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SUSTAINING FREE TRADE IN REPEATED GAMES

WITHOUT GOVERNMENT COMMITMENT

by

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ABSTRACT

This paper examines how free trade can be sustained in a repeated tariff game in a simple two-country general equilibrium model. In the standard model, free trade can be sustained by 'punishment strategies' with only a mild degree of forward looking behaviour on the part of governments. However, when there are short term factor market rigidities, and governments cannot precommit to an ex-ante optimal tariff, it may be much more difficult to sustain free trade. This is illustrated in two models.

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SECTION I INTRODUCTION

Governments persistently use tariffs and other trade barriers. Although there are many arguments for protection, both old and new, economists seem to agree that given the reality of retaliation, all countries would be better off under free trade. But we know, at least since Johnson (1953), that in a world of large countries, free trade suffers from the prisoners dilemma problem. Given the tariff of the foreign country, the home country is better off by imposing a tariff. In a symmetric Nash equilibrium each country imposes tariffs and is worse off than under free trade[1].

The problem with this explanation for tariffs, as noted by many authors (Dixit 1987, Enders 1987), is that with long-lived trading relationships, it should be easy to sustain equilibria with tariffs much lower than the 'one-shot Nash' equilibrium rates. If governments are even slightly forward looking, free trade can be supported as a rational outcome of repeated play, using 'trigger' strategies. The benefit to any player of deviating from free trade, and imposing tariffs, is always offset by the discounted cost of cheating. Typically the former is just the utility gain from a terms of trade improvement, while the latter is the future utility loss incurred as a result of a switch to a 'worse' equilibrium, triggered by the deviation.

This paper offers a simple explanation of why free trade might not be sustainable in infinite tariff games; the time inconsistency of the classical 'optimal tariff'. Following a number of recent papers (Lapan 1988, Staiger and Tabellini 1987), we use the fact that in the presence of short term rigidities in factor mobility, there is a distinction between the 'ex-ante' and 'ex-post' optimal tariff from

[1] Of course in an asymmetric situation, one country may gain relative to free trade.

the perspective of any one government. An ex-ante optimal tariff takes into account domestic and foreign supply response to the tariff choice. It corresponds to the classical 'optimal tariff'. An ex-post optimal tariff takes supply decisions as given. Unless governments have some outside commitment ability, the ex-ante optimal tariff lacks credibility, and in a one-shot game will neither be chosen by governments nor expected by private agents. Lapan (1988) shows that without commitment, a government will always choose excessively high tariffs, and leave both home and foreign agents worse off than if commitment were possible.

We extend Lapans analysis to a model of infinitely repeated trade between two large countries, where both countries are choosing tariffs optimally. There are two goods, and one fixed factor of production. This factor is ex-ante mobile between sectors, but once allocated at the beginning of a period, must remain in place until the beginning of the next period. Governments are free to alter tariffs after factors are in place. Clearly, with rational expectations, anticipated prices and tariff rates will be realized.

If governments can commit to an ex-ante optimal tariff, or equivalently, there are no short-term factor rigidities, then the usual folk theorem applies. Using a 'maximal punishment' in the sense of Abreu (1984) free trade is an equilibrium of the game as long as discount factors are greater than half. If however, such commitment is infeasible, and there are exist short-term factor rigidities, free trade may not be sustainable, even with very high discount factors.

The reason that free trade is harder to achieve is simple. Short-term factor rigidities raise the temptation to deviate from a hypothetical free trade equilibrium, since, as shown by Lapan (1988), the elasticity of the ex-post foreign offer curve is lower than that of the ex-ante offer curve. On the other hand, since factors can relocate between periods, and the 'punishment' can only be imposed in the future, the cost of a deviation is unchanged. For quite reasonable discount factors, the benefits always exceed the costs and so free trade is not an equilibrium[2].

The key factor determining the sustainability of free trade is the difference between the ex-ante and the ex-post offer curve. The higher is the ex-ante intersectoral supply response of factors due to price changes, the greater is this difference. In the first part of the paper, encompassing Sections II and III, we employ a simple Ricardian trade model in which the ex ante intersectoral supply response is potentially infinite. This allows for a simple, exact derivation of the conditions for sustaining free trade. In the Section IV the same arguments are developed with concave production technologies, and the results are derived numerically.

