

Quality of Government Regulated Goods

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Abstract

Regulators face the difficult task of determining the area for right combinations of price and quality of government regulated goods. While the monopolist maximizing profits always produces less in quantity than they would produce in a free competitive environment, the level of quality produced by this monopolist is not unequivocal: it depends on the costs function and demand changes. The social effect of quality change is not unequivocal, either, because it depends, apart from the costs function, on the direction and degree of change of the demand curve tilt. The problem lies in the fact that we cannot determine how the price elasticity of basic need goods will change with the change of quality level, or whether this change of quality is socially desired. This paper analyzes quality – which is often treated as constant or exogenous – as a decision variable in the government regulated goods sector. Because the quality of government regulated goods reminds an externality, in particular cases the optimal level of the quality of these goods can be determined. Paradoxically, regulator's introducing prices to guarantee a minimum return on investment may even make it impossible to achieve Pareto effective contracts for government regulated goods.

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1. Introduction and structure of the paper

Apart from budget constraints, two conditions determine the actual level of investment in public infrastructure: the level of quality which the government regulated enterprise wants to achieve and the limitation of the insolvency risk connected with limiting investment. In this paper, I analyze quality – often treated as constant or exogenous – as a decision variable in the government regulated goods sector. I will show that it is possible to determine the optimal level of quality of these goods, which may facilitate a regulating body its task of controlling the level of quality.

Section 2 presents the main milestones of economic thought on quality. In section 3, I analyze the influence of quality changes on price elasticity of the demand for government regulated goods, which has been an area neglected by economists. In section 4, I build the demand and cost functions, taking into account the level of quality and I analyze the influence of quality changes on welfare, i.e. when quality changes are socially desired. 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 5 describes the effectiveness and social implications of this paper for regulators.

2. Relation to the Literature

The research on demand and regulation of quality in government regulated goods has been quite recent (Auriol 1998:170). The first research was connected with the American health system (PPS) and the mechanism of rewarding hospitals. Johnson (1984) and Boyles and Rosko (1985) studied the stimuli to offering high quality services. Tirole (1994) analyzed the elasticity of demand in relation to quality, while Lewis and Sappington (1991) examined the influence 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 costs) tend to put more effort into the 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 the other one, in which quality is observable only *ex post*. They came to the conclusion that incomplete information about the producer leads to the decrease in the quality

level and they analyzed how the power of stimuli to increase the quality level changes the function of demand and supply. Auriol (1998) analyzed the influence of competition on quality demand and stated that quality has features similar to public goods. Tangerås (2002), acknowledging in his work the achievements in 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, health care), he proposed de-regulation of costs and quality and rewarding the producer with reference 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 (1997:435-437) 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 (1987:197) only claim that it is easier to regulate price than quality in natural monopolies. Varian (1992:239-241) analyzes the quality of goods generally. He treats quality as a good and whose production costs. The increase of the quality level 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 monopolist maximizing profits always produces less in quantity than they would produce in a free competitive environment, the level of quality produced by this monopolist is not unequivocal: it depends on the costs function and demand changes. The social effect of quality change is not unequivocal, either, because it depends, apart from the costs function, on the direction and degree of change of the demand curve tilt. Nevertheless, Varian does not give any guidelines on how to analyze the changes in position and tilt of the demand curve.

Tirole (1994:106) 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 ingredients of some products).²

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).

Most goods have characteristics of more than one group. In my opinion, government regulated goods belong to the group of goods whose quality can be learned during use or *ex post*.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 more that informed customers know the level of quality *ex ante*, the more factors encourage the producer to create goods of higher quality (Tirole 1994:108). Although Tirole does not explain this *explicite*, these remarks refer only to standardized consumer goods or to goods which have close substitutes.

