Starting Small in Free Trade Agreements

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Abstract. This paper analyzes the structure of cooperation between two large countries under one-sided incomplete information. Foreign government privately observes its likelihood of experiencing a political economy shock in each period. Home government's prior belief about this likelihood is updated in a Bayesian fashion as the relationship continues. We show that the home government employs its privilege to design a contract so as to start with a few-goods-agreement, and increase the extent of cooperation gradually as its belief is favorably updated through periods. We also provide the conditions under which the home government makes the partner reveal its type in the beginning, or enables it to stay in a cooperative relationship without a complete revelation. As opposed to conventional approaches that relate gradualism with cost of liberalization, we show that asymmetric information provides a sufficient reason for gradualism to emerge.

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1. Introduction

Trade liberalization does not occur overnight. A series of bilateral and multilateral agreements have gradually reduced the average tariff rate from 18% in Europe and 15% in North America in the late 1950s to 4% in the North Atlantic nations by the end of 20th century (Baldwin, 2006). Gradualism in free trade agreements, however, is not limited to tariff reductions. A noteworthy aspect of the transition from protectionist trade policies to freer trade is the gradually increasing scope of liberalization. Trading partners might prefer starting with a few-goods-agreement, and gradually transform it to a more comprehensive one under favorable circumstances.

Historically, one can observe that sector-based gradualism has been manifested in multilateral, bilateral, and regional forms. New tariff concessions under the GATT terms were negotiated on a product-by-product basis in Geneva (1947), Annecy (1949), Torquay (1951), Geneva (1956) and Dillon (1960-61) rounds. Almost two decades after the initial negotiations for the GATT negotiators expanded the method to an industry/sector-wide schedule for the first time in the Kennedy Round of 1962-67. The European Coal and Steel Community (1951) and the US-Canada Auto Pact (1965) are other well known cases which prepared the ground for further cooperation between signatory governments. Yet, not all sector-specific agreements are designed to evolve into broad cooperation schemes. More recently, the US government negotiated sector-specific agreements on “zero-for-zero” basis. Information Technology Agreement (ITA) was developed in 1996 and followed by Financial Services Agreement (FSA) in 1997. Following the success of the former agreement, APEC ministers negotiated nine additional sectors in Vancouver in 1997, which failed due to the objections of Japan and other Asian countries. The most important difference between the agreements with a gradually increasing scope and the recent zero-for-zero sector-based agreements arises in dispute settlement procedure. The former type of agreement denotes a body of linked issues with relatively flexible cross-retaliation prospects; whereas the latter one defines a series of unlinked issues with very limited cross-retaliation possibilities. This paper examines gradualism in free trade agreements in the framework of linked agreements. More specifically, we investigate the mechanism behind the gradual increments in the number of issues linked to the original body. Why do countries prefer starting an agreement with a few sectors rather than settling with the optimal scope at the outset of an agreement? Under which conditions does the initial agreement with limited scope provide further cooperation later on?

This paper proposes an answer for these questions within a stylized perspective. Unilaterally optimal trade policies harm trading partners through terms-of-trade externalities. Reciprocal concessions in otherwise selfishly commanded trade, therefore, provide gains for both countries in a long term relationship. We show, however, that the presence of asymmetric information regarding the partner’s incentive to betray in the future impedes full cooperation in early stages of the relationship. Governments prefer “starting small” in an uncertain environment in order to reduce the cost of partner’s betrayal. Learning about trading partner’s incentive structure enhances expectations and encourages governments to increase their current level of cooperation. More specifically, the uninformed government’s subjective belief for the trading partner being “good” is improved as the partner cooperates under a self-enforcing agreement. This updated belief, in turn, lowers the subjective probability of future betrayal, enabling further progress in cooperation. Learning, therefore, is the mechanism that provides gradualism in our model.

To assess the evolution of cooperation we develop a simple model in which two large countries produce and trade a continuum of goods. Although we assume that countries are symmetric in both demand and supply conditions, there are two important asymmetries: the presence of one-sided incomplete information and the privilege of uninformed government to propose a contract. Foreign government privately observes its dynamically stochastic political economy concerns. It may experience political economy shocks in the form of protectionist bias for its import competing sectors. Home government proposes a contract using its subjective belief, in response, since it cannot observe the actual probability of a shock. Therefore, the model suggests a case where a "weak" (foreign) country requests access to a free trade agreement and the "strong" country (home or a customs union) proposes the terms of the agreement, specifically the scope of the agreement. Some typical examples for these "new regionalist" agreements (Ethier, 1998) are Mexico's accession to NAFTA, EU's enlargement in Eastern Europe, and free trade agreements between US and others[2] which prevail or are proposed.

Our analysis builds on a recursive structure that emerges from an infinitely repeated interaction. We define the type of the foreign government on the basis of its likelihood of experiencing a political economy shock. By choice of parameters, if the probability of that shock is high enough (type-2), then the foreign government betrays by choosing unilaterally optimal tariffs whenever that shock is realized. On the other hand, it cooperates even when the shock occurs if the probability is low enough (type-1). In the absence of informational asymmetry, where the type of foreign government is common knowledge, governments cooperate at a maximum level starting with the first period if they are patient enough given the probability of a shock. Cooperation when the type of foreign government is not observed by the home government is, however, more cumbersome. Home government's prior belief about the foreign government's type is updated in a Bayesian fashion upon observing foreign government's action in each period. Therefore, an agreement should take any additional information revealed in the course of a relationship into consideration. One way to do this is assuming that the long-term relationship is run by a sequence of short-term contracts. Alternatively, the initial agreement can be designed so as to avoid reneging without loss of generality (see Laffont and Tirole, 1990). We follow the second option.

