other sellers, who share in the higher price. Because the marginal seller cannot be recognized as the "best," he cannot receive his full contribution to social welfare. This wedge between social and private benefits results in too low quality and economic inefficiency.
II. Free Market Responses to Market Failure

A number of possible institutional frameworks could respond to the market failure discussed above. We first examine voluntary actions on the part of market participants. Here we consider three possibilities: seller guarantees, private firms that specialize in information provision, and retailers who provide quality screening services.

A number of authors have suggested that sellers could eliminate market failure by offering product guarantees. By voluntarily assuming liability should his product fail to attain a certain quality, sellers of the highest-quality product could "signal" their superiority. Sellers of lower quality would find it too expensive to offer as complete a guarantee; they would then face a lower price reflecting the lower average quality after the departure of the best-quality products. But now the next-best sellers might offer a slightly less-complete guarantee to separate themselves from the remaining masses. The market would "ravel down" in an anti-Akerlof manner, until all but the worst quality offered some form of guarantee. Products of different quality would now be recognized by buyers and paid accordingly; while there might be some excess costs of signalling, there would be some promise of welfare benefits.³

But guarantees are not voluntarily offered in many markets which exhibit asymmetric information. The failure of guarantees to develop is closely related to the nonexistence of insurance against certain kinds of risks. For many goods and services, the ultimate benefits or quality which can be observed depend not only upon the intrinsic quality of the
product, but also on the manner in which it is used by the purchaser. Separating these two causes may be difficult or impossible, and incentives for misuse may exist on the part of the purchaser. This "moral hazard" problem, well-known in the insurance literature, is an important rationale for the policy of *caveat emptor*.

It explains both the lack of certain forms of insurance and the lack of voluntarily offered guarantees. Guarantees can, of course, be provided *involuntarily* by laws making sellers liable for the (observed) quality of their product. 4 We return to this question in the concluding section.

An alternative, voluntary market response might be the emergence of information-providing firms. Indeed, there are some examples of these: *Consumer Reports*, restaurant guides, etc. These firms sell their services directly to buyers. But therein lies a problem. As is well-known, information on quality has many of the aspects of a public good: a consumer can give it away and still have it! Inadequate resources will be channeled to information under such circumstances. If the cost of information provision is not borne entirely by consumers, an equally vexing problem can arise. Consider magazines which rate restaurants, and which receive a substantial fraction of their revenues from advertising. It will be in the interest of restaurants to receive a favorable rating. Part of the benefits of an inflated rating can be kicked back to the magazine in the form of additional advertising. Testifying to this problem are the vehement assertions that "we do not accept advertising" or "we are a non-profit organization" on the part of some of the most respected consumer-testing agencies. 5
Yet another response by the market is the development of informed intermediaries, who market multiple goods or services. Retailers, for example, typically carry many products. While a retailers' customers may purchase a particular item only on rare occasions, they may frequently purchase from amongst the set of products offered. The retailer will be motivated to monitor and maintain the quality of the products he sells, since a dissatisfied customer will take his business elsewhere. In short, multiproduct retailers internalize the basic information externality. Such an argument also can explain the success of product conglomerates, restaurant chains, etc. (It is interesting to note that income tax services are now being offered in certain large retail stores.)

While the existence of informed, multiproduct intermediaries lessens the problem of asymmetric information, it does not seem to eliminate it in all markets. The information to assess the quality of sophisticated products, such as doctors' services, drugs, or microwave ovens, may be difficult or impossible even for a middleman to obtain. And many services do not lend themselves to being offered by multiproduct middlemen.

We conclude that private market responses will not always ameliorate the market failure resulting from asymmetric information. Given that private markets cannot eliminate the problem, the economist trained by the shores of Lake Michigan might be tempted to conclude that no institutional framework can be devised to improve matters. In the following sections, we argue that this is not a correct conclusion.
III. Regulatory Responses to Market Failure

An alternative possible solution to market failure is the use of institutions that further restrict the freedom of individuals' choices. Restrictions may be imposed by a government, by a professional or industry organization, or by both.

In what follows, we shall look at three institutional arrangements, both separately and in combination. The three possibilities considered are:

1) the payment of subsidies to suppliers;
2) the random restriction of entry to a fraction of suppliers (licensing on a random basis); and
3) the imposition of minimum quality standards (licensing on the basis of exceeding minimum quality levels).

