המרכז למחקר בכלכלה חקלאית
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Working Paper No. 9508

PRICES vs. QUANTITIES: THE POLITICAL PERSPECTIVE

by

ISRAEL FINKELSHTAIN &
YOAV KISLEV

Rehovot, Israel, P.O.B. 12

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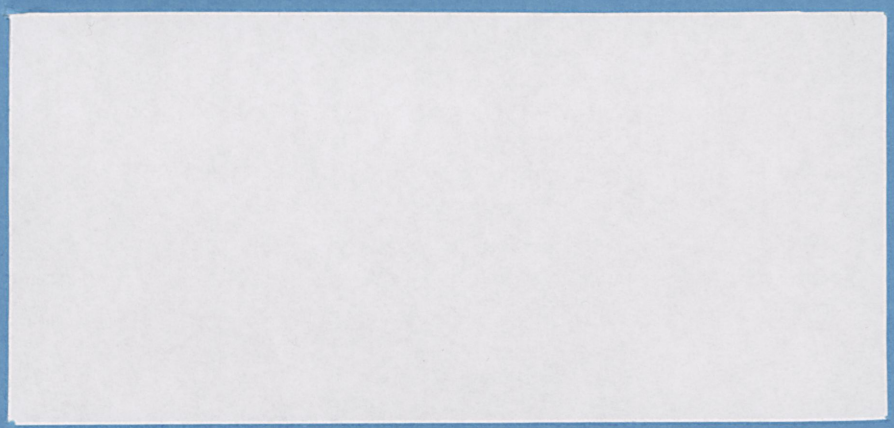

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by

Israel Finkelshtain and *Yoav Kislev**

Abstract

Regulation regimes subject to influence of interest groups are compared. It is shown that allocation of the regulated commodity varies with the implemented control and that the advantage of prices (*vs.* quotas) increases with the elasticity of the demand or the supply of the commodity and decreases with the number of organized producers in the regulated industry. Control regimes can be ranked for negative, but not for positive, externalities. An optimal policy combination, mixing prices and quotas, is identified and limitation on its application are discussed.

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* The Department of Agricultural Economics and Management, the Hebrew University, Rehovot, PO Box 12, 76-100, Israel.

1. Introduction and Summary

Given that government intervention is subject to lobbying and political pressure, when is regulation by prices the preferred regime and when is a quantitative control more adequate? The neoclassical solution to the control dilemma is that price and quota regimes are equivalent—both yield the same resource allocation and social welfare level. But, as Martin Weitzman (1974) has already shown, the equivalence between the controls does not hold where information is imperfect and monitoring incomplete[1]. We focus on a different issue, on the political aspect.

The analysis is of a single regulated industry, employing a factor with negative or positive external effects. We shaw that the political equilibrium—the result of power play and rent seeking—is socially inefficient, it reduces total wealth and it also transfers wealth to the participants in the political process. The wealth transferred is the surplus due to the political agreement and its distribution is determined by the relative power of the negotiating parties.

The political equilibria, and hence the magnitudes of the distortions, differ with the external effect and the implemented control. Under quota and when taxes are imposed to reduce negative effects, the use of the controlled factor will be between the privately profit maximizing utilization and the social optimum; with subsidies (when the effects are positive) the political struggle is for higher payments and the equilibrium allocation will be higher than both private, non-intervention, utilization and the social optimum. It is shown that—when externalities are negative—the comparative advantage of either of the control regimes depends on a factor involving the share of organized producers in the industry, the value of the demand elasticity for the regulated good (or the supply of such a good), and the tax rate. A price regime yields more efficient political equilibrium if this factor is smaller than 1. If not, quota is the more efficient instrument. The preferred control cannot be unambiguously determined when the effects are positive.

[1] For extensions and applications of Weitzman's analysis, see, for example, Fisher (1981) and Cropper and Oates (1992).

The analysis is conducted under the structural assumption that there are no economies or diseconomies of scale in the political activity and its influence[2] . With this assumption, equilibrium can be seen as determined in two stage: use of the controlled factor is set in the first stage; political rewards—the distribution of the surplus—are determined in the second stage. Moreover, factor allocation is the same for alternative models of political economies; the political contributions are, on the other hand, model-specific. Also, with the adopted assumptions, political activity can be organized, just as effectively, in a single lobby, in several influence groups, or even, producers may operate individually.

It is further shown that when the control policy employs both prices and quotas, an optimal mix can be defined, yielding socially preferred allocation. Contrary to expectations, increased reliance on prices does not always result in improved efficiency of the control regime.

2. Society and Polity

Regulation is called for where external effects—in production or consumption—exist, where scale economies lead to natural monopoly, or in the provision of a public good. The analysis in the paper is confined to regulation of a factor of production with externalities affecting consumers or producers elsewhere in the economy; they do not affect producers in the regulated industry. As an example of a negative externality consider an irrigation project lowering water table of a nearby urban center. For an example of a positive effect, take the utilization and disposition of reclaimed sewage. Restricting the discussion to an input does not affect the generality of the conclusions.

The producers using the regulated factor are assumed to behave rationally and disregard externalities associated with their activity. In a free market, the producers tend to overutilize factors of production with negative effects and underuse factors with positive

[2] Grossman and Helpman (1994) also assume linear relations in the political activity.

effects. A social planner, taking into account both the value of production in the controlled industry and its effect on others, can determine the socially optimal utilization of the factor. (Income distribution is disregarded in the analysis.)

The government in our analysis is a political entity whose own utility is affected both by social welfare and by political rewards or contributions. The producers and the government (the politicians), being engaged in a political give and take, constitute a *polity* and the ensuing allocation reflects the equilibrium reached in the political struggle. The government willingly accepts rewards and bends its policy, but it is not powerless. We assume that if a political agreement is not achieved, socially optimal resource allocation is enforced. The social optimum is the threat point of the political game.

The producers operate in the political arena individually or they are organized in lobbies. We analyze the effect of collaboration in the influence groups, but do not discuss the structure of the lobbies and modes of collaboration. Also, by our assumption, the individual political contribution is not determined in the political equilibrium; it is left to the lobby to charge its members. These political rewards may come in all shapes and forms: monetary political contributions (or even outright bribes), demonstrations, letter writing, and assistance in campaigns. They may be negative when the producers punish the government or demonstrate against it. Sometimes the political rewards may enhance welfare—the welfare of the receiving politicians or welfare in a wider sense as when a constructor builds a school in return for a desired permit. The discussion in the paper is limited to the effect of political contributions on government regulation; the nature of the rewards and their wider implications are not analyzed. Also, only "linear", money-like rewards are considered; that is, there are neither economies nor diseconomies of scale in the political activity and its influence. We remark on possible generalizations in the concluding section of the paper.

The political process we consider is embedded in a "constitution" by which the control regime may be either a quota or a price regime (or a certain combination of the two). The

constitution is accepted as predetermined, it is not debatable and we do not consider here the political process leading to its establishment[3].

