Gradual Trade Liberalization with Sluggish Capital Movement

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Abstract

This paper analyzes how domestic sluggish capital movement can affect multilateral trade negotiations between countries. In multilateral trade talks, including the current Doha round of trade talks organized by the World Trade Organization, countries take steps to liberalize even though they seem to be moving toward the ultimate free-trade equilibrium. This paper argues that when capital moves sluggishly between sectors in an economy, there are cases in which countries do not want to move to the ultimate free-trade equilibrium immediately. Instead, they find it more beneficial if they simultaneously move gradually, with their tariffs lowered step by step.
1 Introduction

A very important feature of the post-war world trade is the substantial reduction of the trade impediments imposed by the governments of most countries. Through unilateral decision, bilateral agreements, and multilateral trade negotiations, the average tariff rate of countries has fallen from 50 percent more than five decades ago to 5 percent today. International trade organizations such as the GATT and the WTO (currently the Doha round of trade talks) have played very crucial roles in multilateral trade negotiations.

However, the extensive trade reductions did not happen overnight; instead, it took more than five decades to get this far. The main question is, why did it take so long to achieve this result, if the present situation is what these countries want? In particular, why are trade negotiations a gradual process rather than an immediate one-time tariff adjustment? Furthermore, in the current Doha round of trade talks, are the countries trying to take just a small step in a longer process of extensive trade liberalization in the future? If this is what they are doing, then why do the countries not try to move to the ultimate equilibrium immediately?

The question of gradual trade liberalization has received economists’ attention since the late 1970s, and there have been many studies to explain it. The literature can be divided mainly into three categories, depending on the perspectives on liberalization: unilateral gradualism, multilateral gradualism and perpetual trade liberalization.

The early literature on trade liberalization focuses mainly on the analysis of unilateral liberalization in the presence of adjustment costs and market failure within the domestic economy. For example, Mussa (1986) considers a model with a distortion in the labor resource market, involving adjustment costs of labor: the rate of unemployment rises more than proportionately to the rate of sectoral contraction due to tariff reduction.\(^1\) As a result, gradual tariff reduction is optimal for the economy. His model, however, has been criticized because gradualism depends crucially on convex adjustment cost, and because unemployment in his model is not well founded in micro theory.

The second generation of gradualism examines a two-way, game-theoretic interaction between governments. In this view, trade has to be self-enforcing. Staiger (1995) attributes gradualism in trade liberalization to self-enforceability

\(^1\)Mussa pointed out that immediate elimination of tariffs will be optimal when countries can commit to tariff rates and there are no distortions in the goods and factors markets.
of agreements. The existence of sector-specific labor in an import-competing sector gives each government an incentive to deviate from an agreed tariff reduction path and it acts as a deterrence to trade liberalization. However, if the decrease in the tariff occurs gradually, governments lose their incentive to go back to a tariff war as time goes on. Therefore, the way to liberalization has to have gradual steps, rather than immediate movement towards free trade. Furusawa and Lai (1999), however, point out that Staiger does not take into account the issue of adjustment costs of liberalization, a major concern for countries during negotiation. Using a different approach that includes a fixed adjustment cost for workers switching between sectors, they explain why countries may want to take gradual trade liberalization, and why after a trade liberalization the countries may have an incentive to take further liberalization later. Bond and Park (2001), in another approach, show how consumption smoothing and sunk investments may affect trade negotiations among countries.

The latest generation of gradual tariff reduction literature considers perpetual trade liberalization. Lockwood, Whalley and Zissimos (2001), for example, believe that a trade liberalization process is triggered by political costs at the international level, and they look at the impact of the institutional constraints, like WTO, on the agreed tariff adjustment path. They show that no efficient tariff level exists at which liberalization stops and some liberalization must occur in every period along the liberalization path.

In this paper, we investigate another factor that may cause gradual trade liberalization in a general equilibrium framework. We note that trade liberalization (and many other policies) will cause resource reallocation. However, resource reallocation is costly and takes time. Thus a government, when trying to maximize social welfare, will have to optimize not just the degree of trade liberalization, but also its speed. We show cases in which a government, when negotiating with another government for mutual trade liberalization, will want to gradually reduce trade impediments instead of dismantling them all at once. To highlight the roles of resource allocation and to simplify the present analysis, we assume that only capital movement, but not labor movement, within an economy takes time.

Staiger (1995) and Furusawa and Lai (1999) do not assume convex adjustment cost of labor, which is critical in earlier models.

Lockwood and Thomas (2002) introduce another interesting approach toward gradualism. They show that irreversibility can be a factor of gradualism in a dynamic, partial cooperation model.
Our model differs from previous ones in several aspects. First we focus on capital market. Only a few papers paid attention to capital market.\(^4\) Second, we drop the self-enforcing constraint. Tariff rates are perfectly and immediately observable so there is no gain by cheating. In addition, trade is an infinitely repeating game. If both countries can enhance its own welfare by cooperating and if agreements are binding, there is no reason for going back to a tariff war, especially when there is no gain by deviation. Last, we allow no direct financial cost of adjustment, except for the time involved in resource reallocation. Mussa (1986) and Furusawa and Lai (1999) assume that moving labor from one sector to another requires a cost of adjustment. It is quite obvious that gradual tariff adjustment is expected when such adjustment cost exists. In the present paper, we presume that direct financial cost of moving capital is negligible, but we argue that gradual tariff adjustment may still occur.

The rest of the paper is organized as follows. Section 2 describes the model used in this paper. The section also explains how the countries choose their tariffs in a non-cooperative way. Sections 3 and 4 analyze how the countries bargain to cooperate and lower their trade restrictions. Section 3 considers the case of a perfect world in which the countries choose to liberalize trade fully and immediately. Section 4 turns to a case in which capital movement between sectors in an economy is sluggish. It then examines whether the economies prefer to liberalize trade gradually. The last section concludes.

