Political-Econometrics: The Quantitative Investigation of a Political-Economy

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POLITICAL-ECONOMETRICS: THE QUANTITATIVE INVESTIGATION OF A POLITICAL-ECONOMY

I. A Methodological Introduction

In an earlier work [Zusman and Rausser (1990a)], we expounded a descriptive integrated theory of a political-economy. As is generally the case, the motivations for developing the theory were: (a) to provide a general explanation of the working of a political-economy and (b) to provide a mechanism for predicting the values assumed by the endogenous economic variables and the policy instruments for given environments. The two objectives are, in fact, related in several ways. Evidently, explication and prediction alike must derive from a valid theory. As an introduction to the rest of this paper, we now consider the theory validation problem and the role of theory in prediction as applied to our political-economic theory.

In order to be validated, a theory must be corroborated; that is, it has to pass successfully stringent falsification tests, in which the behavioral implications of the theory are compared to observed behavior. Hence, a theory must be refutable in principle; namely, it should imply observable behavioral patterns comparable to observed behavior. Since the key concepts of the political-economic theory, i.e., the strength of power functions and the cost of power, are essentially nonobservable, the refutability of the theory is not evident, *prima facie*. Hence, an important objective of the present paper is to demonstrate how the relevant hypotheses may be tested. This is especially important because our theory involves many strong a priori specifications. To be sure, the a priori specifications are also not freely selected and, in order to be acceptable, must conform to established social theories and the researcher subjective beliefs, many of which are shared by society at large. Yet, this requirement, too, although quite stringent, does not provide airtight safeguards against false specifications.

In considering the prediction problem, one is interested in a prediction mechanism that successfully predicts the values of the endogenous economic variables and the policy instruments for given environments. Such a mechanism expresses the variables to be predicted as functions of the exogenous variables characterizing the environment; in short, the reduced form.

In some degree, every prediction mechanism is based on theorizing. Consider, for instance, the simplest type of prediction mechanism where all the variables to be predicted are expressed as unrestricted functions of certain exogenous variables. These functions are then estimated from a sample of observations—ordinarily, a time series. The role of theory here is minimal: to determine the list of exogenous variables to be used as explanatory variables. The underlying theory is usually intuitive and implicit. We shall refer to this prediction mechanism as the *minimal political-economic theory reduced form.*

At a higher level of theorizing, the endogenous economic variables are predicted using an economic structure derived from economic theory. A meaningful economic theory imposes restrictions on the economic structure. It dictates the list of structural equations and the variables included in each equation. It also imposes restrictions on the functional forms of the equations and the values of the various structural parameters. Values of the endogenous economic variables are then predicted with the aid of a reduced form derived from the economic structure and thus embodying the theoretical restrictions. In the absence of an explicit political theory, values of policy instruments are predicted as before by employing a minimal political theory reduced form. We shall refer to this prediction mechanism as the *minimal political, full economic theory reduced form.* Finally, our political-economic theory provides for an integrated political-economic structure which is restricted by the combined political-economic theory and not by economic theory alone. The prediction mechanism now consists of a reduced form derived from the integrated structure and thus embodying all the theoretical restrictions imposed on the integrated structure. We shall refer to this prediction mechanism as the *full political-economic theory reduced form.*

Being least restricted, a minimal theory reduced form fits better the observations in the sample period. The greater the role of theory in model building, the more restricted is the corresponding reduced forms and the poorer the fit in the sample period. In fact, the loss in "goodness of fit" relative to the parsimony of the theory may serve as a falsification criterion. However, theory-intensive prediction mechanisms are generally superior for prediction relative to environments not included in the sample. In particular, since predictions are often made for environments that are qualitatively different from those observed during the sample period (e.g., different policy instruments are employed in the new environment), a minimal theory reduced form may be entirely insufficient. Furthermore, as theorizing is inherently a process of generalizing and refining through abstraction, a full theory is more parsimonious and yet more accurate than a minimal theory.[1]

In the following, we indicate how our political-economic theory is instrumental in the formulation and estimation of the political-economic structure and how the principal theoretical hypotheses may be tested. The paper focuses on problems created by the nonobservability of the theory key variables and on identification issues. However, problems of statistical inference will not be addressed.

The following formulation and analysis is exclusively concerned with the group configuration consisting of a single policy-making center and n organized interest groups. A similar approach with some obvious modifications may then be employed in the formulation and analysis of other group configurations.

2. Formulation

The structure of a political-economic system consists of the following components: (i) the economic structural relations; (ii) the set, X_0, of feasible policy instruments; (iii) the participating groups' (one policy-making center and n organized interest groups) policy objective functions; and (iv) the interest groups' strength functions, $s_i(c_i, \delta_i)$.

As the economic structural relations are derived from the relevant economic theory and may be estimated using known econometric methods, no further elaboration is needed on this account. Structural components pertaining to the political process are somewhat more problematic. The policy instruments and the set, X_0, of feasible policy instruments must be prespecified. These should be identified by direct examination of actual policy choices. Having a fully formulated (though not necessarily estimated) economic structure may appreciably facilitate the identification of policy instruments. It is worth noting, in this regard, that quite often the distinction between endogenous economic variables and policy instruments is not that sharp, and several different sets of variables may be considered as potential candidates for policy instruments within a given economic structure. As has been demonstrated by Zusman and Amiad (1977), the choice of policy instruments is likely to affect the structure of political negotiation, although not the ensuing political-economic equilibrium. Arguably, all participants in the political process prefer a choice of policy instruments conducive to a "wheel network" pattern of negotiations. This aspect of the political process is illustrated and further discussed below (section 4).[2]

