INSTITUT FÜR VOLKSWIRTSCHAFTSLEHRE

der

UNIVERSITÄT AUGSBURG

Optimal Regulation of Technical Progress In Natural Monopolies with Incomplete Information

by

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Beitrag Nr. 115 März 1994

Volkswirtschaftliche Diskussionsreihe

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March 1994

Abstract

The focus of this paper is to design optimal regulatory mechanisms which provide for technical progress in natural monopolies taking into account the strategic behaviour of the firm based on incomplete information. One question is, how regulatory schemes intended to reduce monopoly prices and consequently welfare losses would affect the R&D decisions of the firm under consideration. Additionally, we model a regulatory scheme where R&D is optimally determined by the regulator. Our main results are: (a) For the first-best policy we find that firms have an incentive to overstate true costs in order to induce the regulator to subsidize them by an amount in excess of R&D expenditures. (b) Optimal regulatory schemes leaving R&D decisions under the control of the firm are not able to generate a technical progress at a level which could be achieved with a second-best policy. (c) In the case where the regulator determines the level of R&D, by correction of the shadow price of R&D he is able to set its level in such a way that further price reductions and welfare improvements are possible - the second-best solution.

JEL: L51, O3, H42

1. Introduction

The focus of this paper is to design regulatory mechanisms which provide for technical progress in natural monopolies taking into account the strategic behaviour of the firm based on incomplete information. The main question is, how regulatory schemes intended to reduce monopoly prices and consequently welfare losses would affect the R&D decisions of the firm under consideration. With regard to R&D we only investigate the case where these activities lead to improvements in the production process.

Assuming profit maximizing behaviour of the firm a monopoly should have an incentive to accomplish R&D efficiently whenever production costs can be reduced. However, as monoploy rents occur this could not be optimal in a Pareto sense. So, what is the effect on the firm's R&D decisions when regulatory schemes are imposed? As rents are reduced one might expect inefficiencies. In the case of traditional RoR-regulation á la Averch/Johnson (1962) this has been shown in Cantner/Kuhn (1993). In a first reaction to this result one might postulate that any regulatory policy should be designed as not to distore the firm's R&D decisions.

However, if it can be shown that following this rule a pareto-optimal solution can not be obtained, a further question arises: Do optimal regulatory mechanisms exist where the additional direct regulation of R&D has welfare improving effects although the regulator has limited information about costs. In this paper we try to characterize such mechanisms and show that they can assure only for a second-best solution.

We proceed as follows. In section 2 we formulate the basic model and in 3 we discuss the first-best policy of a social planner who is fully informed about production costs. Asymmetric information is introduced in section 4 where we show that the first-best policy will induce the firm to report untruely in order to receive transfers to cover R&D - as a quasi-fixed cost - in excess. Section 5 discusses the optimal regulation where R&D decisions are left to the firm. Contrary to this arrangement, we analyze in section 6 the effects of direct regulation of R&D expenditures. We summarize our analysis in section 7.

2. Basic Model

We consider the production of a private good of quantity q under conditions of natural monopoly. The firm's demand function is given by

$$q(p)\ ,\quad \frac{\partial q}{\partial p} < 0 \tag{1}$$

and the cost function is

$$C(q,R;\theta) = c(\theta,R)q + R \tag{2}$$

where marginal costs are increasing in θ, $c_\theta(\theta,R)>0$ and decreasing in R, $c_R<0$, $c_{RR}>0$. R represents the R&D expenditures of the firm and θ is a parameter representing private knowledge about cost conditions. The price of R&D is normalized to 1. For the type of technological change we consider only process innovations. In (2) R may be interpreted as quasi fixed costs in so far as average costs are declining but as R is a strategic variable of the firm its optimal value will depend on q. As the objective function of the firm profit maximization will be assumed as usual.

The firm is regulated by a social planner where information is asymmetric. This asymmetry is given by the parameter θ which is only known to the manager of the firm. The regulator is able to impose a price schedule $p(\hat{\theta})$ and a transfer schedule $T(\hat{\theta})$ which have as their only argument the reported value of θ furtheron to be labeled as $\hat{\theta}$. This form of regulation is known as regulation á la Loeb and Magat (1979) and Baron and Myerson (1982), the LMBM-regulation. In an alternative model developed in our paper the regulatory scheme is enlarged by an R&D schedule $R(\hat{\theta})$.

