

Regulation Methods in Natural Monopoly Markets Case of Russian Gas Network Companies

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Abstract

The main stakeholders in the gas distribution sector (government, shareholders and consumers) have different interests and goals. The state, as a regulatory body, should find the best regulatory methods in order to achieve the maximum effect of public welfare: direct (pricing) and indirect (price influencing). The use of the “costs plus” method makes it possible to set the lowest possible tariffs for the transportation of natural gas, but it leads to the emergence of a “tariff precedent”, a loss of profits for companies, limited investment in the development of the sector. In order to stimulate the increase in the efficiency of gas distribution organizations, the implementation of the fundamental principle of gas distribution sector regulation is proposed. The use of incentive regulation will help find a balance in setting prices for gas networks in order to cover the costs of companies, increase profitability, stimulate the development of networks and innovations, establish the optimal price for consumers.

Keywords: gas distribution sector, gas networks, pricing rules, regulation, stimulating mechanism.

I. INTRODUCTION

The midstream segment of the gas industry in Russia is mainly represented by gas networks (hereinafter - GN, or gas distribution organizations - GDO), whose task is to ensure technological coherence of production (upstream) and consumption of produced gas (downstream). The need for state regulation of the gas distribution sector is primarily due to the attribution of GN to public services, which cannot function without special regulation due to the high social significance of their activities.

An analysis of the current gas distribution sector regulation revealed the divergent interests of the main stakeholders, including the government, shareholders and consumers. This divergence leads to certain problems for state – from one point of view it must protect consumers from monopoly prices, from the other - GN are commercial organizations, which means they need profits [1]. These two points of view are quite contradictory since getting profit on a regulated market without competitiveness factor and market prices is not optimal for an enterprise. Consumers are also influencing the situation since they require best quality at lowest price possible. As we can see from these observations, gas distribution sector is very omni-directional and its behavior is

difficult to predict and regulate. It is worth noting that the state in the gas distribution industry acts simultaneously as two stakeholders: the first reflects its interests as an authority regulating the functioning and development of the industry; and the second one represents the interests of the state as the main shareholder of gas companies.

A key tool designed to ensure a balance of interests of the above parties is the policy of state price regulation, the goal of which is to prevent market failures in order to maintain and strengthen public welfare [2, 3]. At the same time, the need for state regulation is justified by the social nature of their main activity - the transportation of natural gas, since gas supply is a vital service area, and is also characterized by high environmental and transaction costs.

Main criteria for effective state regulation at monopoly markets are limited resources distribution, production effectiveness, and distribution effectiveness. However, judging by scientific literature analysis, authors deduce that it is impossible to follow all three criteria simultaneously on such market as gas networks (market of general economic value services) due to imperfect competition character of it.

Consequently, government regulation is necessary to find the best regulatory methods and mechanisms in order to achieve the maximum effect of public welfare [3].

II. ACTUAL GOVERNING MODEL

To achieve the above goal in practice there are several methods of regulation, divided into 2 main groups:

- direct, implemented through state participation in the formation of price structure and size, as well as in the establishment of certain pricing rules;
- indirect, aimed at regulating not the prices themselves, but the factors affecting them. They are provided by the use of a methods and means set with the way of promoting the expansion of product supply in the market, increasing demand, managing household incomes, as well as tax regulation [4].

The regulation of natural monopolies is carried out mainly by direct regulation methods. An analysis of the current state regulation of the gas networks in Russia revealed the existence of strict rules governing the activities of the GDO that underline the following main aspects of regulation: operational activities, investment procedures and regulation period.

The analysis of the scientific literature made it possible to attribute the current method in the field of pricing (tariff setting) for the basic services of gas networks to the traditional cost-based form of regulation, which consists in setting prices (tariffs) based on the summation of "planned" costs with "planned" profitability - the "costs plus" method. In some sources, the "costs plus" method is considered as a special case of rate of return regulation [5].