The participants' policy objective functions must be specified on an a priori basis. At first sight, this appears to be a straightforward matter: Producers seek to maximize their net income (producers' surplus), consumers' objective is identifiable with consumers' surplus, taxpayers are interested in minimizing total tax burden consisting of nominal tax payments plus the tax excess burden, etc. However, a closer examination suggests, and this is born out by empirical studies [Zusman and Amiad (1977)], that policy objective functions may be difficult to specify since significant distortions are pervasive. In particular, individual interests may be distorted in the political process since group representatives' (group leadership) personal interests may be superimposed on individual preferences. Also, individuals and groups may ignore some of the benefits and costs when these are considered given [Zusman and Rausser (1990b)]. Finally, the objectives of policy-making centers are usually a puzzle, for politicians' declared goals are often strategic rather than sincere statements, and their revealed preference is often hard to decipher as it also reflects a mixture of political influences. There is, also, the question of whether total or per-capita quantities should be used. Thus, Becker (1983) expresses pressure group interests in per-capita terms. In the long run, when group size varies, this is a nontrivial matter. One hopes that future empirical studies of political-economies will shed light on these problems.

Finally, the strength functions, $s_i(c_i, \delta_i)$, must be specified in order to complete the formulation. As strength functions and their arguments are unobservable, no direct estimation method exists. Nevertheless, our theory implies strong restrictions on these functions which limit the class of permissible strength functions. Let $s_i(c_i, \alpha_i) = \alpha_i(c_i)$ and $s_i(c_i, \beta_i) = -\beta_i(c_i)$. As the theoretical restrictions apply to $\alpha_i(c_i)$ and $\beta_i(c_i)$ alike, we shall list them for $\alpha_i(c_i)$ alone. Thus, for $c_i \geq 0$,

(1.a) $$\alpha_i(0) = 0,$$

(1.b) $$\alpha_i(c_i) \geq 0 \text{ when } c_i > 0,$$

and $\alpha_i(c_i) = 0$ for all values of c_i implies the inability of group i to reward decision agents in the policy-making center.

(1.c) $\alpha_i'(c_i) \geq 0$, i.e., $\alpha_i(c_i)$ is monotone nondecreasing.

(1.d) $\alpha_i''(c_i) \leq 0$, i.e., $\alpha_i(c_i)$ is concave.

The strict inequalities in (1.c) and (1.d) hold when $\alpha_i(c_i) > 0$ for some $c_i > 0$. To minimize the estimation problem, we want $\alpha_i(c_i)$ to be a one-parameter family of functions. Two families of such functions satisfying properties (1.a) to (1.d) above are specified:

Family 1

$$\alpha_i(c_i) = A_i\ c_i^{a_i}; \qquad \beta_i(c_i) = B_i\ c_i^{b_i}$$

where a_i and b_i are prespecified known parameters such that

$$0 < a_i, b_i < 1.$$

Family 2

$$\alpha_i(c_i) = A_i \ln(1 + c_i); \quad \beta(c_i) = B_i \ln(1 + c_i).$$

It is readily verified that the two families of functions satisfy properties (1.a) through (1.d) and could be used in the a priori specification of the strength functions.

3. Estimation and Testing

Having estimated the economic structural relations, having identified the set of feasible policy instruments, and given a specified set of policy objective functions, it is possible to derive the economic efficiency frontier. Our theory predicts that the solution, $u(\bar{x}_0)$, should be on this frontier, but it would be presumptuous to expect the actual solution, $u(\hat{x}_0)$, where $\hat{x}_0$ is the vector of observed values of the policy instruments, to be always on the economic efficiency frontier. After all, real systems very seldom function in such a perfect manner. Nevertheless, one does expect the actual solution to be near the economic efficiency frontier; that is, provided the theory is valid and the objective functions have been specified correctly. Thus, the "closeness" of actual behavior to the economic efficiency frontier may serve as one criterion for selecting objective functions and, indeed, for a general test of the underlying hypothesis.

Another major difficulty stems from the impossibility of observing certain variables. In particular, neither the cost of power, c_i, nor the strength of power, $s_i(c_i, \delta_i)$, is directly observable. Yet, they, and the political efficiency frontier, may be quantified indirectly by observing the actual behavior of equilibrium solutions.

In the following, we shall present a two-phase procedure allowing the estimation of the structural political relations. In the first phase, a point on the economic efficiency frontier corresponding to the "theoretical solutions" is estimated. The "theoretical solution" is utilized in the second phase to estimate the parameters of the strength functions.

Phase 1—The estimation of a "theoretical solution."

Let $\hat{x}_0$ be the observed levels of the policy instruments. A "theoretical solution" is estimated by finding values of policy instruments, $\bar{x}_0$, such that $u(\bar{x}_0)$ is on the economic efficiency frontier and "close" as possible to $u(\hat{x}_0)$, where $u = (u_0, u_1, ..., u_n)$. The estimation procedure consists of finding a pair $(\bar{x}_0, \bar{h})$ such that

(2) $$\sum_{i=0}^{n} \bar{h}_i[u_i(\bar{x}_0) - u_i(\hat{x}_0)] = \min_{\substack{h_i \geq 0, i \in N \\ \sum_0^n h_i = 1}} \max_{x_0 \in X_0} \sum_{i=0}^{n} h_i[u_i(x_0) - u_i(\hat{x}_0)].$$

Intuitively, if the h_i's turn out to be proportional to the unknown b_i's (the weights in the policy governance function) of the system, then maximization with respect to x_0 yields the exact theoretical solution. Also, if $\hat{x}_0$ happens to be on the efficient frontier, the h_i's are the coefficients of the tangent plant at $u(\hat{x}_0)$. Note also that $\bar{h}_i / \bar{h}_0$ is an estimate of b_i. Clearly, $u(\bar{x}_0)$ is on the economic efficient frontier. Now, using the saddle-point theorem of nonlinear programming, it can be shown that $(\bar{x}_0, \bar{\lambda})$ is a primal-dual solution of the programming problem.

