Price – Cap Regulations

- and applications to monopolies in India -

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Abstract

Regulation of monopolies has been a controversial topic dating back to the industrial revolution. Since the introduction of anti-trust laws in the nineteenth century, several methods have been devised to limit the profits that a monopolist should derive. Most prominent among these is the rate-of-return regulation, which caps the return on investment that a monopoly is permitted. However, following the seminal paper by Averch and Johnson, the rate-of-return regulation was mostly abandoned.

In India, most monopoly regulation regimes are of the price cap variety. However, there have recently been several issues regarding whether regulation in some industries are required are not. This paper hopes to provide some theoretical answers to this question.

For that, I first provide a graphical idea of why price cap regulation is superior to rate – of – return regulation. After that, I construct a model that quantifies the cost-reduction incentive for the monopolist operating under a price-cap regime, and finally I present a model of the determinants of the extent of regulation required in a particular industry and its applications in a few Indian industries.

Contents

Section 1

Why Price Cap Regulation?

It is widely acknowledged that rate-of-return regulation leads to an inefficient allocation of resources in the form of over-capitalisation. It also provides a disincentive to cost reducing innovations since the rate of return is fixed. A lot of research has gone into the reason why a price – cap regulation is thus superior to rate-of-return regulation. While leading to greater surplus for the monopolist in the short run, price-cap regulation also leads to cost-reduction and better allocation of resources.

First, I attempt to graphically illustrate why a price-cap regulation is a superior regulatory mechanism to rate-of-return regulation.

Let us start with a case wherein price-cap regulation and rate-of-return regulation fix the same price P_o to be charged by the monopolist. Let the average cost of production for the monopolist equal c_o. For the regulation to be binding on the monopolist, the price P_o has to be below the monopolist price P_m. At this lower price P_o fixed by the regulator, the MR curve would shift down.

To compare the relative effects of a cost reduction in the case of a price-cap regulation vis-à-vis a rate-of-return regulation. Let the monopolist then employ a cost-reducing innovation that reduces the average cost of production from c_o to c_1.

In the case of a rate-of-return regulation, the decrease in cost increases the returns for the monopolist. Since the monopolist was earlier already maximizing his returns (in case the constraint was binding), a decrease in cost would increase his returns beyond the permitted rate of return. Hence, the price permitted due to the regulation would reduce from P_o to P_1. This would represent a loss from the monopolists' earlier surplus, and due to this, the full effects of a reduction in marginal cost (MC) would also not be realized since the marginal revenue (MR) curve also shifts in. These effects can be seen in the following figure.

However, in case of a price-cap regulation, a decrease in cost from C_o to C_1 leads to an unambiguous increase in the monopolists' profits. If this increase in profit is represented by Π, then:

$$\Pi = \int_{c_1}^{c_0} q_m(c).dc$$

Diagrammatically, this increase in profit can be represented by:

Thus, a price cap regulation leads to greater effort by the monopolist into cost reducing innovation. While in the short run the benefit of this innovation accrues to the monopolist, in the long run, the price cap can be reduced to increase consumer surplus.

Also to be noted is the fact that price-cap regulation also ensures that the benefits from cost reduction also result in an increase in the quantity of the good produced by the monopolist and hence, for a regulator whose aim also includes making the commodity available to the maximum number of people, price-cap regulation is superior to rate-of-return regulation.

Section 2

Monopolist's Response

In this section, I deal with the question of how a monopolist responds when placed under price-cap regulation.

Let us consider a monopolist who produces quantity q_s, which is dependent on the cost of production c and the price set by the regulator p_o, i.e. q_s (c, p_o). Since in our model, the price by the regular does not change[1], we can take q_s to be a function only of c.

Let there be two periods – period 1, in which the regulator sets the price p_o based on the actual cost c_0[2]. At the end of period 1, the monopolist realizes a fall in cost of production from c_0 to c_1.

$$c_o - c_1 = f(e)$$

Where e is the investment effort undertaken by the monopolist. However, even the monopolist does not know the exact reduction in cost that the investment effort will yield. Hence, the new cost c_1 is a random variable given by:

$$c_1 = F(e)$$
$$\text{s.t. } F'(e) > 0 \text{ and } F''(e) < 0$$

As can be seen in figure 2.1, the benefit that the monopolist gets from a reduction in cost is given by:

$$\Pi = \int_{c_1}^{c_0} q_s\,(c).dc \text{ - e}$$

G Clemenz (1991) uses mathematics which is beyond the scope of this paper, to derive the expected value of this benefit to be given by:

$$\Pi = \int_{0}^{c_0} q_s\,(c).F\,(e).dc \text{ - e}$$

[1] The monopolists' investment decision will also be based on the frequency of revision of the price cap. For more information on how the time horizon affects investment decision, refer to Biglaiser and Riordan (2000), Pg. 745

[2] Regulator has perfect information about cost. For information asymmetry, refer to Section 3.

