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Quacks, Lemons and Self-Regulation: A Welfare Analysis

by

Thomas Gehrig*
and
Peter-J. Jost**

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*Managerial Economics and Decision Sciences, Kellogg Graduate School of Management, Northwestern University, 2001 N. Sheridan Road, Evanston, Illinois 60208, USA.

**Department of Economics - WWZ, University of Basel, Petersgraben 51, CH-4003 Basel, Switzerland.

Abstract:

The paper provides a framework in which suppliers of experience goods find it in their best interest to provide and enforce quality standards. This self-regulatory outcome is compared to various forms of statutory regulation, such as price regulation and quality regulation. The comparison is attractive, since the suppliers can observe each others' product quality at lower cost than customers or policy maker. As long as quality is the only variable unknown to consumers and policy makers, any self-regulatory outcome can be replicated by an appropriate statutory policy. However, when additional variables (such as cost parameters) are private information of the suppliers, self-regulation may be strictly socially desirable.

Quacks, Lemons and Self-Regulation: A Welfare Analysis

"Despite a long standing interest by policy makers,..., the formal analysis of the economics of the self-regulating profession has received little attention from theorists." (Shaked/Sutton, 1981)

I. Introduction

More then ten years after Shaked and Sutton's (1981) article on the self-regulating profession, little of their assessment has changed (the only exception known to the authors is Shapiro [1986]). This is even more surprising for the concept of self-regulation is quite an interesting economic construct. Consider a market in which consumers cannot observe product quality prior to purchase and suppose that firms have an incentive to provide high quality products in order to serve a large clientele. Each firm has different possibilities to signal quality[1] : for example it can build on reputation effects (see Shapiro, 1986), offer warranties (see Cooper, Ross, 1985), or choose a particular sequence of prices (see Bagwell, Riordan, 1991). However, signaling maybe quite costly, not credible, or even impossible, e.g. when there are only few consumption periods. In those situations some or all firms in the market have an incentive to improve jointly their product qualities. In the present article we focus on the conditions and implications of self-regulation.

The following example of the Swiss Regional Bankers Association illustrates the problems, which may arise in those circumstances: due to the expansion of the Grossbanken and Cantonal Banks in rural areas. Regional Banks which tend to focus on retail and commercial banking in their local areas[2] founded the Re-

[1] See von Weizsäcker (1980a), Chapter 6 for the efforts to provide quality information.

[2] Regional banks are of small size with the largest disposing of assets of around Sfr.8 billion.

gional Bankers Association in 1971 to maintain their competitive position. The reduction of operating costs via centralization of common services as well as the improvement of confidence and safety were two main goals of this association. However, as Swiss banks generally are regarded as safe banks, the Association failed to institute a supervisory board, which would monitor quality standards. Then, in 1991 the Spar-und Leihkasse Thun, a one billion Sfr regional bank, was liquidated and the bank's license was withdrawn by the Federal Banking Commission[3] . The bank's failure had a broad and negative impact on the image of Swiss banking in general, and for the members of the Regional Bankers Association in particular. In order to prevent re-occurence elsewhere, a board of examiners was founded to set business standards and audit their compliance. Inadequate conduct of business now is sanctioned by exclusion as a member of the Association.

In the present article we analyze a slightly more general situation, in which firms enjoy an informational advantage concerning the product they offer. They produce services or products of a quality, which can be observed by consumers only after purchase. Over time consumers will learn the true qualities. We assume that firms have an incentive to provide high quality products, but it is not possible to credibly signal a higher quality of products individually. Hence, firms may have an incentive to self-regulate market conduct.

In such an environment a self-regulatory club sets minimum standards. The example of the Swiss Regional Bankers Association shows that the club has to credibly enforce these standards. In fact, if one member of the club deviates from the prescribed standard to exploit his superior informational position, all club member loose their credibility. We model this aspect by considering the following environment: Firms and consumers are located across isolated islands. Between the consumption periods there is a chance that consumers might need to migrate to ex ante unknown locations. In such cases they loose all their information of former purchases. They have to learn from scratch again[4] . In this world, the

[3] The Federal Banking Commission supervises all Swiss banks.

[4] Implicitly, we assume that it is too costly or even impossible to verify loosely communicated information perfectly.

club can credibly enforce its minimum standard because each member has an incentive to detect and exclude from the club any deviant. The deviant will fool some prospective clients, who in turn revise downwards their appreciation of the club. This destroys reputational capital of other club members. Since such revisions of consumer beliefs hurt expected future revenues of the other club members, those have a strong incentive to enforce the quality standard.

The welfare aspects of self-regulation are particularly interesting. In a first-best world, where the social planner has access to the same information as the firms in the market, there is little scope for self-regulation[5] . So any (interesting) analysis of self-regulation has to start from information asymmetries between market participants and the social planner. Assume that the enforcement of statutory regulation is impeded by the fact that the regulator himself may not be privy of other inside information, e.g. those pertaining to the firms' production costs. In such situations the regulator needs to interpret market signals in an attempt to uncover wrong doings. However, he will remain only partially informed in any statutory regime [6] . We show that the regulator may be willing to grant regulatory power to self-regulatory organizations, provided he cares strongly enough for industry's needs. This result is even more restrictive for firms are assumed to be local monopolists. So the trade-off between provision of quality and the social costs imposed by barriers of entry is omitted (see von Weizsäcker, 1980b).

