PUBLIC CHARACTERISTICS OF NON-PUBLIC GOODS*

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I. INTRODUCTION

The traditional approach to consumption externalities is to model one household's consumption as affecting the utility of another household through a spillover effect. In this paper we deal with aggregate externalities where the spillover depends upon the aggregate level of consumption and not on the identity of the individual consumer. We develop an alternative approach based on the characteristics model of demand theory where each good contains a bundle of attributes determined by its consumption technology. Consumers maximize utility over characteristics, constrained by prices, income, and the consumption technology.[1]

Little work has been done to integrate the theories of publicness and Lancastrian demand. Recent exceptions are Morey [1985, p. 223, f.n.2] and Cornes and Sandler [1986, Ch. 7]. In Morey's work on the demand for recreational activities the author uses the joint supply concept to define a public characteristic; however, he does not apply the concept. Cornes and Sandler model a world of two goods, one private and one with both public and private characteristics. The authors find that the outcomes do not change radically compared to the traditional public goods approach, although substitution effects and free riding are more complicated.

Our approach to externalities and the definition of the public characteristic are different. We assume a world of two goods each of which has three characteristics. We assume one of the characteristics entering the household's and society's utility function is a pure public characteristic in the sense that it causes third-party spillover effects on other households. As in the conventional externalities approach, households ignore the external effect in maximizing utility so private and social optima do not coincide. We show that the characteristics approach, while generating similar results to those in the traditional externalities model, has several advantages over it. Lastly, we demonstrate that, if low priorities must be assigned to certain private attributes in making policy decisions, the attributes to be stressed should be those which the externality-generating good produces at a comparative disadvantage.

II. THE PRIVATE AND SOCIAL OPTIMA

Assume that there are J potential goods associated with one particular activity, where X_j is consumption of the jth good by household h $(h = 1, \ldots, H)$. Assume households have identical, quasi-concave utility functions, weakly separable by activities. Let $K = (K_1, \ldots, K_k)$ be a bundle of k characteristics or attributes

$(i = 1, ..., k)$ where preferences are represented according to the utility sub-aggregator function $U = U(K)$. The amount of each attribute depends on the bundle of goods $X = (X_1, ..., X_J)$ and the consumption technology matrix $B = [b_{ij}]$ relating K to X. We assume a linear technology such that $K_i = \sum_j b_{ij} X_j$. Assume that the k^{th} attribute is public in the sense that the aggregate amount of K_k enters each household's utility function in the form $U = U(K_1, ..., \sum_h K_k) = U(K_1, ..., HK_k)$. Given the price p_j associated with each X_j, all households face the same budget constraint $M = \sum_j p_j X_j$ where M is total expenditure on the activity, rather than total household income. Note that this assumes the household establishes a specific activity budget for transportation.

Given weak separability and a block diagonal technology matrix, we can use partial equilibrium analysis to study the demand for the X_j goods involved in this activity. Formally, the utility maximization problem is:

$$(1) \qquad \begin{array}{llcll} & \underset{X_j}{max}\ U & = & U(K_1, K_2, .., \sum_h K_k) & (h = 1, ..., H) \\ & & & & (j = 1, ..., J) \\ s.t. & (i)\ K_i & = & \sum_j b_{ij} X_j & (i = 1, ..., k) \\ & (ii)\ M & = & \sum_j p_j X_j & (X_j \geq 0) \end{array}$$

Note that since the identity of the household consuming K_k is irrelevant, K_k is an aggregate consumption externality. For $\delta U / \delta K_k \gtrless 0$ the external effect is positive (negative).

Two heuristic examples may be useful here. First, consider a possible extension of Morey [1985]. The activity is days of skiing, the S_j's are various ski areas and the K_i's characteristics of each area. K_k can be the degree of congestion on the ski runs (a negative externality) or a benefit externality from watching and learning from better skiers (here identity of the other consumers does matter). The key is that the total amount of the public characteristic $(\sum_h K_k)$ and not each household's contribution to it (K_k) enters each utility function.

For a second example, let the activity be recreational travel. The various X_j travel models are trips by car, bus, bicycle, train, etc., where certain goods are wholly private and others publicly provided. The various characteristics are comfort, distance travelled, active command of the transport mode, skill required, safety, amount of physical exercise involved, etc. The public characteristic can be noise or air pollution or traffic congestion. Again the aggregate externality is the sum of the individual characteristics K_k.