The first order condition for maximization of Π is given by: (1)

$$\int_0^{c_0} q_s(c).F'(e).dc = 1$$

The corresponding second order condition is given by:

$$\Pi''(e) = \int_o^{c_o} q_s(c).F''(e).dc$$

Given our assumption that $F''(e) < 0$, hence the first order condition is both a necessary and sufficient condition for benefit maximization.

Hence, we can observe from equation (1) that the investment effort by the monopolist will depend on three factors:

(1) Initial Cost (c_0): If the initial cost is high, then the benefit from a reduction in cost is high, since in equation (1), the integration happens over a wider range. This is intuitively obvious.

(2) Distribution of c_1(F(e)): The distribution of c_1, i.e. F(e), will be an important determinant of investment effort since if F(e) is distributed very close to c_o, then the monopolist will not want to undertake investment effort. However, this distribution might not always be available to the monopolist, and hence might not play a significant role in the decision-making process.

(3) The Size of the Market (q_s): The most important determinant of investment decision is the size of the market. If the size of the market is large and/or growing, then the monopolist will undertake a high level of investment. This is because the monopolist is likely to reap the benefits of increased market size.

Section 3

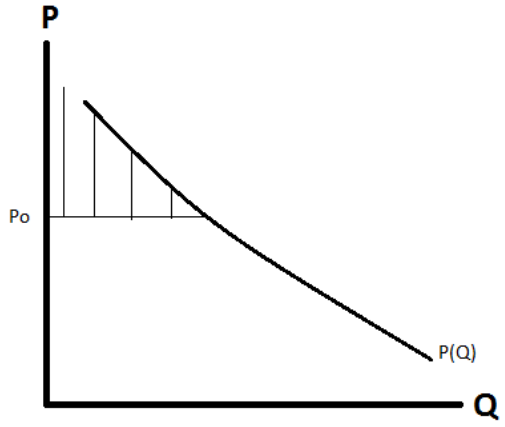
Issues in Regulation

In this section, I discuss what issues are to be considered by the Government in deciding whether a particular industry under monopoly or oligopoly should be put under regulation or not. For this, I construct a simple theoretical model and use calculus to solve for optimum.

Since in India, most of the regulations are of the price – cap variety, we only consider price – cap regulation in this section.

Let there be a regulator who fixed the price charged by the monopoly or oligopoly (henceforth referred to only as a monopoly) at P_o. The objective of the regulator is to maximize the consumer surplus, i.e. the area of the region under the demand curve.

FIGURE 1: THE OBJECTIVE FUNCTION FOR THE REGULATOR



An omniscient (i.e. all-knowing) regulator would fix a price P_o equal to, or marginally above, the average variable cost (AVC) of producing the good such that the monopolist does not exit the business.

However, the problem faced in most regulations is that there is an asymmetry of information, i.e. only the monopolist knows the true cost, and has an incentive to exaggerate his cost so as to raise the regulator-set price, and earn a greater profit. To find out the true cost, a regulator must undertake an audit, which might also not always yield correct results and more importantly, it will include a cost.

In the simple model that we set up, let there be a regulator who has to decide what price cap to set. Let the true AVC be equal to c_o. Let the regulator invest an amount r in the audit. Let the probability of finding out the true AVC be given by λ, which is a function of the audit cost r, such that:

$$\lambda'(r) > 0$$
$$\lambda''(r) < 0$$

Let there be just two cases – firstly, wherein the auditor is able to discover the true AVC with probability λ and when the auditor accepts the monopolist-declared AVC with probability $(1 - \lambda)$. When this auditor undertakes the audit, the expected value of the AVC discovered by the auditor will be:

$$c = \lambda c_o + (1 - \lambda)\theta c_o$$

Where θ is the factor by which the monopolist exaggerates his AVC. $\theta \geq 1$.

