WTO Settlement of Trade Disputes

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The settlement of trade disputes between two countries by the World Trade Organization (WTO) is determined by the optimal market shares for both plaintiff and defendant countries. The WTO process for a settlement is quasi-judicial. Given that the process for dispute settlement is similar to that for the outcome of a chance experiment, I use an analytical framework based on von Neumann-Morgenstern (vNM) utility functions to determine the optimal market shares for both countries in each other's markets. This, in turn, ensures a Pareto optimum. I find that the effects of a retaliatory tariff on the market shares of both countries are dependent upon trade negotiators' attitude toward risk. (*JEL* Classification : F13)

I. Introduction

Trade disputes have frequently occurred between the United States and its major trading partners since the U.S. began to actively implement the trade remedy laws.[1] Unlike the case of GATT 1947, the Uruguay agreement on the dispute settlement is binding. Member countries of the World Trade Organization have committed themselves not to take unilateral action against perceived violations of trade rules but to comply with the WTO's ruling. If bilateral negotiations between, for example, the United States and Japan fail, the WTO settles the

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[1]The principal U.S. trade remedy laws are section 301 (enforcement of U.S. rights and response to foreign trade practices), Super 301 (identification of trade liberalization priorities), Special 301 (identification of intellectual property rights priority), section 701 (countervailing duty), section 731 (antidumping duty), and section 201 (escape clause). See U.S. House of Representatives (1995).

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disputes within statutory time periods through a quasi-judicial process of panels etablished by the Dispute Settlement Body (DSB).[2] Given such a random process, which is similar to that for the outcome of a chance experiment, both plaintiff and defendant countries face the risk of a negative decision by the WTO.

The purpose of this paper is to determine the market shares of two countries in each other's markets that ensure an optimal settlement of trade disputes for the two countries. Since the issue addressed in this paper is essentially a problem of choice under uncertainty, the analytical framework is based on the von Neumann-Morgenstern (vNM) utility functions for two countries in a dispute.[3] This line of thought is largely consistent with the models of international trade under uncertainty developed by Ruffin (1974), Bhagwati and Srinivasan (1996), Helpman and Razin (1977, 1980), Pomery (1979). For convenience, I take a typical trade dispute occurred between the U.S. and Japan and assume the case filed by Japan (the plaintiff country) against the U.S. (the defendant country).

Let us assume that the two countries act as principals and the WTO becomes their common agent. The WTO determines the optimal market shares by maximizing the joint vNM utility at the Nash equilibrium, which ensures the Pateto optimum for both countries. I also find that the effectiveness of a retaliatory tariff imposed by the United States against Japan on market shares of the two countries depends on negotiators' attitude toward risk. Though abstract, the theoretical insights into dispute settlement addressed in this paper provide valuable information for WTO panels and policymakers in all member countries. Hopefully, this type of analysis will contribute toward reducing the incidence of trade disputes in the future.

II. Analytical Model

WTO's process for dispute settlement is basically quasi-judicial. The first step of the process requires consultation. Should consultation fail, and if both parties agree, the case can be brought to the WTO Director-General who, acting in an *ex officio* capacity, will attempt to

[2]See Office of the United States Trade Representative (1994), 353-73.

[3]References on the vNM utility function are not cited here because the function is widely known. Axioms for a utility index are available in standard texts.

reconcile the dispute. Upon failure to arrive at a solution during 60 days, the complainant can ask the DSB to establish a panel to examine the case. The Director-General must constitute the panel of 3 qualified panelists who serve in their individual capacities. The panel submits its final report to the parties within 6 months (3 months in urgent case) and, 3 weeks later, it is circulated to all WTO members. The panel reports are adopted by the DSB within 60 days of issuance. If one party decides to appeal, the DSB establishes a standing Appellate Body (AB) of 7 persons who serve 4 years (3 of 7 sit at any one time to hear appeals). The AB can uphold, modify or reverse the legal findings and conclusions of the panel. The DSB adopts the AB's report 30 days later. The parties must unconditionally accept the AB's report unless there is a consensus against its adoption. Parties negotiate compensation during 20 days. In the absence of a satisfactory compensation agreement between parties after 30 days, the DSB authorizes retaliation. Given such a quasi-judicial process that is expected to result in a more effective resolution of disputes and to enable members to enforce their rights, the plaintiff country files a petition with the WTO and the defendant country responds to it in expectation of WTO's affirmative determination in favor of own-country under uncertainty. The vNM expected utility function is a reasonable model that reflects adequately the WTO settlement process.

