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ENDOGENOUS TARIFF POLICY UNDER UNCERTAINTY

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The past decade has been marked by considerable progress in the modelling of important aspects of tariff determination. One segment of the literature has focused on the role of either governments or firms acting strategically.[1] A second group of studies has dealt with the political economy aspects of tariff policy, focusing on the actions of self-interested voters, lobby groups, and policy makers in the process of tariff determination.[2] In this paper we model tariff policy as the outcome of a process in which governments act strategically and are assumed to choose their tariffs based on one of several possible political objectives. By doing this we can analyze an aspect of tariff determination largely ignored by theoretical trade models[3]--uncertainty on the part of a government as to the policy (or objective, for that matter) of foreign governments.

The practical importance of this type of uncertainty has been emphasized in recent normative analyses of tariff policy (Dixit (1986) and Richardson (1986)) and historical accounts of U.S. tariff policy (Baldwin (1986), Ratner(1972)). The fact that each of the three branches of the U.S. federal government has constitutional powers relating to international trade policy makes it uncertain which branch will ultimately determine tariff policy. Moreover, as Baldwin (1986) discusses at length, the extent to

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1 In a competitive framework, Mayer (1981), Riezman (1982), and Thursby and Jensen (1983) have provided models capable of explaining why observed tariffs may be lower than estimated optimum tariffs either when governments negotiate for tariff cuts or when governments set tariffs which are optimal given the anticipation of retaliation. Alternatively, Brander and Spencer (1981, 1984) and others have shown that in the presence of imperfect competition, governments have an incentive to impose trade restrictions in order to extract foreign rents. For reviews of this literature see Grossman and Richardson (1984, 1985), Deardorff and Stern (1986), and Dixit (1985).

2 For examples see Baldwin (1976, 1982, 1984), Brock and Magee (1978, 1980), Feenstra and Bhagwati (1982), Findlay and Wellisz (1982), Magee and Young (1986), Mayer (1984a and b), Wilson and Wellisz (1986), Young and Magee (1986).

3 For analyses of other types of uncertainty see Anderson and Young (1982), Cassing, Hillman, and Long (1985), Eaton and Grossman (1985), Newbery and Stiglitz (1984), Young and Anderson (1980, 1982), and Young and Magee (1984).

which each of the branches has exercised its powers has varied greatly over time. Even if we knew with certainty which branch would determine tariff policy, there are several other factors which make it difficult to predict policies <u>ex ante</u>. First, there are numerous groups within the economy lobbying in their best interest; second, these groups try to influence decisions on a multiplicity of issues; and finally, there are multiple decision makers influencing the policy choices of a given branch. Any one of these factors would be sufficient to make a foreign government uncertain about U.S. tariff policy objectives, <u>ex ante</u>. The interesting question, theoretically and empirically, is what we can say systemmatically about tariff policy in such an environment. Baldwin's (1986) study is a comprehensive empirical analysis of the factors affecting policy decisions of each of the government branches. The current paper presents a theoretical model of how uncertainty underlying the process of tariff formation affects policy outcomes.

We model trade in a two country world in which each country can affect its terms of trade. The foreign government is assumed to maximize an index of aggregate utility, redistributing income. On the other hand, the objective of the home government is not known with certainty. Because income redistribution is costly, it might choose to leave income shares unaffected by the distribution of tariff revenue and to levy the tariff preferred by a particular group within the economy. For the reasons given above, it is not certain which group the government will favor, so that the home government's objective function can be viewed as a random variable. We examine the Nash equilibrium tariffs of several Bayesian games in which the foreign government has a prior distribution on the possible home country's objectives.

For simplicity, we focus on two groups the home government might favor with respect to tariff policy, one of which is assumed to prefer a higher tariff than the other. In practice it is easy to think of examples of groups desiring different levels of protection. In Section 1 we present several representative examples of tariffs which would be favored by groups (and/or individuals) in Heckscher-Ohlin and specific factor models which are large country extensions of Mayer (1984a, 1984b). In Section 2 we analyze the equilibrium tariffs in a static (one-shot) game in which the group favored by the home government is determined stochastically, and in Section 3 we examine the welfare implications of this type of uncertainty for both the home and foreign country. As one example, when the home government favors a low tariff group, both this group and those who preferred higher tariffs gain from the uncertainty, and the foreign country loses.

A question frequently addressed in the recent normative policy studies (see, for example, Dixit (1986) and Richardson (1986)) is how reputations of governments affect the path of observed policies over time. We address this issue by examining the subgame perfect equilibria of a multistage game in which the government mechanism for deciding tariff policy at any stage is stochastic. One result we obtain is that when the home government adopts the objective associated with a higher tariff in two periods, the effect is to increase utility of some home individuals (and possibly all) since the reputation effect leads to a higher home tariff and lower foreign tariff in equilibrium. A second result is that the uncertainty about the home country's political process can lead to observed tariff cycles. This result is interesting given observed changes in policy outcomes over time (see Baldwin (1986)). Moreover, it occurs even if all trading equilibria are unique and stable, so that it is more appealing intuitively than the justification for Johnson's tariff cycles (1953-54).

1. Objective Functions of Alternative Groups Within the Home Country

In this section we give examples of alternative objective functions and show that, in general, they imply different tariffs than the standard optimum tariff implied by maximization of an aggregate utility index. Whether the model is Heckscher-Ohlin or specific factor, tariff preferences of individuals and/or groups will differ from each other and from the standard optimum whenever factor endowments are unevenly distributed .

A. The Standard Optimum Tariff

Consider a two country world in which the home country exports commodity 2 and imports commodity 1 from the foreign country. Each country can affect its terms of trade by a tariff on imports (denoted by t for the home country and t* for the foreign country), and this is the only price distortion in the model. Markets in both countries are perfectly competitive, production possibility curves are strictly concave to the origin, and within the relevant range of tariffs production is incompletely specialized. The home country's standard optimum tariff is determined by maximizing an aggregate utility index subject to a balance of payments constraint and the foreign offer curve. In indirect form, the home country's utility is given by

$$V = V(p,Y) \tag{1}$$

where $p = \pi(1 + t)$ is the home price of good one in terms of good two and Y is home income given by

$$Y = pX_1 + X_2 + t\pi M \tag{2}$$

where X_j denotes industry output of good j, j=1,2, t is the tariff rate on commodity 1, π is the world price of good one in terms of good 2, M is the quantity imported of good 1,.

To find the optimum tariff we substitute (2) into (1) and totally differentiate to obtain

$$dV = V_Y(\pi t dM - M d\pi) \tag{3}$$

where V_Y is the marginal utility of income,

$$dM = [(\varepsilon^* - 1)/\Delta](\partial M/\partial t)dt + (\varepsilon/\pi\Delta)(\partial M^*/\partial t^*)dt^* \tag{4}$$

$$d\pi = [(\pi/M)(\partial M/\partial t)/\Delta]dt - [(\pi/M^*)(\partial M^*/\partial t^*)/\Delta]dt^* \tag{5}$$

$\Delta \equiv \varepsilon + \varepsilon^* - 1 > 0$, $\varepsilon \equiv -(\pi/M)(\partial M/\partial \pi) > 0$, $\varepsilon^* \equiv (\pi/M^*)(\partial M^*/\partial \pi) > 0$, and use is made of the balance of payments $\pi M(\pi,t) = M^*(\pi,t^*)$. Assuming V is strictly concave in t, the standard optimum tariff is given by

$$\partial V/\partial t = V_Y M^* \beta[1 - t(\varepsilon^* - 1)]/\Delta(1 + t) = 0 \tag{6}$$

where $\beta \equiv -[(1+t)/M](\partial M/\partial t) > 0$.[4]

B. The Median Voter's Optimum Tariff in a Heckscher-Ohlin Model

Alternatively, suppose that because income redistribution is costly, tariff revenue is distributed neutrally (i.e., it does not affect income shares of individuals). Then tariffs will benefit or harm individuals according to their factor endowments and the production structure. We assume factor ownership is given and that each individual owns one unit of labor and a non-negative amount of capital. The model is Heckscher-Ohlin in that all markets are perfectly competitive, factors are mobile between sectors, production functions exhibit constant returns to scale, and, as before, production is incompletely specialized within the relevant range of tariffs. With the exception of terms of trade effects, these assumptions correspond to those of Mayer (1984a).