SECTION II THE MODEL

There are two countries; Home and Foreign, with foreign variables given an asterisk. There are two produced goods, with Home (Foreign) given a comparative advantage in good 1 (good 2). Each country has a single unit of a fixed factor[3], and technologies are Ricardian. We maintain inverse symmetry so that the productivity of the fixed factor in Home (Foreign) in good 1 (2) is α and in good 2 (1) is β, where $\alpha>\beta$. There is a continuum of agents in each country with total

[2] Stahl and Turunen-Red (1990) offer an interesting alternative rationale for the unsustainability of free trade. In their model, the policy-makers tenure in office is uncertain, and she may be replaced with a rival with some positive probability. They show that this may imply that even the ususual 'severe punishments' may fail to support free trade.

[3] This may be thought of as labour or land. If it is labour, the discussion in footnote 4 below must be noted.

measure 1. Home firms are owned completely by Home agents, with each agent owning a single share in each firm. An analogous assumption applies to Foreign firms. Preferences are identical across agents and countries, with period utility given by c_1c_2 ($c_1^*c_2^*$).

A competitive equilibrium can be described in two stages. First, the fixed factor is assigned to one or other sector in each country, depending upon anticipated rates of return. In the second stage, given prices and tariffs, rates of return are determined, and consumers allocate consumption expenditure to each good. We focus only on rational expectations equilibria, so that anticipated and actual returns coincide. In addition, in accord with previous repeated game models of tariff setting (e.g. Dixit 1987, and references therein), we rule out international lending markets.

The allocation of the fixed factor in the first stage can be characterized by the following inequalities

(1)
(i) $p\alpha>\beta(1+t)$ $\quad \ell_1=1$
(ii) $p\alpha\leq\beta(1+t)$ $\quad 0\leq\ell_1\leq 1$

(2)
(i) $p\beta(1+t^*)>\alpha$ $\quad \ell_2^*=1$
(ii) $p\beta(1+t^*)\leq\alpha$ $\quad 0\leq\ell_2^*\leq 1$

Here t (t^*) is the Home (Foreign) tariff rate, p is the relative price of good 1, and ℓ_1 (ℓ_2^*) is total employment of the fixed factor in sector 1 (2) in Home (Foreign). If production is to be diversified, then rates of return must be equal across sectors.

In the second stage consumers maximize utility subject to the price, tariff, and income, taking sectoral outputs as given. Thus the representative Home and Foreign consumers face the problems[4] given by

[4] We wish to avoid distributional issues associated with the possibility that agents may become ex-post heterogenous due to receipt of sector specific income. A similar assumption is made in Lapan (1988), who uses a representative agent framework for derivation of

(3) and (4)

(3) Maximize c_1c_2 subject to $pc_1+(1+t)c_2=py_1+(1+t)y_2+R$

(4) Maximize $c_1^*c_2^*$ subject to $pc_1^*+(1+t^*)c_2^*=py_1^*+(1+t^*)y_2^*+R^*$

Here y_1 $(=\alpha\ell_1)$ and y_1^* $(=\beta(1-\ell_1))$ denote output of good 1 in Home and Foreign respectively, and analogously for y_2 and y_2^*. R and R^* represent lump sum rebates of tariff revenue to Home and Foreign residents, respectively.

Finally, in a competitive equilibrium, markets must clear, and government budget constraints must be satisfied. These conditions are given by (5) and (6).

(5) $c_1+c_1^*=y_1+y_1^*$

(6) $R=t(c_2-y_2)$ $R^*=pt^*(c_1^*-y_1^*)$.

It is easy to show that demand functions for Home and Foreign are

(7) $pc_1= (1+t)/(2+t)[py_1+y_2]$ $c_2= 1/(2+t)[py_1+y_2]$

(8) $pc_1^*= 1/(2+t^*)[py_1^*+y_2^*]$ $c_2^*= (1+t^*)/(2+t^*)[py_1^*+y_2^*]$

Definition 1: A <u>competitive equilibrium</u>, for a given pair of tariffs is defined as the set $(c_1, c_2, c_1^*, c_2^*, p, \ell_1, \ell_2^*, t, t^*)$ which satisfies (i) Labour supply conditions (1) and (2), (ii) consumer maximization (3) and (4), (iii) Market clearing, (5) and (iv) government budget constraints (6).

both ex-ante and ex-post tariffs. There are a number of ways to think about this. If the fixed factor is land, we could let each home agent own a single share in each firm, so that agents are ex-post identical. This avoids any within country distributional consequences of tariffs. Two alternative methods to achieve the same end are a) let each agent own one unit of the fixed factor, (e.g. let the fixed factor be labour), and assume that there are insurance markets so that sell shares in their wage income, diversifying away completely any sector specific income risk, or b) let the Home government, in addition to setting tariffs, choose an optimal lump-sum transfer between agents in sector 1 and 2. In either case, Home agents will remain ex-post identical.

market rigidities. In the second game, such commitment is ruled out.

