A PARADOX IN THE THEORY OF SECOND BEST

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It is now conventional to conclude that when an uncontrollable monopolist exists in an otherwise competitive economy, positive taxes or subsidies on the controllable, competitive sectors of the economy are generally required to move the economy to a social optimum (e.g., Bohm [2], Davis and Whinston [4], Lipsey-Lancaster [7] and Negishi [8]). This basic result of the general theory of second best is generated from models which take the existence of uncontrollable monopoly as given and unrelated to the ability of the government to determine policy over the rest of the economy. Yet why should there be a constraint on monopoly policy to begin with? And, if monopoly policy is in fact constrained, does the institutional environment which permits the constraint imply additional policy restrictions which are not picked up by the formal mathematics of "second best" constrained maximization?

This paper shows that in a political environment generating an uncontrollable monopolist, additional restrictions do indeed exist on the feasibility of controlling certain, other, competitive sectors of the economy and that the additional restrictions imply the optimality of a laissez faire policy. The argument generalizes to all forms of market failure but not to all sources of feasibility constraints on government policy.

1. The General Model

Consider an n-industry economy generating an equilibrium set of outputs, $(x_1,\ldots,x_n)=x$, in which the output of the i^{th} industry, x_i, $i=1,\ldots,n$, depends on the per unit tax (or subsidy) rates on the various outputs, $(t_1,\ldots,t_n)$. Outputs here include "leisure" so that x does not vary with the general level of taxes. To avoid the corresponding indeterminacy in optimal tax rates, we standardize taxes by setting a particular tax, t_n, equal to zero. This means that all taxes are relative to taxes on the n^{th} output. Hereafter, we use $t = (t_1,\ldots,t_{n-1})$ to denote the set of variable taxes. There exists a government which selects t so as to maximize a collective utility function[2], $U[x(t)]$, subject to the social transformation function, $T[x(t)] = 0$, and a tax feasibility constraint, $G(t) = 0$.[3] A "first best" solution exists when $G(t) \equiv 0$, i.e., when any set of taxes satisfies the tax feasibility constraint, or, more generally, whenever $G(t) = 0$ is not a binding constraint. When $G(t) = 0$ _is_ a binding constraint, then there is a "second-best" solution.[4]

When the constraint is not binding, $U[\cdot]$, $T[\cdot]$ and $x(\cdot)$ are everywhere differentiable, and the Jacobian of $x(\cdot)$ does not vanish at the optimum, the traditional first-order conditions for a first-best solution are easily derived. They are, when $\partial U/\partial x_n$ is always positive,

$$(1) \qquad \frac{\partial U/\partial x_j}{\partial U/\partial x_n} = \frac{\partial T/\partial x_j}{\partial T/\partial x_n}, \; j = 1,2,\ldots,n-1.$$

Adding that $U[\cdot]$ and $T[\cdot]$ are quasi-concave, these conditions are necessary and sufficient for an optimum.

2. The Source of the Policy Constraint.

What is the source of the $G(t) = 0$ constraint? While much of the applied literature appealing to "second best" arguments suggests all sorts of informational limitations on government decision makers, this is hardly reasonable given that the decision maker must know the $U[t]$ and $T[t]$ functions in order to know the second best policy. It is clear that the additional constraint comes from certain, political feasibility constraints imposed on the government decision maker. But why would the public impose constraints on its informed decision maker? Why, to cite the most common case considered in the literature, wouldn't the voters allow the informed bureaucrat to subsidize the output of a single monopolist to induce an optimal output and simultaneously apply a lump-sum tax on him so as to make everyone better off? The answer must be that the efficient, per unit subsidy would not, in fact, be complemented by a lump-sum tax sufficient to compensate the relatively uninformed electorate so that the electorate rationally imposes a policy constraint to prevent the monopolist from exercising his political power over the government decision maker. A contemporary example of such an effect is that our voter representatives in the U.S. have not allowed the prices of oil products to rise to levels that could make us all better off because they do not believe that the oil companies would -- in fact -- pay enough of a lump-sum to compensate the great majority of their constituents for the price increase. Rational voters, or their representatives, who do not themselves know the U[•] and T[•] functions, are suspicious of any policy proposal which may redistribute to a special interest group. The voters' skepticism is based on their realization that, given the voters' information disadvantage, a self-interested government official has an incentive to "sell out"to a special interest group and impose an overly small lump-sum tax on it. As a result, it may be rational for the voters to impose policy constraints which reduce the likelihood of government abuse. A general argument for the imposition of such constraints is developed by Brennan and Buchanan [3].