Let us now proceed to maximize (1). First we derive the efficient bundle of goods, depending on prices, income, and the consumption technology, and then derive the preferred bundle from this set. Assume, for simplicity, that we have two goods X and Y and three characteristics, K_1, K_2, and K_k. Following our second heuristic example, let X be number of trips by car per year and Y the number of trips by train. Let K_1 be the trip distance per unit of time (hereinafter referred to as distance) where $\delta U/\delta K_1 = u_1 > 0$ and $u_{11} < 0$. Let K_2 be the individual's ability to control speed and direction (hereinafter referred to as control) where $\delta U/\delta K_2 = u_2 > 0$ and $u_{22} < 0$. Lastly, let K_k be pollution defined as the disutility from air and noise pollution experienced while travelling, where $\delta U/\delta K_k = u_k < 0$ and $u_{kk} < 0$.

With respect to the consumption technology restriction (i) in eq. (1), we assume $b_{2x}/b_{1x} > b_{2y}/b_{1y}$ so that X has a comparative advantage over Y in producing K_2 relative to K_1; i.e., car travel is slower than train travel but allows the traveller more control over the method. We also assume $b_{kx}/b_{1x} > b_{ky}/b_{1y}$ so that X has a comparative advantage compared to Y in producing K_k relative to K_1; that is, cars are relatively more pollution generating than they are distance generating. Note that both assumptions together imply that $b_{2x}/b_{kx} \gtreqless b_{2y}/b_{ky}$ so that either good may have a comparative advantage in producing control, K_2, relative to pollution, K_k.

The budget constraint $M = p_x X + p_y Y$ relates expenditure on recreational travel to the costs per trip of the various travel modes. Given the consumption technologies, prices, and money income, we can derive the efficiency frontiers in $(K_1, K_2, \sum_h K_k)$ space. These are labelled in Fig. 1 as AB, CD, and EF, respectively.

In the first quadrant the vectors OX and OY show the amounts of the characteristics distance and control that can be produced for particular expenditures on car and train trips, respectively. If a traveller spends all the transport budget on Y, OB units of Y are consumed, producing $b_{1y}M/p_y$ units of $K1$ and $b_{2y}M/P_y$ units of $K2$. If all households travel by train and all have the same expenditure M, the average distance and total pollution produced are shown by point D on OY in $(K_1, \sum_h K_k)$ space. Similarly, EF is the implicit constraint facing the community in $(K_2, \sum_h K_k)$ space.

Given any two constraints, the third is determined automatically. Although $(dK_2/dK_k)_x \gtreqless (dK_2/dK_k)_y$, for brevity we restrict our analysis to the case where X has a comparative advantage over Y in producing K_k relative to K_2; that is, cars are more pollution generating than they are control generating. It follows that automobile travel is pollution intensive.

The budget constraint slopes show the rate at which one characteristic can be transformed into another by varying expenditures on X and Y. As such, the slopes represent the marginal rates of transformation between characteristics. Letting q_i stand for the implicit price of attribute i, the slopes of AB, CD, and EF are the relative prices $q_1/q_2, q_1/q_k$, and q_k/q_2, respectively.[2]

In the conventional approach to highway pollution as an aggregate consumption externality (see Tresch [1981, pp. 121-7]), both private consumption of the pollution-causing good (X) and the total amount of pollution (C) are arguments in Tresch's utility function:

$$W = W[X, Y, C(\sum X)] \tag{2}$$

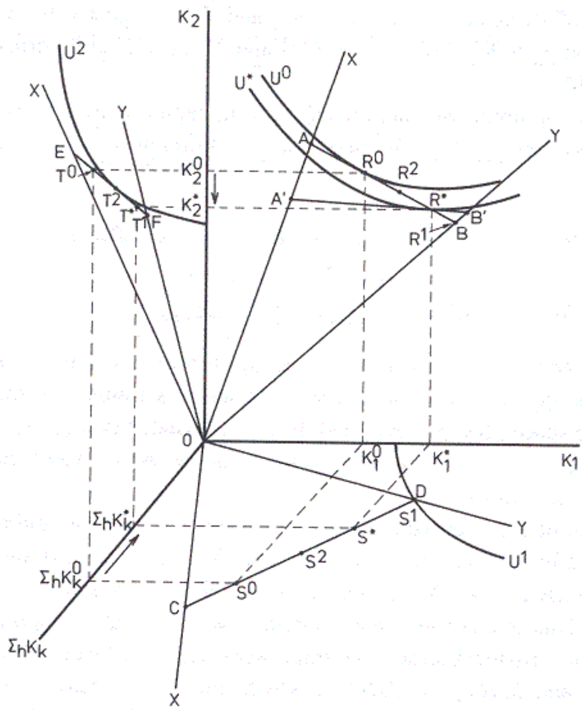
where $\delta W/\delta X > 0, \delta W/\delta Y > 0$, and $\delta dw/\delta C < 0$. Households take C as given and set $MRS_{xy} = MRT_{xy}$. However, Pareto optimality requires:

$$MRS_{xy} = MRT_{xy} - \sum_h MRS_{xy} \tag{3}$$

where $\sum_h MRS_{xy}$ is the sum of external effects. Since this sum is negative, a Pigovian tax is required to correct the "public bad".

FIGURE 1

The Private, Pareto and Policy Optimal Decisions



In our characteristics approach the total amount of pollution ($\sum_h K_k$) enters each person's utility function and not each household's contribution to it (K_k). We assume each household ignores its effect on the aggregate level of pollution when deciding on the transport mode. Although a change in the level of the externality affects utility, each household's impact on this level is very small. In other words, we assume b_{kx} and b_{ky} are small but the sum of all the K_k terms is not.

The representative household therefore maximizes (1) over K_1 and K_2, taking $\sum_h K_k$ as exogenous. Differentiating (1) with respect to X and Y, the private first order condition for a utility maximum, assuming the budget constraint binds, is:

$$u_1/u_2 = (b_{2x}/p_x - b_{2y}/p_y)(b_{1y}/p_y - b_{1x}/p_x), \text{ or} \\ MRS_{12} = MRT_{12} = q_1/q_2 = -dK_2/dK_1 \tag{4}$$

That is, private utility maximization equates the marginal rate of substitution between the two private characteristics ($MRS_{12} = u_1/u_2$) to their implicit price ratio or marginal rate of transformation ($MRT_{12} = q_1/q_2$).

The private optimum is shown as point R^0 in Fig. 1 where the indifference curve U^0 is tangent to the efficiency frontier AB.[3] The representative household thus consumes average amounts of distance and control, K_1^0 and K_2^0, respectively, and the total amount of pollution $\sum h\ K_k^0$. Point S^0 on CD and T^0 on EF also correspond to the private optimum R^0.

To find the social optimum we maximize (1) for the representative household taking account of its impact on $\sum_h K_k$. The first order condition now includes an aggregate externalities term:

$$u_1/u_2 = q_1/q_2 - [\textstyle\sum_h (b_{kx}/p_x - b_{ky}/p_y)/(b_{1y}/p_y \\ - b_{1x}/p_x)] \textstyle\sum_h u_k/u_2, \text{ or} \\ MRS_{12} = MRT_{12} + (q_1/q_k) \textstyle\sum_h MRS_{k2} \tag{5}$$

Comparing (3) and (5), we see two interesting differences between the standard and characteristics approaches. First, in the characteristics framework the externality is measured in one space ($K_2, \sum_h K_k$) and must be translated (via q_1/q_k) into another space (K_2, K_1) for comparison with the private optimum. As a result there is an extra term in (5) not present in (3).

Second, the sign of the externality term is reversed in (5). In the traditional framework, good X produces a negative externality so $\sum_h MRS_{xy} < 0$ and $MRS_{xy} > MRT_{xy}$. A Pigovian tax on X or subsidy to good Y is required to achieve the Pareto optimum. This is a second-best solution when the negative spillover itself is not directly taxable. In the Lancastrian framework K_k is a "bad" attribute so that $\sum_h MRS_{k2} < 0$ and $MRS_{12} < MRT_{12}$, which implies the distance characteristic (K_1) should be subsidized or the control characteristic (K_2) taxed, again assuming K_k itself cannot be taxed. Because private characteristics are not likely to have the same preference revelation problems as public characteristics, they are inherently more measurable and hence taxable. However, if only commodities can be taxed or subsidized our model indicates that the K_1-intensive good (Y) should be subsidized and/or the K_2-intensive good (X) taxed. In this situation, we therefore end up with the same result (i.e., that the high-polluting good (X) should be taxed and/or the low-pollution good (Y) subsidized), but the Lancastrian approach yields richer insights than the standard approach to consumption externalities.