4 This derivation follows work of Mayer (1981) and Jones (1969).

Each individual owns $L^i = 1$ and $K^i \geq 0$ where $K = \Sigma_i K^i$ and L denote capital and labor supplies, and the superscript i refers to ownership by individual i, i=1,...,I. Total income of an individual is given by

$$y^i = w + rK^i + T^i \tag{7}$$

where w and r denote returns to labor and capital, respectively, and T^i denotes tariff revenue received by the ith individual. Since tariff revenue is distributed neutrally, it does not affect an individual's income share from factor ownership. That is, $T^i = \phi^i t\pi M$ where ϕ^i is the ith individual's income share from factor ownership given by

$$\phi^i = (w + rK^i)/(wL + rK) \quad . \tag{8}$$

Finally, individuals are assumed to have identical, homothetic preferences given by the indirect utility function,

$$V^i = V^i(p, \phi^i Y) \tag{9}$$

where Y is total home income given by (2) or

$$Y = wL + rK + t\pi M. \tag{10}$$

To obtain the effect of a tariff change on an individual's utility, we substitute (10) and $p = \pi(1 + t)$ into (9) and totally differentiate to obtain

$$dV^i = V_y^i[\phi^i(t\pi dM - Md\pi) + Yd\phi^i] \tag{11}$$

where V_y^i is the ith individual's marginal utility of income,

$$Yd\phi^i = \delta^i[(1 + t)d\pi + \pi dt] \tag{12}$$

$$\delta^i = [YwLr(k - k^i)(\hat{w} - \hat{r})]/[\hat{p}\pi(1 + t)(wL + rK)^2] \tag{13}$$

where k = K/L and ˆ denotes percentage change. After substitution of (4) and (5) for dπ and dM and some algebraic manipulation, the optimum tariff for individual i is given by

$$\partial V^i/\partial t = \frac{V_y^i M^*}{\Delta}\left[\frac{\phi^i \beta[1-t(\varepsilon^*-1)]}{1+t} - \frac{\delta^i(\Delta-\beta)}{M}\right] = 0 \tag{14}$$

where $\Delta-\beta>0$ if the Metzler paradox does not hold.

Two points are worth noting. First, the economic interest of an individual with regard to any tariff can be indexed by his/her factor endowment. Standard comparative statics shows that the individual's optimum tariff is an increasing (decreasing) function of k^i if and only if the import good is capital (labor) intensive.[5] Second, the home tariff which solves (14) given any t^* differs from the standard optimum ($t_o = 1/(\varepsilon^*-1)$ which solves (6)) only when $\delta^i \neq 0$. From (14) if $\delta^i>0$ (<0), then $\partial V^i/\partial t>0$ (<0)at t_o, so that individual i's optimum tariff must be greater (less) than t_o. From (13) $\delta^i> 0$ (<0) if the home import good is capital intensive and $k^i> k$ ($k^i<k$) or if the import good is labor intensive and $k^i< k$ ($k^i>k$).

Suppose we were to consider the tariff which would be determined by majority voting if the tariff were the single election issue. Assuming no voting costs, and consequently, no free-rider problems, the uniqueness of each person's optimum tariff implies that the home equilibrium tariff under majority voting would be the tariff that is optimal for the median voter. Which voter is the median in this model would depend on the distribution of factor endowments and voter eligibility rules. Following Mayer (1984a, Section IIB), we assume there are no restrictions on voting and that factor endowments are unevenly distributed. That is, the k^i for $i=1,\dots,I$ are distributed according to a nondegenerate distribution F whose mean is the economy's capital-labor ratio $k=K/L$. Assuming that F is unimodal, it follows that the median voter is the person whose relative factor endowment k^m is the median of F. As long as the distribution is skewed, $k^m \neq k$, so that the median voter will prefer a tariff different from the standard optimum. Moreover, the only individual who prefers the standard optimum

5 This monotonicity result is unaffected by changes in the foreign tariff.

under these assumptions is the average voter. Therefore the median voter will prefer a lower (higher) tariff than the average voter (i.e. standard optimum) if he/she is relatively well endowed with the factor which is used intensively in the export (import) industry.

C. Optimal Tariffs for Lobbies in a Specific Factor Model

In this section we show that in specific factor model, as well, lobbies for export and import competing industries will tend to prefer tariffs other than the standard optimum. Since our purpose is merely to give examples of alternative objective options facing the government, we abstract from the formation and maintenance of lobbies, and associated free rider problems. We take their existence as given, and follow Mayer(1984b) in assuming a lobby maximizes the real income, or utility, of its average member. As in the previous section, factor ownership is assumed to be given and income shares of individuals (and, hence, lobbies) are determined solely by endowments and the returns to factor ownership.

Each individual owns one unit of a factor which is mobile between sectors, F_N, and a non-negative amount of one of two specific factors, F_j, j=1,2; so $F_N^i=1$ and $F_j^i \geq 0$ (where equality holds for one j) for i = 1,...,I. Individuals have identical utility functions specified by Mayer (1984b) in indirect form as

$$V^i = V_y^i(y^i - c^i) \tag{15}$$

where c^i represents lobbying costs to individual i[6], and

$$y^i = R_j F_j^i + R_N + t\pi M \tag{16}$$

[6] The free rider problem could be accounted for by noting that it raises c^i to members of the lobby and therefore reduces the optimum tariff below the level preferred without free riding.

where R_j and R_N are returns to the jth specific factor and the mobile factor, repectively. Given the assumption that income shares are not affected by tariff revenue distribution, y^i can also be written as $\Phi^i Y$ where

$$\Phi^i = (R_j F_j^i + R_N)/(\Sigma_{j=1}^2 R_j F_j + R_N F_N) \tag{17}$$

and Y is given by (2), $F_j = \Sigma F_j^i$, $F_N = \Sigma F_N^i$.

Consider a lobby composed of F_{Nj} owners of specific factor j. The indirect utility function of the average member would be

$$V_j^L = (V_y^i/F_{Nj})(\Phi_j^L Y - C_j) \tag{18}$$

where C_j represents lobbying costs for industry j's lobby and

$$\Phi_j^L = (R_j F_j + R_N F_{Nj})/(\Sigma_{j=1}^2 R_j F_j + R_N F_N) \tag{19}$$

is the lobby's share in total income. If lobby membership is assumed constant, the total derivative of (18) is given by

$$dV_j^L = (V_y^i/F_{Nj})[\Phi_j^L(t\pi dM - Md\pi) + Yd\Phi_j^L + (\Phi_j^L - \Phi_{dj}^L)Ddp - dC_j] \tag{20}$$

where D represents aggregate home demand for its import good and Φ_{dj}^L is lobby j's share of total disposable income.[7] Given any foreign tariff, the optimal tariff for the lobby is derived by substituting dM and dπ from (4) and (5) and solving

$$\partial V_j^L/\partial t = \frac{V_y^i}{F_{Nj}}\frac{M^*}{\Delta}\left[\frac{\Phi_j^L\beta(1 - t(\varepsilon^* - 1)}{(1 + t)} + \frac{\delta_j^L(\Delta - \beta)}{M}\right] - \frac{V_y^i}{F_{Nj}}(dC_j/dt) = 0 \tag{21}$$

where $\delta_j^L = \{Yd\Phi_j^L/dp + (\Phi_j^L - \Phi_{dj}^L)D\}$ and $(\Delta - \beta) > 0$.

Thus the extent to which an industry in this model will lobby for a tariff different from the standard optimum depends on the income distributional effects of a change in the home relative price of imports and the cost of lobbying for that tariff. Since $d\Phi_1^L/dp>0$ and $d\Phi_2^L/dp<0$, a lobby

7 See Mayer (1984b) for more extensive derivation and discussion. We allow more than one one lobby, hence $(\Phi_j^L - \Phi_{dj}^L) = \Phi_j^L - (\Phi_j^L Y - C_j)/(Y - \Sigma C_j)$ rather than his expression on p. 429.

for the import competing (export) industry will push for a higher (lower) tariff than t_o as long as that effect outweighs any adverse cost effects.