Our main concern is with comparing a quota with a price regime. Under quota the producers must comply with administrative regulations, with a price control they either pay a tax or receive a subsidy. Focusing on the efficiency of the controls, we eliminate income differences by introducing revenue-neutral policy shifts; that is, lump-sum payments are seen as balancing taxes or subsidies. For example, when the shift is from a quota to a tax, the government pays up front the present value of the taxes which will be applied in the political equilibrium. A shift to a subsidy regime entail a compensating lump-sum tax. Similarly, a shift from a tax to a quota control is associated with a lump-sum payment to the government. The compensation is not debatable and the producers cannot expect to affect it even if the magnitude of the tax or the subsidy is modified in the political negotiations which proceed once the control regime has been in place and the compensation scheme implemented[4].

Compensations of this nature are observed in reality. The government of Israel, for example, is "purchasing" these days production quotas in agriculture in an attempt to gain political acceptance of steps toward elimination of planning and administrative intervention in farming.

3. Recent Theories of Political Economy

Political processes affecting public intervention in the economy have recently been the subject of intensive literature. Examples are: Hillman (1989) and Grossman Helpman (1994) in the context of international trade, Zusman and Rausser (1994) in the field of natural resources, and Scarpa (1994) who studies the consequences of political influence

[3] A similar approach is taken by Grossman and Helpman (1994) who view the evolution of the political economy as proceeding in two stages.

[4] Lump-sum compensating payments eliminate income effects of control regimes and facilitate an analysis of net allocation effects. Sometimes, however, a crucial consideration in the choice of a control is revenue raising and cost covering. These considerations are disregarded in the present analysis.

by a public utility. These studies analyze political equilibria for particular control regimes. In contrast, we attempt to compare the performance of alternative politically influenced regimes.

Writing in the Peltzman (1976) tradition, Hillman (1989) views the government as setting policies to maximize a political support function which trades welfare of voters with divergent interests. In Zusman and Rausser (1994) and in Scarpa (1994) the political process is a Nash (1950) bargaining game with politicians and lobbies negotiating policy parameters and political contributions[5]. Grossman and Helpman (1994) adopt the Bernheim and Whinston (1986) first price menu auction procedure to describe and analyze political economies.

The models differ but they share a common property: the equilibrium reached is politically efficient, it is located on the polity's contract curve. Moreover, as we show shortly, with a linear political reward system, the allocation of the controlled factor is independent of the political contributions and all the above models predict identical allocation (Hillman does not specify rewards explicitly). We are making use of this property—which enables recursive calculation of equilibrium configurations—in the next four sections of the paper.

4. The Model

Net income of a producer in the regulated industry is

$$y^i = \pi^i(q^i) - c^i - tq^i + R^i, \tag{1}$$

where q^i marks the ith producer's utilization level of the regulated factor and the magnitude t marks the tax imposed by the government (for a subsidy $t < 0$). The compensation payment is R and it is equal to the equilibrium level of tq. The variable c indicates political contributions. The function $\pi^i(q^i)$ is the ith producer's profit in the production activity, it is concave and it subsumes the prices of goods other than the regulated good. It

[5] For early theoretical formulation and empirical application see Zusman (1976), Zusman and Amiad (1977).

also subsumes the private market price, p, of the regulated factor but taxes or subsidies are not included in π. The industry supplying q is competitive and characterized by constant return to scale with perfectly elastic supply. There are N producers in the industry and the total factor utilization and political rewards are given, respectively, by

$$Q = \sum_{i=1}^{N} q^i \quad \text{and} \quad C = \sum_{i=1}^{N} c^i \tag{2}$$

The second sector, the government, is viewed as maximizing the weighted sum

$$W = V(\mathbf{q}) \; + \; \alpha C, \tag{3}$$

where $V(\mathbf{q})$ is social welfare defined over the vector $\mathbf{q} = q^1, \ldots, q^N$ and the constant $\alpha > 0$ represents the preference of the government for political bribes relative to public welfare. It can also be seen as standing for the political power of the influence group in the industry. Lobbies in different industries may have different α values.

The welfare function, V, is given by

$$V(\mathbf{q}) \equiv \sum_{i=1}^{N} \pi^i(q^i) + \sum_{j=1}^{M} \mu^j(Q), \tag{4}$$

where $\mu^j(Q)$ is the money-metric utility function of the jth consumer who is influenced by the external effects of the regulated factor. The function μ increases with Q for positive externalities and decreases for negative effects. Utility is also defined over the vector of prices of consumption goods; but, assuming a small economy with all goods traded, prices are constant and they are not represented explicitly in the function.

It is assumed that μ^j is concave in Q, and hence in each q^i. Similarly, since V is the sum of concave functions (in each q^i), it is a concave function itself. All functions are second order differentiable and, except for one case indicated in by eq. (13) below, interior solutions are assumed throughout[6]. It is also assumed that enforcement is costless.

[6] Among other things, interior solutions mean that all producers use positive quantities of q at any of the prices considered.

Due to externalities, optimal levels of q^i from the points of view of the producer, q_i^{pr}, and the society, q_i^s, do not agree. That is,

$$q_i^{pr} = \arg\max_{q_i}[\pi(q)] \neq q_i^s = \arg\max_{q_i}[V(\mathbf{q})]. \tag{5}$$

This, of-course, creates the conflict that induces rent seeking and political rewards.

As indicated, producers in an industry may operate in the political arena individually or in the industrial lobby. We assume that a lobby maximizes total income of the members in the group

$$Y \equiv \sum_{k=1}^{K} y^k \tag{6}$$

The formulation is general: an industry may have just a single producer (N=K=1), this may be a monopsonist in the use of the regulated factor, perhaps a public utility. Alternatively, some or all producers in an industry may form an influence group and lobby for their interests[7].

One difference between the regimes affects behavior in a crucial way: Taxes are uniform and, in an industry with many producers, both those who lobby to modify the policy and the producers who do not—face the same tax. We show that the larger the share of free riders in the industry the weaker it is politically but, as indicated already, we do not analyze the internal structure of the lobby groups and the forces that keep them together.

Under a quantity control, on the other hand, a producer who does not engage in political activity, will be assigned the social quota (with negative externalities non-participants may even get zero quotas to balance overutilization by the political activists). There will therefore be no free riding in the political equilibrium of a quota regime, all producers will participate and be members of the industrial lobby.

[7] With linear rewards, the analysis is the same for any number of lobby groups in an industry. For simplicity and brevity, the discussion is conducted in terms of a single lobby.

5. Equilibrium Utilization of the Regulated Factor

The first stage in the recursive calculation of equilibrium is the determination of the parameters affecting allocation of the regulated factor. This first stage is described here. The determination of the contributions by the K politically active producers is done in the second stage which is presented in Section 7.

Let γ be a common label for the allocation parameters in the three alternative regimes considered in the paper: a quota system where $\gamma \equiv q^1, \ldots, q^N$; an indirect control, a price regime with a per unit tax or subsidy, $\gamma \equiv t$; and a mixed regime where $\gamma \equiv (\mathbf{q}, t)$ (examined in Section 8). Exogenous to the political equilibrium are: the production technology, prices, private and social preferences and the constitution specifying the instrument of regulation.