For an overproduction distortion, such as arises with pollution-type, external diseconomies, the argument would be that a per-unit tax on the overproducers, together with a lump-sum subsidy to them sufficient to prevent them from blocking the tax-subsidy bill, would not gain the support of the voters at large because they cannot measure the lump-sum compensation actually paid to the producers and would not trust the bureaucrat to make such compensation sufficiently small that the voters would gain from the tax-subsidy policy.

3. The Conventional Second Best Problem.

Following the literature, suppose (1) that n-1 of the industries, say industries 2,...,n, are standard competitive industries while the remaining industry contains a "distortion," i.e., an incentive system preventing the marginal equality in (1) from holding for $j = 1$ at $t = \theta$, and (2) that it is not feasible to directly subsidize or tax output of industry 1. The tax feasibility constraint therefore reads: $G(t) \neq 0$ whenever $t_1 \neq 0$ and $G(t) = 0$ for all $t_2,\ldots,t_{n-1}$ whenever $t_1=0$. Industry 1 is said to be "uncontrollable" while the others are "controllable."

To make the discussion more concrete, we shall make industry 1 a simple, non-discriminating monopoly. To derive the monopolist's rational output rule, first consider the n-2 equilibrium conditions for the competitive industries relative to industry n for a given output of industry 1:

$$(2) \qquad \frac{U_j}{U_n} = \frac{T_j(x_1;x_2^*,\ldots,x_n^*)}{T_n(x_1;x_2^*,\ldots,x_n^*)} + t_j \qquad j = 2,\ldots,n-1,$$

where x_2^* through x_n^* are the equilibrium outputs under competition, given x_1 and t. From (2) and $T[x] = 0$, we obtain each competitive industry's output as a function of x_1 and t, or

$$(3) \quad x_j^* = x_j^*(x_1,t), \qquad j = 2,\ldots,n.$$

In contrast to the standard models which assume that x_j^* is constant, our monopolist takes into account the n-1 equilibrium response functions expressed in (3). (Cf. Allingham and Archibald [1] and Negishi [7]). While the assumption that the monopolist knows all the general equilibrium effects of his output choice is unrealistic, it captures the idea that the monopolist is at least as aware of the interdependence among industries as the government and cannot be "fooled" by indirect tax-subsidy policy imposed upon substitute or complementary commodities. Profit to the monopolist in terms of Commodity n, is therefore written:

$$(4)\qquad \pi_1 = x_1 \frac{U_1}{U_n}[x_1, x_2^*(x_1,t), \ldots, x_n^*(x_1,t)] - C(x_1),$$

where C(•) is 1's total cost function in terms of Commodity n. We are following here the standard convention of disregarding the effect which the monopolist's output has on the relative prices of the goods which he consumes, and thus its effect on his optimal output choice. Implicitly, we are assuming that the monopolist consumes only the numeraire commodity. We further simplify the problem by assuming that the monopolist has no significant effect on input prices. Therefore, while his output choices significantly affect the outputs of others, the choices do not significantly affect his factor prices. In this case, of course, $C'(x_1) = T_1(x)/T_n(x)$.

Maximizing (4) by choice of x_1, given t, yields the first-order condition relative to the numeraire commodity produced by Industry n:

$$(5)\qquad \frac{U_1}{U_n} + x_1\left[\sum_{j=2}^{n}\left(\frac{\partial(\frac{U_1}{U_n})}{\partial x_j^*}\ \frac{\partial x_j^*}{\partial x_1}\right) + \frac{\partial(\frac{U_1}{U_n})}{\partial x_1}\right] = \frac{T_1(x)}{T_n(x)}.$$

We assume that the term in large brackets is negative so that our monopolist is sufficiently conventional that he undervalues his output.

From (5) we can write 1's equilibrium output as a function of the tax rates, or

$$(6)\qquad x_1^* = f_1(t)$$

Inserting (6) into (3) yields

$$(7) \qquad x_j^* = f_j(t), \qquad\qquad j = 2,\ldots,n.$$

Note that the resulting equilibrium, x^*, precludes a first best solution when $t_1 = 0$. A non-zero tax imposed on competitive industry i ($i \neq n$) violates (1); and, if zero taxes are applied everywhere, (5) violates the first best conditions in (1).