All involve some extra-market restrictions on individual behavior: the first because it involves the transfer of income through taxation and subsidies; the second and third because restrictions are placed on entry into markets. In our conclusion, we mention two further possible solutions: certification and (involuntary) seller liability.

We first examine the desirability of such institutions when welfare-maximizing policies are followed. Welfare is presumed to be the sum of producers' and consumers' surplus. Welfare-optimal policies are then contrasted with those that maximize sellers' profits (producers' surplus), to examine the implications of allowing industry or professional groups to dictate licensing or other criteria.
IV. A Model of Markets with Asymmetric Information

To present our analysis in a simple but rigorous manner, we adopt the model used in Leland [1979], specialized to a linear-quadratic form that permits explicit solutions to be derived and alternative policies to be analyzed.

Sellers are assumed to offer a specific number of units of goods or services of a given quality level. Without loss of generality, we can rescale quality and quantity units so that the supply of goods is uniformly distributed over the quality interval \([0,1]\). That is:

\[ f(q) = 1, \quad q \in [0,1], \]

where \( f(q) \) is the density of potential sellers of quality level \( q \).

Sellers of higher quality are assumed to have higher opportunity costs. We assume such costs take a simple quadratic form:

\[(1) \quad R(q) = dq^2 + eq + f,\]

with \( R'(q) = 2dq + e > 0 \). As price rises, higher-quality sellers will be induced to offer their goods. Thus, average quality of goods tends to increase with price.

Buyers are presumed to have a marginal willingness to pay (inverse demand):

\[(2) \quad p = a + bq - cy,\]

where \( p \) is the price offered to all units, \( \bar{q} \) is the average quality
of goods offered for sale, and \( y \) is the amount consumed. Thus, consumers recognize average quality but cannot distinguish the quality of any particular seller.

Let \( \hat{q} \) represent the maximal quality index of goods offered for sale and \( L \) represent the minimal quality permitted. Let \( M \in [0,1] \) denote the proportion of sellers with quality between \( \hat{q} \) and \( L \) who are actually allowed to sell. If there are many sellers at each quality level, a random entry restriction would eliminate the same proportion at each quality level. \( L \) and \( M \) are variables that regulatory authorities may be able to control. In the absence of control, \( L = 0 \) and \( M = 1 \).

Given our scaling of \( q \) to produce a uniform distribution of potential supply, actual supply will be given by:

\begin{equation}
(3) \quad y = M(\hat{q} - L) \ .
\end{equation}

Average quality can also be related to \( \hat{q} \) and \( L \). It will be the average of the highest and lowest quality:

\begin{equation}
(4) \quad \bar{q} = (\hat{q} + L)/2 \ .
\end{equation}

Note that, given \( \hat{q} \) and \( L \), \( \bar{q} \) is invariant to \( M \).

We shall consider two alternative environments: (1) where the use of subsidies (or taxes) permit the choice of \( \hat{q} \); and (2) where such subsidies are not possible, and \( \hat{q} \) is determined by the market forces of supply and demand.
If the market determines \( q \), it will set a level where the opportunity cost of the marginal seller, \( R(q) \), just equals the price he receives. Thus, the market equilibrium \( q_e \) is determined by the relationship:

\[
p = a + b(q_e + L)/2 - cM(q_e - L) = d q_e^2 + e q_e + f = R(q_e)
\]

using (1), (2), (3), and (4). This can be solved explicitly for \( q_e \) as a function of \( M \) and \( L \):

\[
q_e = \frac{b}{2} - e - cM + \left[ \left( \frac{b}{2} - e - cM \right)^2 + 4d \left( a - f + \frac{b}{2} + cM \right)L \right]^{1/2}
\]

When \( d = 0 \),

\[
q_e = \frac{a - f + \frac{b}{2} + cM}{cM + e - b/2}
\]

Welfare is given by consumers’ surplus plus producers’ surplus. It is measured by the area under the demand curve (given average quality), less the opportunity costs incurred:

\[
W(q, L, M) = \int_0^{M(q - L)} (a + b(q + L)/2 - cz)dz - M \int_{L}^{q} (dz^2 + ez + f)dz
\]

\[
= (a - f)M(q) + \frac{(b - e)}{2} M(q)^2 - cM^2(q - L)^2 - \frac{d}{3} M(q^3 - L^3)
\]

If the market is allowed to determine the maximal quality \( q \), (7) can be used to yield an expression for welfare \( W \) as a function of
the policy parameters $L$ and $M$. However, $\hat{q}$ itself can be chosen independently if subsidies or entry restrictions are used to induce a different $\hat{q}$ than the market equilibrium.