Trade disputes are essentially a problem of disparity in the market shares between two countries. Prior to the completion of the Uruguay Round, the United States frequently invoked the countervailing duty (section 701) and antidumping duty (section 731). Consequently, trade disputes chiefly revolved around sections 701 and 731. In the absence of effective settlement mechanism of the GATT, cases were ended with the determination, affirmative or negative, made by the U.S. International Trade Commission (ITC), partly incorporated with International Trade Administration (ITA). However, it is now possible for any country to take any case to the WTO for the settlement. Currently, Korea attempts to settle the disputes in connection with U.S. antidumping duties imposed on color televisions, semiconductor, and steel pipes at the WTO. Although it is not necessary to restrict trade disputes to a specific class reflective of any particular type of policy, post-Uruguay trade disputes are most likely to concern section 301 (virtually any type of unfair trade practices other than less-than-fair-value practices), especially so because WTO's ruling is binding and accessible. In fact, there are numerous examples including recent trade disputes between the United States and Japan on autos and auto parts, films, semiconductors, insurance, and airservice rights. Canada was in dispute with the U.S. magazine industry in the recent past. On January 18, 1997, the WTO ruling was in favor of U.S. magazine publishers. The United States required foreign oil companies to immediately reformulate gasoline they export to the United States for environmental reason while allowing domestic producers more time to do so. On the contrary, Venezuela, the largest exporter of gasoline to the United States, filed a petition against the United States with the WTO on the ground that United Sates violated the UR's fair trade agreement by discriminating against Venezuela. In its *first* ruling since the UR agreement went into effect, a dispute settlement panel at the WTO ruled against the United States on January 17, 1996. As Krueger (1995) suggests, section 301 pertains to practices that are deemed unfair but it is not within the purview of the GATT. It is reasonable to assume that trade disputes would frequently occur in connection with section 301 in the future. For this reason and simplicity, I implicitly assume section 301 in this paper.

Let us assume that Japan is the plaintiff country and the United States is the defendant country. I use the following notations:

$S_{US,US}$ = U.S. market share in the U.S.

$S_{US,J}$ = U.S. market share in Japan,

$S_{J,J}$ = Japan's market share in Japan,

and $S_{J,US}$ = Japan's market share in the U.S.[4]

Given

$$\sum_i S_. = 1, \quad (1)$$

it is possible to obtain

$$dS_{j,j} = -dS_{i,j} \ (i, j = \text{U.S. and Japan}). \quad (2)$$

As shown below, I assume that each country has chances for mutually exclusive outcomes when a U.S. retaliatory tariff is imposed

[4]Country i's market share in country j's market is defined as $S_{ij} = Q_{ij}/(Q_{ij}+Q_{jj})$, where Q_{ij} is the quantity supplied by country i to country j and Q_{jj} is the quantity supplied by country j in its own market.

on Japan. An increase in $S_{US,J}$ and hence a decrease in $S_{J,J}$ represent a positive outcome for the United States and a negative outcome for Japan, respectively. The failure to increase $S_{US,J}$ (and hence the same $S_{J,J}$ as before) is a negative outcome for the United States and a positive outcome for Japan. Each outcome occurs with a specific chance or probability. As the WTO era has just begun, there is no experimental basis for computing this probability at present (e.g., the total number of votes in a particular case filed with the WTO and the number of negative (or positive) votes against Japan (or for the United States)). Although the method for computing the probability is not a primary concern here, a rough measure of WTO's enforcement basis against Japan would be the probability of a positive outcome for the United States (and thus a negative outcome for Japan).

Consider

$$\pi = \frac{NTB_J}{T_{US} + NTB_J}, \tag{3}$$

where π is the probability for a positive outcome for the United States, $1-\pi$ is the probability for a negative outcome for the United States, T_{US} is the U.S. retaliatory tariff, and NTB_J is the nontariff barrier in Japan to U.S. exports. Note that the probability of a positive outcome for the U.S. (π) is the probability of a negative outcome for Japan and that the probability of a negative outcome for the U.S. ($1-\pi$) is the probability of a positive outcome for Japan. The rationale here is that the higher the relative degree of NTB of Japan with respect to the total degree of trade barriers in both countries, the higher the chance of obtaining a negative WTO ruling against Japan.