An efficient agreement between the government and the producers is located on the polity's contract curve and it can be characterized by the necessary conditions for an internal solution to the following constrained maximization problem:

$$\gamma*, \mathbf{c}* = \arg\max_{\gamma,\mathbf{c}} W(\gamma, \mathbf{c}) \quad \text{S.T.} \quad Y(\gamma, \mathbf{c}) \geq \bar{Y} \tag{7}$$

In eq. (7), $\bar{Y}$ is the reservation utility, the alternative income of the lobby members in the event that an agreement is not reached. We commence with a quota system.

5.1. A Quota System

The government sets quotas, $\mathbf{q}$, the magnitudes of which are subject to political pressure. In this case $y^i = \pi^i(q^i) - c^i$ and a politically efficient agreement concerning $\mathbf{q}$ is characterized by the following N equations (derivatives are marked as subscripts):

$$\pi^i_q(1+\alpha) = -\sum_{j=1}^{M} \mu^j_Q(Q) \quad i \in \{1, \ldots, N\}, \tag{8}$$

Remarks: a. The political rewards, c^i, do not appear in the necessary conditions for the determination of the quotas. This verifies our earlier assertion on the recursive nature of the solution of the political equilibrium. b. The utilization of the regulated factor does likewise not depend on the compensation, R. c. Equations (8) will be the same whether

the producers in the industry are unionized in a single lobby, in several groups, or they operate individually; political organization does not affect the equilibrium reached. It must be stressed that these three features are due to the linear nature of the political reward system. The equilibrium would have been different with nonlinear rewards—if the political action was subject to economies or diseconomies of scale.

A useful result that emerges from condition (8) is that, as the right-hand-side, $\sum_{j=1}^{M} \mu_Q^j(Q)$, is identical to all i, $\pi_q^i = \pi_q^j = \pi_q \ \forall \ i,j \in \{1,\ldots,N\}$ (similarly, $V_{q^i} = V_q \ \forall \ i,j \in \{1,\ldots,N\}$). In words, the value of the marginal profit (VMP) of the regulated factor is the same for all producers. The political game distorts the level of aggregate factor utilization, but allocation among producers is efficient. This is a reflection of producers with higher VMP pressing harder for quotas[8]. When resources are administratively allocated, the political process replaces the market in securing between-firm efficiency.

Because of the signs of the derivatives μ_Q^j, equation (8) implies that for negative (positive) externalities $\pi_q^i > (<)0$. In addition, equations (8) can now be rewritten as

$$V_q = -\alpha \pi_q, \tag{8'}$$

which implies that for negative (positive) externalities $V_q^i < (>)0 \ \forall \ i \in \{1,\ldots,N\}$. Since all VMP's are equal, all the q^i values move together, and it follows unambiguously from the sign of V_q that for negative (positive) externalities $q_i^{po} > (<) q_i^s \ \forall \ i \in \{1,\ldots,N\}$. Thus, under quota, the political equilibrium is a "compromise": When externalities are negative, factor utilization exceeds the social optimum (where $V_q = 0$) but is lower than free market use (characterized by $\pi_q = 0$). With positive externalities, utilization at the political equilibrium is smaller than socially optimal and larger than the private profit maximizing quantity. These findings are summarized in the first two lines of Table 1.

[8] The argument that producers with higher VMP press harder relies on a "truthful" property; namely, that producers struggle more—offer higher rewards—for more valuable political favors. We comment further on this property in Section 7.2.

Table 1: Properties of the Political Equilibrium

	Marginal contribution of q		Quantity
	Social	Private	
Negative Externalities			
Quota/Tax	$V_q < 0$	$\pi_q > 0$	$Q^s < Q^{po} < Q^{pr}$
Positive Externalities			
Quota	$V_q > 0$	$\pi_q < 0$	$Q^{pr} < Q^{po} < Q^s$
Subsidy	$V_q < 0$	$\pi_q < 0$	$Q^{pr} < Q^s < Q^{po}$

The political equilibrium is depicted graphically for a single producer in Figure 1. The diagram is drawn for negative externalities. The graphs W_1, W_2 and y_1, y_2, are the government's and the producer's indifference curves; their slopes are $-V_q/\alpha$ and π_q^i, respectively. (For the government, the curve is drawn with all other producers at the equilibrium configuration.) Each indifference curve of the government has a minimum at $q = q^s$, the socially desired level, and the point $q = q^s, c = 0$ is the disagreement threat point. The equilibrium quota is q^{po} and the segment $[a, b]$, between indifference curves passing through the origin, marks the core of the political game.

5.2. Indirect Control

A pure price control is either a tax or a subsidy. In this case $y^i = \pi^i(q^i) - tq^i - c^i$ (R omitted), and the producer is free to utilize any quantity of the factor. Doing so, the private first order condition characterizing the producer's choice of q^i is

$$\pi_q^i = t, \tag{9}$$

which implies

$$\frac{\partial q^i}{\partial t} = \frac{1}{\pi_{qq}^i}. \tag{9'}$$

Solving (7) with respect to t and $\mathbf{c}$, while using equation (9), yields the condition that characterizes the political equilibrium under a price regime:

$$\sum_{i=1}^{N} V_{q^i} \frac{\partial q^i}{\partial t} = \alpha Q^K, \tag{10}$$

where Q^K is the aggregate factor utilization by the members of the industrial lobby. The marginal effect of a tax on the whole industry is balanced against its effect on the active group whose utility is reserved on the political contract curve. The remarks following eq. (8) on the independence of allocation apply here too. Also, producers in an industry controlled by prices may operate in several groups, their contributions will be aggregated by the receiving politicians in the government and their effect will be a function of the sum. In this situation, K stands for the total number of participants in all groups.

From $\pi^i_q = t \ \forall \ i \in 1, \ldots, N$, it follows that $V_{q^i} = \pi^i_q + \sum_{j=1}^n \mu^j_Q = V_q \ \forall \ i \in \{1, \ldots, N\}$ and that (10) can be written as

$$V_q = \alpha Q^K \frac{\partial t}{\partial Q}. \tag{11}$$

By concavity of π^i, $\pi^i_{qq} < 0$, and then by (9'), $\frac{\partial t}{\partial Q} < 0$, implying that $V_q < 0$ regardless of the sign of π_q. Thus, under a price control the producers over-utilize (socially) the regulated factor, both when the external effects are negative and when they are positive. With negative externalities, the political pressure is to reduce the tax; with positive effects, it is to increase the subsidy—up to and above the social optimum. Consequently, while under a quota regime the political equilibrium is always a compromise (between the free market allocation and the social optimum), a price regime may yield, in the presence of political power and when the external effects are positive, a resource allocation that is *socially worse than the free market allocation.* In the presence of political pressure, the intervention of an otherwise benevolent government may worsen resource allocation.

