I

Although the following article, originally published in the *Journal of Economic Literature* in September, 1971, was the last to be written of those appearing in this volume, it appears as the introductory essay because, more than any of its companion pieces, it deals with the broad conceptual framework of applied welfare economics. In particular, it provides a background against which the material presented in several other chapters (particularly 2, 3, 4, 5, and 8) can be more easily comprehended and digested.

The three postulates concern the use of (a) demand and (b) supply prices (i.e., the ordinates of the relevant curves) as measures of benefit and cost to demanders and suppliers of successive units demanded and supplied, and (c) the adding up of benefits and costs across different members of the community for which the welfare-economic analysis is being undertaken.

It is important in this context to recognize the substantial degree of subtlety and sophistication that the concepts of demand and supply price involve. In a true sense they reflect the value to the demander or supplier of the alternative(s) that he gives up in demanding or supplying an additional unit of a particular good or service. In this way each point along a demand curve reflects indifference on the part of the demander as between having that particular unit at that particular price on the one hand, and whatever else he would have done instead on the other, and similarly for the supply curve. Moreover, the alternatives in question may be monumentally complex: the choice between a teaching job at a midwestern university and one as economist for a real estate firm in Hawaii entails not only vastly different baskets of goods and services that would be consumed in one as against the other place; it can also involve totally different life-styles. The

choice can also be probabilistic rather than single-valued, in the sense that taking a job in Hawaii real estate probably reduces the probability of each of a whole host of academic and quasi-academic opportunities that might come one's way, but probably raises the chances that any of a number of good business opportunities (other than the Hawaii job itself) will at some point or another present themselves. Yet complex though the alternatives may be, their value to the individual is summarized in the different (though undoubtedly mutually interdependent) supply prices he places upon the respective opportunities of working in the two very different environments.

The case is similar with demand price. Regardless of whether the choice is simple (e.g., that between a cola drink and ginger ale at a sporting event), intermediate (e.g., choosing a meal from a highly varied and elegant menu), or extremely complex (e.g., adjusting a large portfolio in a constantly changing and obviously probabilistic securities market), we can still attach a simple and very important meaning to demand price. For any particular choice or action, demand price is that one which just barely induces the individual to take the choice or action in question, thereby reflecting the borderline between it and its (possibly numerous and complex) alternatives. For choices involving highly divisible goods and services, the maximization of individual welfare entails carrying demand or supply to the point where, at the margin, demand or supply price equals market price. For choices entailing indivisibilities, the demander's or supplier's optimum, among alternative options, is that one which maximizes the excess of demand price over market price (for demanders) or that which maximizes the excess of market price over supply price (for suppliers).

This way of looking at demand and supply prices allows one to appreciate the scientific merit and the considerable intellectual power of the traditional idea of consumer (and producer) surplus. In fact the main thrust of this article is to go into the intellectual underpinnings of this concept, and to deal with some of the main issues that have been raised concerning it.

In the time since this article was published, the great bulk of the comments that I have received have dealt with postulate (c), which by its equal weighting of the demand and supply prices of different individuals ignores or sets aside questions of income distribution. I deal with this matter in a more technical context in my introduction to Chapter 2, so my present discussion concentrates on the broader issues involved. In the first place, let me state emphatically that I advocate the use of postulate (c) fundamentally (indeed, I should probably say

solely) as a technical convention which permits us to separate resource-allocation from distributional effects in the analysis of any given problem. I emphatically do not mean to say or imply thereby that distributional considerations are unimportant, or that economists should refrain from expressing opinions concerning them. In fact, I believe that such opinions can play a vital role in the public debate over many policy issues, especially on the wide range of public programs with explicit distributional orientation.

What I do insist, however, is that we can never expect to achieve a general consensus about the weight that should be attached to the welfare of different groups, and that the tools of economic analysis have in themselves nothing to contribute toward helping us move toward such a consensus. As I have often told my classes, I think I can give a course on how to use the tools of economics to assess the resource-allocation effects of given policies or projects; I cannot, on the other hand, give a course in "how to tell the good guys from the bad guys," let alone indicate ways in which such a judgment could be directly incorporated as an integral part of the technical analysis of a particular public policy or private action.

James Meade's proposed method of assigning distributional weights to the benefits and costs associated with different individuals[1] could perfectly well be incorporated, in place of postulate (c), into the framework proposed here, thus leaving it totally free from the possibility of criticism on distributional grounds. I was constrained not to do this, however, not only because of the impossibility of gaining any general consensus on the relevant weights, but also because of the fact that only in a very small fraction of real-world problems can the benefits and costs of a particular policy, program, or other action be disaggregated among income groups or other categories that might be relevant in the assignment of distributional weights. This is particularly true for the ex ante analysis of policy decisions, where the relevant costs and benefits stretch many years into the future.

Thus in the final analysis I see no relevant or practical alternative to the use of postulate (c), at least for the great bulk of scientific work on the resource-allocation side of applied welfare economics. But this conveys no suggestion or implication that distributional effects should therefore be neglected. It simply means that where they are brought into account, this should be done as a separate part of an overall economic

[1] See J. E. Meade, *Trade and Welfare* (London: Oxford University Press, 1955), Vol. I, Chap. 5, and Vol. II, Chap. 2.

analysis of the problem in question (which in many cases may be even more important than the resource-allocation part, but which should not be mixed up with it).[2]

[2] The approach of distinguishing for analytical purposes between the allocative and the distributive aspects of a problem has a long tradition in the public finance literature. For an excellent modern defense of this approach, set in a somewhat broader context than that of my own paper, see Richard A. Musgrave, *The Theory of Public Finance* (New York: McGraw-Hill, 1959), Chaps. 1 and 2.