3. Influence of quality changes on the demand curve⁴

If goods produced by a monopolist have close substitutes,⁵ 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 influence on quantity changes,⁶ and therefore the demand curve becomes more vertical⁷. If goods produced by a monopolist do not have close substitutes, as is the case with basic need goods and most government regulated goods, the demand curve also becomes more vertical: even if quantitatively the demand changes are only slightly influenced by an increase in quality, the utility coming from consumption will be greater.⁸

³ One could have the impression that a large number of government regulated goods, especially those connected with health care or education, belong to the classification of goods whose quality cannot be learned even after consumption (*credence goods*). More often, due to the uncertainty about its influence on health and environment, customers tend to see in this category such services as: water supply, trash collection, and even providing electricity and gas. Although interesting and partly true, this remark, in fact, refers to all products (cars, mobile phones, etc.), not only to government regulated goods.

⁴ Both in theory and in practice, the issue of the influence of quality on the demand curve is very complicated. In this paper, I only want to present a contribution to this issue in the area of natural monopolies in government regulated goods (i.e. utilities, water, sewage, power, health care, etc.).

⁵ At present, a good example in Poland of goods produced by a monopolist which have close substitutes are traditional telephone calls (mobile phone calls can be treated as their close substitute), as well as gas from the grid (which substitute may be gas sold in cylinders or LPG). The differentiation of goods produced by the monopolist depending on whether they have close substitutes or not is an analytical category and it does not point at focusing on substitution effects, with omission of income effects.

⁶ If price was important, the consumer would buy a cheaper substitute.

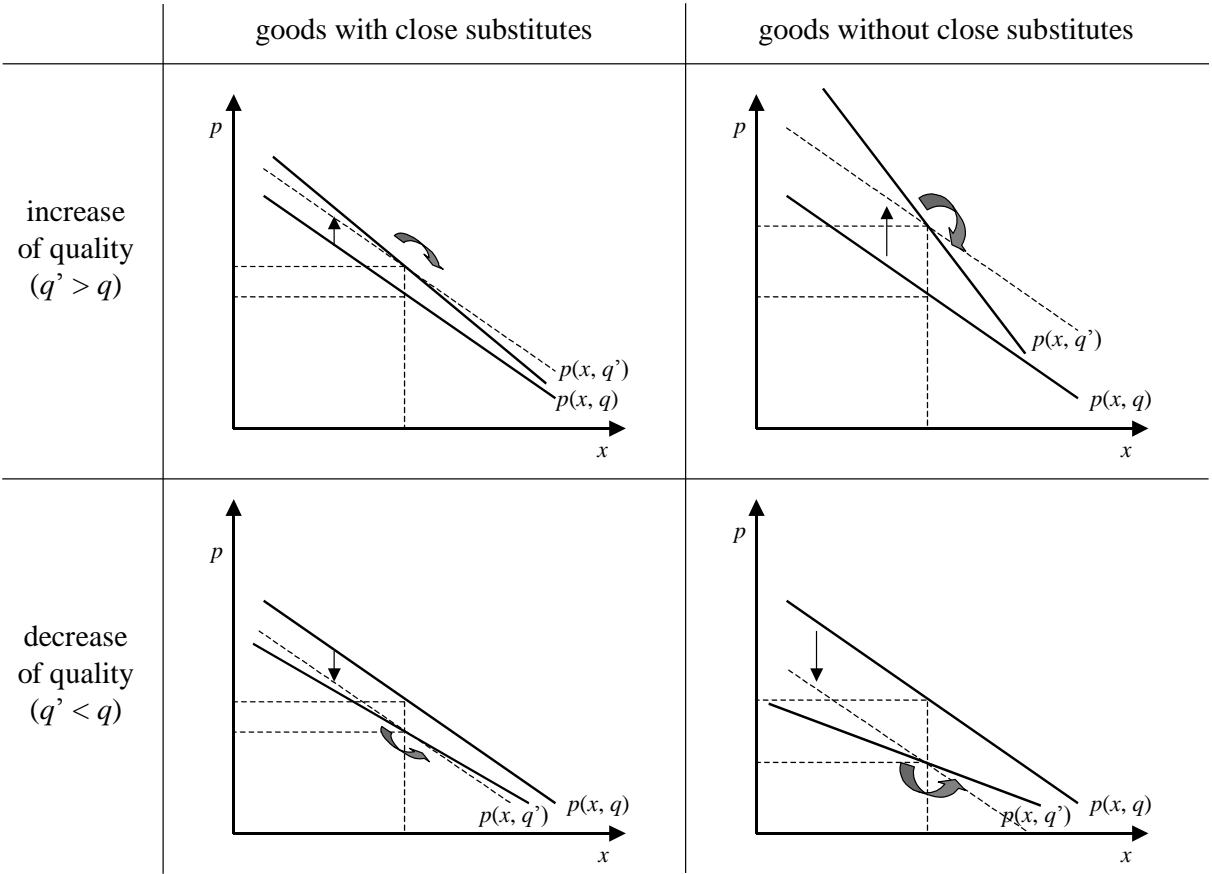
⁷ It is easier to prove taking a decrease in quality as an example. If the product has close substitutes and the quality is decreasing, consumers demand a lower price at a given demand level, but with every increase in price they will limit the demand for this good more and more radically, switching to substitutes. In an article which was widely discussed among scientists, Stiglitz (1987) claims that in the standard theory of economics, price depends on quality. But when the quality is unknown, quality depends on price (Stiglitz 1987:3).