2. A Static Bayesian Tariff Game

In this section we assume that actual home tariff policy is determined by a domestic political process,the outcome of which is uncertain. That is, while we can identify the tariffs preferred by various individuals within the economy, we do not know with certainty who will decide on tariff policy (because of constitutional checks and balances or, perhaps, because of an upcoming election), or we do not know with certainty which tariff objective they will choose because of policy issues outside the model. In any of these cases, we can think of an exogenous probabilistic mechanism determining actual tariff objectives. We model the problem as a game of incomplete information played by Bayesian players (Harsanyi (1967)).

We consider two possible outcomes of the political process in the home country, a low or high tariff. In the case of the Heckscher-Ohlin model, it might be uncertain whether the home government imposes the median voter's optimum tariff or whether it redistributes income and imposes the standard optimum tariff. In describing that case we shall focus on the case where the median voter's optimum tariff is lower than the standard optimum (i.e., average voter's optimum tariff). Although this is only one possible case in the Heckscher-Ohlin model, it has a convenient interpretation which is consistent with empirical results of Baldwin (1986). In the case of U.S. policy, the Congress has tended to be more protectionist than the President. Moreover, the Congress is well known for income redistribution schemes, whereas the President can be thought of as being the only elected official who answers to the public at large. Hence, we might think of this example pertaining to the Congress favoring the standard optimum and the President favoring the median voter's tariff, with uncertainty, ex ante, as to which branch will ultimately determine the tariff. Alternatively, we might think of one political party favoring the average voter and the other the median voter in regard to the tariff issue with the outcome of an election uncertain, ex ante.[8] In the case of the specific factor model, we focus on the tariffs preferred by an import lobby and an export lobby as the possible outcomes. Again, while this is only one of the possible comparisons in that model, it is appealing given the empirical observation that import lobbies tend to argue for more protectionist policies than export lobbies, and, ex ante, it is uncertain which lobbies will be favored with regard to tariffs.

This is a simultaneous move game, so that at the time tariffs are chosen only the home government knows which individual's optimal tariff it will impose. The foreign government is known to maximize an index of aggregate utility. To solve the game we assume the foreign country is a Bayesian with a prior distribution on the possible outcomes of the home country political process (i.e., low or high tariff) and that this distribution is common knowledge (i.e., each country knows the distribution, each knows that the other country knows the distribution, and that the other knows it knows, and so on). We denote the common knowledge probability that the home government will impose the low tariff by α and the probability that it will impose the high tariff by $(1-\alpha)$. Formally, the foreign country's strategy is a choice of a tariff t^* from T^*, a closed interval of the real line. The home country's strategy, however, is a mapping from the set of possible types into T, also a closed interval, or $t:\{l,h\}\rightarrow T$, where l denotes

8 See Baldwin (1986) and Magee and Young (1986) concerning when Democrats and Republicans favored high or low tariffs.

low tariff and h denotes high tariff. That is, the home strategy is type contingent, depending on whether the domestic political process requires it to maximize the utility of the low or high tariff person.[9] Given any feasible triple of tariffs $(t(l),t(h),t^*)$, the expected payoff to the foreign country from the game is

$$U^*(t(l),t(h),t^*) = \alpha V^*(t(l),t^*) + (1-\alpha)V^*(t(h),t^*) \tag{15}$$

where $V^*(t(\cdot),t^*)$ is the foreign indirect utility function, which can be derived from a function analogous to (1) for the home country. The payoff to the high tariff person at home is denoted by $V^h(t(h),t^*)$, where V^h in the Heckscher-Ohlin model is the aggregate home indirect utility function or that of the average person, and in the specific factor model it is the indirect utility function of the average import lobby member. The payoff to the home low tariff person is denoted by $V^l(t(l),t^*)$ where V^l is the median voter's indirect utility function in the Heckscher-Ohlin model and the indirect utility of the average member of the export lobby in the specific factor model. In addition to to the assumption that each indirect utility function is strictly concave in its own tariff, we assume each has a negative second cross partial derivative (i.e., the marginal utility of the own tariff is decreasing in the opposing country's tariff).

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9 Two points bear mention. First, the model can be extended to more than two outcomes, but this complicates the analysis and exposition without substantively altering the results. Second, an alternative way to model the problem would be to have the home government choose a tariff to maximize a weighted average of the utilities of the groups. Uncertainty could be introduced by making these weights random variables. This approach is more cumbersome because the home objective function for each possible set of weights is a weighted average of the possible indirect utility functions. Moreover, if we assumed only two possible sets of weights, then the existence results would be qualitatively similar to those we state, although the exposition and analysis of welfare changes would be more complicated.

The Nash equilibrium for this Bayesian game is then a triple of tariffs $(t(l,\alpha),t(h,\alpha),t^*(\alpha))$, written as a function of α to denote the dependence of the equilibrium on the underlying uncertainty, such that

$$V^l(t(l,\alpha),t^*(\alpha)) \geq V^l(t,t^*(\alpha)) \qquad \text{for all } t\varepsilon T$$

$$V^h(t(h,\alpha),t^*(\alpha)) \geq V^h(t,t^*(\alpha)) \qquad \text{for all } t\varepsilon T$$

$$U^*(t(l,\alpha),t(h,\alpha),t^*(\alpha)) \geq U^*(t(l,\alpha),t(h,\alpha),t^*) \qquad \text{for all } t^*\varepsilon T^*.$$

Notice that the equilibrium must specify the strategies of both possible home types as well as the foreign tariff, since otherwise the foreign country would not be able to solve its problem in equilibrium.

It is helpful to first analyze the outcomes of the two possible certainty games. Suppose it is common knowledge that the home government will impose the high tariff with certainty, or $\alpha=0$. Then we have a standard Nash equilibrium (t_h,t_h^*) given by the intersection of the reaction functions $r_h(t^*)$ and $r^*(t)$, which are defined implicitly by the equations $\partial V^h/\partial t = 0$ and $\partial V^*/\partial t^* = 0$. Under our assumptions on V^h and V^*, both reaction functions are negatively sloped, the slope of the composite best response function $r_h(r^*(t))$ is less than one, and the equilibrium is unique and locally stable. Conversely, suppose that it is common knowledge that the home government will impose the low tariff with certainty, or $\alpha=1$. Then the Nash equilibrium is (t_l,t_l^*), given by the intersection of the reaction functions $r_l(t^*)$ and $r^*(t)$, where $\partial V^l/\partial t = 0$ implicitly defines $r_l(t^*)$. Under our assumptions on V^l, the home government's reaction function is negatively sloped, the slope of the composite reaction function $r_l(r^*(t))$ is less than one, and the equilibrium is unique and locally stable. These equilibria are depicted in Figure 1. The assumptions made for these two certainty games are sufficient to prove the existence of a unique and locally stable equilibrium for the Bayesian game.

<u>Theorem 1</u>. There exists a unique and locally stable Bayesian equilibrium $(t(l,\alpha),t(h,\alpha),t^*(\alpha))$ such that for any given $\alpha\varepsilon(0,1)$: $t_l < t(l,\alpha) < t(h,\alpha) < t_h$, $t_h^* < t^*(\alpha) < t_l^*$, $t(l,\alpha)$ and $t(h,\alpha)$ are decreasing in α, and $t^*(\alpha)$ is increasing in α.