The vNM expected utility desired to be maximized by the United States ($E(U^{US})$) and Japan ($E(U^J)$) are, respectively:

$$EU^{US}(S_{US,J},\ S_{J,US}) = \pi\, u_1^{US}(G_{US}) + (1-\pi)u_2^{US}(B_{US}) + d_1, \tag{4}$$

$$EU^J(S_{US,J},\ S_{J,US}) = (1-\pi)u_1^{J}(G_J) + \pi\, u_2^{J}(B_J) + d_2, \tag{5}$$

where

G_{US} = positive outcome for the United States $= S_{US,J} + \Delta S_{US,J}$,

B_{US} = negative outcome for the United States $= S_{US,J}$,

G_J = positive outcome for Japan $= S_{J,J} = 1 - S_{US,J}$,

B_J = negative outcome for Japan $= S_{J,J} - \Delta S_{J,J} = (1 - S_{US,J}) + \Delta S_{US,J}$, and d_1 and d_2 are the fixed points which correspond to "Pareto superior to the initial endowment."

It is assumed that an increase in $S_{US,J}$ is proportionally induced by the intensity of the U.S. retaliatory tariff which, in turn, is dependent upon the disparity in market shares of both countries (i.e., the difference between $S_{J,US}$ and $S_{US,J}$), if Japan's appeal against a U.S. tariff filed with the WTO fails. If Japan succeeds, $S_{US,J}$ is kept the same as before. It is then possible to have

$$\Delta S_{US,J} = \phi T_{US} \qquad (0<\phi<1) \tag{6}$$

$$T_{US} = \Psi (S_{J,US}-S_{US,J}) \qquad (0<\Psi<1) \tag{7}$$

where $S_{J,US}, > S_{US,J}$ by assumption.

Given equations (6) and (7), positive and negative outcomes for both countries in equations (4) and (5) become $G_{US} = S_{US,J}+ \delta (S_{J,US}-S_{US,J})$, $B_{US} = S_{US,J}$, $G_J = S_{J,J} = 1-S_{US,J}$ and $B_J = (1-S_{US,J})+ \delta (S_{J,US}-S_{US,J})$, respectively.

Using equations (1) through (7), we can construct a joint vNM function which is a function of all attainable sets for both countries. The WTO, as the agent of two principals, maximizes the function:

$$\begin{aligned} W &= \lambda EU^{US}+(1-\lambda)EU^{J} \\ &= \lambda [\pi u_1^{US}\{S_{US,J}+ \delta (S_{J,US}-S_{US,J})\}+(1-\pi)u_2^{US}(S_{US,J})] \\ &\quad +(1-\lambda)[(1-\pi)u_1^{J}(1-S_{US,J})+ \pi u_2^{J}\{(1-S_{US,J})+ \delta (S_{J,US}-S_{US,J})\}], \end{aligned} \tag{8}$$

where EU^{US} is the U.S. expected utility, EU^{J} is Japan's expected utility, $0 < \lambda < 1$ and $0 < \delta = \phi \cdot \Psi < 1$.[5]

For simplicity, I assume that $d_1 = d_2 = 0$ in this section. The first-order conditions for the maximum joint vNM utility are

$$\begin{aligned} \partial W/\partial S_{US,J} = {} & \lambda \{\pi (\partial u_1^{US}/\partial S_{US,J})+(1-\pi)(\partial u_2^{US}/\partial S_{US,J})\} \\ & +(1-\lambda)\{(1-\pi)(\partial u_1^{J}/\partial S_{US,J})+ \pi (\partial u_2^{J}/\partial S_{US,J})\} = 0, \end{aligned} \tag{9}$$

$$\partial W/\partial S_{J,US} = \lambda \{\pi (\partial u_1^{US}/\partial S_{J,US})\}+(1-\lambda)\{\pi (\partial u_2^{J}/\partial S_{J,US})\} = 0. \tag{10}$$

Consequently, equations (9) and (10) are functions of two variables, $S_{US,J}$ and $S_{J,US}$, generating the reaction function of Japan to the United States and the reaction function of the U.S. to Japan:

$$S_{J,US} = f(S_{US,J}), \tag{11}$$

$$S_{J,US} = f(S_{J,US}). \tag{12}$$

[5]See Friedman(1990) for this type of joint function constituted for a two-person game.

