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GOVERNMENT FIRM REGULATION  
OF A  
VERTICALLY INTEGRATED INDUSTRY

BY

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I. Introduction

Government intervention in an industry can take various forms. Fiscal policy (tax/subsidy), antitrust legislation, price and quantity control and nationalization are alternative modes that the state has available to regulate an industry. Another increasingly common form of government intervention is government ownership of one or more of the firms in the industry.<sup>1</sup> In this mode of intervention the state owned firm competes directly with the privately owned firms.

Harris and Wiens [1977a] [1977b] have examined this form of public organization in the situation where the government firm competes directly with privately owned firms in an oligopolistic setting. They addressed themselves to the normative question<sup>2</sup> of how a government firm should be used to promote economic efficiency within a non-competitive environment.

Their fundamental result is that a government firm that acts as a dominant firm in an oligopolistic industry can induce an "optimal" allocation of resources. This allocation is optimal in the sense that all firms behave in a competitive manner. The government firm simulates a competitive environment in the industry by declaring an output and investment in capital stock policy which eliminates the strategic interdependence among the private firms. Their result suggests that government firm regulation is a viable alternative to other forms of public intervention.

The question as to which mode is superior in a given real world situation remains unanswered. Harris and Wiens [1977a] have examined the costs and benefits of these alternative modes of regulating an oligopolistic industry in a world of uncertainty and



imperfect information. In certain situations government firm regulation is the preferred alternative. The purpose of the present paper is to extend the Harris-Wiens analysis to an industry which consists of a small number of vertically integrated firms.

The traditional form of state intervention in a vertically integrated industry is antitrust and vertical divestiture legislation. However, as Williamson [1968] [1975] has clearly pointed out, while market power is decreased and rents are lower when vertical integration is prevented, the social cost of imposing this particular form of organization on industry will normally take the form of decreased economies in production.

Vertical integration represents a shift from a market mode of organization to internal organization. This shift may result in greater efficiency in the sense that the unit cost of producing the final consumption good is reduced. Reasons cited by Williamson [1975] for increased efficiency include attenuation of moral hazards, internalization of externalities, reliability of supply and improved information exchange.<sup>3</sup>

Another source of efficiency mentioned by Williamson and analyzed explicitly by Schmalensee [1973] is the familiar variable proportions distortions argument. If a factor of production is priced above the competitive price, then substitution away from this factor by firms in the next stage of production will result in inefficient factor proportions. A firm with market power in the factor market has an incentive to integrate into the next stage to "capture" some of this efficiency loss in the form of increased rents. However, as we show in section III, output may be further restricted after integration. The efficiency



gain from integration may be partially offset by a welfare loss above that which existed because the firm restricted factor output before integration.

This trade-off presents policy makers with a dilemma.<sup>4</sup> Vertical integration may result in economies in production. Antitrust and divestiture legislation designed to limit merger or integration may have antisocial efficiency implications. The desired welfare gain from increased output may be offset by the loss due to inefficient factor proportions.

In this paper we will argue that government firm regulation can resolve this dilemma. A government firm, by competing directly with the vertically integrated firms can ensure that an "optimal" allocation of resources obtains at each stage of production while still permitting all the economies inherent to integration.

An important aspect of government firm regulation in this situation is the extent to which the government firm itself should integrate.<sup>5</sup> The answer is that starting from the factor markets, the government firm should locate itself at those stages where private firms exercise market power and use the "reaction function mode" of regulation described in section II. To ensure efficiency in its operations, the government firm must also integrate if doing so results in economies of production. This procedure will obtain an "optimal" allocation of resources through the entire industry.

The paper proceeds as follows. In section II we briefly summarize the Harris-Wiens analysis of the "reaction function mode" of



regulation. Section III presents diagrammatically the variable proportions distortions argument. Section IV presents the case for regulating a vertically integrated industry via a government firm. In the final section we examine some of the limitations of government firm regulation and suggest problems for future research.

## II Government Firm Regulation:

The following framework was used by Harris and Wiens [1977a] [1977b] to analyze the "reaction function mode" of regulation via a government firm. Consider an oligopolistic industry where all firms produce the same homogeneous good sold domestically. Assume that either through explicit or implicit collusion industry output is restricted thus rents are being earned by the firms<sup>6</sup> and domestic consumers suffer a loss of consumer surplus. If the government becomes aware of this situation and decides to take remedial action, its intervention can take various forms. Assume it decides to intervene either by purchasing an existing firm or by creating a new firm. If the state purchases a firm previously privately owned it will immediately acquire information on cost and demand conditions in the industry. In either case it will obtain valuable information in the day-to-day operation of its firm.