Proof. A Bayesian equilibrium exists if there exists a $t^*(\alpha)$ such that $f(t^*(\alpha)) = 0$, where

$$f(t^*) = \alpha[\partial V^*(r_l(t^*),t^*)/\partial t^*] + (1-\alpha)[\partial V^*(r_h(t^*))/\partial t^*]. \tag{16}$$

Since $\partial^2V^*/\partial t\partial t^* < 0$ and $r_l(t_h^*) < r_h(t_h^*) = t_h$, it follows that $f(t_h^*) = \alpha[\partial V^*(r_l(t_h^*),t_h^*)/\partial t^*] > 0$. Similarly, since $r_h(t_l^*) > r_l(t_l^*) = t_l$, $f(t_l^*) = (1-\alpha)[\partial V^*(r_h(t_l^*),t_l^*)/\partial t^*] < 0$. Now observe that

$$f'(t^*) = \alpha[(\partial^2V^*/\partial t\partial t^*)r_l'(t^*) + (\partial^2V^*/\partial t^{*2})] + (1-\alpha)[(\partial^2V^*/\partial t\partial t^*)r_h'(t^*) + (\partial^2V^*/\partial t^{*2})].$$

Notice that the condition for uniqueness and local stability of the Nash equilibrium of a certainty game between the foreign government and the home government imposing the low tariff, namely $r_l'(r^*(t))r^{*\prime}(t) < 1$, implies that the expression in the square brackets of the first term of $f'(t^*)$ is negative. The condition for uniqueness and local stability in the certainty game between the foreign government and the home government imposing the high tariff similarly implies that the expression in square brackets in the second term of $f'(t^*)$ is negative. Together these imply that $f'(t^*) < 0$, which completes the proof of existence (in pure strategies), uniqueness, and local stability. It also shows that $t_h^* < t^*(\alpha) < t_l^*$, and therefore that $t_l < t(l,\alpha) < t(h,\alpha) < t_h$ since $\partial^2V/\partial t\partial t^* < 0$, $r_l'(t^*) < 0$, and $r_h'(t^*) < 0$. That $t^*(\alpha)$ is increasing in α follows from $f'(t^*) < 0$ and the fact that $\partial^2V^*/\partial t\partial t^* < 0$ and $r_l(t^*) < r_h(t^*)$ imply $\partial f/\partial\alpha > 0$. This plus the negatively sloped reaction function of each home type proves that $t(l,\alpha)$ and $t(h,\alpha)$ are decreasing in α. Q.E.D.

Figure 1 shows the result of Theorem 1 in the standard reaction function framework. Given $t^*(\alpha)$, $t(l,\alpha)$ and $t(h,\alpha)$ are determined by the intersection of the horizontal line at $t^*(\alpha)$ with $r_l(t^*)$ and $r_h(t^*)$. Since $t^*(\alpha)\varepsilon(t_h^*,t_l^*)$, we must have $t_l < t(l,\alpha) < t(h,\alpha) < t_h$. Uncertainty in the mind of the foreign country about the outcome of the home country political process leads it to use a tariff lower than that it would use if it knew the home government were going to impose the low tariff, but higher than that it would use if it knew the home government were going to impose the high tariff. Because the home government knows that the foreign government is uncertain, it also uses a different tariff whatever the actual outcome of the political process. A process favoring the low tariff group will involve a higher tariff than if the foreign government knew the outcome, and a process favoring the high tariff group will involve a lower tariff than the certainty outcome.

Now consider an increase in the probability that the home government will impose the low tariff. Since $r_l(t^*) < r_h(t^*)$ and $\partial^2V^*/\partial t\partial t^* < 0$, this increases the expected marginal payoff to the foreign country and leads it to increase its tariff. This shifts up the horizontal line at $t^*(\alpha)$ and so leads to lower tariffs in equilibrium for both home outcomes.

Finally, given the attention in previous literature to the Nash equilibrium of a static game in which the governments levy the standard optimum tariff, it is worth discussing how the Bayesian equilibrium in our Heckscher-Ohlin model compares. Notice that in both the median voter and the standard optimum outcomes, the home tariff in equilibrium is less than in the certainty equilibrium in which both governments levy the standard optimum (i.e. (t_h,t_h^*) in that model). This is consistent with Hamilton and Whalley's (1983) results that observed tariffs tend to be less than estimated Nash equilibrium standard optimum tariffs. In order to obtain the result that the foreign tariff in the Bayesian model is also less than the standard optimum, either of two approaches can be taken. The simplest is to assume that the foreign government levies its median voter's tariff with certainty and that factor endowments are such that the median voter prefers a lower tariff than the standard optimum. The other would be to drop our assumption that the foreign government's objective is known with certainty. As shown in Appendix A, in a model where the foreign government levies its median voter's tariff with probability β and a higher standard optimum with probability $(1-\beta)$, for high enough values of α and β, both foreign and home tariffs are less than the certainty Nash equilibrium tariffs.

3. Welfare Effects

A natural question to ask is who gains and who loses from the existence of this type of uncertainty.[10] As one might expect some individuals lose and some gain; but interestingly, if the ex post outcome is the home country actually imposing the low tariff, even those individuals who lobbied for (or preferred) a higher tariff gain from the uncertainty. The results are summarized in the following propositions, which are stated without proof since they follow directly from Theorem 1 and the assumptions on utility functions.

Proposition 1. Suppose the low tariff is the ex post outcome of the home political process. Then compared to the outcome which would have occurred if there were no uncertainty, the possibility that the high tariff might have been imposed increases the utility of both the low and high tariff individuals and decreases the welfare of the foreign country.

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10 In a different context, Dixit(1986) and Richardson (1986) have addressed the issue of whether the U.S. would be better or worse off if it were to become more predictable in its trade policy.

Proposition 2. Suppose the high tariff is the ex post outcome of the home political process. Then compared to the outcome which would have occurred if there were no uncertainty, the possibility that the low tariff might have been imposed decreases the utility of the high tariff person. Depending on their tariff indifference curves (TICs), the low tariff person and the foreign country may gain or lose.

These results can be seen easily from Figure 2. Note that the reaction functions are the loci of the maximum points on tariff indifference curves for the respective home country individuals and the foreign government. A tariff indifference curve for an individual in the home country shows those pairs of tariffs, home and foreign, which provide the same utility to that person.[11] A TIC is concave in its own tariff, and it follows from the assumptions on the utility functions that lower TICs correspond to higher utility since this means reducing the foreign tariff for a given home tariff. Hence the utility of a home individual increases as you move southeast along its reaction function. Foreign TICs have analogous properties with respect to the foreign tariff, so that in the figure a higher subscript on a TIC denotes higher utility. A comparison of TICs at points a and b illustrates Proposition 1 since a is the equilibrium of a game in which the home government is known with certainty to impose the low tariff and b is the equilibrium outcome of the Bayesian game when the home government actually imposes the low tariff. Both low and high tariff individuals are better off at b than a since the uncertainty induces the foreign government to levy a lower tariff than if it had known the home government was going to impose the low tariff. If we were to draw TICs with the usual properties through points c and d, we could illustrate Proposition

11 See Mayer (1981) on the derivation of TICs.

2. It is clear that the TIC^h passing through c (the Bayesian equilibrium outcome when the home government actually imposes the high tariff) will indicate lower utility that the one passing through d (the certainty equilibrium with a high tariff home government). It is also clear that the welfare implications of the high tariff outcome for the low tariff individual and the foreign country will vary depending on the particular slopes of TIC^l and TIC^* through c and d.

To see the practical importance of these results, suppose the home government were to consider legislating a change in tariff-making procedures so as to reduce uncertainty about its policy. For example, in the specific factor model it might consider a rule of adopting either the export or import lobby's optimal tariff. If it were to adopt a rule of always levying the export lobby's tariff, the converse of Proposition 1 says that both lobbies would be worse off compared to the situation where there is uncertainty. On the other hand, if the home government intends to adopt the import lobby's optimal tariff, the converse of Proposition 2 says that a rule is preferred to uncertainty because the foreign government will levy a lower tariff if it knows with certainty that the home country tariff will be the import lobby's optimal tariff.

4. Repetition and Reputation

We now analyze a multistage (stochastic) game with N stages, where N is a large but finite positive integer. At every one of the N plays of the tariff game there is uncertainty as to which individual's tariff the home government will levy (i.e., the government mechanism for determining tariff policy is stochastic). One way to think about this uncertainty is that because of multiple policy issues or repeated elections, there are factors outside the model which make the utility function maximized by the home government at any play a random variable. Although there is uncertainty at any date as to the government behavior, we assume that if the game has a large enough number of stages, then there is a true proportion of times the government will maximize the low tariff individual's utility. It is reasonable to assume that this true proportion is not known at the beginning of the game, so that Bayesian players will assume some prior and update it as they observe which individuals' tariffs are actually used. This notion of persistent uncertainty and policy determination allows us to analyze how past behavior of the home country, which can be thought of as its reputation, affects current plays of the game.