(3) Maximize V with respect to x_0 subject to

$$V \leq u_i(x_0) - u_i(\hat{x}_0) \qquad i = 0, 1, ..., n$$

and

$$F(x_0) \geq 0,$$

where the constraints $F(x_0) \geq 0$ correspond to $x_0 \in X_0$, and $\bar{h}_i = \bar{\lambda}_i / \Sigma_{i=0}^{n} \bar{\lambda}_i$.

Any one of several existing nonlinear programming algorithms may be employed in obtaining the solution. Under the convexity assumptions, the solution, $\bar{x}_0$, minimizes the distance, $D(x_0, \hat{x}_0)$, where

$$D(x_0, \hat{x}_0) \equiv \max_{i \in N}[u_i(x_0) - u_i(\hat{x}_0)] \qquad N = \{0, 1, 2, ..., n\}.$$

This implies that the gain in the policy objective functions is equal for all i; that is,

$$(4) \qquad u_i(\bar{x}_0) - u_i(\hat{x}_0) = V, \quad i = 0, 1, 2, \ldots, n.$$

To see that this is indeed so, suppose, to the contrary, that for some $k \in N$, $u_k(\bar{x}_0) - u_k(\hat{x}_0) > V = u_i(\bar{x}_0) - u_i(\hat{x}_0) \ \ \forall i \neq k$. Then, since there exist conflicts of interest among groups, $\bar{x}_0$ could be changed in such a way that, for all $i \neq k$, $u_i(x_0) - u_i(\hat{x})$ is raised while $u_k(\bar{x}_0) - u_k(\hat{x}_0)$ is lowered. The minimization of $\max_{i \in N}[u_i(\bar{x}_0) - u_i(\hat{x}_0)]$, therefore, implies equation (4).

The solution of the programming problem for $n = 1$ is depicted graphically in Figure 1.

An Identification Problem

As demonstrated above, the b_i's may be estimated by solving the maximization problem (3). However, a closer inspection of the solution reveals an identification problem lurking in the structure of the estimation procedure. To see this, note first that, due to equation (4), minimizing $\Sigma_{i=0}^{n}[u_i(\bar{x}_0) - u_i(\hat{x}_0)]$ with respect to $(h_0, h_1, \ldots, h_n)$ $\left(\Sigma_{i=0}^{n} \bar{h}_i = 1\right)$ cannot yield a unique solution $(\bar{h}_0, \bar{h}_1, \ldots, \bar{h}_n)$, and, consequently, no unique estimates of $(b_1, \ldots, b_n)$ are obtainable. The desired estimates are, in fact, obtained from the first-order conditions (FOC) for maximum (2) with respect to x_0. Suppose $\bar{x}_0$ is an interior solution, then the FOC are

$$(5) \qquad \sum_{i=0}^{n} h_i \frac{\partial u_i(\bar{x}_0)}{\partial x_0} = 0, \quad \sum_{i=0}^{n} h_i = 1.$$

Expressing (5) in matrix notation, one gets

$$(5') \qquad h'[K(\bar{x}_0) \vdots e] = d'$$

where: $h'_{[1 \times (n+1)]} = [h_0, h_1, \ldots, h_n]$, and

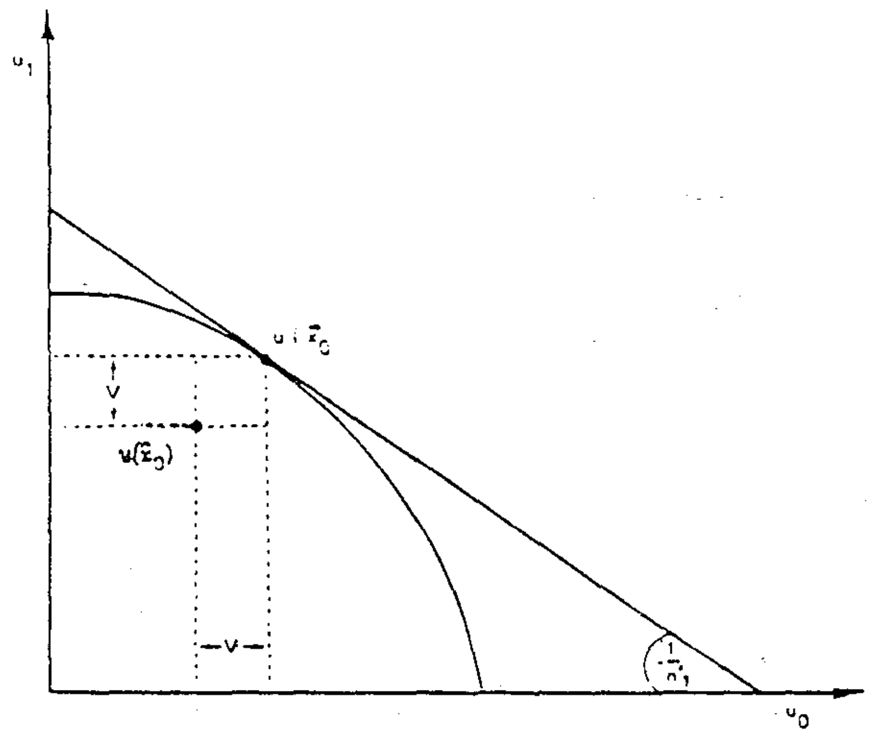


Figure 1. The estimation of a theoretical solution in a political-economic system with two players.