Chapter 1

Three Basic Postulates for Applied Welfare Economics: An Interpretive Essay

I

This paper is intended not as a scientific study, nor as a review of the literature, but rather as a tract — an open letter to the profession, as it were — pleading that three basic postulates be accepted as providing a conventional framework for applied welfare economics. The postulates are: (a) the competitive demand price for a given unit measures the value of that unit to the demander; (b) the competitive supply price for a given unit measures the value of that unit to the supplier; (c) when evaluating the net benefits or costs of a given action (project, program, or policy), the costs and benefits accruing to each member of the relevant group (e.g., a nation) should normally be added without regard to the individual(s) to whom they accrue.

In an era when literally thousands of studies involving cost-benefit analysis or other types of applied welfare economics are underway at any given moment, the need for an accepted set of professional standards for this type of study should be obvious. In proffering postulates (a)–(c) as the basis for such a set of standards, I do not want to overstate their benefits. Just as the road-construction standards that a team of highway engineers must meet can be checked by other highway engineers, so the exercise in applied welfare economics carried out by one team of economists should be subject to check by others. But while the highway engineers can apply professional standards to characteristics such as thickness of base, load-carrying capacity, drainage characteristics, and the like, characteristics such as scenic beauty are beyond their competence as professional engineers. In the same way, any program or project that is subjected to applied-welfare-economic analysis is likely to have characteristics upon which the economist as such is not professionally qualified to pronounce, and about which one economist is not professionally qualified to check the opinion of another. These elements — which surely include the income-distributional and national-defense aspects of any project or program, and probably its natural-beauty aspects as well — may be exceedingly important, perhaps even the

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dominant factors governing any policy decision, but they are not a part of that package of expertise that distinguishes the professional economist from the rest of humanity. And that is why we cannot expect to reach a professional consensus concerning them. If we are to take a (hopefully justified) professional pride in our work, we also must have the modesty and honesty not to claim for our profession more than we are particularly qualified to deliver. But this does not mean that we need be silent on matters that lie outside the range of our professional expertise; economists should probably participate more rather than less in the public discussion of such matters, but hopefully in a context that recognizes the extra-professional nature of their intervention.

Some readers will undoubtedly recognize that postulates (a)–(c) underlie most analyses that use the concepts of consumer and producer surplus. That being the case, one might ask, what is the need for a tract on the subject? My answer stems from the fact that, as an inveterate practitioner of applied welfare economics along many different lines, I encounter with considerable regularity colleagues who are skeptical of consumer surplus on one or more of several alleged grounds:

(i) Consumer-surplus analysis is valid only when the marginal utility of real income is constant.

(ii) Consumer-surplus analysis does not take account of changes in income distribution caused by the action(s) being analyzed.

(iii) Consumer-surplus analysis is partial-equilibrium in nature, and does not take account of the general-equilibrium consequences of the actions whose effects are being studied.

(iv) Consumer-surplus analysis, though valid for small changes, is not so for large changes.

(v) The concept of consumer surplus has been rendered obsolete by revealed-preference analysis.

While I do not have the impression that the skeptics dominate professional opinion in this area, they are sufficiently numerous (and a number of them sufficiently prestigious) that we surely cannot be said to have achieved a high degree of professional consensus on the subject. Yet I feel, precisely because of the power and wide applicability of the consumer-surplus concept, that a recognizable degree of consensus concerning it would increase, to society's general benefit, the influence on public policy of good economic analysis. Moreover, I think that there is a fair chance of convincing a goodly share of the skeptics that postulates (a) to (c) constitute the most reasonable basis on which to seek professional consensus in the area of applied welfare economics. The merit of attaining something like a consensus, and the possibility of helping to induce some movement toward that end, provide the motivation for this tract.

II

Ordinarily, I would consider it quixotic to expect much to result from any such effort. But in this case my hopes are buoyed by the fact that it is easily possible for many skeptics to join the consensus without really changing their

minds on any fundamental issues. How can this happen? Because (1) we already have a reasonably well-established consensus on the basic methodology of national-income measurement, (2) it is easy to show that postulates (a)–(c) incorporate a greater degree of subtlety of economic analysis than does national-income methodology, and (3) most of the "objections" to consumer-surplus analysis hold a fortiori with respect to the measurement of national income. If we are prepared to more-or-less agree on national-income methodology (while being mindful of its defects), why should we resist approaching an agreement on a methodology for applied welfare economics (also keeping its defects in mind, but aware at the same time that they are much less serious than those applying to national income)?

Let us consider specifically objections (i), (ii) and (v) above, comparing in each case the force with which the objection applies to consumer-surplus analysis on the one hand, and to the use of national income as an indication of welfare on the other — objections (iii) and (iv) are dealt with in section III below.

Objection (i). I will later show that the assumption of constancy of the marginal utility of real income is not essential for the validity of consumer-surplus measures of welfare. Here, however, I shall only note that the benefits and costs treated in most applications of consumer-surplus analysis (e.g., measures of the efficiency costs of a tax or an agricultural program, cost-benefit analyses of highway or irrigation projects, etc.) involve only a small fraction of a normal year's growth in GNP. Far more vulnerable to the objection that the marginal utility of real income might have changed are observations like "Real GNP doubled between 1950 and 1970," or even "National income will grow by $60 billion next year."

Objection (ii). By the same token, the changes in income distribution resulting from a particular measure being subjected to cost-benefit or consumer-surplus analysis are likely to be minimal by comparison with those that occur from decade to decade, or even from year to year, as a consequence of all causes. If, then, it is felt that "distributional weights" should be applied in the former case, before judgments can be made, it is even more important that they should be incorporated in the latter case.

Objection (v). Consider the case of the coal miner who, racked with silicosis, voluntarily quits a $7-an-hour job in the mine to take a newly available $2-an-hour job clerking in a grocery store. National income goes down, but welfare in all likelihood goes up. In this case consumer-surplus analysis accords with revealed preference, while the movement of national income is in the opposite direction from the change in welfare. The same is true for the textbook case of the housekeeper who marries her employer.

