“Access pricing with multiple competing regulators”, *Leonid Andreev, doctoral student, department of economics*, Telefon: +(47) 46410770, leonid.andreev@bi.no; Norwegian School of Management BI, Nydalsveien 37, 0484 Oslo, Norway.

Abstract

The regulation of access pricing in the energy supplying industries has been intensively studied in the economic literature on access pricing but most of the papers focus on the case with single regulator. In the present work I consider a case of upstream competition between alternative networks regulated by different supervisory bodies, like electricity network that may be provide an alternative access for retail telecom services but is not regulated by the telecom sectoral regulator. If the merger between governmental bodies with overlapping mandates is not an option, it is interesting to study consequences of their possible competition.

A model with two industries and two regulators moving sequentially is applied to study welfare implications of separated versus unified regulation. The unified regulator cares about both industries and consumers while the separated regulators maximize welfare of its respective sectors. Regulators decide access price for the conventional and the bypass network. If the regulator is unified the best alternative is applied, but separated regulators compete in the Stackelberg manner for the entrant.

In this paper that relates to the literature about optimal decision-making design and the access pricing literature I show that the regulatory competition might lead to the non-efficient outcomes due to both prohibition of the socially desirable bypass or the setting non-optimal access prices. If the unified regulator cannot subsidize bypass access that is efficient, but the access provider incurs losses, case with separated regulators may yield more bypass than in the case with the unified regulator. Besides, due to the competition even if the socially desirable bypass occurs, access price may be set below the welfare-optimizing level pushes the access price.

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1. Introduction

Liberal reforms of 90th separated competitive and the regulated segments of the network industries in gas, electricity, and local telecommunications. For the vertically integrated incumbents production of "essential input" (usually transmission and distribution network with features of natural monopoly) was detached from the final output, and the free access for the competitors in the final market was introduced. In electricity market an incumbent often is split into a regulated upstream service provider and an unregulated firm acting in the retail market, while in the local telecommunications an incumbent remains a vertically integrated provider of both retail and wholesale services.

Entry intensifies competition in the downstream market that the authorities often consider desirable and encourage newcomers by mandating open access to existing upstream networks owned by the vertically integrated incumbents. There are two main reasons for this policy. First, production of essential input often exhibits characteristics of a monopoly such as sizeable scale and scope economies and the network duplication becomes socially wasteful. Second, such regulation implies that the incumbent is interested[1] in either total foreclosing the potential entrants (for instance, by charging them with prohibitively high access price) or providing them with access services of deteriorated quality. Therefore, regulators usually impose strict requirements to the price and quality of access although some authors show that the basic assumptions are not necessarily valid.

Although the regulator may encourage to use incumbent's network, an entrant may prefer other solutions. Technological development may cheapen constructing of its own network or make available an alternative provider of essential input. For instance, telecom network may be bypassed by use of existing network infrastructure (electricity, railway) for transmission of the information.

Hence, the potential entrant decides: a) whether to enter; b) whether to purchase access services or to construct its own network; c) if to purchase, either to purchase from the conventional network or employ the

[1] Mandated access is supported by the logic of the “essential facilities” theory of antitrust legislation or the concept of “unbundled network elements (“UNEs”) from the UK’s Telecommunications Act of 1996 (see Kahn, Tardiff and Weismanc(1999), Economides (1999), Hazlett (1999)).

bypass possibility. Access price is often the only regulatory instrument, and hence it is applied for many tasks it may distort optimal decisions of the entrant on either stage.

For instance, socially undesirable network duplication happens when the firm is discouraged from purchasing access from existing network by high access price or sabotage. On the contrary, Vogelsang (2003) shows that mandated access may lead to the underinvestment to the own network.

When entrants have market power, access charges should be used in order to control retail prices, and this would typically lead to reduction in access charges. Lower input costs reduce equilibrium prices, thereby counteracting the entrants' market power. See Laffont and Tirole (2000, section 3.3.1) for a discussion of this issue.

I am interested in situations where the production of the essential input by the bypass producer falls outside regulation of the sectoral supervisor. Sectoral regulators are usually independent branches of the government, whose regulatory tasks and tools of regulation are delegated by the legislative mandate[2], and prescribing the regulator's objectives and the instruments of perceiving them, and changes with changing political goals, technological development[3]. Generally, sectoral regulators are supposed to care about interests of the industry participants, but the regulator's independent status and information advantage over the government provides regulator's significant discretion over the regulatory process such that it may pursue also its own intrinsic interests.

Also, it is not always possible to define clearly the regulatory domain. Sectoral regulators and the competition authorities often have overlap in regulation of the competitive segments of industries. Some industries like gas and electricity in UK became progressively interrelated, something that could give rise to inefficiencies under the existing market frameworks.

Sometimes existing co-ordination problems are solved in an informal way, for example, in Norway the collaboration is established between the regulator of telecommunications (PT) and the media regulator.

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[2] For instance, the British regulator Ofgem must have regard to guidance on the government's environmental and social objectives, issued by the Secretary of State within the overall scheme of regulation established under the Utilities Act (Boweri (2003)).

[3] For example, in the British Utilities Act the overall objective of the regulator has been redefined to "protect the interests of consumers… wherever appropriate by promoting effective competition between persons… engaged in the generation, transmission, distribution or supply of electricity", which replaced a requirement to balance the interests of all industry participants (see Littlechild (2000)).

However some countries started to merge regulatory bodies horizontally or vertically and create new unified regulators, with widely formulated mandate. For instance, the British regulator Ofgem regulates both electricity and gas industries. In the Netherlands the telecommunications regulator (OPTA) merged vertically with the competition authority[4].

Centralization of regulation may solve some coordination issues and reduces costs of communication but brings about costs of other kinds. Specialized regulators possess better industry-specific information and there is a trade-off between rent extraction and efficiency. There are two large groups of models that deal with the issue. In the first, an optimal allocation of regulatory tasks is considered in the context of organisational structure of the government[5]. Here the regulators play a role of either information intermediaries between the government and the regulated firm or links in the decision-making chain.

