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QUALITY OF GOVERNMENT-REGULATED GOODS

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Marian Moszoro[1]

Abstract

Regulators face the difficult task of determining the sets of price and quality of government-regulated goods. While the profit-maximizing monopoly always produces less in quantity than under free competition, the level of quality produced by the monopoly is not unequivocal: it depends on its cost and demand functions. The social effect of quality change is not unequivocal, either, because it depends, apart from the cost function change, on the shift and tilt change of the demand curve. The problem lies in determining how the price elasticity of basic-need goods responds to quality change and whether this change of quality is socially desirable. This paper analyzes quality as a decision variable in the government-regulated goods sector. Because the quality of government-regulated goods remains an externality, in particular cases the optimal level of the quality of these goods can be determined. Paradoxically, rate-of-return regulation may even make it impossible to achieve Pareto-efficient contracts for government-regulated goods.

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1. Introduction and Structure of the Paper

Two conditions determine the investments in regulated utilities and public infrastructure: the quality level aimed for and the sunk cost in infrastructure adequate to the quality target, i.e., liquidity risk. In this paper, I analyze quality – often treated as constant or exogenous – as a decision variable in the government-regulated goods sector. I show that it is possible to determine the optimal quality level of these goods, which facilitates the regulator's task of controlling the level of quality.

Section 2 presents the main milestones of economic thought on quality. In section 3, I analyze the effect of quality change on demand price elasticity for government-regulated goods, which has been an area neglected by economists. In section 4, I build the cost and demand functions taking into account the level of quality and analyze the effect of quality change on welfare, i.e., whether quality changes are socially desirable. Section 5 is devoted to the analysis of quality as an externality and the application of Coase Theorem to the quality of government-regulated goods. Section 6 concludes with efficiency and social implications of regulations.

2. Relation to the Literature

The research on demand and regulation of quality in government-regulated goods has been quite recent (Auriol, 1998, p. 170). The first research was connected with the American health system (PPS) and the mechanism of rewarding hospitals. Johnson (1984) and Broyles and Rosko (1985) studied the stimuli for offering high-quality services. Tirole (1994) analyzed the elasticity of demand in relation to quality, while Lewis and Sappington (1991) examined the effect of optimal regulations on the fact that quality can be contracted. The idea that economic agents appointed to perform multiple objectives (for example, providing high quality at low cost) tend to put more effort into those objectives which are best rewarded was formally developed and analyzed by Holmström and Milgrom (1991). Laffont and Tirole (1993) presented two models for regulating quality: one, in which quality is observable *ex ante,* and another, in which quality is observable only *ex post.* They came to the conclusion that incomplete information about the producer leads to a decrease in quality, and they analyzed how stimuli to increase quality affect demand and supply functions. Auriol (1998) analyzed the effect of competition on quality demand and stated that quality has features similar to public goods. Tangerås (2002),

while acknowledging achievements in the quality-regulation field, claimed that not much had been done up to that point. In the government-regulated goods sector, where the demand of a particular consumer depends on quality (for example, healthcare), he proposed de-regulation of costs and quality, and producer rewards linked to regulated measures (*yardstick competition*).

The quality of consumer goods has rarely been analyzed in economic categories.[1] Baumol and Blinder (1988), Fischer et al. (1990), Mas-Colell et al. (1995), Samuelson and Marks (1998), and Samuelson and Nordhaus (1985) ignore the issue of quality completely. On the other hand, economists give quality high importance when the subject of analysis is the quality of government-regulated goods. Stiglitz (1997, pp. 435-437) devotes a few pages to the issue of quality when he describes the consumer's perception of quality on the basis of prices on markets with incomplete information. Gwartney and Stroup (1987, p. 197) only claim that it is easier to regulate price than quality in natural monopolies. Varian (1992, pp. 239-241) analyzes the quality of goods generally. He treats quality as a good with a production cost. The increase of the quality can be decomposed, according to Varian, in two effects: an upward shift of the demand curve and a change of the demand curve tilt. While the profit-maximizing monopoly always produces less in quantity than under free competition, the level of quality produced by the monopoly is not unequivocal: it depends on the cost and demand functions. Neither is the social effect of quality change unequivocal, because it depends, apart from the cost function change, on the shift and tilt change of the demand curve. Nevertheless, Varian does not give any guidelines on how to analyze the changes in position and tilt of the demand curve.

Tirole (1994, p. 106) divides goods, on the basis of our knowledge about their level of quality, into:

- Goods whose quality can be learned before use (*search goods*).
- Goods whose quality can be learned during use or *ex post* (*experience goods*).
- Goods whose quality cannot be learned even after use (*credence goods*, for example we never know all the ingredients of some products).[2]

Most goods have characteristics of more than one group. In my opinion, government-regulated goods are experience goods.[3] In the case of these goods, according to Tirole, the basic issue is information: how customers learn about quality and what stimuli companies have to produce goods at a given level of quality. He proves that the better informed customers are about the level of quality *ex ante*, the more the producer is motivated to produce goods of higher quality (Tirole, 1994, p. 108). Although Tirole does not explain this *explicitly*, his remarks refer only to standardized consumer goods or to goods which have close substitutes.

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[1] Marketing theoreticians and specialists pay much more attention to the issue of quality.

[2] The first two categories were introduced by Nelson (1970); the third category was introduced by Arrow (1963) and Darby and Karni (1973).

[3] Government-regulated goods can be regarded as credence goods because of the uncertainty about their ultimate effect on health and the environment. Customers tend to see credence goods in services such as water supply, trash collection and energy. However, this remark in fact can refer to all products in general (cars, mobile phones, etc.), not only to government-regulated goods.