The government can then extrapolate this information to the entire industry. The accuracy of this extrapolation depends on the correlation between the government firm's and the private firms' cost schedules. Since a substantial subset of the relevant factor prices are the same for all firms in any industry and given equal access to technology,



one would expect that the degree of correlation is quite high. The principal source of variance between cost schedules would be location specific advantages and technologies. At any rate the government can use information about its cost and demand conditions to estimate industry demand and cost schedules.<sup>7</sup>

Suppose the government's initial suspicion is confirmed and it discovers that monopoly rents are being earned. By correctly operating its firm it can eliminate these rents and achieve an "optimal" allocation of resources.

The procedure is quite simple. Given its information regarding demand and cost conditions the government firm can compute that level of industry output for which industry marginal cost equals price of output.<sup>8</sup> The government firm announces that it will make up any difference between target industry output and what the private firms choose to produce. This reaction function ensures that all private firms face a fixed output price and their optimal decisions are to choose their output levels so that price of output equals marginal cost at that output for each firm. Notice that if each private firm is setting output so that price equals its marginal cost; then the above reaction function will ensure that the government firm sets output so that price equals its marginal cost.

Of course, to be effective the government firm's reaction function must be credible. If the private firms decide to test the resolve of the government firm and continue to restrict output after the government firm announces its strategy, then the government firm could incur losses



in the short run. During this period it would produce output at a level were its marginal cost of output exceeded the price of output. Thus the credibility of the government firm's strategy depends on the financial backing of the government.

Furthermore, the government firm must have sufficient plant capacity to make up any difference between desired output and total private output. In the extreme case where all private firms decide to close down their operations it would be necessary for the government firm to produce all the desired output. This aspect of the problem requires an explicit dynamic framework which takes the strategic intertemporal interaction of the government and private firms into account and is treated in Harris and Wiens [1977b].

Given that it is credible, the above scheme has the following interesting features. First, the dominant strategy for any private firm is to produce where price equals its marginal cost independent of what other firms are doing. Second, the scheme is stable against collusion by private firms since it will be impossible for any group of private firms to make themselves collectively better off by colluding. In effect the government firm's reaction function negates the interdependence among firms which results from the industry demand function and the small number of firms. It is important to note that while the government firm determines the optimal level of production for the industry, profit maximization on the part of the private firms determines the optimal distribution of production across firms.



The above analysis shows how a government firm can be used to regulate an oligopolistic industry producing a homogeneous good. It assumed the industry consisted of a fixed number of firms, such that in an allocation with all firms having price equal to marginal cost, no firms incur a loss. Harris [1978] has shown that these results hold in the situation where firms have fixed costs or increasing returns and where the number of firms in the industry is taken as endogeneous. Here the government firm's reaction function takes into account the effect that profits and losses have on entry and exit.

A government firm can also be used to regulate an industry characterized by a few firms producing products which are close substitutes or complements. In this monopolistically competitive situation the above results hold in a weaker sense. If the government firm can shift each private firm's demand function through changes in the price of its product, a reaction function exists which will enforce a desired allocation of output across firms. However this reaction function has neither the dominant strategy property nor is it stable against coalitions. In effect the government firm threatens individual firms with retaliation in the form of increased or decreased output. The government firm may be unable to backup its threat if more than one firm decides to call its threat.

In the next section we present a diagramatic model of vertical integration which illustrates the trade-off between efficiency and restricted output. After that we show how a government firm can resolve this dilemma.



III Vertical Integration: Efficiency Versus Restricted Output

Consider the situation described by Schmalensee [1973]. A monopolist in a factor market sells his product to a competitive industry. To capture rents he restricts output and prices the factor above its competitive or efficient price. This has two effects. First, if the competitive industry maintains the efficient factor proportions, then its cost schedule shifts upward with an increase in the price of the monopolized factor. Second, given variable proportions in production, the competitive industry will substitute away from the monopolized factor partially shifting down the relevant cost schedule. Here inefficient factor proportions prevail.

This situation is illustrated in Diagram I. The curves  $DD'$  and  $RR'$  are respectively the industry demand and marginal revenue schedule. For ease of exposition we have assumed a linear homogeneous production function for the initially competitive industry. At the competitive factor price  $P_C$ , the industry cost schedule is the horizontal line  $AP_C$ , at the factor price  $P_1$ , the schedule is  $CP_1$ .