2 The Model

Consider two large open economies labeled Home and Foreign, in which goods 1 and 2 are produced and consumed using labor and capital.\(^5\) Denote the labor and capital endowments of Home by \(\bar{L}\) and \(\bar{K}\), respectively, and those of Foreign by \(\bar{L}^*\) and \(\bar{K}^*\), respectively (asterisks to stand for Foreign variables). Denote the Home production function of sector \(i\) by \(Q_i = F_i(K_i, L_i)\), \(i = 1, 2\), where \(Q_i\) is the output, and \(K_i\) and \(L_i\) are the capital and labor inputs in sector \(i\), respectively. The production function is assumed to be continuous, increasing, twice differentiable, and concave. Denote the Home

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\(^4\)Bond and Park (2001) briefly cover the capital market, paying their attention on the sunk cost of capital market.

\(^5\)In order to analyze sectoral capital movement, we assume that both economies, especially the home economy, remains diversified in production at all relevant prices.
social utility function, which is continuous, increasing, twice differentiable, and quasi-concave, by 
\[ u = u(C_1, C_2), \]
where \( u \) is the utility level and \( C_i \) is the consumption of good \( i \). Choosing good 2 as the numeraire, define \( p \) as the relative price of good 1. Denote the home GDP function by 
\[ g = g(p, \bar{K}, \bar{L}) \]
and its indirect trade utility function by 
\[ v = v(p, \bar{K}, \bar{L}, b), \]
where \( b \) is the transfer revenue the government receives from abroad.\(^6\) The derivatives of the indirect trade utility function, which are denoted by subindices, are

\[
\begin{align*}
    v_p &= -\lambda M_1 \\
    v_K &= \lambda r \\
    v_L &= \lambda w \\
    v_b &= \lambda,
\end{align*}
\]

where \( M_1 \) is the import of good 1 and \( \lambda \) is the marginal utility of income. Without satiation, \( \lambda > 0 \). Equations (1a) and (1d) can be combined to give the import demand function:

\[ M_1 = M_1(p, b) = -v_p/v_b, \]  

(2)

where for simplicity the given factor endowments are dropped from equation (2). Totally differentiate (2) to give:

\[ dM_1 = M_{1p} dp + M_{1b} db, \]  

(3)

where \( M_{1p} = \partial M_1/\partial p \) and \( M_{1b} = \partial M_1/\partial b \).

Foreign production functions and social utility functions can be defined in a similar way, and are denoted by 
\[ Q^*_i = F^*_i(K^*_i, L^*_i) \] and 
\[ u^* = u^*(C^*_1, C^*_2). \]

Similarly its GDP and indirect trade utility functions are denoted by 
\[ g^* = g^*(p^*, \bar{K}^*, \bar{L}^*) \] and 
\[ v^* = v^*(p^*, \bar{K}^*, \bar{L}^*, b^*). \]

The foreign export supply of good 1 function is equal to

\[ E^*_1 = E^*_1(p^*, b^*) = v^*_p/v^*_b. \]  

(4)

Totally differentiate equation (4) to give

\[ dE^*_1 = E^*_{1p} dp^* + E^*_{1b} db^*. \]  

(5)

\(^6\)For the regular properties of a GDP function and an indirect trade utility function, see, for example, Wong (1995, Chapter 2).
Trade in goods between the countries is allowed without any transport costs but is subject to possible tariffs imposed by the governments. Without loss of generality, assume that Home exports good 2 and imports good 1 at all relevant prices and policies considered in this paper. Capital, however, cannot move between countries, but within a country it can move between sectors in the way described below. Home imposes a non-prohibitive tariff of ad valorem rate $\tau$ on imported good 2 while Foreign imposes a non-prohibitive tariff of ad valorem rate $\tau^*$ on imported good 1. Define $p^w$ as the relative price of good 1 in the world, which adjusts perfectly and costlessly to equilibrate the goods markets. The domestic prices in the countries are related to $p^w$ by

\begin{align}
    p &= p^w(1 + \tau) \quad (6a) \\
    p^* &= \frac{p^w}{(1 + \tau^*)} = \frac{p}{(1 + \tau)(1 + \tau^*)}. \quad (6b)
\end{align}

Equation (6b) gives

\begin{equation}
    dp^* = \frac{dp}{(1 + \tau)(1 + \tau^*)} - \frac{pd\tau}{(1 + \tau)^2(1 + \tau^*)} - \frac{p d\tau^*}{(1 + \tau)(1 + \tau^*)^2}. \quad (7)
\end{equation}

The tariff revenues generated by the tariffs are equal to

\begin{align}
    b &= \tau p M_1/(1 + \tau) \quad (8a) \\
    b^* &= \tau^* M_2^* = \tau^* p^*(1 + \tau^*) E_1^*. \quad (8b)
\end{align}

Totally differentiate the equations in (8) to give

\begin{align}
    db &= \frac{\tau M_1}{1 + \tau} dp + \frac{p M_1}{(1 + \tau)^2} d\tau + \frac{\tau p}{1 + \tau} dM_1 \quad (9a) \\
    db^* &= \tau^*(1 + \tau^*) E_1^* dp^* + p^* E_1^* (1 + 2\tau^*) d\tau^* + \tau^*(1 + \tau^*) p^* dE_1^*. \quad (9b)
\end{align}

Combine (3), (5), and (9) together, making use of (7), we can define the following functions: $M_1 = \tilde{M}_1(p, \tau)$, $E_1^* = \tilde{E}_1^*(p^*, \tau^*)$, $b = \tilde{b}(p, \tau)$, and $b^* =$
\[ \tilde{b}^*(p^*, \tau^*) \], where their derivatives are

\begin{align*}
\tilde{M}_{1p} &= m[M_{1p} + \tau M_1 M_{1b}/(1 + \tau)] \quad (10a) \\
\tilde{M}_{1\tau} &= m p M_1 M_{1b}/(1 + \tau)^2 \quad (10b) \\
\tilde{E}_{1p}^* &= e^*[\tilde{E}_{1p}^* + \tau^*(1 + \tau^*) E_1^* E_{1b}^*] \quad (10c) \\
\tilde{E}_{1\tau^*}^* &= e^* p^* E_1^* E_{1b}^*(1 + 2\tau^*) \quad (10d) \\
\tilde{b}_p &= \tau(M_1 + p\tilde{M}_{1p})/(1 + \tau) \quad (10e) \\
\tilde{b}_\tau &= p[M_1 + \tau(1 + \tau)\tilde{M}_{1\tau}]/(1 + \tau)^2 \quad (10f) \\
\tilde{b}_{p^*} &= \tau^*(1 + \tau^*) (E_1^* + p^*\tilde{E}_{1p}^*) \quad (10g) \\
\tilde{b}_{\tau^*}^* &= p^*[E_1^*(1 + 2\tau^*) + \tau^*(1 + \tau^*)\tilde{E}_{1\tau^*}^*] \quad (10h) \\
m &= 1 - [p\tau/(1 + \tau)] \\
e^* &= 1 - p^* \tau^*(1 + \tau^*). 
\end{align*}