Profits to sellers depend on the price they receive times supply, less opportunity costs. When the market determines $\hat{q}$, profits will be

$$\Pi = p y - M \int_0^{\hat{q}} E(q) dq$$

$$= [a + b(\hat{q} + L)/2 - cM(\hat{q} - L)]M(\hat{q} - L) - M \int_0^{\hat{q}} (dq^2 + eq + f) dq.$$  

If, through subsidies, sellers are paid a higher price, (9) can be suitably modified.

Our reference case has:

$$a = b = d = 1$$
$$c = 2$$
$$e = f = 0.$$  

These numbers were chosen because they yield interior solutions for all problems considered.

Figure 1 shows market equilibrium when no policy instruments are used: $L=0$, $M=1$, and $\hat{q}$ is determined by the market. In this case,

$$\hat{q} = .5$$
$$W = .3333$$
$$\Pi = .08333$$
$$p = .25.$$
FIGURE 1

COMPETITIVE EQUILIBRIUM

\(a=b=d=1; \ c=2; \ e=f=0\)

\[R(\bar{q}) = \bar{q}^2\]

\[P(\bar{q}) = 1 + \bar{q} - 2q\]

\[= 1 + \frac{1}{2} \bar{q} - 2q\]

\[= 1 - \frac{3}{2} \bar{q}\]
The market failure associated with competitive equilibrium can be shown by differentiating (8) with respect to \( \hat{q} \) and using (5), yielding:

\[
\left. \frac{dW}{d\hat{q}} \right|_{L=0, M=1, \hat{q}=\hat{q}_e} = \left[ \hat{q}_e \left( \frac{1}{2} b \right) \right]_{L=0, M=1, \hat{q}=\hat{q}_e} d\hat{q} = \frac{1}{2} b \hat{q}_e > 0.
\]

At competitive equilibrium, a further increase in the maximum quality level \( \hat{q} \) would increase welfare. Below, we show that information about individual sellers' quality is not required for a number of policies which serve to raise \( \hat{q} \). Welfare improvements are possible without additional information.

V. Welfare-Optimizing Policies

We assume now that the regulatory authority can adjust \( \hat{q}, M, \) or \( L \), or combinations of the three. The nature of such adjustments and the information requirements to determine optimal policies are briefly discussed below.

Adjustment in \( \hat{q} \) to a level above the market equilibrium \( \hat{q}_e \), can be achieved by offering subsidies to sellers. Subsidies induce people who previously were unwilling to sell (because of high opportunity costs) to enter the market. The cost of such a subsidy plan depends upon whether the regulatory authority can identify high-quality sellers or not. If they can, only these people need to be offered subsidies, at a level just sufficient to induce them to enter the market. For example, scholarships might be offered to talented applicants. If the authority offering the subsidies cannot identify the more talented potential
sellers, the subsidy would be paid to all. Computation of the optimal subsidy does not require the agency to know the quality of individual sellers but does require knowledge of market demand and opportunity-cost schedules. But even without such knowledge, (10) indicates that at least small welfare improvements can be made through small subsidies.

Adjustment of $M$, the fraction of willing sellers who are actually permitted to sell, requires that the authority be able to restrict entry. The number of licenses might be fixed or places in required educational programs limited. The important feature of the control parameter $M$ is that knowledge of individual quality levels is not required. It can be viewed as random-entry restriction or licensing—a fraction of all quality levels is refused entry. By restricting entry, price will tend to rise, thereby attracting more applicants and resulting in higher average quality. This higher quality may merit the initial restriction on entry.

Adjustment of $L$ requires that the authority be able both to restrict entry and to ascertain whether sellers' quality lies above or below $L$. An obvious extension would be where the authority imperfectly measures whether the seller lies above or below $L$; when monitoring is totally ineffective in judging quality, we are back to the case of setting $M$.

Our results for the reference case are detailed in table 1.