We specify two classes of equilibrium in asymmetric information environment. In a pooling equilibrium, both types of foreign government cooperate perpetually as long as no shock is observed. Only a type-2 foreign government betrays whenever a shock is realized. We show that the home government proposes increasing the cooperation gradually, conditional on the cooperative action of foreign government in equilibrium. Eventually the cooperation level reaches the maximum and stays stationary afterwards unless betrayal is observed. In a separating equilibrium, on the other hand, probability of political economy shock for a type-2 foreign government is high enough that it betrays, even before a shock is realized, when the cooperation is stationary. Home government needs to provide sufficient intertemporal incentives to keep type-2 foreign government in a cooperative relationship. This comprises

[2] These countries include Australia, Bahrain, Chile, Colombia, Israel, Jordan, Korea, Morocco, Singapore, Panama, Peru and Oman.

our version of the well known “Bicycle Theory,” which was discussed by Bhagwati (1988). A failure to provide further liberalization ends up bringing cooperation to an end. However, “pedaling” cannot be sustained forever in our model since the level of cooperation is bounded above by the number of goods. Therefore, cooperation with a “bad” partner is dissolved eventually once the countries deplete their liberalization prospects, if not before. Yet the dissolution of partnership through the separation of types is also non-trivial due to the “ratchet effect.” After the foreign government is revealed to be type-1, the home government optimally proposes maximum cooperation for the rest of the relationship. However, foreseeing this jump in cooperation level, type-2 foreign government postpones the betrayal one period to get a higher deviation payoff in maximum cooperation stage. We show that when the home government is optimistic enough about the foreign government’s type, it prefers “testing” the foreign government in the beginning of their relationship by proposing a high cooperation level. An interesting implication is that the more patient that an uninformed government is, the more likely it resolves the uncertainty in the beginning of relationship by “testing” its partner.

The literature on gradualism in trade agreements extensively utilizes a non-stationary economic environment as the source of dynamic adjustment in tariffs. Staiger (1995) formalizes gradual tariff reduction in a self-enforcing trade agreement framework. Existence of import competing sector workers with sector-specific skills provides rent-generating potential of tariff hikes. Liberalization relocates a portion of these workers. Once a worker is relocated from the import competing sector, she loses her sector-specific skill with a given probability, which yields a non-stationary environment. As the supply of workers with sector specific skills shrinks, high tariffs become less desirable and the sustainable cooperative tariff drops. Therefore, initial progress in trade liberalization enables further liberalization in the future. Similarly, Furusawa and Lai (1999) shows that gradualism emerges when adjustment costs arise due to labor mobility between sectors. Chisik (2003) explicitly recognizes the non-stationary aspect of trading environment. In his paper, specialization and development of partner specific capital decreases the most cooperative tariff within time. A small tariff reduction provides further accumulation of capital in the export sector with a certain degree of irreversibility, which in turn increases both the benefit of continuing the liberalization and cost of a tariff war. Chisik (2009) analyzes multi-sector free trade agreements with an emphasis on dynamic changes in the scope of linked agreements and the emergence of zero-for-zero agreements. Linking agreements provide further liberalization in the presence of irreversible partner specific costs and perfectly correlated noise across sectors. As the correlation decreases, however, liberalization becomes more enforceable in some sectors in an unlinked agreement. The paper also shows that unlinked agreements will eventually be pursued as the body of linked agreements matures. In Maggi and Rodriguez-Clare (2005), frictions in capital mobility and lobbying lead to gradualism.

As opposed to previous literature, Bond and Park (2002) formalize a case where the gradualism result does not depend on evolution of a state variable. Given asymmetric country sizes, liberalization exhibits a non-stationary pattern due to desire of the small country to smooth consumption over time. As the non-stationary and efficient trade agreement promises rising payoffs to the small country, most cooperative tariffs are reduced over time through relaxation in its incentive constraint, which is the binding one. Conconi and Perroni (2004) also focus on asymmetric country size as a source of dynamic change in degree of liberalization, however with an emphasis on commitment issues in small countries. Finally, Zissimos (2007) investigates the impact of GATT dispute settlement procedure (specifically Article XXIII) on gradual liberalization.

Our work differs from the first group of literature in the sense that we show gradualism can emerge without adjustment costs. Similar to Bond and Park (2002), economic environment is stationary in our model. However, unlike the second group of literature, we do not use asymmetries between economies. Hence, our result of gradualism is robust to changes in economic environment. Game theoretic technique employed in this paper is similar to a long term partnership model with two-sided incomplete information developed in Watson (1999) and Watson (2002). Formalizing dynamic games with variable stakes and two types of players, the latter work describes the equilibrium regimes where different types of players separate in the beginning since a certain type of player 1 deviates, and level of cooperation rises gradually then after, under commitment. The former paper models cooperation under renegotiation condition and shows a quick separation phase followed by a gradual cooperation one. Furusawa and Kawakami (2006) shows that gradualism arises in a two sided incomplete information game with variable stakes and outside options. In this paper we characterize a long term relationship with one-sided incomplete information and Prisoner's Dilemma type payoff structure. A major difference that brings our problem close to a screening framework is hierarchical relationship between players, i.e. home government has privilege to design the contract.

The paper proceeds as follows. Next section describes the basic economic environment and trade relationship between countries. We solve for a complete information optimal cooperation model as a benchmark case. Section 3 introduces asymmetric information into the model. We derive incentive constraints in a self-enforcing trade agreement and define incentive feasible cooperation with respect to different types of the foreign government and the optimal cooperation with respect to the home government. The last section concludes. Proofs are contained in the appendix.

2. The Model

In this section, we present the characteristics of our basic model of trade between two large countries. We start by defining the structure of trade within a simple framework; we introduce an optimal agreement model with complete information where the home government, observing conditions in the foreign country, proposes an incentive compatible contract that maximizes its expected welfare.