3. Effect of Quality Change on the Demand Curve[4]

If goods produced by the monopoly have close substitutes,[5,6] increasing the quality level differentiates the product from its substitutes and the customer is willing to pay more for it. Changes in prices have a smaller effect on quantity changes,[7] i.e., the demand curve becomes steeper.[8] If goods produced by the monopoly do not have close substitutes, as is the case with basic-need goods and most government-regulated goods, the demand curve also becomes steeper: even if quantitative demand changes are only slightly affected by quality increase, utility from consumption will be higher.[9]

As for the magnitude of demand change due to quality change, the shift of the demand curve will be bigger for goods which do not have close substitutes than for those which do. This results from the fact that substitutes create a cap for price increases (relative prices equal relative marginal utility of substitutes).

The tilt change will also be bigger for goods without close substitutes, because customers are willing to pay more for additional quality of a good which has close substitutes, but if the price increases at a given level of quality, customers switch demand to substitutes. Such an action cannot take place in the case of goods without close substitutes; therefore an increase in utility resulting from higher quality is reflected in an increase of consumer surplus together with a decrease of demand price elasticity. Figure 1 illustrates shifts and tilts in a demand curve due changes in quality.

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[4] Both in theory and in practice, the issue of the effect of quality on demand is complex. In this paper, I limit my argument to natural monopoly theory in government-regulated goods.

[5] Examples of goods produced by a monopoly with close substitutes are land telephone lines vs. mobile phone, and natural gas from the grid vs. natural gas sold in cylinders.

[6] The differentiation of goods produced by the monopoly depending on whether they have close substitutes or not is analytical and does not point to Hicksean substitution effects.

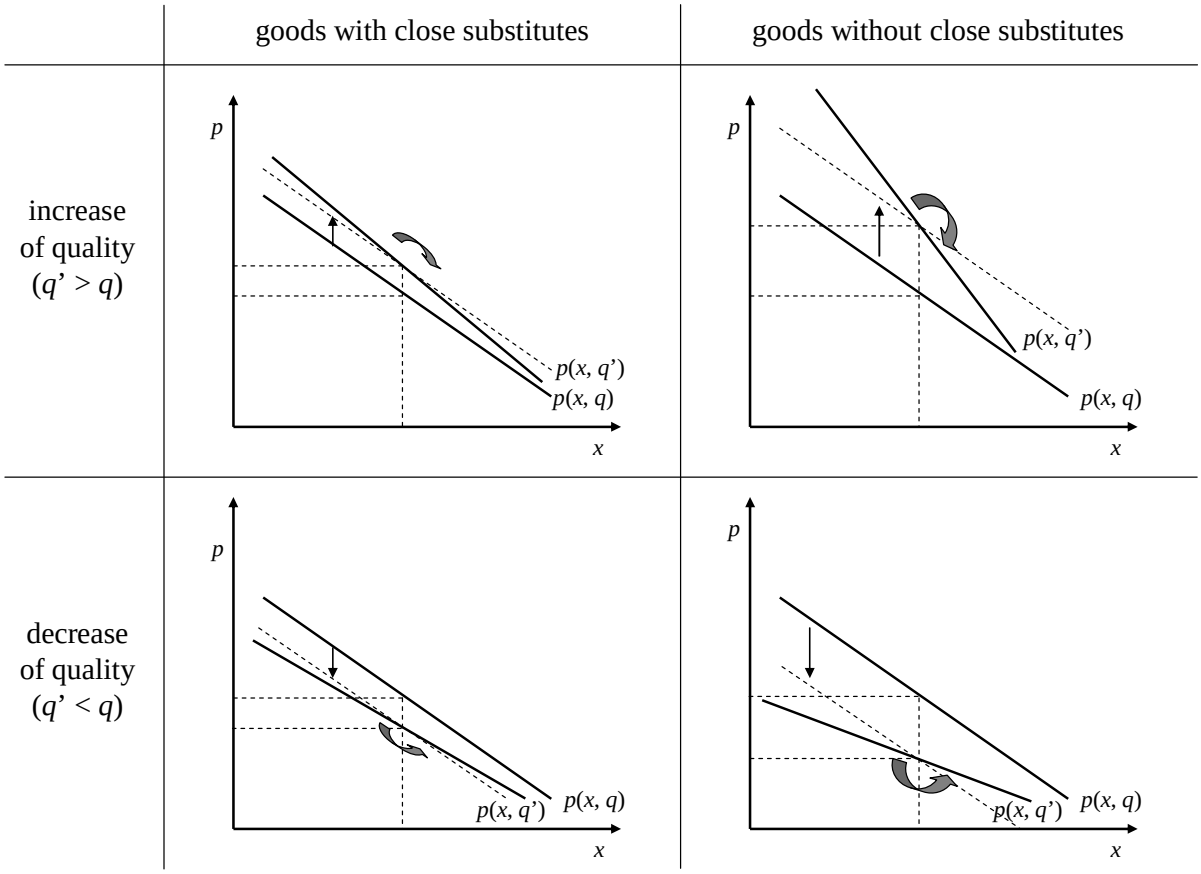
[7] If price were important, the consumer would buy a cheaper substitute.

[8] This statement is easier to prove *a contrario*, i.e., taking a decrease in quality as an example. If the product has close substitutes and quality decreases, consumers will pay a lower price at a given demand level, but with every increase in price they will limit demand for this good more sharply, or switch to a substitute. In a widely discussed article, Stiglitz (1987) claimed that, in standard economic theory, price depends on quality. But when quality is unknown, perceived quality depends on price (Stiglitz, 1987, p. 3).

[9] Let quality be a dimension, besides price and quantity. Therefore, instead of a demand curve there would be a 'demand surface,' and quality change results in a different section of the surface (in a two-dimensional plot: a different curve), without change of preferences. Changes in preferences would change the location of the whole demand surface.

