ESTIMATION OF POLICY PREFERENCE FUNCTIONS: AN APPLICATION TO U.S. BEEF IMPORT QUOTAS

by

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Policy criterion functions provide a basis for evaluating desirability of alternative economic outcomes or states. Typically public decision makers must choose between alternative policy proposals which influence different sectors of society in various ways and which have different welfare connotations to these segments of society. We take the objective of economic policy analyses to be that of generating information to aid policy makers in the choice among alternative policy programs. Further, we note that the formalized approach of economic analyses to policy making is presumed to supplement rather than to supplant contemporary procedures used in formulating and administering economic policy.

In the quantitative analysis of economic policy, two approaches have been advanced with respect to the use of a policy criterion function. The first, which we denote the explicit approach, involves a formally stated objective function as an integral component of the policy analysis. These analyses include not only the various optimizing models of decision making, e.g., Holt [1962], Theil [1968], Tinbergen [1968] and Prescott [1971], but also the work of Fromm [1969] and others who have used an objective function in the explicit evaluation of simulation experiements. The second approach generates, for selected values of the instrument variables, the time paths of the endogenous variables. This approach has been advanced principally by Naylor [1967, 1968, and 1970]. While this approach does not involve the representation of a criterion function, such a function may be regarded as a concealed component of the analysis. We call this approach the implicit approach since (implicitly) a criterion function is used in choosing the policy alternatives for experimentation[1]

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and in choosing the endogenous or performance variables for which these alternatives are to be compared.

In contrasting the first approach with the second it may be argued that explicit specification of the criterion function (or set of criterion functions): (i) does not necessarily involve an arbitrary selection of the policy variable levels to be investigated, (ii) allows the investigator to assist public decision makers with the choice of weights across various arguments or goals entering the criterion function, particularly if a set of criterion functions are examined, (iii) provides an initial and formal basis for interaction between the investigator and the public decision maker, and (iv) does not typically result in a situation in which public decision makers are inundated with so much data that they cannot realistically make choices. The latter is one of the principal difficulties of the implicit experimental approach. The explicit approach usually involves some arbitrariness in the specificaiton of trade-offs between different arguments while the implicit experimental approach involves such elements in the selection of the specific policy alternatives investigated. Neglecting investigator costs of the two approaches, arbitrariness emanating from the former approach may be less objectionable than the degree of arbitrariness present in the second approach.

In view of the above position, this paper contains a general framework for the specification and estimation of policy criterion functions (W's). We preface this framework with some comments on the structure of, and processes of public decision making in section II. The framework advanced is somewhat analogous to the conventional procedures for estimating an econometric model. This is treated in section III along with three sources of information which might be used to estimate a set of criterion functions. Finally, in section IV, we illustrate our procedure by estimating a set of W's used in a policy analysis

of United States beef import quota regulations.

II. Alternative Public Decision Models.

There are a number of models which have been advanced as attempts to explain public decision making. To simplify the discussion, these models will be classified into the borad categories of disaggregate and centralized public decison making models. Examples of the former include Arrow [1951], Bergson [1938], and McKean [1968] while those of the latter include Maass [1966], Musgrave [1959], Rothenberg [1961] and Steiner [1969]. To be sure, between these two extremes we find other models which posit varying degrees of decomposition and some incorporate multi-level public decision-making procedures (Malinvaud [1967]).

Models of disaggregated public decision making envisage society formulating decisions on social policy as a committee or direct democracy in which the selection of a policy involves each member casting a vote. For this framework the W (by which alternative economic outcomes are to be evaluated) would be based upon aggregation of individual preference functions. In welfare economics literature the aggregation approach to the construction of a W stems from the seminal studies of Bergson [1938] and Arrow [1951]. The principal source of contention that has intrigued economists in formulating aggregation rules concerns the desirability of, and procedures for, assigning weights to the preferences of individuals or of being able to measure and compare individual preference intensities.[2] While this controversy raises some conceptual and operational difficulties, the principal criticism of the aggregation theories concerns whether this model provides a realistic description of social choice behavior in contemporary societies. Drewnowski [1961] has characterized such a model as utopian and non-effective. The type of decentralized

public decision making behavior envisaged by the aggregation approach to the construction of W is rarely observed in contemporary societies with their highly specialized structure. In practice most individuals are not directly involved in the making of policy decision makers.

In the sequel, we follow the works of Downs [1957], Little [1957], Maass [1966], Rothenberg [1961], Steiner [1969], among others, and regard the process of public decision making as a bargaining process between a finite number of centralized public decision making groups and/or individuals. The specialized structure of contemporary societies is presumed to result from the expected costs and benefits of individuals becoming active participants in the policy making process; for most individuals the expected costs of obtaining, sifting, and analyzing information exceed the expected benefits emanating from these activities. For this reason, many individuals are quite prepared to delegate authority to a small number of representative decisions.[3] This delegation of authority as well as the importance of the bargaining process in policy making is recognized by most centralized or aggregate models.[4] In the context of the Federal government, which is our principal concern, the specialized public decision makers include the President and his advisors, members of Congress, and members of pressure groups.

The preference function entering centralized models may be regarded as a special of Bergson's general welfare function. It contains the scale of values of centralized group which has the actual authority. Moreover, it is not concerned with individual utilities as is the general welfare function but with measurable quantities existing for a particular economy. It exists and manifests itself in observable economic actions. Much like the consumer preference function, it may be revealed by policy actions and hence it is "observable." Such a function, following Tinbergen [1956, pp. 14-15], might

be defined as the policy-maker's welfare function or more simply as a policy preference function.

The manner in which the policy preferences are arrived at may be described as a type of bargaining game between political representatives and interested pressure groups. The preferences of various central decision makers are, of course, the basic inputs into the bargaining process. The outcome of this process will be influenced by the intensity of decision makers' preferences and by the intensity of decision makers' preferences and by the inter-decision maker properties of these preferences. These properties include independence, benevolence, malevolence, and cooperation. A basic characteristic of the entire process concerns the formation and maintenance of a consensus.

The importance of the bargaining process in political decision making suggests an alternative approach to the construction of a policy preference function. Rather than construct a unique W the investigator might consider the policy implications for several functions. These functions would reflect the extreme viewpoints and preferences of different central decision makers actively involved in the bargaining process, as well as preference sets lying between these extremes.[5] Furthermore, by indicating the rational policy outcome for different preference functions, the information generated by the economist's analysis might even contribute to the efficiency of the bargaining process in reaching a consensus.