2.1. Basic Set Up

We consider a two country partial equilibrium model where both countries produce goods in a continuous interval $[0, n]$. We assume that demand functions are identical across goods and countries: $D_i(P_i) = A - P_i$, and $D_i^*(P_i^*) = A - P_i^*$, $i \in [0, n]$, where P_i and P_i^* denote the local prices of good i in the home and foreign countries. All goods in the model are produced in both countries, however have different supplies: $Q_i(P_i) = a_i P_i$ and $Q_i^* = a_i^* P_i^*$. The corresponding home and foreign country export supply and import demand functions are then: $E_i(P_i) = Q_i(P_i) - D_i(P_i)$, $M_j(P_j) = D_j(P_j) - Q_i(P_j)$, $E_j^*(P_j^*) = Q_j^*(P_j^*) - D_j^*(P_j^*)$, and $M_i^*(P_i^*) = D_i^*(P_i^*) - Q_i^*(P_i^*)$, respectively. We assume $a_i = a_j^* = \overline{a}$, and $a_j = a_i^* = \underline{a}$, $\forall\, i \in [0, n/2)$, $j \in (n/2, n]$, where $\overline{a} > \underline{a}$. It is immediate that the home country exports in the region $[0, n/2)$, and imports in the region $(n/2, n]$. We will denote the former interval as export sector, and the latter one as import sector for the home country. Countries, therefore, have identical supplies of goods within a specific sector, and they are symmetric; i.e. the supplies of home export goods and foreign exports goods are identical.

Each government imposes a specific import tariff, τ_j and τ_i^* on their importable goods. Importers pay the world price of an imported good and the specific import tariff, whereas exporters of that good get only the world price $P_j(\tau_j) \equiv P_j^w(\tau_j) + \tau_j$ and $P_j^w(\tau_j) = P_j^*(\tau_j)$, where asterisk denotes foreign value. In the presence of non-prohibitive tariffs market clearing conditions provide the equilibrium world and local prices. Solving $M_j(P_j^w + \tau_j) = E_j^*(P_j^w)$ we get the equilibrium prices $\hat{P}_j(\tau_j)$ and $\hat{P}_j^w(\tau_j)$ with explicit solutions: $\hat{P}_j^w(\tau_j) = \frac{2A - \tau_j(1+a_j)}{2+a_j+a_j^*}$, and $\hat{P}_j(\tau_j) = \frac{2A + \tau_j(1+a_j^*)}{2+a_j+a_j^*}$. The prices of foreign country import goods are found analogously.

Following the convention, we assume that each government maximizes a social welfare function composed of consumer surplus, producer surplus and tariff revenues from import goods. Formally, social welfare on a single exportable good in the home country is given by:

$$W_i(P_i^w) = x_i = \int_{P_i^w}^{A} D_i(P_i)dP_i + \pi_i(P_i^w) \tag{2.1}$$

Welfare generated by a single importable good in the home country is:

$$W_j(\hat{P}_j, P_j^w) = m_j = \int_{\hat{P}_j}^{A} D_j(P_j)dP_j + \pi_j(\hat{P}_j) + [\hat{P}_j - P_j^w]\, M_j(\hat{P}_j) \tag{2.2}$$

We define the aggregate welfare in home country as the sum of welfares generated by individual export and import goods: $w(.) \equiv \int_{i=0}^{\underline{i}} x_i di + \int_{j=\underline{i}}^{n} m_j\, dj$. As opposed to the home government, we assume that foreign government faces political economy considerations in import competing goods. This is represented by identical weight parameters, γ, assigned to producer surpluses of respective goods imported by the foreign country. Formally, the foreign country welfare on an importable good is, then:

$$W_i^*(\hat{P}_i^*, P_i^w) = m_i^* = \int_{\hat{P}_i^*}^{A} D_i^*(P_i^*)d\,P_i^* + \gamma\pi_i^*(\hat{P}_i^*) + [\hat{P}_i^* - P_i^w] M_i^*(\hat{P}_i^*) \tag{2.3}$$

Foreign country political-economy parameter γ is drawn from a discrete set of possible values $\Gamma \equiv \{\gamma^L, \gamma^H\}$ in each period, where γ^L and γ^H denote the low and high values of γ respectively. Therefore, we associate a "state of nature" with the realized political-economy parameter: A high (low) state denotes the realization of a high (low) political economy parameter in an arbitrary period. On the other hand, the "type" of foreign government is defined with respect to the probability of getting low state of nature in each period. A type-1 (good type) foreign government has probability p_1 of getting a low state of nature (good state) in a given period, whereas a type-2 (bad type) foreign government's likelihood is defined with p_2, where $0 < p_2 < p_1 < 1$. The type of foreign government is determined by nature beforehand and is fixed throughout the game as opposed to state of nature.

In the absence of a trade agreement, governments apply Nash tariffs in importable goods, which unilaterally maximize their own welfares, $\tau_j^N \equiv \arg\max m_j(\tau_j)$ and $\tau_i^{*N}(\gamma) \equiv \arg\max m_i^*(\tau_i^*(\gamma), \gamma)$. Using the first order conditions one can show that the foreign country Nash tariff is increasing in its political economy parameter. Due to the identical demand and supply structures, unilaterally optimal tariffs and therefore welfares on goods in the same sector are equal. This enables us remove subscripts that denote different goods in the same sector. With no cooperative agreement the relationship between the trade partners exhibits characteristics of a repeated prisoner's dilemma game. Each country's welfare is increasing in its own tariff but is decreasing in partner's tariff due to terms-of-trade deterioration. Jointly efficient tariffs maximize the world welfare, but are undermined by unilateral incentives to deviate.

