Working Paper No. 308

THE POLITICAL ECONOMY OF PUBLIC GOOD PROVISION

by

David Zilberman and Harry de Gorter

California Agricultural Experiment Station
Giannini Foundation of Agricultural Economics
April 1984
Competitive industries may use inputs that have "public good" characteristics. Recognition of the suboptimality of the competitive resource allocation in these situations may lead to several arrangements supplementing the market resource allocation. They include provision of public goods by the public sector or collusion among producers (with the blessing of the government which does not apply antitrust laws) to produce the public good inputs collectively.

It is not clear that these arrangements will lead to a socially optimal resource allocation or even improve social welfare compared to the free-market outcome. As the recent theories of economic regulation suggest [Posner, 19_; Downs, 19_; Peltzman, 19_; and Stigler, 19_], decision makers in the public sector may weigh unevenly the well-being of different groups in society or may be even "captured" by one particular group and make decisions aiming to improve the welfare of this group. Similarly, when producers collude to produce a public good, they aim to maximize their own and not society's overall welfare. Thus, the provision of the public good inputs and the resource allocation in general will vary for different alternative political and institutional situations, and welfare analysis should take the institutional and political setting into account.

United States agriculture is an example of an industry with a high degree of government involvement of a public good, namely, technological knowledge. There is a vast body of empirical literature that indicates that there is
underinvestment in public research in agriculture [Haylicek, 19--; and Otto, 19--]. Agricultural economists have, for a long time, suspected that political and institutional factors are responsible for this suboptimal resource allocation and generated a significant body of evidence [Rose-Ackerman and Evanson, 19--; Gutterman, 19--; Huffman and Miranowski, 19--; and Bonnen and Ruttan, 19--].

This paper obtains, compares, and evaluates analytically the provision of an input with public good properties under alternative regimes. In two cases the taxpayers finance the provision of the public good: in one, the determination of the quality of the public good is controlled by consumers and, in the other, it is controlled by producers. The third case is when producers finance the provision of the public good and determine its quantity. Outcome in all these cases is compared to the benchmark case when a socially optimal level of the public good is provided.

II. THE MODEL

The analysis uses a deterministic, static, and partial equilibrium model. Suppose that consumer preferences are represented by the separable additive utility function $U(q, Z) = U(q) + Z$ where $q$ is the good we are interested in and $Z$ is a numeraire good. It is assumed that the marginal utility of consuming $q$ is positive and declining, $U_q > 0$, $U_{qq} < 0$.

A competitive industry is producing $Q$ units of output, and its cost function $C(Q, E)$ depends on output and public good expenditure, $E$. It is assumed that marginal cost of output is positive and increasing ($C_Q > 0$, $C_{QQ} > 0$); that an increase in public good expenditures reduces cost as long as the expenditures are below a saturation level, $E^*(Q)$, i.e., $C_E < 0$. 
0 \leq E < E^0(Q), E^1(Q) = 0; and that cost is convex in both E and Q (C_{EE} \geq 0, C_{EE} C_{QQ} - C_{QE} > 0). It is also assumed that the marginal impact of public good on cost is nonincreasing with the level of operation (C_{EQ} \leq 0). If the public good affects only the fixed cost of production, then C_{QE} = 0; if an increase in E reduces variable cost, then C_{QE} < 0. To consider alternative scenarios of the incidence of burden of public good expenditure, let \( \alpha \) denote the share of public good expenditure paid by consumers. When the government provides the public good using the taxpayers' money obtained from consumers, \( \alpha = 1 \). When the industry colludes and finances the public good provision by itself, \( \alpha = 0 \). Assume that individual consumers and producers consider \( \alpha \) and E as given in determining the consumption and production choices. Thus, consumers choose \( q \) to maximize \( U(q, Y - pq - \alpha E) \) where \( p \) is output price and \( Y \) is income, and producers choose \( q \) to maximize \( pq - C(q, E) - E(1 - \alpha) \). The resulting demand and supply relationships are, respectively, \( q = D(p) = U_q^{-1}(p) \) and \( q = S(p, E) = C_q^{-1}(p, E) \) where \( D \) is demand and \( S \) is supply. Equilibrium in the product market is obtained when marginal cost equals marginal utility, \( C_q = U_q \); thus, equilibrium price and quantities are functions of the public good expenditure denoted by \( q^*(E) \) and \( p^*(E) \).

