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MERGER AND REGULATORY INCENTIVES

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# Merger and Regulatory Incentives*

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**Abstract**

This paper examines the incentives for two-product price-regulated firms to cross-subsidize when there are no economies or diseconomies of scope. If the two products are substitutes and each product faces a separate regulatory constraint, after merger the product with the looser initial constraint is favored relative to a regulated, single-product firm. Under a joint constraint, the more tightly regulated product is emphasized. This paper takes as an example a merger between two firms featuring Averch-Johnson behavior. While, in general, merger encourages reductions in joint output, with separate regulatory constraints, the merged firm produces relatively more of the good with a smaller initial degree of overcapitalization.

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# 1 Introduction

An antitrust analysis of a merger of two price-regulated firms requires an extension of the Department of Justice (DOJ) Merger Guidelines. The DOJ Guidelines discuss markets where firms have the ability to increase prices anticompetitively. In the regulated public utility arena, all prices are either set or, at least, approved by the regulatory agency. The Guidelines treat regulation as an "other factor" with little specificity to methodological approach. Welfare effects arising from a merger between regulated firms must be determined within a regulatory framework rather than by asking the question "How does one add regulation to the standard analysis?" If the combined firm is unable to simultaneously raise prices in both submarkets, to prove a successful antitrust argument against a merger of regulated firms requires at least three elements: 1) The firms must be in the same relevant product market;[1] 2) Regulation must provide incentives for the merged firm to further distort prices, inputs or outputs to one of the component companies or the other; and 3) The regulatory agency must allow the merged firm to redirect resources between these business segments.

If two regulated firms can exploit regulatory behavior by merging, over-

[1]A market power theory against merger requires the firms to be within the same market. The DOJ Guidelines asks whether a hypothetical monopolist could profit by raising price five percent. In a regulated market, a firm cannot raise prices at all without regulatory approval. To determine whether the merged firm has market power, one can just examine whether the component firms are in the same general product market, that is, that there are significant cross-elasticities of demand between the two specific products.

all consumer welfare may be reduced even if the two firms produce goods in separate product markets. Regulation often provides the "deep pockets" required for a firm to cross-subsidize a less tightly regulated market. While regulation generally allows the firm to predate in the less regulated product market, it has no incentive to do so for the usual reasons. Models of combination utilities cross-subsidizing separate markets because of cost allocation problems in regulatory accounting schemes under economies of scope are reviewed in McGee (1980) and Brown (1988). This paper is not concerned with this phenomena, but rather with the question of whether significant cross-elasticities of demand between products will induce a price-regulated firm to favor one line of business over another. In the cross-subsidization model, this is a second-order effect and has been ignored. In many markets, though, it may be the only effect. Consider for example a proposed merger of a gas and electric distribution utility. Except for billing and marketing, there are no efficiencies of joint production.[2] It may be the case that these two fuel sources are substitutes. Will the merged regulated firm behave any differently than its separate component firms?

Typical models of regulatory behavior assume a firm maximizes profit subject to a regulatory constraint. This paper compares two firms solving this constrained optimization problem with a single firm maximizing joint profits subject to either separate or joint regulatory constraints.[3]

[2]If the electric company generates electricity, the merger may also eliminate transactions costs associated with the purchase of natural gas.

[3]Using the LaGrange method, if a constraint has a large associated shadow value, the increase in the size of the constrained objective because of a slight relaxation of the

As an example, I consider the Averch-Johnson (A-J) (1962) model[4] of regulatory behavior. An A-J firm maximizes profits subject to a fixed, binding constraint on the rate-of-return to capital.[5]

## 2 The Model

In the A-J model, regulatory behavior is modelled as a constraint allowing the firm to earn nominal profits $(r+s)K$, where $r$ is the cost of capital and $s$ is the excess allowed rate-of-return. The firm maximizes economic profits such that they are less than $sK$. The firm's control variables are capital and labor. The firm is required to meet all demand at the model's resulting price.[6]

constraint, then I will call that constraint "tight."

[4]An excellent graphical treatment of the A-J model is provided in Zajac (1970). A more complete one-firm model is provided in Bailey (1973).

[5]The literature contains many criticisms of that the A-J model. Regulators typically use the rate-of-return only to calculate revenue requirements and then set the price charged until the next hearing. Since, in the A-J model, the firm still controls price, joint output is reduced as the result of the merger. Regardless of this primary effect, the resulting intuition of the relationship between the regulatory constraint and resource allocation is robust.

[6]Using a labor requirements function, $L(Q,K)$, instead of a production function allows the overcapitalization results to arise from a single first-order condition.