The equilibrium condition of the good-1 market is

\[ \tilde{M}_1(p, \tau) = \tilde{E}_1^*(p^*, \tau^*). \quad (11) \]

Condition (11) is combined with (6b) to solve for the equilibrium price:

\[ p = \hat{p}(\tau, \tau^*). \quad (12) \]

The derivatives of \( \hat{p}(\tau, \tau^*) \) are obtained by totally differentiating (11) and rearranging terms:

\begin{align*}
\hat{p}_\tau &= x \left\{ \tilde{M}_{1\tau} + p\tilde{E}_{1p^*}/[(1 + \tau)^2(1 + \tau^*)] \right\} \\
\hat{p}_{\tau^*} &= -x \left\{ \tilde{E}_{1\tau^*}^* - p\tilde{E}_{1p^*}/[(1 + \tau)(1 + \tau^*)]^2 \right\} \\
x &= \left\{ -\tilde{M}_{1p} + \tilde{E}_{1p^*}/[(1 + \tau)(1 + \tau^*)] \right\}^{-1}.
\end{align*}

The price function in (12) also defines the foreign price function:

\[ p^* = \hat{p}^*(\tau, \tau^*) = \frac{\hat{p}(\tau, \tau^*)}{(1 + \tau)(1 + \tau^*)}. \quad (13) \]

The two price functions are then used to define alternative functions of the tariff revenues:

\begin{align*}
b &= \hat{b}(\tau, \tau^*) \equiv \tilde{b}(\hat{p}(\tau, \tau^*), \tau) \quad (14a) \\
b^* &= \hat{b}^*(\tau, \tau^*) \equiv \tilde{b}^*(\hat{p}^*(\tau, \tau^*), \tau^*). \quad (14b)
\end{align*}
Using equations (12), (13), and (14), the indirect trade utility functions of the countries reduce to

\[ V(\tau, \tau^*; \bar{K}, \bar{L}) = v(\hat{p}(\tau, \tau^*), \hat{b}(\tau, \tau^*); \bar{K}, \bar{L}) \]  
\[ V^*(\tau, \tau^*; \bar{K}^*, \bar{L}^*) = v^*(\hat{p}^*(\tau, \tau^*), \hat{b}^*(\tau, \tau^*); \bar{K}^*, \bar{L}^*) \].  

(15a)  

(15b)

The derivatives of these functions are

\[ V_\tau = \lambda(-M_1 \hat{p}_\tau + \hat{b}_\tau) \]  
\[ V^*_\tau = \lambda(-M_1 \hat{p}^*_\tau + \hat{b}^*_\tau) \]  
\[ V^*_{\tau^*} = \lambda^*(E_1^* \hat{p}^*_\tau + \hat{b}^*_\tau) \]  
\[ V^*_{\tau^*} = \lambda^*(E_1^* \hat{p}^*_\tau + \hat{b}^*_\tau) \].  

(16a)  

(16b)  

(16c)  

(16d)

Initially, both countries choose the tariff rates in a non-cooperative way. This means that the governments choose their own tariffs to satisfy the following equations, each country taking the tariff rate of the other country as given:

\[ V_\tau = 0 \]  
\[ V^*_{\tau^*} = 0. \]  

(17a)  

(17b)

Equations (17) define the two Nash tariff rates, \((\tau^n, \tau^{n*})\). Under normal conditions, \(\tau^n, \tau^{n*} > 0\). Denote the corresponding utility levels of the countries by

\[ V^n = v(p(\tau^n, \tau^{n*}), \bar{K}, \bar{L}, b(\tau^n, \tau^{n*})) = V(\tau^n, \tau^{n*}) \]  
\[ V^*_{n*} = v^*(p^*(\tau^n, \tau^{n*}), \bar{K}^*, \bar{L}^*, b^*(\tau^n, \tau^{n*})) = V^*(\tau^n, \tau^{n*}) \].  

(18a)  

(18b)

Suppose now that the countries engage in a bilateral negotiation to reduce the tariff rates. The results depend on the degree of mobility of capital between the sectors.

### 3 The Case of Perfect Factor Mobility

Suppose now that the countries negotiate to set their trade policies in a cooperative way and assume that whatever agreements they sign are binding.

\[7\]  

\[8\]
Moreover, all factors can move freely and costlessly between sectors within an economy.9

Equilibrium is achieved through Nash bargaining between the countries; i.e.,

$$\max_{\tau, \tau^*} [V(\tau, \tau^*) - V^n]^{\phi} [V^*(\tau, \tau^*) - V^{*n}]^{1-\phi}$$

s.t. $V(\tau, \tau^*) \geq V^n$, $V^*(\tau, \tau^*) \geq V^{*n}$, $\tau$, $\tau^* \geq 0$, (19)

where the variable $\phi$ is a measure of the bargaining power of Home: for $\phi \in (0, 1)$, a rise in $\phi$ represents an improvement in Home’s bargaining power.

To have meaningful analysis, we exclude the extreme case with $\phi = 1 \ (0)$, in which Home (Foreign) has all the bargaining problem so that the problem in (19) reduces to maximizing Home’s (Foreign’s) utility function. It is assumed that if the bargaining breaks down, both countries remain at the Nash equilibrium.