In this section we focus only on the Heckscher-Ohlin model. There are two reasons for this. One is that the Heckscher-Ohlin production structure is more appropriate for analyzing long-run situations, while the specific factor model is more appropriate for the short-run. The second is that in order to model a dynamic game with lobbies, one needs to know how campaign contributions (i.e. lobbying costs) are affected by the actual outcomes in each period of the game and how changes in contributions affect each lobby's estimate of obtaining its optimal tariff. Modelling this is beyond the scope of the current paper; and we prefer not to make an arbitrary assumption about these effects, so that we restrict our attention to the Heckscher-Ohlin model. We continue to focus on a Heckscher-Ohlin model in which the median voter's tariff is below the standard optimum.

Let G be a cumulative distribution (or measure) whose support is the unit interval and whose mean is $\alpha \varepsilon (0,1)$. The multistage game begins at stage 0 with nature selecting a draw from this distribution, say α^*, representing the true probability that the home government will favor the median voter in any one of the N stages. Hence, if the game has a large enough number of stages, then the proportion of stages at which the median voter actually is favored will converge to α^* with probability one. We assume that this true proportion is not revealed to either country before or during the game. Because α^* is unknown to both countries, they both estimate it at the beginning (first stage) of the game by α, the mean of the distribution from which it was drawn.

We shall confine our analysis to situations in which the subgame perfect (or sequential) equilibria of the multistage game have the following fully revealing (or "honest") property: at any stage of the game when the home government favors the median voter (standard optimum), the tariff actually levied is the one which maximizes the utility of the median voter (standard optimum) at that stage. In these situations the equilibrium tariffs in the first stage are the ones described by Theorem 1, $t(l,\alpha)$ for the median voter, $t(h,\alpha)$ for the standard optimum, and $t^*(\alpha)$ for the foreign country. The equilibrium outcome in the first stage is therefore "honest" in the sense that the home tariff actually observed reveals which individual was favored by the home government at that stage. That is, the foreign country learns the outcome of the home political process in the first stage at the completion of that stage after observing the home tariff actually levied. This information should be used by the foreign country to revise its estimate of the probability that the median voter will be favored in the second stage. Since all of this information is known to the home government, it will know the foreign government's revised estimate as well (i.e., the new reputation is also common knowledge). Using Bayes theorem to update the probabilities, it is necessary that this common knowledge estimate increase if the outcome in stage one is $(t(l,\alpha),t^*(\alpha))$ and decrease if it is $(t(h,\alpha),t^*(\alpha))$. That is, if home favors the median voter in stage one, then its reputation for favoring the median voter must be greater in stage two. Formally, letting the revised estimate that home will favor the median voter at the next stage be $u(\alpha)$ if it favors the median voter today and $d(\alpha)$ if it levies the standard optimum tariff today, then $0<d(\alpha)<\alpha<u(\alpha)<1$.

If the actual outcome in stage one is $(t(1,\alpha),t^*(\alpha))$, or the median voter is favored, then the revealing subgame perfect (sequential) equilibrium tariffs at stage two are $(t(1,u(\alpha)),t(h,u(\alpha)),t^*(u(\alpha)))$, the tariffs given by Theorem 1 with α replaced by $u(\alpha)$. The revised estimate of the probability home will favor the median voter in stage three is then $u(u(\alpha))$ if the median voter is favored in stage two and $d(u(\alpha))$ if the standard optimum tariff is levied in stage two. Conversely, if the stage one outcome is $(t(h,\alpha),t^*(\alpha))$, then the revealing equilibrium at stage two is $(t(1,d(\alpha)),t(h,d(\alpha)),t^*(d(\alpha)))$. The revised estimate in stage three is then either $u(d(\alpha))$ if the median voter is favored in stage two and $d(d(\alpha))$ if the standard optimum tariff is levied in stage two. Continuing in this fashion, in principle we can write down all possible revealing equilibrium paths.

The preceding discussion, of course, presumes that the strategy of levying at each stage the tariff which maximizes the utility of the individual favored at that stage is indeed a subgame perfect equilibrium strategy for the multistage game. The primary concern here is ruling out the possibility, for example, that the median voter might do better by asking for the standard optimum tariff at some stage to try to mislead the foreign government into revising its estimate down (instead of up) or confusing it into not revising its estimate. We prefer to abstract from such strategic attempts to influence the foreign country's estimate in order to focus on reputational effects which still exist even when the home country always plays "honestly". Note well that we define the home country's reputation to be the estimated probability that it favors the low tariff group.[12] Fortunately, it is possible to show that there exist circumstances in which these revealing strategies and the Bayesian updating rules do constitute a subgame perfect equilibrium. This proof is relegated to the Appendix, but essentially it requires showing only that any future expected discounted gain is less than the loss of current utility from choosing a nonrevealing tariff.

Theorem 2. If the discount factor of the home country is bounded above (by a number not necessarily less than one), then there exists a subgame perfect equilibrium for the N stage Bayesian tariff game which is revealing. That is, it has the property that at any stage n when the common estimate that the home country will favor the median voter is α_n, the equilibrium tariffs are $(t(l,\alpha_n),t(h,\alpha_n),t^*(\alpha_n))$. If $n<N$, then the equilibrium at stage n+1 is $(t(l,u(\alpha_n)),t(h,u(\alpha_n)),t^*(u(\alpha_n)))$ if the outcome at n is $(t(l,\alpha_n),t^*(\alpha_n))$ and $(t(l,d(\alpha_n)),t(h,d(\alpha_n)),t^*(d(\alpha_n)))$ if the outcome at n is $(t(h,\alpha_n),t^*(\alpha_n))$.

Now suppose that home levies the median voter's tariff at stage one. Then since $u(\alpha)>\alpha$, Theorems 1 and 2 imply that the home country's standard optimum and median voter's tariffs in equilibrium are lower, and the equilibrium tariff of the foreign country is higher at stage two. Conversely, if home levies the standard optimum tariff at stage one, then both home tariffs are higher and the foreign tariff is lower at stage two.

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12 This point is worth noting because elsewhere in the literature the term reputation has been used to describe an intangible asset maintained by costly strategic behavior in the current period (see, for example, Milgrom and Roberts(1982)), and it is this type of behavior which we are ruling out here.

Since the preceding argument applies to any pair of stages in the revealing equilibria of the multistage game, we have proved the following.

Proposition 3. Suppose that the median voter's tariff is levied at any stage. Then in the next stage the home country's standard optimum and median voter's tariffs in equilibrium are lower and the foreign country's is higher. Moreover, if the median voter's tariff is levied in the next stage, then the utility of every individual in the home country whose endowment of the factor used relatively intensively in the home import good is no less than the median is lower and the welfare of the foreign country is higher.

Proposition 4. Suppose the home country levies the standard optimum tariff at any stage. Then the home country's standard optimum and median voter's tariffs in equilibrium are higher and the foreign country's is lower in the next stage. If the standard optimum tariff is levied again in the next stage, then the utility of every individual in the home country is higher.

There are three aspects of these results which deserve further discussion. One is that if home levies $t(l,\alpha)$ at stage one and $t(h,u(\alpha))$ at stage two, then the median voter may be better off or worse off in stage two depending upon the precise fashion income is redistributed in stage two. Another thing to note is that saying that the standard optimum and median voter's tariffs are lower in stage two does not necessarily imply the tariff actually used in stage two is lower. That is, depending on the magnitude of $u(\alpha)-\alpha$ and the slopes of the two home reaction functions, $t(l,\alpha)$ may be less than, equal to, or greater than $t(h,u(\alpha))$. Similarly, $t(h,\alpha)$ may be greater than, equal to, or less than $t(l,d(\alpha))$.