The marginal effect of an increase in public good expenditures on outputs is obtained by total differentiation of the first-order condition to yield

\begin{equation}
q_{E}^{*} = \frac{C_{Q E}}{U_{Q Q} - C_{Q Q}} = \frac{C_{Q E} \eta^S \eta^D}{p(\eta^S - \eta^D)},
\end{equation}

where \( \eta^S \) denotes price elasticity of supply and \( \eta^D \) denotes price elasticity of demand. Using equation (1) and the total differentiation of the consumer decision rule, \( U_q = p \), yields the marginal impact of change in public good expenditures on output price,
Figure I illustrates the implications of expressions (1) and (2). Let $D_1$ and $S_1$ denote initial demand and supply, respectively, and $q_1$ and $p_1$ denote initial equilibrium levels of output and output price, respectively. An increase in public good expenditure shifts supply from $S_1$ to $S_2$, thus reducing prices (from $p_1$ to $p_2$) and increasing output (from $q_1$ to $q_2$). The magnitude of the shift depends on the magnitude of the marginal impact of public good expenditures on marginal cost ($|C_{qE}|$); thus, a larger $|C_{qE}|$ results in a greater horizontal shift in supply, a greater increase in output, and a greater reduction in output price.

To see the effects that the elasticity of demand has on $q^*_E$ and $p^*_E$, compare the outcome when the demand curve is $D_1$ to the outcome when the demand is less elastic and the demand curve is $D_2$. Since $q_3 < q_2$, $p_3 < p_2$, Figure I suggests that an increase in public good expenditure will have a stronger output price effect and a weaker output effect as the elasticity of demand is smaller (in absolute value). To analyze the impacts of the elasticity of supply, suppose $S_3$ and $S_4$ are the supply curves before and after the increase in the public good expenditure and $D_1$ is the demand curve. The equilibrium output and output price levels are $q_1$ and $p_1$ before the increase in $E$ and $p_4$ and $q_4$ after the increase. Since $S_1$ and $S_2$ are more elastic than $S_3$ and $S_4$, $p_2 < p_4$, and $q_2 > q_4$, an increase in public good expenditure has a smaller price effect and a smaller output effect as supply is more inelastic.
A problem is the less severe than the consumer pay or the socially desirable.
Introducing $q^*(E)$ and $p^*(E)$ into the profit and utility functions yield equilibrium utility ($U$) and profit ($\pi$) as functions of public good expenditure, namely,

$$U^*(E) \equiv U[q^*(E)] + Y - p^*(E) q^*(E) - \alpha E$$

and

$$\pi^*(E) \equiv p^*(E) q^*(E) - C[q^*(E), E] - (1 - \alpha) E.$$ 

Differentiation of these functions with respect to the public good expenditure, using $c_q = \frac{Uq}{q}$ and equations (1) and (2), yields

$$U^*_E = -q^* p^*_E - \alpha = -C_E \frac{\varepsilon^Q}{1 - \eta D/\eta S} - \alpha$$

$$\pi^*_E = -C_E + q^* p^*_E - (1 - \alpha) = -C_E \left[1 - \frac{\varepsilon^Q}{1 - \eta D/\eta S}\right] - 1 - \alpha$$

where $\varepsilon^Q = \frac{C_{QE} \cdot Q}{C_E}$ is the output elasticity of the marginal impact of public good or cost. This elasticity, $\varepsilon^Q$, is nonnegative; it equals zero when the public good affects the fixed cost of production while it may be larger than 1 when the public good affects the variable cost. For example, if the cost function is multiplicative and separable in $Q$ and $E$, $C(Q, E) = h(Q) q(E)$, then $\varepsilon^Q = h_Q Q/h(Q) > 1$ by the convexity of the cost function. If the cost function is additive in $Q$ and $E$, $C(Q, E) = h(Q) - q(E)$; then $\varepsilon^Q = 0$.