That taxes and subsidies differ in their effects on resource allocation modifies—for a political economy—the Coase (1960) and Weitzman (1974) conclusion that property rights do not affect the nature of the solution to an externality problem. If the producer owns the right to pollute the air, to take an example from these references, q will stand for the resources going into pollution prevention, their use will have positive externalities and will be subsidized. If the public, represented by the government, owns these rights—the polluters will be taxed. With political pressure, resource allocations will differ: in the first

case the equilibrium will be characterized by overinvestment in pollution prevention, it will be sub-optimal in the second.

Another useful way to write eq. (11) is in elasticity terms as

$$V_q = \alpha \frac{\sigma}{s\eta} \pi_q, \tag{12}$$

where $s = t/(p+t)$, η is the factor demand elasticity, defined at the price the producer actually pays, $p+t$, and $\sigma = \frac{Q^K}{Q}$ is the share of the regulated factor utilized by the producers in the lobby group[9]. The formulation of (12) is utilized in the analysis to follow.

Expressing V_q in its extended form, eq. (12) can be rewritten as

$$\sum_{j=1}^{M} \mu_Q^j = \pi_q \left(\frac{\alpha\sigma}{s\eta} - 1\right), \tag{13}$$

which implies that, for positive externalities and a price regime, internal, tangency solutions are confined to the region where $\frac{\alpha\sigma}{s\eta} < 1$.

6. Comparative Efficiency of Factor Allocation

We are ready now to turn to the question of *prices or quantities.* To examine it, we define: a control yields a *more efficient* utilization of the regulated factor than the alternative regime if and only if it yields a higher level of social welfare, $V(\mathbf{q})$.

6.1 A Formal Proposition

With negative externalities, both under quota and in a tax regime, the quantity of the regulated factor is between the privately desired level and the social optimum. This "closeness" of the equilibria enables an analysis of the comparative performance of the alternative regimes. Such an analysis is impossible for a positive externality because of the distance between equilibria in which, under a quota, q is lower than the social optimum and

[9] With a subsidy ($t < 0$), s can be either negative or positive. When $|t| < p$, $s < 0$; when $|t| > p$, $s > 0$. In the latter case, calculated $\eta > 0$; in both cases, $s\eta > 0$. For completion, we set $s\eta = 1$ for $|t| = p$.

with a subsidy—it is above the optimum. With these considerations, the central finding of the paper is expressed in the following proposition.

Proposition 1: *Suppose the government is regulating the utilization of a factor by either a price or quota control. The factor is used by many producers. With quotas all producers are represented in the political process; with prices, not all producer are necessarily members of the industrial lobby. Then,*

(i) *with a negative externality, a price (quota) regime yields a more efficient factor utilization, if and only if* $|\frac{\sigma}{\eta s}| < (>)1$;

(ii) *with a positive externality, a price regime yields a larger factor utilization than under quota, efficiency comparison is however inconclusive;*

(iii) *under both types of externalities, the efficiency of a price relative to a quota control increases with the elasticity of the demand for the regulated factor and decreases with the share of organized producers in total production;*

(iv) *efficiency of both controls decreases with the political power of the producers,* α.

Proof : Part (i). Mark $\epsilon \equiv |\frac{\sigma}{s\eta}|$. For $\epsilon = 1$, resource allocation under quota is identical to allocation in a tax regime. To compare the controls, consider a shift in a given industry from a quota to a tax. Since the move is between equilibria, the compensation (R) is implemented and the only difference in the first order condition is in the value of ϵ. Examining $(8')$ and (12) one realizes that for $\epsilon < 1$, V_q in (12) is smaller in absolute value than in $(8')$; a tax regime is then comparatively more efficient. The inequality is reversed for $\epsilon > 1$, as required for the proof. Part (ii) is proved by noting that because of the differences in V_q values in Table 1, comparative advantage cannot be determined. Part (iii) and (iv) are is proved by examination of (12). ∎

We turn now to interpretations and elaborations.

6.2. Demand Elasticity

The intuition behind the role played by demand elasticity in comparing efficiency of the regimes in Part (i) of Proposition 1 can be explained conveniently for $\sigma = 1$, $p = 0$,

$s = 1$; that is, the industry consists of a single producer or of an all embracing lobby, the good is free under a quota regime, and the tax is the entire unit price under a price regime. For this situation, q_0 in Figure 2 is an initial quantity, either determined by a quota or reached by the producer when the tax was set to t_0. Consider the rent seeking effort that increases the quantity to q_1. Depending on the control, the change may be achieved by either an increase in the quota itself or by reducing the tax to t_1. The corresponding gain to the producer is

Price regime	$A + B$
Quota regime	$B + C$
Difference	$A - C$.

With unitary elasticity, $A = C$ and the difference vanishes, the regimes are equivalent at the margin. The returns to marginal political efforts of equal quantitative effects are identical. Alternatively, if the factor demand is elastic, $A < C$, the returns under a price regime are smaller than under quota. Consequently, under a price regime the political struggle will be less intensive, and the equilibrium will be closer to the social optimum. Similarly, for Part (*iii*), the more elastic the demand function passing through (q_0, t_0) the smaller the area $A + B$, and the less intensive the political struggle. In Figure 1, more elastic demand is expressed in smaller slopes of the producer's indifference curves and a move of the political equilibrium quantity to the left.

These findings may seem to contradict the established Ramsey- Boiteux tradition (Atkinson and Stiglitz, 1980) of optimal taxation by which the more elastic the demand (or supply) the more socially harmful is an intervention in prices. The apparent contradiction is resolved by recognizing that when taxes are levied to raise revenue, optimal rates minimize their effect on resource allocation, while here the sole purpose of taxes is to modify use of resources.

6.3. Organization of Producers

With a single producer, $\sigma = 1$ and the difference between the control regimes is reflected only in the size of the product $s\eta$. As we saw earlier, under quota, all producers

are politically active and the degree of their organization does not affect the equilibrium reached. Similarly, if in a tax regime all producers are organized in a lobby and operate in unison, $\sigma = 1$ and the number of producers or their organizations does not affect equilibrium. But a price regime is conducive to free riding.

The explanation for the importance of cooperation in determining the political equilibrium of an industry is simple and the situation is familiar to observers of administrative controls. With a quota, every producer is trying to increase his or her own utilization of the controlled factor and so does a lobby arguing for its members. The political activists present convincing arguments aplenty. For the government it is relatively easy to yield to the pressure of a particular individual or lobby—the quantitative effect is relatively small. Alternatively, in a price regime with a uniform tax rate, the government is standing firmer—a concession to one producer or group is a concession to the whole industry. Consequently, the greater the amount of free-riding in a price regime, the stronger the comparative social advantage of this control.

By conventional wisdom, heterogeneity of the production units argues in favor of price control as prices, being uniform, economize on information while, with heterogeneous producers, efficiency calls for unequal, individually tailored quotas. This argument was qualified by Weitzman (1974) who noted that for iterative planning there is no significant information difference between a price and a quota regime. In a political environment, heterogeneity in production affects equilibrium allocation only to the extend that a more heterogeneous industry may tend to be more loosely organized and have a larger number of free riders.