A trade agreement specifies a sequence of cooperative tariffs (τ_t, τ_t^*) and a sequence of cooperation level α_t for $\alpha \in \left[0, \frac{n}{2}\right)$ and $t \in \{1,2,..\}$, which denotes the number of goods included in the agreement. We restrict attention to a symmetric and stationary tariff case, where both countries apply the identical cooperative tariff throughout the cooperative relationship, in order to focus on effects of cooperation level. This cooperative tariff is lower than the unilaterally optimal one, and can be equal to zero as well. Any particular value, however, does not have a critical implication for our purposes in this paper; therefore we do not specify it explicitly to avoid an unnecessary restriction. Stage game payoffs are defined as the sum of cooperative welfares on agreement goods and non-cooperative welfares on non-agreement goods. The cooperative payoff of the home country in period t is:

$$w^c(\alpha_t) \equiv \int_0^{\frac{n}{2}-\alpha_t} x^N di + \int_{\frac{n}{2}-\alpha_t}^{n/2} x^c di + \int_{n/2}^{\frac{n}{2}+\alpha_t} m^c di + \int_{\frac{n}{2}+\alpha_t}^{n} m^N di \tag{2.4}$$

Given the level of cooperation in an arbitrary period, α_t, the first term on the right hand side in equation (2.4) denotes the sum of the welfares from export goods that are not included in the agreement, the second term is the welfare from export goods that are in the agreement, the third term is the welfare from import goods in the agreement, and the final term is the welfare from import goods that are not included in the agreement. The identical structure of demand and production across the goods in each sector enables us write this equation as $w^c(\alpha_t) \equiv \left(\frac{n}{2} - \alpha_t\right) \cdot (m^N + x^N) + \alpha_t(m^c + x^c)$. We will write the welfare of foreign government in a high (low) state of nature with an over-bar (under-bar). Figure 1 displays the payoff matrices for a bundle of goods in different states of nature under the agreement.

Low State of Nature

	Betray	Cooperate
Betray	$x^N + m^N$, $\underline{x}^N + \underline{m}^N$	$x^c + m^N$, $\underline{x}^N + \underline{m}^c$
Cooperate	$x^N + m^c$, $\underline{x}^c + \underline{m}^N$	$x^c + m^c$, $\underline{x}^c + \underline{m}^c$
Type 1:	(p_1)	
Type 2:	(p_2)	

High State of Nature

	Betray	Cooperate
Betray	$x^N + m^N$, $\overline{x}^N + \overline{m}^N$	$x^c + m^N$, $\overline{x}^N + \overline{m}^c$
Cooperate	$x^N + m^c$, $\overline{x}^c + \overline{m}^N$	$x^c + m^c$, $\overline{x}^c + \overline{m}^c$
Type 1:	$(1 - p_1)$	
Type 2:	$(1 - p_2)$	

Figure 1. Payoffs from a bundle of goods in different states of nature under an agreement

In the absence of an external enforcement mechanism, we characterize a self-enforcing agreement that depends on credible threats of future punishments to enable cooperation in a non-cooperative environment. We assume that governments abrogate the agreement and permanently reverse to unilaterally optimal tariffs following a deviation by either country. Nash reversion strategies imply that when a government betrays by applying Nash tariffs, it prefers to do so in all import goods since the partner applies Nash tariffs in all goods in the punishment stage. Stage game payoff of the betraying foreign government in a low state of nature becomes $\underline{w}_t^d(\alpha_t) \equiv \left(\frac{n}{2} - \alpha_t\right) \cdot \left(\underline{m}^N + \underline{x}^N\right) + \alpha_t\left(\underline{m}^N + \underline{x}^c\right)$. Since the welfare on an import good is always greater with unilaterally optimal tariffs by definition, the stage game payoff in a deviation period is greater than the one in a cooperative period. The payoff in the Nash reversion period has the lowest value among others $\underline{w}_t^{*N} \equiv \frac{n}{2}\left(\underline{m}^N + \underline{x}^N\right)$. Payoffs of the home country are defined analogously. However, we introduce an assumption about unilaterally optimal tariffs.

Assumption 1. *Foreign Nash tariffs are prohibitive.*

The reasoning behind this assumption is as follows. Foreign government's Nash tariff changes with different political economy parameter values, which is bounced in variations in home government welfares on export goods. However, we want to restrict the mechanism through which the home government can extract signals about the type of foreign government in our model with one-sided incomplete information. Therefore, the practice of foreign government in non-agreement goods is assumed to provide no further information about its type and state of nature. Nevertheless, this assumption provides great simplification without changing qualitative results of our model. This condition is represented by identical home government Nash payoffs in export goods in Figure 1. The interaction between trading partners is then an infinitely repeated prisoner's dilemma in α non-stationary identical issues with stochastic payoffs in each period. Next section characterizes the equilibrium of this relationship in the absence of informational asymmetries.

2.2. Stationary Cooperation in a Complete Information Environment

This section introduces a benchmark case with a long-term relationship in the absence of informational asymmetry. We provide a non-result for the emergence of gradualism in a complete information environment. The idea here is that when the home government observes the probability of a shock in the foreign country, then whatever policy is incentive compatible for a single good is also incentive compatible for the entire import sector. The number of goods included in an agreement does not induce the foreign government with more or less incentives to cooperate. The future costs of betrayal and the current benefits from it change proportionally with scope of an agreement. Similarly, costs for the home government borne by the risk of foreign government betrayal rises in proportion to the rise in benefits from cooperation. Hence, both governments prefer cooperating at a maximum rate given that it is incentive compatible.