Of course, economists do not truly believe that real NNP or national income is a complete measure of welfare. But it is equally true that in most of the contexts in which changes in these magnitudes, or comparisons of them across

regions or countries are dealt with, the discussion carries strong welfare connotations, often to the point where it would be meaningless if those connotations were denied. National income and NNP are, in a very real sense, measures of welfare under certain assumptions, but only to a first order of approximation. No one would deny that many other factors are important — the strength of the social fabric, the quality of life, and certainly the issue of to whom the income accrues — but it is not feasible to build these into a national-income measure. Hypothetically, one might contemplate a national-income measure incorporating "distributional weights," but two obstacles stand in its way: first, the impossibility of achieving a consensus with regard to the weights, and second, the fact that most of the data from which the national accounts are built are aggregates in the first place, and do not distinguish the individuals or groups whose dollars they represent. Giving equal weight to all dollars of income is mathematically the simplest rule, and our data come that way in any event. In a sense, the second obstacle imposes, rather arbitrarily to be sure, a solution to the perplexing difficulties posed by the first. This solution is obviously a far-from-perfect measure of national welfare — indeed it is surprising how little dissatisfaction has been expressed (until quite recently) with its use as such. But even its firmest detractors would probably not deny the usefulness of the national accounts and the necessity for them to be built on the basis of rules or conventions reflecting some degree of professional consensus.

An easy way to see the relationship between national income and the consumer-surplus concept is to consider the first two terms of the Taylor expansion of a utility function

$$U = U(X_1, X_2 \cdots X_n) \tag{1.1}$$

$$\Delta U = \sum_i U_i \Delta X_i + \tfrac{1}{2} \sum_i \sum_j U_{ij} \Delta X_i \Delta X_j. \tag{1.2}$$

Since U_i is a function solely of $(X_1, X_2 \cdots X_n)$, we can write $\sum_j U_{ij} \Delta X_j = \Delta U_i$; with this (1.2) simplifies to

$$\Delta U = \sum_i U_i \Delta X_i + \tfrac{1}{2} \sum_i \Delta U_i \Delta X_i. \tag{1.3}$$

Now, assuming utility maximization in the face of market prices $(P_1 \cdots P_n)$ we have $U_i = \lambda P_i$, where λ represents the marginal utility of income, and

$$\Delta U_i = \lambda^0 \Delta P_i + P_i^0 \Delta\lambda + \Delta P_i \Delta\lambda. \tag{1.4}$$

Substituting from (1.4) into (1.3) we obtain

$$\frac{\Delta U}{(\lambda^0 + \frac{1}{2}\Delta\lambda)} = \sum P_i^0 \Delta X_i + \tfrac{1}{2} \sum \Delta P_i \Delta X_i + \frac{1}{4} \frac{\Delta\lambda \sum \Delta P_i \Delta X_i}{(\lambda^0 + \frac{1}{2}\Delta\lambda)}. \tag{1.5}$$

Neglecting third-order terms, this yields

$$\frac{\Delta U}{\lambda^0 + \frac{1}{2}\Delta\lambda} \approx \sum P_i^0 \Delta X_i + \tfrac{1}{2} \sum \Delta P_i \Delta X_i. \tag{1.5'}$$

The first term on the right-hand side of (1.5′) measures the first-order change in utility, and can be identified with the change in national income (or, more properly, net national product) expressed in constant prices. The second term

measures the second-order change in utility, and can be identified with the change in consumer surplus.[1] The fact that the consumer-surplus concept is associated with a higher-order term in the Taylor expansion of the utility function is simply the mathematical counterpart of the statement made earlier that "postulates (a)–(c) incorporate a greater degree of subtlety of economic analysis than does national-income methodology."

Note, too, that (1.5) in effect converts the change in utility into monetary terms by dividing it by the marginal utility of income. There is obviously no problem when the latter is not changing, but when it does change as a consequence of the action(s) being analyzed, the conversion of utility into money is implicitly carried out at the midpoint of the beginning and ending marginal utilities of income. The criticism[2] that consumer-surplus concepts have validity only when the marginal utility of income is constant must therefore be rejected.

The conversion of utility into money also greatly eases the aggregation problem. Clearly both the first-order and the second-order terms on the right-hand side of (1.5) can be aggregated over individuals without difficulty.

III

In this section I shall discuss objections (iii) and (iv), which were left aside in the comparison between consumer surplus and national-income methodologies in the preceding section. Objection (iii), that consumer-surplus analysis is

[1] This is strictly true only when the point of departure is one of full, undisturbed equilibrium. When the starting point is one where distortions are already present, some of the change in consumer surplus is incorporated in the first term. This point will be treated in more detail below.

[2] The origin of this criticism is probably the thought that changes in consumer surplus ought directly to measure changes in utility. That this would be a fruitless pursuit should be obvious — among other things consumer surplus would not be invariant to monotonic transformations of the utility function. However, the measure $1/2\Sigma\, \Delta X_i\, \Delta P_i$ is invariant, with the change in ΔU stemming from a monotonic transformation being offset by the change in $(\lambda + 1/2\, \Delta\lambda)$ in the denominator of the left-hand side of (1.5). The following way of stating the same argument avoids the approximation implicit in a two-term Taylor expansion: the change in utility stemming from the change in a policy variable from z_0 to z^* is

$$\Delta U = \int_{z_0}^{z^*} \sum_i U_i(z) \frac{\partial X_i}{\partial z}\, dz.$$

This, being expressed in utils, is not invariant to a monotonic transformation. However, transforming utility into money continuously through the integration process, always at the marginal utility of money prevailing at that point, we have

$$\Delta W = \int_{z_0}^{z^*} \sum_i \frac{U_i(z)}{\lambda(z)} \frac{\partial X_i}{\partial z}\, dz = \int_{z_0}^{z^*} \sum_i P_i(z) \frac{\partial X_i}{\partial z}\, dz.$$

This obviously is invariant under any transformation of the original utility function which leaves unchanged the relevant behavioral reactions to changes in z.