Governments maximize discounted utility of their domestic representative agent. Both governments use the discount factor δ, $0 \leq \delta \leq 1$.

First we define the stage game, or one-shot game, for each case. Let the game A be described as

A $\qquad \max_{t \in R_+} c_1 c_2 \qquad\qquad \max_{t^* \in R_+} c_1^* c_2^*$

subject to $\qquad\qquad$ subject to

(1),(2),(3),(4),(5), and (6). $\qquad$ (1),(2),(3),(4),(5), and (6).

This corresponds to the standard one-shot tariff game. Governments choose tariffs to maximize domestic utility subject to a competitive equilibrium. In particular, domestic and foreign supply responses are explicitly taken into account.

The game without commitment is described as

B $\qquad \max_{t \in R_+} c_1 c_2 \qquad\qquad \max_{t^* \in R_+} c_1^* c_2^*$

subject to $\qquad\qquad$ subject to

(3),(4),(5), and (6). $\qquad$ (3),(4),(5), and (6).

In game B, governments take labour allocations as given in choosing tariff rates.

Definition 2: A tariff equilibrium with commitment is (i) a solution to the game A, and (ii) a competitive equilibrium.

Definition 3: A tariff equilibrium without commitment is (i) a solution to the game B, and (ii) a competitive equilibrium.

Proposition 1. Autarky is an equilibrium of both game A and game B.

This proposition is well known in the literature (e.g. Dixit 1987). If the Foreign government sets a tariff at an autarchic rate, then there is no trade. The utility of the home consumer is then independent of home tariffs, and thus a weakly best response of the home government is to set an autarchic tariff also. In the game A, autarchic tariffs are any above the rate $\alpha/\beta-1$ for both countries. In game B tariffs above the rate y_1/y_2-1 for the home country, and y_2^*/y_1^*-1 for the foreign country, will induce autarky. In a tariff equilibrium without commitment, factor supply will adjust under autarky so that $\ell_1=\ell_2^*=\frac{1}{2}$, so by the definition of y_i and y_i^*, the autarky tariff limits are the same for both games.

Our interest in the autarky Nash equilibrium of the tariff games stems from its convenience as a 'punishment' in the definition of the trigger strategy equilibria outlined below.

Now focus on the infinitely repeated versions of game A and game B, and the associated tariff equilibria. We look at history dependent strategies, which are defined as follows. Let $t^t\equiv(t_0, t_1, \ldots t_t)$ and $t^{*t}\equiv(t_0^*, t_1^*, \ldots t_t^*)$ represent the tariff histories up to time t, assuming the game begins at 0. Then $H_t=(t^t, t^{*t})\in R_+^t\times R_+^t$ represents the history of the game up to period t. A tariff action at each date is a function $T_t(H_t)=t_t$, $T_t: R_+^t\times R_+^t\rightarrow R_+$. A Home (Foreign) strategy is defined as $\Sigma=(T_i)_{i=0}^{\infty}(\Sigma_0^*=(T^*)_{i=0}^{\infty})$.

We are interested in (symmetric) 'trigger' strategies of the following form. Let $\tilde{t}=(\tilde{t}_0, \tilde{t}_1, \tilde{t}_2, \ldots)$ and $\hat{t}=(\hat{t}_0, \hat{t}_1, \hat{t}_2, \ldots)$ be two tariff profiles. Then the strategy of each government is defined as

$$T_t=\begin{cases}\tilde{t}_t \text{if } H_{t-1}=(\tilde{t}^{t-1}, \tilde{t}^{*t-1}) \\ \hat{t}_t \text{otherwise}\end{cases} \tag{10}$$

Each government chooses the 'cooperative' tariff rate $\tilde{t}_t$ as long as all governments have done so in the past. If not, then all governments revert to a 'punishment' phase involving the $\hat{t}_t$ tariffs.

In order to sustain the greatest possible degree of cooperation, it is necessary to identify the maximal credible punishment that can be imposed. It is clear that an infinite reversion to autarky represents the maximal punishment. Autarky is a Nash equilibrium of the one-shot game and represents a subgame perfect equilibrium of the overall game. In addition, no government could be made worse off than autarky forever - if this was the case, governments could unilaterally choose autarky, and therefore make themselves better off.

The key question of interest is whether the maximal punishment threat can sustain free trade. That is, taking the 'punishment' tariffs $\hat{t}$ to be such that $\hat{t}_t > \alpha/\beta - 1$ for all t, can this sustain $\tilde{t}_t = 0$, for all t? In what follows we restrict attention to stationary solutions for Σ.