Financial markets are good examples of the model we have in mind, since financial services largely are credence or experience goods rather than search goods (see Mayer, Neven, 1991). In the case of credence goods even ex post it may be difficult to ascertain product quality, while in the case of search goods the quality can be established immediately on purchase. In fact, clients in financial services cannot easily observe the quality of investment advice or portfolio management. They cannot easily discriminate bad draws of fundamentals of the underlying assets from strategic manouvering against their interests such as in-

[5] Here we mean that in such a world statutory regulation could implement self-regulatory outcomes as well.

[6] Implicitly, we assume that it is too costly or even impossible to verify inside information perfectly.

sider trading or rate cutting for example. Currently, interest in self- regulation features prominently in the regulatory reform of European financial markets. So the Financial Services Act (1986) in UK explicitly confers regulatory power to five Self- Regulatory Organizations, which consist of member firms actively operating in those markets. Direct access to the London financial market requires membership in one of these five clubs.

Our model follows Shapiro (1986) quite closely in spirit. The value of reputational capital determines the quality of investments firms undertake initially. While Shapiro discusses various policy options a profession might like to consider, such as product licensing and certification, we concentrate on the underlying justification for self-regulation and the welfare comparison with alternative statutory regulation. Thus, like Shapiro, we generalize the initial work of Leland (1979) and Shaked, Sutton (1981) to settings, where the firms' investment decisions are determined endogenously.

The paper is organized as follows. In section II we present the basic economy. The next section III analyzes market failure in absence of a regulatory scheme. Section IV considers the case in which firms can join a self-regulatory club. Statutory regulation schemes are discussed in section V. Statutory regulation is compared with self-regulation under conditions of cost uncertainty in section VI. The last section concludes with some final remarks.

II. The Basic Model

We consider a segmented market in which firms supply the product only in localized regional markets. The products are non-durable and can be offered in different qualities. Consumption can take place in two periods. The key features of our model are the demographic structure, consumer demand and the information structure.

Demographic structure

Consumers are evenly located across N isolated islands. Shopping on other islands is prohibitively expensive so that consumers are constrained to buy products on the island they inhabit at the given period.

Between the two periods a fixed proportion $\lambda \in [0,1]$ of consumers migrates to another island such that the population in each island remains constant. We assume that the migration decision is caused by exogenous events and is unforeseen by the consumers in period 1.

Consumer demand

In modelling demand for a specific island we follow Shaked and Sutton (1982). Consumers are characterized by their income $y \in [0, \bar{y}]$ and by their "reservation quality" $r \in [0, \bar{r}]$. The reservation quality of a given consumer defines his minimal quality satisfaction level in the sense that he derives no utility for products of any lower quality. Consumers demand at most one unit. The utility a consumer with characteristics (y, r) derives from consuming a product of quality q is given by:

$$u(y,r) \;=\; max\{q - r, 0\} \cdot y.$$

Income and reservation qualities are uniformly distributed on $[0, q]$ and $[0, \bar{r}]$, respectively. Let p denote the price for a product of quality q then market demand reads

$$\begin{aligned} D(p,q) &= \frac{1}{\bar{r}\bar{y}} \int_{q \geq r} \int_{y \geq p} dr dy \\ &= \frac{1}{\bar{r}\bar{y}} q(\bar{y} - p) \end{aligned}$$

Firms and information structure

We assume that a firm can supply only a single island. Furthermore we assume that each firm offers a single product. Products can be offered in different qualities $q \in [0, \bar{q}]$. Production of quality q requires a fixed outlay of $C(q) = q^2$.

Qualities are set before the market opens and cannot be changed during the periods. However, at the beginning of each period a firm can set prices p_1 and p_2 respectively. Prices on a given island are set simultaneously by the competitors.

Product quality is private information of the firms initially. Only after consumption a consumer can learn the quality of a product. This implies that only in period 2 consumers can ascertain the quality offered by a particular supplier.

We assume that it is impossible to communicate the quality of a product. Hence in period 2 immigrants in an island cannot inherit the experience of the locals. Moreover, consumption decisions of other consumers are not observable to consumers. So they cannot make inferences from transaction volumes.

Game structure

Our analysis is based on a non-cooperative game with two consumption periods $t = 1, 2$. We consider the following time structure of events:

- $t = 0$: Firms choose the quality of their products. Before period $t = 1$ starts, each firm observes the quality set by the other firms.
- $t = 1$: Firms set prices for the first consumption period. Thereafter, consumption takes place. At the end of period 1 some consumers migrate across islands.
- $t = 2$: Firms set prices for the second period. Then, consumers make their consumption decision.