⁸ In the approach presented here quality is another dimension besides price and quantity. Therefore, instead of the demand curve one should talk about 'demand surface', and the change in quality by the producer results in a different section of the area (in a two-dimensional system: a different curve), without changes of preferences. Of course, changes in preferences would change the location of the whole 'surface' of demand.

As far as the size of changes is concerned, the shift of the demand curve will be greater for goods which do not have close substitutes than for those which have them. It results from the fact that substitutes create the cap for price increases (the relation of prices will equal the relation of the marginal utility of substitutes).

The change of the tilt will also be bigger for goods without close substitutes. It is due to the fact that we are willing to pay for additional quality of a good which has close substitutes, but if the price increases at a given level of quality, we quickly switch our demand to the substitutes. Such an action cannot take place in case of goods without close substitutes, therefore the increase of the utility resulting from higher quality is reflected in the increased consumer's surplus together with the decrease of price elasticity of demand. Figure 1 illustrates parallel shifts and tilt changes in a demand curve influenced by changes in the quality of the goods.

Figure 1. Influence of changes in quality on the shape of demand curve



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

The increase of quality always influences negatively the demand curve tilt (the demand curve becomes more vertical). I cannot find an example of a good for which the increase in

quality would mean a more horizontal demand curve⁹. However, the greater tilt does not mean that the demand becomes less elastic. As it was said before, the 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 price elasticity of demand. After the increase in quality, the price elasticity of demand 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.¹⁰

The increase of quality does not have to cause the quantitative increase of demand or the increase of expenses on such goods in home budgets, even if the supply curve does not change. If energy carriers, such as gas, coal, and petrol become more effective (powerful), in order to achieve the same effect, a smaller amount of the carrier would be used.¹¹

The changes of quality, as well as technological changes and changes of consumers' preferences over time, pose another difficulty for the analysis of the demand curve for government regulated goods. If we assume – as a matter of simple observance – that the quality of electric energy, high-methane gas from the grid, and especially water from the water supply system increased in Poland in the years 1990-2007 after the fall of the communist system, this fact combined with the increase in prices of those goods would support the thesis concerning a fairly vertical demand curve for basic need goods.

The problem of quality rests in the fact that it is not a product, as Varian (1992:239) claims, but an 'accident', i.e. an entity contingent upon the existence of a certain product or service.¹² It is difficult to capture or measure it (Viscusi, Vernon, and Harrington 2000:403). 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 goods or services should be approached individually. For example, Tangerås (2002) analyzes the market of public medical services in the USA, where there is competition between service providers, while the prices of medical services are regulated. In this case, the demand is reported where the quality offered is the highest. Fabbri and Fraquelli (2000) analyzed the so-called *hedonic* functions of costs (taking

⁹ This question should rather be directed at Hal Varian, who accepts such a possibility (1992:240).