Two features of problem described by (19) can be pointed out. First, no inter-country lumpsum transfer is assumed. Second, import subsidies are ruled out so that the tariffs to be chosen cannot be negative.10

The absence of lumpsum transfer has a strong implication on the cooperative tariff rates. Since free trade is the best policy for the two countries as a whole, if lumpsum transfers are allowed, a cooperative equilibrium will imply free trade, with an appropriate lumpsum transfer to be distributed between the countries in order to share the gain from free trade. With no inter-country transfer, the negotiation in the present problem may not result in free trade.

To simplify our notation, define $A = A(\tau, \tau^*) = V(\tau, \tau^*) - V^n \geq 0$ and $B = B(\tau, \tau^*) = V^*(\tau, \tau^*) - V^{*n} \geq 0$. Note that both $A$ and $B$ are positive if the bargaining leads to a change in tariff rates of the countries. The first-order conditions of the maximization problem can be written as

$$\phi BV_\tau + (1 - \phi) AV^*_\tau \leq 0$$

$$\phi BV^*_\tau + (1 - \phi) AV^*_\tau \leq 0,$$ (20a)

where each weak inequality will be replaced by an equality if the corresponding optimal tariff rate is positive. The chosen tariff rates depend on the initial Nash equilibrium and the countries’ bargaining power.

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9The case of sluggish capital movement will be analyzed in the next section.

10Both assumptions are made in accordance with what is observed, since in multilateral or bilateral negotiations, lumpsum transfers are seldom included in any agreements and tariffs seldom become negative at the end of any negotiation.
We are particularly interested in finding out whether free trade will be chosen. We distinguish between two cases, with the conditions for each case stated:

1. The P Case (Free Trade Is Possible): \( V(0, 0) > V^* \) and \( V^*(0, 0) > V^* \).

2. The NP Case (Free Trade Is Not Possible): either (a) \( V(0, 0) > V^* \) and \( V^*(0, 0) \leq V^* \), or (b) \( V(0, 0) \leq V^* \) and \( V^*(0, 0) > V^* \). \( \text{11} \)

We first consider the P Case, which is illustrated in Figure 1. The diagram shows the Home iso-welfare contour, AB, that passes through the initial Nash equilibrium point \((\tau^*, \tau^*)\). The curve is above the origin, showing that \( V(0, 0) > V^* \). The diagram also shows the Foreign iso-welfare contour, CD, that passes through the Nash equilibrium point N. Curve CD goes below the origin, showing that \( V^*(0, 0) > V^* \). If negative tariffs are allowed, the negotiation will lead to a point on the contract curve between the two countries, EGOHF, which passes through the origin. \( \text{12} \) In the extreme case in which \( \phi = 1 \) (0), with Home (Foreign) possessing all bargaining power, the negotiation equilibrium is represented by point H (G).

To analyze the bargaining equilibrium, for the time being treat Home’s bargaining power \( \phi \) as a parameter and allow negative tariffs to be chosen. A rise in the value of \( \phi \) from zero to unity will imply that the point representing the negotiated tariffs in Figure 1 moves along EF from point G to point H. Because of continuity, there exists a value of \( \phi \in (0, 1) \) that will lead to negotiated tariffs represented by the origin, i.e., free trade. Denote this value of \( \phi \) by \( \tilde{\phi} \). If \( \phi \neq \tilde{\phi} \), and if negative tariffs are ruled out, the negotiated tariffs will not be a point on GH. Instead, it will be a point on either axis, with one country allowing free trade while the other country choosing a positive tariff.

Add up the two first-order conditions (20a) and (20b), replacing the weak inequalities with equalities, to give

\[ \phi B(V_\tau + V_{*\tau}) + (1 - \phi)A(V^*_\tau + V^*_{*\tau}) = 0. \] \( \text{(21)} \)

Rearrange the terms in (21) and define

\[ \Phi(\tau, \tau^*) = \frac{A(V^*_\tau + V^*_{*\tau})}{A(V^*_{\tau} + V^*_{*\tau}) - B(V_\tau + V_{*\tau})}. \] \( \text{(22)} \)

\( \text{11} \) Note that because free trade is the best policy for the world, it is not possible to have \( V(0, 0) \leq V^* \) and \( V^*(0, 0) \leq V^* \).

\( \text{12} \) That the contract curve passes through the origin is due to the fact that the best policy for the world is free trade.
Variable $\Phi(\tau, \tau^*)$ solves equation (21).

When evaluated at the origin with $\tau = \tau^* = 0$, the derivatives of the indirect trade utility functions reduce to:

\[
\begin{align*}
V_{\tau} &= -\lambda pM_1Z \\
V_{\tau^*} &= -\lambda pM_1Z^* \\
V_{\tau}^* &= \lambda^* pE_1^*Z \\
V_{\tau^*}^* &= \lambda^* pE_1^*Z^*
\end{align*}
\]

Making use of (23), $\Phi(\tau, \tau^*)$ evaluated at the origin is equal to

\[
\Phi(0,0) = \frac{\lambda^*_0A_0}{\lambda_0A_0 + \lambda_0B_0},
\]

where the subscript "0" denotes the value of a variable evaluated at $\tau = \tau^* = 0$. It is clear from equation (24) that $0 < \Phi(0,0) < 1$. We now have:

**Proposition 1** (a) In the P case, if the two countries negotiate cooperatively, they end up with the Nash bargaining solution, $(\hat{\tau}, \hat{\tau}^*)$, such that

1. $\hat{\tau} = \hat{\tau}^* = 0$, if $\phi = \Phi(0,0)$,
2. $0 < \hat{\tau} < \tau^*$ and $\hat{\tau}^* = 0$, if $1 > \phi > \Phi(0,0)$,
3. $\hat{\tau} = 0$ and $0 < \hat{\tau}^* < \tau^*$, if $0 < \phi < \Phi(0,0)$.