Both of these methods have a lot in common and allow you to receive income that covers the operating and capital costs of the company, as well as a share of "fair income". However, the "costs plus" method is more strict than rate of return regulation method. The regulated company sets the tariff based on the calculated operating costs, capital involved, and the cost of capital for the agreed period, as a rule, for the last 12 months for which complete data are available. The supervisor then checks these calculations and determines a fair rate of return. The total revenue requirement is determined using verified cost data (Equation 1):

$$RR_i = OE_i + De_i + TE_i + (RB_i * ROR_i) \quad (1)$$

where RR_i - required revenue; OE_i - operational expenses; De_i - depreciation expenses; TE_i - tax expenses; RB_i - rate base; ROR_i - rate of return.

Tariffs for gas transportation services through gas networks can be indexed by the amount of inflation.

It is believed that the use of the "costs plus" method allows setting the lowest possible tariffs for the transportation of natural gas [6].

However, in practice, this method of regulation often leads to appearance of "dropped out" income from the gas operators, which causes them to contact the regional energy commissions with a request to revise the established tariffs or compensate for uncovered costs. In the scientific literature, this phenomenon has the definition of "tariff precedent" [7]. Tariff precedent is necessary for regulated companies to obtain additional funds for a number of needs: pipeline maintenance; measures to improve the quality of fuel transportation; expansion of gas distribution networks, etc.

Further analysis of the current "costs plus" approach revealed a number of significant shortcomings. First, this method directs the gas networks to a situation of "stagnation", since it focuses on restraining profits, and not on reducing costs while maintaining the reliability and quality of the services provided and encouraging innovative activity. Secondly, it stimulates an excessive level of capitalization of the gas networks assets (Averch-Johnson effect [8]) and an increase in costs through an increase in the volume of repair work, the costs of which are non-standardized. Thirdly, the process of tariff adjustment in accordance with the inflation forecast is an unreasonable action, since this increase largely determines inflation itself [9].

Success of the suggested scheme can be determined by market "failures" appearance/disappearance. However, judging by

conducted analysis, existing state price regulation in gas networks is not enough for successful market work. That leads to low gas network profitability, shortage of investments, low gasification level in several country regions, lack of innovation activity, physical and moral depreciation of gas networks.

Main goal of state price regulation is connected with optimal price level evaluation for gas networks and consumers. Resulting price should fulfill requirements for minimal profitability for networks modernization and gas transportation as well as satisfy customers by being optimal. That needs thorough research and redesign of existing regulation schemes in the field of gas distribution.

III. INCENTIVE REGULATION METHODS

It seems proper to consider the foreign experience of regulating the natural monopoly sector, in particular, network monopolies, in order to identify the possibility of adapting successfully applied incentive regulation schemes to the market realities of Russian gas distribution sector.

Analysis of natural monopolies incentive regulation methods

According to the Jamasb and Pollit, the basic idea of incentive regulation is to provide regulated companies with incentives to use their detailed cost information to increase operational efficiency and investment decisions and provide consumers with positive effects from these activities [5]. Thus, incentive regulation allows the use of information asymmetry for positive gains, reducing its negative effects, which, according to Vickers and Yarrow, generate imperfect incentives, which leads to inefficiency [10].

Incentive regulation is usually developed for a specific period and often includes inflationary, effective, and qualitative adjustments. There are 2 main concepts of incentive regulation design schemes [11]:

- "freeze" of the regulatory process: the limit is set at the level of the firm's confirmed costs, but its subsequent adjustment is not fixed, it is carried out only in accordance with the inflation index, therefore natural monopoly subjects are motivated to reduce costs, as they can get additional benefit from their reduction;
- application of external information: determination of limits based on an analysis of external pricing, which would have been established if the market were competitive.