Figure 1

Effect of quality change on the demand curve



p – price; *q* – quality; *x* – amount of good.

An increase of quality always negatively affects the demand curve slope, i.e., the demand curve becomes steeper. I cannot find an example of a good for which an increase in quality would mean a flatter demand curve.[10] However, greater tilt does not mean lower demand price elasticity. As said before, an increase of quality brings two effects: the upward shift of the demand curve and the change of its tilt. The upward shift means, *ceteris paribus*, an increase of the demand price elasticity. After an increase in quality, the demand price elasticity will, therefore, be the outcome of two components: its increase, as a result of the demand curve shift, and its decrease, resulting from the change of the demand curve tilt.[11]

An increase in the quality of first-need goods does not have to cause a quantitative increase of demand or an increase of expenses on such goods, even if the supply curve does not change.

[10] This question should rather be directed at Hal Varian, who accepts such a possibility (Varian, 1992, p. 240).

[11] A simple example will illustrate it clearly. Let a demand curve be $x = 100 - 10p$. A change of quality will cause the shift of the demand curve (effect 1) and the demand curve will now be $x = 120 - 10p$. The demand is now more price elastic at every point, because the same percentage quantitative change in demand corresponds to the same absolute but smaller percentage price change. Let us assume further that the change of quality also changes the demand curve tilt into a steeper one (effect 2), so that $x = 120 - 12p$. It can be easily noticed that the price elasticity of this demand curve is the same as that of the original demand curve.

For example, if natural gas, coal and petrol become more powerful, in order to achieve the same effect, a smaller amount of them would be used.[12]

The problem of quality rests in the fact that it is not a 'product,' as Varian (1992, p. 239) claims, but an 'accident,' i.e., an entity contingent upon the existence of a certain product or service.[13] It is difficult to capture or measure it (Viscusi, Vernon, and Harrington 2000, p. 403). There is no 'price for quality,' either, but there is price for a good of a certain quality. Therefore it is difficult to generalize, and each type of good or service should be approached individually. Tangerås (2002) analyzes the market of public medical services in the United States, where there is competition between service providers, while prices of medical services are regulated. In this case, demand is reported where the quality offered is the highest. Fabbri and Fraquelli (2000) analyze the so-called *hedonic* cost functions, which take into account quality, in the water supply sector. According to them, the quality of water is a basic problem of the production process, and thus of the costs. They quote the work of Feigenbaum and Teeples (1983), who treat the production of water as a process which 'changes the location (in place and time) of water and improves its quality.' Each company from this sector operates in different environmental conditions which affect the cost structure of drinkable water production. In this case the authors treat 'quality' as a 'cost' of production of the same water and – focusing on the cost aspect – do not analyze the effect of quality on demand.

It is very difficult to establish the 'appropriate' level of quality for the consumer and for the producer. In the case of classic consumer goods, competing companies produce goods of various quality and price levels, and consumers express their preferences by making choices.[14] In the case of goods produced by government regulated companies, the problem of choosing the level of quality appears. If the company was selected in a simple franchising tender process where attention is paid mainly to price, the quality will be relatively low, because the bidding companies will offer the lowest possible prices. The winner of the tendering contract will be offering the lowest quality at the price approximating the average cost (Viscusi, Vernon, and Harrington, 2000, p. 403). However, this combination of 'low price–low quality' may not be preferred by consumers.[15]

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[12] The substitution effect and the income effect would offset each other in this case. Changes of quality pose another interesting feature for the analysis of the demand curve for government-regulated goods, when quality improvement and price increase happen at the same time in developing countries and transition economies. For example, the quality of electric energy, natural gas and running water increased in Central and Eastern Europe in the years 1990-2010 after the fall of the communist system while quantity demand remained quite stable. This fact combined with the increase in prices of those goods would support the hypothesis concerning a fairly steep demand curve for basic-need goods.

[13] Aristotle would say that it is an 'accident' of a being: although we can talk about 'whiteness', it does not exist on its own, but always in some being.

[14] For example, when purchasing a car, with or without ABS, with or without electric windows, with or without the airbag for the passenger, etc. The higher the expenses on the purchase of a particular good or service in relation to our income, the more attention is paid by the consumer to the quality of this good.

[15] Richard Posner (1972, p. 115) proposed a mechanism which comprises an 'open season,' during which all candidates for franchisees would have the freedom to offer their products to the residents of a particular area. This would not be just a presentation; the candidates for franchisees would try to secure real orders from potential customers. At the end of this period, the orders collected by candidates would be compared and the franchise would be given to the company which secured the highest income. In this way, the voice of every customer would be measured by their willingness to pay, and the winner would be the candidate who, in free competition, would be preferred by the majority of customers. To secure fair competition, each candidate would have to make a commitment that they would, if they won, provide the level of services and prices they offered in this period. If they failed to keep their promises, the franchise could be withdrawn and a new 'open season' could be announced.

The tender may also concern the level of quality in the form of minimum standards. Nevertheless, the problem arises of establishing and subsequently monitoring these standards. There will always be objective and subjective problems of quality regulation caused by the asymmetry of information. For example, it is difficult for a regulator to continually measure the pressure level in the whole water supply system, and the regulator does not know the customers' exact preferences.

4. Effect of Quality Change on Welfare

A question can be raised: When is a positive change in quality socially desirable? That is, when does the total consumer and producer surpluses increase due to an increase in quality?

As shown above, an increase of the quality can be described as an upward shift of the demand curve and change in its tilt into a steeper one. A way to describe it mathematically is to add a straight line with negative slope to the demand function:

$$p(x, q^H) = p(x, q^L) + a + b - \frac{b}{x^L} x \qquad (1)$$

where:

q^H – high level of quality

q^L – low level of quality

x^L – level of quantity equilibrium before the quality change

a, b – positive parameters: parameter a reflects the shift of the demand curve, while $b - \frac{b}{x^L} x$ is a change of the demand curve tilt at point x^L.