Strategies and equilibrium

The strategy for a firm is a triple (q, p_1, p_2), where $q \in [0, \bar{q}]$ is the chosen quality and p_i are the prices set in period $i = 1, 2$. [7]

In period 1 consumers base their purchase decision on their common expectation q_1^e of product qualities and the observed prices. In period 2 non-migrant consumers have learned the quality of the supplier whose product they consumed. Migrants, however, have no further information about the qualities of suppliers on their new island and maintain an expectation of q_2^e.[8]

We employ the concept of perfect Bayesian equilibrium (Fudenberg, Tirole (1991)). Let $\pi(q, p_1, p_2, q_1^e, q_2^e)$ denote a firm's revenue function. Then in equilibrium

- a firm's strategy (q^*, p_1^*, p_2^*) has to be an optimal response to their rivals' strategies for given beliefs of the consumers:

$$\pi(q^*, p_1^*, p_2^*, q_1^e, q_2^e) \geq \pi(q, p_1, p_2, q_1^e, q_2^e) \quad , \forall (q, p_1, p_2)$$

- consumers' beliefs are consistent in the sense that in equilibrium they expect firms to play equilibrium strategies: [9]

$$q_2^e(p_2^*) = q^*$$

[7] We abuse notation and let denote $p_1 = p_1(q)$ and $p_2 = p_2(q, p_1)$ firms' price decisions

[8] Again we abuse notation and use $q_i^e = q_i^e(p_i)$ to denote consumers' expectations.

[9] Given that production requires fixed costs only, which are sunk at the pricing stage, and given marginal costs are independent of quality, signaling product quality through pricing (Bagwell, Riordan, 1990) will not occur in equilibrium. In fact, this result will apply even, when marginal costs vary in quality, provided sunk costs are large enough. For hat reason we suppress the dependence of quality expectations on period 1 prices.

III. The Case of Local Monopolies

Consider a particular island and assume that the local firm has selected a strategy (q, p_1, p_2).

As a reference case let us consider the situation in which consumers can perfectly observe the quality in both periods. Here the local monopolist faces a straightforward optimization problem. Prices and quality are set such that his revenue function

$$\pi(q, p_1, p_2, q, q) = D(q, p_1)p_1 + D(q, p_2)p_2 - C(q)$$

is maximized.

Result 1 (full information)

When consumers can observe the product qualities offered by local monopolists the optimal choice for local monopolists requires:

$$\hat{q} = \frac{\bar{y}}{4\bar{r}} \quad and \quad \hat{p}_1 = \hat{p}_2 = \frac{\bar{y}}{2}.$$

Equilibrium revenues are

$$\pi(\hat{q}, \hat{p}_1, \hat{p}_2, \hat{q}, \hat{q}) = \frac{\bar{y}^2}{16\bar{r}^2}.$$

Since market demand is enhanced by higher quality the monopolist has an incentive to offer high quality products. This incentive is counteracted by the increasing fixed cost of supplying higher quality. In equilibrium monopolists just balance net revenues and costs.

When consumers cannot observe product quality monopolists may not capture the full net revenue. Hence the differential information reduces the incentives to provide high quality products. Therefore, let us now consider the situation in which quality is not observable to consumers before consumption.

Given consumers expect quality $q_1^e(p_1)$ to be offered demand in period 1 is $D(p_1, q_1^e)$. In period 2 the non-migrant consumers will know the true quality on offer. On aggregate they demand $(1-\lambda)D(p_2, q)$ accordingly. The migrant consumers are uniformed. If they expect quality $q_2^e(p_2)$ to be offered their aggregate demand is $\lambda D(p_2, q_2^e)$.

Accordingly the firm's revenues $\pi(q, p_1, p_2, q_1^e, q_2^e)$ are:

$$\pi(q, p_1, p_2, q_1^e, q_2^e) \;=\; D(q_1^e, p_1)p_1 \;+\; \big(\lambda D(q_2^e, p_2) \;+\; (1-\lambda)D(q, p_2)\big)p_2 \;-\; C(q)$$

Equilibrium requires the choice (q^*, p_1^*, p_2^*) to be optimal, i.e.

$$\pi(q^*, p_1^*, p_2^*, q_1^e, q_2^e) \geq \pi(q, p_1, p_2, q_1^e, q_2^e)$$

Optimality is achieved when the following set of first order conditions is satisfied:

$$\begin{aligned} q_1^e(\bar{y} - 2p_1^*) \;&=\; 0 \\ (1-\lambda)q^*(\bar{y} - 2p_2^*) \;+\; \lambda q_2^e(y - 2p_2^*) \;&=\; 0 \\ \frac{1-\lambda}{\bar{r}\bar{y}}(\bar{y} - p_2^*)p_2^* - 2q^* \;&=\; 0 \end{aligned}$$

Furthermore, equilibrium requires that expectations about qualities are rational, i.e. $(q_1^e, q_2^e) = (q^*, q^*)$.

Result 2 (asymmetric information)

In the case of local monopolists equilibrium is given by:

$$q^* = \frac{(1-\lambda)\bar{y}}{8\bar{r}} \quad \textit{and} \quad p_1^* = p_2^* = \frac{\bar{y}}{2}.$$

Monopolistic revenues in equilibrium are:

$$\pi(q^*, p_1^*, p_2^*, q^*, q^*) = (1-\lambda)\frac{\bar{y}^2}{16\bar{r}^2}(1 - \frac{1-\lambda}{4}).$$

Note that in equilibrium the quality offered is below the full information quality. This is due to the informational advantage of the monopolists. In period 1 quality is not observed by consumers. Hence monopolists have an incentive to underprovide quality (relative to the full information quality). The only incentive to provide quality above the minimal level derives from the segment of informed consumers (non-migrants) in period 2. Indeed when all consumers migrate in the second period ($\lambda = 1$) the monopolists provides minimal quality.

Consequently the reservation utilities of less consumers are met and market demand is lower in the case of informational asymmetries. Since equilibrium prices are identical in both situations consumer welfare is strictly higher in the full information case.

