1 The Competition of Product Standards

1.1 The Lemons Problem

Consumers and producers have asymmetric information about the quality of a product.

Consumers' lack of information implies that sellers who would have liked to offer good quality products and charge a higher price for them refrain from doing so.

The sellers who offers poor products will try to persuade consumers that these are of high quality.

So the market for good quality products will disappear.

The problem is not about justice but one of allocative efficiency.

The consumers will not be fooled because they can foresee producers behavior and pay a low price.

The problem is that they will be unable to buy high-quality products at higher prices.

It is most severe when a large number of acts over a long period are required before the quality can be assessed.

Consumption product that might cause cancer shows how severe the problem can be.

Consumers often face a small risk of a very serious disease and they may not have time to look for information.

To solve these problems nations use regulation.

For example, Germany has developed product standards to prevent French liquor with too little alcohol to be sold.

Swedish chocolate contains too little cacao to be sold as chocolate in some countries (even though it sometimes tastes better...).

Our concern today is that if systems competition among regulating countries does not work, then centralized actions on the EU-level may have to be considered.

I first present the bench mark model. Then we look at what regulation can do.

1.2 A Model of Private Quality Competition

- Assume there is a lemon good of quantity x.

- There is also a normal good of quantity y that can be transformed into the lemon good by shifting factors of production between productive activities.

- Let q be the quality of the lemon good, and $c(q)$ the unit production cost of the lemon good.

Assume that $c'(q) < 0$ for $q < q^*$, $c'(q) > 0$ for $q > q^*$ and $c''(q) > 0$.

- The price of the lemon good in terms of the normal good is given by P.

- Consumers' utility function is given by

$$U(x)V(q) + y,$$

where

$U'(x) > 0, U''(x) < 0, V'(q) > 0$ and $V''(q) < 0$.

- Note that the formulation implies that quality and quantity are complements in the sense that the marginal utility of one item increases with the consumption of the other item.

- Formally, $\frac{\partial U}{\partial x} = U'(x)V(q)$ is increasing in q.

- The individuals endowment is given by $\overline{y}$ and this can consequently be spent on either x or y.

- Importantly, buyers are less informed than sellers; they can only observe the average quality of the lemon good sold.

- This captures assumption that consumers can talk to other people to get an idea about the average quality of a product. However, ex ante, when buying a particular product, the consumer cannot judge whether it is good or bad.

Consumers can not decide the products' quality.

So taking q as given, the consumer's problem is given by

$$\max_{x,y} U(x)V(q) + y \tag{1}$$

$$s.t \ \overline{y} = y + Px$$

We can substitute for y to get

$$\max_{x,y} U(x)V(q) + \overline{y} - Px. \quad (2)$$

The first-order condition with respect to x is

$$U'(x)V(q) = P. \quad (3)$$

The producer maximizes his profits by choosing the lemon good's quantity x and quality y, which only he can observe.

He therefore solves

$$\max_{x,q}(P - c(q))x \quad (4)$$

The necessary conditions for the solution of our problem are

$$P = c(q), \quad (5)$$

and

$$c'(q^*) = 0. \quad (6)$$

The first condition is standard.

It says that the firm selects a quantity such that the marginal benefit, P, and the marginal cost, $c(q)$, are identical.

The second condition says that the producer chooses the quantity q^* at which the unit cost of production is minimized.

In other words, since the price cannot be made dependent on q, there is no marginal benefit of increasing the quality.

Combining the consumers' first-order condition with respect to the quantity x, $U'(x)V(q) = P$, with the firms', $P = c(q)$, yields the market equilibrium expression

$$U'(x)V(q) = c(q). \tag{7}$$

It says that the consumer's marginal willingness to pay for a unit of the lemon good is equal to the marginal cost of production.

So there is no efficiency problem with respect to the quantity x.

1.2.1 An Allocative Explanation of the State Regulation of Quality

To study whether the market is efficient or not we now look for the welfare optimum.