The cost function also changes – both fixed costs (more depreciation and debt service) and variable costs increase.[16] This effect can be simply described with the addition of a straight line with positive slope to the cost function:

As Williamson (1985, p. 334) points out, the pre-contract offering prevents a political agent from imposing the level of quality and facilitates choice among various price-quality combinations.

Although the introduction of pre-contract offering in Posner's conception was very clever – this is the continuation of Williamson's criticism – it is not usually practiced. First of all, it assumes that consumers are able to make an abstract evaluation of price-quality packages and that they have the time and willingness to do so – which poses the problem of bounded rationality. Secondly, the pre-contract offering causes the aggregation of preferences in a rather arbitrary way. It may, for example, happen that the package A, being the combination of high price and high quality, with 40% of the society choosing it, will win over packages B, C, D and E, which are combinations of low price and low quality, which were chosen by 15% of the society each. Can we draw a conclusion, asks Williamson (1985, p. 335) rhetorically, that A is socially preferred?

According to other economists, a disadvantage of pre-contract offering proposed by Posner is the possibility of non-substantial influence on potential customers, for example, paying them for a declaration of using their services. I understand that this is an objection to Posner's theory. Nevertheless, if we believe in human rationality (or bounded rationality), we must admit that potential customers can discount other 'non-substantial' factors. Although it may seem 'non-substantial,' the so-called 'pre-election party' is part of a formal offer (also in politics).

[16] An example of both fixed costs and variable costs increasing with quality is the inverse of the estimated annual cost of energy not delivered. It increases with frequency of short circuits, the volume of peak demand, the length of distributing cables, the length of breaks and loss due to outages. The cost of energy not delivered is estimated at

$$\mathrm{TC}(x, q^H) = \mathrm{TC}(x, q^L) + l + mx \quad (2)$$

where l and m are positive parameters. Therefore the marginal cost equals:

$$\mathrm{MC}(x, q^H) = \mathrm{MC}(x, q^L) + m \quad (3)$$

The change of welfare counted as the joint consumer and producer surplus[17] equals:

$$W^H - W^L = \int_0^{x^H} p(x, q^H)dx - \int_0^{x^H} \mathrm{MC}(x, q^H)dx - \int_0^{x^L} p(x, q^L)dx + \int_0^{x^L} \mathrm{MC}(x, q^L)dx \quad (4)$$

where x^H is the level of the quantity equilibrium after the quality change.

Replacing (1) and (3) in (4), we obtain:

$$W^H - W^L = \int_0^{x^H}\left[p(x, q^L) + a + b - \frac{b}{x^L}x \right]dx - \int_0^{x^H}\left[\mathrm{MC}(x, q^L) + m\right]dx - \int_0^{x^L} p(x, q^L)dx + \int_0^{x^L} \mathrm{MC}(x, q^L)dx =$$

$$= \int_{x^L}^{x^H} p(x, q^L) - \int_{x^L}^{x^H} \mathrm{MC}(x, q^L) + (a + b - m)x^H - \frac{b}{2x^L}(x^H)^2 \quad (5)$$

The quantity equilibrium will be at the same level ($x^H = x^L$) if the shift of the demand curve equals the increase of the marginal cost ($a = m$). At this quantity equilibrium level, the change of welfare will be positive for every $b > 0$. If the demand curve tilt does not change ($b = 0$), there is no change in welfare.

If $a > m$, the quantity equilibrium will be at a higher level ($x^H > x^L$) and, analogically, if $a < m$, the quantity equilibrium will be at a lower level ($x^H < x^L$). It is very difficult to predict the social effect in this case, using the general functions of demand and supply. On the one hand, it depends on the new level of equilibrium, i.e., on the result of $\int_{x^L}^{x^H} p(x, q^L) - \int_{x^L}^{x^H} \mathrm{MC}(x, q^L)$, but on the other hand, it depends on changes of the curve location [so on $(a + b - m)x^H - \frac{b}{2x^L}x^{H^2}$].

Focusing on the second term of the right-hand side of the expression (5), for $a < m$, $(a + b - m)x^H - \frac{b}{2x^L}x^{H^2} > 0$, if and only if x^H falls in the interval between 0 and

5-30 USD per MWh depending on the region of the world (Morgen, M. "W kierunku jakości energii elektrycznej. Optymalizacja sieci dystrybucji SN," *Rzeczpospolita*, December 19, 2001, supplement Energia XXIX).

[17] For simplification, I assume that the weight of 1 profit in the social surplus equals 1. That is why parameter l, reflecting the change in fixed cost, does not appear in the welfare function, because it is both a customer expense and revenue of the monopoly.

$\min\left[2x^L\left(1+\frac{a-m}{b}\right),\ x^L\right]$,[18] so between 0 and $2x^L\left(1+\frac{a-m}{b}\right)$ for $m-a>\frac{1}{2}b$ or between 0 and x^L for $m-a\le\frac{1}{2}b$. Maximum welfare at these assumptions is reached at $x^H=x^L\left(1+\frac{a-m}{b}\right)$. However, if $m-a>b$, the quality increase does not cause an increase of welfare.[19] It is interesting from an economic point of view that, given a demand function and a marginal cost function, welfare has an unequivocal optimal level with respect to quality.[20]

5. Application of the Coase Theorem to Quality of Government-Regulated Goods

The quality of government-regulated goods holds characteristics of public goods: nobody can be excluded from enjoying it (*non-excludable*) and the consumption of quality by one customer does not diminish the consumption of quality by other customers (*non-rival*). However, it is difficult to treat quality as another good, independent of quantity as it is definitely not a self-existing good. Quality of government-regulated goods can be treated as an externality: desired for the consumer ($\delta u/\delta q > 0$) and costly to the producer ($\delta TC/\delta q>0$).