Incentive regulation models were widely used for the first time in the UK regarding the gas industry, but by the mid-1990s almost 50 British companies with natural monopoly characteristics (air transportation, water supply, and electric power industry) were regulated using price limits [12]. Incentive schemes can be included both in the regulation of profits, and in price regulation, taking into account cost-effectiveness, profit distribution mechanisms and / or quality of service.

Three groups of incentive regulation models can be distinguished:

Upper price limit regulation

This method involves the adjustment of external restrictions to increase prices and does not take into account the link between costs and prices, which is the basis of rate of return regulation and "costs plus" traditional methods.

Regulated companies can profit from reduced costs, that is, price regulation has built-in incentives for cost effectiveness. Moreover, this regulation method leads to the implementation of technological innovations, which, in turn, improve the production process. However, price regulation also tends to encourage lower quality, and does not take into account the required expansion of production capacity.

The main idea of this method is to establish limits for goods or services of a monopolist company. In this case price limits can be set for all consumers or for a specific category [13]. A single price limit is used, which means that the entire basket of services is being regulated rather than individual tariffs. This approach allows companies to conduct a very flexible tariff policy and it has some advantages, for example, prevention of costs shifting between consumer segments (that is, there is virtually no cross-subsidization). In the literature, the regulation method of the upper price limit is usually related to the regulation of a goods or services basket [14].

According to Makhholm, there are 3 main elements in the regulation of the upper price limit: 1) taking into account the level of inflation and its evaluation; 2) consideration of the X factor; 3) accentuation of those costs that directly affect prices [15].

Regulation of the upper price limit is often defined by planned periods, and during these periods prices may vary from year to year in accordance with pre-established rules. An establishing period of several years is important, because, otherwise, this method of regulation will not have enough time to implement incentives to improve the efficiency of the monopolistic company. The calculation of the upper limit of company prices (i) in the year (t) is carried out according to equations 2 and 3 [5]:

$$P_{i,t} = P_{i,t-1} * (1 + RPI - X_i) \pm Z_i \quad (2)$$

$$P_i = \sum p_j q_j \quad (3)$$

where $P_{i,t}$ - upper price limit; RPI – retail price index; X_i – efficiency factor; Z_i – external changes indicator; p_j - cost (tariff) of products or services; q_j – quantity of products or services.

In formula 2, the inflation index should take into account changes in the product prices for the whole economy or in sector prices for products or services, the price index of the gross domestic product (GDP deflator), the retail price index (RPI) or other price indexes. The calculation of the X-factor is the most difficult task in this regulation method. The X factor usually takes into account projected performance gains, as well as the potential for efficiency gains. Upper limit price formulas may also contain additional quality factors that

encourage or apply directly opposite measures for regulated companies [16].

In the upper price limit regulation in a predetermined period, the average price of products or services cannot grow faster than, for example, the retail price index. The price of goods or services outside of the basket can be changed for a fixed period, which gives regulated companies some freedom to restructure prices. On the other hand, if companies can cut costs by more than those projected by an efficiency factor of X, then they can save additional profits. This creates incentives to reduce costs. This hypothesis is confirmed in the works of M. Beesley: he emphasizes that the strength of the upper price limit regulation is that this method stimulates the growth of economic efficiency and allows companies to flexibly regulate the price structure within the basket [7]. Moreover, it should be noted that this regulatory method also stimulates innovative development - investing in new technological solutions, since they can retain the benefits and additional revenue associated with the risk of their implementation [17].

The duty of the regulator is to make sure that companies comply with the general pricing formula, while specific pricing decisions are made by the companies themselves [10]. The disadvantage of the upper price limit regulation is the fact that reducing costs can lead to lower quality services. To avoid negative consequences, planned price restrictions may include established quality indicators. A special example of this regulation method is establishing the X-factor equal to the inflation rate, and the Z-coefficient equal to zero, that is, it works as there are no costs associated with external factors [18]. Prices remain constant throughout the entire regulatory period, which forces the regulated company to independently resist the risks of external price shocks (sharp price fluctuations).