Eq. (5) implies that, at the social optimum, the household's indifference curve is less steeply sloped than the budget constraint. Let point R^* on U^* be the welfare maximum in Fig. 1 (with corresponding points S^* and T^*). The wedge between the slope of the indifference curve through R^* (equals $A'B'$) and the budget line just equals the externality, and hence determines the Pigovian tax-cum-subsidy. Various combinations of a subsidy to the low-polluting good Y and/or tax on the high-polluting good X, financed if necessary by an equal-yield lump sum tax, can be used to move the household choice from R^0 to R^*. At the Pareto optimum, note that the consumption of K_2 and $\sum_h K_k$ is lower, and K_1 higher, than at the private optimum.[4]

We can use the expenditure function to measure the size of the aggregate consumption externality (see Boadway and Bruce [1984, pp. 205-6] and Morey [1985, pp. 223-4]). The indirect utility function corresponding to (1) is $V(M, p, K)$ which when inverted yields the expenditure function $E(U, p, K)$. If the initial price and characteristics vectors maximizing utility at U° are p° and K°, and those generating utility U^* are p^* and K^*, we can define the equivalent variation EV^* as:

$$(6) \qquad EV^* = E(U^*, p^\circ, K^\circ) - E(U^*, p^*, K^*) = d\ M$$

That is, EV^* is the amount of income (positive or negative) that must be added to the initial transportation budget constraint M in order to give the household the new utility level U^*. Since $U^* \leq U^\circ$ the EV^* is negative.

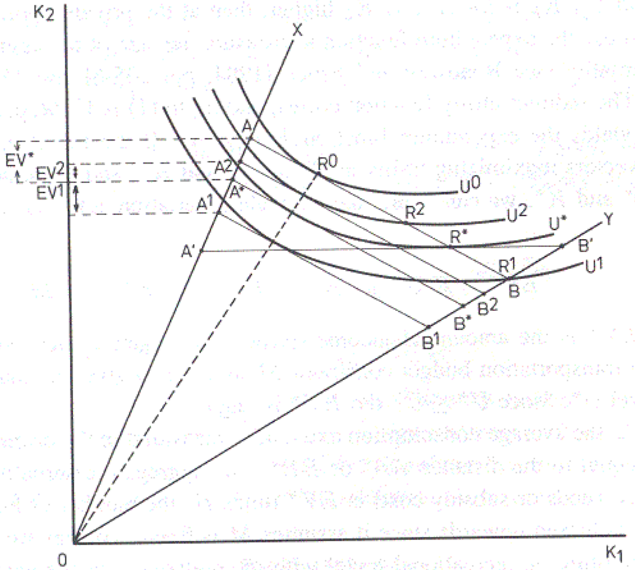
In Fig. 2, the average consumption externality measured in the original prices yields an EV^* equal to the distance AA^* or BB^*. The aggregate externality (and thus the total tax proceeds or subsidy cost) is EV^* times H, the number of households. Note that EV^* is biased upwards since it assumes M is fixed, whereas we expect a fall in total expenditure on recreational travel with internalization of the externality.

The characteristics approach has certain advantages over the conventional consumption externalities approach. First, the characteristics method explicitly recognizes that different goods generate differing amounts of the externality, rather than the standard assumption that only one good generates an external effect. That is, this approach takes the comparative advantages of the different goods into account (via the implicit price ratios of private characteristics relative to the public characteristic) in determining the optimal tax-cum-subsidy structure.[5]

Second, the traditional analysis levies the tax on the good generating the externality assuming a given output-externality ratio. The attributes approach recognizes that the tax-cum-subsidy applies directly to characteristics and, only where they are not taxable, to the goods generating the externality. Since the public characteristic is by definition nonexcludable, one solution is to tax the characteristic most closely associated with the pollution-intensive good (i.e., control with cars).[6] However, given the difficulties in measuring and therefore taxing control, another alternative is to subsidize the characteristic least associated with the pollution-intensive activity. Thus a change in the consumption technology relating goods to characteristics is more easily incorporated here compared to the conventional approach. For example, if technological change reduces b_{ky} so that train travel (Y) is less polluting, q_1/q_k rises and the $MRS_{12} - MRT_{12}$ gap declines in (5), reducing the tax-cum-subsidy.

FIGURE 2

Using Equivalent Variations to Compare Optima



Third, (5) can be used to illustrate the theory of second best. Suppose b_{kj} is identical for X and Y (which is Morey's [1985] definition of a public characteristic) and $p_x = p_y$. Then $\sum_h (b_{kx}/p_x - b_{ky}/p_y) = 0$ and $MRS_{12} = MRT_{12}$. That is, where all externality-generating goods have identical b_{kj} externality coefficients and identical prices, private and social optima coincide. In this case, removing one externality (e.g., setting $b_{ky} = 0$) or changing relative commodity prices causes a welfare loss, i.e., a second best point.