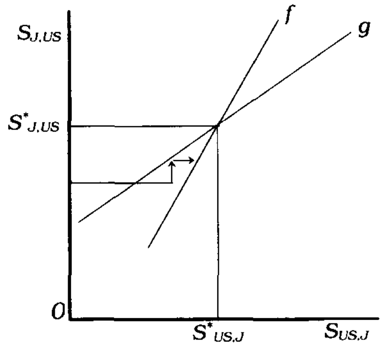

FIGURE 1
REACTION FUNCTIONS

Among four possible cases for interactions between f and g functions : (1) $f' > 0$ and $g' > 0$, (2) $f' > 0$ and $g' < 0$, (3) $f' < 0$ and $g' > 0$, and (4) $f' < 0$ and $g' < 0$, only the first case is reasonable in reality. It is so because the United States attempts to increase its market share in Japan when Japan increases its market share in the United States and Japan attempts to increase its market share in the United States when the United States increases its market share in Japan. Figure 1 exhibits this case. I assume that $f' > g'$. If $S_{US,J}$ is greater than what Japan expects for the given $S_{J,US}$, Japan raises $S_{J,US}$.

Through the subsequent adjustments made by the two countries, they reach an equilibrium at the intersection point. Their optimum market shares are $S^*_{J,US}$ and $S^*_{US,J}$ which imply to determine $S^*_{J,J}$, $S^*_{US,US}$. The solution set is the Nash equilibrium because each country's expectation concerning the other county's market share is correct and each country is maximizing the market share. There are no incentives for either country to alter its behavior. If the pressure from either side disturbs the equilibrium, then there will be processes for automatic adjustments in two market shares converging to the equilibrium point. Therefore, the equilibrium is stable.

III. Effectiveness of U.S. Trade Policy Under Uncertainty

A primary objective of this paper is to determine whether a U.S retaliatory tariff imposed against Japan would increase the U.S. market share in Japan and/or decrease the Japanese market share in the United States. In order to investigate the effects of the U.S.

tariff on $S_{US,J}$ and $S_{J,US}$, equations (9) and (10) are combined together to obtain

$$\partial u_1^J/\partial G_J = \{\pi/(1-\pi)\}\{(NTB_J/T_{US}) - (1-\delta)/\delta\}\delta(\partial u_2^J/\partial B_J), \tag{13}$$

where NTB_J is a nontariff barrier of Japan to U.S. exports and T_{US} is the tariff of the U.S.

This equation is based on: (i) the assmption that the marginal utility of a market share for the U.S. is independent of the marginal utility of a market share for Japan (i.e., the cross-country utility marginal rate of substitution (CUMRS) = 0)[6], and (ii) the property that the MRS of $S_{US,J}$ for $S_{J,US}$ on the same utility curve u_2^J equals the ratio of NTB of Japan (NTB_J) to tariff of the U.S. (T_{US}). The rationale here is that, since Japan allows the U.S. to increase $S_{US,J}$ subject to U.S. payment of the NTB of Japan, the NTB of Japan may be viewed as the price which Japan charges to the United States for an additional unit of $S_{US,J}$ (e.g., one percent). Similarly, the price that Japan pays for an increase in $S_{J,US}$ is the U.S. retaliatory tariff.

Dividing through equation (9) alone by $\partial u_2^J/\partial B_J$ and applying assumption (i) to the resulting equation, we get

$$\partial u_1^J/\partial G_J = -\{\pi/(1-\pi)\}(1+\delta)(\partial u_2^J/\partial B_J), \tag{14}$$

Meanwhile, it is possible to derive

$$\lambda(\partial u_1/\partial G_{US} - \partial u_2^J/\partial B_J) = -\partial u_2^J/\partial B_J, \tag{15}$$

from equation (10).