An issue arises in connection with the comparability of measures of welfare loss, when one is comparing moves on two different paths (say T_1 and T_2) away from the undistorted equilibrium. If the marginal utility of the numeraire (here real income) is constant, there is no issue in this regard. However, comparability does not require constancy of the marginal utility of real income, but only "well-behavedness." By this I mean that when real income falls by ΔY as a consequence of the imposition of T_2, its marginal utility should change by the same amount as occurs when real income falls by ΔY as a consequence of a tax T_1.

partial-equilibrium in nature, and fails to take account of general-equilibrium considerations, is totally invalid on a theoretical level, but can fairly be levied against some practical applications.

Taking the theoretical issue first, one need only note that rigorous general-equilibrium formulations of consumer-surplus measurement have long since been a part of the corpus of economic theory. Hotelling [10, 1938], Hicks [7, 1941; 8, 1946; 9, 1956], and Meade [18, 1955, esp. Vol. II] all have derived, in a general-equilibrium framework, measures of welfare change that are consistent with postulates (a)–(c), and many others have followed in their train.[3]

The key to understanding the general-equilibrium nature of the consumer-surplus concept is the following simple measure of welfare change:

$$\Delta W = \int_{z=0}^{z^*} \sum_i D_i(z) \frac{\partial X_i}{\partial z}\, dz. \tag{1.6}$$

Here D_i represents the excess of marginal social benefit over marginal social cost per unit level of activity i; X_i represents the number of units of activity i; and z is the policy variable, the effects of a change in which we are interested in measuring. The D_i (distortions) can take many forms — about which more will be said below — but here, for simplicity of exposition, I shall assume that all the D_i take the form of taxes. A tax quite obviously drives a wedge between demand price (which under postulate (a) measures the value of the marginal unit to the demander) and supply price (which under postulate (b) measures the value of the marginal unit to the supplier), and this fits most naturally into the framework of this paper.

If a tax is placed on a single good j in the absence of any other distortions, (1.6) becomes

$$\Delta W = \int_{T_j=0}^{T_j^*} T_j \frac{\partial X_j}{\partial T_j}\, dT_j, \tag{1.7}$$

which is equal to the familiar welfare-cost triangle (*ABC* in Figure 1.1). Though the demand and supply functions of other goods may shift as a consequence of placing a tax on good j, the measure of welfare change is unaffected by such shifts since the distortions D_i in all other markets are, by assumption in this case, zero. However, if taxes on other goods already exist when T_j^* is imposed, the effects of its imposition are given by

$$\Delta W = \int_{T_j=0}^{T_j^*} T_j \frac{\partial X_j}{\partial T_j}\, dT_j + \int_{T_j=0}^{T_j^*} \sum_{i \neq j} T_i \frac{\partial X_i}{\partial T_j}\, dT_j. \tag{1.8}$$

This is equal to the triangle *ABC* in Figure 1.1 (which generates a negative contribution to welfare) plus, with constant T_is, the expression $\sum_{i \neq j} T_i\, \Delta X_i$ where ΔX_i measures the change in the equilibrium quantity of X_i occasioned by the imposition of T_j^*. Any of the terms in this summation, which is what

[3] See Corlett and Hague [1, 1953]; Harberger [3, 1964; 4, 1964]; Johnson [11, 1960; 12, 1962]; Lange [14, 1942]; Lipsey and Lancaster [15, 1956–57]; Lipsey [16, 1970]; and McKenzie [17, 1951].

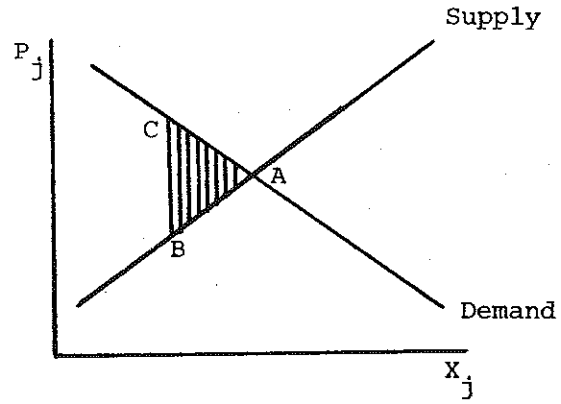

FIGURE 1.1

makes the difference between partial- and general-equilibrium approaches when other distortions are present, can be either positive or negative — when the distortion itself is positive (e.g., a tax), a positive contribution is made to the change in welfare if, as a consequence of a new disturbance (in this case the imposition of T_j^*), X_i increases, and a negative contribution if X_i decreases. When the distortion itself is negative (e.g., a subsidy), the contribution to welfare associated with activity i as a consequence of T_j^* is negative if $\partial X_i/\partial T_j > 0$ and positive if $\partial X_i/\partial T_j < 0$. This case is illustrated in Figure 1.2, where it is assumed that both the demand and supply curves of X_k shift as a consequence of the imposition of T_j^*. If the shift is from the solid demand and supply curves (when $T_j = 0$) to the broken ones (when $T_j = T_j^*$), the area *EFGH* ($= T_k\, \Delta X_k$) is an added loss; if the shift is in the other direction it is an added benefit helping to offset (and possibly actually outweighing) the triangle *ABC* in Figure 1.1.