The single product firm's problem is:

$$\max_{Q,K} \pi$$

$$\text{subject to} \qquad \pi \leq sK \tag{1}$$

$$\text{and} \qquad \pi = p(Q)Q - wL(Q,K) - rK.$$

The appropriate Lagrangian is:

$$\mathcal{L} = (1-\lambda)(p(Q)Q - wL(Q,K) - rK) + \lambda sK. \tag{2}$$

The appropriate first order conditions are:

$$\mathcal{L}_K = -(1-\lambda)(wL_K + r) + \lambda s = 0 \tag{3}$$

$$\text{and} \qquad \mathcal{L}_Q = (1-\lambda)(p_Q Q + p - wL_Q), \tag{4}$$

which can be solved as:

$$L_K = \frac{-(1-\lambda)r + \lambda s}{(1-\lambda)w} \tag{5}$$

$$\text{and} \qquad L_Q = \frac{p_Q Q + p}{w}. \tag{6}$$

The firm sets its marginal rate of technical substitution at greater than the negative of the ratio of input prices. As a result, the firm overcapitalizes. A firm under this type of rate-of-return regulation sets the marginal-revenue-product of labor equal to the wage rate. The tightness of the constraint, $\lambda$, is, *ceteris paribus,* correlated with a lower allowed rate-of-return on capital and a higher observed degree of overcapitalization.

Equation (5) can be rewritten relating the Lagrange multiplier to the degree of overcapitalization:

$$\lambda = \frac{wL_K + r}{wL_K + r + s}. \tag{7}$$

The assumption of local nonsatiation implies that:

$$0 \leq \lambda \leq \frac{r}{r+s} \tag{8}$$

in which $\lambda$ represents the value to the firm of lifting the constraint. For instance, for a *small* $\Delta\pi$, if the regulatory constraint changed from $\pi \leq sK$ to $\pi \leq sK + \Delta\pi$, after appropriate changes in its control variables, the firm constrained profits would increase by $\lambda\Delta\pi$. The stringency of the constraint is positively related to the degree of overcapitalization. A lower allowed rate-of-return, $s$, is associated with a tighter constraint.

**Proposition 1** *Along its expansion path, a merged two-product firm subject to separate regulatory constraints reduces joint output if the two products are substitutes. After this contraction of output, the merged firm shifts resources to the product with higher marginal profits and a looser pre-merger regulatory constraint relative to the separate one-product A-J firms.*

Consider two firms, each subject to rate-of-return regulation as above. Allow the firms to produce substitute goods with entirely separate cost functions. Once these firms merge, one agent now controls input, output and price variables for both goods, but each line of business remains separately regulated. The superscripts $a$ and $b$ indicate the separate products.

The merged firm's problem is:

$$\max_{Q^x, K^x} \pi^a + \pi^b$$

$$\text{subject to} \qquad \pi^x \leq sK^x \tag{9}$$

$$\text{and} \qquad \pi^x = p^x(Q^x, Q^y)Q^x - wL^x(Q^x, K^x) - rK^x \qquad \forall x, y \in \{a, b\}, x \neq y,$$

where $x$ is the product under consideration and $y$ is the other product. The appropriate Lagrangian is:

$$\mathcal{L} = (1-\lambda^a)\pi^a + \lambda^a sK^a + (1-\lambda^b)\pi^b + \lambda^b sK^b. \tag{10}$$

The first order conditions are:

$$\mathcal{L}_{K^x} = -(1-\lambda^x)(wL^x_{K^x} + r) + \lambda^x s = 0 \tag{11}$$

$$\text{and} \qquad \mathcal{L}_{Q^x} = (1-\lambda^x)(p^x_{Q^x}Q^x + p^x + p^y_{Q^x}Q^y - wL^x_{Q^x}), \tag{12}$$

which can be solved as:

$$L^x_{K^x} = \frac{-(1-\lambda^x)r + \lambda^x s}{(1-\lambda^x)w} \tag{13}$$

$$\text{and} \qquad L^x_{Q^x} = \frac{p^x_{Q^x}Q^x + p^x + p^y_{Q^x}Q^y}{w}. \tag{14}$$

The first order conditions are similar to the one-product case. The degree of overcapitalization is dependent only on the product-specific Lagrange multiplier. The firm sets the marginal-revenue-product of labor in each industry equal to the wage rate taking into account the effect changing each product's output on the other product's total revenue. If the goods are substitutes, overall output is reduced. While the first order conditions regarding input distortion are the same as the one product model, given significant cross-elasticities of demand, the firm has the incentive to redirect customers between products.

Once again, consider each industry separately before the merger. Product $x$'s linearized demand is $Q^x = p_0^x + p_{Q^x}^x Q^x + p_{Q^y}^x Q^y$. A *small* exogenous change in the other industry's output of $\Delta Q^y$ changes this industry's implied demand intercept, $p_0^x$, by $p_{Q^y}^x \Delta Q^y$. This induces a change in the optimal unconstrained profit level by some marginal profit rate, $\frac{\partial \pi^x}{\partial p_0^x}$. Since a *small* increase in the unconstrained profit function of $\Delta \pi^x$ increases the constrained profit level by $(1-\lambda_0^x)\Delta\pi^x$, the other product's output change of $\Delta Q^y$ changes this industry's total profits by:

$$\Delta(\pi^x)^* = p_{Q^y}^x \frac{\partial \pi^x}{\partial p_0^x}(1-\lambda_0^x)\,\Delta Q^y. \tag{15}$$