III. Specification and Estimation of a Criterion Function Set.

Prior to specifying and estimating a policy preference function set, an analysis of the leverage points of the political process involved should prove useful. Leverage points, in this context, are defined by groups who are able to, and desire to, effect a substantial influence on the final outcome of a

policy decision. Some preliminary analyses of sort, reported in Bauer and Gergen [1968], appear to have been productive exercises in guiding a formal treatment of public decision making.

An initial step in this analysis involves isolating the leverage points and, if possible, aggregating these points into a smaller number of groups which represent similar preferences with respect to the pending policy issue.[6] Habitual strategies, the information sources of decision makers, and the perceived political orientations and influence of policy makers are crucial determinants of the behavior of participants in the policy making process. Isolation of the major leverage points and preferences provide some indication of the likely patterns of communication and negotiation involved in the bargaining process as well as the major areas of contention among the public decision makers. From this information we would hope to obtain a tractable number of W's to be used in an analysis of future policy decisions.

A formal framework which is analogous to procedures in constructing an econometric model may be utilized in specifying and estimating a set of policy preference functions. This procedure involves three steps: (1) selection of the relevant variables as arguments; (2) determination of an appropriate mathematical structure; and (3) obtaining estimates of a set of values for the parameters of the function.

Selection of the arguments of the preference function should relate to those (performance) variables which are considered important by central decision makers who are responsible for the formulation and administration of policy. In particular the variables should relate to key factors which are expected to be dominant in the bargaining process. It is anticipated that these variables will be closely associated with the economic welfare of groups who, potentially, will be affected by policy changes. Note also that these variables

may include some or all of the control or policy variables. In most situations several sources may assist in the selection of preference arguments. For example, executive promulgations, legislative authorizations, and interviews with governmental officials may provide useful guidelines in this selection.

Given a list of the relevant arguments, the general mathematical form of W should formalize assumptions regarding the marginal utility of individual arguments and the rate of substitution between different arguments. In this vein, the formulation of W is analogous to the maintained hypothesis of the conventional econometric model.[7] Any algebraic form would be admissable, e.g., additive, multiplicative, nonlinear, discontinuous, and various combinations.

In most applications a preference function reflecting several goals will be required and, thus, multidimensional structures are relevant. Two general cases of multidimension preference functions may be distinguished: (i) a scalar valued function providing a single overall utility index may be specified if the various dimensions of utility can be amalgamated in some way; and (ii) where amalgamation is not possible, (i.e., where it is not possible to convert various objectives or goals into a common rubric), but where it is possible to rank goals in order of preference or priority, a lexicographically ordered preference or vector valued function may be specified. In addition, some combination of these two specifications might be employed. Amalgamation procedures require specifying barter terms, or trade-offs among different goals. For most decision models, a scalar valued preference function simplifies computation of, and presentation of, the numerical results. In situations where the goals or arguments are non-comparable or when they cannot be expressed on a quantitative scale, or when the marginal rate of substitution between them is zero (lexicographic orderings), the investigator may resort to a vector valued function

for his specification.[8]

Turning to the quantification of the parameters of the specified structure, it is clear that as in the case of an econometric model a vast number of techniques may be employed.[9] As indicated above, given the desire to obtain a set of functions rather than a unique function, the principal concern should be with a range of values for the parameters rather than with a point estimate. The estimated parameters should reflect the marginal utility and marginal rates of substitution properties specified in the second step.

The difficulties in constructing a set of W's would appear to increase as we move from selection of the relevant variables to specification of an appropriate mathematical structure and then to caputring a set of parameters or weights, as does the number of arbitrary assumptions that must be imposed. An important part of the anlaysis should involve the explicit statement and evaluation of these assumptions. One advantage of this approach is that it provides a logical framework for making explicit any assumptions which can then be evaluated by others, including the public decision makers.

Information Sources

Three alternatives might be considered when searching for information to construct a set of W's. We may denote these alternatives as the direct, the indirect, and the arbitrary. In practice some combination of these alternatives might be utilized especially if we want to examine the consistency among them.

The direct alternative involves interviewing techniques to determine preferences. Gergen [1968] suggests a process of sequential interviewing of decision makers to determine the main issues of concern and the individuals or groups who seem likely to significantly influence the final outcome of the policy bargaining process. Several procedures have been proposed for attempts

to determine preference functions via this approach. These procedures have been reviewed by Dillon [1971] and they include direct measurement, the Von-Neumann-Morgenstern or standard reference contract, the modified reference contract, and the Ramsey method. In addition, Frisch [1957] has suggested plotting preference functions from data collected by interviewing prominent politicians about the policies to be pursued.

There are at least two major problems which confront the interview approach. First, there is some doubt, (as Naylor [1970, p. 264] suggests) about whether political decision makers are prepared to articulate their preference weights in detail. In part, successful bargaining in the political process places a premium on not revealing one's true preferences. Furthermore, decision makers' perceptions of their preference functions as well as their choice possibility sets may be imperfect and change in response to new information obtained during the bargaining process. Maass [1966] has supported this view arguing that the relative importance, or trade-offs between various goals may be resolved, to a large extent, as part of the bargaining process. Second, the interview procedure is costly and it may be difficult to obtain access to central decision makers.

With the indirect alternative the parameters of the preference function are inferred from decisions that have either been made in the recent past or might be considered in the future. On the basis of past decisions, Nijkamp [1970] has developed a procedure which infers the unknown coefficients of the preference function from actual decisions. This approach treats as givens the mathematical form and arguments of the preference function, the econometric model relating the endogenous to the controllable variables and optimal, i.e., preference maximizing, policy decisions. A similar approach has been utilized by Reuber [1964] in an empirical determination of Canadian monetary policy

objectives. The restrictive nature of this procedure should be evident. It presumes that the policy maker is a rational and consistent preference function maximizer, that his preferences are stationary, and that the policy maker and investigator have the same clear and precise perception of the decision possibility frontier (i.e., they have in mind the same structural model representation).

The indirect alternative might also be employed in the context of possible future decisions or control variable levels. This procedure when combined with interview methods could be based upon policy simulation experiments. This is, utilizing a constructed econometric model we may simulate some potential policy maker(s) his (their) rankings of the various states generated. Such informa- may then be used to infer at least bounds on the parameters of the indirect preference function underlying the revealed rankings. In this regard a procedure advanced by Churchman and Ackoff [1954] and applied by Stimson [1969] should prove useful. This indirect procedure as well as the one developed by Nijkamp [1970] and Reuber [1964] are suggestive even if the investigator is unwilling to go all the way and collate previous or possible future decisions as perfectly revealing existing or future preferences.