Income limiting method

This method of regulation is considered in the academic literature as a particular case of the previous method - the adjustment of the upper price limit, since these two approaches have a huge number of common features. However, there are differences. Unlike the regulation of the average price of a basket of goods or services, regulation by the method of "income limitation" focuses on the total income of the company. According to T. Woolf and J. Michals, the fundamental difference is that the allowable income level may change to reflect changes in sales levels [13]. In other words, you can return the difference between actual and projected income to consumers or recover income.

M. Beesley explains the difference between these two methods of regulation as follows: when regulating the upper price limit, the average price of services in the basket, which is calculated as a weighted average taking into account the previous year, is not allowed to increase by more than the value of "RPI-X". While with the method of "limiting income," the projected average revenue per unit of output cannot increase more than "RPI – X". The forecast of output in the income formula can be based on data from previous periods, and the increase in load is usually taken into account using a specific predetermined correction factor [7]. Equation

4 shows the main components of the profitability calculation [5]:

$$R_{i,t} = (R_{i,t-1} + CGA_i \cdot \Delta Cust_i) \cdot (1 + RPI - X_{i,t}) \pm Z_{i,t} \quad (4)$$

where $R_{i,t}$ – allowable income in year t ; CGA_i – consumer growth adjustment; $\Delta Cust_i$ – change in customer numbers; RPI – retail price index; $X_{i,t}$ – efficiency factor; $Z_{i,t}$ – external changes indicator.

The advantages of the considered method of regulation are very similar to the advantages that are inherent in the method of upper price limit regulation. Additional advantage is that the introduction of incentive schemes, for example, quality adjustments, is a fairly simple process, since adjustments can be implemented directly to regulated revenues. However, if there are no such adjustments, the regulation of limiting income can be an obstacle to the development of quality [19]. The direct impact of various corrective factors may make it easier for stakeholders in the regulated industry to understand the interdependence of regulation and development of the business environment.

Methods of regulating incomes and prices now rarely exist in pure form. In practice, it is more convenient to use a combination of several different regulatory approaches that form different types of hybrid schemes, the theoretical and practical aspects of which are covered in the works of the following modern researchers: Joskow [20, 21], Crew and Kleindorfer [22], Armstrong and Sappington [23].

The price cap regulation or income limiting method can be supplemented by incentive schemes, in terms of quality supply or other parameters as well as in combination with various profit or loss combination schemes (sliding mechanism - contracts with separate economic effect).

Yardstick regulation

Efficiency studies are often carried out using various measurement methods. In general, this type of regulation is a method of encouraging competition between companies through a regulatory mechanism [10, 24]. In other words, the allowed prices or revenues of regulated companies depend on the performance of other companies. Regulation of the criterion can be difficult, since it does not always take into account differences in the business environments of regulated companies. Differences between companies in costs are partly explained due to geographic and demographic factors. Equation 5 shows the key elements of this method of regulation [5]:

$$P_{i,t} = \alpha_i C_{i,t} + (1 - \alpha) \sum (f_j C_{j,t}) \quad (5)$$

where $P_{i,t}$ – overall price cap for a company i ; α_i – share of company's own costs; $C_{i,t}$ – company unit cost; f_i – revenue share or quantitative share of a homogeneous group of companies j ; $C_{j,t}$ – group of companies unit cost j ; n – quantity of companies in specified group.

The advantage of this regulation method is that it can provide the regulator with effective tools for determining the X factor. By comparing similar firms, the regulator can use the costs level of other companies to set a level for a given company

and, by allowing regulated companies to recover estimated rather than actual costs, the regulator can encourage cost reductions and also weaken the information advantage of regulated companies [25]. The considered method of regulation is successfully applied in cases where data on the costs of companies are not available, as well as in conjunction with other methods of regulation [18].