The game starts after the realization of foreign government's type by nature in period 0, and the home government proposes a contract upon observing this type. Equilibrium is characterized by an incentive compatible path of cooperation level and tariffs. We consider a stationary cooperation level, i.e. $\alpha_t = \alpha,\ \forall t \in [1, \infty)$, to show this ex-post. A cooperative action profile is sustainable if payoff structure does not induce the governments with a profitable one-shot deviation. We analyze the incentive structure of foreign government in the presence of an agreement, and then go back to period 0 to investigate the home government's optimal contracting problem. We start with a type-1 foreign government. Incentive compatibility requires that:

$$(1-\delta)\cdot \underline{\Omega}^d \le \delta \cdot E(\Omega^c|p_1) \qquad (IC-1L)$$

$$(1-\delta)\cdot \overline{\Omega}^d \le \delta \cdot E(\Omega^c|p_1) \qquad (IC-1H)$$

Where $\underline{\Omega}^d \equiv \underline{m}^N - \underline{m}^c$ denotes a onetime gain from deviation on a single good in a low state of nature. Foreign government uses expected gain from an agreement, $E(\Omega^c|p_1) \equiv (1-p_1)\cdot \overline{\Omega}^c + p_1 \cdot \underline{\Omega}^c$, in order to calculate the future payoff stream. The expected gain is a weighted sum of gains in a high state of nature $\overline{\Omega}^c \equiv \overline{m}^c + \overline{x}^c - \overline{m}^N - \overline{x}^N$ and in a low state $\underline{\Omega}^c \equiv \underline{m}^c + \underline{x}^c - \underline{m}^N - \underline{x}^N$, since the states are not correlated through consecutive periods. A notable aspect of these incentive constraints is the non-existence of cooperation level in the explicit formulation even though they denote overall payoffs. This property arises because the cooperation level appears linearly on both sides of the inequalities[3]. This shows that if a type-1 foreign government betrays (cooperates) in a complete information environment with a stationary cooperation level, it does so regardless of the time and cooperation level.

[3] To see how the cooperation level is eliminated from these constraints we write them in the following way. For a type-1 foreign government these become $\underline{w}_t^{*c} + \delta . V^{*c}(p_1) \ge \underline{w}_t^{*d} + \delta . V^{*N}(p_1)$ in a low state and $\overline{w}_t^{*c} + \delta . V^{*c}(p_1) \ge \overline{w}_t^{*d} + \delta . V^{*N}(p_1)$ in a high state. Here V^{*c} and V^{*N} denote the continuation values following a cooperative and non-cooperative action profile in the current period. Formally, $V^{*c}(p_1) = \frac{1}{(1-\delta)}\left[(1-p_1)\overline{w}^{*c} + p_1 \underline{w}^{*c}\right]$, and $V^{*N}(p_1) = \frac{1}{(1-\delta)}\left[(1-p_1)\overline{w}^{*N} + p_1 \underline{w}^{*N}\right]$. When we plug the explicit forms of continuation values into the constraints, cooperation levels are cancelled out since both sides contain it in multiplicative form.

We now compare the two incentive constraints in terms of strictness to show that the one in a high state of nature binds first. The following Lemma specifies some characteristics of complete information game regarding the payoffs of foreign government, which will be useful to determine the binding constraint.

Lemma *1*. *For small enough cooperative tariffs in foreign country,*

(a) Gains from cooperative agreement decreases in political economy parameter, $\frac{d\Omega^c}{d\gamma} < 0$*; therefore* $\underline{\Omega}^c > \overline{\Omega}^c$,

(b) Gains from deviation increases in political economy parameter $\frac{d\Omega^d}{d\gamma} > 0$*; therefore* $\overline{\Omega}^d > \underline{\Omega}^d$.

Using the results from Lemma 1 to evaluate the left hand side values of the incentive constraints for a type-1 foreign government, we see that the constraint in high state of nature binds first. Intuitively, if a type-1 foreign government does not betray at a time when domestic political pressures are at a peak, then it does not do so when the pressure is lower. Solving $(IC - 1H)$ for the critical level of probability, we get a necessary condition for cooperation $p_1 \geq \hat{p}_1$, where $\hat{p}_1 = \frac{(1-\delta)\overline{\Omega}^d - \delta\overline{\Omega}^c}{\delta\left[\underline{\Omega}^c - \overline{\Omega}^c\right]}$. By Lemma 1, again, it is straightforward to show that this critical level of probability decreases in discount factor for high enough values. Therefore, the requirement regarding the frequency of a shock is stricter for relatively impatient foreign governments.

We now describe the incentive compatibility issues for a type-2 foreign government. A type-2 foreign government characterizes a "risky" partner for the home government as opposed to the "safe" type-1 foreign government in our model. To introduce this characteristic, we start with a key assumption that will hold throughout this paper.

Assumption 2. $p_2 < \overline{p}_2$, *where* $\overline{p}_2 = \frac{(1-\delta)\overline{\Omega}^d - \delta\overline{\Omega}^c}{\delta\left[\underline{\Omega}^c - \overline{\Omega}^c\right]}$.