6.4. A Caveat

The intuitive interpretations, and indeed Proposition 1 and particularly its Part (i), should be accepted with care. The proposition is defined for the conditions of a political equilibrium. The equilibrium ratio s is endogenously determined; and the elasticity of the factor demand is also in general an endogenous magnitude. These variables are components

of a political equilibrium. The proposition, as indicated, *characterizes* the equilibrium: if in equilibrium (with negative externalities) $|\frac{\sigma}{\eta s}| < 1$, price control dominates. It may however happen that even for an elastic demand and a comparatively small lobby, the equilibrium value of s will be so small that $|\frac{\sigma}{\eta s}| > 1$, and then a quota regime will be more efficient. The situation is simpler for an inelastic demand and $\sigma = 1$; it is then assured that $|\frac{1}{\eta s}| > 1$ and a quota control clearly dominates.

7. Political Contributions

While the characterization of the allocation parameters was based in the first stage of the calculation of equilibrium solely on the common property of efficiency, the contributions depend on the specific political process. We examine two alternative mechanisms: 1) the Harsanyi-Zusman model of cooperative bargaining (Zusman 1976); 2) Grossman and Helpman's (1994) model which employs the procedure of a first price menu auction. As before, the analysis is conducted under the assumption that all organized producers are members of a single industrial lobby and that under a price regime some producers may not participate in the political play. As indicated earlier, with our structural assumption of constant cost and effect of the political activity, only the aggregate reward, C, is determined in the political equilibrium; the individual c^i values are set by the lobby.

7.1. Cooperative Bargaining

As indicated earlier, the threat point of the political bargaining game is taken here to be the social resource allocation with no reward to the politicians. The government is thus supposed to have the power to enforce this allocation if it is not bribed into a political compromise. By Nash (1950) solution, equilibrium levels of the policy parameters, γ, and political contributions, C, satisfy

$$(\gamma^{po}, C^{po}) = \arg\max_{\gamma, C} \Delta W \Delta Y, \tag{14}$$

where, $\Delta W = W(\gamma, C) - \bar{W}$, $\Delta Y = Y(\gamma, C) - \bar{Y}$ and $\bar{W}$ and $\bar{Y}$ stand for the disagreement (threat point) utility and profit levels of the government and the lobby, respectively. (W

is defined as in eqs. (3) and (4) and Y is the sum for the K members of the lobby, as in (6)). Where applicable, the rebate, $R = tq$, is added to or subtracted from the payoff of the producers. The simultaneous solution of the necessary conditions for a maximum in (14) defines the political equilibrium.

For a quota regime, the maximization is with respect to q^i and C; for a tax control it is done with respect to t and C. The first order conditions are marked a and b and expressed in a general form as

$$a: \quad \Delta Y V_\gamma + \Delta W Y_\gamma = 0 \tag{15}$$

and

$$b: \quad \alpha \Delta Y - \Delta W = 0. \tag{16}$$

Since a Nash solution is efficient, its first order conditions characterize points on the political contract curve. This can be demonstrated by substitution of (16) into (15) to yield

$$V_\gamma + \alpha Y_\gamma = 0 \tag{15'}$$

which is the equilibrium factor allocations of (8) and (10).

How does a shift from one regime to the other affect political contributions? As in Proposition 1, we can answer this question unambiguously only for negative externalities. Making use of the recursive nature of the calculation of equilibrium in politically efficient economies, we answer the question by employing a graphical argument. Recalling that under both control regimes, $\pi_q^i = \pi_q^j \ \forall \ i, j \in \{1, \ldots, N\}$, the political equilibria can be depicted in the space C, q^i, where i is arbitrarily chosen.

The lines a and b with the superscripts q and t in Figure 3 are the graphs of equations (15) and (16)—the first order conditions for the control modes. The political equilibrium under quota regime is denoted by e^q. From Proposition 1, the political equilibrium under price regime is positioned to the left (right) of e^q if and only if $|\frac{\sigma}{s\eta}| < (>)1$. We denote these alternative equilibria, e_l^t and e_h^t.

To show that the picture is correct, we proceed as follows. First, note that equation (15′) implies that a^q and a^t are both vertical; this a reflection of the recursive nature of the calculation of equilibrium. Next, writing equation (16) in detail for quota and price regimes yields, respectively,

$$\alpha(\sum_{i=1}^{N}\pi^i(q^i)-C)-\sum_{i=1}^{N}\pi(q^i)-\sum_{i=1}^{M}\mu(Q)=0 \tag{16′}$$

and

$$\alpha(\sum_{i=1}^{k}\pi^i(q^i)-C)-\sum_{i=1}^{N}\pi(q^i)-\sum_{i=1}^{M}\mu(Q)=0. \tag{16″}$$

Comparing the first term in (16′) and (16″) shows that b^t is positioned below b^q.

Differentiating equation (16′) and (16″), while incorporating the equilibrium constraint $R=tq$, one gets

$$\frac{\partial C}{\partial q^j}|_{(16')} = \frac{1}{2\alpha}[\sum_{i=1}^{N}(\alpha\pi^i{}_q - V_{q^i})\frac{\partial q^i}{\partial q^j}], \tag{17′}$$

and

$$\frac{\partial C}{\partial q^j}|_{(16'')} = \frac{1}{2\alpha}[\sum_{i=1}^{k}(\alpha\pi^i{}_q\frac{\partial q^i}{\partial q^j}-\sum_{i=1}^{N}V_{q^i})\frac{\partial q^i}{\partial q^j}]. \tag{17″}$$

Using (8′) and (12) and the entries in Table 1, with negative externalities, $\frac{\partial C}{\partial q^j}>0$, under both regimes, which complete the argument that supports Figure 3.

Two immediate conclusions emerge and are summarized in Proposition 2a.

Proposition 2a: *Consider the setup of Proposition 1 with negative externalities and suppose a cooperative bargaining between the government and the lobby. Then:*
(i) if $|\frac{\sigma}{\eta s}|<1$, *a quota regime induces a larger level of political contributions,*
(ii) if $|\frac{\sigma}{\eta s}|>1$ *but* $\sigma<1$, *a quota regime may yield a larger or a smaller level of political contributions.*

Thus, if the utilization level under price regime is smaller than under quota regime, the political contributions are necessarily smaller under the price regime. However, if in

spite the free riding under price regime ($\sigma < 1$), the utilization level is larger, then the political contributions under price regime may be larger or smaller than under quotas.

To gain intuitive insight, imagine a thought experiment changing the size of the lobby. Let $e*$ mark the equilibrium for an all embracing lobby in which $K = N$. A gradual reduction of K will shift both the a^t line to the left and the b^t line downward. A smaller lobby both exerts less political pressure and achieve less (the tax increases as K becomes smaller). Further reduction of K will place the equilibrium point still to the right of a^q but the contribution will be smaller than under quota at e^q.