It is also important to observe that this model allows tariff cycles of the type originally discussed by Johnson (1954) even when all relevant reaction functions are negatively sloped. For example, suppose that the home government levies the median voter's tariff in the first and third stages but a standard optimum in the second and fourth stages. Under many prior distributions (such as a beta) it is true that $u(d(\alpha))=\alpha$, so observing the home median voter's tariff and then a standard optimum leaves the probability that the home tariff will be the median voter's the same as it was initially. Then the common knowledge estimate that the home tariff will be the median voter's rises from α to $u(\alpha)$ at stage two, falls back to α at stage three, and then rises back to $u(\alpha)$ at stage four. The corresponding equilibrium outcomes are $(t(l,\alpha),t^*(\alpha))$, $(t(h,u(\alpha)),t^*(u(\alpha)))$, $(t(l,\alpha),t^*(\alpha))$, and $(t(h,u(\alpha)),t^*(u(\alpha)))$, where clearly $t^*(u(\alpha))>t^*(\alpha)$. As noted above, we cannot ascertain unambiguously whether $t(l,\alpha)$ is greater than, equal to, or less than $t(h,u(\alpha))$. However, since it is highly unlikely that they are equal, the home tariff either rises and falls or vice versa. Figure 3 shows the case where $t(h,u(\alpha))>t(l,\alpha)$.

Proposition 5. If there is persistent uncertainty about the home country's political process, then in the revealing subgame perfect equilibrium of a multistage Bayesian game we can observe tariff cycles even if all trading equilibria are unique and stable.

4. Concluding Remarks

This paper has examined an issue largely ignored by theoretical trade models, uncertainty as to the objective of governments in choosing tariff policy. The model presented allows us to explain observed tariffs in a large country model not only in terms of the usually considered elasticities of offer curves, but also in terms of the economic interests of individuals in an economy with a skewed distribution of factor endowments and beliefs concerning which of these individuals will be favored by the government.

Hence tariffs other than those estimated by standard elasticities may be observed either because (i) governments manipulate terms of trade effects in order to benefit an individual other than the average citizen or (ii) when they do set tariffs to maximize an index of aggregate utility, the foreign government places a positive probability on the possibility that the government will benefit an individual other than the average citizen.

The model also allows us to examine welfare implications of this type of uncertainty. In both the static and multistage versions of the game, it is shown that, depending on the actual outcome, some people may gain from the uncertainty. In the static game, if the actual outcome is determined by the utility of individuals who prefer low tariffs, then both these people and those who prefer higher tariffs benefit from the uncertainty. Similarly, in the revealing subgame perfect equilibria of the multistage game, the utility of each of these people is lower when the low tariff is imposed repeatedly because the "reputation" effect causes the foreign government to impose a higher tariff. On the other hand, when high tariff individuals are favored, the uncertainty in the static model harms the high tariff people (relative to the certainty equilibrium). And in the multistage game, a "reputation" for imposing the high tariff is beneficial. Hence one policy implication of the analysis would be that rules adopted with the intent of eliminating uncertainty about the decision-making process are beneficial to the individual the government wants to favor only if that individual prefers a high tariff. In this context, at least, gaining a reputation for imposing low tariffs is harmful to a number of individuals at home, including those people who prefer low tariffs.