A marginal increase in public good expenditure has four effects. It has a cost-reducing effect measured by $-C_E$; a price-reducing effect equal to the marginal decline in price times the quantity, $q^* p^*_E$; and a two-expenditure effect which equals $\alpha$ for the consumers and $1 - \alpha$ for the
producers. Equation (3) suggests that the marginal impact on consumers of an increase in public good is the difference between the price-reduction effect and the increase in consumer expenditure. Equation (4) suggests that the marginal impact on the producers' welfare of an increase in public good is the difference between the cost-reducing effect and the sum of the price-reducing effect and the producers' expenditure effect.

Obviously, when producers control the provision of the public good, \( \pi^*(E) \) is maximized, while \( U^*(E) \) is maximized when consumers have the power to determine \( E \). The welfare evaluation of outcomes under alternative institutional arrangements is obtained by using the total surplus function, \( W^*(E) = U^*(E) + \pi^*(E) \). This is an appropriate welfare standard since, given resources and technology \( [Y \text{ and } C(\cdot, \cdot)] \), utility from consumption is \( W(q, E) = U(q) + Y - E - C(q, E) \). For each \( E \), \( W(q, E) \) is maximized when \( C_q = U_q \); hence, \( q \) behaves according to \( q^*(E) \). Utility as a function of \( E \) is:

\[
W(q^*, E) = U(q^*) - \alpha E + p(q^*) q^* - p(q^*) q^* - C(q^*, E) - (1 - \alpha) E = U^*(E) + \pi^*(E).
\]

A differentiation of the welfare criteria function yields

\[
(5) \quad W^*_E = -C_E - 1.
\]

Social welfare is increasing with the public good expenditure as long as the marginal reduction in cost associated with the public good expenditures exceeds the marginal increase in the expenditures. Total differentiation of (5) and substitution for \( q^*_E \) using (1) yields

\[
W^*_EE = \frac{C_{EE} C_{qq} - C_{qE}^2}{U_{qq} - C_{qq}} - C_{EE} U_{qq}.
\]
The cost and utility function assumptions assure that $W^*(E)$ is concave ($W^*_{EE} < 0$).

The optimal public good expenditure is zero if the introduction of an infinitesimal quantity of public good results in a cost-reduction effect that is smaller than the public expenditure. Otherwise, it occurs at a level where the marginal cost-reduction effect associated with the public good equals the marginal expenditure, i.e.,

$$E^* = 0 \quad \text{if at } E = 0, -C_E < 1$$

$$E^* > 0 \quad \text{if at } E^*, -C_E = 1.$$  \hspace{1cm} (6)

III. INCIDENCE OF COST/BENEFITS UNDER ALTERNATIVE ALLOCATION MECHANISMS

This section examines the implications of three alternative allocation mechanisms and compares them to the competitive outcome without provision of public good and the social optimum. The cases considered are:

1. Consumers finance the public good and producers determine its level. In this case, $\alpha = 1$, and $E$ is determined by maximizing $\pi^*(E)$. This is the case when the government provides the public good and the administrators in charge are captured by industry.

2. Consumers finance the public good and determine its level. In this case, $\alpha = 1$ and $E$ is determined by maximizing $U^*(E)$. This is the case where the government provides a public good but the administration is captured by consumer groups.

3. Producers finance the public good and determine its level. In this case $\alpha = 0$, and $E$ is determined by maximizing $\pi^*(E)$. This is the case of collusion among the producers in the provision of the public good.
The following subsections will analyze in detail each of the cases.

**Consumer Financing of Public Good; Producer Determination of Quantity**

Let \( E^1 \) denote the public good expenditure in this case. It is nonnegative and maximizes the producers' profit for \( \alpha = 1 \). In this case the marginal impact of an increase in the public good expenditure on the producers' profit is the difference between the cost-reducing effect and the price-reducing effect. Using equation (4),

\[
\pi_E^* = -C_E + q^* p_E^* = -C_E \left[ 1 - \frac{\epsilon Q}{1 - \eta D/\eta S} \right].
\]

Assuming concavity of profit in \( E \) and \( Q \), equation (7) suggests three types of solutions for \( E^1 \).

\[
E^1 = 0 \quad \text{if } 1 - \eta D/\eta S < \epsilon Q \quad \text{for } E = 0
\]

\[
0 \leq E^1 \leq E^2(Q^*) \quad \text{if } 1 - \eta D/\eta S = \epsilon Q \quad \text{for } E = E^1
\]

\[
E^1 = E^2(Q^*) \quad \text{if } 1 - \eta D/\eta S > \epsilon Q \quad \text{for } E = E^2(Q^*)
\]

where \( E^2(Q^*) \) denotes the saturation level of the public good expenditures associated with the market-clearing output level.