If the basic theorem concerning externalities – the Coase theorem – is to be applied,[21] assuming the lack of transaction costs, the efficient level of demand for and supply of quality of government-regulated goods does not depend on the allocation of the initial resources and rights of the agents, i.e., it does not depend on the bidding power of the monopoly and the regulator.[22]

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[18] The first expression in square brackets comes directly from the analysis of the square function $(a+b-m)x^H-\frac{b}{2x^L}x^{H2}$, while the second from the fact that if $a < m$, then $x^H < x^L$.

[19] Still keeping the assumption that $\int_{x^L}^{x^H} p(x,q^L)-\int_{x^L}^{x^H}\mathrm{MC}(x,q^L)=0$.

[20] For subsequent quality changes, *a, b, l* and *m,* do not have to be necessarily constant.

[21] See Coase (1960). Coase *de facto* did not formulate the theorem; it was, as he himself admits, attributed to him by Stigler (1966). After all, Coase's work was so revolutionary that it inspired a lot of literature in Neo-Institutional Economics and Law & Economics, and it finally earned him the Nobel Prize in 1991.

[22] The bidding power of the monopoly and the regulator in a government-regulated enterprise can be analyzed using the Lerner's index $\frac{p-\mathrm{MC}}{p}$. The higher the index, the more bidding power the monopoly has.

Defining the unequivocal optimal level of quality would be particularly important in understanding the purpose of regulating quality and prices in natural monopolies producing basic-need goods or services on the basis of maximum prices and minimum quality standards.[23]

Let us assume an economy with one monopoly producing a basic-need good x with quality q, with many companies producing $n-1$ goods in a competitive market and one consumer maximizing utility. Let us introduce:

x_{-1} – quantity vector of all goods except the government-regulated basic-need good.

p_{-1} – price vector of all goods, except the government-regulated basic-need good; let us assume that the prices of these goods remain constant and that the quantity and price of the first-need good does not affect these prices.[24]

n – number of goods.

w – income that can be spent on goods and services.

Thus, assuming that we allocate the whole income,[25] $w = \sum_{j=1}^{n} x_j \cdot p_j$, so:

$$w - x \cdot p = \sum_{j=2}^{n} x_j \cdot p_j = x_{-1} \cdot p_{-1} \qquad \textbf{(6)}$$

The consumer maximizes utility, defined as the function of quantity and quality of the basic-need good and quantity of other goods, and allocates resources subject to budget constraints. The consumer is willing to pay a higher price for higher quality, and so resigns from other goods, thus expenses on basic-need goods decrease the available income to be allocated for the remaining goods.[26]

A family of indifference functions to various utility levels, whose variables are the quality of the basic-need good and quantity of other goods, can be presented as follows:

$$u = u(x, q) + u(x_2) + \ldots + u(x_j) = u(x, q) + \sum_{j=2}^{n} u(x_j) \qquad \textbf{(7)}$$

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[23] Tirole (1994, pp. 113-114), discussing the issues of quality, information and public policy, uses a meaningful heading 'Failure of the Coase Theorem and Product Liability.' Tirole's aim is to prove that the intervention of a regulator is necessary to achieve an efficient level of quality production. He argues that there are always externalities on third parties and transaction costs. Therefore, in his opinion, the Coase theorem does not have any application here, so the intervention of the regulator is purposeful and desirable.

In my opinion, talking about the failure of the theorem by denying its assumptions is a logical error. Tirole's arguments do not impair the theorem, but only its assumptions and practical application. Besides, Coase himself did not claim that there are no transaction costs – on the contrary, he claimed that they exist and are significant.

[24] Analogical assumptions were made by Mas-Colell et al. (1995), Chapter 11, where they analyze externalities and public goods.

[25] This is a redundant assumption if we assume that savings are also a good (investment) from which we obtain utility.

[26] The decrease in quantity demand for basic-need goods in favor of higher quality ones, although theoretically possible, does not happen due to the nature of these goods.

Using the indirect utility function $u(\vec{x}) = v(w, \vec{p})$ (Mas-Colell, Whinston, and Green 1995, pp. 56-57), we obtain $\sum_{j=2}^{n} u(x_j) = v(w - x \cdot p, p_{-1})$. Hence we can describe utility as the sum of the utility functions of quantity and quality of a basic-need good and the indirect utility of the goods which can be purchased with the income left after buying the basic-need good:

$$u = u(x, q) + v(w - x \cdot p, p_{-1})$$

Assuming a constant marginal utility of the indirect utility function,[27] we obtain a quasi-linear utility function:

$$u = u(x, q) + w - x \cdot p \tag{8}$$

i.e., the consumer's utility depends *ceteris paribus* on the price and the quality level of the basic-need good.

The monopoly maximizes profit, given by:

$$\pi = p \cdot x - \mathrm{TC}(x, q) \tag{9}$$

From the first order conditions of maximization of utility and profit with respect to q we have:

$$\frac{\partial u(x,q)}{\partial q} - x\frac{\partial p}{\partial q} = 0 \tag{10}$$

$$\frac{\partial p}{\partial q} = \frac{\partial u(x, q)}{x \partial q} \tag{11}$$

and

$$x\frac{\partial p}{\partial q} - \frac{\partial \mathrm{TC}(x, q)}{\partial q} = 0 \tag{12}$$

$$\frac{\partial p}{\partial q} = \frac{\partial \mathrm{TC}(x, q)}{x \partial q} \tag{13}$$

Equaling (11) and (13) we obtain:

$$\frac{\partial u(x, q)}{\partial q} = \frac{\partial \mathrm{TC}(x, q)}{\partial q} \tag{14}$$