To understand the curve  $FF'$  consider the situation when the factor price is  $P_1$ . At this price the industry cost schedule is  $CP_1$ . Entry or exit will take place until industry output is  $OQ_1$ . The vertical distance  $Q_1P_1$  represents the average cost to the competitive industry using the inefficient factor proportions at price  $P_1$ . The distance  $Q_1D$  represents these same factor proportions valued at the competitive price  $P_C$ . Thus the curve  $FF'$  represents the value, at competitive factor prices, of the inefficient factor proportions used by the competitive industry to



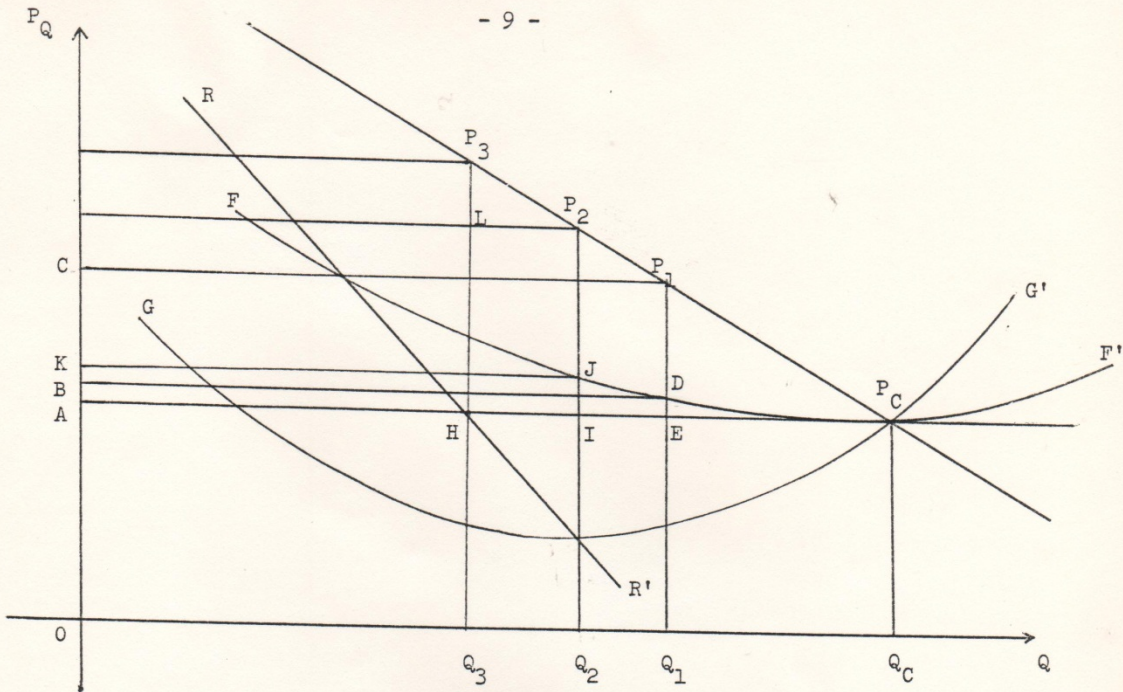


DIAGRAM I

produce a unit of output. We call this schedule the competitive industry's average cost schedule from the monopolist's point of view.

Other important information can be obtained from Diagram I. The monopolist's rent, at factor price  $P_1$ , is given by the rectangle  $BCP_1D$ . The efficiency loss at this price due to substitution away from the monopolized factor is given by the rectangle  $ABDE$ . We also call the schedule  $GG'$  the industry's marginal cost schedule from the monopolist's point of view. It is the curve marginal to the total cost schedule corresponding to the average cost curve  $FF'$ . The monopolist will be maximizing profits when he sets the factor price  $P$  so that at the



corresponding level of output  $Q$ , industry marginal revenue equals the industry's marginal cost from the monopolists point of view. In Diagram I this occurs at a factor price of  $P_2$  and output of  $Q_2$  at the intersection of schedules  $RR'$  and  $GG'$ .

We have assumed that the monopolist is content to sell his factor to the competitive industry. However, he can do better by integrating into this industry. The source of his increased rent is the efficiency loss described above due to inefficient factor proportions. By integrating forward and substituting efficient factor proportions he can increase his profits. But integration may result in a further reduction of output. This is clearly the case in Diagram I where the fully integrated monopolist is maximizing profits at output  $Q_3$ . At this level of output, industry marginal revenue equals marginal cost where the relevant marginal cost schedule now is  $AP_C$ .