Some authors consider trade-off between information benefits from having two or more regulators and the corresponding costs, like coordination costs. Laffont (2000) focuses on the benefits from the decentralisation in form of yardstick competition and better commitment of the government. In the structure with more than one regulator and incomplete contracts it is easier to provide incentives to the regulators and to improve information they supply, like in Laffont and Martimort (1997) where asymmetric information between colluding agents creates transaction costs of collusion and makes it less beneficial for regulators. Seabright (1996) argues that the voters better control the local politicians and that is why decentralisation may be preferred.

Sah-Stiglitz (1986, 1988, 1990) model assumes bounded rationality of the decision-makers, that can commit errors of type I or type II and considers trade-off between cost of adopting wrong projects and lost benefits of non-adopting the right ones. Regulatory process should be decentralised if the initial distribution of project quality is favourable, and the cost of communication and regulation are not high.

Another group of models considers the regulatory structure as exogenously given. One firm may be regulated by several regulators divided geographically (i.e. multinational enterprise) or by activity (environmental and

[4] See de Bijl (1998).

[5] The issue of centralisation and decentralisation of regulation is considered as a part of the literature of incomplete contracts in Laffont and Pouyet (2003), Martimort (1999).

monopoly regulation). Baron (1995), Bartolini (2005) studied the issue of missing coordination in the case where more than one regulator regulate various aspects of activity of one firm. For instance, the water utility supplies both water and pollution as a side product, and specialized energy and environmental regulators separately and simultaneously try to influence level of the firm's production. Bartolini (2005) shows that if the externalities are not internalised in the tariff the production would exceed the optimal level, and that the regulators' cooperation is the best option.

Similar to these papers I consider the situation with competition between sectoral regulators, nevertheless in my paper they do not have opposing interests in regulating of the same firm but promote interests of the industries they supervise and become involved into direct competition in the market for the upstream essential input.

The research also relates to the access pricing literature. In the standard model on access pricing vertically integrated incumbent produces and sells essential inputs (e.g., network access) to the entrant, its downstream market competitor. In the upstream market the incumbent is a monopoly and has to be regulated, unlike the retail market where the prices are typically the free market outcome, although the government may affect the market through the access price regulation. It is usually assumed that the lower access price alleviates entry, and that the regulated access price is beneficial for the entrants, but for instance, Damania (1996) used the duopoly model with Cournot competition to show that both vertically integrated firm and its rival are interested in greater input price. The same result is obtained in Sappington (2005) where access price is not regulated and is produced by the bargaining process between the incumbent and the entrant. Moreover, Sappington, Wood and Zarakas (2004) shows that for the standard model of retail price competition any prices for key inputs that ensure the solvency of the incumbent producer will induce the efficient make-or-buy decision.

The first best solution for access prices is that access is priced at marginal cost there is important theoretical background for prices deviate from underlying costs. In the various access pricing models regulator may employ many regulatory instruments as an input tax on entrants, price ceiling on the retail price, ban to price discriminate etc. In today's practice access pricing is often the single instrument the regulator disposes.

From the supply side, marginal cost charge rarely covers fixed costs and if direct subside is unavailable or too costly, Ramsey mark-up over marginal cost is added. From the demand side, if the regulator may allow compensating incumbent's lost profits in the downstream market due to the entry by including a special ECPR component into the access charge. For instance, regulated retail tariffs may be initially set to promote universal service or to redistribute income. Therefore, access service is typically priced above it costs to produce it, although if competition is considered socially desirable regulator may subsidize entry by lowering access price and reimbursing fixed costs to the incumbent.

The situation may be disturbed by the possibility of bypass that can happen even if it is not efficient, i.e. if the incumbent is the least-cost producer of the access service, but the entrant can purchase or produce it cheaper due to the mark-ups on the cost[5]. I emphasise three consequences of bypass: customers are supplied with the services of different quality (perhaps, lower) quality, entrant reduces its input purchasing costs, and vertically integrated incumbent produces less access services which is bad if input production exhibits increasing return to scale.

The main trade-off of the bypass problem is the social costs of network duplication vs. social gain from the better competition (variety, quality improvements etc). In this paper the construction costs of both networks are ignored (assuming that they are sunk) and the difference between the alternatives is that they provide services of different (perhaps, lower) quality with different unit costs. I study the consequences bypass decision (a version of buy-it-or-make-it decision) has on the welfare in the Stackelberg sequential game with the price competition between the regulators.

I show that the regulatory competition might lead to the non-efficient outcomes due to both prohibition of the socially desirable bypass or the setting non-optimal access prices. If the unified regulator cannot subsidize bypass access that efficient but loss-making for the access provider, case with separated regulators may yield more bypass than in the case with the unified regulator. Besides, due to the competition even if the socially desirable bypass occurs access price may be set below the welfare-optimizing level pushes the access price.

The model.

Let us consider an economy with two sectors, providing telecom and electricity services.

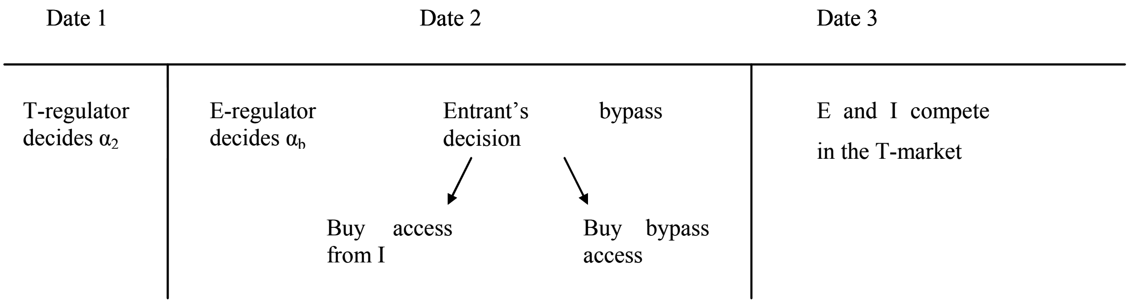


Figure 1[6].