Regulated companies can also be compared with a hypothetically effective model company [18]. However, this approach is rather difficult, since the long-term effectiveness forecasted for a hypothetical model company may not correspond to the real fixed and total costs of regulated companies.

Partial cost adjustment method

In the regulation of partial cost adjustment, prices are related to the actual expenses of the regulated company. Incentives for cost savings are provided by making price adjustments a level lower than they actually change (Formula 6) [5]:

$$P_{i,t} = C_i + \lambda (C_{i,t} - C_i) \quad (6)$$

where $P_{i,t}$ – adjusted price; C_i – model unit price; $C_{i,t}$ – actual unit price; λ – distribution parameter.

Partial cost adjustments can be applied, for example, when assessing the validity of capital investments.

Sliding scale regulation method or profit distribution method

The purpose of profit distribution methods is to share certain risks or the resulting savings between consumers and firms [26].

In the case of savings sharing it is assumed that as a result of the incentive schemes application for regulation purposes, the company will receive excess profits, which can be divided between the firm and its customers according to the rules established in advance. Also, this method allows consumers to directly participate in losses incurred by regulated companies [18].

A distribution option that initiates a refund or price reduction can be defined as a specific number or a wide range.

In the theory of regulation, such a situation in the natural monopolies market is called a “profit sharing contract” or a “sliding scale” method. This mechanism was considered in detail in the works of scientists such as R. Schmalensee and T. Lyon [26, 27]. Researchers have suggested that the introduction of the profits distribution is always a more positive effect than the use of only one method of regulation, for example, the price limit. If we compare the end result of a regulated firm using the sliding scale method and the method of the rate of return regulating, the latter always loses. However, the results of this method are by an order of magnitude more modest than the results obtained using pure methods.

Regulation with a sliding scale allows regulated companies to retain excess profits or to experience a lack of profit in a

predetermined period [18]. Equation 7 mathematically describes a simple regulation method with a sliding scale [5]:

$$r_t = r_{t-1} - \lambda (r_{t-1} - r^*) \quad (7)$$

where r_t – allowed profit level at time t ; r_{t-1} – actual income level at previous period; r^* – yield test factor; λ – distribution parameter.

Menu of contracts

A particular case of hybrid incentive regulation schemes is the contract regulation menu, which allows regulated companies to choose between different incentive regulations, for example, between combinations of price constraints and profit distribution described above [18].

Thus, the company's profit share (σ) can be defined as a function of the X factor deviation, as shown in equation 8 [5]:

$$\sigma = f(X) \quad (8)$$

The maximum allowable return of funds can be set at a sufficiently high level, but there are no guarantees of it, and efficiency requirements are set at a relatively high level. On the other hand, the same contract menu may allow gas networks company owners to choose guaranteed low returns and less demanding performance targets. Different contracts may also include special incentives for the company.

The development of this mechanism was obtained in the works of J. Laffont and J. Tirole [11]. This mechanism allows regulated companies to independently choose a tariff plan, based on individual preferences and features of the industry in which it operates.

Quality regulation

In foreign scientific literature, quality control is distinguished as a separate method of incentive regulation. Thus, incentive regulation contributes not only to cost reduction, but also to quality increase. To reduce the negative effect of the transition to new regulatory schemes and to ensure a sufficient level of gas or electricity supply quality, regulators often introduce targeted incentive schemes that focus on quality issues. In addition, targeted incentive programs can also focus on other specific aspects of work, such as environmental factors [5]. The goal of such programs is to achieve results through the implementation of quality incentive schemes [28, 29, 30].

IV. DISCUSSION

After conducting a thorough study of existing regulation methods, we can summarize their restrictions and benefits.

Restrictions consist of following points:

- high dependence on the existing institutional environment - state has to consider possibility of creating an independent regulator;
- the need to develop additional capital cost monitoring procedures;
- the burden growth for the regulatory body in order to collect more information for a better analysis;

- effective applicability for relatively newly formed energy systems;
- the presence of the adverse information selection risk, as well as unfair behavior.