7.2. First Price Menu Auction

This model conceptualizes the political process as a two-stage noncooperative auction game. In the first stage, lobbies representing different industries, and often opposing interests, offer political contributions for changes in policy parameters. In the second stage, the government chooses parameters that maximize its utility which is, as in eq. (3), a weighted sum of social welfare and political rewards. The perfect Nash equilibrium of this game is not unique, but "truthful" strategies lead to unique Nash equilibria which are coalition proof. Moreover, these strategies do not reduce welfare of the influence groups. Truthful strategies may therefore be considered focal[10]. Acting truthfully implies, in the Grossman and Helpman (1994) model, that the contributions are $C = Y - B$, where $B \geq 0$ is an industry constant, related to its political power. The contributions, and hence the division of the surplus between the government and the producers, are determined by competition between lobbies. With a single lobby, as is the situation we analyze, the constant B is set such that the government gets just its reservation utility and all surplus in the polity is received by the producers.

[10] Marginally and when contribution schedules are differentiable, all politically efficient equilibria are truthful: at points of tangency in Figure 1, producers under quota offer $\frac{\partial c}{\partial q} = \pi_q$, and in a tax regime, they offer $\frac{\partial c}{\partial t} = q$; in both cases the marginal contribution is equal to the true value of an additional unit of the negotiated control.

The government reservation utility is given by $V(q_1^s, \ldots, q_N^s)$. Accordingly

$$C = V(q_1^s, \ldots, q_N^s) - V(q_1^{po}, \ldots, q_N^{po}). \tag{18}$$

The political contributions grow with the deviation of equilibrium allocation of the regulated factor from the social optimum.

Using eqs. (18) we conclude:

Proposition 2b: *Consider the setup of Proposition 1 with negative externalities and suppose that the political process follows a first price menu auction. Then, a quota (price) regime induces a larger level of political contributions, if and only if* $|\frac{\sigma}{\eta^s}| < (>)1$.

If the political process follows the procedure of a first price menu auction, then Propositions 2b completes, together with Part (i) of Proposition 1, the main answers to the question of *prices or quantities:* a. the comparative advantage of either of the regimes can be determined unambiguously for negative externalities; b. with negative externalities, the condition for price regimes to be more efficient both in yielding resource allocation closer to the social optimum and in saving on political pressure and rewards, is that $|\frac{\sigma}{\eta^s}| < 1$; c. with positive externalities the comparative efficiency of either of the regimes cannot be determined in general terms.

8. Combining Controls

Intuitively, one may expect that if controls could be combined, then, the higher the reliance on prices, the less room there is for political maneuvering of quotas and the more efficient the ensuing equilibrium. To examine the intuition, and to incorporate the real world possibility of lobbies struggling for both prices and quantities, we depart in this section from the dichotomous policy choice by which the control was either a quota or a price. We examine policy combinations as when water is priced positively but at a price too low for exact market clearing and allocation is administrative. Two conclusions emerge: a. the intuition is correct for most cases but not for all; b. a welfare maximizing policy mix can be identified

8.1. The Political Equilibrium

A key difference between price and quantity controls is that with the former, the private first order condition, eq. (9), is satisfied, while with the latter it is not. Based on this difference, a continuum of policies can be modelled by introducing a parameter measuring the extent by which condition (9) is fulfilled.

Define the parameter ρ by

$$\rho \equiv \frac{\pi_q^i - t}{\pi_q^i} \; \forall i \in 1, \ldots, N. \tag{19}$$

Thus ρ equals the marginal rent as a percentage of marginal profit. It follows that marginal profit, π_q, is again the same value for all producers. By the definition, $\rho = 0$ means that condition (9) is fully satisfied and that the policy is a pure price regime and $\pi_q = t$. The other extreme case, $\rho = 1$, characterizes a pure quota control. Given ρ, the sides to the polity—the government and the producers— negotiate while being constrained to a fixed marginal rent. The line $\rho+$ in Figure 4 marks the path of negotiation for $0 < \rho < 1$ ($\rho < 0$ is possible and depicted as $\rho-$ in the figure); the pair (t, q) is a policy mix for negative externalities ($t > 0$). Constrained to this path, the producers seek to reduce the tax and increase the quota and the government opposes their pressure. For the sake of simplicity, we now assume a single producer in the industry.

The definition of ρ implies

$$t = \pi_q(1 - \rho) \quad \text{and} \quad \frac{\partial t}{\partial q} = \pi_{qq}(1 - \rho) \tag{20}$$

and the single producer's payoff can be written as

$$y^i = \pi^i(q^i) - \pi_q^i(1 - \rho)q^i - c^i. \tag{21}$$

To analyze simultaneously allocation and contributions, we adopt the Nash bargaining framework and accordingly maximize (14) with respect to q^i and c^i, with y^i in Y defined as in (21). The first order conditions are

$$a: \quad V_Q \Delta Y + \Delta W \pi_q [\rho - \frac{1 - \rho}{s\eta}] = 0, \tag{22}$$

and

$$b: \quad \alpha\Delta Y - \Delta W = 0. \tag{23}$$

By substitution,

$$V_q = -\alpha\pi_q[\rho - \frac{1-\rho}{s\eta}], \quad i = 1, \ldots, N\,. \tag{24}$$

The last equation, (24), reduces to the first order condition under a pure price (quota) regime as $\rho \longrightarrow 0(1)$.

We may turn now to the intuitive assertion in the opening passage of the section. It is examined in a comparative static analysis.

8.2 Comparative Statics

The analysis is conducted for the effect of a change in ρ on the endogenous variables q and c. Again, the equality $R = tq$ is maintained in equilibrium and therefore, $\frac{\partial Y}{\partial \rho} = 0$. Accordingly, taking the derivatives of (22) and (23)

$$a_\rho = \Delta W \pi_q[1 + \frac{1}{s\eta}], \quad b_\rho = 0 \text{ and } b_q = -2V_q \tag{25}$$

and the comparative static equations are

$$\frac{\partial q}{\partial \rho} = -\frac{\Delta W \pi_q[1 + \frac{1}{s\eta}]b_c}{\Delta}, \tag{26}$$

and

$$\frac{\partial c}{\partial \rho} = -\frac{\Delta W \pi_q[1 + \frac{1}{s\eta}]2V_q}{\Delta}. \tag{27}$$

The signs of eqs. (26) and (27) indicate changes in levels of the endogenous variables as the policy mix is modified toward a greater reliance on quota and a smaller reliance on prices. It is convenient to think of such changes as, in the first instant, a reduction in the tax or in the subsidy, while holding the quota constant. Negotiations will then create a new political equilibrium, generally it will be moved away form the initially set point.

Using $\pi_q > 0$ for negative externalities, $\pi_q < 0$ for positive effects, and $b_c < 0$; the signs of the comparative static equations are reported in Table 2.