$$K(\bar{x}_0)_{[(n+1)\times m]} = \left[k_{ij}(\bar{x}_0)\right] = \left[\frac{\partial u_i(\bar{x}_0)}{\partial x_{0j}}\right]$$

is a matrix of partial derivatives of the $(n + 1)$ policy objective functions with respect to each of the m policy instruments (i.e., $x_0, \in R^m$). The partial derivatives are evaluated at the solution point, $\bar{x}_0$, $e_{[(n+1)x1]}$ is a vector whose elements are all equal to one (i.e., $e_i = 1$, $i = 0, 1, \ldots, n$); and

$$d'_{[1\times(n+1)]} = [0,0,0, \ldots 0, 1].$$

A unique solution for $\bar{h}$ exists if and only if the rank of $K(\bar{x}_0)$ is n. This is the *rank condition* for the *identification* of $\bar{h}$. The unique values of $\bar{h}$ are then

$$\bar{h}' = d'[K(\bar{x}_0) \vdots e]^{-1}. \tag{6}$$

A *counting condition* follows as a corollary; namely, for $\bar{h}$ to be identified, the number of policy instruments, m, must be equal to or greater than the number of organized interest groups, i.e., $m \geq n$. If the number of organized interest groups exceeds the number of policy instruments, i.e., $n > m$, then the number of columns in $K(\bar{x}_0)$ is smaller than n and the rank of $K(\bar{x}_0)$ is smaller than n, in which case $\bar{h}$ is underidentified. However, if $m > n$, the number of columns in $K(\bar{x}_0)$ is greater than n. Yet, the number of independent rows is still n (there are $n + 1$ rows in $K(\bar{x}_0)$ but, since $\bar{h}' K(\bar{x}_0) = 0$, with $\bar{h} \neq 0$, only n rows are linearly independent). Consequently, $m \geq n$ is a counting condition for the identification of $\bar{h}$.

When $\bar{h}$ is underidentified or just identified (i.e., $m \leq n$), the vector $u(\hat{x}_0)$ calculated from the observed values of the policy instruments, $\hat{x}_0$, is on the economic efficiency frontier because $h \in R^{n+1}$ is restricted only by the $m + 1 \leq n + 1$ linear constraints $h'[K(\hat{x}_0) \vdots e] = d'$. Consequently, $\bar{x}_0 = \hat{x}_0$, and $\bar{V} = 0$. When $\bar{h}$ is just identified (i.e., $m = n$), $K(\bar{x}_0) = K(\hat{x}_0)$ and $\bar{h}$ is the vector of coefficients of the plane tangent to the economic efficiency frontier at $u(\hat{x}_0)$. However, when $m > n$, $u(\hat{x}_0)$ is unlikely to be on the economic efficiency frontier: consequently, $\bar{x}_0 \neq \hat{x}_0$ and $\bar{V} > 0$. In this case one could obtain C_m^n distinct estimates, $\hat{h}^{(j)}$, of $\bar{h}$

$$\hat{h}'^{(j)} = d'[K^{(j)}(\hat{x}_0) \vdots e]^{-1},$$

where $K^{(j)}(\hat{x}_0)$ is a $(n + 1) \times n$ submatrix of $K(\hat{x}_0)$ consisting of n columns selected from the m columns of $K(\hat{x}_0)$. Since $m > n$, there are C_m^n such matrices. In this sense, one may say that, when $m > n$, $\bar{h}$ is *overidentified*. Note that the estimation procedure stated in (3) yields a unique estimate of $\bar{h}$ even if $\bar{h}$ is overidentified.

The estimates $\hat{b}_1, \ldots, \hat{b}_n$ are just (over) identified when $\bar{h}$ is just (over) identified. It should be emphasized that, even if b is underidentified because $m < n$, interesting analytic results are still obtainable by imposing *identifying restrictions*. Consider, for instance, the single commodity subsidy case. The group configuration of this political-economy consists of the government ($i = 0$), consumers ($i = 1$), and producers ($i = 2$). There is a single policy instrument: the subsidy, s. As $m = 1 < n = 2$, the power coefficients are underidentified. However, by imposing the identifying restriction, $b_1 = b_2 = b$, one obtains a single just identified power coefficient, b, which may be interpreted as embodying the power of the organized interest groups (consumers and producers) over the government. Let $\hat{s}$ be the observed subsidy level; then, since $m < n$, $u(\hat{s})$ is on the economic efficiency frontier. Hence, $\bar{s} = \hat{s}$ and

$$K(\hat{s}) = \left[\frac{\partial u_i(\hat{s})}{\partial s}\right]$$

is (3×1). Under the identifying restriction, $b_1 = b_2 = b$, the FOC for maximum W is

$$\frac{\partial u_0(\bar{s})}{\partial s} + b\left[\frac{\partial u_1(\bar{s})}{\partial s} - \frac{\partial u_2(\bar{s})}{\partial s}\right] = 0. \tag{7}$$

Consequently,

$$\hat{b}(\hat{s}) = -\frac{\partial u_0(\hat{s})}{\partial s} / \left[\frac{\partial u_1(\hat{s})}{\partial s} + \frac{\partial u_2(\hat{s})}{\partial s}\right] > 0, \tag{8}$$

since

$$\frac{\partial u_0(\hat{s})}{\partial s} < 0,$$

while

$$\frac{\partial u_i(\hat{s})}{\partial s} > 0 \qquad \text{for } i = 2, 3.$$

The value of $\hat{b}$ is of interest as it reflects the "average power" of consumers and producers over policymakers in government.