The social utility is the sum of consumer rent

$$U(x)V(q) + y,$$

and the producer rent

$$Px - xc(q).$$

Since $\overline{y} = y + Px$ it follows that welfare in this model is equal to

$$W = U(x)V(q) + \overline{y} - Px + Px - xc(q),$$

or

$$W = U(x)V(q) + \overline{y} - xc(q).$$

The welfare optimum follows from the following optimization problem

$$\max_{x,q} U(x)V(q) + \overline{y} - c(q)x. \tag{8}$$

The necessary condition for a welfare optimum includes the quantity condition

$$U'(x)V(q) = c(q). \tag{9}$$

This was the one we already derived and concluded was efficient.

In addition, we have the quality condition

$$U(x)V^{'}(q) = c'(q)x. \tag{10}$$

This equation requires equality between the marginal benefit and the marginal cost of an increase in quality q, given the quantity x.

Now, we know that $U'(x)V(q) > 0$ and therefore $c'(q)x > 0$.

Since $c'(q^*) = 0$ and $c'' > 0$ it follows that $q > q^*$.

Proposition: From a welfare perspective it is optimal to choose a higher quality than the one determined by the market.

The reason is that, due to asymmetric information, firms do not take into account the positive aspects of increased product quality, only the negative.

To see this, let's study the solution in the case of symmetric information.

In this case, the quality depends on the price such that

$$\max_{x,y}(Pq - c(q))x.$$

The first order conditions are

$$P = c(q), \tag{11}$$

and

$$P = c'(q^*). \tag{12}$$

The first-order condition with respect to the quantity is the same as before.

The condition with respect to the quality is different.

The firm now produces the point where the marginal cost, $c'(q^*)x$, is equal to the the marginal benefit of an increase in quality q, the price level Px.

Consumers can affect the quality through consumption. They solve

$$\max_{x,q} U(x)V(q) + y \tag{13}$$

$$s.t.\ \ \overline{y} = y + Pqx.$$

Consumers optimally choose the quality at which their marginal willingness to pay for an improvement in quality is equal to the expenditure increase the market requires

$$U(x)V^{'}(q) = Px. \tag{14}$$

Because $P = c'(q^*)$ we have

$$U(x)V^{'}(q) = c'(q^*)x, \tag{15}$$

which is the optimality condition.

Hence, there is no distortion in quality.

We now study the difference between the firms behavior under asymmetric information and the optimal social behavior.

We depict the situation in the quantity-quality-space.

We will draw an "optimal quantity curve", which shows the optimal quantity given quantity

$$U'(x)V(q) = c(q),$$

denoted by DD.

We also draw an "optimal quality curve", which shows optimal quality given quantity

$$U(x)V'(q) = c'(q)x,$$

denoted by EE.

To be able to see which regulation policy the government should use we now look at the slopes of these curves.

We first look for the slope of the optimal quantity curve.

To do this, let's implicitly differentiate the DD curve

$$U'(x)V(q) = c(q).$$

We then get

$$U''(x)V(q)dx + U'(x)V'(q)dq = c'(q)dq, \qquad (16)$$

or

$$U''(x)V(q)dx = (c'(q) - U'(x)V'(q))dq. \qquad (17)$$

So we finally get

$$\frac{dx}{dq}\mid_{DD} = -\frac{U'(x)V'(q) - c'(q)}{U''(x)V(q)} \tag{18}$$

We know that $U''(x)V(q) < 0$ and $U'(x)V'(q) > 0$.

Also, at q^* we know that $c'(q) = 0$.

Because $c'(q) < 0$ for $q < q^*$ we know that the DD-curve is upward sloping to the left of q^*.

This is because it is assumed that the goods are complementary. A higher quality increases consumers' marginal utility of quantity.

But the higher the quality the more costly it is to provide so there will also be a tendency for the quantity to be reduced.

To the right of q^* the result is therefore ambiguous.

In particular, for relatively low q's, the effect of $U'(x)V'(q)$ is dominating the effect of $c'(q)$.

Eventually, for large q's, the DD curve will be downward sloping because of the strong positive effect arising from the marginal cost curve.

In this interval, more quality leads to reduced quantity because it is very costly to create good products.

We denote the point where the derivative is equal to zero by $\overline{q}$.

Next, consider the optimal quality curve.

Claims:

1. The curve EE, which shows $U(x)V'(q) = c'(q)x$ in the $x - q$ space, approaches the vertical at q^* asymptotically as x goes to infinity.