Whether integration results in an increase or a decrease in output depends on whether the intersection of  $GG'$  and  $RR'$  falls to the left or to the right of  $Q_3$ .<sup>9</sup> Diagram II illustrates the situations where integration results in an increase in output.<sup>10</sup> In the situation of Diagram I, integration results in a net welfare gain if the loss in consumer surplus (triangle  $LP_2P_3$ ) is less than the removal of the dead weight loss (rectangle  $AIJK$ ) and assuming that we regard the increase in monopoly rent as a neutral transfer payment from consumers to the monopolist.<sup>11</sup> In the situation of Diagram II, integration results in an unambiguous welfare gain. Of course in both cases industry output is less than competitive industry output  $Q_C$ .

In the analysis above we assumed that a monopolist in a factor market sells his product to a competitive industry. The diagrammatic analysis



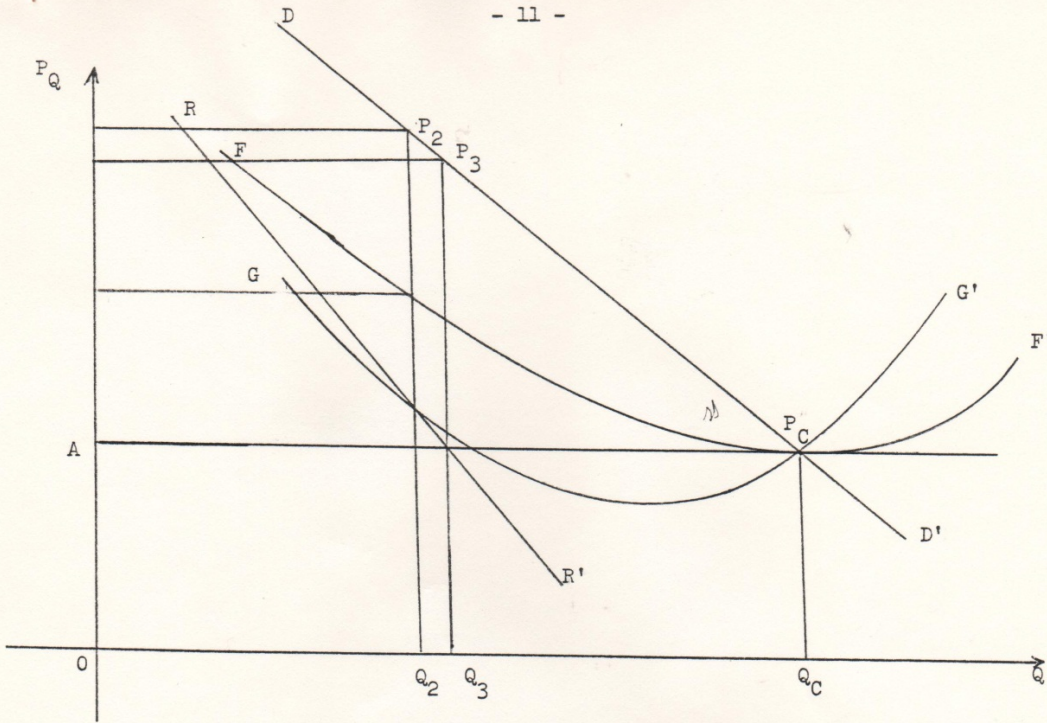


DIAGRAM II

shows in a simple manner the potential trade-off inherent in merger or vertical integration between increased efficiency on one hand and restricted output on the other.<sup>12</sup> Attempts by the state to limit the natural evolution of organizational forms, in the interests of "increased competition", may impair efficiency and may in fact decrease output. In section IV we will present one solution to this dilemma.

The analysis above can be modified in a straight forward manner to tackle the problem we are concerned with in this paper. Suppose the factor producing industry is an oligopoly instead of a monopoly. If the members of the oligopoly are earning rents, then the same efficiency loss described above will prevail. Each oligopolist will have an



incentive to integrate forward to capture some of this loss in the form of profits by substituting efficient factor proportions. Furthermore, the industry purchasing the factor need not be a competitive industry for this incentive to exist. The potential for an efficiency loss exists if the factor producing industry is earning rents and if production at the next stage admits variable factor proportions. Following integration, industry output may increase or decrease. In either situation output is less than the competitive level of output.

#### IV Vertical Integration and the Government Firm.

We will now show how a government firm can be used to maintain the potential efficiency in production advantages of integration and still ensure that output levels are competitive. Consider an industry with the following structure.

The production process consists of a number of stages where the production units of one stage can be taken to be separate from those of the next. For example, the petroleum industry can be divided into the following stages: exploration, extraction, transportation (pipelines), refining, wholesale and retail. Furthermore, the industry of interest consists of a small number of integrated firms which may compete with independent firms at each stage. A government concerned that firms in the industry are earning rents has various instruments at its disposal. The comments above about intervention in the form of tax/subsidy, antitrust and price and quantity regulation remain in force.