Fourth, the approach can be related to the literature on product variety. The characteristics approach implies that if there are k characteristics and J goods where $J \geq k$, at most k goods are bought since bundles containing more than k goods are inefficient (see Gravelle and Rees [1981, p. 126]). [7] We have also shown that the representative household maximizes utility only over private characteristics. Suppose the utility function is of the form:

$$U = U(K_1, \ldots K_i, \sum_h K_{i+1}, \ldots \sum_h K_k) \tag{7}$$

where the first i characteristics are private and the $i+1$ to k^{th} characteristics are public. Since the household maximizes over the first i attributes, at most i goods are bought by private choice. Maximization of social welfare, however, implies that at most k goods are bought. Therefore private choice leads to less product variety than is Pareto optimal. A set of Pigovian taxes (subsidies) on products intensive in their use of negative (positive) externality characteristics can be used to extend the efficient budget set to a k-segmented frontier (i.e., as if $k-i$ new goods, efficiently priced, were introduced). If all households have identical utility functions, private choice still implies at most i goods are bought (although the product mix is likely to change). However, with different preferences among households it is possible that all k goods are consumed. Thus, providing households with "new information" (taxes-cum-subsidies) can raise social welfare and product variety. This appears to be a natural extension of Auld [1975] and Lancaster [1975].

Lastly, this approach can make an important contribution to applied policy analysis, to which we now turn.

III. FEASIBLE POLICY OPTIONS

Although theoretically similar, the standard and characteristics approaches to consumer externalities are operationally different. The Lancastrian framework has the advantage in that it explicitly recognizes that utility is derived from a number of attributes, and that different goods have different absolute and comparative advantages in providing these characteristics depending on prices and the consumption technology.

Recognizing a range of personal utility-bestowing attributes is important when policies to control an externality are determined since all arguments in the utility function must be considered for a Pareto optimum. This may be operationally unwieldy where the number of characteristics is unknown or some are difficult to measure. For example, in our model the policy-maker may not be aware of the entire range of characteristics or their relative preference ranking that consumers associate with travelling to and from work. In this case, the policy-maker is likely to emphasize known characteristics, missing unknown ones. Secondly, even if there is not informational asymmetry, one or more characteristics may be very difficult to measure (e.g., control). Under such circumstances an operational policy based on quantitative data will focus on the measurable characteristics.

Thirdly, the government may choose to stress certain attributes at the expense of others. This may be related to the classic merit goods argument whereby the policy-maker believes that interference with consumer sovereignty is justified on grounds such as ignorance, irrationality or social equity. For example, one could argue that individual control over the transport mode may also imply the probability of more traffic accidents and that households are ignorant of this effect. In such a case, K_2 is effectively a "mixed characteristic" because it has both private and public elements. Publicness is now introduced at two levels: the characteristic Z and part of K_2. In the case where the policy-maker substitutes his or her preferences for household preferences on merit want grounds (e.g., if the policy-maker feels that there should be less car driving even after full internalization of the public bad Z), the outcome involves an additional tax on driving and/or subsidy to railcars. This is a second-best argument if merit wants are not an element in a first-best world.[8,9]

The gain from administrative feasibility is an apparent cost of biasing the policy choice in favour of commodities intensive in the high-priority attributes and against goods intensive in the low-priority ones. This overshooting or undershooting of the social optimum may be considered a reasonable price to pay to ensure an operational policy. However, we show below that the true cost may be substantially higher since a "wrong" choice of priorities can prevent the policy optimum from being attained other than as a corner solution where only one good is bought.

First, consider the case where at the collective decision-making level the private characteristic K_2 is assigned a low priority and eliminated from the welfare function. The policy-maker maximizes (1), assigning a zero priority weight to K_2. Since $u_1 > 0$ and $u_k < 0$ private indifference curves are positively sloped with intercepts on the K_1 axis, curving away from the $\sum_h K_k$ axis. Higher K_1 intercepts represent higher utility levels (see Fig. 1). Assuming the transportation budget is spent, we expect a corner tangency solution. Using the Kuhn-Tucker method,[10] the first order condition for a policy welfare maximum is:

(8) $$\sum_h u_k/u_1 > (b_{1x}/p_x - b_{1y}/p_y)/\sum_h(b_{ky}/p_y - b_{kx}/p_x), \text{ or}$$
$$\sum_h MRS_{k1} > MRT_{k1} = q_k/q_1 = -dK_1/d\sum_h K_k$$

Eq. (8) implies that the policy optimum is a corner solution with $Y > 0$ and $X = 0$ since the summed MRS_{k1} (which is negative since K_k is a "bad") exceeds q_k/q_1. The policy optimum (let us call it R^1) corresponds to point D where U^1 is the highest indifference curve touching CD (see also points B and F). The necessary tax-cum-subsidy to achieve R^1 is determined by the wedge between the budget line AB and the slope of the indifference curve U^1 passing through point B (see Fig. 2).