2. The curve EE is declining in the relevant interval.

3. It cuts the curve DD to the right of its maximum, i.e., to the right of $\overline{q}$.

Proofs:

First, rewrite the optimality equation such that

$$\frac{U(x)}{x} = \frac{c'(q)}{V'(q)} \tag{19}$$

where $\frac{U(x)}{x} > 0$ by assumption since $U(x)$ was assumed to be a strictly concave monotonically increasing function.

Moreover, recall that $c'(q) < 0$ for $q < q^*$, $c'(q^*) = 0$, $c''(q^*) > 0$ and that $V(q)$ is also strictly concave. We make the following observations:

1. $q^* < q$.

2. As $x \to \infty, \frac{U(x)}{x} \to 0$ and also $c'(q) \to 0$.

In addition $c'(q) \to 0$, $q \to q^*$.

In words, as x approaches infinity $\frac{U(x)}{x}$ approaches zero and consequently so does $c'(q)$. We know that for this to be true q has to come very close to q^*.

We next study the slope of the EE curve by implicitely differentiating

$$U(x)V'(q) = c'(q)x.$$

We then get

$$U'(x)V'(q)dx + U(x)V''(q)dq = c''(q)xdq + c'(q)dx, \tag{20}$$

or

$$(U'(x)V'(q) - c'(q))dx = (c''(q)x - U(x)V''(q))dq. \tag{21}$$

Therefore, the slope of the "optimal-quality curve" is given by

$$\frac{dx}{dq}\mid_{EE} = \frac{c''(q)x - U(x)V''(q)}{U'(x)V'(q) - c'(q)}. \tag{22}$$

The nominator is positive because $c''(q)x > 0$ and because $U(x)V''(q) < 0$.

As long as $U'(x)V'(q) - c'(q)$ is negative, DD and EE cuts one another and we have a welfare optimum.

From the analysis of the DD-curve we know that this term can only be negative to the right of the maximum of the DD-curve, i.e., where $q > \overline{q}$.

Hence, we know that the point of intersection between EE and DD is where a marginal rise in the quality standards lowers the quantity produced. This is a nice policy implication.

Let's sum up the results:

(i) In the case of asymmetric information the state can increase welfare by setting minimum product-quality standards beyond the quality chosen by a competitive market.

(ii) The standard is too low if raising it would induce an increase in the quantity produced. The socially optimal standard lies in a range where a marginal rise in the standard results in a decline of the quantity produced.

1.2.2 The Competition of Laxity

What happens when the borders are opened and unrestricted trade is allowed?

Consider first the optimistic assumption that consumers in all countries know, and can judge, the national standards, $\widetilde{q}$.

In this case, $P(\widetilde{q})$ would emerge in the market.

Consumers therefore solve

$$\max_{x,q} U(x)V(\widetilde{q}) + y \tag{23}$$

$$s.t. \;\; \overline{y} = y + P(\widetilde{q})x$$

The problem can therefore be rewritten as

$$\max_{x,q} U(x)V(\widetilde{q}) + \overline{y} - P(\widetilde{q})x. \tag{24}$$

Consumers optimally choose the quality at which their marginal willingness to pay for an improvement in quality is equal to the expenditure increase the market requires

$$U(x)V^{'}(\widetilde{q}) = P'(\widetilde{q})x. \tag{25}$$

The national regulatory agencies would solve

$$\max_{\widetilde{q}}(P(\widetilde{q}) - c(\widetilde{q}))x. \tag{26}$$

Note that it can here influence the price level through the standard.

The standard $\widetilde{q}$ is set such that

$$P'(\widetilde{q})x = c'(\widetilde{q})x \tag{27}$$

Combining the two conditions yields

$$U(x)V^{'}(\widetilde{q}) = c'(\widetilde{q})x. \tag{28}$$

Recall that this is the condition for efficiency, which of course is not surprising since the price is dependent on the quality.

However, in reality consumer can probably not judge national standards.

The consumers' confusion in the national context probably carry over to the international choice problem.

As a matter of fact, the problem is probably larger on the international level because more products may be subject to asymmetric information.