Condition (8) suggests that the public good will not be provided if the price-reducing effect associated with the public good is larger than the cost-reducing effect even for small \( E^1 \)s. When the public good is provided, its exact quantity is determined at a level where the marginal price-reducing effect \( q^* p_E^* \) equals the marginal cost-reducing effect \( -C_E \). This level may be the public good saturation level if, for smaller levels of public good expenditures, the marginal cost effect dominates the marginal price
effect. Condition (7) also indicates that the public good expenditures increase as the elasticity of demand is increasing (in absolute value), the elasticity of supply is decreasing, and the output elasticity of the marginal impact of public good on cost is decreasing. Thus, when producers control the public good provision, more money will be spent on the public good as follows: (1) when it has a stronger impact on fixed costs than when its main influence is to reduce variable costs, (2) when the industry is facing elastic demand (a small country exporting to the world market) than when it is facing inelastic demand, and (3) when the industry has rigid production coefficients than when it can easily adjust its production capacity in response to changes in economic conditions.

Consumer Financing of the Public Good and Determination of Quantity

Let $E^2$ denote the public good expenditure in this case. It is nonnegative and maximizes consumers' welfare for $\alpha = 1$. Using (3), in this case the marginal input of an increase in public expenditure on consumer welfare is the difference between the price-reducing effect of a marginal increase in public good expenditure and the expenditure itself, i.e.,

\[ U^*_E = -q^* p^*_E - 1 = -C_E \frac{\varepsilon Q}{1 - \eta D/N} - 1. \]

Assuming concavity of consumer welfare in $E$, condition (9) suggests two types of solutions for $E^2$. The public good will not be provided if the price-reduction effect associated with the introduction of an infinitesimal quantity of the public good is smaller than the expenditure it involves ($E^2 = 0$ if $-q^* p^*_E < 1$ at $E = 0$). Alternatively, if the public good is
provided, the optimal quantity is determined by equating the marginal price-reducing effect with the marginal expenditure (at $E^2 - q^* p_E^* = 1$).

From (9), the behavior of the optimal outcome can be rewritten as:

$$E_2 = 0 \quad \text{if} \quad -C_E < \frac{1 - \frac{D}{\eta}}{\varepsilon} \quad \text{at} \quad E = 0$$

(10)

$$0 \leq E_2 < E^2(Q^*) \quad \text{if} \quad -C_E = \frac{1 - \frac{D}{\eta}}{\varepsilon} \quad \text{at} \quad E = E^2.$$

Since $C_{EE} < 0$, condition (10) indicates that public good expenditures increase as the elasticity of demand is decreasing; the elasticity of supply is increasing, and the output elasticity of the marginal impact of public good on cost is increasing. Thus, consumers will not support any level of public good expenditure if the demand is infinitely elastic, if the supply is inelastic, or if the public good affects fixed cost and not variable cost. On the other hand, when demand is inelastic and public good expenditure has a strong impact on variable cost (and, thus, shifts supply to the right), a relatively large volume of public good expenditures will be supported by consumers.