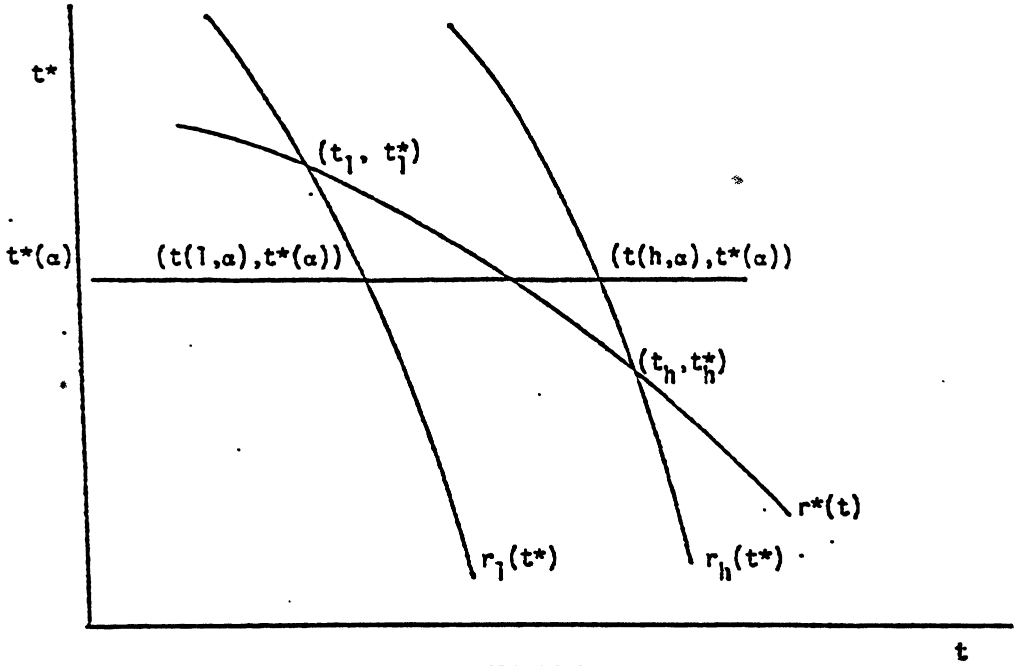

FIGURE 1

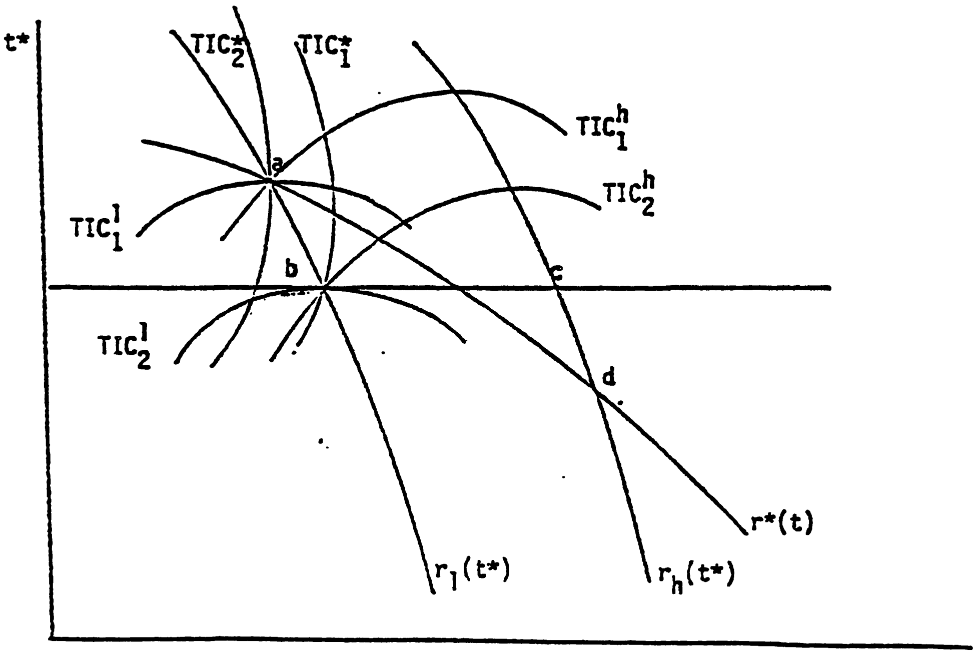

FIGURE 2

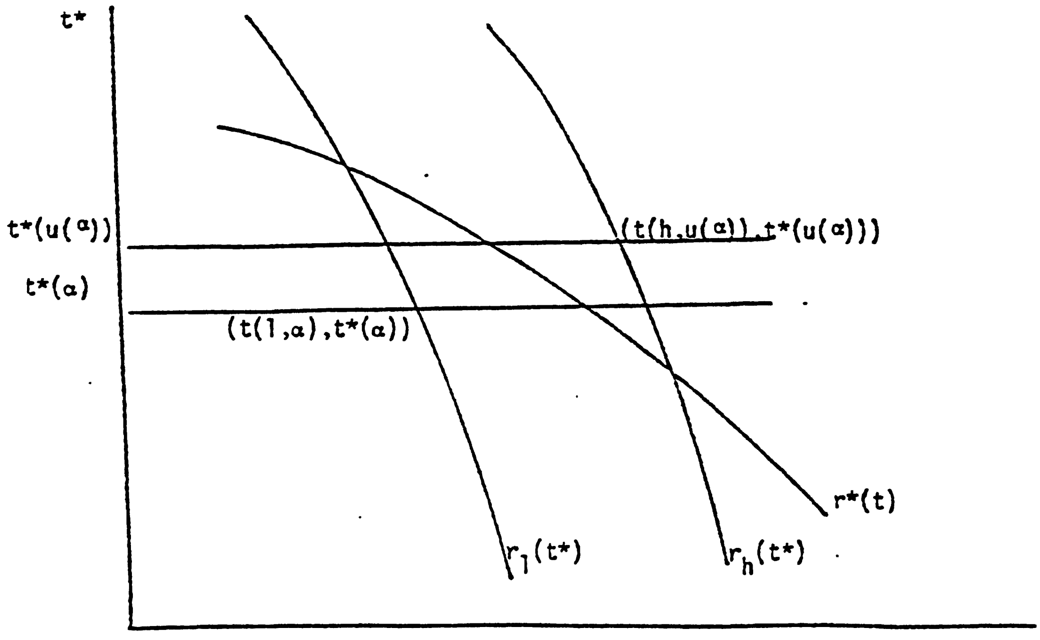

FIGURE 3

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Appendix

A. Two-sided Uncertainty

Now assume that the foreign government's objective is also unknown. That is, it will choose a tariff to maximize the (indirect) utility of its median voter $V^{*l}(t,t^*)$ with probability β or to maximize an aggregate utility index $V^{*h}(t,t^*)$ with probability $1-\beta$, where $\partial V^{*i}/\partial t^*$ is decreasing in both t^* and t for $i=h,l$. Notice that notation has been chosen such that the foreign median voter prefers a lower tariff than the foreign standard optimum (an analysis entirely analogous to that in Section 1B shows this occurs if the foreign median voter is relatively well-endowed, compared to the mean, with the factor used relatively intensively in the foreign export good). Thus, if $r_h^*(t)$ and $r_l^*(t)$ are the certainty reaction functions associated with $\partial V^{*h}/\partial t^* = 0$ and $\partial V^{*l}/\partial t^* = 0$, then $r_h^*(t) > r_l^*(t)$ for all relevant t. The foreign government's strategy is now type-contingent also, $t^*:\{l,h\} \to T^*$.

Given any feasible tariffs $(t(l),t(h),t^*(l),t^*(h))$, the expected payoff to the home country's median voter and that associated with the aggregate home utility index are

$$U^l = \beta V^l(t(l),t^*(l)) + (1-\beta)V^l(t(l),t^*(h))$$
$$U^h = \beta V^h(t(h),t^*(l)) + (1-\beta)V^h(t(h),t^*(h)),$$

while the expected payoff to the foreign median voter and that associated with the aggregate foreign utility index are

$$U^{*l} = \alpha V^{*l}(t(l),t^*(l)) + (1-\alpha)V^{*l}(t(h),t^*(l))$$
$$U^{*h} = \alpha V^{*h}(t(l),t^*(h)) + (1-\alpha)V^{*h}(t(h),t^*(h)).$$

A Nash equilibrium for this Bayesian tariff game with two-sided uncertainty is then a quartet of tariffs $(t(l,\alpha,\beta), t(h,\alpha,\beta), t^*(l,\alpha,\beta), t^*(h,\alpha,\beta))$ such that for each $i = h,l$,

$U^i(t(i,\alpha,\beta), t^*(l,\alpha,\beta), t^*(h,\alpha,\beta)) \geq U^i(t, t^*(l,\alpha,\beta), t^*(h,\alpha,\beta))$ for all $t \in T$

$U^{*i}(t(l,\alpha,\beta), t(h,\alpha,\beta), t^*(i,\alpha,\beta)) \geq U^i(t(l,\alpha,\beta), t(h,\alpha,\beta), t^*)$ for all $t^* \in T^*$.

To prove the existence of an equilibrium, note that this can be viewed as a game with four players (home l, home h, foreign l, foreign h). Since T and T^* were defined to be closed intervals, the strategy set of each player is a compact and convex subset of the real line. Moreover, the payoff functions U^i and $U^{*i}(i=h,l)$ are continuous and bounded for all strategies, and each is strictly concave in that player's tariff (by the assumptions on V^i and V^{*i}). Hence existence follows directly from several well-known existence theorems for noncooperative games (see, for example, Theorem 7.1 in Friedman (1977)).

To prove the claim in Section 2, first consider the equilibrium of the certainty game when both countries maximize an aggregate utility index. This is (t_h, t_h^*) given by $r_h(r_h^*(t_h)) = t_h$ and $t_h^* = r_h^*(t_h)$. Next consider the equilibrium of the certainty game when each maximizes the utility of its median voter, (t_{ll}, t_{ll}^*) given by $r_l(r_l^*(t_{ll})) = t_{ll}$ and $t_{ll}^* = r_l^*(t_{ll})$. Because the certainty reaction functions are negatively sloped, $r_l(t^*) < r_h(t^*)$ for all t^*, and $r_l^*(t) < r_h^*(t)$ for all t, it follows that either $t_{ll} < t_h$ or $t_{ll}^* < t_h^*$, if not both. A sufficient condition for both $t_{ll} < t_h$ and $t_{ll}^* < t_h^*$ is $r_h(t_h^*) - r_l(t_h^*) = r_h^*(t_h) - r_l^*(t_h)$. Since this would occur if the two countries were symmetric, it follows that $t_{ll} < t_h$ and $t_{ll}^* < t_h^*$ when both countries are very similar ("nearly symmetric). Finally, consider the infinite sequences $\{\alpha^m\}$ and $\{\beta^m\}$ such that $\alpha^m \varepsilon (0,1)$ and $\beta^m \varepsilon (0,1)$ for m = 1,2,... and such that both converge to one. Then it follows from the continuity in the model that one can construct a sequence of equilibria $(t(l,\alpha^m,\beta^m), t(h,\alpha^m,\beta^m), t^*(l,\alpha^m,\beta^m), t^*(h,\alpha^m,\beta^m))$ such that $t(l,\alpha^m,\beta^m)$ converges to t_{ll} and $t^*(l,\alpha^m,\beta^m)$ converges to t^*_{ll}. Hence, if α and β are close (but not equal) to one, if the countries are nearly symmetric, and if each decides to maximize the utility of its median voter, then the equilibrium tariffs observed will be less than the standard optimum tariffs.

B. Proof of Theorem 2

First consider a game with two stages in which α is the common estimate that the home country will favor its median voter in the first stage. Specification of a subgame perfect (or sequential) equilibrium for this game includes both strategies and beliefs which are consistent with those strategies and Bayes theorem. Consider the following system of beliefs for the foreign country: if $t(l,\alpha)$ is observed at the completion of the first stage, it updates its belief that home will favor its median voter in the second state to $u(\alpha)$; if $t(h,\alpha)$ is observed, it updates its belief in the second stage to $d(\alpha)$; and if any other home tariff is observed, it does not change its belief (i.e., α is its belief in the second stage also). This system of beliefs is consistent with the revealing strategy of levying $t(l,\alpha)$ if the median voter is favored and $t(h,\alpha)$ if the standard optimum is favored. As is well known by now, one must specify beliefs for all possible outcomes - including those which have zero probability in equilibrium. Hence, the notion that α is not altered if a tariff other than $t(l,\alpha)$ or $t(h,\alpha)$ is observed corresponds to the event that the home country made a mistake in choosing its first stage tariff, in which case the foreign country has received no useful information about which individual was favored in the home country. Since both individuals in the home country know which of them was favored (regardless of the home tariff actually levied), each updates its belief to $u(\alpha)$ if the median voter was favored and $d(\alpha)$ if the standard optimum was favored.