Furthermore, note that even in the case when no migration takes place, i.e. $\lambda = 0$ the first best level of quality is not offered due to the informational asymmetry in period 1.

Revenues are lower when qualities are not observable. In fact equilibrium revenues are decreasing in λ.[10] This is due to a reputation effect for the monopolist: the more consumers in period 2 can evaluate the quality of his products

[10]
$$\frac{\partial \pi}{\partial \lambda} = -\frac{\bar{y}^2}{16\bar{r}^2}(1 + \frac{1-\lambda}{2}) < 0.$$

the larger are his incentives to provide high quality. Hence, in principle monopolists prefer to commit to high quality. However, when quality is not observed by consumers they cannot commit not to underprovide quality. These information costs are expressed in lower than full information revenues.

The discussion demonstrates that with asymmetric information both consumers and firms are worse off relative to the full information case. This implies that consumers as well as producers have an incentive to improve on this situation.

Producers have a strong incentive to self-regulate the market in the sense to commit to high quality. Since all producers enjoy superior information about product quality a commitment mechanism can be implemented as follows: before date 0 local firms gather in a club and impose a minimum product quality as a membership requirement. In order to credibly impose these minimum standards for club members a non-complying firm needs to be punished. Indeed each member firm has an incentive to monitor other members and to punish non-compliants. If a non-compliant were not punished for a certain fraction of his consumers the standards are no longer credible in period 2. This reduces own profits since some of these consumers form future demand due to migration.

Consumers would like an independent authority to impose some kind of regulation on producers. This is the case of statutory regulation. Here the government could enact price regulation, quantity or quality regulation. While price and quantity regulation are easily feasible, the regulation of qualities by imposing a minimum standard meets the difficulty that the government cannot directly observe the qualities provided.

IV. Self-Regulation

Consider a situation in which local monopolists can join a club to commit to some minimum standard $q_{SR} > 0$ before period 0. After the club agreements have been decided, consumers can observe membership to the club. However, as before, they cannot observe the actual quality selected before consumption.

Note that firms have no incentive to provide qualities higher than the standard since they cannot commit on their own to higher quality. So they are not rewarded for increased costs. On the other hand if a club member deviates without being excluded from the club it behaves like the monopolist in the asymmetric information case and selects quality q^*. The deviant's decision is driven by the tradeoff between the revenues from non- migrant consumers, knowing precisely the quality in period 2, and the costs for providing quality, just as in the monopoly case.

Assume that consumers trust the club agreements. This means when purchasing from club members they expect products of at least minimum quality, i.e. $q^e \geq q_{SR}$. If first period consumption reveals that in fact quality is less than the standard, $q < q_{SR}$, the club agreement is no longer credible and consumers revise their perceptions. In this case they believe that all firms behave as local monopolists and quality q^* is offered by all club members.

To ensure compliance with the club agreement, members need to monitor each other and to punish non-compliants. Punishment means that after the quality decision in stage 0 a non-compliant firm is excluded from the club before the market game starts. Since consumers observe this decision, excluded members are in the same position as any other local monopolist.

As a consequence of migration, $\lambda > 0$, each club member has an incentive to actually sanction deviations from club agreements. In period 2, each club member expects a fraction of $\frac{\lambda}{N}$ of the non-compliant's consumers. The club commitment is no longer credible for these consumers and hence they expect quality $q^* < q_{SR}$ to be offered. This reduces local revenues by:

$$\frac{\lambda}{N}\left[D(p_2^*, q_{SR})) - D(p_2^*, q^*)\right]p_2^* \; > \; 0$$

If club members are correctly perceived to offer quality q_{SR}, equilibrium prices are identical in both periods and revenues amount to

$$2D(p, q_{SR}) - C(q).$$

Result 3 (self-regulation)

For $\lambda > 0$ the full information allocation can be implemented by the coalition of all local firms. This coalition imposes the full information quality level as a membership requirement. Non-compliance is credibly sanctioned by exclusion from the coalition:

$$p_{SR1}^* \; = \; p_{SR2}^* \; = \; \frac{\bar{y}}{2}, \quad q_{SR}^* \; = \; \frac{\bar{y}}{4\bar{r}}$$

Observe that self-regulation enhances welfare of each individual player relative to the non-commitment case, since better qualities are offered at the same prices and market demand is thus enhanced. Indeed the solution is identical to the situation of full information (result 1).

V. Statutory Regulation

In order to evaluate self-regulation let us now consider the case of statutory regulation. We proceed in three steps: as a reference case we start with the ideal situation of a benevolent dictator who is perfectly informed about product qualities. If in reality the regulator enjoys an informational advantage over consumers this case maybe of interest. However, if he does not enjoy any informational advantage over consumers, only second-best regulation can be employed. Here we consider the cases of price regulation and quality regulation.

Welfare comparisons are based on both consumer surplus CS, industry gross profits Π and costs of production C. All islands and both periods carry equal weight. Let $\alpha \in [0, 1]$ be the weight the regulator attaches to consumer surplus. Hence social welfare reads

$$W = \alpha CS + (1 - \alpha)\Pi - C.$$

The informed regulator

The informed regulator can observe product quality and hence enforce any regulation on quality he might consider. In addition he has control over prices and since periods are equally weighted, prices are identical over time.