The Game with Commitment

On these assumptions for $\tilde{t}$ and $\hat{t}$, first take (10) as a potential equilibrium in the repeated tariff game with commitment. This constitutes a subgame perfect equilibrium of the game if no government would ever wish to deviate from free trade, given that a deviation will be followed by an infinite reversion to autarky, beginning in the next period.

The incentive to deviate from a free trade outcome is given by the one period utility derived from cheating on free trade and setting an optimal tariff, less the utility of free trade itself. As noted above, the latter is $\alpha^2/4$ for each country. What is the optimal tariff for a country given that the other country is pursuing free trade? Take the Home country for example. The best it can do is to set a tariff so that the gains from trade are completely eliminated for the foreigner, but still allowing for international specialization. Thus the price must be $p=\alpha/\beta$. With the Home terms of trade any higher than this, the foreigner would be unwilling to trade anything. The Appendix shows that this involves setting the home country tariff at $t' = 2(\alpha/\beta - 1)$. With $p=\alpha/\beta$, (3) ensures that the Home country will still specialize in good 1. From above, utility for Home is $\alpha^2(1+t)/(2(2+t))$ given that Foreign sets a zero tariff, as long as both countries are still specializing. This will be the case so long as $t \leq t'$. For $t=t'$ Home utility is $\alpha^2(2\alpha/\beta-1)/(2(\alpha/\beta)) = \alpha^2/2-\alpha\beta/4$. The incentive to cheat is then $(\alpha^2-\alpha\beta)/4$.

What is the cost of cheating? This is given by the value of free trade forever, beginning next period, less the value of autarky forever, again beginning next period. Thus the cost of cheating is $\delta/(1-\delta)(\alpha^2-\alpha\beta)/4$.

Putting these together, Free Trade can then be sustained as a subgame perfect equilibrium if

(11) $(\alpha^2-\alpha\beta)/4 \leq \delta/(1-\delta)(\alpha^2-\alpha\beta)/4$

or, in other words, if $\delta \geq \frac{1}{2}$.

This is the usual prediction of trigger strategies based on 'severe punishments', and suggests that free trade should be relatively easy to achieve given only a mild degree of forward looking behaviour on the part of governments.

The Game without Commitment

Now look at the tariff game without commitment. Can free trade be sustained by the strategies (10)? Under free trade, countries will specialize, so that $y_1=y_2=\alpha$, so again, utility is given by $\alpha^2/4$. But the current utility of a deviation from Free Trade now has to be assessed conditional on a fixed factor allocation. Given $y_1=y_2=\alpha$, Home utility is $\alpha^2(1+t)/(2(2+t))$, for any non-negative tariff rates. Since supplies are committed, and countries are specializing, trade will still take place at any finite tariff rate. The Home country will thus set $t=\infty$ in assessing the benefits from cheating on Free Trade[5]. The utility from cheating is thus $\alpha^2/2$. So the incentive to cheat on free trade is $\alpha^2/4$. What is the cost of cheating? Again,

[5] Another way to see this is to recognize that for Cobb-Douglas preferenc and full specialization, the foreign offer curve is completely inelastic o its whole range. Thus Home's optimal tariff is infinite.

this is given by the discounted value of free trade for ever less autarky forever, beginning next period. The cost of cheating is the same as in the game with commitment, since factors can reallocate within one period. Thus, free trade is a subgame perfect equilibrium of the game without commitment if and only if

(12) $\alpha^2/4 \leq \delta/(1-\delta)(\alpha^2-\alpha\beta)/4$

or if $\delta \geq 1/(2-\beta/\alpha)$.

Is this condition likely to be fulfilled? Take a value of β/α at 0.95, a five percent cost differential between high and low productivity sectors. Then free trade requires $\delta \geq 0.95$; governments must have very high discount factors in order to sustain free trade. Free trade becomes much harder to achieve in this game.

The explanation for the difficulty in sustaining free trade in the game without commitment is self-evident. With tariff commitment, or equivalently, no factor market rigidities, Home's incentive to cheat on a free trade agreement is equal to the gains from trade; that is, the utility of trade less the utility of autarky; $(\alpha^2-\alpha\beta)/4$. By cheating, it can remove all gains from trade accruing to Foreign. The cost of cheating is however, also proportional to the gains from trade (since these gains are lost forevermore), by a factor of $\delta/(1-\delta)$. Thus, the only relevant parameter in calculating the sustainability of Free Trade is the discount factor. In particular, the magnitude of the gains from trade itself are irrelevant.