¹⁰ A simple example will illustrate it clearly. Let's assume the demand curve for which $x = 100 - 10p$. The 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 corresponds to the same absolute, but smaller percentage price change. Let's assume then, that the change of quality also changes the demand curve tilt into a more steep one (effect 2), so that $x = 120 - 12p$. It can be easily noticed that price flexibility of this demand curve is the same as price flexibility of the original demand curve.

¹¹ The substitution effect and the income effect would neutralize each other in this case.

¹² 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.

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 undoubtedly influence 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 influence 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, the competing companies produce goods of various quality and price, and consumers express their preferences by making choices.¹³ 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 2000:403). However, this combination of ‘low price–low quality’ may not be preferred by consumers.¹⁴

¹³ 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.

¹⁴ Richard Posner (1972:115) proposed a mechanism which comprises an ‘open season’, during which all candidates for franchisees would have the freedom to offer their products to the inhabitants 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 whose guaranteed income would be the highest. 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 the community of customers. To secure fair competition, each candidate would have to make a commitment that, if they won, they would 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.

As Williamson (1985:334) rightly points out, the pre-contract offering prevents a political body from imposing the level of quality and facilitates the 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 (1985:335) 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 someone’s services. I understand that this is an objection to Posner’s theory. Nevertheless, in my opinion, if we

The tender may also concern the level of quality in the form of minimum standards. Nevertheless, the problem of establishing and subsequent monitoring of these standards appears. There will always appear objective and subjective problems of regulation caused by the asymmetry of information. For example, it is difficult for a regulator to measure the pressure level in the whole water supply system all the time, and the regulator does not know exactly the preferences of the customer.

4. Influence of quality changes on welfare

A question can be raised: When a positive change in quality is socially desired, that is, when does the total consumer and producer surplus increase due to the increase in the quality level?

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

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

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 – fixed costs increase because of the investment made and variable costs increase, too. This effect can be simply described with the addition of a straight line with positive slope to the cost function:

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

Where l and m are positive parameters, therefore the marginal cost equals:

believe in human rationality (or even 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 spending’ is part of a formal offer (also in politics).

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

The change of welfare counted as the joint consumer and producer surplus¹⁵ equals:

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

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

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

$$\begin{aligned} W^H - W^L &= \int_0^{x^H} \left[p(x, q^L) + a + b - \frac{b}{x^L} x \right] dx - \int_0^{x^H} [\text{MC}(x, q^L) + m] dx - \int_0^{x^L} p(x, q^L) dx + \int_0^{x^L} \text{MC}(x, q^L) dx = \\ &= \int_{x^L}^{x^H} p(x, q^L) dx - \int_{x^L}^{x^H} \text{MC}(x, q^L) dx + (a + b - m)x^H - \frac{b}{2x^L}(x^H)^2 \end{aligned} \quad (5)$$

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 one hand,

it depends on the new level of equilibrium, that is on the result of $\int_{x^L}^{x^H} p(x, q^L) dx - \int_{x^L}^{x^H} \text{MC}(x, q^L) dx$,

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 element 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 $\min\left[2x^L\left(1 + \frac{a-m}{b}\right), x^L\right]$,¹⁶ so between 0 and $2x^L\left(1 + \frac{a-m}{b}\right)$ for $m - a > \frac{1}{2}b$ or between 0

¹⁵ For the purpose of simplification, I assume that the weight of all profits in the social surplus, equals 1. That is why parameter l , reflecting the change in fixed costs, does not appear in the welfare function, because it is both a customer's expense and a revenue of the monopolistic enterprise.