So consider the following more plausible version of the model.

Since the product price cannot be made dependent on the state's minimum standards, a profit maximizing national regulatory authority selects its standard $\widetilde{q}$ such that the production costs of the domestic firms are minimized.

That is, it chooses

$$c'(\tilde{q}) = 0, \tag{29}$$

which implies

$$\tilde{q} = q^*.$$

Proposition: It cannot be assumed that the consumers will be able to distinguish between state-regulated national quality standards. An equilibrium in the competition between regulatory authorities is thus characterized by too lax standards. Systems competition results in a lemons equilibrium.

Intuition: Consumer protection benefits the foreigners because the quality of the goods consumed by foreigners increases without their having to pay more to cover the additional costs. And for the same reason, it harms the domestic firms.

So a supra-national regulator is necessary!

Readings

- Akerlof, 1978, "The Market for "Lemons": Quality Uncertainty and the Market Mechanism", *QJE*. (compulsory)

- Sinn, 1997, "The Selection Principle and Market Failure in Systems Competition", *Journal of Public Economics*.

2 The Competition of Product Standards when Quantity and Quality are Substitutes.

Assume asymmetric information between producers and consumers and that consumers' utility function is given by

$$U(x) + V(q) + y,$$

in contrast to

$$U(x)V(q) + y.$$

as assumed in the book.

So quantity and quality are substitutes, rather than complements.

Let's first look at the consumers' problem.

They cannot decide the quality, but they can influence the quantity.

So taking q as given, the consumer's problem is given by

$$\max_{x,y} U(x) + V(q) + y \tag{30}$$

$$s.t\ \overline{y} = y + Px$$

We can substitute for y such that the problem becomes

$$\max_{x,y} U(x) + V(q) + \overline{y} - Px \tag{31}$$

The first-order condition with respect to x is

$$U'(x) = P. \tag{32}$$

Let's now study the firms' problem.

In the case of asymmetric information, the firm solves

$$\max_{x,q}(P - c(q))x \tag{33}$$

The first-order conditions are, as before,

$$P - c(q) = 0$$

and

$$c'(q) = 0.$$

Naturally, these are independent of the choice of the utility function.

We can combine $U'(x) = P$ with $P = c(q)$ to get the market quantity equilibrium condition,

$$U'(x) = c(q).$$

What are the socially optimal levels of x and q?

The welfare optimum follows from the following optimization problem

$$\max_{x,q} U(x) + V(q) + \overline{y} - c(q)x. \tag{34}$$

The first-order condition with respect to x is

$$U'(x) = c(q). \tag{35}$$

It is identical to the market equilibrium condition above so there is no distortion in terms of quantity.

The first-order condition with respect to q is

$$V'(q) = c'(q)x \tag{36}$$

Since $V'(q) > 0$ we know that $c'(q)x > 0$.

Since $c'(q^*) = 0$ and $c'' > 0$ it follows that $q > q^*$.

So the quality the firms select is too low from the society's perspective.

So far, the results of the model has not been sensible to whether quantity and quality are complements or substitutes.

But let's now study the properties of the model in the quantity-quality-space.

To be able to see which regulation policy the government should use we now look at the slopes of these curves.

We first look for the slope of the optimal quantity curve, (the DD curve).

To do this, let's implicitly differentiate the DD curve

$$U'(x) = c(q).$$

We get

$$U''(x)dx = c'(q)dq$$

or

$$\frac{dx}{dq} \mid_{DD} = \frac{c'(q)}{U''(x)} < 0$$

This is negative to the right of q^* because the cost function is upwards sloping in that interval and because consumers have a concave utility in x.

When the quantity and quality are complementary goods, increasing the quality will, through consumers' preferences, tend to increase the quantity produced.

However, when goods are substitute, the only effect that exists is that quality is costly, which reduces the optimal quantity provided.

Next, let's study the EE-curve.

Total differentiate the first-order condition

$$V'(q) = c'(q)x$$

to get

$$V''(q)dq = c''(q)xdq + c'(q)dx.$$

We therefore have

$$\frac{dx}{dq}\mid_{EE} = \frac{c''(q)x - V''(q)}{-c'(q)} < 0 \quad \text{for } q > q^*. \tag{37}$$

So both curves are downward sloping.