Benefits can be formulated in this manner:

- the flexibility allows the regulator to create a combination of stimulating mechanisms;
- incentive regulation boost efficiency;
- growth of investment attractiveness;
- greater customer orientation and product/service quality.

It is worth noting that at present, the rate of return regulation and the “costs plus” method are usually combined with effective incentives and profit distribution schemes [3].

The combination of the applied regulatory schemes is individual for each country and differentiated depending on a number of conditions: geography, climatic zones, population density, the prevailing institutional environment, prerequisites for the transition to incentive regulation [31]. Regarding the last point, the Russian researcher Yu. Orlova revealed the following trend: the prerequisites for the transition to this type of regulation in developed countries are due to the need to increase competition and production efficiency, as well as improve the quality of customer service; in developing countries, the transition to incentive schemes solves the problems of establishing business processes, reducing commercial losses, as well as the tasks of public services (gasification and electrification) of the territories [32].

In Russian publications, the following conditions are separated from others because their fulfillment favorably affects the adoption of regulatory reform and the transition to incentive schemes in practice [32, 33]:

- current regulatory rules are transparent and clear;
- the pricing system in the wholesale and retail markets is already established and does not affect the regulation of prices and tariffs in the domestic market;
- a functioning institutional environment contributes to the “painless” introduction of new regulatory schemes;
- regulatory body is independent or incentives and motivation are created for this;
- regulatory policy is predictable.

V. CONCLUSION

At last, after thorough consideration of the incentive regulation theoretical aspects, we can identify the key tasks of the incentive schemes practical application:

- creating strong incentives to minimize costs;
- promoting efficient investment;
- providing fair cost recovery for firms and a fair return on investment;
- improving information disclosure in order to level the traditional asymmetry between the regulator and the regulated companies.

According to I. Vogelsang, the fundamental principle of incentive regulation is to propose practical, not optimal, regulatory methods [18].

Interest to incentive regulation is often reflected by the need for practical regulatory approaches that may not always be consistent with the theories of economics regulation. Right now, the main goal is to find real solutions to practical issues. Some approaches use separate regulation of operating and capital costs - this is an integral approach, that is, its incentives apply to a certain part of the costs (France, Czech Republic, Sweden).

A composite approach is also presented: the total costs are regulated, and the incentives, respectively, affect not only the company's operations, but also investment (Germany, the Netherlands, Spain, Finland). Each approach has its own advantages and disadvantages (Table 1).

Table 1: Main features of regulation approaches [34]

Approach	Evaluation criteria		
	Cost decrease	Investment attractiveness	Risk level for gas networks
Integral	Lowest	High profits possible	Low risks
Composite	Highest	Risks of low profits are presented	High risks

Moreover, in the domestic research project devoted to the regulation of natural monopoly entities, in particular, the consideration of incentive methods as mechanisms to improve the efficiency of network entities, the following trend has been identified with regard to the practical application of incentive regulation schemes [34, 35]:

The most common and applicable incentive regulation mechanisms are those schemes that are aimed at improving the efficiency of operations, as well as improving the quality and reliability of customer service;

The least common and riskier mechanisms are aimed at increasing investment efficiency, as well as schemes whose use entails an increase in system-wide utility or are aimed at increasing the innovative activity of companies.

After analyzing the practical application of incentive regulation, we can conclude that it is in its starting steps in Russia. However, many EU countries have already moved to this type of regulation. The massive choice of incentive schemes came in the mid-2000s. Despite the extensive geography of application, in-depth analysis of countries that use various incentive regulation schemes in practice is very difficult, since there is no "only correct" set of parameters: the duration of the regulatory period (3, 5 or 8 years); regulation

of full costs or separate regulation of operational and capital costs, etc.

Further research will be carried out within the framework of applying a composite approach of stimulating regulation of the operating costs of Russian gas distribution organizations.

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