But without commitment, a government evaluates the benefits from cheating as being the gains from trade conditional on specialization. These gains are potentially much higher; $\alpha^2/4$. On the other hand,the cost of cheating is unaltered, since a punishment can only come into place beginning next period, after factors of production can relocate. Thus the absence of commitment in tariff setting may dramatically reduce the chances of sustaining free trade. Now not only the discount factor, but the gains from trade also, are important. The larger is the differential between the gains from trade conditional on specialization, and the unconditional gains from trade, the less likely is it that Free Trade is sustainable.

If free trade is not sustainable in the tariff game without commitment, the maximal degree of cooperation will require some positive tariff level. Again concentrating on symmetric strategies, take this tariff to be $\tilde{t}$. If this is to induce specialization, $\tilde{t} \leq \alpha/\beta-1$ must hold. In that case $\tilde{t}$ is implicitly defined by

(11) $\alpha^2/(2+\tilde{t})^2=\delta/(1-\delta)(\alpha^2(1+\tilde{t})/(2+\tilde{t})^2-\alpha\beta/4)$

The left hand side is the benefits from cheating on the cooperative tariff equilibrium with tariff rates $\tilde{t}$. The right hand side measures the cost of cheating as the utility from trade in the cooperative tariff equilibrium less the utility of autarky. Figure 1 illustrates condition (11) for given parameter values. There are two tariff rates at which (11) is satisfied. But only the lower is relevant, since the higher tariff rate would induce specialization.

If there is no $\tilde{t} \leq \alpha/\beta-1$ satisfying (11), then all trigger strategy equilibria in the game without commitment must involve diversification. But diversification requires equal returns to factors in each sector. Using conditions (1) and (2), along with the symmetry implication p=1, this implies that $\tilde{t}=\tilde{t}^*=\alpha/\beta-1$. Figure 2 describes this equilibrium. Each country diversifies, but tends to specialize in its α good. But, as is shown in the Appendix, this is in fact a <u>one-shot</u> <u>Nash</u> equilibrium to the tariff game without commitment. Then, with tariff rates $\alpha/\beta-1$, the incentive to deviate must be zero, since there is by definition no individual gain to a deviation from a one-shot Nash equilibrium. On the other hand, the costs of deviation are positive, since the interior one-shot Nash equilibrium gives higher welfare than autarky, c.f Figure 2. Therefore, the tariff rates $\alpha/\beta-1$ can always be sustained by a threat of autarky.

SECTION IV TARIFF GAMES IN A MORE GENERAL MODEL

Now we focus on a more general production structure, while maintaining the same assumptions on preferences. Let Home and Foreign production functions for goods 1 and 2 be written as

(13) $y_1=\alpha L_1^{\gamma} \quad y_2=\beta L_2^{\gamma} \qquad y_1^*=\beta L_1^{*\gamma} \quad y_2=\alpha L_2^{*\gamma}$

The analogous conditions to (1) and (2) are then

(1') $p\alpha L_1^{\gamma-1} = (1+t)\beta(1-L_1)^{\gamma-1}$

(2') $p(1+t^*)\beta L_1^{*\gamma-1} =\alpha(1-L_1^*)^{\gamma-1}$

The ex-ante output supply functions are then

(14) $y_1(p) = \dfrac{\alpha(p\alpha)^{1/(1-\gamma)}}{((p\alpha)^{1/(1-\gamma)}+\beta^{1/(1-\gamma)})} \qquad y_2(p) = \dfrac{\beta(\beta)^{1/(1-\gamma)}}{((p\alpha)^{1/(1-\gamma)}+\beta^{1/(1-\gamma)})}$

(15) $y_1^*(p) = \dfrac{\alpha(p\beta)^{1/(1-\gamma)}}{((\alpha)^{1/(1-\gamma)}+(p\beta)^{1/(1-\gamma)})} \qquad y_2^*(p) = \dfrac{\alpha(\alpha)^{1/(1-\gamma)}}{((p\beta)^{1/(1-\gamma)}+\alpha^{1/(1-\gamma)})}$

The second stage competitive equilibrium is described exactly as in Section II. For given factor allocations, prices are determined by (9). It is straightforward to derive the following results for a symmetric free trade equilibrium

(16) $L_1^F = L_2^{*F} = \dfrac{\alpha^{1/(1-\gamma)}}{(\alpha^{1/(1-\gamma)}+\beta^{1/(1-\gamma)})}$

(16a) $U^F = U^{*F} = .25\left[(\beta^{1/(1-\gamma)}+\alpha^{1/(1-\gamma)})^{(1-\gamma)}\right]^2$

As in section III, autarky is again a Nash equilibrium. Autarky allocations and welfare are given by

(17) $L_1^A = L_2^A = \frac{1}{2}$

(17a) $U^A = U^{*A} = \alpha\beta\frac{1}{2}^{\gamma}$

As $\gamma \to 1$, these expressions approach those of the previous section.