(b) In the NP case, if $V(0,0) \leq V^*$ and $V^*(0,0) > V^{*n}$, the Nash bargaining solution, $(\hat{\tau}, \hat{\tau}^*)$, will have $\hat{\tau} > 0$ and $\hat{\tau}^* = 0$ for all $\phi \in (0,1)$. If $V(0,0) > V^*$ and $V^*(0,0) \leq V^{*n}$, the Nash bargaining solution will involve $\hat{\tau} = 0$ and $\hat{\tau}^* > 0$ for all $\phi \in (0,1)$.

(c) In all cases, $\hat{\tau} < \tau^*$, $\hat{\tau}^* < \tau^{*n}$, and at least one of $\hat{\tau}$ and $\hat{\tau}^*$ is zero.$^{13}$

**Proof.** (a) Rewrite the first order conditions in equations (20a) and (20b), evaluate them at $\tau = \tau^* = 0$, and rearrange the terms to give

\[
[ -\phi \lambda_0B_0 + (1 - \phi)\lambda^*_0A_0]A \leq 0,
\]

$^{13}$As Mayer (1981) argues, at least one of the countries will allow free trade if both countries cooperate.
where \( \Lambda = M_2^* M_{1p}/(E_1^* - M_{1p}) \). If both countries cooperatively choose free trade, the weak inequality in (25) is replaced by an equality. Equation (25) reduces to

\[-\phi \lambda_0 B_0 + (1 - \phi) \lambda^*_0 A_0 \leq 0,\]

which implies

\[\phi = \frac{\lambda^*_0 A_0}{\lambda^*_0 A_0 + \lambda_0 B_0}.\]  

Equation (26) implies that if \( \phi = \Phi(0, 0) \), then the first-order condition is satisfied at \( \tau = \tau^* = 0 \). In the P case, both countries gain and do not have any incentive to go back to initial Nash equilibrium.\(^{14}\) This is case 1.

For case 2, note that if \( \phi > \Phi(0, 0) \), and if negative tariff rates can be considered, the bargaining solution implies a point in Figure 1 on the contract curve but closer to the Foreign contour CD. This will involve a positive Home tariff rate but a negative Foreign tariff rate. Since negative tariff rates are ruled out, this case will involve zero Foreign tariff rate while the Home tariff rate remains to be positive. Furthermore, with well-behaved Foreign iso-welfare contour, the Home tariff rate chosen as a result of the bargaining will be less than its initial Nash tariff rate. Case 3 can be proved in the same way.

(b) The NP case rules out the possibility of having both countries choosing free trade cooperatively. If it is Home that will be hurt by free trade, it wants to maintain a positive tariff rate while Foreign will choose to allow free trade. Similarly, if Foreign is hurt by free trade, it will want to maintain a positive tariff rate while Home will allow free trade.

(c) Furthermore, the above analysis implies that the chosen tariff rate of each country is less than the initial Nash rate, and that it is not possible that both \( \tilde{\tau} \) and \( \tilde{\tau}^* \) are positive. ■

It is clear from the proposition that \( \Phi(0, 0) = \tilde{\phi} \), the value of \( \phi \) that will give free trade as the bargaining outcome. If \( \phi \neq \tilde{\phi} \), then only one country will liberalize trade completely. Denote the bargained tariffs by \( (\tau^L, \tau^* L) \).

\(^{14}\)The second-order condition is assumed to be satisfied.
4 Sluggish Sectoral Capital Movement

We now assume sluggish capital movement between the sectors in the Home economy and analyze how it may lead to gradual trade liberalization.\textsuperscript{15} Let there be an infinite number of time periods, indexed by variable $t$, $t = 0, 1, 2, ..., \infty$, with factor endowments constant over time. All relevant variables will be time-indexed by superscripts; for example, $\tau^i$ is the tariff rate imposed by the Home government at $t = i$. At time $t = 0$, the Nash tariffs are imposed, $\tau^0 = \tau^0$ and $\tau^*0 = \tau^*0$. The governments negotiate for cooperative tariff rates. To allow the possibility of gradual trade liberalization, we assume that the governments can set their tariff rates twice through negotiation, first when $t = 1$ and then when $t = 2$. In other words, $(\tau^1, \tau^*1)$ and $(\tau^2, \tau^*2)$ are the results of the negotiation. After period 2, the tariff rates remain fixed, $(\tau^t, \tau^*t) = (\tau^2, \tau^*2)$, for all $t \geq 2$. We further assume that the time discount rates of the countries are not too high. This implies that in period 2 both governments will choose the tariff rates $(\tau^2, \tau^*2) = (\tau^L, \tau^*L)$, the same as those determined in the one-period case described in the previous section. Thus the present analysis can focus on the determination of $(\tau^1, \tau^*1)$.

Sectoral movement of capital in Home is sluggish in the sense that it takes one whole period for the movement. For example, $k^1$ needs to be moved from sector 1 to sector 2. In the beginning of period 1 the movement starts and it will arrive sector 2 in the beginning of period 2. During the move, the piece of capital is not productive and the owner receives no income.\textsuperscript{16} Note that even though tariff rates are chosen to be the long-run rates in period 2, because it takes one period to transfer capital from one sector to another means that prices will settle down to the long-run levels in period 3 and beyond.

With the sluggishness of capital movement, the present model in each period is similar to a specific-capital one. As a result, the rental rates in the two sectors may not be equalized. Denote the Home rental rate in sector $j$ at $t = i$ by $r^j_i$ and the discount factor by $\delta$. The Home wage rate at $t = i$ is denoted by $w^i$.\textsuperscript{17} Note that since the economy reaches a long-run equilibrium

\textsuperscript{15}For simplicity, we assume that the Foreign country still has costless factor movement between sectors.

\textsuperscript{16}It is easy to justify the sluggish capital movement: It takes time to dismantle a machine, ship it to another sector, and assemble it again. Moreover, some kind of adjustment of the machine may be needed before it is productive in another sector. All these steps take time.

\textsuperscript{17}Note that with perfect labor mobility between sectors, there is only one equilibrium
at $t = 3$, the factor prices at $i \geq 3$ are $(r_1^i, r_2^i, w^i)$.