¹⁶ The first expression in square brackets comes directly from the analysis of the square function $(a + b - m)x^H - \frac{b}{2x^L}x^{H^2}$, while the second from the fact that if $a < m$, then $x^H < x^L$.

and x^L for $m - a \leq \frac{1}{2}b$. The 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 change does not cause an increase of

welfare.¹⁷ It is interesting from an economic point of view that for, given a demand function and a marginal cost function, welfare has an unequivocal optimal level with respect to quality.¹⁸

5. The application of the Coase Theorem to the quality of government regulated goods

The quality of government regulated goods has the characteristics of public goods: nobody can be excluded from using it (*not excludable*) and the consumption of quality by one customer does not diminish the consumption of quality by other customers (*nonrival*). However, it is difficult to treat quality as another good, independent of quantity as it is definitely not a self-existing good. In my opinion, the quality of some goods, especially of government regulated goods, can be treated as a specific 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,¹⁹ assuming the lack of transaction costs, the effective level of demand for and supply of quality of government regulated goods does not depend on the allocation of the initial resources and the rights of the agents, that is, in the analyzed cases, it does not depend on the bidding power of the monopolist and the regulator.²⁰

Defining the unequivocal optimal level of quality would be particularly important in understanding the purpose of regulating quality and prices in natural monopolies producing

¹⁷ Still keeping the assumption that $\int_{x^L}^{x^H} p(x, q^L) - \int_{x^L}^{x^H} MC(x, q^L) = 0$.

¹⁸ Of course, for each subsequent change of the parameters a , b , l and m , do not have to be necessarily constant (this would be quite strange).

¹⁹ See Coase (1960). Coase *de facto* did not formulate the theorem; it was, as he himself admits it, 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.

²⁰ The bidding power of the monopolist and the regulator in a government regulated enterprise can be analyzed using the Lerner's index $\frac{p - MC}{p}$. The higher the index is, the more bidding power the monopolist has.

basic need goods or services (belonging to the government regulated sector) on the basis of maximum prices and minimum quality standards.²¹

Let us assume an economy with one monopolistic firm producing a basic need good x with quality q , with many companies producing other goods in a competitive market and one consumer maximizing utility. Let us introduce:

x_{-1} – quantity vector of all goods except the first one,

p_{-1} – vector of unit prices of all goods, except the first one; let us assume that the prices of these goods remain constant and that the quantity and price of the first need good does not influence these prices,²²

n – number of goods,

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

Thus, assuming that we allocate the whole income,²³ $w = \sum_{j=1}^n x_j \cdot p_j$, so:

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

The variables that the consumer takes into account when evaluating a basic need good are utility, defined as the function of quantity and quality of this good, and its price.

Expenses on basic need goods decrease the income to be allocated for the remaining goods. On the other hand, the consumer is willing to pay a higher price for higher quality, and so resigns from other goods.²⁴

We can conclude that it is possible to present a family of indifference functions to various utility levels, whose variables are the quality of basic need goods and other goods:

²¹ Tirole (1994:113-114), 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 the public body is necessary to achieve an effective 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 governing body 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 quite significant.

²² Analogical assumptions were made by Mas-Colell et al. (1995), when they analyze externalities and public goods in Chapter 11.

²³ This is a redundant assumption if we assume that savings are also a good (investment) from which we obtain utility.

²⁴ The decrease in quantity demand for basic need goods in favour of higher quality ones, although theoretically possible, does not practically happen in reality due to the nature of these goods: these are basic need goods and their price elasticity of demand is very low.

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

Using the indirect utility function, where $u(\vec{x}) = v(w, \vec{p})$ (Mas-Colell, Whinston, and Green 1995:56-57), we obtain $\sum_{j=2}^n u(x_j) = v(w - x \cdot p, p_{-1})$. Thus 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 basic need goods:

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

If we also assume a constant marginal utility of the indirect utility function,²⁵ we obtain a quasi-linear function of utility:

$$u = u(x, q) + w - x \cdot p \quad (8)$$

In the formula (8), we achieved the situation where the consumer's utility level depends *ceteris paribus* on the price and the quality level of the basic need good.