As usual we further assume that the regulator attempts to maximize social welfare W defined as the sum of consumer CS and a fraction α of producer surplus Π, $\alpha \leq 1$. The parameter α reflects the welfare loss caused by unequal distribution of profits among the society. For $\alpha = 1$ we consider the case of a public firm (with no welfare loss due to distribution), with $\alpha < 1$ it may account for the fraction of private shareholders.

3. First-Best Policy

First consider as a normative yardstick the optimal policy of a social planner who has complete information about θ and who attempts to maximize social welfare here defined as the sum of consumer surplus CS and producer surplus Π

$$W = CS + \Pi \tag{3}$$

This is equivalent to a situation where a public firm produces the good under consideration ($\alpha = 1$) and no moral hazard[1] occurs. Maximization of social welfare with respect to R and p leads to the following first order conditions:

$$p = c(\theta, R) \tag{4}$$

$$c_R(\theta, R)\, q(p(\theta)) = -1 \tag{5}$$

As usual the social planner runs production until price equals marginal costs. Additionally he engages in R&D until the cost of R equals its marginal value product. Please note that producer surplus in this case is negative. Therefore, a private

[1] For a discussion of technical progress in public production run by bureaucratic managers see Cantner/Kuhn (1994).

monopoly to produce and supply this good has to be subsidized with a transfer T covering R&D expenditures completely:

$$T(\theta) = R(\theta) \tag{6}$$

Let us compare this solution with the case of an unregulated monopoly which also engages in R&D. Here, first the well known Cournot solution applies with price above marginal costs. Second, R&D will accomplished according to (5) where, however, the marginal productivity of R&D is higher and hence the amount of R&D spent lower. The reason for this is that the output in the Cournot solution is lower compared to the one obtained by the social planner.

4. Asymmetric Information

Remember (a) that the regulator does not have information about marginal costs and (b) that R&D is a strategic variable of the firm which normally is not expected to be regulated because a profit maximizing firm has a natural incentive to accomplish the cost minimizing level of R&D. In order to implement a regulation scheme the regulator depends on the report $\hat{\theta}$ of the firm. Hence, if the regulator tries to set first best policy $M=\{p(\hat{\theta}), T(\hat{\theta})\}$ with

$$p(\hat{\theta}) = c(\hat{\theta}, R(\hat{\theta})) \tag{7}$$

$$T(\hat{\theta}) = R(\hat{\theta}) \tag{8}$$

it can immediately be shown that the firm has an incentive to overstate costs. And as a consequence the firm will receive a transfer above their optimal R&D expenditures $R(\hat{\theta},\theta)$. Note that the regulator can compute the transfer by assumption that the firm will choose R&D efficiently. However, for this calculation he has to use the reported value $\hat{\theta}$.

To prove the above statement:[2] The regulated firm maximizes profits Π with respect to $\hat{\theta}$ and R:

$$\Pi(\hat{\theta},R;\theta) = p(\hat{\theta})q(p(\hat{\theta})) + T(\hat{\theta}) - c(\theta,R)q(p(\hat{\theta})) - R \tag{9}$$

First order conditions imply that

$$\hat{\theta}(\theta) > \theta \tag{10}$$

$$T(\hat{\theta}) = R(\hat{\theta}) > R(\hat{\theta},\theta) \tag{11}$$

where $R(\hat{\theta},\theta)$ denotes the optimal level of R&D chosen by the firm. With this solution the underlying regulation cannot be optimal. This result has to be qualified as the regulator is assumed to believe that the firm reports truely. In the next chapter we want to give up this assumption. This allows us to present a model where an optimal regulation scheme can be found based on the regulators' expectations about the true cost conditions.

5. Optimal Regulation with Private R&D Decisions

Our model is designed as a Bayes-Nash game where nature is assumed to determine the type $\theta \in [\theta^-, \theta^+]$. The expectation of the regulator about θ is represented by a density

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2 For conditions (10) and (11) to hold one has to consider that $\partial R/\partial\theta > 0$ for all TETA. A sufficient condition for this to hold is (a) that $c_{R,\theta}(\theta,R) < 0$ and (b) a relatively inelastic demand function which can be expected normally in the case of public production. For (b) see equivalently Dasgupta/Stiglitz (1980). (a) means that R&D has cost reducing effects also when the parameter θ is increasing.

function $f(\theta)$ with the property that $f(\theta)>0$ and $F(\theta)/f(\theta)$ is nondecreasing[3] where $F(\theta)$ is the associated distribution function. The regulator then has to choose a mechanism which maximizes expected social welfare by taking into account the optimal reponse of the firm. The strategy set of the firm consists of functions $\hat{\theta}(\theta)$ and $R(\hat{\theta}, \theta)$ in order to maximize profits taking a certain regulatory scheme as given.