**Consumer Financing of Public Good: Comparison of Consumer, Producer, and Social Optima**

Using equations (5), (8), and (10) and assuming that three welfare functions, $W^*(E)$, $U^*(E)$, and $\pi^*(E)$, are concave in $E$, $W^*$, $U^*$, and $\pi^*$ under alternative conditions. The results of these comparisons are:
1. It is optimal not to provide the public good from the producers', consumers', and social perspectives if the introduction of an infinitesimally small quantity of the public good results in a cost-reducing effect which is smaller than the price-reducing effect and which, in turn, is smaller than the public good expenditure. For example,

\[ E^1 = E^2 = E^* \quad \text{if at } E = 0, -C_E < -q^* p_E^* < 1. \]

2. Some quantity of public good will be provided under the producers' control even though no provision of public good is optimal both from the consumers' and the social perspective. That is, some public good would be provided if the introduction of an infinitesimal quantity of public good results in a price-reduction effect that is smaller than the cost-reduction effect which, in turn, is smaller than the public good expenditure. For example,

\[ E^2 = E^* < E^1 \quad \text{if at } E = 0, -q^* p_E^* < C_E < 1. \]

3. Some quantity of public good will be provided under the consumers' control even though no provision of public good is optimal both from the social and the producers' perspectives. That is, some public good would be provided if the introduction of an infinitesimal quantity of public good results in a cost-reduction effect that is smaller than the public good expenditure which, in turn, is smaller than the price-reduction effect. For example,

\[ E^1 = E^* = 0 < E^2 \quad \text{if at } E = 0 - C_E < 1 < -q^* p_E^*. \]
4. The public good level provided under the producers' control is larger than the social optimum, which is greater than the consumers' optimum, and will not provide public good if the introduction of an infinitesimal quantity of public good results in a cost-reduction effect that is greater than the public good expenditure which, in turn, is greater than the price-reduction effect. For example,

\[ E_1 > E^* > E^2 = 0 \text{ if } -C_E > 1 > -q^* p^*_E. \]

5. The public good level provided under the consumers' control is larger than the social optimum, which is greater than the producers' optimum, and will not provide public good if the introduction of an infinitesimal quantity of public good results in a price-reduction effect that is larger than the public good expenditure and which is larger than the cost-reducing effect. For example,

\[ E^2 > E^* > E_1 = 0 \text{ if at } E = 0, -q^* p^*_E > 1 > C_E. \]

6. The producers', consumers', and social optima of public good levels are positive if introduction of an infinitesimal quantity of public good results in a cost-reduction effect which is greater than the price-reduction effect and which is greater than the public good expenditure. For example,

\[ E^2, E_1, E^* > 0 \text{ if at } E = 0, 1 < -q^* p^*_E < -C_E. \]
a. When $E^1$, $E^2$, $E^* > 0$, the producers' optimum of public good levels is greater than the social optimum which, in turn, is greater than the consumers' optimum if, at the producers' optimum, the cost-reduction effect associated with a marginal increase of the public good is smaller than the increase in expenditure. For example,

$$E^2 < E^* < E^1 \quad \text{if at } E^1, -C_E < 1.$$  

b. When $E^1$, $E^2$, $E^* > 0$, the consumers' opinion is greater than the social optimum which, in turn, is greater than the producers' optimum if, at the producers' optimum, the cost-reduction effect associated with a marginal increase of the public good is larger than the increase in expenditure. For example,

$$0 < E^1 < E^* < E^2 \quad \text{if at } E^1, -C_E > 1.$$  

Some of the above results are depicted graphically in Figures IIa, IIb, and IIc. The analysis uses the functions, $\tilde{\pi}(E) = \tilde{\pi}^*(E) - \pi^*(0)$, $\tilde{U}(E) = U^*(E) - U^*(0)$, and $\tilde{W}(E) = W(E) - W(0)$ which denote welfare gains to the groups relative to competition, with no provision for public good. Figure IIa depicts a possible scenario with $U^*_E(0) < 0$. The concavity of $U^*$ implies $\tilde{U}(E) < 0$, $\tilde{U}_E^*(E) < 0$. Obviously, $E^2 = 0$ in this case. If both producers' and social optima are positive (as in the case where they are $E^1_1$ and $E^*_1$ and the relevant welfare functions are $\tilde{\pi}_1$, $\tilde{W}_1$, $\tilde{\pi}_E^*(0) > 0$, and $\tilde{W}_E^*(0) > 0$; and $\tilde{\pi}(E)$ is above $\tilde{W}(E)$ when both are positive since $\tilde{W}(E) = \tilde{\pi}(E) + \tilde{U}(E)$. At the producers' optimum, $E^1$, the slopes of both $\tilde{W}(E)$ and $\tilde{U}(E)$ are identical.
Figure IIa, IIb, IIc
since $\pi_E + U_E = \tilde{W}_E$ and $\pi_E(0) = 0$. Since, in our case, $U_E(0) < 0$, $\tilde{W}_E(0) < 0$ and, thus, the producers' optimum is larger than the social optimum, this is captured by condition (14). Note that social welfare at the producers' optimum may be smaller than in the case of no provision for public good [\(\tilde{W}(E_1)\) may be negative] and, thus, society as a whole may lose from the provision of public good under producers' control in cases with $-C_E > 1 - q^* p_E$ at $E = 0$.