The third approach involves the investigator himself specifying arbitrary coefficients or what he believes the "preference weights" ought to be. This approach embraces the imaginary interviewing procedure suggested by Van Eijk and Sandee [1959]. Clearly, of the approaches considered, various arbitrary procedures have the advantage of simplicity and minimal costs. Moreover if the arbitrary assumptions are made explicit so that others with perhaps different prejudices may evaluate them this may be a worthwhile approach. Procedures of this sort have been utilized by Fromm [1969], Holt [1962], and Theil [1968]. Arbitrary procedures appear even more reasonable if the group or centralized

choice hypothesis as well as the nature of political bargaining process dictates the formulation of a number or set of social preference functions.

In summary, while in many cases it may be feasible to isolate some general attributes of a social preference function it is not equally possible to construct a unique function satisfying a criterion of relevance. A perusal of past decision behavior, together with any information on the expressed interests and objectives of participants in the policy process should suggest the relevant arguments and the general mathematical form of the function. It is in estimating or capturing the parameters that the principal difficulties arise. Interviews are expensive and their ability to reveal preferences is questionable while indirect procedures rest on some doubtful assumptions.

IV. Application to U.S. Beef Import Quotas

In this section the procedures outlined above are applied to U.S. policy decisions on beef import quota levels. The importance of this illustrative example is indicated in U.S. Congress [1969] and U.S. Tariff Commission [1964] reports. As indicated in the Congressional report, there has been substantial controversy over the present U.S. beef import quota policy. Consumers have argued that recent increases in beef prices are due, in part, to import quota restrictions imposed by the U.S. government, while beef producers contend that unrestricted beef imports "...could cause irreparable harm to the domestic livestock industry" (U.S. Congress [1969, p. 51]). Very recently, consumer meat prices have increased substantially and the administration has not imposed beef import quotas for the year 1973.

This application begins with a brief discussion of the general sources of information on which our estimates are based. The arguments and mathematical form of W are then specified followed by the estimation of the parameter or

policy preference function set. Since an evaluation of the explanatory properties of this estimated set requires knowledge of the policy possibility surface, an econometric model of the U.S. livestock stock sector estimated by the authors and reported elsewhere is briefly outlined in the next subsection. Finally, the explanatory properties of the estimated set of criterion functions are evaluated in terms of observed beef trade policy over the period 1959-69.

Information Utilized

A detailed analysis of the major leverage points of U.S. beef trade policy, their interaction, and an assessment of the intensity of preferences for key public officials is presented in Rausser and Freebairn [1972]. The leverage points isolated included: public opinion, members of Congress, Congressional committees and their members, the President and other members of the administration hierarchy, and interested pressure groups (particularly political lobbies representing domestic producer groups and foreign countries exporting beef to the U.S.). The preference of these leverage points are treated in terms of producer returns, consumer meat costs, and trade relations. In what follows, a brief historical sketch of U.S. beef trade policy is provided.

For the main part, with the exception of the introduction of beef import quotas in 1964, the beef industry has been left to market forces. Under legislation enacted in the 1964 meat import bill (PL 88.482), quota limitations on the annual (maximum) level of U.S. beef imports were imposed. From a base which was formulated as the average level of imports over the period 1959-1963 the legislation provides for the import quota to rise proportionately with expansion of the domestic beef industry. Moreover, the bill provides the President with authority to change the quota levels in light of national priorities. In 1968, 1970, and again in March, 1972, this authority was exercised to expand the annual

import quota level. As previously indicated, in 1973 no beef import quotas were imposed.

From a perusal of the House and Senate committee hearings on the bills to limit imports in 1964 several objectives and conflicting points of view concerning the legislation can be ascertained.[10] The beef producer organizations dominated the evidence presented to the hearings. They were concerned with the adverse effects of imports on their incomes. To a large extent the producers focused on the price effects as such, rather than direct measures of income. However, others who gave evidence, e.g., the Secretary of Agriculture, were concerned with net farm income and the return on investment in the industry. Some concern was also expressed about the likely effects of the legislation on America's trade relations. In addition, some "urban congressmen" expressed concern about the effects of quotas on meat costs to consumers, particularly the lower income groups who spend significant portions of their income on the type of beef being imported. A few other farm commodity pressure groups, especially the feed grains and dairy groups, noted their desire for high beef prices and continued prosperity of a domestic beef industry.

Arguments of W

As suggested by the above discussion, three categories of performance variables will be investigated as arguments of W. These variables are chosen as representative measures of consumer welfare, of beef producers' welfare, and or preferences for the policy instrument variable (the level of the import quota). As will become obvious, these measures are partial measures, but they are chosen so as to be approximately in line with those variables considered to be important by public decision makers. In what follows we define and discuss variables which provide proxy measures for consumer and producer welfare.

The welfare effects of beef trade policy on the consuming segment of the United States populous will be evaluated in terms of effects on the costs of a market basket of meat commodities. Based on classical consumer utility theory, consumer welfare is assumed to be a function of the quantities of goods consumed. Applying some theorems based on the assumption of a separable utility function we reduce the scope of our analysis by restricting it to the effects of trade policy on a subset of food commodities. This assumption almost certainly simplifies the real situation. DeJanvry [1966] and George and King [1971] have discussed these simplifications and their work suggests that it is tolerable to regard meat products as belonging to a separable commodity group. Hence, we will focus on the cost of four meat commodities--fed (quality) beef (q_1), other beef (q_2), pork (q_3), and poultry (q_4).

Consumers will be disaggregated into five classes according to income per household.[11] This segregation is made for two reasons: first, the average consumer at different income levels purchases a substantially different market basket of meat products;[12] and, second, some allowance should be made for the potentially regressive effects of reduced import quotas. With respect to the latter, cross section and time series data indicate that the average percentage of consumer disposable income spent on meat products declines with rising incomes, and some congressmen have expressed concern over the regressive effects of beef import quotas. We will make the further simplifying but plausible assumption that meat costs to consumers in each of the income classes may be treated additively in W.