Denote the capital stock and labor input in sector $j$ at $t = i$ by $K_j^i$ and $L_j^i$, respectively. Denote the marginal products of capital and labor in sector $j$ at $t = i$ by $F_{jK}(K_j^i, L_j^i)$ and $F_{jL}(K_j^i, L_j^i)$, respectively. Perfect labor mobility between the sectors implies equalization of the value of marginal product of labor:

$$p^i F_{1L}(K_1^i, L_1^i) = F_{2L}(K_2^i, L_2^i).$$  \hfill (27)

If the given labor endowment is $\bar{L}$, which is constant over time, perfect flexibility of prices implies full employment of labor,

$$L_1^i + L_2^i = \bar{L}. \hfill (28)$$

Substitute (28) into (27) and rearrange terms to give

$$L_1^i = \psi(p^i, K_1^i, K_2^i). \hfill (29)$$

It is straightforward to determine the signs of the derivatives of function $\psi$: $\psi^i_p > 0$, $\psi^i_1 > 0$, and $\psi^i_2 < 0$, where $\psi^i_p \equiv \partial \psi / \partial p^i$, $\psi^i_1 \equiv \partial \psi / \partial K_1^i$, and $\psi^i_2 \equiv \partial \psi / \partial K_2^i$.\footnote{These derivatives can be obtained by differentiating (27).}

Using the labor allocation rule as given by (29), we can determine the factor prices:

$$w^i = w(p^i, K_1^i, K_2^i) = p^i F_{1L}(K_1^i, \psi(p^i, K_1^i, K_2^i)) \hfill (30a)$$
$$r_1^i = r_1(p^i, K_1^i, K_2^i) = p^i F_{1K}(K_1^i, \psi(p^i, K_1^i, K_2^i)) \hfill (30b)$$
$$r_2^i = r_2(p^i, K_1^i, K_2^i) = F_{2K}(K_2^i, \bar{L} - \psi(p^i, K_1^i, K_2^i)). \hfill (30c)$$

The factor prices in (30) can be used to define the GDP function:

$$g^i = \hat{g}(p^i, K_1^i, K_2^i) = w^i \bar{L} + r_1^i K_1^i + r_2^i K_2^i. \hfill (31)$$

For simplicity, the given labor endowment in the GDP function is dropped. Equation (31) shows that GDP, which is equal to GNP in the absence of international factor movement, depends on the capital stocks in the two sectors.

Movements of capital between sectors are determined by price-taking capital owners. As analyzed earlier, trade liberalization will raise the rental rate
in sector 2. There are three options for the owners of capital in sector 1: (a) keep their capital in sector 1 in all periods; (b) move their capital in the beginning of period 1 and stay in sector 2 forever; (c) keep their capital in sector 1 in period 1 but move their capital in the beginning of period 2. The payoffs under these three options are:

\[ R^a = r_1^1 + \delta r_1^2 + \delta^2 r_1^L + \delta^3 r_1^L + \cdots = r_1^1 + \delta r_1^2 + \frac{\delta^2}{1 - \delta} r_1^L \]  

\[ R^b = 0 + \delta r_2^2 + \delta^2 r_2^L + \delta^3 r_2^L + \cdots = \delta r_2^2 + \frac{\delta^2}{1 - \delta} r_2^L \]  

\[ R^c = r_1^1 + 0 + \delta^2 r_2^L + \delta^3 r_2^L + \cdots = r_1^1 + \frac{\delta^2}{1 - \delta} r_2^L. \]  

In equilibrium, these three options yield the same payoffs: \( R^a = R^b = R^c \), which implies\(^{19}\)

\[ r_1^1 = \delta r_2^2 \]  

\[ r_1^2 = \frac{\delta}{1 - \delta} (r_2^L - r_1^L). \]  

Equation (33b) has a strong implication: In the presence of sluggish capital movement, the long-run rental rates of the sectors are not equalized since \( r_1^2 > 0 \). The intuition is clear: if at any time the next period rental rates of the sectors are sufficiently close, capitalists in sector 1 will have no incentive to move their capital, and the rental rates cannot get equalized.

Equalization of long-run rental rates, which represents long-run efficiency for Home, can be achieved by imposing a subsidy, \( s = r_1^2 \), to the capitalists who move their capital from sector 1 to sector 2 in period 2. The subsidy expenditure is financed by lump-sum taxation. With the subsidy, the income of the capitalists under option (c) is given by

\[ R^c = r_1^1 + s + \delta^2 r_2^L + \delta^3 r_2^L + \cdots = r_1^1 + \delta r_2^2 + \frac{\delta^2}{1 - \delta} r_2^L. \]  

Comparing equations (32a) and (34) implies that (33b) is replaced by

\[ r_1^1 = r_2^L. \]  

\(^{19}\)Equation (33a) is obtained from (32b) and (32c), and (33b) is derived from (32a) and (32b)
As a result, a total of $k^L$ units of capital will move from sector 1 to sector 2, which implies that the amount of capital that moves in period 2 is equal to $k^2 = k^L - k^1$.

With moving capital being non-productive, the amounts of productive capital stocks in the sectors in different periods are

\[
\begin{align*}
K_1^1 &= K_1^0 - k^1 \\
K_2^1 &= K_2^0 \\
K_1^2 &= K_1^0 - k^2 = K_1^0 - k^L \\
K_2^2 &= K_2^1 + k^1 = K_2^0 + k^1 \\
K_1^L &= K_1^0 - k^L \\
K_2^L &= K_2^2 + k^2 = K_2^0 + k^L.
\end{align*}
\]

These capital stocks are substituted into (33a). Using the functions of the rental rates and the labor allocation function, we have

\[
\begin{align*}
0 &= \partial_k\psi - p^1 F_{1K}(K_1^0 - k^1, \psi(p^1, K_1^0 - k^1, K_2^0)) + \delta F_{2K}(K_2^0 + k^1, L - \psi(p^2, K_1^0 - k^L, K_2^0 + k^1)).
\end{align*}
\]