Substituting (6) and (7) into U[x], the government's second-best optimization problem is

$$(8) \qquad \max_t U[f_1(t), f_2(t),\ldots,f_n(t)], \quad \text{given } t_1 = 0.$$

Since the output functions in (7) already satisfy the transformation function, the latter is not included as an independent constraint on the maximization problem.

The necessary marginal conditions for (8) are:

$$(9) \qquad \sum_{k=1}^{n} \frac{\partial U}{\partial f_k} \frac{\partial f_k(t)}{\partial t_i} = 0 \qquad\qquad i = 2,\ldots,n-1.$$

Solving for $\frac{\partial f_n}{\partial t_i}$ from both (9) and the transformation function, $T[f_1(t),\ldots,f_n(t)] = 0$, setting them equal, and rearranged terms, we obtain

$$(10) \qquad \sum_{k=1}^{n-1} \left(\frac{\frac{\partial U}{\partial f_k}}{\frac{\partial U}{\partial f_n}} - \frac{\frac{\partial T}{\partial f_k}}{\frac{\partial T}{\partial f_n}} \right) \frac{\partial f_k}{\partial t_i} = 0 \qquad\qquad i = 2,\ldots,n-1.$$

Equation (10) says that taxes are changed until the sum of the excesses of marginal social benefits over marginal social costs in each industry times the induced change in that industry's output is equal to zero. This condition must hold simultaneously for each variable tax rate. So, starting with zero taxes everywhere, while each sum has its last n-2 terms zero because of the competition in the corresponding industries, each of the first terms is generally non-zero because the bracketed term in (5) is non-zero (otherwise, no distortion could exist) while $\partial f_1/\partial t_i$ is generally non-zero. Hence, with $\partial f_1/\partial t_i$ non-zero for some i, a second best solution requires non-zero taxes on the controllable industries. Such taxes will create inequalities between marginal benefit and marginal cost in these industries.

Zero taxes on all controllable industries (i.e., laissez-faire policy) is indicated if and only if there is no ultimate effect of a tax change on the monopolist, i.e., if and only if $\partial f_1/\partial t_i = 0$, all $i \geq 2$. This would occur, for example, if Industries 1 and n were separable from the rest of the economy in both the collective utility and commodity transformation functions. (See Faith-Thompson [6]).

The above conclusions are very similar to those found in the literature; our model differs from previous analyses only in that (1) our monopolist accounts for the effects of changes in his output on the outputs of other industries and (2) our marginal conditions in (10) reflect the system's response to the available policy variables rather than assuming that the policy maker can directly select industry outputs.

4. The Paradox.

However, our marginal conditions in (10) expose a paradoxical characteristic of the conventional second best solution. The conditions show that improving upon zero taxes on the competitive industries always involves increasing the monopolist's output.[5] That is, the second best policy is to tax and subsidize other industries, creating distortions in those industries which are compensated for by the increase in monopoly output. But increasing a monopolist's output generally requires a relative increase in demand or a relative decrease in variable costs, both of which serve to increase the monopolist's profit.[6] Recalling that the reason for the infeasibility of first best policy is that the voters fear a redistribution of wealth to the monopolist, the second best intervention should also be infeasible. It is, to say the least, paradoxical that the government cannot induce an increase in monopoly output by increasing monopoly profits via a direct subsidy but can induce the output in-increase by generating a like increase in monopoly profits via more costly, distortion-creating, indirect taxes and subsidies. At the very least, one may doubt the empirical relevance of a model admitting such a paradox.

The paradox applies to any imperfection, not just monopoly. Suppose industry 1 is, rather than a monopoly, a competitive industry generating an external economy and that a per-unit subsidy is precluded because the consumer-voters fear an insufficiently low lump-sum tax on industry 1 because of the latter's ability to form a powerful lobby. Then the second-best policy, using (10), would induce the industry to expand its output. But the only way to do this is to tax substitutes or subsidize complements in order to increase prices or reduce costs in industry 1. So there is still, in effect, a subsidy to industry 1. The only difference is that the feasible subsidy is more expensive than the infeasible one in that it generates new distortions.