Given the foregoing assumptions the variable measuring consumer welfare may be expressed as:

$$y_1 = - \sum_k \beta_k p^{r'} q_k, \tag{1}$$

where y_1 denotes the negative of aggregate consumer meat costs, $p^{r'} = (p_1^r, \ldots, p_m^r)$, $q_k' = (q_{k1}, \ldots, q_{km})$, β_k denotes the relative weight attached to consumers in income class k, p_i^r denotes the average retail price of meat product i purchased by consumers in income class k, k = 1, ..., n (n = 5), and i = 1, ..., m (m = 4). Since q_{ki} are available only for 1954 and 1964 (U.S. Department of Agriculture, 1955, 1966), these variables are treated as predetermined weights, $\bar{q}_{ik}$. This suggests that (1) may be represented as $y_1 = -\Sigma_i g_i p_i^r$, where $g_i = \Sigma_k \beta_k \bar{q}_{ik}$. The coefficients g_i are determined as $g_i = N_H g_i^*$, where N_H denotes the number of households and g_i^* is the weighted quantity of meat commodity i consumed per household. The weighted factors g_i^* are based on the proportion of households in each income category k, and a distributional preference factor for the various household income categories. With respect to the latter, we assume that the inverse of the marginal personal income taxation rate is a reasonable index of decision makers' progressive distributional preferences among consumers.[13]

The second set of performance variables entering W will provide measures of U.S. beef producer welfare. Empirical evidence presented in Rausser and Freebairn [1972] suggests that beef goes through two production stages and, to a large extent, different individuals are involved in these two stages. These two groups are beef breeding cow-calf producers and cattle feeders. Changes in beef trade policy might be expected to have different effects on the returns to the two activities. There may be a tendency for public decision makers to place greater weight on the welfare of breeding beef cow-calf producers than on the welfare of cattle feeders. There are more of the former producers and they represent an established, and more politically organized, group of producers than do cattle feeders.

Based on the above reasoning the welfare of cattle producers will be represented by two variables measuring the aggregate gross return to breeding

cow-calf producers (y_2) and to cattle feeders (y_3), respectively. More specifically these variables will be determined by

$$y_2 = f_2(K_b, p_2^f, p_5^f, \eta_2) \tag{2}$$

$$y_3 = f_3(I_f, p_1^f, p_5^f, p_c^f, \eta_3) \tag{3}$$

where y_2 denotes the aggregate gross returns to the breeding beef cow activity, y_3 denotes the aggregate gross returns to the cattle feeding activity, K_b is the stock of breeding beef cows, I_f is the number of cattle on feed, p_1^f is the producer price of fed beef, p_5^f is the producer price of feeder calves, p_c^f is the producer price of corn; η_2 is a vector composed of calf survival rates, heifer replacement rates, cow death rates, average sale weights of cows, average sale weight of calves, and variable input expenditures for the breeding cow activity; and η_3 is a vector composed of similar elements for the cattle feeding activity. The empirical relationships (2) and (3) are synthetically constructed on the basis of agricultural experiment station extension reports for various beef producing and cattle feeding regions of the U.S.[14]

In summary, the general form of W for a particular (annual) control period t may be represented as

$$W_t = W(y_{1t}, y_{2t}, y_{3t}, u_t) \tag{4}$$

where y_{1t}, y_{2t}, and y_{3t} are defined in (1), (2), and (3), respectively, and u_t denotes the import quota level.

Mathematical Form of W

Available evidence suggests that W should satisfy the following properties with respect to the performance variables:

$$W_{y_1} > 0 \quad W_{y_1 y_1} < 0,$$

$$W_{y_2} \begin{cases} > 0, \text{ if } y_2 < y_2^o \\ \leq 0, \text{ if } y_2 \geq y_2^o \end{cases}, \text{ and } W_{y_3} \begin{cases} > 0, \text{ if } y_3 < y_3^o \\ \leq 0, \text{ if } y_3 \geq y_3^o \end{cases} \tag{5}$$

where $W_y = \partial W/\partial y$, $W_{yy} = \partial^2 W/\partial y^2$, and y_2^o and y_3^o denote some normal gross return level for beef cow breeding and cattle feeding activities, respectively. The properties related to the consumer welfare proxy (y_1) suggest disutility of higher food prices. These properties arise from the policy goal of readily available food supplies, and from political pressure (particularly by urban and labor representatives) to lower food costs. In the case of the producer welfare proxies, the normal return levels y_2^o and y_3^o might be determined partly by considerations of equity. However, since for most producers, beef activities are but one of several activities contributing to farm income, the determination of this equity level would require some heroic assumptions. Perhaps more important in terms of influence on the political bargaining process is the desire of domestic producer groups and of the agricultural committees in Congress to improve producers' incomes. This along with various producer organizational statements implies that both y_2^o and y_3^o would appear to be greater than their actual 1971-1972 levels.

Turning to the control variable u, two sets of partially conflicting preferences may be isolated. Preferences of decision makers for the status quo, i.e., for not diverting time and other resources to change previous decisions, would result in a marginal preference of the form

$$W_{\Delta u} < 0, \text{ for } \Delta u \neq 0 \tag{6}$$

where Δ denotes a first difference operator. Producer lobbies from exporting countries and public officials desiring an expansion in the trade of other commodities, are presumed to have marginal preferences of the form

$$W_u > 0, \text{ and } W_{uu} < 0. \tag{7}$$

Both of these marginal preference forms (6) and (7) can be approximated by a quadratic function on u, say as the linear and quadratic terms of a Taylor series expansion.[15]

As a local approximation, an additive specification of the argument variables in W appears reasonable. In effect this assumption, by setting the coefficients on the interaction terms to zero, implies that the marginal utility of one variable is independent of the level of another variable. The reasonableness of this assumption follows from fed beef producers and breeding beef cow-calf producers being, for the most part, two distinct sets of producers; and beef producers representing less than five percent of the beef consumers (Rausser and Freebairn [1972]). If we restrict our attention to relatively small changes in the levels of the argument variables from the status quo it seems reasonable to assume that marginal social preference functions can be represented by the additive structure for W.

On the basis of the above discussion, (4) may be specified as a quadratic function in which each argument is treated additively, i.e.,

$$\bar{W}_t = k_t' y_t + h_t u_t - y_t' K_t y_t - u_t H_t u_t, \tag{8}$$

where $k_t' = (k_{1t}, k_{2t}, k_{3t})$, $y_t' = (y_{1t}, y_{2t}, y_{3t})$, h_t, H_t, and u_t are scalars, and K_t is a 3 x 3 diagonal matrix. The parameters represented in k_t, h_t, K_t, and H_t reflect assumptions imposed on the marginal preferences of the individual arguments and the rates of substitution between these arguments. In the following subsection we complete the representation of W_t by isolating a set of values for these parameters.

Estimation of Parameter Set

Estimates of the k_t, h_t, K_t, H_t parameters entering the quadratic criterion function (8) must be consistent with the marginal preferences (5)-(7) and they should reflect assumptions or available knowledge about the marginal rates of substitution between the different arguments. To simplify, we shall assume for the moment that $h_t = H_t = 0$, $k_t = k$, and $K_t = K$ for all t.