Telecom sector consists from the vertically integrated incumbent *I* operating both in the final downstream market and producing upstream input and the entrant *E*, competing for the downstream customers with *I*. Entrant to the downstream requires the essential input, i.e. access to the network controlled by the vertically integrated incumbent ("bottleneck segment" or the "essential facility"). Entrant chooses between purchasing access from the vertically integrated incumbent or from the alternative source. The technology of production of the final output entails combining one unit of an upstream input with one unit of a downstream input to produce each unit of the retail product. For simplicity the upstream input is assumed to be produced with constant returns to scale.

The entrant chooses the option that maximizes its profit, anticipating the downstream price competition to follow. In the final market the firms compete in prices. The upstream input price, the firms' costs and consumers' preferences are all common knowledge.

I model electricity industry as a single regulated monopoly that provides services in electricity transmission and distribution of required quality in demanded volume by regulated price. This price is computed based on the break-even condition, i.e. the (known) regulated firm's costs from the have to be reimbursed. Customers need a specified volume of services and obtain constant utility from that and greater amount, and zero utility

6 α_2 and α_b are access prices without and with bypass respectively.

if amount is less. The firm cannot reduce its costs by deteriorating quality, and since all costs are observed and reimbursed, the firm supplies exactly needed amount of services of required quality.

Besides its core activity the electricity firm N may also provide access services to telecom entrant E through the existing network. Since the network is already built, costs of providing telecom access is very low such that we can neglect them, but the common costs of the firm's production now should be allocated between the regulated core and the non-core activities, not directly regulated[7].

Choice of methods of allocation of common and fixed costs between the core and non-core activities[8] has weak theoretical underpinnings, and regulator has quite large discretion over the procedure. Here I assume that the regulator may apply freely some cost allocation rule in order to produce desirable share of directly reimbursed common and fixed costs, and that is the same, the electricity regulator directly decides access bypass price.

The timing in the model is as follows (see the figure 1). In the model the two regulators make decisions sequentially, and the telecom regulator moves first.[9] Initially, the price (α_2) at which the entrant can purchase the upstream input from the incumbent is established. Secondly, El-regulator decides the access price for an alternative network. The entrant chooses whether to buy the upstream input from the incumbent or apply the bypass opportunity. Thirdly, the entrant and incumbent determine retail prices simultaneously and independently.[12] Finally, consumers trade in the final telecom market.

As a result of entry the downstream market (the "competitive segment") turns into a duopoly and the prices there are not directly regulated. I and E compete in prices for heterogeneous customers different in their attitude towards the firms and the products they offer.

Customer *i* obtains utility from consuming one unit of good with quality *q* and price *p*

[7] The cost-allocating problem may appear. For example, the firm that is subject to cost-plus regulation in one market and unregulated in another competitive market, would have an incentive to allocate as much as possible of the common and fixed costs to the regulated market. More generally, the firm will wish to shift its costs towards the markets where costs are covered by cost-based scheme from the markets that are either not regulated or subject to a regulation with strong cost-reducing incentives.

[8] Fully distributed cost (FDC), historically recorded cost allocated proportionally to volume; Long Run Average Incremental Costs (LRAIC) that employs the same principle of average costs but takes the perspective economically proved costs not the historically recorded ones.

[9] The specialized telecom regulator has to decide access price by its mandate, and others observe this price and adjust to it.

$$U = s_i q - p$$

parameter s_i is distributed uniformly in the interval $[0;1]$. Since I and E offer products of different quality parameter s may be treated as a measure of individual passion for quality.

The incumbent and the entrant compete in the final telecom market. Assume that the incumbent provide higher quality service than the entrant, i.e. $q_E < q_I$

This is the demand the entrant faces:

$$x_E = \frac{p_I - p_E}{q_I - q_E} = \frac{p_I - p_E}{Q}$$

and the incumbent's demand is correspondingly:

$$x_I = \frac{Q - p_I + p_E}{Q}$$

c_I and c_E denote unit costs of producing downstream products by I and E respectively.

The incumbent's unit costs of producing the upstream input is denoted α_1, and α_2 is an access price that entrant pays.

Q represents quality differential between incumbent and entrant's downstream services (if the letter employs the incumbent's network). I assume that quality of the services produced with use of the input purchased from the competitor may not surpass the quality of the services that the competitor produces itself, and hence Q is nonnegative.

We see that demand for incumbent's service grows with quality differential.

The incumbent and the entrant simultaneously maximize their profits:

$$\max_{p_E} \left\{ x_E (p_E - c_E - \alpha_2) = \frac{(p_I - p_E)(p_E - c_E - \alpha_2)}{Q} \right\}$$

$$\max_{p_I} \left\{ x_I (p_I - c_I - \alpha_1) = \left(1 - \frac{p_I - p_E}{Q}\right)(p_I - c_I - \alpha_1) \right\}$$

f.o.c. yield reaction functions:

$$p_E = \frac{c_E + \alpha_2 + p_I}{2} \quad \text{and} \quad p_I = \frac{c_I + \alpha_1 + p_E + Q}{2}$$

$$x_E = \frac{c + Q + \alpha_1 - \alpha_2}{3Q} \quad x_I = \frac{c + Q + \alpha_1 - \alpha_2}{3Q}$$

(Without bypass the entrant buys access from the incumbent.)