A. Use of Subsidies to Change $\hat{q}$

Because of the nature of market failure, we know that increasing $\hat{q}$ can always increase welfare. This is reflected in our optimal $\hat{q}$,
<table>
<thead>
<tr>
<th>Authority Can Set:</th>
<th>Minimum Quality L</th>
<th>Entry Fraction M</th>
<th>Price Subsidy to Sellers</th>
<th>Maximum Quality $\tilde{q}$</th>
<th>Price to Consumers</th>
<th>Supply</th>
<th>Average Quality $\tilde{q}$</th>
<th>Profit</th>
<th>Welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Nothing (competitive equilibrium)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>.5</td>
<td>.25</td>
<td>.50</td>
<td>.25</td>
<td>.083</td>
<td>.333</td>
</tr>
<tr>
<td>B. Subsidy only (determining $\tilde{q}$)</td>
<td>0</td>
<td>1</td>
<td>.31</td>
<td>.62</td>
<td>.07</td>
<td>.62</td>
<td>.31</td>
<td>.157\textsuperscript{a}</td>
<td>.348</td>
</tr>
<tr>
<td>C. Entry fraction M only</td>
<td>0</td>
<td>.88</td>
<td>0</td>
<td>.55</td>
<td>.30</td>
<td>.48</td>
<td>.28</td>
<td>.099</td>
<td>.335</td>
</tr>
<tr>
<td>D. Minimum quality L only</td>
<td>.22</td>
<td>1</td>
<td>0</td>
<td>.70</td>
<td>.49</td>
<td>.48</td>
<td>.46</td>
<td>.127</td>
<td>.360</td>
</tr>
<tr>
<td>E. Subsidy and L</td>
<td>.20</td>
<td>1</td>
<td>.28</td>
<td>.78</td>
<td>.33</td>
<td>.58</td>
<td>.49</td>
<td>.199\textsuperscript{a}</td>
<td>.372</td>
</tr>
<tr>
<td>F. Subsidy and M</td>
<td>(same as (D) above: use subsidy only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. M and L</td>
<td>(same as (D) above: use minimum quality only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Subsidy M and L</td>
<td>(same as (E) above: use subsidy and minimum quality only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a}This assumes all sellers are offered the subsidy.
which is achieved by offering a subsidy of .31 to sellers. Because of
the increased supply, the price to consumers falls to .07. Total welfare
increases by about 5 percent.

If all sellers are paid the subsidy (rather than just those who
require it to offer their services), profit to sellers will be .157.
Subsidies improve the welfare of sellers markedly; if consumers of the
goods or services are required to pay the subsidies through taxes, their
consumer surplus will in fact fall.

Subsidies can also be useful in conjunction with minimum quality
standards. Line E of table 1 indicates that subsidies and minimum qual-
ity standards jointly increase welfare. In comparison with line B, where
subsidies only are used, we note that both the extent and total expense
of subsidies is less when minimum quality standards also are enforced.

Table 1 lists numerical results for the reference example only.
We have also examined the response of numbers in the table to changes in
the parameters of our model. Our results are as follows:

The percentage welfare gains from subsidies become larger as:

1) the value of low-quality units (parameter a) is relatively
   low;
2) the fixed costs of quality provision (parameter f) is rela-
   tively high;
3) the sensitivity to quality (parameter b) is relatively
   high;
4) the marginal cost of providing higher quality (parameters d
   and e) is relatively small; and
5) the elasticity of demand (at the competitive equilibrium price and quantity) is relatively high.

The last calculation considers a simultaneous shift in parameters \( a \) and \( c \), which rotates the demand curve through the original price/quantity equilibrium to a steeper slope.

B. Use of Random-Entry Restrictions \( M \)

When no other policy options are available, welfare can nonetheless be improved in some cases by randomly restricting entry. For our reference case, it was welfare-optimal to exclude 12 percent of all applicants. This raises price, thereby inducing higher-quality sellers to apply for entry. Even though some of these higher-quality applicants are (randomly) rejected, average quality and welfare rise.

Random restrictions are not always beneficial. Varying the parameters of our model showed:

The benefits from random-entry restriction increase as:

1) the value of low-quality units (\( a \)) is relatively low;
2) the fixed costs of quality provision (\( f \)) is relatively high;
3) demand is relatively sensitive to average quality (\( b \));
4) demand is relatively inelastic; and
5) the marginal cost of providing higher quality is relatively small (\( d \) and \( e \)).

These situations are similar to those that yield gains to subsidies, with the exception of the effect of demand elasticity.
It should again be stressed that random licensing is not always beneficial. Welfare may be decreased by such restrictions when markets are not described by the above characteristics. Furthermore, the results in table 1 indicate that, if other instruments are available, random licensing will not be desirable. This is true for other parameter values than the reference case.