To derive a Baysian-Nash equilibrium we follow the revealation approach suggested by Baron/Myerson (1982).[4] The optimal solution can be obtained in two steps. First, we characterize mechanisms which guarantee that the dominant strategies of the firm satisfy the following conditions:

$$\hat{\theta}(\theta) = \theta \tag{12}$$

$$R(\hat{\theta},\theta) = R(\theta,\theta) =: R(\theta) \tag{13}$$

This means that the firm maximizes profits only by reporting true costs and perform R&D expenditures efficiently (with respect to the optimal quantity determined by the regulated price level). Furtheron the regulatory scheme has to provide for that profits

$$\Pi(\theta) \geq 0\ , \ \textit{for all}\ \theta \tag{14}$$

In the second step the welfare maximizing mechanism will be selected by the regulator.

Let us start with the characterization of mechanisms which provide for a revealing of true costs and an undistorted R&D allocation of the firm. Given any regulatory scheme

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3 This condition is satisfied for the uniform, normal, exponential and other frequently used distributions. See Baron (1989, p.1372).

4 See also Baron (1989) for an detailled description of the procedure.

$\{p(\hat{\theta}), T(\hat{\theta})\}$ the maximization of $\Pi(\hat{\theta}, R; \theta)$ as given by (9) leads to the following first order conditions:

$$\frac{\partial \Pi}{\partial \hat{\theta}} = p'(\hat{\theta})q(p(\hat{\theta})) + T'(\hat{\theta}) + \left(p(\hat{\theta}) - c(\theta,R)\right)q'(p(\hat{\theta})) = 0 \tag{15}$$

$$\frac{\partial \Pi}{\partial R} = -c_R(\theta,R)q(p(\hat{\theta})) - 1 = 0 \tag{16}$$

From (15) and (16) the firm's optimal response functions with respect to θ can be derived: $\hat{\theta}=\hat{\theta}(\theta)$ and $R=R(\hat{\theta},\theta)$.

Taking $\Pi(\theta)$ as the state variable and assuming optimal response of the firm we obtain:

$$\Pi(\theta) = \int_{\theta}^{\theta^+}\left(c_\theta(\theta^o,R(\theta^o))q(p(\theta^o)) + \left(c_R(\theta^o,R(\theta^o))q(p(\theta^o) + 1\right)\frac{\partial R}{\partial \theta}\right)d\theta^o + \Pi(\theta^+) \tag{17}$$

This allows to determine a transfer schedule $T(\hat{\theta})$ given by:

$$T(\hat{\theta}) = \int_{\hat{\theta}}^{\theta^+}\left(c_{\hat{\theta}}(\theta^o,R(\theta^o))q(p(\theta^o)) + \left(c_R(\theta^o,R(\theta^o))q(p(\theta^o)) + 1\right)\frac{\partial R}{\partial \hat{\theta}}\right)d\theta^o$$
$$+ \Pi(\theta^+) - p(\hat{\theta})q(p(\hat{\theta})) + c(\hat{\theta},R(\hat{\theta}))q(p(\hat{\theta})) + R(\hat{\theta}) \tag{18}$$

Substituting this transfer $T(\hat{\theta})$ into the definition of the profit function (9) and taking the derivatives with respect to $\hat{\theta}$ and R it can be shown that after some algebraic manipulations the first-order conditions simplify to:

$$\left(c(\hat{\theta},R(\hat{\theta})) - c(\theta,R)\right)q'(p(\hat{\theta})) = 0 \tag{19}$$

$$\frac{\partial\Pi}{\partial R} = -c_R(\theta,R)q(p(\hat{\theta}))-1 = 0 \tag{20}$$

With respect to (19), since $\partial R/\partial\hat{\theta}>0$ this implies $\hat{\theta}=\theta$. Using this result, (20) implies $R(\hat{\theta},\theta)=R(\theta)$ which means that R&D is accomplished efficiently given the optimal quantity $q(p(\theta))$ - which, however, can determined only when the price schedule has been announced.