Hence, the entrant and the incumbent charge prices

$$p_E = \frac{2c_E + 2\alpha_2 + c_I + \alpha_1 + Q}{3} \tag{1}$$

$$p_I = \frac{2c_I + 2\alpha_1 + c_E + \alpha_2 + 2Q}{3} \tag{2}$$

And obtain profits

$$\Pi_E = \frac{(c_E - c_I + \alpha_2 - \alpha_1 - q)^2}{9Q} = \frac{(\alpha_2 - \alpha_1 - c - Q)^2}{9Q} \tag{3}$$

and $\Pi_I = \dfrac{(\alpha_2 - \alpha_1 - c + 2Q)^2}{9Q}$ (4)

respectively.

Consumer surplus is

$$S = \int_0^{s^*} (sq_E - p_E)ds + \int_{s^*}^{1} (sq_I - p_I)ds = \frac{(p_I - p_E)^2}{2Q} - p_I + \frac{q_I}{2}$$

Where s* is the share of customers consuming from E.

And with the prices (1)

$$S = \frac{(c + Q - \alpha_2 + \alpha_1)^2}{18Q} - \frac{q_I - 4q_E + 2c_E + 4c_I + 4\alpha_1 + 2\alpha_2}{6} \tag{5}$$

The final market outcome determines amount of access the entrant purchases. It pays the price α_2 to the regulator that reimburses unit cost α_1 to the incumbent. I assume that the regulator may run deficit and therefore there is no restrictions on $\alpha_2 - \alpha_1$ its budget is

$$B = (\alpha_2 - \alpha_1)x_E = \frac{(\alpha_1 - \alpha_2 + c + Q)(\alpha_2 - \alpha_1)}{3Q}$$

For the same values of access prices incumbent's profit and the budget are increasing in α, while consumer surplus and the entrant's profit are decreasing.

The budget is negative, and if we have to have all the players break even, we move to the right, such that Π_I grows, Surplus and Π_E fall.

Entrant's profit falls with α_2 and for $Q>c$ incumbent's profit grows with α_2.

Entry with bypass does not change the nature of the final market competition with the same market outcomes, except E offers services of the deteriorated quality, and B=0.

The formulae (1-5) now look like:

$$p_E^b = \frac{2c_E + 2\alpha_b + c_I + \alpha_1 + Q_b}{3} \qquad (1)$$

$$p_I^b = \frac{2c_I + 2\alpha_1 + c_E + \alpha_b + 2Q_b}{3}$$

$$\Pi_E^b = \frac{(\alpha_b - \alpha_1 - c - Q_b)^2}{9Q_b} \qquad \Pi_I = \frac{(\alpha_b - \alpha_1 - c + 2Q_b)^2}{9Q_b}$$

$$S^b = \frac{(c + Q_b - \alpha_b + \alpha_1)^2}{18Q_b} - \frac{q_I - 4q_b + 2c_E + 4c_I + 4\alpha_1 + 2\alpha_b}{6}$$

If the electricity network company provides bypass access for entrant, it will obtain profits from that, given the assumption about the zero unit costs and the zero profit from the core activity:

$$\Pi_K = \alpha_b x_E^b = \frac{(\alpha_1 - \alpha_b + c + Q_b)\alpha_b}{3Q_b}$$

The baseline case.

Assume that the planner can determine both downstream and upstream prices. In this case it maximizes $W = \Pi_I + \Pi_E + \Pi_K + S_T + S_K + B$ w r.t. α_2, α_b, p_I, p_E.

W without bypass $W_w = \dfrac{-(p_E - p_I)^2 + 2c(p_I - p_E) - 2c_I Q + Q(q_I - 2\alpha_1)}{2Q}$ does not depend on α_2.

F.o.c. with respect to retail prices yields relationship $p_I = p_E + c$ which implies

$$W_w^* = \frac{c^2 - 2c_I Q - 2Q\alpha_1 + Qq_I}{2Q} \qquad (6)$$

In this case choices of the upstream prices and the level of downstream prices do not affect the social value given equal weights for the profits and the consumer surplus, but if the profits are less valuable for the planner they may be set on the zero level (to avoid subsidizing) without loss in the welfare, which entirely goes to the consumers. Then, we need

$$p_E = \alpha_2 + c_E \qquad p_I = c_I + \alpha_1$$

From $p_I - p_E = c + \alpha_1 - \alpha_2$ follows $\alpha_1 = \alpha_2$

$$p_E = \alpha_1 + c_E$$

And analogously for the case with bypass:

$$p_I = p_E + c + \alpha_1$$

$$W_b = \frac{2(\alpha_1 + c)(p_I - p_E) - (p_I - p_E)^2}{2Q_b} - 2c_I - \alpha_1 + \frac{q_I}{2} \qquad (7)$$

And

$$W_b^* = \frac{2\alpha_1 c + c^2}{2Q_b} - 2c_I - \alpha_1 + \frac{q_I}{2}$$

Bypass is optimal for the α_I bigger than $\frac{c\left(\sqrt{Q_b}-\sqrt{Q}\right)}{\sqrt{Q}}=\alpha^I$, i.e if only the quality with and without bypass were equivalent bypass would be always optimal.

Now I consider cases with unified regulator and two separated regulators. The regulators typically do not control the retail prices and have the access prices as a single instrument of regulation.