Remember that foreign government betrays regardless of the time, if it ever does so, in a complete information environment with stationary cooperation levels. Assumption 2 formally specifies that a type-2 foreign government always betrays in a high state of nature. Hence, the realization of a political economy shock is a sufficient but not necessary condition for a type-2 foreign government to deviate from cooperative path. The incentive constraint of a type-2 foreign government in a low state of nature is different than the one for type-1 in the sense that the former constraint incorporates possible future betrayal payoffs. Formally,

$$(1 - \delta p_2)\underline{\Omega}^d \leq \delta \cdot \left[E(\Omega^c|p_2) + (1 - p_2) \cdot \overline{\Omega}^d\right] \qquad (IC - 2L)$$

which can be reduced to $p_2 \geq \hat{p}_2 = \frac{\underline{\Omega}^d - \delta\left(\overline{\Omega}^c + \overline{\Omega}^d\right)}{\delta\left[\underline{\Omega}^d + \underline{\Omega}^c - \left(\overline{\Omega}^d + \overline{\Omega}^c\right)\right]}$. It is straightforward to show that for $\delta \geq \frac{\underline{\Omega}^d}{\left(\overline{\Omega}^d + \overline{\Omega}^c\right)}$ this inequality is satisfied trivially, and for discount rate values lower than this critical level there is no solution. These characteristics illustrate that for a sufficiently patient type-2 foreign government, a relationship with stationary cooperative level is sustainable as long as a shock does not occur.

In a complete information environment, the type of foreign government, the associated minimum probability that provides cooperation, and the actual probabilities are all common knowledge. Therefore, the home government is provided with the ability to tailor the agreement to maximize its expected payoffs. It is obvious that we have equilibria in which the foreign government betrays in the first period, and the home government does not propose any cooperation. These cases arise when sufficiently small probabilities violate the incentive constraints of foreign government, i.e. $p_1 < \hat{p}_1$ and $p_2 < \hat{p}_2$. However, we shall focus on more interesting cooperative equilibria in which the foreign government cooperates perpetually and the home government proposes positive cooperation level. Incentive compatibility condition for the home government interacting with a type-1 foreign government is:

$$w^d(\alpha) + \delta V^N \leq w^c(\alpha) + \delta V^c \tag{2.4}$$

Similar to foreign government incentive constraints, this condition rules out a profitable one-shot deviation for the home government. In the absence of an external enforcing mechanism, the agreement proposed by the home government needs to be credible, i.e. the home government should have no incentive to betray. The following proposition provides an important result regarding the complete information case.

Proposition 1. *If incentive compatibility constraints are satisfied for both governments, then a trade agreement with maximum cooperation in all periods Pareto dominates others in a complete information environment.*

Proposition 1 shows that the home government proposes a maximum cooperation in the beginning of a relationship, when incentive constraints are satisfied. Using this result to define the cooperative continuation value on the right hand side, we get $V^c = \sum_{i=0}^{\infty} \delta^i w^c(\overline{\alpha})$, where $\overline{\alpha}$ denotes the maximum cooperation level. Therefore, inequality (2.4) can be reduced to $\delta \geq \frac{\Omega^d}{(\Omega^d + \Omega^c)}$. When $p_1 \geq \hat{p}_1$and home government is patient enough, cooperation starts at maximum level and is sustained afterwards. If foreign government is known to be type-2, then home government needs to incorporate the probability of high state of nature into account, since the foreign government betrays in that case. Incentive constraint for the home government becomes:

$$p_2 w^d(\overline{\alpha}) + (1 - p_2) w^N(\overline{\alpha}) + \delta V^N \leq p_2[w^c(\overline{\alpha}) + \delta V^c] + (1 - p_2)[w^{-d}(\overline{\alpha}) + \delta V^N] \tag{2.5}$$

Using the result from proposition 1, we get $V^c = \frac{1}{1-\delta p_2}\left[p_2 w^c(\overline{\alpha}) + (1 - p_2) w^{-d}(\overline{\alpha}) + \frac{\delta(1-p_2)}{1-\delta} w^N\right]$, which involves the risk of being betrayed in each period. Plugging this in (2.5) and solving for the minimum discount factor that satisfies the incentive constraint, we get $\delta \geq \frac{\Omega^d}{{p_2}^2(\Omega^d + \Omega^c)}$, which can be shown to be greater than the value in case of a type-1 foreign government. Therefore, there exists an interval of discount factor values where home government cooperates only with a type-1 foreign government. The greater is the probability of getting a low state of nature for a type-2 government, the more patient home government needs to be to propose full cooperation in complete information case.

This result shows that cooperation level proposed in a complete information trade agreement is given by the following conditions:

$$\forall t \in [1,\infty), \quad \alpha_t = \begin{cases} \overline{\alpha} & if\ type1\ and\ \ p_1 \geq \hat{p}_1\ , \delta \geq \dfrac{\Omega^d}{(\Omega^d + \Omega^c)} \\ \overline{\alpha} & if\ type2\ and\ p_2 \geq\ \hat{p}_2\ , \delta \geq \dfrac{\Omega^d}{{p_2}^2(\Omega^d + \Omega^c)} \\ 0 & otherwise \end{cases} \tag{2.6}$$

As a result, given that the probabilities of a shock are low enough to provide cooperation for both types of the foreign government, home government employs its privilege to design a contract in order to implement the optimal level of cooperation immediately in the absence of informational asymmetry in our model. Home government's incentive constraints do not face dynamic changes since there is no update in the state variables of maximization problem. Therefore, the optimal cooperation does not exhibit a gradual path. Stochastic states of nature do not contribute much to the analysis besides changing it from an interim maximization to an ex-ante maximization problem for home government.

Our result for the complete information case is analogous to the findings reported in the linkage literature. We model identical structure in demand and supply conditions. Combined with the assumption of identical tariffs across the goods within an import sector, the degree of enforcement is also identical across the bundle of goods in an agreement. This shows that there is no slack enforcement power that could be transferred to other goods through linking separate agreements. Therefore, whatever is enforceable for a single bundle is also enforceable for the entire sector. This result holds both for the static and incremental linkage story. We now focus on our gradualism results and condition that give rise to them.