If quality and prices are (q, p, p) consumer surplus for both periods is:

$$\begin{aligned} CS &= \frac{2N}{\bar{r}\bar{y}} \int_{q \geq r} \int_{y \geq p} (q - r)(y - p) dr\, dy \\ &= \frac{N}{2\bar{r}\bar{y}} q^2 (\bar{y} - p)^2 \end{aligned}$$

Hence the welfare function can be expressed as:

$$W(q,p) \;=\; \alpha\frac{N}{2\bar{r}\bar{y}}q^2(\bar{y}-p)^2 \;+\; (1-\alpha)\frac{2N}{\bar{r}\bar{y}}q(\bar{y}-p)p \;-\; q^2N.$$

Result 4 (first-best regulation)

When $\bar{r} \geq \bar{y}$ for any given α the social optimum $(\check{q}(\alpha), \check{p}(\alpha), \check{p}(\alpha))$ is uniquely determined. It has the following properties:

i) optimal quality is an increasing function in the social weight attached to consumers:

$$\frac{\partial \check{q}}{\partial \alpha} \;>\; 0.$$

ii) optimal prices are decreasing functions in the social weight attached to consumers:

$$\frac{\partial \check{p}}{\partial \alpha} \;<\; 0.$$

Proof:

The first-order conditions imply:

$$\begin{aligned} q \;&=\; \frac{2(1-\alpha)}{\alpha}\frac{\bar{y}-2p}{\bar{y}-p} \\ 2\bar{r}\bar{y}(\bar{y}-2p) \;&=\; \alpha(\bar{y}-p)^3 \end{aligned}$$

ad ii) The second equation determines a unique solution $\check{p}(\alpha) \in [\frac{\bar{y}}{4}, \frac{\bar{y}}{2}]$: for $p = \frac{\bar{y}}{4}$ the left-hand side exceeds the right-hand side given $\bar{r} \geq \bar{y}$ and for $p = \frac{\bar{y}}{2}$ the right hand side is larger than the left-hand side.

By virtue of the implicit function theorem the second equation yields:

$$\frac{\partial p}{\partial \alpha} < 0 \quad \Longleftrightarrow \quad 3\alpha(\bar{y} - p)^2 < 4\bar{r}\bar{y}$$

Using the second equation above the right hand side is always fulfilled.

ad i) The implicit function theorem for the first equation yields:

$$sign\left(\frac{\partial q}{\partial \alpha}\right) = -sign\left(\frac{\partial p}{\partial \alpha}(\bar{y} - 2p)(\bar{y} - p)\right)$$

Obviously the implication for q holds iff it is also true for p.

Q.E.D.

So if potential quality is sufficiently dispersed the more weight the regulator attaches to consumers the higher are optimal qualities and the lower are optimal prices. Note that for little dispersion in potential qualities an optimum may involve corner solutions with either minimal or maximal quality.

For any $\alpha > 0$ the social optimum differs from the allocation achieved by self-regulation. So for instance optimal prices are lower than equilibrium prices. On the other hand optimal qualities increase with optimal prices. So optimal quality exceeds equilibrium quality of local monopolists.

Price regulation

Here we consider the case where the regulator sets prices (p_1, p_2). Given these prices local monopolists select profit maximizing product qualities $\tilde{q}$. Their choices are given by:

$$\pi(q_{PR}, p_1, p_2, q_1^e, q_2^e) \geq \pi(q, p_1, p_2, q_1^e, q_2^e) \quad \text{for all } q$$

Hence the optimal product quality depends on second period prices only:

$$q_{PR} = \frac{1-\lambda}{2\bar{r}\bar{y}}(\bar{y} - p_2)p_2$$

Thus first-period prices are set by the regulator in a way to redistribute consumer surplus and gross profits.

The regulator's optimization problem with respect to price regulation is given by the following program:

$$
\begin{aligned}
W(p_1, p_2) \;=\; & \alpha \frac{N}{4\bar{r}\bar{y}} q_{PR}^2 (\bar{y} - p_1)^2 \;+\; (1-\alpha) \frac{N}{\bar{r}\bar{y}} q_{PR} (\bar{y} - p_1) p_1 \\
+ \; & \alpha \frac{N}{4\bar{r}\bar{y}} q_{PR}^2 (\bar{y} - p_2)^2 \;+\; (1-\alpha) \frac{N}{\bar{r}\bar{y}} q_{PR} (\bar{y} - p_2) p_2 \;-\; q_{PR}^2 N
\end{aligned}
$$

subject to the condition

$$\pi(q_{PR}, p_1, p_2, q_{PR}, q_{PR}) \geq 0$$

Result 5 (price regulation)

Let $\bar{r} \geq \frac{\bar{y}}{2}$. Then the social optimum $(q_{PR}^*(\alpha), p_{PR1}^*(\alpha), p_{PR2}^*(\alpha))$ is unique and satisfies the following properties:

i) the higher the social weight attached to consumers, the lower the first period price and the higher the second period price:

$$\frac{\partial p_{PR1}^*}{\partial \alpha} \leq 0, \quad \frac{\partial p_{PR2}^*}{\partial \alpha} > 0$$

ii) the higher the social weight attached to consumers, the lower the optimal product quality:

$$\frac{\partial q_{PR}^*}{\partial \alpha} < 0$$

Proof:

Note first, that the non-negative profit constraint for local monopolists is satisfied as long as firms choose their optimal quality, given prices (p_1, p_2):

$$\begin{aligned}\pi(q_{PR}, p_1, p_2, q_{PR}, q_{PR}) &= \frac{1}{\bar{r}\bar{y}}(\bar{y}-p_1)p_1 q_{PR} + \frac{(1-\lambda)}{2\bar{r}^2\bar{y}^2}(\bar{y}-p_2)^2 p_2^2(1-\frac{1-\lambda}{2}) \\ &\geq 0\end{aligned}$$

Hence, the regulator's optimization problem is solved by the corresponding first-order conditions:

$$-\alpha(\bar{y}-p_1)q_{PR}^2 + 2(1-\alpha)(\bar{y}-2p_1)q_{PR} = 0$$

$$\begin{aligned}\alpha\frac{(1-\lambda)^2}{8\bar{r}^2\bar{y}^2}(\bar{y}-p_2)p_2\left[(\bar{y}-p_1)^2(\bar{y}-2p_2)-(\bar{y}-p_2)^2(\bar{y}-3p_2)\right]& \\ +(1-\alpha)\frac{1-\lambda}{2\bar{r}\bar{y}}(\bar{y}-2p_2)\left[(\bar{y}-p_1)p_1+2(\bar{y}-p_2)p_2\right]& \\ -\frac{(1-\lambda)^2}{2\bar{r}\bar{y}}p_2(\bar{y}-p_2)(\bar{y}-2p_2) &= 0\end{aligned}$$

Differentiating the first equation shows that the first-order condition guarantees a maximum if $\alpha < \frac{4}{4+q}$. Moreover, the first equation implies

$$p_{PR1} = \bar{y}(1-\frac{2(1-\alpha)}{4(1-\alpha)-\alpha q_{PR}})$$

and $p_{PR1} \geq 0$ if $a \leq \frac{2}{2+q}$. Hence $\frac{\partial p_{PR1}}{\partial\alpha} \leq 0$. Note that $p_{PR1} = 0$ for $\alpha = 1$ and $p_{PR1} = \frac{\bar{y}}{2}$ for $\alpha = 0$.

Evaluating the second equation at $\alpha = 0$ implies $p_{PR2} = \frac{\bar{y}}{2}$. For $\alpha = 1$ the equation reduces to $(p_{PR1} = 0)$

$$(\bar{y} - p_2)p_2\left[(\bar{y} - 2p_2)(\bar{y}^2 - 2\bar{r}\bar{y}) + (\bar{y} - p_2)^2(\bar{y} - 3p_2)\right] \;=\; 0.$$

The social welfare function is maximized when the term in the brackets equals zero, i.e. when

$$(\bar{y} - 2p_2)\bar{y}(4\bar{r} - \bar{y}) = (\bar{y} - p_2)^2(\bar{y} - 3p_2).$$

This equation determines a unique solution $p_{PR2} \in [\frac{\bar{y}}{2}, \bar{y}]$: for $p_2 = \frac{\bar{y}}{2}$ the right hand side is negative and the left hand side is zero, whereas for $p_2 = \bar{y}$ the left-hand side is negative and the right hand side is zero.

To see that this is indeed the only solution in $[0, \bar{y}]$ note that the left hand side intersects the axis $\{p_2 = 0\}$ at $\bar{y}^2(4\bar{r} - \bar{y})$ and the right hand side intersects $\{p_2 = 0\}$ at $\bar{y}^3$. by assumption $\bar{y}^2(4\bar{r} - \bar{y}) \geq \bar{y}^3$. Moreover the derivative of the right hand side in $p_2 = 0$ is negative.

Continuity of the social welfare function in α guarantees that the optimal second period price is a continuous function in α with $\frac{\partial p_{PR2}}{\partial \alpha} > 0$.

To see the second part of the result use the best response function for firms concerning their optimal product quality. Derivation by second period prices implies

$$\frac{\partial q_{PR}}{\partial p_{PR2}} \;=\; \frac{1-\lambda}{2\bar{r}\bar{y}}(\bar{y} - 2p_{PR2}) \;<\; 0$$

since $p_{PR2} > \frac{\bar{y}}{2}$ for $\alpha > 0$.

Q.E.D.

Quality regulation

We consider now the effect of quality regulation on social welfare. Suppose that the regulator fixed product quality standard at a level q_{QR}.

To enforce this quality standard, we assume that the regulator can verify product qualities produced by local monopolists. If this verification reveals that a monopolist did deviate from the quality standard q_{QR}, the regulator imposes a penalty $P > 0$, i.e. the profits of a non-complying monopolist are reduced by P. Moreover, we assume that the regulator can make his information about produced qualities publicly available. Thus, after the verification of product qualities all consumers are perfectly informed about the quality of the products.

Suppose that the monopolist complied with the desired product standard. Then he chooses prices (p_1, p_2) to maximize his profits $\pi(q_{QR}, p_1, p_2, q_{QR}, q_{QR})$. Optimality requires

$$q_{QR}(y - 2p_1) = 0, \quad q_{QR}(\bar{y} - 2p_2) = 0.$$

Hence, $p_1 = p_2 = \frac{y}{2}$.