Since a prohibitive tax is required to eliminate consumption of X, the probability of coincidence between the private choice and the public objective is low, and the policy optimum likely to be unattainable. The problem is caused by the policy-maker ignoring the private characteristic control. Since train travel (Y) has a comparative disadvantage in providing control (K_2), eliminating K_2 from the welfare function causes a bias towards Y in the policy choice. In the true social optimum point R^* would be chosen. By ignoring K_2 the policy-maker overshoots this optimum and selects the (perhaps unattainable) point R^1.

If, on the other hand, the policy-maker assigns a zero priority to distance (K_1) the policy optimum maximizes (1) over K_2 and $\sum_h K_k$, ignoring K_1. Since $u_2 > 0$ and $u_k < 0$, private indifference curves are positively sloped with intercepts on the K_2 axis and curving away from the $\sum_h K_k$ axis in Fig. 1. Since a facet optimum is likely to occur where U^2, the highest indifference curve, is tangent along EF (see note 4), the first order condition for the policy welfare maximum is:

$$(9)\qquad \begin{aligned}&\textstyle\sum_h u_k/u_2 = (b_{2x}/p_x - b_{2y}/p_y)/\sum_h(b_{ky}/p_y - b_{kx}/p_x), \text{ or}\\ &\textstyle\sum_h MRS_{k2} = MRT_{k2} = q_k/q_2 = -dK_2/dK_k\end{aligned}$$

The policy optimum when K_1 is dropped from the welfare function corresponds to point T^2 on EF (also R^2 and S^2) in Fig. 1. We know T^2 must be left of T^* (the true social optimum) because T^2 ignores the characteristic distance in which X has a comparative disadvantage. Therefore T^2 must represent an allocation with more of X and less of Y than does T^*. However, T^2 may lie either to the right or left of T^0. The household maximizes over K_1 and K_2, ignoring $\sum_h K_k$ while the policy-maker maximizes over K_2 and $\sum_h K_k$ ignoring K_1. As a result, in both cases too much of good X and too little of Y is chosen. However, since car travel produces relatively more pollution compared to K_1 than does train travel we expect T^0 to lie to the left of T^2. The tax-cum-subsidy required to achieve this policy optimum is measured by the wedge between AB and the slope of the private indifference curve U^2 passing through R^2 in Fig. 2.

What this analysis suggests is that if policy-makers ignore private characteristics which are produced at a comparative disadvantage by the low-polluting good (control by train, or K_2 by Y), they tend to overshoot the true social optimum. (Or, stating this in terms of the high-polluting good, if policy-makers ignore private characteristics produced at a comparative advantage by X they overshoot R^*). Too little of the pollution-intensive good X and too much of the low-polluting good Y is selected as the policy choice. As a result, the policy optimum R^1 may not be attainable by corrective taxes-cum-subsidies. On the other hand, if policy-makers ignore private characteristics produced at a comparative advantage by the low-polluting good (distance by train, or K_1 by Y) they tend to undershoot the policy optimum. However, the policy choice does remain attainable by traditional Pigovian methods in this case.[11]

We can use the equivalent variations technique to compare the welfare losses generated by under- or overshooting the Pareto optimum. For base prices we can use either p^0 (the private choice price vector) or p^* (the social choice vector); however, using p^0 has two advantages: these prices are known and the policy optima can also be compared to the private choice. Therefore let EV^z $(z = 1,2)$ be the change in income required to make the household indifferent between $(p^z, K^z, M + EV^*)$ and $(p^z, K^z, M + EV^* = EV^2)$ where $EV^1 < 0$ and $EV^2 > 0$.