This is a convenient place to point out the relationship between the general expression (1.8) for welfare change and the approximation (1.5′). Define $C_i + T_i = P_i$, and assume constant costs of production C_i, with the resource constraint $\sum C_i X_i = Y$, a constant.[4] When a tax is imposed on X_j in the presence of pre-existing taxes on other goods $i \neq j$, we have, substituting $C_i + T_i = P_i^0$ for $i \neq j$, $C_j = P_j^0$ and $T_j^* = \Delta P_j$ into (1.5′),

$$\sum P_i^0\, \Delta X_i + \tfrac{1}{2} \sum \Delta P_i\, \Delta X_i = \sum C_i\, \Delta X_i + \sum T_i\, \Delta X_i + \tfrac{1}{2} \sum \Delta C_i\, \Delta X_i + \tfrac{1}{2} T_j^*\, \Delta X_j \tag{1.5″}$$

Since $\sum C_i\, \Delta X_i = \sum \Delta C_i\, \Delta X_i = 0$ under our assumptions, we have

$$\sum P_i^0\, \Delta X_i + \tfrac{1}{2} \sum \Delta P_i\, \Delta X_i = \sum T_i\, \Delta X_i + \tfrac{1}{2} T_j^*\, \Delta X_j \tag{1.5‴}$$

[4] These assumptions are consistent with a situation in which the tax revenues received by the government are redistributed to the private sector via neutral transfers. For a more detailed treatment see Harberger [3, 1964].

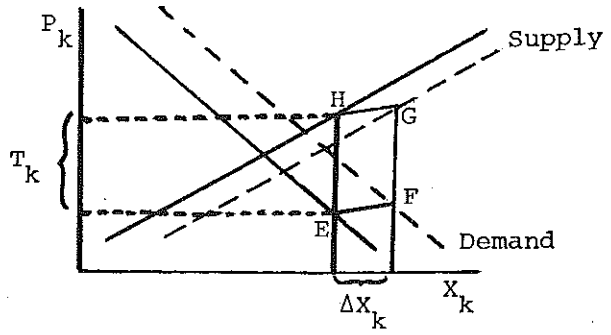

FIGURE 1.2

as a measure of the change in welfare stemming from the imposition of T_j*.[5] This is precisely what emerges from (1.8) in the case where the demand and supply curves for X_j are linear. It also shows how, when there are pre-existing distortions, elements of consumer surplus are present in the expression $\sum P_i^0 \, \Delta X_i$, representing the first-order approximation to welfare change.

Let us return to the discussion of objection (iii), that consumer-surplus analysis neglects general-equilibrium considerations. While it is clear that no theoretical obstacle stands in the way of taking such considerations into account, it is in fact rarely done in studies involving applied welfare economics. I do not want to appear to defend this neglect — indeed, the sooner it is rectified, the better — but at the same time I want to try to dispel any thoughts that the job of incorporating general-equilibrium aspects is so big as to be effectively hopeless. All that job entails is adding to the standard partial-equilibrium welfare analysis (of the tax T_j* in our example), an expression $\sum_{i \neq j} D_i \, \Delta X_i$. That may look like a formidable task but it need not be. The set of activities with significant distortions is a subset of the set of all activities; the set of activities whose levels are significantly affected by the action under study (e.g., T_j*) is another subset of the set of all activities. Only their intersection (see Figure 1.3) is important for the analysis of the effects of the specific policy

[5] Where no pre-existing distortions are present, and a vector of distortions $T^* = (T_1^*, T_2^* \cdots T_n^*)$ is introduced, (1.6) becomes, for linear demand and supply curves, $\Delta W = \frac{1}{2} \Sigma T_i \, \Delta X_i$, where

$$\Delta X_i = \int_{\mu=0}^{1} \left(\frac{\partial X_i}{\partial T} \right) T^* \, \mu \, d\mu.$$

That is to say, if the final set of taxes is (.5, .2, .1), one can imagine the process of integration taking place through steps like (.05, .02, .01), (.10, .04, .02), (.15, .06, .03), etc. The locus of points traced out by this exercise will define the set of triangles $1/2 T_i \, \Delta X_i$. As this exercise can in principle be performed for any set of distortions (not just taxes), it is quite general. One must note, however, that the triangles traced out here are not triangles between stable demand and supply curves but rather triangles defined by the loci of marginal social benefit (demand price) and marginal social cost (supply price) as μ goes from zero to one. On this result see Hotelling's equation 19 and the subsequent discussion [10, 1938].

action in question, and it is to be hoped that in most cases the number of elements in it will be of manageable size.[6]

Objection (iv) can be dealt with on several levels. In the first place, there is the issue of the exactness of (1.5); when the basic utility functions are quadratic, the first two terms of the Taylor expansion are all that are needed to describe the function fully; but when the basic utility functions are not linear or quadratic, (1.5) will be an approximation. And (1.5′) is vulnerable even when the utility function is quadratic, because of its neglect of the third term of (1.5). But while (1.5) and (1.5′) thus may contain errors of approximation which will be smaller, the smaller are the changes being studied, (1.6) is not subject to the same charge. The integrals set out there can be taken for curved as well as linear demand and supply curves, or, more properly stated, for curved or linear loci of demand prices and supply prices.

At another level entirely, one might interpret the large-versus-small-changes issue as raising up the old consumer-surplus conundrums about the value attaching to the first units of liquid or the first units of food, etc. I prefer to sidestep this issue on the ground that the problems arising in applied welfare economics typically do not involve carrying people to or from the zero point