The set of points for $q, p \in \{R^+\}$, for which the marginal utility of the basic-need good equals its marginal cost, is the contract curve (Mas-Colell, Whinston, and Green 1995, p. 523; Varian 1992, p. 324). The equilibria on this curve are Pareto optimal. It should be noted that, with the given assumptions for internal solutions, quality does not depend on the price and quantity of

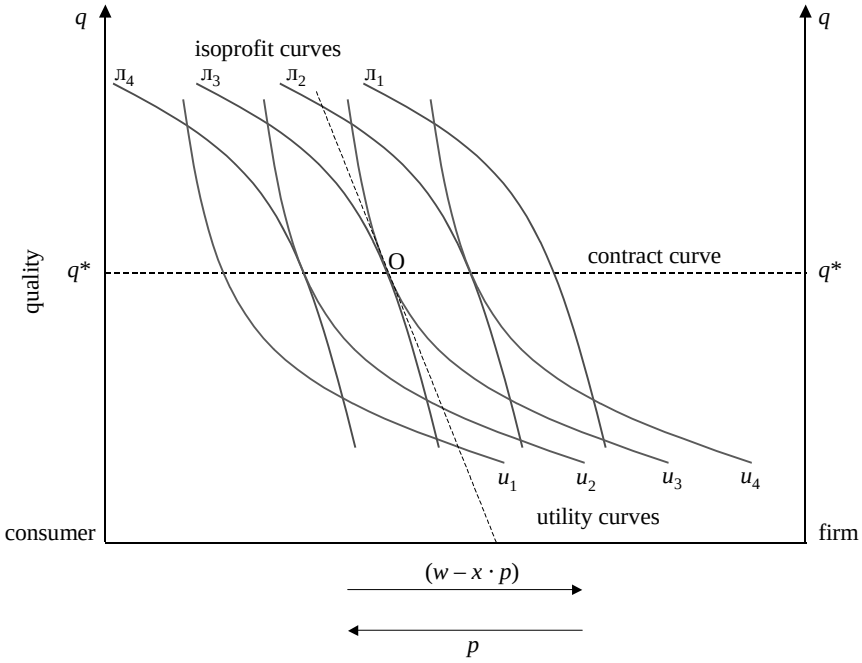
[27] In other words, we analyze the basket of all goods except for the basic-need good as a single good (treated here as the *numéraire*) and assume its constant marginal utility (Mas-Colell, Whinston, and Green 1995, p. 311). This *numéraire* can be the money left after the purchase of a basic-need good.

the basic-need good, or on initial endowments. Thus the Coase theorem holds for quality of basic-need goods.[28]

The contract curve tilt with respect to the quality of a basic-need good and the remaining income to be allocated after the purchase equals zero (horizontal curve). Hurwicz (1995, p. 57) illustrates the above result for externalities using a modified Edgeworth's box[29] (see Figure 2).

Figure 2

Indifference curves, isoprofit curves, and the contract curve regarding the quality of a basic-need good and the remaining income to be allocated after its purchase



Source: author, based on Hurwicz (1995, p. 57).

The horizontal axis from left to right shows the income to be spent by the consumer after the purchase of a basic-need good, and from right to left, the price of a basic-need good produced by the monopoly. The vertical axis shows quality, which is a good for the customer and a cost for the monopoly. Curves $u_{1,\ 2,\ldots}$ are consumer's utility curves such that $u_1 < u_2 < u_3$ and so on. Analogically, curves $\pi_{1,\ 2,\ldots}$ are isoprofit curves of the monopoly such that $\pi_1 < \pi_2 < \pi_3$ and so on.

The location of point *O* on the contract curve depends on the bidding power of the agents, i.e., on the monopoly power, who aim at maximizing profit, and the regulator, representing the consumer and aiming at maximizing social welfare.

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[28] It should be said that, in the case of quasi-linear utility functions, there is no income effect related to the non-*numéraire* good (Hurwicz 1995, p. 49). In the market of a particular good, quality and quantity make a family of indifference curves. A change of quality (unless it is caused by a technological change affecting costs and prices) produces an equilibrium along the same indifference curve, thus the income effect does not occur.

[29] Hurwicz (1995, p. 54) remarks that this interpretation was suggested earlier by Newbery (1989, pp. 211-242) and Eggertsson (1990, pp. 105-109). Eggertsson, on the other hand, attributes this interpretation to Haddock and Spiegel (1984).

Hurwicz (1995) proved that quasi-linear functions of utility (that is parallel preferences) are not only a sufficient but a necessary condition for the Coase theorem to hold.[30]

6. Efficiency and Social Implications of Regulation

The regulator sets maximum prices and minimum quality standards.[31] If the maximum price and minimum quality standards are set independently from each other, i.e., if there are no regulatory function dependences between maximum price and quality, as well as between the minimum quality and price (mathematically $\frac{\partial p_{\max}}{\partial q} = 0, \quad \frac{\partial q_{\min}}{\partial p} = 0$), the regulated natural monopoly will aim towards the edge of the regulated contract area, to point *R* (see Figure 3), where it maximizes its profit with respect to price and quality.

If point *R* is not on the contract line (i.e., if it is below or above the line), price and quality regulation leads to Pareto inefficient contracts. If the minimum quality standard is below the optimal level, the monopoly could shift along the same isoprofit curve (π_3 in Figure 3) from point *R* to point *O* on the contract curve. This point is preferred by the consumer to point *R* (indifference curve u_3). The shift from point *O* to point *R* is not possible, however, due to the price regulation.

If minimum quality standards are set above the optimal level, optimal Pareto conditions cannot occur either.[32]

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[30] Hurwicz (1995, pp. 66-73) showed that all other acceptable classes of utility functions which are not quasi-linear, do not lead to the horizontal contract line. Probably even Coase, whose use of mathematics was limited to simple addition and subtraction, would be surprised by these conclusions.