In the second step the regulator chooses a price schedule in order to maximize expected welfare W:

$$W = \int_{\theta^-}^{\theta^+}\left\{\int_{p(\theta)}^{\infty} q(p^o)dp^o - T(\theta) + \alpha\Pi(\theta)\right\}f(\theta)d\theta \tag{21}$$

subject to $\partial p/\partial\theta \geq 0$ for all $\theta \in [\theta^-, \theta^+]$ and (14).[5]

Substituting the $T(\theta)$ from (18) and $\Pi(\theta)$ from (17) and differentiating with respect to $p(\theta)$ we obtain as necessary condition:

$$p(\theta) = c_\theta(\theta,R(\theta))\frac{F(\theta)}{f(\theta)}(1-\alpha) + c(\theta,R(\theta)) \tag{22}$$

First note that $p(\theta)$ is monotonous as required considering our assumption on the distribution of θ (see footnote 2). As normally the regulated price is independent of the demand function because of constant marginal costs. It depends on the marginal costs, the prior information of the regulator, R&D expenditures and ownership parameter α.

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5 After substitution of $T(\theta)$ (14) can be replaced by $\Pi(\theta^+)\geq 0$ because $\partial\Pi/\partial\theta<0$ holds for all θ. Then $\Pi(\theta^+)$ becomes a control variable of the maximization problem, with the optimal value of $\Pi(\theta^+)=0$. Concerning the constraint of a non-decreasing price function this is a result from the fact that $\hat{\theta}(\theta)=\theta$ to be the dominant strategy of the firm. See Baron (1989) for detailled discussion.

To interprete (22) price exceeds marginal costs whenever $\alpha < 1$. Although this price is lower than the one found in the unregulated Cournot solution, the regulator still faces a welfare loss due to private ownership. This can be interpreted as a rent on private costs information appropriated by the monopolist. The rent is here given by the term $(1-\alpha)F(\theta)/f(\theta)$. As price is distorted from marginal costs these rents cannot be eliminated totally. Insofar this shows to be the standard result found in regulation theory.

The results with respect to R&D are of major importance for our analysis. We find that R&D as optimally choosen by the firm according to (16) has a cost decreasing and therefore price decreasing effect. Consequently, output is comparably higher than without R&D engagement. Furtheron a Cournot monopolist would spent a lower amount of R because Cournot output is comparably lower than the output found here requiring a higher productivity of R&D there. However, the regulated R&D level, although from the firm's point of view choosen optimally, is still not pareto-optimal because the monopolist is not operating at marginal cost prices.

Therefore it would be interesting to ask whether the regulator could improve on this by regulating R&D directly. This could be done by applying more powerful regulatory schemes which allow the firm to use certain budgets for research purposes only fixed by the regulator in a socially optimal sense. To remember, we find that private monopolist does not guarantee for this because of price distortions.

6. Optimal Regulation of R&D

In this section we consider regulatory mechanisms $M=\{p(\hat{\theta}), T(\hat{\theta}), R(\hat{\theta})\}$ which are enhanced by direct regulation of R&D, like p and T also depending on $\hat{\theta}$. As a consequence the strategy set of the firm is reduced and now contains $\hat{\theta}$ only. Induced dominant strategies of the firm have to satisfy the following:

$$\hat{\theta}(\theta) = \theta \tag{23}$$

$$\Pi(\theta) \geq 0 \;, \; \textit{for all } \theta \tag{24}$$

The reaction function of the firm is the same as derived in (15) where R has to be substituted by $R(\hat{\theta})$ which is taken by the firm as a parameter.

Proceeding as in section 5 we obtain for the state variable Π:

$$\Pi(\theta) = \int_{\theta}^{\theta^+} c_\theta(\theta^o, R(\theta^o))\, q(p(\theta^o))\, d\theta^o + \Pi(\theta^+) \tag{25}$$

and for the optimal transfer as a control variable of the regulator:

$$T(\hat{\theta}) = \int_{\hat{\theta}}^{\theta^+} c_{\hat{\theta}}(\theta^o, R(\theta^o))\, q(p(\theta^o))\, d\theta^o + \Pi(\theta^+) - p(\hat{\theta})\, q(p(\hat{\theta})) + c(\hat{\theta}, R(\hat{\theta}))\, q(p(\hat{\theta})) + R(\hat{\theta}) \tag{26}$$

Substituting these results again into the definition of profits $\Pi(\hat{\theta},\theta)$ and differentiate with respect to $\hat{\theta}$ indicates that $\hat{\theta}(\theta)=\theta$, which is the dominant strategy.