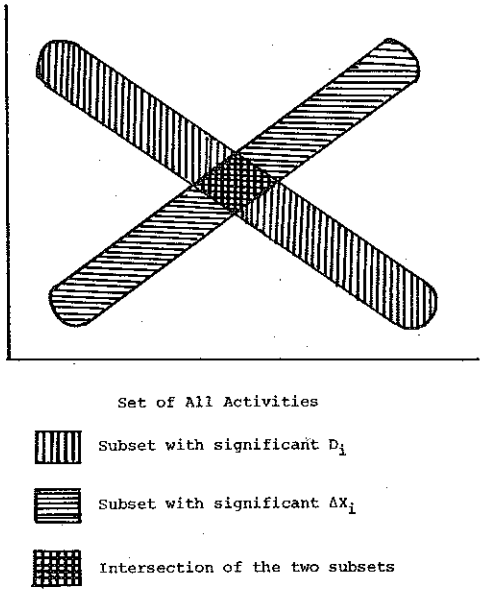

FIGURE 1.3

[6] Certain distortions, such as the property tax or the corporation income tax, which apply to a large subset of activities, can be taken into account through the use of shadow prices — e.g., in this case the social opportunity cost of capital. See Harberger [5, 1968 and 6, 1969]. Once the "general" distortions have been dealt with in this way, the remaining ones, it is to be hoped, will be sufficiently small in number so as to keep the problem manageable.

in their demand curves for food or for liquids, and where they do (as, for example, in famine relief programs), it appears more appropriate to approach the problem through assigning a monetary value to the human lives saved or lost, a task which necessarily carries us beyond the narrow confines of consumer-surplus analysis.

At still another level, when large changes are involved, the well-behavedness of functions is less easily guaranteed than when only small changes are present. For example, it is easy to show that the Hicks-Slutsky substitution properties apply to demand functions defined by movements constrained to a locus of the form $\sum C_i X_i = Y$, a constant (*FG* in Figure 1.4) so long as one is concerned with small changes in the neighborhood of the undistorted equilibrium (e.g., in the neighborhood of *A*). However, this cannot be shown to be generally true for large changes. For example, Figure 1.4 is so constructed that at both *B* and *E* the indifference curves intersecting *FG* have the same slope. This means that a demand function constrained to the locus *FG* (with real income being held constant in this sense) will have two quantities associated with the same relative price. Except in the case where the income expansion path at that price coincided with the segment *EB* between these two quantities, there would have to be some range(s) in that quantity interval in which the own-price elasticity of each good was positive, thus violating one of the Hicks-Slutsky conditions.[7]

There are at least two ways in which analyses based on postulates (a) to (c) can be justified in the face of this possible criticism. At the strictly theoretical level, while some results of some exercises in applied welfare economics may derive directly from the Hicks-Slutsky properties, the validity of equation (1.6) does not depend on the existence of well-behavedness in this sense. Alternatively one may simply take it as a matter of convention that, just as measurements of real national income in a sense are built on a linear approximation of the utility function, so we shall base consumer-surplus and cost-benefit analyses upon a quadratic approximation of that function, incorporating the Hicks-Slutsky properties. This more "pragmatic" approach would presumably be

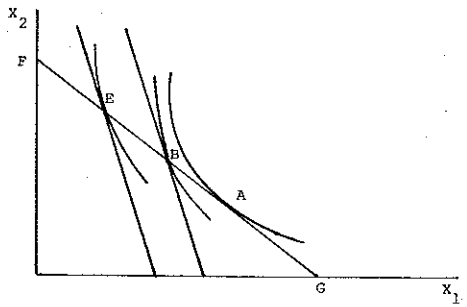

FIGURE 1.4

[7] For a further elaboration of this point see Foster and Sonnenschein [2, 1970].

based on the unlikelihood of our encountering cases in which empirical evidence can be mustered showing that such an approximation yields seriously biased numerical estimates of welfare costs and/or benefits.

A final variant of the large-versus-small-changes question concerns the normalization of measures of welfare change to correct for changes in the general price level. Consider the case of a two-good economy with $X_1C_1 + X_2C_2 = Y$, a constant. In this context one can analyze the effects of imposing, say, a 100 percent tax on X_1, with no distortion on X_2, or alternatively granting a 50 percent subsidy to X_2 with no distortion in the market for X_1. Assuming that the tax proceeds are returned to the public via neutral transfers and that the money for the subsidy is raised by neutral taxes, we should expect the same real equilibrium to be achieved in both of the alternative situations being compared. We should also, presumably, arrive at the same measure for ΔW. If we set $C_1 = C_2 = 1$, which is simply a question of choice of units and entails no loss of generality, with the 100 percent tax on X_1, the measure of welfare change is $\Delta W = 1/2 \sum \Delta X_i \, \Delta P_i = 1/2 \, \Delta X_1$. Alternatively, with a 50 percent subsidy to X_2, the welfare change measure is $-1/4 \, \Delta X_2$, which is equal to $1/4 \, \Delta X_1$, since under our assumptions $\Delta X_2 = -\Delta X_1$. This ambiguity can readily be resolved through the appropriate choice of a numeraire. When X_1 is the numeraire, the 100 percent tax on it is reflected in the price vector changing from (1, 1) to (1, 1/2), which is exactly what happens when a 50 percent subsidy to X_2 is introduced, so long as X_1 is the numeraire. Likewise, when X_2 is the numeraire, the 50 percent subsidy to it produces the same price vector (2, 1) as is generated by the 100 percent tax on X_1. My own preference as to a conventional way of correcting for changes in the absolute price level is to normalize on net national product = national income. This entails setting $\sum P_i X_i = \sum C_i X_i = Y$, a constant, which in turn implies, since $C_i + T_i = P_i$, that $\sum T_i X_i = 0$. This normalization automatically calls attention to the fact that most problems of applied welfare economics are "substitution-effect-only" problems, a point to which we shall turn in the next section.

IV

In this section I shall discuss some of the complexities that may arise in applications of the analytical approach represented by postulates (a)–(c). Let us first consider in more detail the close relation of the postulates to "revealed preference." Essentially, postulates (a) and (b) state that when demanders (suppliers) pay (get) their demand (supply) price for each marginal unit, the balance of their indifference as between demanding (supplying) that unit and undertaking the relevant available alternative activities has just barely been tipped. In effect, demand and supply prices are measures of the alternative benefits that demanders and suppliers forego when they do what they decide to do.