Equation (37) can be used to express $k^1$ as a function of the two price ratios, $k^1 = k(p^1, p^2)$. Denote the derivatives of $k(p^1, p^2)$ as $k_1 \equiv \partial k/\partial p^1$ and $k_2 \equiv \partial k/\partial p^2$. Differentiate equation (37) totally and rearrange the terms to give

\[
\Psi dk^1 = (F_{1K} + p^1 F_{1KL} \psi_p^1)dp^1 - \delta F_{2KL} \psi_p^2 dp^2,
\]

where $\Psi = p^1 (F_{1KK} + \psi_1^1 F_{1KL}) + \delta (F_{2KK} - \psi_2^2 F_{2KL})$. Note that $(F_{1KK} + \psi_1^1 F_{1KL})$ is the total effect of an increase in the capital stock in sector 1 on the sector’s marginal product of capital. Its sign is ambiguous, but we assume that the direct effect dominates, when the value of $\psi_1^1$ is sufficiently small, so that $(F_{1KK} + \psi_1^1 F_{1KL}) < 0$. Similarly, $(F_{2KK} - \psi_2^2 F_{2KL})$ is the total effect of an increase in sector 2’s capital on the marginal product of capital. With the direct effect assumed to be dominating, $(F_{2KK} - \psi_2^2 F_{2KL}) < 0$. Thus $\Psi < 0$. Equation (38) gives the signs of the derivatives of $k(p^1, p^2)$: $k_1 < 0$ and $k_2 > 0$.

In the presence of sector-specific capital, the indirect trade utility function of the economy at $t = i$ can be defined as:

\[
\tilde{V}(p^i, K_1^i, K_2^i, b^i) = \max u(C_1^i, C_2^i) : p^i C_1^i + C_2^i \leq \tilde{g}(p^i, K_1^i, K_2^i) + b^i.
\]

\[\text{With perfect mobility of labor between sectors within an economy, the labor endowment is dropped from the function in (39).}\]
Denote the import demand function for good 1 at \( t = i \) of Home by \( M_i^1 = M_i(p^1, K_1^i, K_2^i, b^i). \) It is easy to determine the derivatives of the import demand function: \( M_{i1p}^1 = \partial M_i^1 / \partial p^i < 0, \) \( M_{i11}^1 = \partial M_i^1 / \partial K_1^i < 0, \) \( M_{i12}^1 = \partial M_i^1 / \partial K_2^i > 0, \) \( M_{ib}^1 = \partial M_i^1 / \partial b^i > 0. \) Similarly, the export supply function of good 1 of Foreign at \( t = i \) is represented by \( E_i^{*i} = E_i^1(p^{*i}, b^{*i}). \)

Following the approach developed in Section 2, the import demand/export supply function and the tariff revenue can be combined to define new reduced functions: \( M_i^* = \tilde{M}_i^1(p^1, K_1^i, K_2^i, \tau^i), b^i = \tilde{b}(p^1, K_1^i, K_2^i, \tau^i), \) \( E_i^{*i}(p^{*i}, \tau^{*i}), \)

\( b^{*i} = \tilde{b}^{*i}(p^{*i}, \tau^{*i}). \)

Using the capital stocks given in (36) and the price equations in (6), the equilibrium conditions at \( t = 1, 2 \) are

\[
\tilde{M}_1^1(p^1, K_0^1 - k^1, K_2^0, \tau^1) = E_1^{*1}(p^1/(1 + \tau^1)(1 + \tau^{*1}), \tau^{*1}) \quad (40a) \\
\tilde{M}_1^2(p^2, K_0^1 - k^1, K_2^0 + k^1, \tau^2) = E_1^{*2}(p^2/(1 + \tau^L)(1 + \tau^{*L}), \tau^{*2}). \quad (40b)
\]

Equations (40) can be solved for the two equilibrium price ratios as functions of \( k^1 \) and the corresponding tariff rates, i.e., \( p^1 = p^1(k^1, \tau^1, \tau^{*1}) \) and \( p^2 = p^2(k^1). \) The two price functions are then substituted into the capital flow function to yield a reduced-form function:

\[
k^1 = \hat{k}^1(\tau^1, \tau^{*1}) \equiv k^1(p^1(k^1, \tau^1, \tau^{*1}), p^2(k^1)). \quad (41)
\]

Totally differentiate equation (41) to give

\[
dk^1 = k_1^1(p_k^1 dik^1 + p_{\tau^1}^{1}d\tau^1 + p_{\tau^{*1}}^{1}d\tau^{*1}) + k_2^1 p_k^2 dik^1,
\]

which can be solved for the derivatives of \( k^1(.,.,) : \)

\[
\hat{k}_{\tau}^1 \equiv \partial \hat{k}^1 / \partial \tau^1 = k_1^1 p_{\tau}^1/(1 - k_1^1 p_k^1 - k_2^1 p_k^2) \quad (42a) \\
\hat{k}_{\tau^{*1}}^1 \equiv \partial \hat{k}^1 / \partial \tau^{*1} = k_1^1 p_{\tau^{*1}}^1/(1 - k_1^1 p_k^1 - k_2^1 p_k^2). \quad (42b)
\]

Using the function of the moving capital, the indirect trade utility function reduces at periods 1 and 2 to reduce to

\[
U^1 = U^1(\tau^1, \tau^{*1}) \equiv \tilde{V}(p^1(\hat{k}^1(\tau^1, \tau^{*1}), \tau^1, \tau^{*1}), K_1^0 - \hat{k}^1(\tau^1, \tau^{*1}), K_2^0, b^1(\tau^1, \tau^{*1})). \quad (43a) \\
U^2 = U^2(\tau^1, \tau^{*1}) \equiv \tilde{V}(p^2(\hat{k}^1(\tau^1, \tau^{*1})), K_1^0 - k^L, K_2^0 + \hat{k}^1(\tau^1, \tau^{*1}), b^2(\tau^1, \tau^{*1})). \quad (43b)
\]

\[\footnote{For simplicity, the factor endowments are dropped from the Foreign export supply function.}\]
The aggregate welfare level of Home over these two periods is then equal to

\[ W(\tau_1, \tau^*_1) = U^1(\tau_1, \tau^*_1) + \delta U^2(\tau_1, \tau^*_1). \] (44)