3. Non-Stationary Cooperation under Incomplete Information

In this section we solve an infinitely repeated game with stochastic states of nature and one-sided incomplete information. We assume that state of nature in each period and type of foreign government are privately observed by the foreign government. However, the prior probability of foreign government being type-1 (μ_0) and type-2 ($1 - \mu_0$) are common knowledge, where $\mu_0 \in (0,1)$. Probabilities of low and high states of nature conditional on foreign government's type are identical with complete information scenario. Game follows the identical path described in previous section[4].

[4] To put this environment in perspective, note that it is similar to a two-type screening model and repeated prisoner's dilemma game. However, there are both static and dynamic differences. In a standard principal-agent framework, the "good" type agent (efficient or low cost) has an incentive to imitate the "bad" type (inefficient or high cost), which instigates the principal to decrease transaction with the latter one to reduce the information rent extracted by the former type. The ability of principal to propose a menu of contracts with respective transfers assures this result. On the other hand, the agency problem therefore optimal contracting issue is ignored in a standard repeated prisoner's dilemma game. Our model unifies these two environments in the sense that we have payoff structure of a repeated prisoner's dilemma game with agency problem. The good type agent (type-1 foreign government) is the one who pays for its inability to reveal its type, whereas the bad type agent (type-2 foreign government) extracts information rent. The principal (home government) is constraint to propose a single contract that specifies a unique cooperation level.

Given incomplete information structure, home government faces the problem of choosing an optimal cooperation path $\{\alpha_t\}_{t=1}^{\infty}$ that maximizes welfare. Remember that home government observes only actions of the foreign government in each period. Let $\{\mu_t\}_{t=1}^{\infty}$ be the sequence of the probabilities home government assigns to the event foreign government being type-1 in respective periods. Each μ_t denotes the posterior belief upon observing the foreign government's action in period $(t-1)$, and is used to construct expectations for period t and afterwards. This belief evolves in a Bayesian fashion, formally:

$$\mu_{t+1} \equiv \mu_t / [\mu_t + (1-\mu_t)p_2] \tag{3.1}$$

In order to define this posterior probability in terms of the prior belief, μ_o, we iterate it:

$$\mu_t = \mu_0 / [\mu_0 + (1-\mu_0)(p_2)^{t-1}] \tag{3.2}$$

Only exception is the first period, where there is no new information available before players move, hence home government uses the prior belief $\mu_1 = \mu_0$. It is obvious that after enough periods of successful cooperation this belief converges to one, $\lim_{t\to\infty} \mu_t = 1$. We define the home government's belief of foreign government acting cooperatively in current period by q_t. This probability is composed of probability of the foreign government to be a type-1, and probability of nature choosing a low state if it is type-2. This corresponds to home government's subjective belief of not getting a type-2 foreign government with a high-state of nature. Formally, $q_t = \mu_t + (1-\mu_t)p_2$. Iterating this, we get the subjective probability of foreign government cooperating in k'th period after period t, given that it cooperates in period $t-1$:

$$\prod_{i=0}^{k} q_{t+i} = \mu_t + (1-\mu_t)(p_2)^{k+1} \tag{3.3}$$

Cooperation levels specified in the contract for each period and belief sequence, together with governments' strategies form a Perfect Bayesian Equilibrium if: Foreign government's actions are optimal given the cooperation level in each period; home government's actions are optimal given its posterior beliefs and subsequent strategies in each period; and the posterior belief is derived from the prior, foreign government's strategy and observed action profile. These conditions require that governments act optimally at any point in history of the game. Self-enforcing character of the agreement eliminates commitment concerns, yet following Laffont and Tirole (1990) we assume that the initial contract is designed to incorporate additional information. Intuitively, Bayesian updating mechanism alters home government's incentive scheme after each period, relaxing the incentive constraint and providing further cooperation. Both types of foreign government receive higher payoffs with higher cooperation, therefore renegotiation is allowed. However, without loss of generality, the original contract is designed to avoid future renegotiation.

We can now characterize the incentive structure of foreign government. Incentive constraints for different types of foreign government differ from complete information case due to non-stationary character of cooperation level through consecutive periods. Remember that in a complete information case, where cooperation is stationary, net balance of discounted gains and punishments is the single factor that provides the foreign government with the incentive to act cooperatively or not. Therefore this incentive form is also stationary throughout the game. On the contrary, in an incomplete information game we have inter-temporal incentives in addition to static balance of one period gains and punishments. An expected augmentation in stage game cooperative payoff in the future due to rising level of cooperation provides an additional incentive for the foreign government to cooperate in the current period. Therefore, postponing betrayal becomes profitable if cooperation level increases fast enough to more than compensate the time discounting.

We start with a type-1 foreign government. As we mentioned in previous section, we assume that this type of foreign government cooperates perpetually throughout the game. And as in the previous section, the incentive constraint for this type binds in a high state of nature. Formally:

$$\alpha_t \cdot \overline{\Omega}^d \leq E(\Omega^c|p_1) \cdot \sum_{i=t+1}^{\infty} \delta^{i-t} \alpha_i \qquad (IC-1H)'$$

Intuitively, this condition states that discounted sum of expected future gains from an agreement, which is contingent on probabilities of different state of natures and the increasing level of cooperation, should be at least as large as benefit from betraying in current period, which is a function of current cooperation level. This condition would be null had the cooperation level could grow infinitely in the future. But existence of an upper bound implies a structural change in above mentioned condition once the maximum level of cooperation is reached. Solving this incentive constraint, we get the condition for perpetual cooperation once the maximum cooperation level is attained, $p_1 \geq \hat{p}_1$, which is identical with complete information case.