Given these assumptions, the function (8) may be transformed to

$$W_t = \sum_i [k_i^2/4K_i - K_i(y_{it} - y_i^o)], \tag{9}$$

where $y_i^o = k_i/4K_i$ denotes the maximum level of the variable y_i. Noting that the first term on the right hand side of (9) is a constant, the marginal perference function for y_i is given by

$$W_{y_{it}} = -2K_i (y_{it} - y_i^o) \tag{10}$$

and the marginal rate of substitution between the two arguments (say i and j) is given by $W_{y_{it}}/W_{y_{jt}}$. Now, if we know, or could specify, values for the W_{y_i}'s, for y_i^o's, and for a base comparison point of the y_i's, which may be denoted as $\bar{y}_i$, we can determine values for the parameters k_i and K_i. Procedures of this sort are employed in what follows.

Specifically, we proceed to obtain estimates of the k_i and K_i parameters by treating the base comparison point $\bar{y}_i$ as an average of the current levels of the variables, specifying the quasi-estremum[16] values y_i^o, and assuming a number of arbitrary values for the trade-off ratios or marginal rates of substitution W_{y_i}/W_{y_j}. In other words, for particular levels of $\bar{y}_i$ and y_i^o, relative W_{y_i} (i.e., W_{y_i}/W_{y_i}) will be employed to generate the set of parameters for k_i, and K_i. Clearly, the resulting estimates will be unique only up to a linear transformation since it is the ratios $W_{y_i}; W_{y_i}$ which are unique and not the absolute values of W_{y_i}.

For the various reasons noted in the previous section, we expect that preferences for higher producer returns will be given a greater weight than the

preferences for lower food costs to consumers. Taking producers (breeding beef cow-calf producers and cattle feeders) as a collective group we will consider preference weights for aggregate consumer meat costs relative to aggregate producer gross margin returns ranging from 0.25:1.0 to 1.0:1.0. With respect to the two types of producers, some reasons were offered for placing greater weight on preferences for returns to cow-calf producers relative to cattle feeders. On this basis, we consider weights for aggregate cow-calf producer returns relative to aggregate cattle feeder returns over the range 2.0:1.0 to 1.0:1.0. Regarding the policy variable u we will consider two cases, one in which zero weight is attached to preferences for this variable, and one in which a million pound change in u is equated to a million dollar increase in consumer meat cost.

In Table I, the procedure utilized for deriving the k_i and K_i parameters for average 1965-1969 conditions is illustrated. The following set of assumptions underlie the computations appearing in this table: (1) as indicated in Rausser and Freebairn [1972] and the assumptions discussed there, the performance variables for average 1965-1969 conditions may be specified as

$$y_1 = -60[1.62\ p_1^r + .70\ p_2^r + 1.78\ p_3^r + 1.40\ p_4^r], \tag{11}$$

$$y_2 = 35[3.63\ p_5^f + 1.45\ p_2^f - 60], \text{ and} \tag{12}$$

$$y_3 = 23[10.44\ p_1^f - 5.20\ p_5^f - 62.7\ p_c^f], \tag{13}$$

where the price variables p_i^r (i = 1, 2, 3, 4), p_1^f, p_2^f, p_5^f, and p_c^f are as previously defined; (2) for the specifications (11), (12), and (13) the base comparison points for these variables $\bar{y}_i$ (i = 1, 2, 3) are determined by average 1965-1969 values; (3) the quasi-extremum values for the three variables are determined by $y_1^o = .9\ \bar{y}_1$, $y_2^o = 1.4\ \bar{y}_2$, and $y_3^o = 1.4\ \bar{y}_3$; and (4) the trade-off weightings for a dollar increase in aggregate consumer meat costs, a dollar decrease in aggregate gross margins to the breeding beef cow activity, a dollar

decrease in aggregate gross margins to the cattle feeding activity, and a pound change in the import quota control variables is assumed to be 1:3:2:0. The resulting criterion function may be summarized as

$$W = -899\ y_1 + 1049\ y_2 + 700\ y_3 - .0232\ y_1^2 \qquad (14)$$
$$-.1541\ y_2^2 - .1631\ y_3^2.$$

Similar procedures are employed to compute the other criterion functions in the set to be used in analysis of U.S. beef trade policy. These other criterion functions reflect different base comparison points $\bar{y}_i$ and thus quasi-extremum values y_i^o, and particularly assumptions about the trade-off ratios between the argument variables, i.e., $W_{y_i} : W_{y_j}$. Normalizing on the consumer meat cost performance variable, some of the parameters entering these functions for average 1969-1971 levels of the variables are reported in Table II.

Econometric Model

To evaluate the explanatory properties of the estimated criteria function set treated in previous subsection, we require knowledge of the policy possibility set. This set of constraints in the present analysis will be represented by an econometric model of the U.S. livestock sector. More specifically, since the argument variables of W specified in (4) are determined as a linear combination of the endogenous variables $p_i^r (i = 1, 2, 3, 4)$, p_1^f, p_2^f, p_5^f, K_b, and I_f, at least nine constraints or equations are required. However, if these endogenous variables are embedded in a larger structural system, i.e., they are interdependent with a number of other endogenous variables, more than nine equations will be involved. For the present investigation, available evidence suggests that the nine endogenous variables mentioned above are either interdependent or seemingly unrelated to a number of other (current) endogenous variables characterizing the U.S. livestock sector. Hence, although our ultimate concern is with the

reduced form relations of the state or endogenous variables entering W, we initially estimated a structural model of the U.S. livestock sector.

In developing this model, an attempt was made to represent the significant components of the aggregate (annual) behavior of economic units involved in the production, consumption, and trade of meat products. As usual, it is not maintained that the real world in every detail is actually represented by the constructed model. However, we proposed that the model does provide a sufficiently accurate approximation of the more important causal behavior patterns. Its specific components may be described as (i) consumer demand, (ii) margin and producer prices, (iii) cattle producers, (iv) beef imports, (v) pork producers, and (vi) poultry producers and marketing. These components are collectively represented in the structural model by thirty equations, of which twenty are stochastic and ten are identities.

The theoretical foundations underlying the structural model, knowledge of technical relationships influencing consumer and producer decisions related to meat products, the sample data, the complete econometric model specification, and the estimators employed are completely described in Freebairn and Rausser [1972]. For purposes of the present analysis we simply note that the estimated econometric model provides us with a linear policy possibility set. The slopes of the policy possibility set are based on the reduced form coefficients (impact multipliers) associated with the beef import quota variable (u). For some selected endogenous variables of the estimated model, these impact multipliers along with their corresponding standard errors are reported in Table III.