In Fig. 2, EV^1 corresponds to the distance A^*A^1 or B^*B^1, and EV^2 to A^*A^2 or B^*B^2. Whether $|EV^1| \gtrless EV^2$ depends upon (i) the distance between R^1 and R^2 relative to R^* (which depends upon the technical coefficients matrix and the relative weights of K_1 and K_2 in the utility function), (ii) the curvature of the indifference map (i.e., the degree of substitutability between K_1 and K_2), and (iii) whether or not preferences are homothetic so that all tangencies lie on the ray OR^0.

It is possible, though unlikely, that policy choice R^1, while requiring a prohibitive tax on X, generates a smaller welfare loss than R^2, i.e., $A^*A^1 < A^*A^2$. This could occur if u_1 is arbitrarily large and u_2 arbitrarily small at the optimum so that assigning a low priority to K_1 results in a large welfare loss relative to the Pareto optimum, while assigning a low priority to K_2 generates a small loss. Also, by comparing the equivalent variations EV^z with EV^* (see Fig. 2) the policy-maker can determine whether the least-inefficient policy may do nothing (i.e., if $EV^* < EV^z$). In such a case the private choice "status quo" is more efficient than an imperfect, perhaps unattainable, policy choice — albeit in a second best sense.

This analysis also has public choice implications. If policy-makers ignore certain characteristics in decision-making and do stress the "wrong" characteristics, they are drawn towards a corner solution overshooting the social optimum. Although a prohibitive tax is an unlikely choice, regulation and pollution control standards are commonly used methods that can achieve similar results. Thus we would expect governments to prefer regulation to the corrective taxes-cum-subsidies favoured by economists as a policy solution in negative externality cases. Over-reliance on regulation as a policy tool may therefore be the likely result of attaching priorities to characteristics.

IV. CONCLUSION

The purpose of this paper was to develop the theory of public and private choice using the Lancastrian characteristics framework. Private and social optima were developed along with the necessary corrective taxes-cum-subsidies. The paper then assumed the policy-maker must assign a low priority to one of the private characteristics. The subsequent over- or undershooting of the social optimum together with the attainability of the policy choice were determined. Private, social, and policy optima were compared using equivalent variations.

The advantages of the characteristics approach to public choice over the traditional framework are, first, that the Lancastrian approach combines the consumption technology, the budget constraint and household preferences in a single maximizing framework. Second, the characteristics approach generalizes the public goods model to a world of N goods and M characteristics where the taxation of goods and/or characteristics is based on their relationship to the public characteristic, which can be either a public good or public bad. Third, this approach is a useful and illustrative method of demonstrating the theory of second-best and the influence of product variety. Lastly, the major contribution of this approach is its ability to explore the outcomes of policy-maker decisions under informational uncertainty, measurement difficulties, and merit want arguments.

The analysis can be generally extended to cover households with different characteristics and incomes, many different goods relating to a particular activity, and the introduction of new goods, as in Morey [1981, 1985]. The model could also be extended to examine subsequent rounds of policy choices when it is known that the optimal target has been under- or overshot. For example, if it is optimal to move to more public and less private transportation, the policy-maker could consider a tax, subsidy, or combination of both to achieve the desired change. Welfare comparisons of actual policy options to the social optimum or the status quo could then be made using the equivalent variations technique. We therefore conclude that the characteristics approach can be a powerful tool for applied microeconomic work on public choice problems.

NOTES

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1 On consumption externalities see Tresch [1981, pp. 121-7]. On the characteristics approach see Lancaster [1966, 1971] and Gravelle and Rees [1981, pp. 119-30].

2 For example, the slope of AB is $-dK_2/dK_1 = -(b_{2x}dX + b_{2y}dY)/(b_{1x}dX + b_{1y}dY) = -(b_{2x} + b_{2y}dY/dX)/(b_{1x} + b_{1y}dY/dX)$. Substituting in the budget constraint and rearranging, we have $-dK_2/dK_1 = (b_{2x}/p_x - b_{2y}/p_y)/(b_{1y}/p_y - b_{1x}/p_x) = q_1/q_2$. Similarly one can prove that $-dK_i/d\Sigma_h K_k = q_k/q_i (i = 1, 2)$. See also Gravelle and Rees [1981].