Maximization of the expected social welfare with respect to $p(\theta)$ and $R(\theta)$ (and $\Pi(\theta^+)$) subject to $\Pi(\theta^+) \geq 0$ and $\partial p(\theta)/\partial\theta \geq 0$ for all θ implies the optimal price function:

$$p(\theta) = c(\theta, R(\theta)) + (1-\alpha)\, c_\theta(\theta, R(\theta)) \frac{F(\theta)}{f(\theta)} \tag{27}$$

For the optimal regulation of R we obtain:

$$-c_R(\theta,R(\theta))q(p(\theta)) = 1 + (1-\alpha)c_{\theta,R}(\theta,R(\theta))q(p(\theta))\frac{F(\theta)}{f(\theta)} \tag{28}$$

For an interpretation of (27) and (28) we should first emphasize that R(θ) and p(θ) are determined simultaneously. The main difference between the price schedule in (27) compared to (22) is that in the former the regulator chooses the level of R&D whereas in the latter it is the firm's decision.

We find that price in (27) would be lower whenever the optimal regulation schedule enforced by (28) leads to a higher R&D-level than the firm would engage in as determined by (16). Inspection of (28) shows that the regulator finds it optimal to correct the factor price of R&D whenever firm ownership is (partly) private and information is (consequently) incomplete. The resulting shadow price of R&D given by RHS of (28) is lower than its market price (=1). Thus, a comparably higher level of R&D is induced.

This result implies that the regulator finds it optimal to enforce an inefficient level of R&D from the firm's point of view. Although this would rise costs above minimal costs and reduce producer surplus, the rising consumer surplus overcompensates this loss. The underlying regulation scheme is therefore to be considered as a second-best policy where the level of R&D is pushed towards the pareto-optimal solution. The distortion of the factor price of R&D nevertheless has to be considered as optimal since this is a consequence of the inevitable distortion of the commodity price under the assumed scenario.

7. Concluding Remarks

The main results of our paper can be summarized as follows: (a) For the first-best policy we find that firms have an incentive to overstate true costs in order to induce the regulator to subsidize them by an amount in excess of R&D expenditures which are to be taken as quasi-fixed costs. (b) Optimal regulatory schemes leaving R&D decisions under the control of the firm are not able to generate a technical progress at a level which could be achieved with a second-best policy. The reason for this result is that although R&D expenditures are accomplished efficiently from the firm's point of view they are not high enough to induce the regulator to further reduce the price towards the level of marginal costs. (c) In the case where the regulator additionally determines the level of R&D, by correction of the shadow price of R&D he is able to set its level in such a way that further price reductions are possible. Thus, total welfare increases by a reduction of producer surplus and a comparably higher rise in consumer surplus.

As to the policy implication of our results, it would be interesting to compare them with the performance of a public firm facing the same regulatory constraints. However, this makes sense only when the rent seeking behaviour of public managers and moral hazard is taken into account. With respect to the discussion about deregulation one should be cautious to interpret our results as an argument for strengthening regulation. To give an definite answer to this question one has to compare the performance of the regulated monopoly with oligopolistic competition possibly enforced by deregulation. However, in the case of natural monopolies considered here where high sunk costs - like R&D -could prevent competitive firms from entry, it might not be successful to establish oligopolistic competition. Under these circumstances optimal regulation schemes such as those developed here can be seen as a prefered second-best solution.

References

Cantner U. and T. Kuhn (1994), Technical Progress in Bureaucracies, forthcoming in: Public Choice. For a German version see also Institut für Volkswirtschaftslehre, Universität Augsburg, Working Paper #61, 1991.

Cantner U. and T. Kuhn (1993), A Note on Technical Progress in Regulated Firms, Institut für Volkswirtschaftslehre, Universität Augsburg, Working Paper #105, 1993.

Baron D.P. (1989), Design of Regulatory Mechanisms and Institutions, in: Schmalensee R. and R.D. Willig, Handbook of Industrial Organization, Volume 2, Elsevier, 1989.

Baron D.P. and R.B. Myerson (1982), Regulating a Monopolist with Unknown Costs, Econometrica, Vol.50(4), 1982, pp.911-29.

Dasgupta P. and J. Stiglitz (1980), Industrial Structure and the Nature of Innovative Activity, Economic Journal, Vol.90, 1980, pp.266-93.

Loeb M. and W.A. Magat (1979), A Decentralized Method for Utility Regulation, Journal of Law and Economics, Vol.22, 1979, pp.399-404.

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