Of course, without adequate sanctions or penalties the regulator would be unable to implement the quality standard q_{QR}. The amount of the penalty P determines whether a monopolist behaves in his interests or not. Furthermore, the incentives for a monopolist to deviate from the product quality standard depend on the timing of the regulator's quality verification. Two cases can be distinguished:

i) case: quality verification before first period consumption

If the regulator is able to verify produced product qualities before the first period consumption, all information is common knowledge in the economy. Suppose a monopolist deviates from the quality standard q_{QR} by choosing a quality $\tilde{q} < q_{QR}$.

When deciding on his optimal strategy the monopolist faces the same situation as in the full information case (see Result 1). Hence, he maximizes his profits when he decides on a product quality $\tilde{q} = \frac{\bar{y}}{4r}$.

A monopolist has no incentive to deviate from the quality standard, if his profits for non-compliance are lower than his profits when choosing q_{QR}:

$$\pi(q_{QR}, p_1, p_2, q_{QR}, q_{QR}) \geq \pi(\tilde{q}, p_1, p_2, \tilde{q}, \tilde{q}) - P, \quad \text{hence}$$

$$P \geq (q_{QR} - \frac{\bar{y}}{4\bar{r}})^2.$$

ii) case: quality verification after first period consumption

Assume that the regulator cannot verify product quality before the market opens but can before the second-period consumption. Now a monopolist can benefit from his private information on his actual produced product quality in the first period. Compared with the case i) this implies that his incentive not to comply with q_{QR} increases. Hence, the regulator has to impose a higher penalty for non-compliance.

To see this consider the optimal product quality of a monopolist if he deviates from q_{QR}. Taking advantage of consumers incorrect first-period quality expectations, he chooses a quality $\tilde{q}$ to maximize second-period gross profits minus production costs. Hence, he maximizes

$$\frac{1}{\bar{y}\bar{r}}\tilde{q}(\bar{y} - p_2)p_2 - (\tilde{q})^2.$$

Optimality requires a choice $p_2 = \frac{\bar{y}}{2}$ and $\tilde{q} = \frac{\bar{y}}{8\bar{r}}$ (see Result 2 for $\lambda = 0$).

To provide appropriate incentives for the monopolist's compliance, penalty for a deviating product quality has to be

$$P \geq \pi(\tilde{q}, p_1, p_2, \tilde{q}, q_{QR}) - \pi(q_{QR}, p_1, p_2, q_{QR}, q_{QR}), \quad \text{hence}$$

$$P \geq (q_{QR} - \frac{\bar{y}}{8\bar{r}})^2.$$

Result 6 (quality regulation)

i) The regulator can implement the social optimal product quality q^*_{QR}, if he imposes a penalty for non-compliance which exceeds the monopolists' cost-savings for reduced quality production. The socially optimal product quality is then given

$$q^*_{QR} = \frac{2\bar{y}(1-\alpha)}{8\bar{r} - \alpha\bar{y}}.$$

ii) If $\bar{r} \geq \frac{\bar{y}}{8}$, the social optimal quality q^*_{QR} is higher, the lower the social weight attached to consumers:

$$\frac{\partial q^*_{QR}}{\partial \alpha} < 0$$

Proof:

ad i) Assume that penalties are such that a monopolist has no incentive to deviate from the quality standard. Then the regulator maximizes the social welfare function with respect to product quality q_{QR}:

$$W = \alpha \frac{\bar{y}N}{8\bar{r}} q^2_{QR} + (1-\alpha)\frac{\bar{y}}{2\bar{r}} q_{QR} - q^2_{QR}N$$

The optimal quality standard is the given by the first-order condition which proves part i).

ad ii) Differentiation of the social optimal quality standard gives

$$\text{sign}(\frac{\partial q^*_{QR}}{\partial \alpha}) = \text{sign}(2\bar{y}(\bar{y} - 8r)) < 0$$

by assumption.

Q.E.D.

VI. Statutory regulation versus self regulation under cost uncertainty

We now investigate the question whether the regulator should use statutory regulation to maximize social welfare or whether he should promote self regulation by local monopolists. We are particularly interested in situations, in which the regulator may actually prefer to implement a self regulatory scheme.

Of course, the regulator prefers to regulate markets by prices or qualities if the social weight attached to consumers is high. To see this consider the social welfare in the case in which the regulator builds on self regulation by firms. Using result 3 social welfare reads:

$$W_{SR} = \frac{\bar{y}^2 N}{16\bar{r}^2}\left[1 + \alpha\left(\frac{\bar{y}}{8\bar{r}} - 2\right)\right]$$

The term in the brackets becomes negative if α exceeds some critical value. Hence social welfare becomes negative, if local monopolists regulate themselves, but social welfare is mostly determined by consumer surplus.

Thus, the social planner will be inclined to favour self regulation only when the social weight attached to consumers is not too large. However, note that even when the regulator cares about firms' profits only, he can implement the self regulatory solution and maximize social welfare. He simply sets the product quality standard q_{QR} equal to the product quality $\hat{q}$ in the self regulation situation. Hence there is no need for self regulation in the context of our basic model. Basically, in equilibrium the regulator will always be as well informed as the firms. Firms have no real informational advantage and hence statutory regulation can always mimic self regulatory actions.

This argument no longer applies, when the regulator faces some kind of uncertainty. When qualities for example also depend on some technological variables, which are unknown [11] to the regulator, it may be impossible for him to

[11] This essentially is a short hand for saying that such variables are costly to observe for the regulator.

discover and appropriately punish misconduct. In such situations even in equilibrium the regulator will only be partially informed. Hence, even in equilibrium firms maintain an informational advantage and it is precisely for that reason that self regulation may give firms more flexibility. Consequently, when the regulator cares sufficiently about firms' performance he may have no alternative but resort to self regulation.