The monopolist maximizes profits given by the function:

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

From the first order conditions of maximization of utility and profits in relation to q we have:

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

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

and

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

$$\frac{\partial p}{\partial q} = \frac{\partial \text{TC}(x, q)}{x \partial q} \quad (13)$$

After equaling (11) and (13) we obtain:

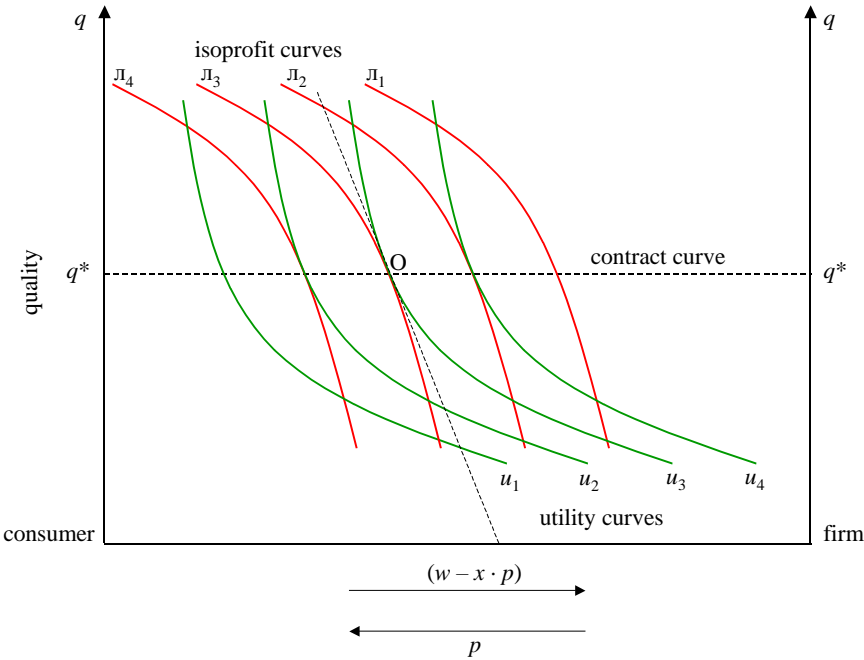
$$\frac{\partial u(x, q)}{\partial q} = \frac{\partial \text{TC}(x, q)}{\partial q} \quad (14)$$

²⁵ In other words, we analyze the basket of all goods except for the basic need good as a single good (treated here as the unit of calculation – *numéraire*) and we assume its constant marginal utility (Mas-Colell, Whinston, and Green 1995:311). This *numéraire* good can be the money left after the purchase of a basic need good.

The set of points for $q, p \in \{R^+\}$, for which the marginal utility of basic need goods equals the marginal cost, is called the contract curve or line (Mas-Colell, Whinston, and Green 1995:523; Varian 1992:324). The solutions on this line are Pareto optimal. It should be noticed that with the given assumptions, for internal solutions the quality level does not depend on the price of a basic need good nor on the quantity of this good, nor on initial endowments. Thus the Coase theorem for quality of basic need goods holds.²⁶

The contract curve tilt regarding the quality of a basic need good and the remaining income to be allocated after the purchase equals zero (horizontal curve). Hurwicz (1995:57) illustrates the above score generally for external effects, using a modified Edgeworth's box²⁷ (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: own work on the basis of Hurwicz (1995:57).

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

²⁶ It should be said that in case of quasi-linear utility functions, the income effect related to the non-*numéraire* good does not exist (Hurwicz 1995:49). In the market of a particular good, quality and quantity make a family of indifference curves. The change of quality (unless it is caused by technological changes influencing costs and prices) causes the movement along the same indifference curve, thus the income effect does not occur.