C. Use of Minimum Quality Standards

Welfare can often be increased by using minimum quality standards, even when other policy instruments are available. Line D of table 1 indicates that a welfare rise of about 9 percent can be effected by a minimum quality standard that eliminates the bottom 22 percent of potential sellers. Note that the net effect on supply is a reduction of only 4 percent. The elimination of low-quality sellers raises average quality and price, which, in turn, attracts entry of high-quality sellers. Both price and average quality soar when contrasted with previous equilibria.

As with random licensing, minimum quality standards are not always socially beneficial. Parametric investigations reveal:

The benefits from minimum quality standards increase as:

1) the value of low-quality units \((a)\) is relatively low;
2) the fixed costs of quality provision \((\xi)\) is relatively high;
3) demand is relatively sensitive to average quality \((b)\);
4) demand is relatively inelastic; and
5) the marginal cost of providing higher quality is relatively small \((d \text{ and } e)\)
Thus, minimum quality standards will increase welfare in the same types of situations where random restrictions will be beneficial. We found no combination of parameters where random restrictions were preferred to minimum quality standards when $d \geq 0$. And line G of table 1 indicates random restrictions will not be useful in conjunction with minimum quality standards. Although, from a welfare viewpoint, minimum quality standards dominate random-entry restrictions, their implementation requires more knowledge on the part of the regulatory authority. Where knowledge of seller quality is difficult or impossible to obtain, random restrictions may be the only feasible option.

We again note from line E of table 1 that minimum quality standards are useful in conjunction with subsidies. In all cases examined, the optimal minimum quality standards were less restrictive when subsidies could also be used. A fortiori, markets in which minimum quality standards alone are not beneficial will not gain from minimum standards when subsidies are possible.

VI. Profit-Maximizing Policies

We now consider policies that maximize profits (seller revenues less opportunity costs) rather than welfare. Policy variables are the same as before: $q$, the maximal quality seller; $M$, the fraction of willing sellers who are permitted to sell; and $L$, the minimum quality permitted for sale. While adjustment of $M$ and $L$ require the same information and are implemented in the same manner (but with a different objective) as before, the choice of $q$ is implemented somewhat differently. Recall
that the welfare-optimizing authority was permitted to induce higher-quality sellers by offering subsidies. This implicitly assumes the welfare-optimizer has the ability to tax, since subsidies imply revenues paid to sellers beyond those received from the sale of goods or services. We shall presume that the profit-maximizing authority does not have the ability to tax and therefore cannot raise \( \hat{q} \) above the market equilibrium level, given \( L \) and \( M \). Nonetheless, the profit-maximizing authority can reduce \( \hat{q} \) below the market equilibrium if he can identify high-quality sellers and prohibit their entry. In certain circumstances, this may increase profits.

Table 2 gives the optimal profit-maximizing policies for the reference example. We offer the following observations.

A. Restricting Maximal-Quality Level

In the absence of alternative policies, it will be profit-maximizing to restrict entry of high-quality applicants. In so doing, price is driven up even though average quality falls. As elasticity of demand rises, or sensitivity to quality increases, this policy becomes less attractive as a means to increase profit. It should be noted that, for the reference example, some restriction of maximal quality was optimal, even when other restrictions could be used. From a welfare point of view, such restrictions are unambiguously bad because they exacerbate the fundamental market failure.
<table>
<thead>
<tr>
<th>Authority Can Set:</th>
<th>Minimum Quality $L$</th>
<th>Entry Fraction $M$</th>
<th>Maximum Quality $q$</th>
<th>Maximum $q$ Willing to Enter</th>
<th>Price to Consumers</th>
<th>Supply</th>
<th>Average Quality $\bar{q}$</th>
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<th>Welfare</th>
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<td>.5</td>
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<td>.25</td>
<td>.5</td>
<td>.25</td>
<td>.083</td>
<td>.333</td>
</tr>
<tr>
<td>B. $q$ only</td>
<td>0</td>
<td>1</td>
<td>.30</td>
<td>.74</td>
<td>.55</td>
<td>.30</td>
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<td>.30</td>
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B. Random Restrictions

Prohibition of entry on a random basis also can increase profits. For the reference example, it was profit-maximizing to allow only 33 percent of applicants to enter. Profits increased considerably, and welfare fell from the competitive equilibrium level. Both price and average quality were high. In contrast with the welfare-optimizing policies, random restrictions were used in addition to minimum quality standards when both were available. However, both the minimum standard and the fraction refused entry fell from levels that were optimal when only one or the other could be used.