The analysis of Foreign is much simpler because sectoral capital movement is costless. The analysis provided in the previous section can be applied here. The foreign utility levels in periods 1 and 2 are equal to

\[ U^1(\tau_1, \tau^*_1) = V^1(p^1(\hat{k}^1(\tau_1, \tau^*_1), \tau_1, \tau^*_1), b^1(\tau_1, \tau^*_1)) \] (45a)
\[ U^2(\tau_1, \tau^*_1) = V^2(p^2(\hat{k}^1(\tau_1, \tau^*_1), \tau_1, \tau^*_1), b^2(\tau_1, \tau^*_1)). \] (45b)

Using equations (45a) and (45b), the foreign aggregate welfare over periods 1 and 2 are

\[ W^*(\tau_1, \tau^*_1) = U^1(\tau_1, \tau^*_1) + \delta^* U^2(\tau_1, \tau^*_1), \] (46)

where \( \delta^* \) is the foreign discount factor.

We now examine the Nash bargaining problem, which can be described as

\[ \max_{\tau_1, \tau^*_1} (W - W^n)^\phi (W^* - W^{*n})^{1-\phi}, \] (47)

s.t. \( W \geq W^n, W^* \geq W^{*n}, \)
\[ \tau_1 \geq 0, \tau^*_1 \geq 0. \]

As assumed before, both countries will stay at the Nash equilibrium if negotiation breaks down. To simplify our notation, define \( \tilde{A} \equiv A(\tau_1, \tau^*_1) = W - W^n \) and \( \tilde{B} \equiv B(\tau_1, \tau^*_1) = W^* - W^{*n}. \) The first-order conditions of the problem, are

\[ \phi \tilde{B} W_\tau + (1 - \phi) \tilde{A} W^*_\tau \leq 0 \] (48a)
\[ \phi \tilde{B} W^*_\tau + (1 - \phi) \tilde{A} W^*_\tau \leq 0, \] (48b)

where a weak inequality is replaced by equality if the equilibrium value of the corresponding tariff rate is positive.

Equations (40a) and (40b) are solved for the countries’ tariff rates in period 1. The solution can be illustrated by Figure 2. Point N represents the initial values of the tariff rates set in period 0, the Nash equilibrium

\[ \text{ Again, for simplicity, factor endowments are dropped from the foreign indirect utility function.} \]
with the countries choosing their tariff rates in a non-cooperative way. The iso-welfare contours of the countries that pass through point N are shown: AB being Home’s contour and CD being that of Foreign.\textsuperscript{23} The diagram also shows the contract curve between the countries, EF, which is the locus of tangency points between the Home iso-welfare contours and the Foreign iso-welfare contours. We assume that EF is well behaved so that it is negatively sloped. It is well-known that the solution to the bargaining problem in (47) is represented by a point on EF.\textsuperscript{24} Assuming that the optimal long-run tariffs of the countries are zero, gradual trade liberalization occurs when the Nash bargaining equilibrium tariffs in period 1 are positive but less than the Nash equilibrium levels.

**Proposition 2** Assume that the optimal long-run tariffs of the countries are zero and that the contract curve is negatively sloped. (a) Gradual trade liberalization occurs when the contract curve (i) is in between the Nash equilibrium point N and the origin; and (ii) cuts the countries’ iso-welfare contours passing through the Nash equilibrium at points with positive tariffs. (b) Trade liberalization will be complete if the contract curve is below the origin.

The proposition can be proved and illustrated in Figure 2, which shows the case in which both countries cooperate to get free trade in the long run. The contract curve has a segment GH bounded by the two iso-welfare contours passing through point N entirely in the first quadrant. This means that the bargaining solution, which is a point (depicted by point T) on GH, involves positive tariffs by both countries in period 1. This is a case of gradual tariff reduction. If, however, EF is below the origin (a case not shown in Figure 2), then the bargaining solution will be the origin since negative tariffs are ruled out. In this case, complete trade liberalization is immediate.\textsuperscript{25}

\textsuperscript{23}Note that the iso-welfare contours do not necessarily have the usual slopes at point N - zero slope for AB and infinite slope for CD - because the Nash equilibrium is obtained by having each country maximizing its long-run utility function, not function $W(\ldots)$.

\textsuperscript{24}If $\phi$ is treated as a parameter, a rise in $\phi$ will shift the equilibrium point along EF toward point F.

\textsuperscript{25}If the segment GH is partly beyond the vertical axis and/or horizontal axis, the bargaining solution may involve free trade by one (but not both) of the countries in period 1. See Kim and Wong (2007) for more details.
The case shown in Figure 2 can be used to illustrate the current and previous trade talks. Because of sluggish resource reallocation, countries could find it beneficial to take steps to move to the free-trade equilibrium, which is the optimal cooperative equilibrium in the long run. This explains why all these talks, including the present Doha Round, involve only partial but not complete trade liberalization.

5 Conclusion

In this paper, we examine how two countries negotiate for trade liberalization when agreements are binding. In a frictionless world, at least one of the countries (or even both) will choose to allow free or freer trade immediately, even if no international lumpsums are available.

In the real world, it is observed that multilateral or bilateral trade negotiations usually involve gradual trade liberalization. We offer one explanation of this phenomenon: costly and sluggish resource reallocation. Using a neoclassical framework of international trade, we explain how sluggish resource reallocation may affect the countries’ negotiation and their choice of tariff rates. For the countries, choosing to liberalize trade gradually instead of immediately is a way to maximize their welfare.

Our model consists of two chances of tariff change. In a more complicated model, countries can have more chances of tariff adjustment, as countries in the real world can. Following the same line of argument, one can find the conditions under which gradual trade liberalization can take place in many periods. One implication of this is that what the countries are trying to reach in the current Doha Round of trade negotiation is not the long-run optimal point and the Doha round may not be the final round, i.e., more rounds of trade talks can be expected in the future.
Figure 1
Figure 2
References