Another scenario depicted in Figure IIa is where the social welfare curve is $\tilde{W}_2$, producers' welfare is $\pi_2$, and consumers' welfare is $U$. Since $\tilde{W}(E) < 0$, social optimum is at $E = 0$, producers' optimum is at $E_2^*$, and society obviously loses from the introduction of the public good. This case is summarized by condition (12).

Figure IIb depicts scenarios with $\pi_E(0) < 0$. Condition (15) is the case where the welfare functions are $\tilde{\pi}, \tilde{W}_1$, and $U_1$, while the case of condition (13) is where the welfare functions are $\tilde{\pi}, \tilde{W}_2$, and $\tilde{W}_2$.

Figure IIc depicts scenarios where both $U_E(0)$ and $\pi_E(0)$ are positive. Here, for small $E$'s, all functions are increasing; and, as long as they increase, $\tilde{W}$ is larger than both $\tilde{U}$ and $\tilde{\pi}$. In the case where producers' welfare peaks first (the welfare functions are $\tilde{\pi}_1, \tilde{U}_1$, and $\tilde{W}_1$), the consumers' welfare is increases at $E_1$ and $U(E_1) < 0$.

Condition (17) and Figure IIc indicate that the producers and consumers are better off if the amount of public good provided under the producers' control is positive but smaller than the social optimum. The scenario where the welfare curves are $\tilde{\pi}_2, \tilde{W}_2$, and $\tilde{U}_2$ corresponds to the case of condition (18). Here the social welfare curve peaks before the producers' welfare curve ($E_1 > E_1^*$). In such cases, consumers' welfare under
producers' control of the public good provision may be larger (as depicted here) or smaller than under competition with no public good provision. One can use Figure IIc to realize that both the producers' and consumers' welfare will always improve when consumers control public good provisions if E² < E*. If E² > E*, producers may lose from the provision of public good if it is under the consumers' control.

Since the price-reducing effect embodies the impact of the values of η_D, η_S, and E^Q and the cost-reducing effect is, in essence, a measure of the productivity of the public good, the scenarios developed above can be linked to different orders of magnitude of demand elasticity and public good productivity (mostly at E = 0) given η_S and E^Q. Such an analysis suggests that, when the productivity of public good is low--(C_E < 1) but the elasticity of demand is sufficiently high--public good will be provided under the producers' control even though consumers and society will lose in welfare. Actually, when demand is infinitely elastic (η_D = 0) and -C_E < 1, the gap between the producers' optimum and consumers' optimum of the public good is at an extreme [E* = 0, E^1 = E^2(Q)].

When public good productivity is low and demand elasticity is low, one may encounter situations in which social optimum and producers' optimum are the same and no public good is provided. In such situations [as in the case of (13)], it may be optimal to provide a substantial amount of public good from the consumers' perspective.

When public good productivity is high but demand is sufficiently elastic, social optimum will require a provision of a certain level of public good, but producers' interest will require a higher level. Thus, under producers'
control of the provision of $E$, consumers may actually lose compared to nonintervention [in the case of (14)]. If, however, public good productivity is sufficiently high and demand elasticity is sufficiently low, a situation may arise where both consumers and producers benefit from the introduction of public good [in the case of (16)]. One such situation is the case of (17) where the producers' optimum of public good levels is smaller than the social optimum.

Since the demand for agricultural products is notoriously low and productivity of public research and development (R&D) is high [Schultz, 191, the outcome in (17) makes one suspect that the tendency to underprovide public agricultural R&D may reflect a situation where control of R&D is captured by producers. Moreover, (17) suggests that, under such a scenario, consumers benefit relative to no intervention; thus, they will not strongly oppose the producers' optimum of public good levels.