The $\lambda_0$'s represent a localized value of the constraint at the initial point where the two firms operate independently. These are derived from the one-firm problem for both industries. Allow this product's optimal output to change from the other's output at a rate of $\frac{\partial (Q^x)^*}{\partial Q^y}$. The other product's profits similarly change by:

$$\Delta(\pi^y)^* = \frac{\partial (Q^x)^*}{\partial Q^y} p_{Q^x}^y \frac{\partial \pi^y}{\partial p_0^y}(1-\lambda_0^y)\,\Delta Q^y. \tag{16}$$

From its initial position where both firm's maximize profits subject to the rate-of-return constraint, the newly merged firm will expand output in the product market where the constraint is less binding and the marginal profit from expanding demand is highest, *ceteris paribus*. Since overcapitalization is positively related to the tightness of the constraint, the merged firm will direct resources to the industry with less input distortion. The merged firm will continue shifting resources between sectors until the marginal increase in profits in one sector equals the marginal decrease of profits in the other.

**Proposition 2** *A merged two-product firm subject to a joint regulatory constraint reduces joint output and shifts resources to the product with higher marginal profits and a tighter pre-merger regulatory constraint relative to separate one-product A-J firms.*[7]

In the joint regulated model, the regulator allows the firm to have total profit rate equal to an allowed rate-of-return on the combined capital stock of both business lines.

The merged firm's problem is now:

$$\max_{Q^x, K^x} \pi^a + \pi^b$$

$$\text{subject to} \qquad \pi^a + \pi^b \leq s(K^a + K^b) \tag{17}$$

and $\qquad \pi^x = p^x(Q^x, Q^y)Q^x - wL^x(Q^x, K^x) - rK^x \qquad \forall x, y \in \{a, b\}, x \neq y.$

The appropriate Lagrangian is:

$$\mathcal{L} = (1 - \lambda)(\pi^a + +\pi^b) + \lambda s(K^a + K^b). \tag{18}$$

The first order conditions are:

$$\mathcal{L}_{K^x} = -(1 - \lambda)(wL^x_{K^x} + r) + \lambda^x s = 0 \tag{19}$$

[7]Peles and Sheshinski (1976) present this model where the demands are independent. This would apply to two firms selling the same product in differing geographic markets. Since a joint constraint allows more latitude than two separate constraints, merger is never unprofitable.

$$\text{and} \qquad \mathcal{L}_{Q^x} = (1-\lambda^x)(p^x_{Q^x}Q^x + p^x + p^y_{Q^x}Q^y - wL^x_{Q^x}), \tag{20}$$

which can be solved as:

$$L^x_{K^x} = \frac{-(1-\lambda)r + \lambda s}{(1-\lambda)w} \tag{21}$$

$$\text{and} \qquad L^x_{Q^x} = \frac{p^x_{Q^x}Q^x + p^x + p^y_{Q^x}Q^y}{w}. \tag{22}$$

The first order conditions are the same as in the separately regulated case allowing for only one Lagrange multiplier. The merged firm equates the marginal rates of technical substitution in the two product lines. Once again, the firm sets the marginal-revenue-product of labor in each industry equal to the wage rate, thereby reducing output. In general, the A-J input distortion results are the same. However, given significant cross-elasticities of demand, the firm might have the incentive to direct customers to one product or the other.

If the merged firm is to have both lines of business regulated jointly, it views the constraints as somehow averaging. Consider the two regulated firm, both with binding constraints, merging. Start with the merged firm not changing its choice of inputs. Allowing again $\lambda^x_0$ to represent this industry's Lagrange multiplier in the one firm model, the merged firm can violate this product's constraint by one dollar as long as the other product's constraint is tightened by one dollar. The new regulatory regime allow profits in this industry to change such that:

$$\Delta\pi^x = -\frac{\lambda^x_0}{\lambda^y_0}\Delta\pi^y. \tag{23}$$

Moving along the constraint, the firm will try to shift demand to the previously more constrained product. With joint regulation, since overcapitalization is positively related to the tightness of the constraint, production is shifted toward the more overly capital intensive product. As in the separate-regulation model, the firm shifts demand to the product with greater marginal profits.

# 3 Conclusions

The propositions illustrated above are quite general if the newly merged firm has any control over price. If the two products are substitutes, the firm will reduce overall output. In addition, this firm will favor the less constrained product if each is regulated separately. If regulated jointly, the new constraint is an "average" of the old ones and the firm will favor the product with the tighter constraint. In either case, products with higher marginal profits are favored. The general input distortion conclusions are appropriate over a wide class of behavioral regulatory models.[8]

While a merger may yield incentives for regulated firms to misallocate resources between submarkets, the regulatory agency's rules may foreclose these opportunities. These rules may disallow marketing expenditures aimed at promoting one service over another. Minimum quality regulations may not allow the firm to reduce production of one product with the intentions of shifting to another. An antitrust authority must not evaluate only the

[8] An excellent review of one-product models of regulatory distortion is in Joskow and Rose (1989).

regulated firm's incentives to misallocate resources, but rather the merger, in fact, allows such misallocation.

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