Now let us evaluate the conditions for sustaining free trade in the games with and without commitment. First take the incentive to defect on the a free trade allocation when governments can commit. In that case the optimal deviation involves setting t equal to the elasticity of the ex-ante foreign offer curve. For the present case, the foreign ex ante excess supply curve of good 2 is written as

$$X(p) = y_2^*(p) - \tfrac{1}{2}[py_1^*(p) + y_2^*(p)]$$

The optimal tariff for the home country is reciprocal of the elasticity of the foreign excess supply curve. This is

$$t = -X(p)/pX'(p)$$

Written out explicitly, this becomes

(18) $$t = \frac{y_2^* - py_1^*}{(\gamma/(1-\gamma)2y_2^*/(1+(1/p\beta)^{1/(1-\gamma)}) + py_1^*)}$$

Finally, utility for the home country after a deviation from free trade is

$$U^D = [py_1(p) + y_2(p)]^2(1+t)/[(2+t)^2p]$$

which depends upon t, implicitly described by (18), and p and y, described by (9), (14) and (15).

There is no exact solution for t and p which satisfies (9), and (18). Instead, a numerical solution procedure is employed to calculate the benefits of cheating on free trade[6]. The key condition is

(19) $$U^D - U^F - \delta/(1-\delta)(U^F - U^A) \le 0$$

Figure 3 illustrates the left-hand side of condition (19) for different values of γ and δ. Note that for a discount factor greater than a half, the incentive to cheat on is always dominated by the

[6] The procedure is to carry out a grid search potential price and tariff rates and choose the combination which come closest to satisfying (9) and (20).

threat of a revertion to autarky (the expression is negative).

Now turn to the game without commitment. Denote y_1^{*F} and y_2^{*F} to be the levels of foreign output of goods 1 and 2 under free trade. The ex-post foreign excess supply curve facing Home is

$$X(p) = \bar{y}_2^* - \tfrac{1}{2}[p\bar{y}_1^* + \bar{y}_2^*]$$

where the bars denote that outputs are taken as given. If it deviates from free trade, the home government will set an optimal tariff of

$$(20) \qquad t = (\bar{y}_2^{*F} - p\bar{y}_1^{*F})/p\bar{y}_1^{*F}$$

The solution for t and p in a deviation from free trade in the game without commitment is implicitly described by conditions (9) and (20), where factor allocations are based at their free trade outcomes. Again, a numerical procedure is used to solve for t and p. Home welfare following a deviation is computed from these solutions. Again, free trade is a subgame perfect equilibrium in the game without commitment if the incentive to deviate is less than the discounted costs of the deviation. The latter are the same as in the game with full commitment. Figure 4 again describes the left hand side of condition (19), except that U^D is welfare of a deviation for a given factor allocation. For high values of γ, the discount factor δ must be much higher, in this game, than in the game with full policy commitment, in order that free trade be sustainable. So we see that the qualitative results of the previous section are reproduced. In economies with factor market rigidities which drive a significant wedge between ex-ante and ex-post supply elasticities, it becomes much more difficult to sustain free trade.

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APPENDIX

We demonstrate first that an optimal deviation from free trade for a government with commitment is to set the tariff $t=2\alpha/\beta-1$. To remove Foreign gains from trade completely, while maintaining Foreign specialization, the price must be $p=\alpha/\beta$. But, with complete specialization, (9) implies that

$$\alpha/\beta = (2+t)/2t$$

which implies the tariff written above. This outcome is illustrated in Figure 5.

Now it is shown that the symmetric equilibrium with diversification, and tariffs given by $t=\alpha/\beta-1$, is in fact a one-shot Nash equilibrium of the game without commitment. In the second phase of each period, excess supply of Home and Foreign is, respectively,

$$X(p) = \bar{y}_1-(1+t)/((2+t)p)[p\bar{y}_1+\bar{y}_2]$$

$$X^*(p) = \bar{y}_2^* -(1+t^*)/((2+t^*)p)[p\bar{y}_1^*+\bar{y}_2^*]$$

The Foreign optimal tariff is characterized by the condition

$$t^* = X(p)/pX'(p)$$

Substituting from the definition of X(p), and imposing symmetry; $t=t^*$, $p=1$, and $y_1^*=y_2\equiv y_\alpha$, $y_2^*=y_1\equiv y_\beta$, we have, for either country,