Unified regulator

As in the baseline case the unified regulator cares about the firms and the customers in both sectors, but can decide just access price α_2 and the bypass access price α_b. The unbiased regulator considers maximal attainable social welfare W with and without bypass and commands the entrant which one to use.

a) *Entry without bypass*

The maximal welfare in this case is given by

$$W(\alpha_2)=\Pi_E+\Pi_I+B+S$$

Welfare maximization and first-order condition yield $\alpha_2^*=\alpha_1+Q-2c$, which produces an efficient outcome $p_I-p_E=c$

Substituting this into the objective function yields the efficient outcome:

$$W_w^*=\frac{c^2-2c_IQ-2Q\alpha_1+Qq_I}{2Q}$$

b) *With bypass*

If the entrant employs bypass possibility the social welfare is a sum of the consumer surplus in the T-market, profits of entrant, incumbent and the extra profit of the network electricity firm:

$$W_b(\alpha_b)=\Pi_E^b+\Pi_I^b+\Pi_N^b+S^b$$

F.o.c. gives us $\alpha_b^* = -2\alpha_1 - 2c + Q^b$ which is positive only if $\alpha_1 < \frac{Q^b}{2} - c$. If a bypass access price is negative the electricity company profit is negative as well and these losses have to be reimbursed through the transfers or higher prices for its core product. If such transfers are unattainable the non-negativity condition has to be introduced, i.e. until $\alpha_1 = \frac{Q^b}{2} - c$ $\alpha_b^* = -2\alpha_1 - 2c + Q^b$, and if α_1 is higher $\alpha_b = 0$: $\alpha_b^* = \max\{0; -2\alpha_1 - 2c + Q^b\}$.

Maximal affordable welfare with bypass is efficient

$$W_b^* = \frac{2\alpha_1 c + c^2}{2Q_b} - 2c_I - \alpha_1 + \frac{q_I}{2}$$

The social planner chooses the optimal provider for the entrant and sets the input price on the optimal level. Bypass is preferred if W_b (α_{b^*}) is greater than $W_w(\alpha^*)$. Bypass point is efficient as well: $\alpha^* = \frac{c\left(\sqrt{Q_b} - \sqrt{Q}\right)}{\sqrt{Q}}$

Regulatory game of two separated sectoral regulators

Now we have two regulators each for each industry. Regulators move sequentially by choosing access price for the entrant.

There are some simplifying assumptions:

- Firms serve only their own customers;
- There are no horizontal relations between the firms, such that incumbent never buys access from the alternative access provider.

In this case regulators separately maximize each own programmes W^T and W^E respectively. The model is solved backward. The E-regulator takes the access price α_2 as given and sets its own access price α_b, trying to underbid the T-regulator's offer. Reaction of the final telecom market is incorporated into the E-regulator problem. Here I assume that the K-firm cannot run with deficit.

If the E-regulator does not manage to offer α_b that yields better profit for the entrant, bypass does not happen.

Stage 2: the E-regulator's problem

The E-regulator solves problem and finds a bypass input price $\alpha_b(\alpha_2)$ as a reaction function of the conventional input price.

$\max_{\alpha^b} W^E = \Pi_K$ s.t. a participation constraint $\Pi_E^b \geq \Pi_E$

The Lagrangian

$$M = \Pi_K + \left(\Pi_E^b - \Pi_E\right)\mu$$

f.o.c. yields:

$$\alpha^b = \frac{(\alpha_1 - c_E + c_I + Q_b)(3(1+\lambda) - 2\mu)}{2(3 + 3\lambda - \mu)}$$

$$\frac{\left(c_E + \alpha^b - c_I - \alpha_1 - Q_b\right)^2}{9Q_b} \geq \frac{(c_E + \alpha_2 - c_I - \alpha_1 - Q)^2}{9Q} \quad \text{and} \quad \mu \geq 0$$

We must also verify that $\Pi_K > 0$, i.e. $\dfrac{\left(\alpha_1 + c_I - c_E - \alpha^b + Q_b\right)^2}{3Q^b} \geq 0$

1. $\mu = 0$

$$\alpha^b = \frac{\alpha_1 - c_E + c_I + Q_b}{2} = \frac{A_b}{2}$$

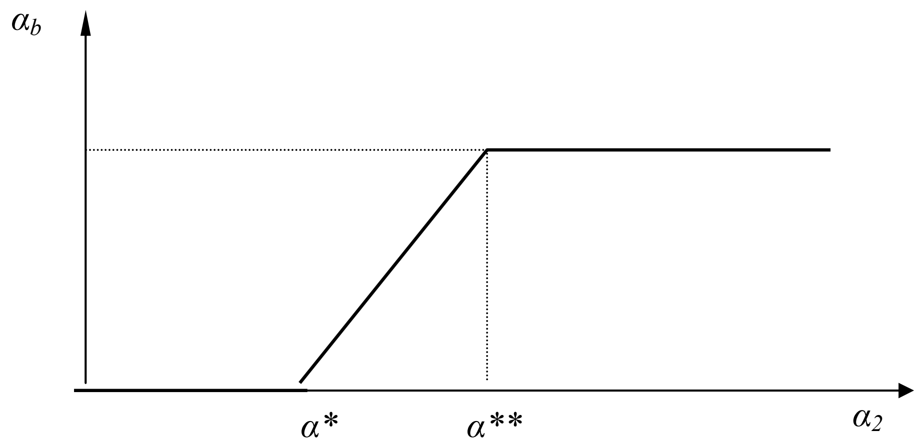


Figure 1. Response of E-regulator to the choice of access price by the T-regulator. Access price below α* prevents bypass.

in order to satisfy the $\Pi_E^b \geq \Pi_E$ α_2 has to belong the interval $\left[A - \sqrt{\frac{Q}{Q_b}} \frac{A_b}{2}; A \right)$

where $A = \alpha_1 + c + Q$

$A_b = \alpha_1 + c + Q_b$

$c = c_I - c_E$, c is positive by assumption.

2. $\mu > 0$. The bypass constraint is binding, i.e.

$\frac{Q}{Q_b}(\alpha_2 - A)^2 = (\alpha_b - A_b)^2$; and $\alpha^b = A_b + (\alpha_2 - A)\sqrt{\frac{Q_b}{Q}}$

In order to have $\Pi_N > 0$ we have to have $\alpha_2 \in \left[A - A_b \sqrt{\frac{Q}{Q_b}}; A - \frac{A_b}{2} \sqrt{\frac{Q}{Q_b}} \right)$

The maximum access price that the T-regulator may charge without triggering bypass is $\alpha_2 = A - A_b\sqrt{\frac{Q}{Q_b}} = \alpha_2^*$. Prices above up to $\alpha_2 = A - \frac{A_b}{2}\sqrt{\frac{Q}{Q_b}} = \alpha_2^{**}$ determine the bypass access price according to the reaction function of the E-regulator, and when it becomes constant. (see the figure 1).