Of particular concern in this section is antitrust legislation. Antitrust and divestiture legislation which limits integration and which forces firms to divest themselves of some of their production units may have antisocial consequences. Limiting integration may result in lower rents to these firms. However, these lower rents are obtained at the price of over all decreased efficiency in production. With government firm regulation this trade off does not occur.

The government firm should use the following procedure. Starting from the factor markets, the government firm should enter those stages of production where it suspects that firms are exercising market power. It should use the reaction function method described in section II to eliminate rents in these stages to obtain an "optimal" distribution of productive resources. Furthermore, it should integrate into those stages where integration results in efficiency gains to its own operations. Provided that it operates on a cost minimizing basis, this will ensure that the government firm provides its regulation service efficiently and it will ensure that an "optimal" allocation of resources obtains for the entire industry.

V Caveats and Conclusions:

Results of this paper clearly support the robustness of the Harris-Wiens "reaction function mode" of regulation. The original result was obtained in an oligopolistic setting. On theoretical grounds regulation via a government firm was found to be a viable alternative to other instruments of public policy. In a vertically integrated industry,



government firm regulation has an additional and very important advantage.

Unlike antitrust and divestiture legislation, government firm regulation does not place constraints on the organizational form of the privately owned firms. The work by Williamson [1975] has clearly spelled out the social shadow price of these constraints in the form of decreased over all efficiency. Government firm regulation permits firms to choose a profit maximizing (and thus cost minimizing) organizational form. Market power and rents which may result from increased concentration is offset by direct competition from the government firm. By acting as a decentralized regulating agent, the government firm can respond quickly to cost and demand conditions. By using the correct reaction function and by acting as the dominant firm in the industry, the government firm simulates a competitive environment to obtain an optimal allocation of resources.

Criticisms leveled by Stigler at all forms of regulation apply to government firm regulation as well. The positive aspects of government firm regulation need to be modelled and analyzed. To be interesting, a positive theory must include the self-interest interactions of consumers, private producers, politicians and managers of the government firm.<sup>13</sup>

The general belief among economists is that government agencies do not cost minimize. If an enterprise's criterion of success is not profit maximization then cost mimimization does not necessarily follow. This efficiency loss represents the social price of regulation via a



government firm. If this price is less than the welfare gain of increased output, then government firm regulation appears desirable. The arguments above suggest that the government firm is the preferred mode of regulating a vertically integrated industry.



#### Footnotes

1. Prominent examples of firms owned by the Government of Canada which fall into this category are Petro-Canada, Canadian National Railways, Air Canada, Canadian Broadcasting Corporations, Polymer, Eldorado Nuclear and the Atomic Energy Commission. Examples of firms owned by provincial governments are Pacific Western Airlines and the Insurance Corporation of British Columbia.
2. The positive issue of how such firms actually behave is still largely unexplored. For case studies see Sheahan {1960} and Davies {1970}. For further references see Merrill and Schneider {1966}, footnote 1.
3. See Arrow {1975} and Green {1974} for further argument about the potential advantages of vertical integration.
4. For any early statement and analysis of this issue see Williamson {1968}.
5. Petro-Canada, the Government of Canada's entry in the petroleum industry, has a mandate to enter all stages of the industry. To date it has only entered the exploration and extraction stage.
6. As Archibald {1971}, p. 153 points out, in this situation the persistence of rent depends exclusively on the existence of barriers to entry.
7. This "window on the industry" source of information is not available to other forms of regulation and is a built-in advantage of government firm regulation.
8. Harris and Wiens {1977a} have devised an iterative scheme which will converge to the desired level of industry output when the government firm only knows the industry demand function and its own cost function.
9. For the monopolist to be in a profit-maximizing equilibrium in the pre-integration situation, the second order sufficient conditions require that at the point of intersection, the slope of  $RR$  be less than the slope of  $GG'$ . This condition can be satisfied either to the left or to the right of  $Q_3$ .
10. Which situation obtains depends, in a complicated manner, on the elasticities of substitution in production and consumption. See Schmalensee {1973} for a complete analysis.
11. If the monopolist is foreign owned, the opposition to the monopoly rents will be stronger.
12. Burstein {1960a}, {1960b} has shown that firms with monopoly power with respect to one good need not integrate forward to increase their rents. In his theory of "full-line" forcing, he shows how tie-in sales and other mechanisms can be used for this purpose.
13. For an initial attempt at a positive model of this situation along the lines of Stigler {1971} and Peltzman {1976} see Wiens {1978}.



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