In order to make specific this argument we will assume that the regulator is not completely informed about the monopolists' production costs. Asymmetric information is introduced in form of a production parameter, which is private information for local monopolists. The regulator knows the corresponding probability distribution only. He maximizes social welfare and selects the regulatory framework solely on the basis of his expectations concerning production costs.

We modify our basic model in the following way. If a monopolist supplies product of quality $q \in [0, \bar{q}]$ the production of quality requires fixed costs $C(q) = bq^2$, where $b \in [\underline{b}, \bar{b}]$ denotes the production parameter. For simplicity, we assume that the production parameter b is distributed on $[\underline{b}, \bar{b}]$ and its realization is identical for all firms. The regulator only knows the expected value of the production parameter $E[b]$.

Our previous results on the optimal product qualities take now the following form:

$$q^*_{SR} = \frac{\bar{y}}{4\bar{r}\bar{b}}, \quad q^*_{PR} = \frac{1-\lambda}{2\bar{r}\bar{y}E[b]}(\bar{y} - p^*_{PR})p^*_{PR}, \quad q^*_{QR} = \frac{2(1-\alpha)\bar{y}}{8\bar{r}E[b] - \alpha y}$$

Result 7 (self regulation vs. statutory regulation)

A regulator, who is uncertain about the production parameter b and who weighs firms' profits sufficiently highly in social welfare, prefers self regulation to any form of statutory regulation.

Proof:

The regulator has three regulation possibilities available: He can either use price or quality regulation instruments or he promotes self regulation. In the first two cases the regulator maximizes social welfare about expected production costs and expected product qualities. In the third case the regulator builds expectations about the social welfare achieved by self regulation.

Let $W_{PR}(E[b])$, $W_{QR}(E[b])$, $E[W_{SR}]$ denote the corresponding social welfare and consider the extreme situation in which social welfare is determined by firms' profits only, i.e. $\alpha = 0$.

Then price regulation is characterized by $p^*_{PR1} = p^*_{PR2} = \frac{\bar{y}}{2}, q^*_{PR} = \frac{(1-\lambda)\bar{y}}{8\bar{r}E[b]}$ and

$$W_{PR}(E[b]) = \frac{(1-\lambda)\bar{y}^2 N}{16\bar{r}^2 E[b]}\left[1 - \frac{1-\lambda}{4}\right].$$

Quality regulation is given by $p^*_{PR1} = p^*_{PR2} = \frac{\bar{y}}{2}, q^*_{PR} = \frac{\bar{y}}{8\bar{r}E[b]}$ hence

$$W_{QR}(E[b]) = \frac{\bar{y}^2 N}{16\bar{r}^2 E[b]}.$$

In the case of self regulation equilibrium is determined by $p^*_{SR1} = p^*_{SR2} = \frac{\bar{y}}{2}, q^*_{SR} = \frac{\bar{y}}{4\bar{r}b}$ hence

$$E[W_{SR}] = \frac{\bar{y}^2 N}{16\bar{r}^2} E\left[\frac{1}{b}\right].$$

Comparing social welfare we immediately see that

$$W_{PR}(E[b]) < W_{QR}(E[b])$$

and by Jensen's inequality[12] :

$$W_{QR}(E[b]) < E[W_{SR}] \iff \frac{1}{E[b]} \leq E[\frac{1}{b}].$$

Q.E.D.

Consequently, regulators will prefer self regulatory regimes, whenever they value firms'profits highly and when the potential costs of false statutory regulation have a significant impact on firms'profits.

[12] In the case of a uniform distribution this inequality is strict.In this case $\frac{1}{E[b]} = \frac{2}{\underline{b}+\bar{b}}$ and $E[\frac{1}{b}] = \frac{1}{\underline{b}\bar{b}}E[b]$. Hence, the strict inequality is satisfied whenever $\underline{b} \neq \bar{b}$.

VII. Concluding remarks

This essay discusses self regulation in a context where all members of a self regulatory club can observe each others products perfectly well. Migration of customers creates a strong incentive for all club members to monitor and especially to enforce the club standards.

Self regulation is of potential social value, whenever the club members have better access to information about rivals' product qualities. On one hand such firms can perform the monitoring task more cost efficiently and on the other hand it gives members of the club greater flexibility to adjust to unforeseen (cost) shocks.

The costs of self regulation are the standard costs associated with some degree of monopoly power conferred to the club. Therefore, it comes as little surprise that a social planner will enact self regulation only, when he is quite lenient to industries' needs and when the costs of false statutory regulatory action may have serious consequences for firm revenues.

The above analysis can be extended in several ways. First, an interesting question would be, to analyze competition between clubs. Competition should reduce the impact of monopolistic pricing of a single club. On the other hand lower revenues reduce incentives to maintain quality.

Another interesting question is to pursue the analysis in situations, where club members still enjoy some informational advantage over regulators or consumers, but where monitoring requires the use of costly resources (effort). In such an environment the incentives to monitor and enforce club standards will be affected by the size of the club and the corresponding severity of the associated free rider problem. In this case the club has to explicitly specify some form of monitoring rules.

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