Hence, the objective function facing the regulator is:

$$\text{Max} \int P(Q) - c - r$$
$$\Rightarrow \quad \text{Max} \int P(Q) - [\lambda co + (1 - \lambda)\theta co] - r$$

Hence, the first order condition for existence of a maximum will be:

$$\frac{\partial}{\partial r}\left(\int P(Q) - [\lambda co + (1 - \lambda)\theta co] - r\right) = 0$$
$$\Rightarrow \quad \int \frac{\partial}{\partial r}\left(P(Q) - [\lambda co + (1 - \lambda)\theta co] - r\right) = 0$$

If we assume that the partial differential of price with respect to regulation cost

$$\delta P(Q)/_{\delta r} = \delta P(Q)/_{\delta Q} \; x \; \delta Q/_{\delta r}$$

is fixed, then our problem becomes a simple linear minimization of the marginal benefit of regulation versus the marginal cost of regulation. Let this be represented by ω.

The objective function now becomes:

$$Min\ \omega = \lambda . Co + (1 - \lambda)\theta Co + r$$
$$\Rightarrow \quad Min\ \omega = \lambda . Co\ (1 - \theta) + \theta . Co + r$$

The first-order condition for minimization (interior solution) is: (2)

$$\omega'(r) = Co\ .(1 - \theta).\ \frac{\delta \lambda}{\delta r} + 1 = 0$$

By definition, $\lambda'(r) > 0$ and $\theta > 1$, which implies that $\omega'(r) \leq 1$.

The second-order condition for minimization is:

$$\omega''(r) = Co\ .(1 - \theta).\ \frac{\delta^2 \lambda}{\delta r^2} = 0$$

By definition, $\lambda''(r) < 0$ and $\theta > 1$, which implies that $\omega''(r) > 0$, and hence the first order condition for minimization is both necessary and sufficient.

Hence, to determine whether regulation in a particular sector is required and not, and what should be the extent of regulation, the regulator has to look primarily at three factors.

(1) The Elasticity of Demand: In our analysis, we assumed that the elasticity of demand is negligible, and hence we could ignore the term $\delta P(Q)/\delta r$ in our analysis. However, this will be true only in case of necessary goods, or for goods which are very near to their perfect-competition level of production. Hence, regulation should be introduced in sectors where there is a high level of production as compared to the perfect – competition level, such as transportation, fuel and telecommunications.

(2) Actual AVC: The greater the AVC of the firm, the greater is the requirement of auditing. Hence, industries that are typically seen to have high cost of production are also the ones that require more regulation.

(3) Cost exaggeration by the monopolist: Since every monopolist would ideally like to exaggerate the AVC, θ can be expected to be always more than one. However, the degree of θ might vary from firm to firm. However, if θ is somehow equal to 0, then the industry does not need any auditing.

(4) Marginal benefit of audit: Some industries are such that even better auditing is unlikely to increase the probability of finding out the true cost. These are industries in which the information asymmetry is extremely high. For example, in telecom, due to introduction of new technologies, it is hard to keep track of actual AVC.

Hence, a decision by the Government to place a particular sector under regulation has to be guided by these parameters.

Section 4

Applications

In this section, we analyse a few monopolies / oligopolies / cartels in India and argue intuitively what kind of regulation is required in the industries.

What industries should be placed under regulation?

Referring to equation (2), the first-order condition for the regulation/auditing requirement is given by:

$$\omega'(r) = c_0 . (1 - \theta) . \frac{\delta\lambda}{\delta r} + 1 = 0$$

	$\delta P(Q)/\delta Q$	c_o	$\frac{\delta\lambda}{\delta r}$	θ
Telecom	↓	↓	↓	↑
Railways	↑	↑	↑	1
Healthcare	↑↑	↑	↔	↑

For the telecom sector as a whole, especially when the individual firms form a cartel, elasticity of demand is low, since telecommunications is now a necessity. This should result in greater regulation. However, the marginal cost is low, manipulation of accounts and user base (represented by θ) is high and the marginal improvement in probability of finding the actual cost is low. Hence, regulation in the telecommunications sector can be said to be needless, or at best a failure.

The railway sector is a Government – owned monopoly in India. Hence, there is no incentive for the railways to exaggerate costs, hence θ = 1. Hence, there does not exist any interior solution for level of regulation, and hence, the optimal level of regulation for the Indian railways is r = 0.

If the healthcare sector in India was to be cartelized, then it must be placed under regulation since it is an absolute necessity, costs are high (especially with expanding technology), the cost exaggeration is high and the marginal benefit of regulation is moderate.

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