Evaluation of Explanatory Properties

To evaluate the explanatory properties of the derived set of criterion functions, a framework along the lines of Reuber [1964] and Nijkamp [1970] is

utilized. This framework involves evaluating the consistency of the criteria function set by implicitly or indirectly deriving the weights associated with the various performance and control variables over the period 1959-1969. More specifically, given that the econometric model outlined in the previous subsection represents public decision makers perceptions of livestock sector behavior, assuming rationality or optimal policy decisions and specification (8) for W, the parameters k_i, K_i, h, and H may be inferred from actual policy actions regarding the beef import quota levels over the period 1959-1969. Equivalently, given knowledge of the policy possibility set (i.e., the econometric model representation), the procedure for evaluating the explanatory properties of the criteria function set is to assess the consistency of the observed policy decisions with those decisions which would have been "optimal" assuming the different criterion functions. The term "optimal" in this context should be interpreted with great care since the procedure rests on a number of doubtful assumptions. Each of these assumptions as well as the optimality assumption are advanced within the context of the "as if" principle.

The specific assumptions in addition to (8) are: (i) a social time preference rate of zero;[17] (ii) An expected, known policy possibility set, i.e., all coefficients entering the econometric model and characterizing the policy possibility set are presumed to be known with certainty and the expected values of disturbance terms are zero (a more realistic analysis would, of course, recognize the uncertain nature of the estimated set of constraints); (iii) beef trade quotas are determined so as to maximize W of (8) subject to the expected policy possibility set represented by the estimated econometric model of the livestock sector.

For the above assumptions, the model may be collapsed and presented schematically as in Figure 1, where AB defines the boundary of the policy possibility set.

The slope of this boundary is given by

$$\frac{dy_1}{du} \Big/ \frac{d(y_2 + y_3)}{du} = \frac{dy_1}{d(y_2 + y_3)} \tag{15}$$

where u is the level of beef imports. In the econometric model, the price variables in y_1, y_2, and y_3 are linear functions of the level of imports, hence AB is linear. The curves I' and I" are the social indifference curves derived for a particular W. Given the assumed W underlying I', the welfare maximizing point is given by point E in Figure 1, i.e., where $dy_1/d(y_2 + y_3) = -W_{y_2+y_3}/W_{y_1}$. In general, with respect to the model as depicted in Figure 1, we may isolate three different policy situations;

$$-\frac{dy_1}{d(y_2 y_3)} \begin{cases} = \dfrac{W_{(y_2+y_3)}}{W_{y_1}}, & \text{no policy change,} \quad (16.a) \\ < \dfrac{W_{(y_2+y_3)}}{W_{y_1}}, & \text{reduce imports,} \quad (16.b) \\ > \dfrac{W_{(y_2+y_3)}}{W_{y_1}}, & \text{increase imports.} \quad (16.c) \end{cases}$$

Over the period 1959-1969, four policy phases with respect to the level of beef imports may be examined. The period prior to 1964 of no policy change; the enactment of beef import quota limitation in 1964; a second period of no policy change covering the years 1965 through 1967; and finally the period of 1968-1969 during which the President used his authority to increase the beef import quota. These four phases will be denoted by t = 1, 2, 3, 4. For each of these periods, the explanatory properties of the set of constructed W's are evaluated by computing $dy_1/d(y_2 + y_3)$ and $W_{(y_2+y_3)}/W_{y_1}$.

The computation of $W_{(y_2+y_3)}/W_{y_1}$ is based upon $y_{1t} = -58\alpha_1 p^r_t$, $y_{2t} = 31\alpha_3 p^f_t$, and $y_{3t} = 18\alpha_3 p^f_t$ for the first two periods, i.e., t = 1, 2, and $y_{1t} = -60\alpha_1 p^r_t$, $y_{2t} = 35\alpha_2 p^f_t$, and $y_{3t} = 23\alpha_3 p^f_t$ for the second two periods, i.e., t = 3, 4, where α_1 = (1.62, .70, 1.78, 1.40), α_2 = (0., 1.45, 3.63, 0., 60.00), α_3 =

(10.44, 0., -5.20, -62.70, 0.), $p_t^{r'} = (p_1^r, p_2^r, p_3^r, p_4^r)'$, and $p_t^{f'} = (p_1^f, p_2^f, p_5^f, p_c^f, -1)'$; and the quasi-extremum values, $y_{1t} = .9\,\bar{y}_{1t}$, $(y_{2t} + y_{3t})^o = 1.4(\bar{y}_{2t} + \bar{y}_{3t})$, where $\bar{y}_{1t}$, $\bar{y}_{2t}$, and $\bar{y}_{3t}$ denote average variable levels for each phase, $t = 1, 2, 3, 4$. The slope of the production possibility set, i.e., $dy_1/d(y_2 + y_3)$ is derived from (11), (12), (13) and impact multipliers reported in Table III.

In Table IV, results of the evaluation are reported for each of the four phases and a selected subset of the estimated W's, viz., those based on relative weightings ($W_{y_1}:W_{(y_2 + y_3)}$) of 1:1, 1:2, 1:3, and 1:4. For each of the W's, the relative magnitudes of $-dy_1/d(y_2 + y_3)$ and $W_{(y_2 + y_3)}/W_{y_1}$ are compared according to the rules specified in (16). Such a comparison suggests that over the period 1959-1969 public policy makers weighted a two dollar increase in beef producer returns (as measured by $y_2 + y_3$)) as approximately equivalent in social value to a one dollar decrease in consumer meat costs (as measured by y_1).[19] That is, trade-off ratios in the vicinity of 1:2:2:0 for the four arguments y_1, y_2, y_3, and μ of W are consistent with actual beef trade policy decisions for the periods analyzed. This evaluation, of course, only provides an *ex post* justification for the estimates derived. For purposes of beef trade policy analysis it does, however, support or at least does not refute our arbitrary assumption that the criteria function set be based on a relative weight range of 1:1:1:0 to 1:4:4:2.

Summary

In contemporary societies policy decisions have been viewed as an output from a bargaining process between political groups representing conflicting social preferences. These conflicts arise for the most part in terms of the relative weights (i.e., intensity of preferences) that the groups attach to different dimensions of alternative policy decision outcomes. In this context

it was argued that it is both unnecessary and unrealistic to specify a unique or single-valued social preference function. Instead investigations ought to be based on an understanding of the political process and the revealed preferences of important leverage points. With respect to deriving this information interviews are expensive and their ability to reveal preferences are questionable while indirect procedures rest on some doubtful assumptions. A less costly approach is, of course, to employ a range of plausible values for its parameters of a policy preference function chosen arbitrarily by the investigator. Our proposed framework provides a formal basis for specifying and evaluating these arbitrary assumptions.