Having estimated $b = (b_1, ..., b_n)$, one wishes to estimate the strength functions. However, in so doing, one encounters a difficulty due to the unobservability of the strength and cost of power. Estimating the parameters of a strength function forces one to normalize the cost of power so that the estimated costs of power are actually in relative terms.

Thus, let $E_1, ..., E_T$ be the sampled environments characterized, respectively, by values of the k dimensional vectors of exogenous variables, $z_1, z_2, ..., z_T$, and giving rise to the observed policy instruments, $\hat{x}_{0,1}, ..., \hat{x}_{0,T}$. That is, the triplet $(E_t, z_t, \hat{x}_{0,t})$ is a sampled observation, there being all together T such observations in the sample. Suppose b_t is identified in all t, then, from derivation in Zusman and Rausser (1990a) and the specification of the strength functions, we have

$$\hat{b}_{i,t} = a_i A_i \, c_{i,t}^{a_i - 1} \tag{9}$$

or

(9')
$$\hat{b}_{i,t} = A_i / (1 + c_{i,t})$$

depending on the preferred specification of $\alpha_i(c_i)$. However, $c_{i,t}$ is unobservable and one is forced to adopt the normalization $c_{i,t_0} = 1$ for some $t = t_0$. Consequently,

(10)
$$\hat{A}_{i,t_0} = b_{i,t_0} / a_{i.}$$

or

(10')
$$\hat{A}_{i,t_0} = 2\hat{b}_{i,t_0}$$

depending on whether (9) or (9') holds.

To avoid the inconsistencies of further normalization, all other observations may be utilized in the estimation of $c_{i,t}$ (for $t \neq t_0$) without any additional contribution toward the estimation of A_i. That is,

(11)
$$\begin{aligned}\hat{c}_{i,t} &= \left\{\hat{b}_{i,t} / [a_i \hat{A}_{i,t_0}]\right\}^{1/(a_i-1)} \\ &= \left[\hat{b}_{i,t} / \hat{b}_{i,t_0}\right]^{1/(a_i-1)}\end{aligned}$$

or

(11')
$$\begin{aligned}\hat{c}_{i,t} &= \hat{A}_{i,t_0} / \hat{b}_{i,t} - 1 \\ &= 2\hat{b}_{i,t_0} / \hat{b}_{i,t} - 1.\end{aligned}$$

Falsification Tests

Two possible falsification tests are outlined and investigated in the present paper. Both tests were employed in empirical analyses reported in the economic literature. The first test examines the "distance" of the observed values of the policy objective functions, $u(\hat{x}_0)$, from the economic efficiency frontier, while the second test compares impact multipliers estimated from the sample under the constraints imposed by the full-political-economic theory to impact multipliers estimated from the sample under the far milder constraints imposed by the minimal theory (the minimal theory reduced form). The first falsification test is designated the *efficiency*[3] *loss test* and the second test is referred to as the *sample impact multiplier test*.[4] Let us consider each of the two tests in turn.

The test criterion in the efficiency loss test is the value of V calculated from equation (4). In effect, V provides a measure of the loss in each organized group prespecified objective function entailed by the observed values of the policy instruments compared to the "efficient" choice of instruments predicted by the model (the "theoretical solution," $\bar{x}_0$). Evidently, with a just identified b (i.e., when $m = n$), $V = 0$ and the test cannot discriminate between a "right theory" and a false theory. Intuitively, one expects V to increase with the degree of overidentification so that the value of V relative to $m - n$ should serve as a test criterion.

In their quantitative investigation of the Israeli dairy program, Zusman and Amiad formulated a model comprising the government and three organized interest groups (a consumer group and two producer groups). The model featured five policy instruments; thus, $m = 5 > n = 3$, and the b_i's were overidentified. The sample consisted of a single triplet of observations (E, z, $\hat{x}_0$), along with the corresponding observations on the endogenous economic variables. The efficiency loss falsification test yielded a very high value of V, strongly indicating the rejection of the political-economic theory. However, altering the producer groups' policy objective functions lowered V significantly. The modified theory, where dairy farmers' policy objective functions included the aggregate production quota as well as net producers' income as target variables, was not rejected. In the original specification, producers' net income alone served as the policy objective function.

The sample impact multipliers test as employed by Beghin focuses on changes in the policy instruments in response to changes in the exogenous variables (impact multipliers). The minimal-theory-reduced-form is defined to be the functional relation

(12) $$\hat{x}_{0t} = \Pi(z_t) \qquad t = 1, 2, \ldots, T;$$

$\Pi(z_t)$ is then estimated using the sample observations. Let $\hat{\Pi}(z_t)$ be the corresponding estimated reduced form. The associate matrix of impact multipliers is the m x k matrix $\partial\hat{\Pi}(\bar{z}) / \partial z$ evaluated at $\bar{z} = \Sigma_{t=1}^{T} z_t / T$.