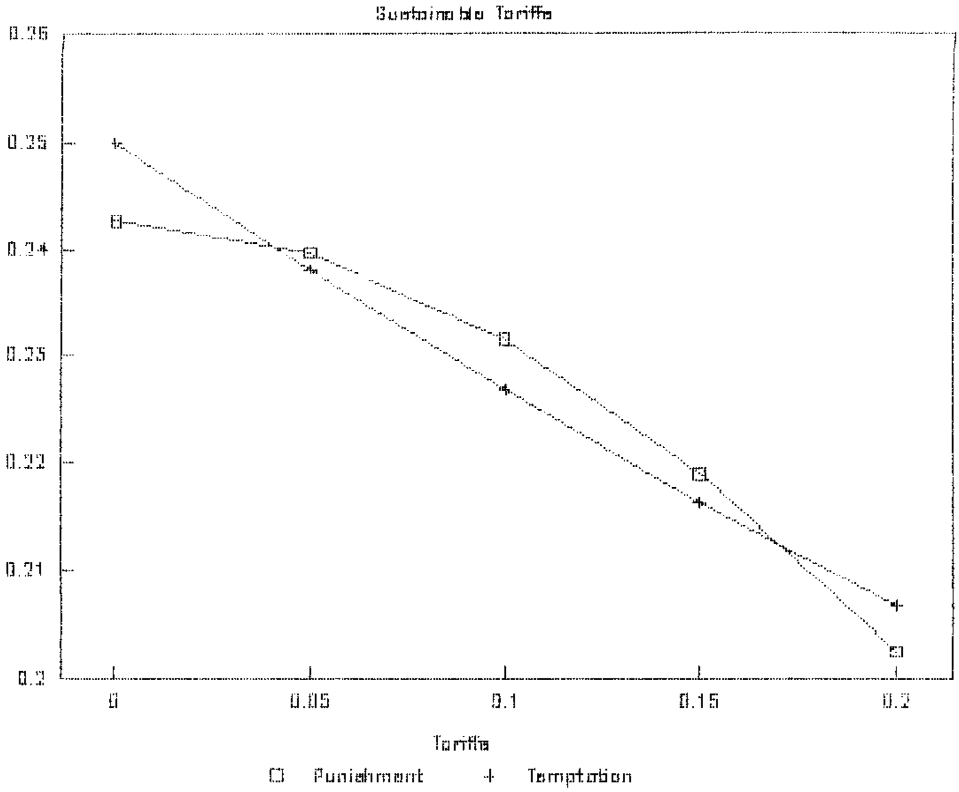
$$t = \frac{y_\alpha-(1+t)y_\beta}{(1+t)y_\beta}$$

or

$$t = (y_\alpha/y_\beta)^{\frac{1}{2}} - 1$$

But, in order that diversification be consistent with anticipated factor returns, it must be that $\alpha/\beta=(1+t)$. Then, given that $y_\alpha/y_\beta = \alpha\ell/\beta(1-\ell)$, this implies that the equilibrium ℓ is $\alpha/(\alpha+\beta)$. Therfore the optimal tariffs in the symmetric one shot Nash equilibrium with trade are $\alpha/\beta-1$.

Figure 1



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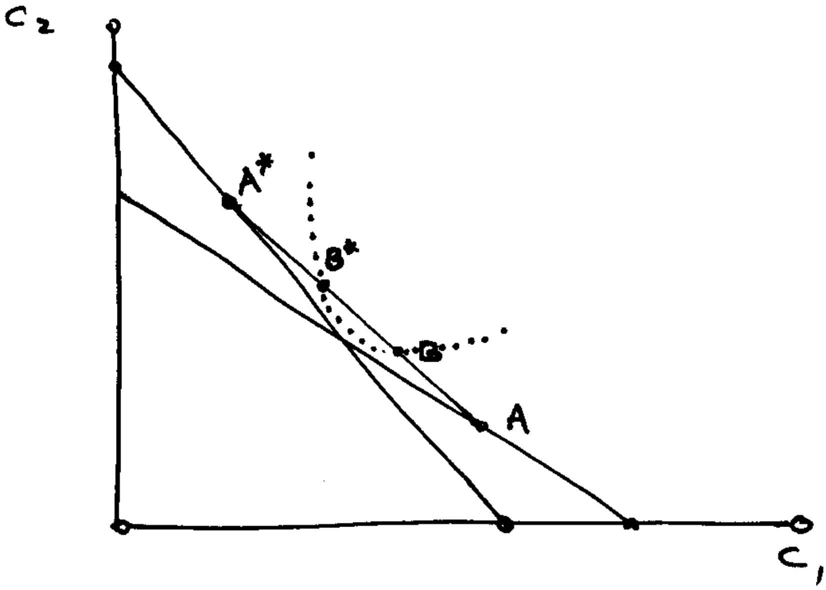