We have illustrated the application of our suggested framework in specifying a set of W's to be used in an economic analysis of U.S. beef trade policy. The principal arguments of the function were specified to be (i) the cost of a market basket of meat commodities to consumers disaggregated by household income level, (ii) the gross margin returns to beef breeding cow-calf producers, and (iii) the gross margin returns to cattle feeders. The assumed quadratic form of the function seems to provide a reasonable representation of policy preferences over the expected range of variation of the argument variables. A procedure for estimating a range of values for parameters reflecting different trade-off ratios between the argument variables was illustrated. Using a naive revealed preference model we found that a trade-off ratio of about a one dollar decrease in producers' gross returns was consistent with observed beef trade policy actions in the 1960's.

In conclusion, the set of policy preference functions constructed using the suggested (or for that matter any other) framework might be best regarded as an imperfect, but nonetheless, plausible means for assisting in the analysis of public decision making rather than as an end in itself. This position has

been nicely summarized by Fromm [1969]: "At this time, I would not advocate the rigorous application of utility functions for the evaluation of policies. Nevertheless, employing them in a limited fashion, especially when a range of arguments and weights are used, is helpful in acquiring perspective on the relative desirability of alternative policies."

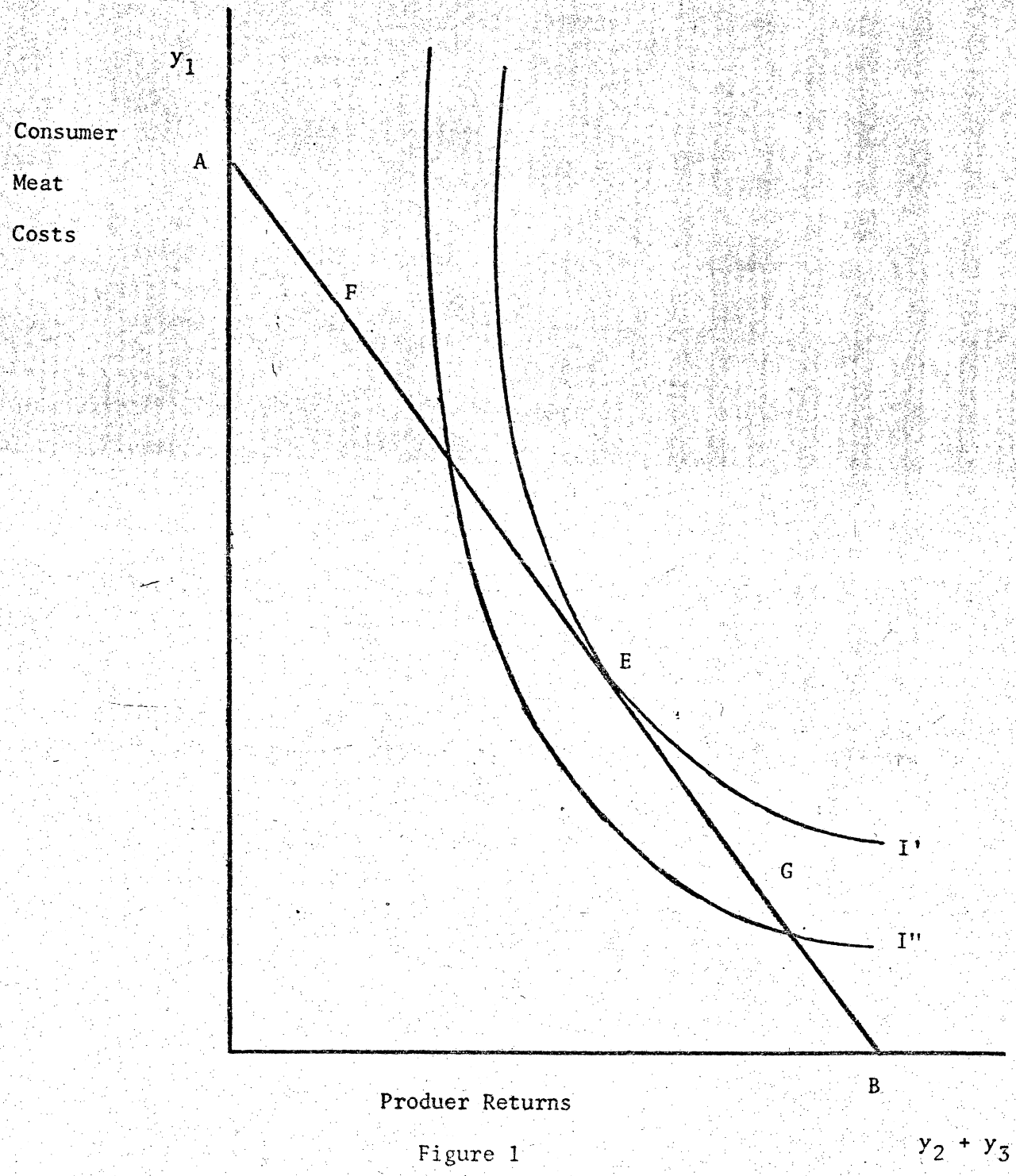

Figure 1

TABLE I

Estimation of 'k_i' and 'K_i' Parameters of Criterion Function for a Particular Set of Assumptions[1/]

Variable in social preference function	Base comparison level of variable (million dollars)	Quasi-maximum level (y^o) (million dollars)	Relative marg. utility at base comparison level W_{y_i}	K_i [2/]	k_i [3/]
y_1	-21528	-19375	100	.0232	-899
y_2	2433	3406	300	.1541	1049
y_3	1532	2145	200	.1631	700

1. y_1, y_2 and y_3 are defined according to (11), (12) and (13) respectively; $\bar{y}_i$ is defined at average values for 1965-1969; and trade-off weighting between arguments at mean 1965-1969 levels are specified as 1:3:2:0.

2. $\hat{K}_i = -W_{y_i}/2(\bar{y}_i - y_i^o)$.

3. $\hat{k}_i = 2\, y_i^o\, \hat{K}_i$.