The full-political-economic-theory-reduced-form is based on the political-economic theory presented in Zusman and Rausser (1990a). It assumes that $\bar{x}_0$ maximizes the policy governance function, $W(x_0)$, so that the following FOC holds

(13) $$\frac{\partial W(x_0)}{\partial x_0} = \sum_{i=0}^{n} b_i \frac{\partial u_i(\bar{x}_0)}{\partial x_0} = 0, \quad b_0 = 1.$$

Since the strength of power and the cost of power are not directly observable, so are the political efficiency frontier and the disagreement point. Although having estimated $\alpha_i(c_i)$ and $\beta_i(c_i)$, the political efficiency frontier and the conflict point may be calculated [see, for instance, Zusman (1976)]. However, such calculations are quite complex. Another route is simply to assert that the b_i's and u_i's depend on z; i.e., $b_i = b_i(z)$ and $u_i = u_i(x_0, z)$. The effect of environmental changes can then be derived by total differentiation of (13) with respect to z; which yields:

(14) $$\sum_{i=0}^{n} \frac{\partial b_i}{\partial z}\left[\frac{\partial u_i(\bar{x}_0, z)}{\partial x_0}\right]' + \sum_{i=0}^{n} b_i \left[\left(\frac{\partial^2 u_i(\bar{x}_0, z)}{\partial z \partial x_0}\right)' + \left(\frac{\partial \bar{x}_0}{\partial z}\right)' \frac{\partial^2 u_i(\bar{x}_0, z)}{\partial x_0\, \partial x_0}\right] = 0$$

where

$\frac{\partial b_i}{\partial z}$ is $k \times 1$, $\frac{\partial u_i}{\partial x_0}$ is $m \times 1$, $\frac{\partial^2 u_i}{\partial z\, \partial x_0}$ is $m \times k$, $\frac{\partial \bar{x}_0}{\partial z}$ is $m \times k$, and $\frac{\partial^2 u_i}{\partial x_0 \partial x_0}$ is $m \times m$

matrices of coefficients. Consequently,

$$\text{(15)}\quad \underset{(k\times m)}{\left[\frac{\partial \bar{x}_0}{\partial z}\right]'} = -\left\{\sum_{i=0}^{n} \underset{(k\times 1)}{\frac{\partial b_i}{\partial z}} \underset{(1\times m)}{\left[\frac{\partial u_i(\bar{x}_0, \bar{z})}{\partial x_0}\right]'} + \sum_{i=0}^{n} \bar{b}_i \underset{(k\times m)}{\left[\frac{\partial^2 u_i(\bar{x}_0, \bar{z})}{\partial z \partial x_0}\right]'}\right\} \underset{(m\times m)}{\left[\sum_{i=0}^{n} \bar{b}_i \frac{\partial^2 u_i(\bar{x}_0, \bar{z})}{\partial x_0\, \partial x_0}\right]^{-1}}.$$

By the second-order conditions of maximum W, the matrix

$$\sum_{i=0}^{n} \bar{b}_i \frac{\partial^2 u_i(\bar{x}_0, z)}{\partial x_0\, \partial x_0}$$

is negative definite and, thus, nonsingular. All terms on the right-hand side of (15), except $\bar{b}_i$ and $\partial b_i / \partial z$, may be calculated using the a priori specifications; the observed values of the exogenous variables, z_t ($\bar{z} = \Sigma_{t=1}^{T} z_t / T$); and the calculated $\bar{x}_0$. As was shown in the preceding section, $\hat{b}_t$ is estimable for every t in the sample period. Hence, $\bar{b}_i$ is calculated as the sample mean ($\bar{b}_i = \Sigma_{t=1}^{T} \hat{b}_{it} / T$). Finally, the functional relation, $b_i(z)$, may be estimated from the sample and $\partial b_i / \partial z$ derived. Consequently, one gets two sets of impact multipliers for the sample period: (a) minimal-theory multipliers, $\partial \hat{\Pi} / \partial z$, and (b) full-political-economic-theory multipliers, $\partial \bar{x}_0 / \partial z$. The political-economic theory is rejected when the two sets of multipliers strongly disagree.

In his analysis of the Senegalese food prices political-economy, Beghin found that "the two approaches give the same impact directions in more than 75 percent of the cases, but the magnitudes differ. The game approach tends to yield larger multipliers" (Beghin, 1990, pp. 145 and 146). Beghin attributes the disparity in the multipliers' absolute values to dynamic effects; that is, the full political-economic theory multipliers abstract from the dynamics of adjustment and constitute long-term responses to environmental changes, while the minimal theory multipliers represent short-term responses.

Thus, both Zusman and Amiad and Beghin found substantial disagreements between the behavior implications of our political-economic theory and the behavior observed in the sample. Both studies suggested alterations in the theoretical specification and interpretation that would make the theory acceptable. Had the proposed theoretical change apply solely to the observed sample as a special case, they should have been regarded as theoretically superfluous *ad hoc* explanations. However, as the proposed theoretical alterations were rather general and, in principle, refutable by tests applied in other sampled environments, the proposed theoretical changes should be viewed as legitimate theoretical contributions. The modified theories should be construed as alternative theories replacing the falsified ones. The theoretical revision and reinterpretation process reported in the cited studies, in fact, demonstrate the importance of the insight provided by our political-economic theory.

4. Policy Instruments and the Negotiation Network

As alluded to earlier, the question of which variables constitute policy instruments and which are endogenous economic variables may be hard to decide. Yet, a researcher studying a particular economy must choose among several candidates. Interestingly enough, the political-economic equilibrium predicted by the theory is invariant under the choice of policy instrument although the implied pattern of political negotiations is significantly affected. The problem is best explained by an example.