Table 2: Policy Mix—Comparative Statics

	$\lvert s\eta\rvert > 1$	$\lvert s\eta\rvert < 1$
Negative Externalities		
Factor Utilization, q	+	−
rent seeking, c		
$V_q < 0$	+	−
$V_q > 0$	−	+
Positive Externalities		
Factor Utilization, q	−	−
rent seeking, c		
$V_q < 0$	−	−
$V_q > 0$	+	+

For an interpretation of the entries in the table, consider negative externalities. An increased ρ brings the policy closer to a quota regime. As we saw in Proposition 1, a quota regime is less efficient if $|s\eta| > 1$; and indeed, an increased ρ causes an increase in both q and C when $|s\eta| > 1$ and for the usual case of $V_q < 0$. The intuitive interpretation for the reduction of rent seeking for $V_q > 0$ is that in this situation, the government is also interested in increasing the quantity and the more the control shifts toward quota, the less the producers need to pressure the government to be allowed to use more of the controlled factor. The other entries in the table can be interpreted similarly.

Returning to the intuition of the beginning of the section, increased reliance on prices is realized here in lower values of ρ. Thus in the table, the intuition is confirmed if q increases with ρ for negative externalities, and decreases for positive effects. This is the case for three configurations but not for negative externalities and $|s\eta| < 1$. Thus, increased reliance on prices improves efficiency, but not always.

8.3 Optimal Policy Mix

To assert the second conclusion in the opening passage of the section, note that by

equation (24) for

$$\rho* = \frac{1}{1+s\eta} \tag{28}$$

$V_q = 0$ and the resource allocation in the political equilibrium is optimal resource allocation. Unfortunately, as Proposition 3 demonstrates, this policy mix is not always feasible.

Proposition 3: *Consider the setup of Proposition 1 and suppose that the government employs a combination of price and quota controls. Then,*

(i) *with negative externalities with* $|s\eta| > 1$ *and with positive externalities, there exists a policy mix, given by* $\rho*$ *in* (28)*, that induces socially optimal resource allocation;*

(ii) *the optimal policy mix,* $\rho*$ *also minimizes political contributions.*

Proof: (i) From equation (24) it is clear that $\rho*$ yields $q = q^s$. However, only ρ values that simultaneously satisfy equation (28) and maintain the sign properties of the external effects, can be considered optimal. By simple calculations it can be verified that, in the case of positive externality, such a ρ can be always found. However, with negative externalities and $|s\eta| < 1$, the calculated $\rho* > 1$; this in turn implies, by (20) and $t > 0$, $\pi_{q^s} < 0$, which contradicts the definition of negative externality.

(ii) To prove this part, we rely on the comparative static analysis. By equation (27), the derivative $\frac{\partial c}{\partial \rho}$ vanishes at $\rho = \rho*$ ($V_q = 0$). From eq. (24),

$$\frac{\partial V_q}{\partial \rho} = -\alpha\pi_q(1+\frac{1}{s\eta}) > (<)0 \tag{29}$$

for positive externalities (negative externalities and $|s\eta| > 1$). With these signs, the appropriate entries in Table 2 assert that $\frac{\partial c}{\partial \rho} = 0$ characterizes a minimum at $\rho = \rho*$. ∎

8.4. Interpretation and Qualification

The case of a positive externality is straightforward, the producer attempts to increase the subsidy and reduce the quota. There exists a value of ρ which balances these efforts and yields an equilibrium consistent with the social optimum. In the case of a negative externality an optimal mix is found only for the case where $|s\eta| < 1$, which implies $\rho < 0$

and $t > \pi_q$. Here, to achieve social optimum, the government has to force the producers to use more of the quantity they desire (given t) of a factor with negative effects. Hardly a probable situation.

9. Concluding Remarks

Government intervention invites political pressure and a political environment affects the efficiency of the instruments of public regulation. Our principal findings were that conditions for preference of a tax or a quota regime can be identified for negative externalities, but not for positive effects, and that for a wide range of cases, the regime resulting in more efficient factor allocation also implies lower levels of political activity. Moreover, the comparative advantage of the control regime—always in terms of factor allocation and in many cases also in terms of political contributions—are the same for markedly different modes of political activity. We have also shown that an optimal policy combination can be identified and that it is not always true that an increased reliance on prices improves allocation efficiency.

Simplifying and clarifying, we chose to restrict the discussion to linear political influence structure. But cost of political activity can increase, as when it becomes harder and harder to mobilize demonstrators and other activists, and it can decrease—when a large lobby is more effective then the sum of its members. Likewise, the marginal political influence may decrease with the amount of the political contributions or with the intensity of the demonstrations. Incorporating decreasing or increasing cost and influence, we have found elsewhere (not reported yet) that allocation and contributions are determined simultaneously and, more interestingly for the purpose of our analysis, the major findings of the paper are left intact; they are not affected by the adoption of the simplifying assumptions.

The robustness of the conclusions to changes in structural assumptions and in the political mechanism, augments our confidence in the generality of our findings.

The analysis can be extended in several directions. For example, one feature of the analysis with the assumed structure is that the conclusions are the same whether the

industry has one lobby group or several. In a non-linear structure, lobbies may compete, and one lobby may be stronger than the others. An additional possibility may be that consumers and socially conscientious individuals—and not only producers—will organize in influence groups and counterbalance, at least partly, the political influence of the industrial lobbies. We hope to attend to these and other possibilities in the future.

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Figure 1: Construction of Political Equilibrium