3 By assuming (i) the budget constraint always binds, (ii) utility maximization where $u_1 > 0$, $u_2 > 0$, and $u_k < 0$, and (iii) the private optimum is a facet optimum rather than a corner solution, we are putting certain implicit restrictions on the AB, CD, and EF budget constraints. Since $u_1/u_2 > 0$, the constraint AB must slope down which implies that good with a comparative advantage in production of K_i must also have an absolute advantage in its production, i.e., $b_{1y}M/p_y) > b_{1x}M/p_x$ and $b_{2x}M/p_x > b_{2y}M/p_y$ since we assumed $b_{2x}/b_{1x} > b_{2y}/b_{1y}$. Also, if the budget constraint is to bind, the highest policy indifference curve (see below) cannot be tangent along either the OX or OY commodity vectors. To rule out this

possibility we assume the good with the comparative advantage in K_k also has an absolute advantage in K_k; i.e., $\Sigma_h b_{kx} M/p_x > \Sigma_h b_{ky} M/p_y$ since we assumed $b_{kx}/b_{ix} > b_{ky}/b_{iy}$ (where $i = 1, 2$).

[4] Note that this technique is perfectly general. If the aggregate externality is positive, $MRS_{12} > MRS_{12}$ at the social optimum so that R^* lies to the left of R^0. Also, if the graph is reversed so that X rather than Y has a comparative advantage in K_1, the social optimum becomes $MRS_{12} = MRT_{12} - (q_1/q_k)\Sigma_h MRS_{k2}$, which implies Y should be subsidized and/or X taxed.

[5] This is an extension of the Cornes and Sandler [1986] model where only one good possesses two characteristics, one of which is public. Not only does our model entail three characteristics for both goods, but the public characteristic applies to both goods.

[6] It is interesting to note that Cornes and Sandler [1986, pp. 121-23] find that, given a nonexcludable characteristic, the number of free riders may diminish as the population increases.

[7] It should be noted here that if the number of characteristics exceeds the number of goods, the precise number of goods purchased will depend on the nature of the consumption technology.

[8] We would like to thank a referee and the editor, Dieter Biehl, for drawing the merit goods argument to our attention.

[9] Note that Head [1991] emphasizes that the merit wants concept can be nested in a broader concept of consumer sovereignty so that interference by the policy-maker may not be a second-best argument.

[10] Because corner solutions are likely to occur we use the Kuhn-Tucker method. Since U is differentiable and quasi-concave, dU/dK_k is negative and the constraints are linear, constraint qualification is satisfied using the Arrow-Enthoven sufficiency theorem (see Chiang [1984, pp. 744-8]). Thus the Kuhn-Tucker maximum conditions are both necessary and sufficient.

[11] Note the similarity to the policy recommendation in Auld [1975] where it is always more profitable to advertise (i.e., stress) the characteristic which is produced at a comparative disadvantage. In our model, policy-makers should stress the characteristic produced at a comparative disadvantage by the low-polluting good. This result may also possibly explain why, in some political decisions where certain aspects of a policy are not accorded much attention, there is violent objection to the policy, whereas in other circumstances there is little reaction to the assignment of low priority to certain policy aspects.

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Summary: *Public Characteristics of Non-public Goods.* — This paper develops the theory of public and private choice using the Lancastrian characteristics approach. Private and social optima are developed along with the necessary corrective taxes-cum-subsidies. The paper then assumes the policy maker must assign a low priority to one of the private characteristics. The subsequent over- or undershooting of the social optimum together with the attainability of the policy choice are determined. Private, social, and policy optima are compared using equivalent variations.

Résumé: *Caractéristiques publiques de biens non publics.* — Ce papier développe la théorie de choix public et privé en utilisant l'approche des caractéristiques de Lancaster. Les optima privé et social sont développés en utilisant des impôts et subsides correctives nécessaires. Ce papier suppose ensuite que le décideur politique doit assigner une faible priorité à l'une des caractéristiques privées. Le "sur-" ou "sous-"ciblage de l'optimum social qui en résulte sont déterminés en même temps que la réalisation des choix politiques. Les optima pour le secteur privé, la société dans son ensemble et sous contrainte de réalisation politique sont comparés en utilisant des variations équivalentes.

Zusammenfassung: *Öffentliche Merkmale nicht-öffentlicher Güter.* — Der Artikel entwickelt die Theorie der öffentlichen und privaten Wahl unter Anwendung des von Lancaster entwickelten merkmalsbezogenen Ansatzes. Dabei werden private und soziale Optima mit den notwendigen korrektiven Steuern-cum-Subventionen entwickelt. Es wird angenommen, daß der Politiker einem der privaten Charakteristika eine geringe Priorität zuweisen muß. Darüber hinaus werden das Über- oder Unterschießen des sozialen Optimums zusammen mit der Erreichbarkeit der Politik-Wahl bestimmt und private, soziale und politische Optima unter Verwendung äquivalenter Variationen miteinander verglichen.