Consider the political-economy of a single domestic market for an importable commodity depicted in Figure 2. Domestic demand is represented by the demand curve, $D(P_c)$, and domestic supply the supply curve, $S(P_p)$. The government levies a tariff, t per unit import, and subsidizes consumption at a subsidy s per unit commodity consumed ($t \leq s$). The economic structure comprises the following structural relations:

(16.a) $$q_c = D(P_c),$$ domestic demand

(16.b) $$q_s = S(P_p),$$ domestic supply

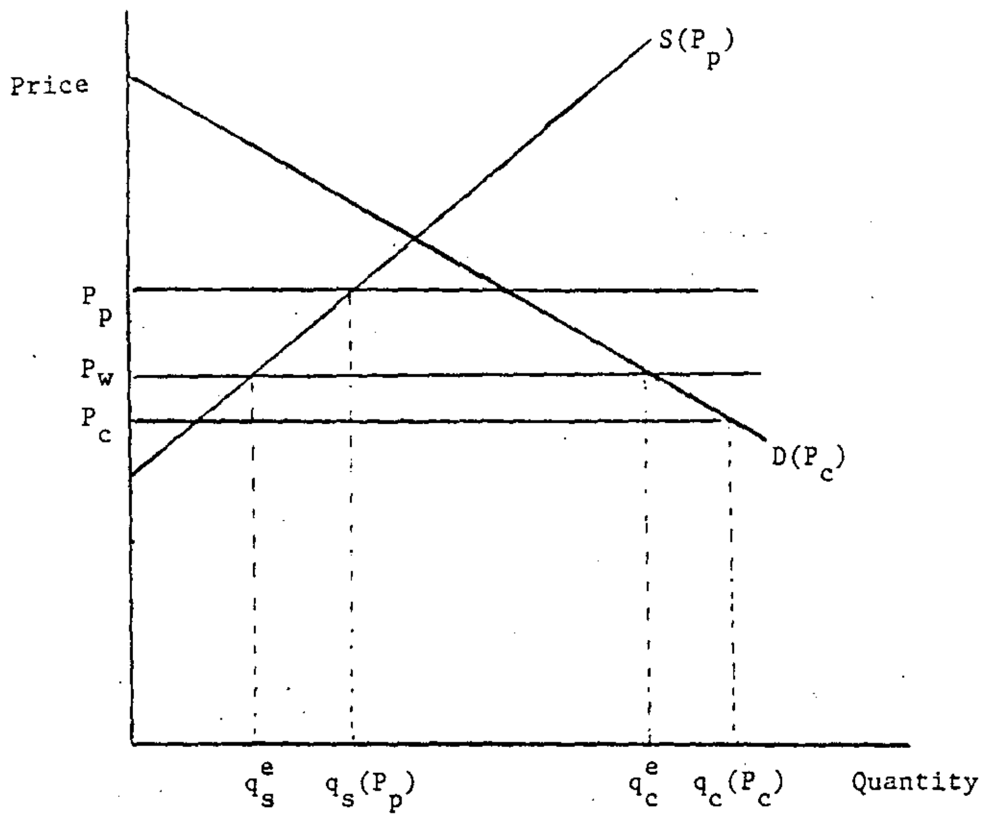


Figure 2. The domestic market for an importable commodity with tariff and consumer subsidy.

(16.c) $q_m = q_c - q_s$, demand for import

(16.d) $P_p = P_w + t$, producer price relation

(16.e) $P_c = P_w + t - s$ consumer price relation,

where q_c and q_s are, respectively, the quantities demanded and supplied domestically; q_m is the quantity imported; P_c and P_p are consumers and producers' price, respectively; s and t are the subsidy and tariff rates, respectively; and P_w is the international market price (cif). Of the seven variables—q_c, q_s, q_m, P_p, P_c, s, and t—two may be designated policy instruments;[5] the other five are endogenous variables determined by the five equations economic structure for given values of the policy instruments.

Let the group configuration consist of the government ($i = 0$) and two organized interest groups: consumers ($i = 1$) and producers ($i = 2$).

Suppose, first, that the tariff, t, and the subsidy, s, were selected as policy instruments. then the groups' policy objective functions relative to a "no tariff ($t = 0$)-no subsidy ($s = 0$)" state are:

(17.a) $$u_0(s, t) = q_m(t, s)\, t - q_c(t, s)\, s$$

(17.b) $$u_1(s, t) = [P_w - P_c(s, t)]\,[q_c^* + q_c(t, s)]/2$$

(17c) $$u_2(s,t) = t[q_s^* + q_s(s,t)]/2$$

where q_c^* and q_s^* are the free trade domestic demand and supply, respectively. Thus, the government seeks to maximize its net revenue, while consumers and producers seek to maximize the consumer surplus and the producer surplus, respectively.

Note that there are two policy instruments and two organized interest groups (i.e., $m = n$) so that b is just identified. Consider the matrix $K(s, t)$; the algebraic signs of the $k_{ij}(s, t)$ are presented in Table 1.

Suppose next that t and P_c are selected as policy instruments while s becomes an endogenous variable whose value is determined by equation (16.e). The policy objective functions, (17.a)-(17.c), are the same as before but with an appropriate change in variables; that is, the same functions are now expressed in terms of policy instruments (t, P_c) rather than (s, t). The algebraic signs of the coefficients $k_{ij}(t, P_c)$ are presented in Table 2.