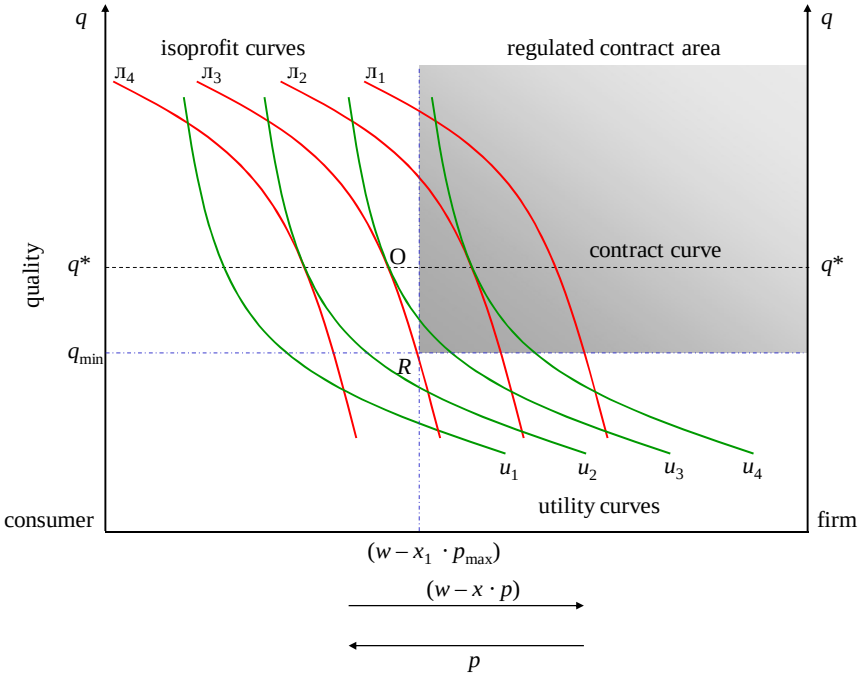
[31] Quality standards of basic-need goods are regulated in appropriate bills, or in contracts between public authorities (e.g., municipalities) and operators. Below are some examples of quality standards by sector:

- In public transportation – routes, frequency of connections, timetables and fares (Love and Cox, 1999).
- In disposal of solid waste – frequency and times of waste collection, and insurance, health and hygiene conditions (Dziarski, 1999).
- In electric energy – annual cumulated time of constant outages (planned and unplanned) per customer (Morgen, M. (2001),"W kierunku jakości energii elektrycznej. Optymalizacja sieci dystrybucji SN," *Rzeczpospolita*, December 19, supplement Energia XXIX; Díaz-Varela, M. "El servicio eléctrico empeoró en el 2001", *La Vanguardia*, March 6, 2002, Barcelona, p. 55).
- In drinkable water – organoleptic, bacteriologic and physiochemical factors; in Poland these factors are listed in the Ministry of Health's resolution listing 81 factors (6 organoleptic, 7 bacteriologic and 68 physiochemical) in line with EU and WHO norms. In the city of Warsaw, for example, detailed analysis of water is carried out every few weeks by sanitary and epidemiological inspections. Only a few basic factors are analyzed daily: turbidity, color, smell, reaction, hardness, oxygen consumption, ammonia, chlorides, iron, manganese, chlorine, Cola bacteria, streptococcus, anaerobes and the total number of bacteria developed at 22 and 37 degrees Celsius Krakowski, L. (2002), "Czy wiemy, co pijemy," *Rzeczpospolita,* No. 92 (6169) April 19, s. A4).

[32] We can say that in this case the regulator wants 'too much' for the consumer, who would prefer lower quality at a lower price, without a decrease in the monopoly's profit. Obviously, the above model situations can be analyzed from the perspective of improving the profitability of the monopoly without any changes for the consumer, as well as improving the situation of both the consumer and the monopoly.

Figure 3

Maximum prices, minimum level of quality, and regulated contract area



The regulator, therefore, has a difficult, if not Sisyphean task: to set the maximum price and the minimum standard of quality so that the consequent combination set is on the contract curve.[33] This statement refers not only to the case of quasi-line preferences, so not only in the case where the Coase theorem for the quality of basic-need goods holds, but also to all cases of regulated monopolies.

Legislators, consciously or not, seem to share the opinion that the optimal level of quality does not depend on the price and quantity of goods supplied, or on the initial allocations of agents' endowments, but only on consumers' preferences and the cost function of the producers. On the one hand, there are generally strict quality norms (that is minimum quality standards, which each local monopoly must meet, regardless of the region or the city), but on the other hand, local authorities have the power to change prices, when they find it appropriate.[34]

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[33] When experiencing the size (and difficulty) of regulating tasks, policy academicians show discrepancies. For example Zerah (2000), having analyzed the privatization of water supply and sewage systems in Buenos Aires (Argentina), La Paz-El Palo (Bolivia) and Manila (Philippines), postulates the necessity of establishing an independent office regulating contracts between public and private sectors. Szablewski (2003), ("Jak regulować sektor telekomunikacyjny. Specjalny urząd nie jest potrzebny," *Rzeczpospolita* No. 63 (6443), March 15-16, on the example of the telecommunication system, shows that a special office is not needed, and it would be best to get rid of the existing ones.

[34] Public opinion surveys show that the overwhelming majority of Poles fear the freeing of government-regulated prices. In case of heat energy, 63% respondents claimed that freeing the heat energy prices will lead to their increase in the future, 4% claimed that it will not have any effect, and only 2% predicted that the prices will fall. The remaining 34% did not have any opinion (the survey was commissioned by *Rzeczpospolita* and conducted on 21-22-11-1999 by Pracownia Badań Społecznych in Sopot among a sample of 1056 people representing the adult population of Poland: results were presented in *Rzeczpospolita* on December 8, 1999, p. B1).