For all variations of parameters considered with $d \geq 0$, profit-maximizing restrictions on entry were stricter than optimal welfare restrictions.

C. Minimum Quality Standards

Minimum quality standards improved profits, whether used uniquely or in combination with other policies. When used alone, minimum quality standards raised profit by a smaller amount than other policies, but was the only policy in the reference example that raised welfare above its competitive level. As demand becomes more elastic and more sensitive to quality, minimum quality standards become more profitable relative to other policies, and will increase welfare above the competitive equilibrium level by larger amounts.

Thus the contention that professional groups set too high standards seems warranted in markets described by our model.
VI. Some Policy Implications

It is always dangerous to generalize from a theoretical example to real-world markets. A conservative approach would be to interpret our results as a counterexample. It disproves the hypothesis that minimum quality standards (or other policies) can never improve welfare. For a market described by a given set of parameters, we have shown that welfare can be increased by a number of policies, including subsidies, minimum quality standards, and even random entry restriction. And no additional ability to discern individual sellers' quality is required for subsidies or random entry restriction.

To draw positive implications from our model requires review of its key elements:

1) The market is characterized by informational asymmetries.

2) Higher prices tend to attract higher-quality sellers.

3) The opportunity costs of higher-quality supply are convex.

Clearly, not all markets are described by these elements, and our results are not applicable in such cases. When markets are described by these elements, we offer the following observations based on our analysis.

a) There will be market failure in competitive equilibrium.

b) Even if the regulatory authority cannot identify the quality of individual sellers, welfare may be increased by subsidies or random entry restrictions.

c) Subsidies can always increase welfare. Computation of optimal subsidies require that the regulatory authority know aggregate demand functions and opportunity-cost functions, but not the quality of individual sellers.
d) Random entry restrictions will not always increase welfare but will tend to be beneficial in markets with relatively inelastic demand, high sensitivity of demand to average quality, and low marginal costs of increasing quality.

e) Minimum quality standards will not always increase welfare, but will tend to be more beneficial in markets with relatively inelastic demand, high sensitivity to quality, and relatively low marginal opportunity costs of providing quality. Implementation does require knowledge of individual seller quality.

f) Minimum quality standards will always be preferred to random entry restrictions when welfare optimization is the goal. A combination of subsidies and minimum quality standards will generally yield the greatest welfare within the set of instruments considered.

g) Optimal policies tend to increase producers' surplus more than consumers' surplus; in many cases, the latter actually falls.

h) Profit-maximizing policies yield higher prices, higher average quality, and lower supply than the equivalent welfare-maximizing policies. Relative to competitive equilibrium, welfare may be higher or lower.

i) Profit-maximizing minimum quality standards are too high. Welfare may be higher or lower than in competitive equilibrium. Welfare will tend to be higher as demand is more elastic and more sensitive to average quality.
Our conclusions lend some support to both camps on the question of the desirability of minimum quality standards. On the one hand, we indicate that standards can be socially desirable. On the other hand, we indicate that, when left to the profession or industry, standards will be set at too high a level, perhaps resulting in lower welfare than when no standards are imposed. And in markets that are not characterized by asymmetric information, minimum standards can only serve to lower welfare.

VII. Some Extensions

The preceding analysis has been limited to the case where quality levels of individual sellers are fixed, and opportunity costs increase with quality and are convex. Analysis in Leland [1979] indicates that minimum quality standards may be even more desirable in the case where firms (or individuals) can choose the quality of their goods or services, if informational asymmetries persist. And decreasing opportunity costs also strengthen the case for minimum quality standards, since the sellers eliminated have the highest (rather than lowest) opportunity costs. Random entry restriction or subsidies would not be desirable for these markets, however.

The analysis becomes greatly complicated when costs are concave. Corner solutions become the rule rather than the exception. Disjoint supply intervals might be preferred to a single quality interval. Except to retain the conclusion that there is market failure in competitive equilibrium, our analysis, as presently developed, cannot adequately analyze
this case. Whether costs are convex or concave is, of course, an empirical question.