Equation (1.6) appears to capture all effects of an exogenous policy change, z, that are relevant to our three postulates — and indeed it does except when the exogenous change z in itself alters the resources available to the economy in question, the technological possibilities under which it operates, or the trading conditions that it faces in external markets. So long as the exogenous change

does not alter any of these things, all that it entails is the reshuffling of available resources among activities. It is in this sense that "substitution effects only" are involved in expression (1.6) in such cases.

To see that (1.6) does not capture the "income effects" of changes in resources, technology, or trading conditions, let us consider them in turn. Suppose, for example, that the exogenous change is that emigrant remittances, which were previously outlawed under foreign countries' exchange controls, are now permitted. The country receiving the remittances clearly gains, even if no distortions whatsoever are present in its economy. Hence (1.6) fails to capture the direct benefit associated with the remittances, even though in the presence of distortions it would capture the welfare "repercussions" that the receipt of the remittances might engender.

When technological advance occurs, the resources thus freed are enabled to increase total welfare, again even if no distortions are present. In Figure 1.5, the benefit from a technological advance that reduced unit costs from OA to OB would be given by the area $ABCD$ in the absence of other distortions, and by that area plus expression (1.6) in their presence. Expression (1.6) would of course include the area $CDEF$ if a unit tax equal to ED were already in existence on X_1. The exogenous force z in (1.6) would in this case be the reduction in unit cost (price) of producing X_1 and the terms in $\partial X_i/\partial z$ would include movements due to both the income and the substitution effects of this price change.

An exactly similar analysis applies in the case of an improvement in trading conditions in external markets. Here again a measure of the contribution to welfare that would be entailed in the absence of distortions must be added to (1.6), and the $\partial X_i/\partial z$ in (1.6) reinterpreted as above.

I believe that the three cases mentioned — new resources (gifts from outside), new technology (gifts of science and nature), and improved trading terms — or their respective negatives, are the only ones for which estimated first-order income effects must be added to expression (1.6). It is very important to note that such effects are not generated by price changes taking place within the economy under study in the absence of technical change. In this case, unless there are distortions, the benefits to demanders of a fall in price are cancelled

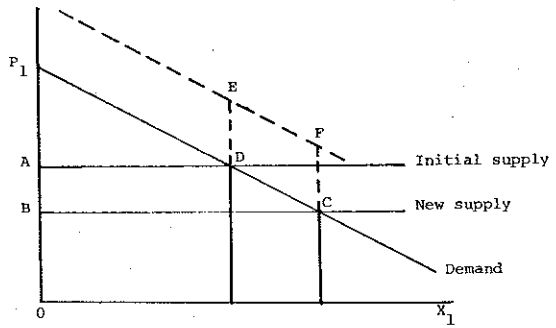

FIGURE 1.5

by the costs to suppliers, and vice versa in the case of a rise in price. And when distortions are present, (1.6) captures their effect. Likewise it is important to recognize that no additional term should be added to (1.6) in cases where production moves from a point on the true (outer) production frontier to some interior point as a consequence of the introduction of a new distortion (such as a tax on the employment of a factor in some lines of industry but not in others).

This brings to mind a second subtlety involved in (1.6): it is essential to recognize that the X_i refer to activities, not just products. In the case just mentioned the tax would be on the activity of using, e.g., capital in a certain subset of industries — say the corporate sector. D_i would here be the tax per unit of corporate capital, and X_i its amount. The activities of producing and consuming a given good should be kept analytically separate whenever the distortions affecting them differ;[8] likewise, a given type of activity which is affected by different distortions in different regions should be broken down into as many separate activities as there are different distortions. Perhaps the best guide that can be given in this matter is "identify the relevant distortions and let them define the relevant set of activities."

We now turn to a brief listing of the various types of distortion. (1) Taxes have probably been given sufficient attention already; let me only add that all kinds of taxes (income, excise, property, sales, consumption, production, value-added, etc.) fit easily into the framework presented here. (2) Monopoly profits, in the sense of any return (above the normal earnings of capital) that is obtained as a consequence of artificially restricting sales to a point where price exceeds marginal cost should also clearly be included. Note that for a great many analytical purposes monopoly profits can be treated as a privately imposed and privately collected tax. (3) The excess of price over marginal revenue in any external market in which the society in question has monopoly power is another case. This is a negative distortion which can be offset by an optimal export tax or by the implicit tax imposed by a private export monopoly. Categories (4) and (5) are simply the counterparts of (2) and (3) for the case of monopsony, the distortion in (4) stemming from monopsony profits, and that in (5) from the excess of marginal cost over price in any external market in which the society in question has monopsony power. (6) Externalities of all kinds represent distortions, positive or negative. Pollution of air or water is a negative distortion, which could, under postulates (a)–(c), be offset by a tax per unit of pollutant equal to what people would be willing to pay not to have it, or what they require as compensation in order to put up with it. The congestion of highways and streets represents another negative distortion, which could in principle be offset by an optimum congestion toll reflecting the extra cost (in terms of time, fuel, wear and tear, etc.) imposed upon others as a consequence of the presence of the marginal driver on the road.

Some readers may be inclined to question my classifying all taxes (and all monopoly profits) as distortions, only to go on to point out cases where they can be used to offset other distortions. Why not make special categories for

[8] Except in the trivial case of a closed economy or of nontraded goods, where production and consumption are necessarily the same.

cases like the optimum tariff, optimum export tax, optimum pollution charge, and optimum congestion toll? My answer is twofold. First, it is overwhelmingly simpler to avoid the special categories, and its cost — if any — is only the acceptance of the idea that distortions can offset each other. But this idea is needed in any event for activities where more than one distortion is present; different distortions applying to a given activity can either reinforce, or wholly or partially offset each other. Second, by avoiding special categories we highlight the fact that we are very unlikely to find optimal taxes and tolls in any real-world context.