²⁷ Hurwicz (1995:54) remarks that this interpretation was suggested earlier by Newbery (1989:211-242) and Eggertsson (1990:105-109). Eggertsson, on the other hand, attributes this interpretation to Haddock and Spiegel (1984).

produced by the monopolist. Instead of pollution, the vertical axis shows quality, which is a good for the customer and a cost for the monopolist. Curves $u_1, 2, \dots$ are consumer's utility curves such that $u_1 < u_2 < u_3$ and so on. Analogically, curves $\pi_1, 2, \dots$ are isoprofits of the monopolist such that $\pi_1 < \pi_2 < \pi_3$ and so on.

The location of point O on the contract curve will depend on the bidding power of the agents, that is on the monopolist power, who aims at maximizing profits, and the regulator, representing the consumer and aiming at maximizing social welfare.

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 take place.²⁸

6. Effectiveness and social implications of regulator activity

The regulator may establish maximum prices and minimum quality standards.²⁹ If the maximum price and minimum quality are established independently from each other, that is if there are no regulatory function dependences between maximum price and quality, as well as between the minimum level of quality and price (mathematically $\frac{\partial p_{\max}}{\partial q} = 0$, $\frac{\partial q_{\min}}{\partial p} = 0$) the

²⁸ Hurwicz (1995:66-73) 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.

²⁹ The quality of basic need goods is regulated in appropriate bills and related orders, or in contracts between public authorities (usually municipalities) and operators. Below some examples are given.

In the case of public transport services, the public authorities establish the routes, frequency of connections, timetables and other requirements related to the public interest, as well as fares (Love and Cox 1999).

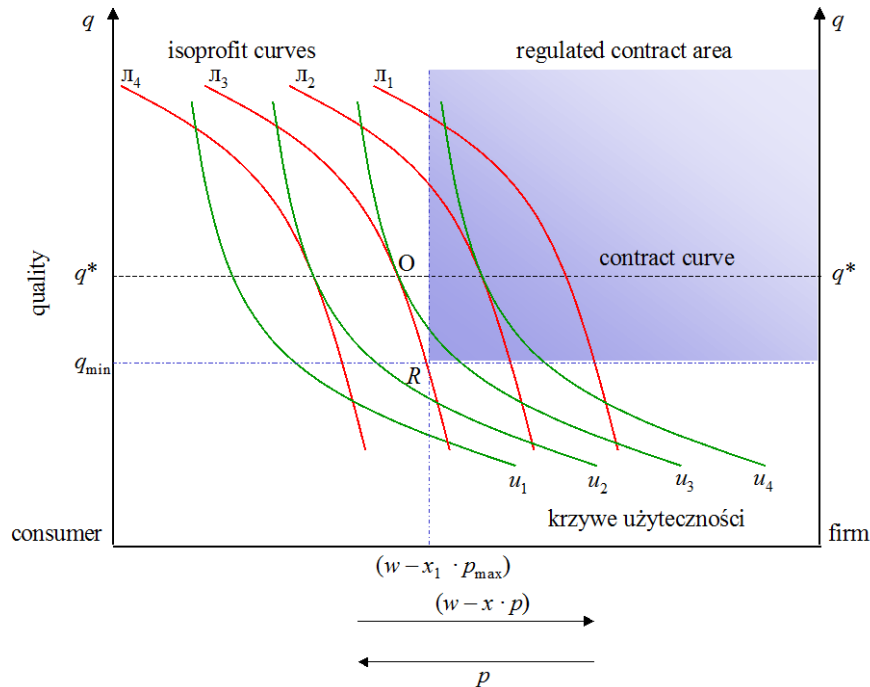
In contracts on disposal of solid waste, after determining the scope of the service, municipal officials need to clearly define, for example, the frequency of waste collection, acceptable times of waste collection, and requirements concerning insurance and warranty and health and hygiene conditions (Dziarski 1999).