However, the paradox may not extend to any form of political constraint. For one thing, eq. (10) depended on the conventional, controllability-uncontrollability distinction. Our result is only that the form of political constraint suggested by the standard theory generates a policy paradox. More important, the paradox is based on our own, special, political model. There may be other political models generating non-paradoxical results. One such model might rely on differential resource costs in observing the outputs of the various industries for tax purposes. However, in a world in which essentially all outputs are already taxed via general sales and income taxes, this assumption would not be very plausible.

5. Removing the Paradox.

In any case, within our Brennan-Buchanan-type political model, the conventional feasibility constraint creates a paradox which is only removed by imposing sufficient additional tax constraints that the taxes on the controllable industries do not affect the profits, and hence the outputs, of the distorted one. So, for h, any member of H, the new controllable set, $\frac{\partial f_1}{\partial x_h} = 0$. Since the exercise yielding (10) can be duplicated when $t_k = 0$, $k \notin H$, rather than just $t_1 = 0$, our new conditions for optimal taxes are the same as (10) except that they apply only for $i \in H$ rather than for $i = 2,\ldots,n$. Since $\frac{\partial f_1}{\partial x_h} = 0$, it is immediately seen that having zero taxes on the controllable industries is necessary and sufficient for a second best optimum.

Adding distorted but controllable sectors to our economy, we merely apply classical economic policy to these sectors to arrive at our second best solution. For if the sector is controllable, it has no noticeable effect on the noncontrollable sectors and the standard optimality conditions apply. Thus, in developing policy toward any one sector, we can assume the rest of the economy is perfectly competitive (even though it certainly is not) and suggest a policy that would induce the otherwise distorted sector to behave as if it were perfectly competitive. In this way, our derived second-best-constraints serve to rationalize the classical, "piecemeal" approach to policy which Davis and Winston [5] represent as having been destroyed by second-best theorists. This piecemeal approach is of great potential value to economics because it allows different economists to specialize on different sectors or problems but still come out with a collection of policy recommendations which achieves a social optimum.

6. Summary.

We are left with the impression that second best theory is, rather than a general policy framework for economists wishing a more politically realistic view, just another abstract theory in search of an application. Along these lines, it may be useful to outline a quasi-realistic example of how conventional second best theory might be currently used and how our argument upsets the application. Conventional second best theory says that because it is politically infeasible to lift the recently imposed price controls on oil products, a myriad of new taxes and subsidies on non-oil products would be required for a social optimum. But we have seen that any such myriad would, by inducing a lower cost of producing oil, amount to an indirect subsidy to the oil industry and therefore should be deemed infeasible for the same reason that the first-best policy is infeasible. The fact that oil price controls have not been accompanied by significant changes in tax and subsidy rates outside the oil industry indicates that political feasibility constraints do indeed extend beyond the distorted sectors to related, undistorted sectors.

FOOTNOTES

1 Geoffrey Brennan, Jack Marshall, and Nick Tideman provided valuable comments.

2 For any x, aggregate output is allocated among all individuals while maintaining given levels of utility for all individuals but one and maximizing the utility of the one individual to obtain the utility index U(x) with the conventional curvature. This is to be contrasted with Samuelson's [7] attempts to construct social indifference contours which require lump-sum transfers to maintain a "correct" distribution of utility. Here we are anticipating some final distributional solution when assigning utility levels.

3 For notational simplicity, lump-sum taxes and subsidies and, correspondingly, a governmental budget balancing equation, are ignored, although they will continue to be included in our informal discussions on policy.

4 Since we are dealing with a technological environment containing outputs only, the question of efficient use of inputs does not arise. Allingham and Archibald [1] have shown that in a model with concave production functions, aggregate resource constraints, and an uncontrollable monopolist, second-best production takes place on the production frontier. Thus, we simply appeal to their results as a rationale for using a transformation constraint.

5 To see this, first multiply (10) by ∂t_i and note that at $t = \theta$, only the first terms on the left side of (10) may be non-zero. Then note that since the net social value of x_1 (the coefficient of ∂x_1) is positive, the net social value of the tax change (the entire left side of (10)) is positive if and only if ∂x_1 is positive.

6 While it is conceivable that the second best taxes and subsidies could work to flatten the monopoly demand curve, inducing the monopolist to expand without increasing his profit, the same effect could be achieved by a non-linear, first-best, tax-subsidy schedule. Moreover, for externality imperfections, such an effect would not be present. The firms in a competitive industry generating an external economy <u>must</u> receive a higher price or pay a lower cost in order to expand output.

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