If $\alpha_2 < \alpha_2^*$ bypass price is 0.

If $\alpha_2 \in \{\alpha_2^*; \alpha_2^{**}\}$ bypass price is $\alpha_b(\alpha_2)$

If $\alpha_2 > \alpha_2^{**}$ bypass price is constant.

Stage 1: The T-regulator's problem

In the first stage T-regulator decides whether to allow bypass or not and what price to set in either case. The response function of the E-regulator is incorporated into the problem. The telecom regulator maximizes the sum of the entrant's and the incumbent's profits, consumer surplus and its own budget, and a possibility of bypass is considered a constraint.

$$W^T = S + \Pi_I + \Pi_E + B$$

I consider separately cases with and without bypass and when discuss the T-regulator's decision. [10]

a) Preventing bypass

In this case the T-regulator's problem does not differ from the case with unified regulator except the optimal access price is bounded from above.

$$\max_{\alpha_2} W_T^d \text{ s.t. } \alpha_2 \geq 0 \text{ and } \alpha_2 \leq A - A_b\sqrt{\frac{q}{q_b}}$$

The function is concave in α_2, and therefore there may be either interior or corner solution to the problem, depending on the values of parameters. In the former case the outcome is optimal for the situation without bypass, but otherwise the welfare would be lower, and we observe welfare loss if the bypass is not allowed.

[10] Separate discussion of two cases matters if the decision about bypass is already taken by, say, the government, but the regulator may pick up any nonnegative access price.

Proposition 1: In the case with regulatory competition for $\alpha_1 \geq 3c\sqrt{\frac{Q_b}{Q}} - c - Q_b$ threat of non-optimal bypass makes T-regulator to charge the access price below the optimal level.

Proof: The T-regulator determines α_2 that maximizes its utility given the constraints. It keeps α_2 at the utility-maximizing level $\alpha_1 - 2c + Q$ or at the lowest possible level that does not trigger bypass such that bypass yields smaller utility for the regulator. Therefore, for $\frac{c\left(\sqrt{Q_b} - \sqrt{Q}\right)}{\sqrt{Q}} > \alpha_1 > 3c\sqrt{\frac{Q_b}{Q}} - c - Q_b$

$\alpha_2 = A - A_b\sqrt{\frac{Q}{Q_b}}$ which is less than $\alpha_2^* = \alpha_1 - 2c + Q$ and generates social welfare at the lower level. □

In the figure 3 we can see that with the regulatory competition optimality path is followed down to tangency point T, and further for $\alpha > \alpha^T$ the T-regulator chooses maximal possible access price that does not trigger bypass (which is below the optimal value), such that the competitor may not undercut its offer, until the Incumbent's costs become too high to produce access itself. Above α^I bypass is accommodated, but the bypass price is pressed to the lowest possible level at the interval (α^T,α^I). The greater α^I above α^I the greater social loss from the separation is.

b) Accommodating bypass

The T-regulator has an option to allow bypass and the maximum satisfaction it may achieve by determining access price can be found from the problem:

$$\max_{\alpha_2} W_b^d \text{ s.t. } \alpha_2 \geq A - A_b\sqrt{\frac{Q}{Q_b}} \text{ and } \alpha_2 \leq A - \frac{A_b}{2}\sqrt{\frac{Q}{Q_b}}$$

Where W_b^d is the utility of the T-regulator in this case. T-regulator knows that any $\alpha_2 > A - A_b\sqrt{\frac{Q}{Q_b}}$ triggers bypass, but by choosing α_2 in $\left\{A - A_b\sqrt{\frac{Q}{Q_b}}; A - \frac{A_b}{2}\sqrt{\frac{Q}{Q_b}}\right\}$ T-regulator makes the E-regulator to outbid the T-regulator's price according to its response function. It has no point to set α_2 above the upper boundary of the interval because the E-regulator loses sensitivity to α_2. Hence, the optimal choice for the T-regulator has to lie inside the interval, but because the objective function is convex in α_2, it may be one of the corner solutions: either the left or right boundary of the interval[11].

Direct comparison of two corner solutions helps us to establish the useful interim result.

Proposition 2: In the situation when the T-regulator has to allow bypass (or cannot charge the prohibitively low price) but has an authority to decide the bypass access price it will be chosen α_b at the lowest possible level.

Proof: The T-regulator always chooses the corner solution with $\alpha_b = 0$. The function is convex, and the optimal solution lies at the interval's boundary. Let us compare the right ($\alpha_b = A_b/2$) and the left ($\alpha_b = 0$) corner solutions. The values are plugged into the objective function. Since $W_b^d(A_b/2) - W_b^d(0) = -\frac{(\alpha_1 + c + Q_b)(5\alpha_1 + 5c + Q_b)}{24Q_b}$ may not be positive for the positive values of parameters, $\alpha_b = 0$ is the utility-maximizing solution for the T-regulator.