Figure 2

A, A* Production B B* Consumption

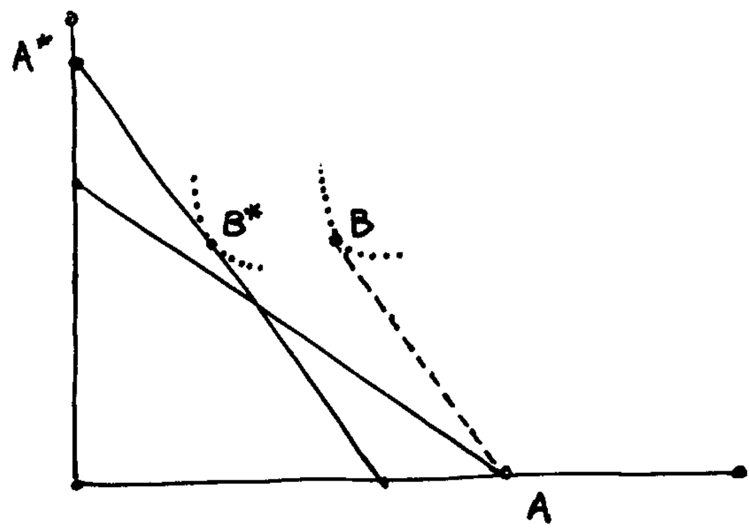

Figure 5

A, A* Production B, B* Consumption

Figure 3

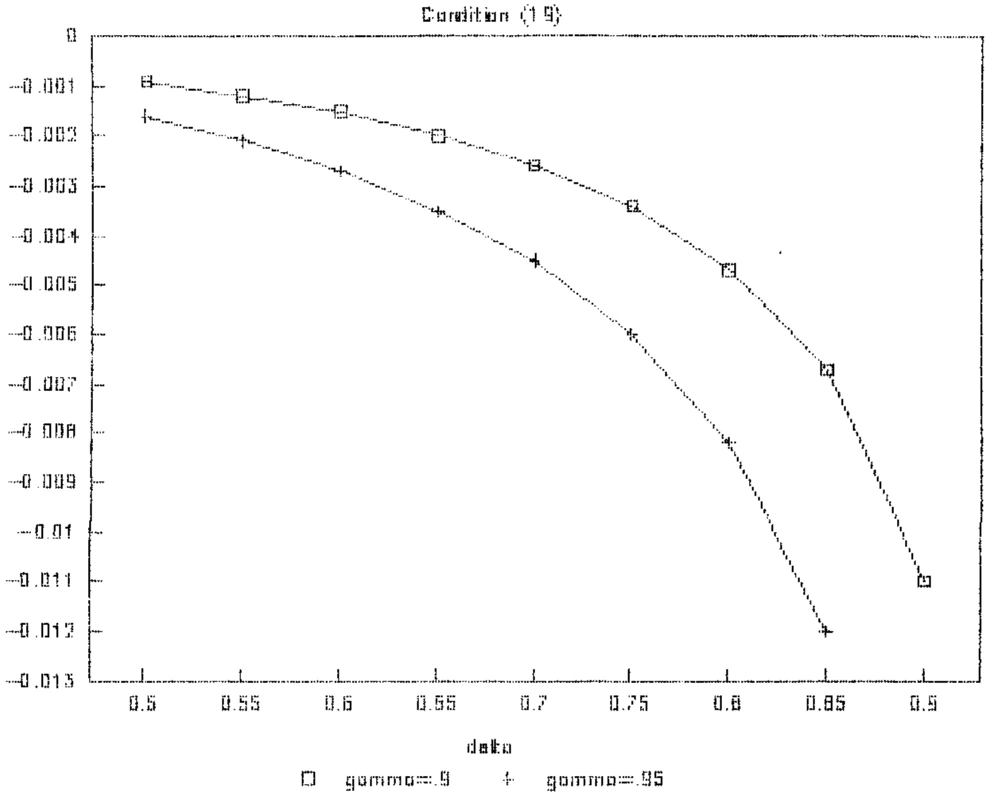
Condition (19)
0
-0.001
-0.002
-0.003
-0.004
-0.005
-0.006
-0.007
-0.008
-0.009
-0.01
-0.011
-0.012
-0.013
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
delta
gamma=.9
gamma=.95

Figure 4

Condition (19)