Combining the above three equations generates

$$\lambda = -(1+\delta)/\{\delta(NTB_J/T_{US}) - 1 + \delta\}, \tag{16}$$

and thus

$$1-\lambda = 1 + [(1+\delta)/\{\delta(NTB_J/T_{US}) - 1 + \delta\}]. \tag{17}$$

Substituting these two equations into equation (9) and differentiating totally the resulting equation with respect to T_{US} yield

$$\begin{aligned} dS_{US,J}/dT_{US} = [&(1+\delta)\{\pi(\partial u_1^{US}/\partial S_{US,J}) + (1-\pi)(\partial u_2^{US}/\partial S_{US,J})\} \\ &- 2\delta\{(1-\pi)(\partial u_1^J/\partial S_{US,J}) + \pi(\partial u_2^J/\partial S_{US,J})\}] \end{aligned}$$

[6]It implies that $EU^{US} \cap EU^J = \phi$. Equivalently, the cross Allen−Uzawa partial elasticity of substitution(AES) between $i \in U^{US}$ and $j \in U^J$ is zero $\forall$ i and j, where i and j represent market shares $S_{US,J}$ and $S_{J,US}$, respectively.

$$/[\{-(1+\delta)T_{US}\}\{\pi(\partial^2 u_1^{US}/\partial S_{US,J}^2)+(1-\pi)(\partial^2 u_2^{US}/\partial S_{US,J}^2)\}$$
$$+\{\delta(NTB_J+2T_{US}\}\{(1-\pi)(\partial^2 u_1^{J}/\partial S_{US,J}^2)+\pi(\partial^2 u_2^{J}/\partial S_{US,J}^2)\}]. \quad (18)$$

The term on the left side indicates the effect of U.S. retaliatory tariff on the U.S. market share in Japan, terms in the numerator on the right side are U.S. and Japanese marginal utilities (*MUs*) of market shares in cases of good outcome ($MU > 0$) and bad outcome ($MU < 0$), weighted by probabilities and other parameters, respectively. Second-order derivatives in the denominator on the right are the terms representing diminishing *MUs* of market shares and thus negative if negotiators in both countries are risk-averters whose utility functions are concave and the terms for increasing *MUs* and thus positive if negotiators are risk-takers whose utility functions are convex, i.e. $\partial u_1^{US}/\partial S_{US,J} > 0$, $\partial u_2^{US}/\partial S_{US,J} > 0$, $\partial u_1^{J}/\partial S_{US,J} < 0$, and $\partial u_2^{J}/\partial S_{US,J} < 0$; $\partial^2 u_1^{US}/\partial S_{US,J}^2 < 0$, $\partial^2 u_2^{US}/\partial S_{US,J}^2 < 0$, $\partial^2 u_1^{J}/\partial S_{US,J}^2 < 0$ and $\partial^2 u_2^{J}/\partial S_{US,J}^2 < 0$ if negotiators are risk-averters and > 0 if they are risk-takers. Note that the value of numerator is always positive and that the value of denominator is positive or negative, depending on negotiators' attitude toward the risk.

***Proposition* 1**

$S_{US,J}$ increases as T_{US} increases, (i) if the U.S. negotiator is a risk-averter and the Japanese negotiator is a risk-taker; (ii) if both are risk-averters but the former negotiator is a stronger risk-averter than the latter; and (iii) if both are risk-takers but the latter negotiator is more of a risk-taker than the former.

This proposition implies that, given the WTO mechanism for settlement of disputes, the U.S. negotiator fails to increase the U.S. market share in Japan if he/she gambles with a retaliatory policy without any objective grounds for imposing a retaliatory tariff.

The same procedure applied to equation (10) yields

$$dS_{J,US}/dT_{US} = (1+\delta)(\partial u_1^{US}/\partial S_{J,US})/ \quad (19)$$
$$[\{-(1+\delta)T_{US}(\partial^2 u_1^{US}/\partial S_{J,US}^2)\}+\{\delta(NTB_J+2)(\partial^2 u_2^{J}/\partial S_{J,US}^2)\}],$$

Interpretation of this equation is similar to that of equation (18). The term on the left side represents the effect of U.S. retaliatory tariff on Japanese market share in the United States. The term in the numerator on the right is the *MU*, i.e. $\partial u_1^{US}/\partial S_{J,US} < 0$; second-order derivatives in the denominator on the right are negative (i.e. $\partial^2 u_1^{US}/\partial$

$S_{J,US}^2 < 0$ and $\partial^2 u_2^J / \partial S_{J,US}^2 < 0$) if negotiators in both countries are risk- averters, and positive (i.e. $\partial^2 u_1^{US} / \partial S_{J,US}^2 > 0$ and $\partial^2 u_2^J / \partial S_{J,US}^2 > 0$) if they are risk-takers.