While we have looked at a number of alternative policies, we have ignored two policies that have been suggested by a number of authors: seller liability, and certification. 10

Seller liability can be viewed as a compulsory insurance policy issued by the seller to the buyer. Such an arrangement can potentially be beneficial since it may serve to internalize the fundamental informational externality. The fact that seller liability has not occurred voluntarily through product guarantees, however, points out that problems may exist with such an institutional arrangement. In section II, we discussed the problem of moral hazard in limiting voluntary liability agreements. Moral hazard will remain a problem with compulsory seller liability; as mentioned before, its presence is a fundamental justification for the doctrine of caveat emptor. If it is difficult to unravel product misuse from poor product quality, buyers may be led to initiate unwarranted claims, with resulting resource misallocations. For example, it has been claimed that fear of malpractice suits has led doctors to overtreatment of patients. Perhaps more importantly, monitoring costs of product quality after use may be greater than the monitoring costs of product quality at the time of sale. This is clearly an empirical question, and no definitive answer can be offered here.

Certification involves identification of seller quality but not prohibition of sales by low-quality purveyors. The information requirements of certification are therefore similar to those for minimum quality
standards. But buyers have a wider range of choice, since they can buy low-quality goods or services if they wish. In section II we argued that private enterprise could not be relied upon to provide complete certification, due to the anomalies of information as an economic good. But it would still seem that a benevolent government might perform this service, with higher welfare than when minimum quality standards were enforced. It would seem that, when possible, certification would dominate minimum quality standards.

But there is another crucial difference between minimum quality standards and certification. Certification involves not only the identification of individual sellers' qualities, but also the communication of this information to buyers. In many cases, this latter step may be costly or impossible. Consider, for example, the rating of drugs. This would involve the results of many tests, most of which would require chemical and statistical expertise to interpret. Without such interpretation, the information is worthless. Correct interpretation by consumers would involve costly education. Rather than incur this expense, consumers might be better off appointing experts as their agents. But the only action such an agent could undertake that would not require information transfer but would affect consumers' choices, would be allowing the product to be sold or not. In short, because of the cost of information transferral, we are in a principal/agent relationship. The relevant action set would be whether the principals (buyers) should be able to buy or not. And this is nothing other than the enforcement of a minimum quality standard.
1 See Friedman [1962] and Stigler [1971], for example.

2 An alternative suggestion is that quality regulation occurs in markets whose products are potentially hazardous. But this seems less satisfactory: knives, for example, are potentially hazardous but are not regulated. Bank portfolios are regulated but are not life-threatening. While potentially hazardous products do tend to be regulated, it is because of difficulties in assessing the hazard (information asymmetry) rather than the hazard itself.

3 The stability of such a signalling equilibrium is not always assured; see Rothschild and Stiglitz [1976].

4 See, for example, Oi [1973] and Epplle and Raviv [1978].

5 A few private information-providing firms who derive their revenues from sellers do exist. Bond-rating services take this form, for example. But there is casual evidence suggesting these services make excess profits, thereby diminishing the advantage of offering inflated ratings, with their subsequent short-term gains but longer-term losses. Indeed, some degree of monopoly power might be viewed as socially desirable if it diminishes the problems of quality deterioration discussed here and in Leland [1979].

6 If $\tilde{q}$ is an initial quality index with distribution of sellers given by $F(q)$, then we simply redefine the quality index by $q = F(\tilde{q})$, with $q$ now uniformly distributed. Note that the quality of each
individual seller is fixed. Extensions of this analysis to include quality choice are discussed in Leland [1979]. Such an extension does not alter the nature of our conclusions here.

We adopt this criterion as a proxy for a professional group or industry operating in its own self-interest. This is not to claim that all professional groups should or would operate to maximize producer's surplus. A detailed examination of group decision-making would be necessary to specify any particular profession's objectives.

It might be suggested that sellers tax themselves ("union dues") to subsidize high-quality entrants. If the quality of entrants could not be determined, all entrants would have to be subsidized, with the tax equal to the subsidy—thus rendering no change in the (total) opportunity cost of entrants. If the quality of entrants could be detected, such a plan might be in the group's interest, but only if willingness to pay $p$ were an increasing function of $q$.

We have not discussed the costs of implementing such standards—clearly one would have to weigh benefits against costs to make a correct decision. The burden of our analysis has been to show that there may be positive benefits. The prevalence of minimum quality standards might be viewed as possible evidence that benefits outweigh costs, although alternative explanations are possible.

Brown [1974], Epple and Raviv [1978], McKean [1970], and Oi [1973] consider seller liability in markets with symmetric information. For a discussion of certification, see Friedman [1962].
REFERENCES