IV. PRODUCERS' PAY AND DETERMINATION OF PUBLIC GOOD EXPENDITURE

Let $E^3$ denote the public good expenditure in this case. It is nonnegative and maximizes producers' welfare for $\alpha = 0$. Using (4), the marginal impact of an increase in public good expenditure on producers' profit is the difference between the cost-reducing effect and the sum of the price-reducing effect and the marginal increase in the expenditure. For example,

\begin{equation}
\pi^*_E = -C_E + q^* p_E - 1 = -C_E \left[ 1 - \frac{e^Q}{1 - \eta^D/\eta^S} \right] - 1.
\end{equation}

Assuming concavity of profits as a function of $E$, condition (19) suggests two types of solutions for $E^3$:
The public good will not be provided if the price-reducing effect and the expenditure associated with the public good are greater than the cost-reducing effect even for infinitesimally small \( E \)'s. If public good is provided, its exact quantity is determined at the level where the sum of the marginal price-reducing effect and the marginal expenditure is equal to the marginal cost-reducing effect. As in the case of \( \alpha = 0 \), here, also, public good expenditures may increase as the elasticity of demand is increasing (in absolute value), the elasticity of supply is decreasing, and the output elasticity of the marginal impact of public good on cost is declining.

Comparing conditions (20), (5), and (8), note that the provision of public good when producers both pay and control the quantity provided cannot exceed social optimum or the producers' optimum of public good when consumers pay. Actually, the likelihood of not providing any public good is more likely under the producers' financing and control than the other two situations. There is no likelihood of an oversupply of public good when the producers pay; at most, the producers' optimum (when producers pay) can equal the social optimum. The equality of positive \( E^3 \) and \( E^* \) occurs when demand is infinitely elastic, supply is completely inelastic, or the public good has no effect on variable cost. Note that, in any of these cases, the producers' optimum when consumers pay will be higher than the social optimum and, actually, it will be at the
saturation level, $E^2(Q^*)$. The social optimum can also be equal to the producers' optimum when producers pay in cases where the public good has a low cost-reducing effect ($-C_E < 1$ at $E = 0$). In these cases, society and the producers will benefit from not producing the public good. Thus, in summary, one finds

$$E^3 = 0 \quad \text{if } E^* = 0$$

$$E^3 \leq E^* \quad \text{if } E^* > 0.$$ 

The concavity of $W^*$ and the behavior described in (21) assure that social welfare cannot decline (compared to no intervention) if producers both pay and control public good provisions. Moreover, if $U^*$ is concave, the consumer can only benefit from positive provisions in public good when producers control and pay for it. Thus, it seems socially desirable not to prevent collusion among competitive industry members in the provision of a public good. Actually, the government may need to interfere and extend a public case provision if demand is inelastic or supply is elastic.

V. CONCLUSIONS

This paper demonstrates that socially optimal allocation of public good does not always coincide with the optima of either of the two main groups that build the economy (consumers and producers), especially when consumers finance the public good provision when the consumer pays for it. Oversupply of a public good is feasible when either the producers or consumers control it; thus, the group not in control is likely to lose in these cases. When the producers' optimum of the public good is smaller than the social optimum,
social, consumers, and producers' welfare are increased with the provision of the public good. When producers control and pay for the provision of public good, there is a larger tendency to undersupply; and the supply may be below social optimum. Nevertheless, the producers' collusion for payment and support of public good may result in an outcome improving welfare of all groups of the population.
FOOTNOTES

1Actually, concavity of $U^*$ and $\pi^*$ is a stronger assumption than most of the following results require. It is sufficient to assume that there is a unique optimal good level for each group and that, if the marginal impact of public good on the producer welfare (consumer welfare) is negative at $E = 0$, it will be negative at $E > 0$. 
REFERENCES

Bonnen and Ruttan

Downs

Gutterman

Havlicek and Otto

Huffman and Miranowski

Peltzman

Posner

Rose-Ackerman and Evanson

Schultz

Stigler