TABLE II

Some Specified Values for the Parameters of the Criterion Function for Alternative Preference Weightings

Trade-off ratio between y_1, y_2, y_3, and u	Linear term parameters				Quadratic term parameters			
	k_1	k_2	k_3	h	K_1	K_2	K_3	H
1:1:1:0	-922	332	332	0	.0208	.0308	.0641	0
1:1:1:1	-922	332	332	150	.0208	.0308	.0641	0
1:2:2:0	-922	666	666	0	.0208	.0617	.1282	0.0416
1:3:2:0	-922	1000	666	0	.0208	.0925	.1282	0
1:3:3:0	-922	1000	1000	0	.0208	.0925	.1923	0
1:4:4:0	-922	1334	1334	0	.0208	.1234	.2564	0

TABLE III

Estimate of the Reduced Form Coefficients (Impact multipliers) and their Standard Errors for Beef Import Quotas

Retail prices				Producer prices			
p_1^r	p_2^r	p_3^r	p_4^r	p_1^f	p_2^f	p_3^f	p_4^f
-.0052	-.0059	-.0011	.0001	-.0018	-.0020	-.0003	-.0015
(.0028)	(.0013)	(.0002)	(.0004)	(.0010)	(.0003)	(.0030)	(.0006)
Domestic production				Stocks			
q_1^s	q_2^s	q_3^s		I_f	K_b		
.1336	-.3649	-.0614		-.1313	.1820		
(.0911)	(.1017)	(.0388)		(.0870)	(.0219)		

TABLE IV

Comparison of Actual Beef Trade Policy Decisions over the Period 1959 to 1969 with Estimates of the Slope of the Boundary of the Policy Possibility Set $[-dy_1/d(y_2 + y_3)]$ and the Slope of Alternative Social Indifference Curves $[W_{(y_2 + y_3)}/W_{y_1}]$

Decision period	Actual policy decision	Estimates of $-\frac{dy_1}{d(y_2 + y_3)}$	Slope of social indifference curves for different W's			
			1:1	1:2	1:3	1:4
1959-1963	No change	1.83	.81	1.62	2.43	3.24
1964	Reduce imports	1.83	2.53	5.06	7.59	10.10
1965-1967	No change	1.59	1.25	2.51	3.76	5.02
1968-1969	Increase imports	1.59	.46	.91	1.37	1.82

FOOTNOTES

1. In general, for realistic policy problems it will not be feasible to trace out the effects of all policy possibilities. Thus, the investigator is required to select some subset of alternatives for evaluation.

2. For the main part one of the two positions regarding interpersonal comparisons of utility has been employed. Those, including Arrow [1951], who refect the possibility of interpersonal utility comparisons are unable to derive acceptable aggregation rules which provide a universal social ranking, e.g., General Possibility Theorem. On the other hand, others including Bergson [1938] and Coleman [1966], who assume cardinal utility functions are able to derive aggregation rules which rank all possible social states. This approach is, of course, confronted with problems regarding attempts to obtain cardinal measures of individual utility functions. Sen [1970] has considered partial comparability of individual preferences including each of the two extreme positions of non and complete comparability. For the main part his analysis is of a conceptual nature. His findings indicate that some degree of comparability, rather than either of the two extreme positions, is sufficient in many cases to generate a complete ordering through the aggregation relation.

3. In practice, there is substantial contention regarding the autonomy of decision makers' preferences and the preferences of those they represent. See, for example, Bergson [1938], Schoettle [1968], and Steiner [1969].

4. A useful integration of some of these models and the allied fields of sociology and political science may be found in Bauer and Gergen [1968].

5. Similar sentiments have been expressed by Fromm and Taubman [1968]. They suggest that the only feasible approach is to present the policy decision making group with a series of assessments based on a variety of preference functions, leaving the policy group to make its own choice of a particular preference function.

6. Gergen [1968] suggests that the actual leverage exerted by an individual will depend on three factors: first, the priority of the issue in the mind of the decision maker, i.e., do the alternatives significantly affect his goals; second, the position of the individual in the policy making process and; third, the personal stature and efficiency of the individual in the policy process.

7. In particular we note that in both the case of an econometric model and W, the maintained hypothesis is as much an art as a science. It is extremely difficult, on empirical grounds, to choose between several closely related hypotheses.

8. Recognizing the time dimension in the preference function introduces some additional, and largely unresolved complications. More specifically, questions related to social time preference rates and discount factors arise. It should also be noted that it is not necessary that the preference function be specified in cardinal terms. A function which is unique only up to a linear transformation provides an adequate index for ranking alternative economic outcomes according to the expected value criterion. While less restrictive than an assumption of cardinal utility, this requirement is less general than a specification based on ordinal utility.

9. Furthermore, it is likely that a number of less precise (perhaps highly arbitrary) and more ingenious methods will be required to determine these parameters than have been commonly utilized to estimate the parameters of econometric models.

10. The appropriate committees are: House-Agriculture; Senate-Finance.

11. This is based on the Household Food Consumption Surveys of 1954 and 1964. We segregate households into categories according to money income per household ($). These categories are: < 2000, 2000-3999, 4000-5999, 6000-7999, and ≥ 8000.

12. Various cross section studies, e.g., the 1964 U.S. Department of Agriculture Food Consumption Survey, illustrate this point.

13. To be sure, progressive taxation is but one of many devices used to redistribute wealth. For further details on the measurement of g_i^* and g_i, see Rausser and Freebairn [1972].

14. Explicit measures of the elements entering η_2 and η_3 as well as y_2 and y_3 are presented in Rausser and Freebairn [1972].

15. Evidence reported in Zellner and Geisel [1968] suggests that quadratic criterion functions provide satisfactory approximations to a number of more general functions when asymmetry is not an important consideration.

16. Since W specified in (8) represents an approximate function, the y_i^o variables obviously need not correspond to global extremum.

17. In the context of our problem this simplifying assumption may be a reasonable one. In the latter portion of this section we show that the boundary of the policy possibility set for a one year horizon has slope $dy_1/d(y_2 + y_3) \simeq 1.7$ (see Table IV). If we were to assume a five year horizon with a time preference rate of unity over this horizon, the boundary of this policy possibility set has a slope of approximately 2.0. This latter figure was computed on the basis of cumulative five year multipliers (Freebairn and Rausser [1972]) rather than the impact multipliers reported in Table III.

18. For example over the period 1959-1964

$$\frac{dy_1}{du} = -58 \sum_{i=1}^{4} \frac{\partial y_1}{\partial p_i^r} \frac{dp_i^r}{du}$$

$$= -58 \left[1.62\, dp_1^r/du + .70\, dp_2^r/du + 1.78\, dp_3^r/du + 1.40\, dp_4^r/du\right]$$

$$= -58 \left[1.62\,(-.0052) + .70(-.0059) + 1.78(-.0011) + 1.40\,(.0001)\right]$$

where the derivatives are the impact multipliers reported in Table III.

19. It should be noted that the definition of producer returns used here underestimates the aggregate effects of beef imports on all producers. For example, we have ignored the depressing effects of beef imports on the value of cull coew, and for the early part of the period we have ignored effects on the value of grass fed slaughter cattle. In short, on this count, the true weighting would be something less than indicated by our treatment.

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