V

This brings me back to my main theme: to plead for the "conventionalization" of postulates (a)–(c). Arguing in favor of them are the facts that they are both simple and robust and that they underlie a long tradition in applied welfare economics. They are simple both in the sense that their use entails no more than the standard techniques of received economic theory, and in the sense that the data that their use requires are more likely to be available than those required by alternative sets of postulates (in particular any that involve the full-blown use of "distributional weights").

The robustness of the postulates is another attribute of special importance. They can readily be used to define a set of policies that characterizes a full optimum. This entails no more than introducing taxes, subsidies, or other policies to neutralize distortions (e.g., monopoly, pollution) that would otherwise exist, so that the consolidated D_i affecting each activity are all zero, and raising government revenue by taxes that are truly neutral (lump-sum or head taxes),[9] or (cheating only slightly) by almost-neutral taxes such as Kaldor's progressive consumption-expenditure tax [13, 1955]. The postulates can also, in principle, be used to solve second-best problems such as finding the excise tax rates T_i on a subset of commodities $X_1, X_2, \cdots, X_k$ that entails the minimum cost of distortions while still raising a given amount of revenue. But these problems, taken from the theoretical literature, are likely to remain textbook problems. The practitioner of applied welfare economics knows full well that his clients do not come to him in search of full optima or elegant suboptima. He is more likely to be asked which of two alternative agricultural programs is better, or what resource-allocation costs a given tax increase involves, or whether a certain bridge is worth its cost. And to be relevant, his answer must recognize the existence of many distortions in the economy, over whose presence neither he nor his client have control. Most applied welfare economics thus answers questions like "Does this action help or hurt, and by approximately how much?" or "Which of two or three alternative actions helps most or hurts least, and by approximately how much?" — all this in a context in which most (if not all) existing distortions have to be taken as given. It is the fact that the three postulates are able to handle these kinds of questions, as well as more elegant optimization problems, that gives them the robustness to which I refer.

While it is true that there is no complete correspondence between what is

[9] The best definition of a head tax is one which must be paid either with money or with the taxpayer's head!

traditional and what is right, some weight must be given to the fact that no alternative set of basic assumptions comes nearly as close as postulates (a)–(c) to distilling the fundamental assumptions of applied welfare economics as we know it. These postulates are reflected not only in the general-equilibrium literature referred to in footnotes 5 and 6, but also in the standard practice of down-to-earth cost-benefit analyses [see, for example, 20, U.S. Inter-Agency Committee on Water Resources, 1958]. And it is here, really, that the need for a consensus is greatest. In the United States, cost-benefit (and its counterpart, "cost-effectiveness") analysis received a major boost when the PPB (Planning-Programming-Budgeting) concept was endorsed by President Lyndon Johnson and decreed as official policy by the Bureau of the Budget. And at the state and local level, investment projects and programs are also being scrutinized with an unprecedented degree of care, largely owing to the increasing concern that people have for environmental issues. Moreover, not just the United States is involved in this movement; the concerns about the environment, the worries about "what we are doing to ourselves," the recognition that our resources are too scarce to be wasted on bad programs, have no national limits. There is, indeed, a worldwide trend in which, country by country, an increasing fraction of the key decision-making posts are occupied by economists, and in which increasing efforts are applied to provide a sound economic justification for the projects that governments undertake. Finally, we have seen in the last decade a growing involvement of international organizations in the issues to which this paper is addressed: three regional development banks newly formed for Africa, Asia, and Latin America; increasing resources are devoted by the United Nations Development Programme to project identification and development, and by the World Bank to project financing. The OECD [19, 1968, 1969] has also shown increasing concern in this area.

The developments described above simply highlight the need for a set of standards, of "rules of the game" by which our professional work in applied welfare economics can be guided and judged. The three basic postulates that have been the subject of this essay provide a de minimis answer to this need: their simplicity, their robustness, and the long tradition that they represent all argue for them as the most probable common denominator on which a professional consensus on procedures for applied welfare economics can be based.

And so, having made my plea, let me salute the profession with what might well have been the title of this paper, with what is certainly the key that points to the solution of most problems in applied welfare economics, with what surely should be the motto of any society that we applied welfare economists might form, and what probably, if only we could learn to pronounce it, should be our password:

$$\text{“}\int_{z=0}^{z^*} \sum_i D_i(z) \frac{\partial X_i}{\partial z}\, dz.\text{”}$$

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II

The following chapter was first presented in 1963 at a conference sponsored by the National Bureau of Economic Research and The Brookings Institution and published jointly by them in a volume titled, *The Role of Direct and Indirect Taxes in the Federal Revenue System* the following year. Together with Chapter 3 of this volume, it deals in some detail with the analysis of the welfare costs of taxation in a general-equilibrium context. The initial problem posed was how, in the analysis of a particular tax or set of taxes, to account for the money (or command over resources) raised by the government in that way. On the one hand it could be assumed that the government spent the tax proceeds in some specific way, but unfortunately there is no limit to the number of alternative patterns of additional spending that could thus be assumed. Similarly, it could be postulated for the purposes of the analysis that other taxes were reduced to compensate the extra revenue generated by the tax(es) being studied. But again there is an infinite range of alternative taxes or combinations of taxes that could play this compensating role. On reflection, it becomes obvious that the problem requires some sort of "conventional" solution.

At the end of section I, I proposed the solution that in analyzing the effects of a particular set of taxes we consider as its counterpart a reduction of income taxes of similar incidence by income bracket (see Table 2.1). This solution has the possible virtue of "sounding practical," and it was with this in mind that I introduced it. But it has the theoretical flaws (a) of entailing distributional changes within income brackets (see footnote 5), and (b) of making it difficult to analyze changes in the income tax itself (indeed, I bypass this assumption when dealing with income taxation as such). And in any case its aura of "practicality" is false, in the sense that in no plausible real-world context would it work out that the