The optimized value with bypass for the T-regulator is then

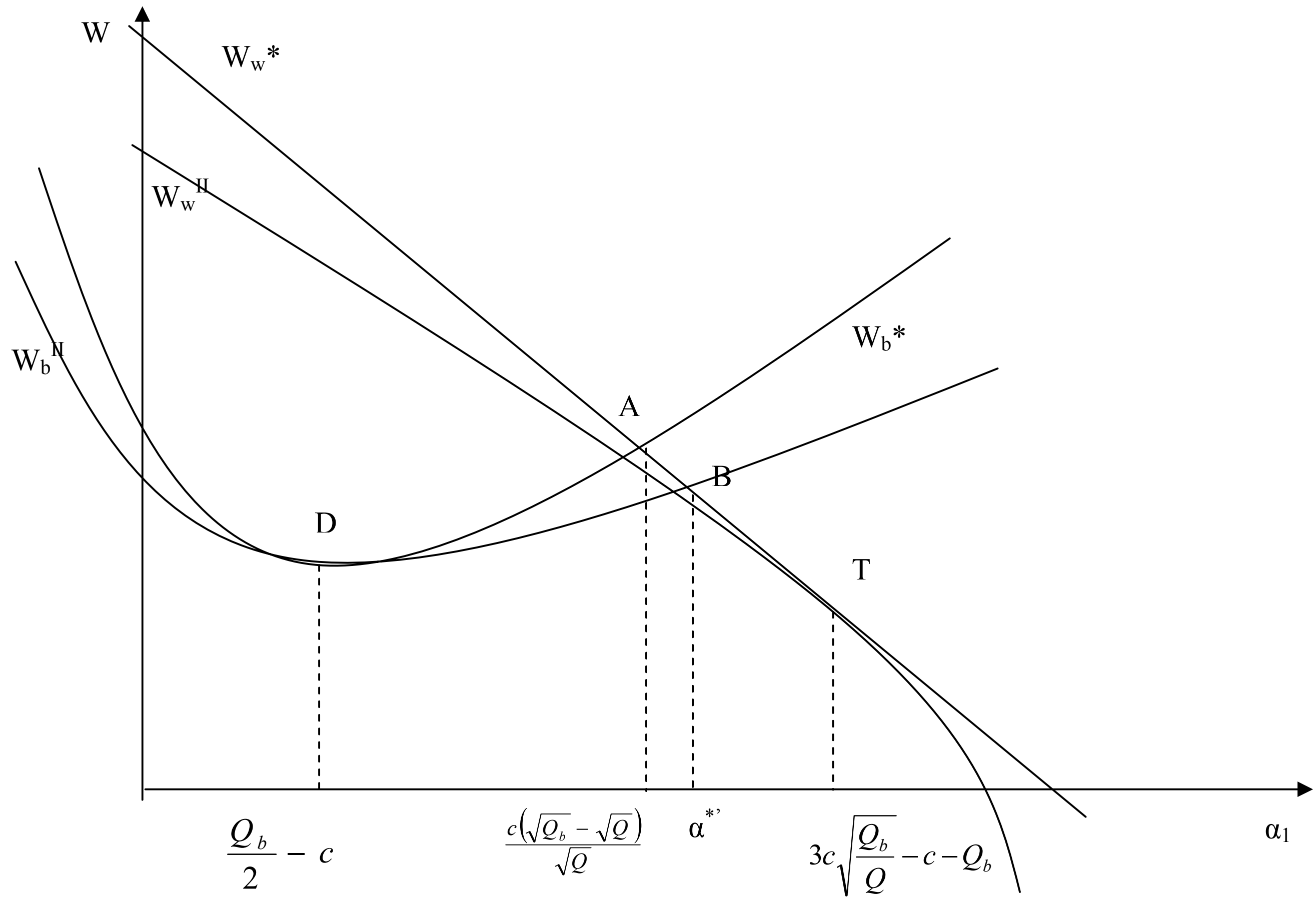
$$\frac{5(\alpha_1 + c)^2 - 14(\alpha_1 + c) + 14Q_b - 18c_E Q_b + 9Q_b q_b}{18Q_b}$$

If the decision about allowing bypass is made by the government and the regulator is mandated to choose the access price, it will squeeze the whole profit of the electricity company by setting α_b equal to zero.

[11] On the opposite, maximization of the concave social welfare function would yield $\alpha_2 = A - \sqrt{\frac{Q}{Q_b}}(\alpha_1 + c)$.

There are two possibilities. The functions W_b may cross the W* above the tangency point T and in this case bypass points are given by the intersections of W_b* and W_b^{II} with W* (points A and B respectively) (figure 3).

1. The figure 2 depicts the first case. The bypass points A and B render intersections of respectively W_b* and W_b^S with W_w*. W_w* is the decreasing function of α_I and we can see that $\alpha_{II} > \alpha_I$ and $W_w(\alpha_{II}) < W_w(\alpha_I)$.



Now, I can establish a proposition 3:

Proposition 3. If final cost differential c is big enough (greater than $\frac{\sqrt{QQ_b}}{2}$), bypass happens rarer with separated regulators than the regulators are unified. The necessarily condition for that is bypass access price is negative and the access bypass provider is subsidized.

Proof: $c > \frac{\sqrt{QQ_b}}{2}$ is the necessary condition for both T and A lies to the right from the tangency point D. Therefore, the bypass points for two cases are given by intersections of Wb* and Wb^I respectively with the same falling Ww*, and hence $\alpha^A > \alpha^B$.

$$W_b^* = \frac{(\alpha_1 + c)^2}{2Q_b} + \frac{q_I - 2\alpha_1 - 2c_I}{2}$$

$$W_b^0 = \frac{5(\alpha_1 + c)^2}{18Q_b} - \frac{-4c + Q_b - 9q_I + 14\alpha_1 + 18c_I}{18}$$

$$W_W^* = \frac{c^2}{2Q} + \frac{q_I}{2} - \alpha_1 - c_I$$

$$\alpha^A = \frac{c\left(\sqrt{Q_b} - \sqrt{Q}\right)}{\sqrt{Q}} \qquad \alpha^B = \frac{3\sqrt{QQ_b(5c^2 + QQ_b)}}{5Q} - c - \frac{2}{5}Q$$

$\alpha^B > \alpha^A$ for all $c > \frac{\sqrt{QQ_b}}{2}$ (and $\alpha^B = \alpha^A$ for $c = \frac{\sqrt{QQ_b}}{2}$).

The T-regulator alone is less inclined to allow bypass because since it ignores benefits outside the T-sector, and allows it only if the incumbent's input production costs are greater than α*.