Equation (19) provides the following proposition:

***Proposition* 2**

$S_{J,VS}$ increases as T_{US}, decreases, (i) if the U.S. negotiator is a risk-taker whereas the Japanese negotiator is a risk-averter; (ii) if both are risk-takers but the former negotiator is a stronger risk-taker than the latter; and (iii) if both are risk-averters but the latter negotiator is more of a risk-averter than the former.

This proposition implies that the U.S. negotiator can decrease the Japanese market share in the United States by gambling with a retaliatory tariff presumably because it is a heavy-handed punitive policy instrument.

Propositions 1(ii) and 2(iii) and Propositions 1(iii) and 2(ii) suggest that the U.S. negotiator cannot simultaneously increase $S_{US,J}$ and decrease $S_{J,US}$ as a risk-averter or risk-taker.

IV. Pareto Optimal Solution

I have assumed that negotiators in the two countries play a cooperative Nash fixed-threat bargaining game.[7] In this bargaining model, the set of attainable payoff pairs is a real number ($W \subset R^2$). I therefore assign payoff points $EU^{US} = (Eu_1^{US}, Eu_2^{US})$ and $EU^J = (Eu_1^J, Eu_2^J) \in W$ so that there are joint actions open to both negotiators that will result in EU^{US} and EU^J being the payoffs. If the negotiators fail to achieve an agreement, they will receive the payoffs (d_1, d_2) which are fixed-threat utility levels achieved with the market shares prior to negotiations.

Assume that EU^{US} and EU^J functions are homothetic and thus the adding-up theorem is applicable to the following algebraic manipulations. Substituting values λ^* and $1-\lambda^*$ determined in accordance with equations (16) and (17) into equation (9) gives

[7]There are numerous references on the cooperative bargaining game. Since game theory in general is popular today, one reference is sufficient here: Friedman(1990)

$$\lambda^* \{ \pi (u_1^{US}/S_{US,J}) + (1-\pi)(u_2^{US}/\partial S_{US,J}) \} + (1-\lambda^*)\{(1-\pi)(u_1^{J}/S_{US,J}) + \pi (u_2^{J}/S_{US,J})\} = 0, \tag{20}$$

which, along with equations (4) (5), yields

$$\lambda^* (EU^{US} - d_1) + (1-\lambda^*)(EU^{J} - d_2) = 0. \tag{21}$$

The payoff possibility frontier (or the Pareto optimal set) to be maximized to get the Nash solution is

$$EU^{US} \cdot EU^{J} = -\{ \lambda^* / (1-\lambda^*) \} (EU^{US})^2 + \{1/(1-\lambda^*)\} \{ \lambda^* d_1 + (1-\lambda^*) d_2 \} EU^{US}, \tag{22}$$

Differentiating equation (22) with respect to EU^{US} generates

$$EU^{US*}(1/2\lambda^*)\{ \lambda^* d_1 + (1-\lambda^*) d_2 \}, \tag{23}$$

From equations (21) and (23), it is possible to determine that

$$EU^{J*} = (d_1 + d_2)/2, \tag{24}$$

Note that solution set (EU^{US*}, EU^{J*}) is the Nash equilibrium because there is no way that one negotiator can take unilateral action that hurts the other.

V. Conclusions

The WTO settles trade disputes through a quasi-judicial process. Given the random nature of this process, trade negotiators in both countries face risk under uncertainty in connection with WTO's prospective decision. The analytical framework in this paper is therefore based on the vNM utility function.

For WTO's optimal settlement of trade disputes, I determine the market shares of the two countries which ensure maximum welfare. In the game theoretical context, the outcome is the Nash equilibrium. Expected utilities are optimum for both countries.

The effectiveness of a retaliatory tariff imposed by the United States against Japan on the shares of the two countries in each other's markets depends upon the attitude toward risk of negotiators in both countries. The retaliatory tariff increases the U.S. market share in Japan if the U.S. negotiator is a risk-averter who would cautiously use the retaliatory policy only on the objective ground. This implies that a retaliatory policy implemented simply on the threatening basis would fail to achieve the U.S. goal. In the U.S. market, however, U.S. risk-taker's heavy-handed punitive action decreases Japanese market share.

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