To complete the proof it must be shown that the revealing strategies are indeed equilibrium strategies under the beliefs given above. The result carries through because: the high (standard optimum) tariff individual can never gain from a nonrevealing strategy; and the median voter must lose current utility from a nonrevealing strategy, so any future gain can always be offset by a low enough (but positive) discount factor. First note that since the second stage is the last stage, the equilibrium then is given by Theorem 1. That is, if $(t(l,\alpha),t^*(\alpha))$ is the outcome of stage one, then under the given beliefs, the equilibrium outcome in stage two is either $(t(l,u(\alpha)),t^*(u(\alpha)))$ with estimated probability $u(\alpha)$ or $(t(h,u(\alpha)),t^*(u(\alpha)))$ with estimated probability $1-u(\alpha)$. If the stage one outcome is $(t(h,\alpha),t^*(\alpha))$, then that in stage two is either $(t(l,d(\alpha)),t^*(d(\alpha)))$ with estimated probability $d(\alpha)$ or $(t(h,d(\alpha)),t^*(d(\alpha)))$ with estimated probability $1-d(\alpha)$. And if the stage one outcome is $(t,t^*(\alpha))$ for $t \not\in \{t(l,\alpha),t(h,\alpha)\}$, then that in stage two is either $(t(l,\alpha),t^*(\alpha))$ with estimated probability α or $(t(h,\alpha),t^*(\alpha))$ with estimated probability $1-\alpha$.

Next suppose that the foreign country levies $t^*(\alpha)$ in stage one. If $\rho \in (0,1)$ is the discount factor, then the expected payoff to the median voter from the entire game is given by

$$V_2^1(t(l,\alpha),t^*(\alpha)) = V^1(t(l,\alpha),t^*(\alpha))+\rho[u(\alpha)V^1(t(l,u(\alpha)),t^*(u(\alpha))) + (1-u(\alpha))V^1(t(h,u(\alpha)),t^*(u(\alpha)))],$$

$$V_2^1(t(h,\alpha),t^*(\alpha)) = V^1(t(h,\alpha)),t^*(\alpha)) + \rho[u(\alpha)V^1(t(l,d(\alpha)),t^*(d(\alpha)))$$

$$+ (1-u(\alpha))V^1(t(h,d(\alpha)),t^*(d(\alpha)))],$$

and for any $t \notin \{t(l,\alpha),t(h,\alpha)\}$ by

$$V_2^1(t,t^*(\alpha)) = V^1(t,t^*(\alpha)) + \rho[u(\alpha)V^1(t(l,\alpha),t^*(\alpha)) + (1-u(\alpha))V^1(t(h,\alpha),t^*(\alpha))].$$

For notational convenience, this expected payoff will be written as $V_2^1(t,t^*) = V^1(t,t^*) + \rho E^1(t,t^*)$. Since V^1 is strictly concave in t, it follows from Theorem 1 that $V^1(t(l,\alpha),t^*(\alpha)) > V^1(t,t^*(\alpha))$ for all t (i.e., the median voter suffers a current loss from using any tariff other than $t(l,\alpha)$). However, under the belief updating system assumed, if the median voter is favored in stage one and selects a tariff other than $t(l,\alpha)$, then there is a divergence in beliefs in stage two which creates an expected discounted gain for the median voter at that stage (compared to using $t(l,\alpha)$ in stage one). For example, using $t(h,\alpha)$ in stage one leads the foreign country to update its belief incorrectly to $d(\alpha)$ instead of $u(\alpha)$. Since Proposition 1 and $u(\alpha)>d(\alpha)$ imply $V^1(t(l,u(\alpha)),t^*(u(\alpha))) < V^1(t(l,d(\alpha)),t^*(d(\alpha)))$ and $V^1(t(h,u(\alpha)),t^*(u(\alpha)))<V^1(t(h,d(\alpha)),t^*(d(\alpha)))$, it follows that $E^1(t(h,\alpha),t^*(\alpha)) > E^1(t(l,\alpha),t^*(\alpha))$. And by an analogous argument $E^1(t,t^*(\alpha)) > E^1(t(l,\alpha),t^*(\alpha))$ for any $t \notin \{t(l,\alpha),t(h,\alpha)\}$. To insure that any expected discounted gain at stage two is less than the loss at stage one from using a tariff other than $t(l,\alpha)$, it is sufficient to assume

$$\rho < \min\left\{\frac{V^1(t(l,\alpha),t^*(\alpha))-V^1(t(h,\alpha),t^*(\alpha))}{E^1(t(h,\alpha),t^*(\alpha))-E^1(t(l,\alpha),t^*(\alpha))},\ \frac{V^1(t(l,\alpha),t^*(\alpha))-V^1(t,t^*(\alpha))}{E^1(t,t^*(\alpha))-E^1(t(l,\alpha),t^*(\alpha))}\right\}.$$

Given this condition and the proposed belief system, $t(l,\alpha)$ is the median voter's best response to $t^*(\alpha)$ at stage one. It is important to note that this condition may hold for any $\rho \in (0,1)$ since there is no guarantee in this model that $E^1(t,t^*(\alpha))-E^1(t(l,\alpha),t^*(\alpha)) > V^1(t(l,\alpha),t^*(\alpha)) - V^1(t,t^*(\alpha))$ for any $t \neq t(l,\alpha)$. This results from the fact that the median voter may not be favored at stage two, in which case that individual has lower utility then than if he/she were favored, and this possibility is taken into account in computing the expected gain from using a $t \neq t(l,\alpha)$ at stage one.

The expected payoffs associated with home's aggregate utility index under these beliefs and given the foreign tariff $t^*(\alpha)$ are

$$V_2^h(t(h,\alpha),t^*(\alpha)) = V^h(t(h,\alpha),t^*(\alpha)) + \rho[d(\alpha)V^h(t(l,d(\alpha)),t^*(d(\alpha)))$$
$$+ (1-d(\alpha))V^h(t(h,d(\alpha)),t^*(d(\alpha)))],$$
$$V_2^h(t(l,\alpha),t^*(\alpha)) = V^h(t(l,\alpha),t^*(\alpha)) + \rho[d(\alpha)V^h(t(l,u(\alpha)),t^*(u(\alpha)))$$
$$+ (1-d(\alpha)V^h(t(h,u(\alpha)),t^*(u(\alpha)))],$$

and for any $t \not\in \{t(l,\alpha),t(h,\alpha)\}$

$$V_2^h(t,t^*(\alpha)) = V^h(t,t^*(\alpha)) + \rho[d(\alpha)V^h(t(l,\alpha),t^*(\alpha))$$
$$+ (1-d(\alpha))V^h(t(h,\alpha),t^*(\alpha))].$$

The strict concavity of V^h in t implies that the high tariff individual suffers a loss at stage one from using any nonrevealing tariff, or $V^h(t(h,\alpha),t^*(\alpha)) > V^h(t,t^*(\alpha))$ for all $t \neq t(h,\alpha)$ by Theorem 1. However, now Proposition 1 and $u(\alpha) > \alpha > d(\alpha)$ imply that $V^h(t(l,d(\alpha)),t^*(d(\alpha))) > V^h(t(l,u(\alpha)),t^*(u(\alpha)))$, $V^h(t(h,d(\alpha)),t^*(\alpha))) > V^h(t(h,u(\alpha)),t^*(u(\alpha)))$, and $V^h(t(l,d(\alpha)),t^*(d(\alpha))) > V^h(t(l,\alpha),t^*(\alpha))$ and $V^h(t(h,d(\alpha)),t^*(d(\alpha))) > V^h(t(h,\alpha),t^*(\alpha))$ for $t \not\in \{t(l,\alpha),t(h,\alpha)\}$. Hence $E^h(t(h,\alpha),t^*(\alpha)) > E^h(t(l,\alpha),t^*(\alpha))$ and $E^h(t(h,\alpha),t^*(\alpha)) > E^h(t,t^*(\alpha))$ for $t \not\in \{t(l,\alpha),t(h,\alpha)\}$. Using a nonrevealing tariff at stage one also imposes an expected loss on the home high tariff individual because it leads the foreign country to a higher estimate that the median voter will be favored in stage two (which makes the high tariff individual worse off at stage two regardless of who is actually favored). The best response of the home high tariff individual to $t^*(\alpha)$ at stage one is therefore the revealing strategy $t(h,\alpha)$.

Finally, given these beliefs, the median voter tariff $t(l,\alpha)$, and the standard optimum tariff $t(h,\alpha)$, it is straightforward to show that the foreign country's best reply is $t^{*}(\alpha)$ (recall Theorem 1). This completes the proof of Theorem 2 for the case of a two-stage game. The result can be extended to any multistage game with a finite number of stages by a standard backward induction argument. The details are omitted because they are cumbersome and add no additional insights to the argument for two stages.