We see that the basic results of the chapter, that asymmetric distorts the economy such that bad quality products will be provided, holds.

In the current setup, however, better quality always reduces the quantity provided (because it is costly to provide).

Policy maker therefore gets no information from the DD-curve.

Let's do an example.

Assume that

$$U(x) = \sqrt{x}$$

$$V(q) = \sqrt{q}$$

and that

$$c(q) = aq^2.$$

$U(x)$ and $U(x)$ satisfy the original assumptions of the model, but $c(q)$ does not.

We continue to assume that x and y are substitutes.

Consumers solve

$$\max_{x,y} \sqrt{x} + \sqrt{q} + y$$

$$s.t \ \overline{y} = y + Px$$

The first-order condition is given by

$$\frac{1}{2\sqrt{x}} = P$$

The firm's problem is

$$\max_{x,q} (P - aq^2)x \tag{38}$$

The first-order conditions are

$$P = aq^2$$

and

$$2aq = 0.$$

Obviously

$$q^* = 0.$$

The production costs are minimized when there is no production at all.

Because

$$\frac{1}{2\sqrt{x}} = P = 0$$

there will be no production at all, so this model does actually not make much sense.

This explains why the unit cost curve $c(q)$ was positive and downward sloping to the left of q^* in the original model.

Nevertheless, let's pin down the solution for the benevolent government.

It solves

$$\max_{x,q} \sqrt{x} + \sqrt{q} + \overline{y} - aq^2 x. \tag{39}$$

The first-order condition with respect to x is

$$\frac{1}{2\sqrt{x}} - P = 0.$$

The first-order condition with respect to q is

$$\frac{1}{2\sqrt{q}} - 2aqx = 0.$$

Since $P = aq^2$ from the firms' behavior we get

$$\frac{1}{2\sqrt{x}} = aq^2.$$

By using some tedious algebra we can solve for the society's optimal levels of quantity and quality.

We have

$$q = (\frac{1}{4ax})^{\frac{2}{3}}.$$

So

$$\frac{1}{2\sqrt{x}} = a(\frac{1}{4ax})^{\frac{4}{3}},$$

and

$$\frac{1}{2a\sqrt{x}} = (\frac{1}{4a})^{\frac{4}{3}}(\frac{1}{x})^{\frac{4}{3}}.$$

It follows that

$$\frac{1}{2a(\frac{1}{4a})^{\frac{4}{3}}} = \sqrt{x}(\frac{1}{x})^{\frac{4}{3}} = \frac{1}{(\sqrt[6]{x})^5}.$$

Hence,

$$\left(\sqrt[6]{x}\right)^5 = 2a(\frac{1}{4a})^{\frac{4}{3}}$$

or

$$x = (2a(\frac{1}{4a})^{\frac{4}{3}})^{\frac{6}{5}} = (\frac{\sqrt[3]{2}}{4}\frac{1}{\sqrt[3]{a}})^{\frac{6}{5}}.$$

Because

$$\frac{2^{\frac{1}{3}\frac{6}{5}}}{4^{\frac{6}{5}}} = \frac{1}{4}$$

we finally get

$$x^* = \frac{1}{4a^{\frac{2}{5}}}.$$

Plugging this into q above shows

$$q = (\frac{1}{4a\frac{1}{4a^{\frac{2}{5}}}})^{\frac{2}{3}}$$

or

$$q = (\frac{1}{a^{\frac{3}{5}}})^{\frac{2}{3}}.$$

So, at last, we get

$$q^* = \frac{1}{a^{\frac{2}{5}}}.$$

How are the optimal quantity and quality affected by an increase in the cost of producing good products, a?

As we can see from the first-order conditions there is a direct decreasing affect on both variables, i.e., the two optimality curves turn inward.

Quality becomes more expensive so it is reduced. Because the price level is a function of this cost, consumers also want less quantity.

The DD and EE curves are however downward sloping.

So when q is reduced, x increased.

But this effect is dominated, such that both q and x fall when a is increased.

We finally note that q is affected to a larger extent than x, which is not strange since a is the cost of producing quality.