The basic instrument measuring the quality of electric energy is the volume of cumulated time of constant outages in a year per customer, planned and unplanned, in the electric energy supply [M. Morgen, "W kierunku jakości energii elektrycznej. Optymalizacja sieci dystrybucji SN" (Towards quality of electric energy. Optimizing the middle voltage distribution network), *Rzeczpospolita*, December 19th 2001, supplement Energia XXIX; M. Díaz-Varela, "El servicio eléctrico empeoró en el 2001" (The electricity service worsened in 2001), *La Vanguardia*, March 6th 2002, Barcelona, p. 55]. Analyzing the quality of energy services provided we should also take into account another volume, i.e. the estimated annual cost of energy not delivered. It increases in line with the annual frequency of short circuits, the volume of peak demand, the length of distributing cables, the length of breaks, invoice price of kWh, and most of all the costs of the consequences of outages. The cost of energy not delivered is estimated at 5-30 USD per MWh in various regions of the world (M. Morgen, op. cit.).

The requirements that drinkable water should meet in Poland are listed in the decree by the Ministry of Health from September 2000. The decree mentions 81 factors: 6 organoleptic, 7 bacteriological, and 68 physiochemical. These norms are very similar to EU and WHO norms. The analysis of water is carried by sanitary and epidemiological inspections. For example, in Warsaw, detailed analysis is carried out every few weeks. Every day only several basic factors are analyzed: turbidity, colour, 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 [L. Krakowski, "Czy wiemy, co pijemy" (Do we know what we drink?), *Rzeczpospolita* No. 92 (6169) April 19th 2002, s. A4].

regulated natural monopolist will aim towards the edge of the regulated contract area – to point R . At this point the monopolist maximizes its profit with respect to price and quality.

Figure 3. Maximum prices, minimum level of quality and regulated contract area



If point R is not on the contract line (that is, if it is below or above the line), price and quality regulation leads to the appearance of Pareto ineffective contracts. If the minimum level of quality is below the optimal level, the monopolist could shift along the same isoprofit (π_3 in figure 3) from point R to point O on the contract curve. This point is more preferred by the consumer than point R (indifference curve u_3). The shift from point O to point R is not possible, however, due to the price regulations.

If the minimum level of quality is regulated above the optimal level, optimal Pareto conditions cannot occur, either.³⁰

The regulator, therefore, has a very difficult, if not Herculean task: to establish maximum prices and minimum levels of quality so as the consequent combination is as close to the contract curve as possible.³¹ This statement refers not only to the case of quasi-line

³⁰ 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 the decrease in the monopolist’s profits. Obviously, the above model situations can be analysed from the perspective of improving the profitability of the monopolist without any changes for the consumer, as well as improving the situation of both the consumer and the monopolist.

³¹ When experiencing the size (and difficulty) of regulating tasks, scientists analyzing this field react in various ways. 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 (“Jak

preferences, so not only in the situation where the Coase theorem for the quality of basic need goods occurs, but also to all cases of regulated monopolies.

The legislators in each country, consciously or not, seems to share an opinion that the optimal level of quality does not depend on the price and quantity of good supplied, or the on initial allocations of agents' endowments, but only on consumers' preferences and the cost function of the producers. On one hand, legislators develop strict quality norms (that is minimum quality standards, which each local monopolist must meet, regardless of the region or the city), on the other hand, those norms give the local authorities the power to accept the prices for government regulated goods, when they find it appropriate.³²

The regulations introducing prices guaranteeing minimum return on invested capital give the investor financial certainty, but from the perspective of effectiveness, this narrows the contract area (in this case as the vertical line on the right side of the contract area in figure 3). Paradoxically, such regulations may even exclude the achievement of Pareto effective contracts on government regulated goods.

regulować sektor telekomunikacyjny. Specjalny urząd nie jest potrzebny”, *Rzeczpospolita* nr 63 (6443), March 15-16, 2003), 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.

³² 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 influence, 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 8th, 1999, p. B1).

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