Nevertheless, under the assumption of nonnegative bypass access price the unified regulator decides α_b=0 to the right from the point D where W_b^I tangents W_b^*, and hence the case with the unified regulator produces the same bypass point B as the case with separated ones. (It is the case if downstream producing cost differential is quite big relatively to the quality differentials, i.e. if $c \geq \frac{\sqrt{QQ_b}}{2}$.)

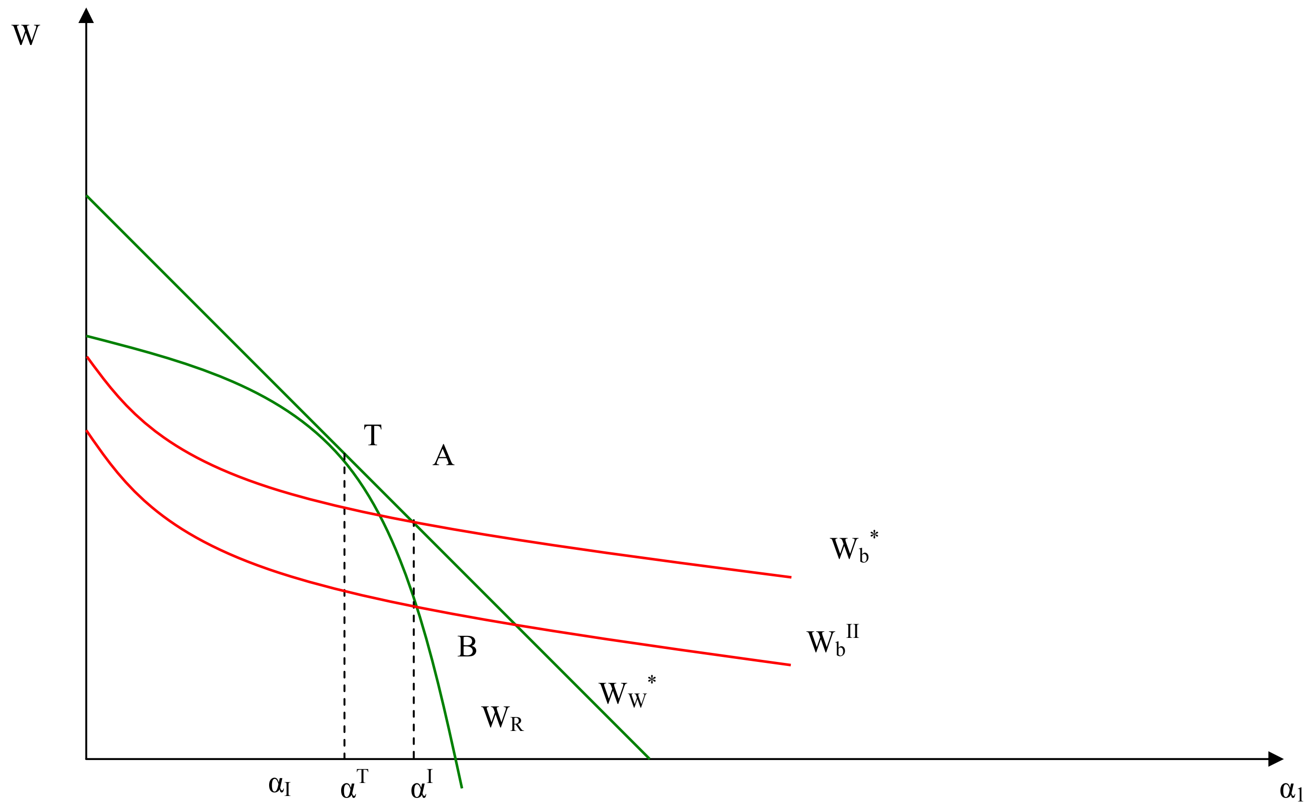


Figure 3.

If $c < \frac{\sqrt{QQ_b}}{2}$ the W_b* crosses W_w* below the tangency point T (the figure 3) and here bypass in the unified regulator case (point A) is determined by the intersection of W_b* and W_w*, while the intersection of W_w^R and W_w* produces bypass point B with separated regulators.

Proposition 4. If c is relatively small bypass occurs efficiently with the separated regulators, but there is welfare loss due to the non-optimal choice of the variables.

Proof: If $c < \frac{\sqrt{QQ_b}}{2}$ bypass point in the case with separated regulators W_w^R and W_b* intersect in $\alpha_1 = \frac{c\left(\sqrt{Q_b} - \sqrt{Q}\right)}{\sqrt{Q}}$, exactly like the intersection of W_w^R and W_w*

Conclusion

In the paper I study what happens with the price regulation of essential input if the input may be supplied not only by the regular but also by an alternative provider, staying outside the scope of the specialized supervisor. Situations like that occur for instance if the bypass provider is not regulated on the national level. Existence of the unregulated bypass opportunity inevitably imposes a constraint on the access prices the regulator can choose, even if the potential bypass provider does not behave strategically. Besides, in this paper the bypass access price is decided by another actor that knows the initial offer and may outbid it.

The outcome of the game is quite intuitive: lack of coordination increases chance for the efficient bypass would be prohibited or/and the access prices would be set not optimally. Therefore, in the model regulatory separation always reduces social welfare, and hence the merger between competing governmental bodies is a right solution. Nevertheless, in some degree the result hangs on the assumptions on the nature of retail competition, information structure, cost structure and the succession of the players' moves. The natural extensions of the paper are related to relaxation of these assumptions.

For instance, there is no information asymmetry, and if we assume that the unified regulator does not know with certainty some cost or demand parameters, that the sectoral regulators know, centralization may be more costly than separation. Moreover, the conventional regulator may outbid the bypass provider even if it is inefficient because it has the first mover's advantage, and with another succession of moves result would be different.

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