Rate-of-return regulation gives the investor financial certainty but, from the perspective of economic efficiency, it narrows the contract area (in this case as a vertical line on the right side of the contract area in Figure 3). Paradoxically, quality and price regulations may even exclude the achievement of Pareto efficient contracts on government-regulated goods.

References

Arrow, Kenneth (1963, "Uncertainty and Medical Care," *American Economic Review* 3 (5), pp. 941-973.

Auriol, Emmanuelle (1998), "Deregulation and Quality," *International Journal of Industrial Organization,* 16, pp. 169-194.

Baumol, W.J. and A.S. Blinder (1988), "Economics. Principles and Policy," 4th ed., Orlando: HBJ.

Broyles, R. and M. Rosko (1985), "A qualitative assessment of the Medicare Prospective Payment Systemm," *Social Science and Medicine,* 20, pp.1185-1190.

Coase, Ronald H. (1960), "The Problem of Social Cost," *Journal of Law and Economics* III.

Darby, M.R. and E. Karni (1973), "Free Competition and the Optimal Amount of Fraud," *Journal of Law and Economics*,16, pp. 67-88.

Dziarski, Grzegorz (1999), „Zawieranie kontraktw na wywoz odpadow stalych," Paper read at Wspolpraca sektorow publicznego i prywatnego - spektrum mozliwosci, June 17-18, at Warsaw.

Eggertsson, Thrainn (1990), "Economic behavior and institutions," New York: Cambridge University Press.

Fabbri, P. and G. Fraquelli (2000), "Costs and Structure of Technology in the Italian Water Industry," *Empirica*, 27.

Feigenbaum, S. and R. Teeples (1983), "Public Versus Private Delivery: A Hedonic Approach," *Review of Economics and Statistics,* 65.

Fischer, S., R. Dornbusch, and R. Schmalensee (1990), "Economía.," México, DF: McGraw-Hill.

Gwartney, J.D. and R.L. Stroup (1987), "Microeconomics. Private and Public Choice," 4th ed., Orlando: HBJ.

Haddock, D.D. and M. Spiegel (1984), "Property rules, liability, and inalienability: one view of the Edgeworth Box," in "Papers presented at the 1st meeting of the European Association for Law and Economics," edited by G. Skog, Lund: University of Lund, Department of Economics.

Hahn, "The economics of missing markets, information, and games," London: Clarendon Press.

Holmström, B. and P. Milgrom (1991), "Multitask Principal-Agent Analysis: Incentive Contracts, Asset Ownership and Job Design," *Journal of Law, Economics and Organization,* 7, pp. 24-52.

Hurwicz, L. (1995), "What is the Coase Theorem?," *Japan and World Economy,* 7, pp. 49-74.

Johnson, D.E. (1984), "Life, death and the dollar sign: medical ethics and cost containment," *Journal of the American Medical Association,* 252, pp. 223-224.

Laffont, Jean-Jacques and Jean Tirole (1993), "A Theory of Incentives in Procurement and Regulation," Cambridge, MA: MIT Press.

Lewis, T. and D. Sappington (1991), "Incentives for monitoring quality," *Rand Journal of Economics,* 22, pp. 370-384.

Love, J. and W. Cox (1999), „Podpisywanie kontraktów w drodze przetargu na świadczenie usług przewozowych," Paper read at Wspolpraca sektorow publicznego i prywatnego - spektrum mozliwosci, June 17-18, at Warsaw.

Mas-Colell, Andreu, Michael D. Whinston, and Jerry R. Green (1995), "Microeconomic Theory," New York: Oxford University Press.

Nelson, P. (1970), "Information and Consumer Behaviour," *Journal of Political Economy,* 78, pp. 311-329.

Newbery, D.M. (ed..) (1989), "Missing markets: consequences and remedies."

Posner, Richard A. (1972), "The Appropriate Scope of Regulation in the Cable Television Industry,! *The Bell Journal of Economics and Management Science,* 3 (1), pp. 98-129.

Samuelson, P., and W. Nordhaus (1985), *Economics.* 12th ed. New York: McGraw-Hill.

Samuelson, W. and S. Marks (1998), "Ekonomia menedzerska," Warszawa: PWE.

Stigler, George J. (1966), "The Theory of Price," 3rd ed., New York: MacMillan.

Stiglitz, Joseph E. (1987), "The Causes and Consequences of the Dependence of Quality on Price," *Journal of Economic Literature,* XXV, pp. 1-48.

Stiglitz, Joseph E (1997), "Economics," 2nd ed., New York: Stanford University, Norton.

Tangerås, T.P. (2002), "Regulation of Cost and Quality under Yardstick Competition," Stockholm: The Research Institute of Industrial Economics, Working Paper No. 573.

Tirole, Jean (1994), "The Theory of Industrial Organization," Cambrige, MA: The MIT Press.

Varian, Hal R. (1992), "Microeconomic Analysis," 3rd. ed., New York: W. W. Norton & Company.

Viscusi, W. Kip, John M. Vernon, and Joseph E. Harrington, Jr. (2000), "Economics of Regulation and Antitrust," 3rd ed., Cambridge, MA: The MIT Press.

Williamson, Oliver E. (1985), "The Economic Institutions of Capitalism. Firms, Markets, Relational Contracting," New York: The Free Press, Macmillan, Inc.

Zerah, M.-H. (2000), "Early Outcomes of Public-Private Partnerships on Providing Water Supply to the Urban Poor: Lessons from India," Paper read at International Conference on Sustainable Development of Water Resources - Socio-economic, Institutional and Environmental Aspects, November 27-30.