The algebraic signs in $K(s, t)$ and $K(t, P_c)$ indicate the changes in each policy instrument desired by the particular interest group. Examining Table 1, one finds that the government and the producer group wish to raise the tariff rate, t, while consumers are interested in a lower tariff (i.e., $k_{02}(s, t)$, $k_{22}(s, t) > 0$, $k_{12}(s, t) < 0$). However, when t and P_c are the policy instruments, consumers are interested only in the consumer price, P_c, and, given P_c, are indifferent with respect to the tariff rate, t. The change in the government's preferences at the political-economic equilibrium is more dramatic, since it now prefers a lower tariff because the net effect of tariff reduction is to increase the government's net revenue: for a given import, q_m, and consumer price, P_c, a decline in tariff revenue would be more than compensated by the savings in subsidy cost and, in addition, there will be an increase in imports due to lower domestic supply. Hence, a lower tariff rate will unambiguously increase government net revenue, and vice versa. These effects are reflected in $K(t, p_c)$ (Table 2), where $k_{01}(t, P_c) < 0$ and $k_{11}(t, P_c) = 0$. The associated change in the political negotiation network is presented in Figure 3. Thus, the "all channel network" prevailing under policy instruments (s, t) (Figure 3a) is supplanted by a "wheel network" when (t, P_c) serve as policy instruments (Figure 3b). That is, in the former case, all interested parties negotiate simultaneously while, in the latter case, negotiations split: The government bargains with each of the organized interest groups separately. Since a "wheel network" entails lower political-economic transaction costs than the "all channel network," it is reasonable to expect that the "wheel negotiation network" will

Table 1

The Algebraic Signs of $K(s, t)$

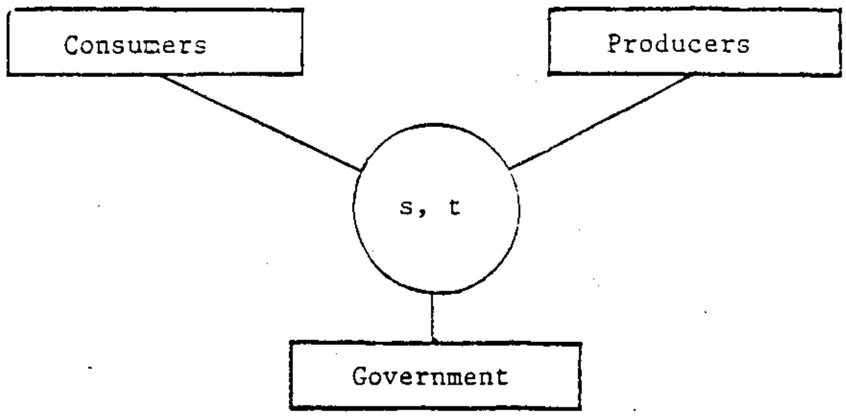
Policy objective functions	Policy instruments	
	s	t
u_0	-	+
u_1	+	-
u_2	0	+

Table 2

The Algebraic Signs of $K(t, P_c)$

Policy objective functions	Policy instruments	
	t	P_c
u_0	-	+
u_1	0	-
u_2	+	0

(a) Policy instruments are (s, t)



(b) Policy instruments are (t, P_c)

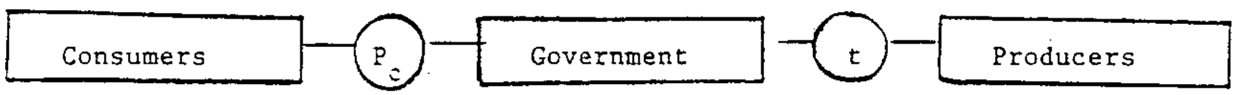


Figure 3. Policy instruments and the negotiation network.

preferred by the parties so that (t, P_c) will be selected as policy instruments.[6] It should be emphasized, in this respect, that the resulting political-economic equilibrium does not depend on the choice of policy instruments; that is, the political-economic equilibrium values of q_c, q_s, q_m, P_p, s, and t will be the same under any choice of policy instruments.

Footnotes

[1]For additional arguments in favor of "structural" as compared to "reduced form" prediction mechanisms, see, also, Abbott (1979a, 1979b) and Beghin (1990).

[2]The foregoing discussion brings out another important problem: How is the mix of policy instruments determined? The present theory should, in principle, be capable of answering this question. Intuitively, the political economic equilibrium should be obtained by finding a mix of policy instruments, x_0, with values $\bar{x}_0$, maximizing the policy governance function, $W(x_0)$, over all feasible instrument mixes and values. While suggestive of a possible partly informal solution procedure, a strictly formal formulation and solution algorithm may necessitate a revision of the topological characterization of the space of feasible policy instruments, X_0. In the rest of this paper, x_0 refers to a given prespecified instrument mix.

[3]In the present context, the term, "efficiency" is to be understood in the narrow sense of the specified political bargaining game. An efficient solution in the narrow sense may still be economically inefficient in a broader welfare context (see discussion in Zusman and Rausser (1990a). Unless otherwise stated, the present qualification applies in the rest of the paper.

[4]The efficiency loss test was developed and explicitly used by Zusman and Amiad (1977). The "sample impact multipliers test" was developed and employed by Beghin (1990).

[5]To qualify as policy instruments, variables should be readily monitored by all parties concerned and easily controlled by the policy-making center. The quantity variables are, therefore, less likely candidates for the status of policy instruments.

[6]Note that (P_p, P_c) could, also, serve as policy instruments with t becoming an endogenous variable whose value is determined by the economic structure (16.a)-

(16.e). As the corresponding negotiation pattern is also a "wheel network," P_p and P_C are equal contenders to t and P_c for the role of policy instruments.

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