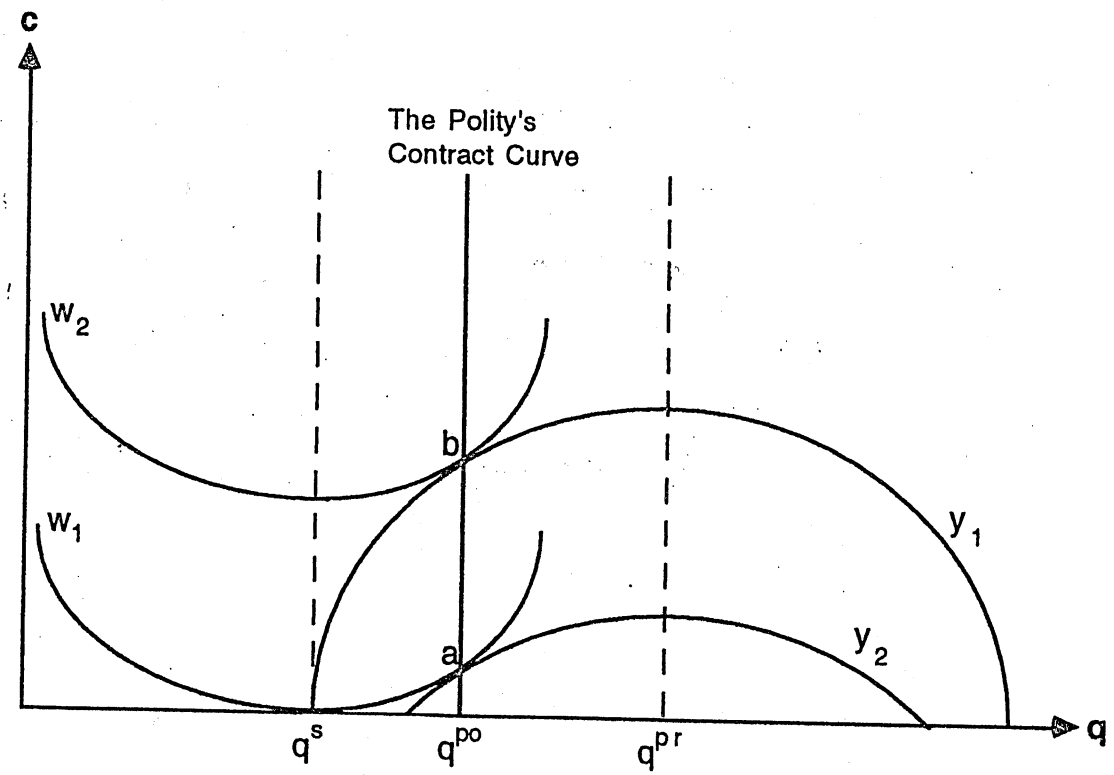


Figure 2: Gain From Political Influence--Prices vs. Quantities

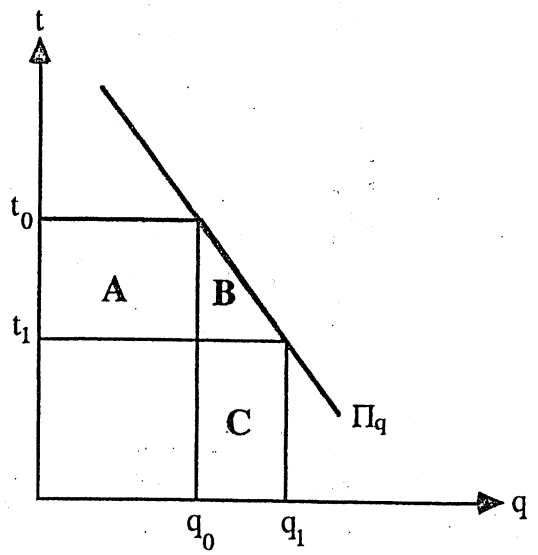


Figure 3: Political Equlibrium with Cooperative Bargaining

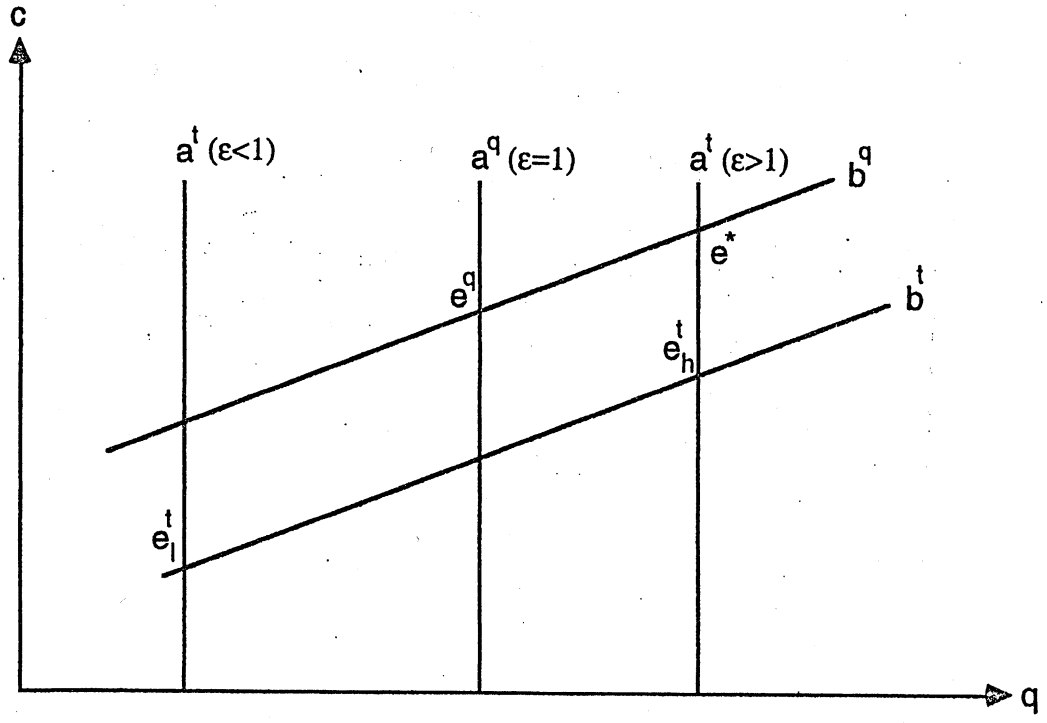
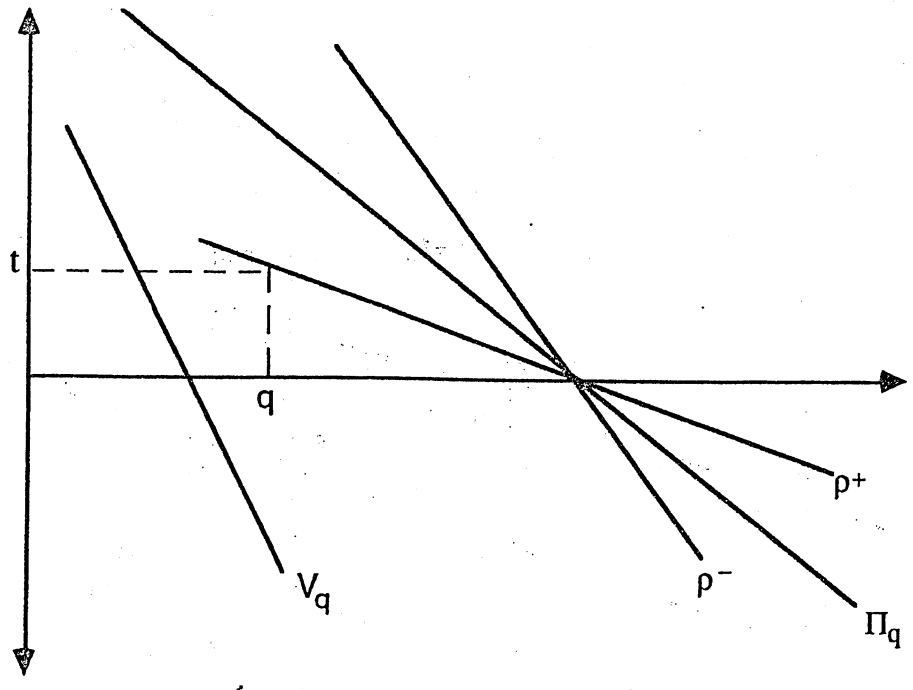


Figure 4: Policy Mix, Negative Externalities



(ρ^+ for $\rho > 0$, ρ^- for $\rho < 0$)

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