Solution for a type-2 foreign government incorporates the fact that it always betrays in a high state of nature. The incentive constraint for this type in a low state of nature reflects this effect through the alteration in cooperative continuation values. Formally:

$$\sum_{i=t+1}^{\infty} (p_2\delta)^{i-(t+1)} \alpha_i \cdot \left[E(\Omega^c|p_2) + (1-p_2) \cdot \overline{\Omega}^d\right] \geq \frac{1}{\delta} \alpha_t \underline{\Omega}^d \qquad (IC-2L)'$$

Intuitively, current cooperative behavior is conditioned on comparison between discounted future gains from agreement with a possible gain from betrayal, and current net benefit of betraying. The left hand-side incorporates the intertemporal gains due to non-stationary level of cooperation. The condition under which type-2 foreign government cooperates perpetually once the maximum level of cooperation is reached is found analogously, and identical to the one in complete information section: $p_2 \geq \hat{p}_2$. We next focus on pooling and separating equilibria.

3.1. Gradualism in Cooperation

Suppose $p_1 \geq \hat{p}_1$ and $p_2 \geq \hat{p}_2$, so that both types of foreign government cooperates perpetually once maximum level of cooperation is attained. Then we get the following result.

Lemma 2. *If* $p_1 \geq \hat{p}_1$ *and* $p_2 \geq \hat{p}_2$*, then both* $(IC-1H)'$ *and* $(IC-2L)'$ *do not bind unless the cooperation level decreases sufficiently within time.*

Intuitively, Lemma 2 implies that home government can only extract "weak" signals from foreign government's cooperative actions. Revelation of foreign government's type in pooling equilibrium occurs only when betrayal is observed, which is reserved for type-2 foreign government in high state of nature. Nevertheless, home government's subjective belief about foreign government being type-1 increases gradually as cooperative action profile is observed through periods. A self-enforcing agreement requires incentive compatibility for home government as well. Formally in period t:

$$q_t \cdot [w^c(\alpha_t) + \delta V^c(q_{t+1})] + (1-q_t) \cdot [w^{-d}(\alpha_t) + \delta V^N] \geq q_t w^d(\alpha_t) + (1-q_t) \cdot w^N(\alpha_t) + \delta V^N,$$

Plugging the explicit payoffs in, we get:

$$\delta q_t [V^c(q_{t+1}) - V^N] \geq \alpha_t (m^N - m^c) \tag{$IC-H$}$$

Nash cooperation value is deterministic and defined as discounted sum of payoff stream when unilaterally optimal tariffs are applied. Cooperative continuation value for the decision maker in period t is formally defined as:

$$V^c(q_{t+1}) = q_{t+1} \cdot [w^c(\alpha_{t+1}) + \delta V^c(q_{t+2})] + (1-q_{t+1}) \cdot [w^{-d}(\alpha_{t+1}) + \delta V^N] \tag{3.4}$$

Therefore, we have a recursive structure in cooperation values. There are two features that worth pointing out here: First, there is more than one (two, specifically) non-stationary variables, the belief q and cooperation level α. Second, both of these non-stationary variables are bounded above: i.e. the belief has an upper limit of one, and level of cooperation is limited by amount of goods traded between countries. However, although the upper limit is reached for latter one in the course of game, as we will show it, upper limit for belief is never attained in a pooling equilibrium. We take advantage of this structural change by defining the critical period in which cooperation level reaches to its maximal level, and analyze rest of the game with reference to that period in proof of Lemma 3. We call the subsection of long-term relationship where level of cooperation is stationary at the maximum level "maximum cooperation phase", and the subsection where cooperation level rises gradually "gradual cooperation phase". First we define a general form for continuation value at an arbitrary point in time, without signifying the structural break point. Solving (3.4) iteratively, we get this general form:

$$V^c(q_t) = \sum_{i=t}^{\infty} \delta^{i-t} \left[w^c(\alpha_i) + (1-q_i) \cdot [w^{-d}(\alpha_i) + \delta V^N]\right] \prod_{j=t}^{i} q_j \tag{3.5}$$

Intuitively, let $\bar{t}$ be the first period with maximum level of cooperation, then continuation value in period $\bar{t}-k$ is the discounted sum of expected payoffs from cooperation in both phases. Expected stage game payoffs increase in gradual cooperation phase as long as governments act cooperatively. This is determined by both non-stationary variables we mentioned. Holding cooperation level constant, expectation of future payoffs increase solely because home government assigns a higher probability to foreign government acting favorably in the future. This "pure belief effect" manipulates the continuation values in both phases of the relationship. Given a higher probability of favorable play in the future, home governments' incentive constraint is relaxed after a cooperative period. This slackness provides some room for further cooperation that makes the incentive constraint bind again. Therefore the continuation value increases due to these two effects after each successfully cooperative action profile in gradual cooperation phase. Following lemma summarizes these findings.

Lemma 3. *$V^c(q_{t+1}) > V^c(q_t)$ for the home government due to:*

i. $q_{t+1} > q_t$ *and* $\alpha_{t+1} > \alpha_t$ *in gradual cooperation phase*
ii. $q_{t+1} > q_t$ *in maximum cooperation phase (pure belief effect)*

We now technically show that cooperation level increases in the first phase. Home government can increase its expected payoff by increasing the level of cooperation when there is slackness in its incentive constraint. Therefore, optimality requires the incentive constraint to bind in every period in gradual cooperation phase. Using $(IC - H)$, the level of cooperation that satisfies the incentive constraint with equality can be written as:

$$\alpha_t = \frac{\delta q_t}{m^N - m^c}\left[V^c(q_{t+1}) - V^N\right] \tag{3.6}$$

Since $V^c(q_{t+2}) > V^c(q_{t+1})$ by Lemma 3 and $q_{t+1} > q_t$ by definition of q and (3.2), we show that $\alpha_{t+1} > \alpha_t$. Following proposition specifies our main result regarding gradualism.

Proposition 2. *By Lemmas 2 and 3, and using* (3.6) *the optimal contract proposes a gradual transition to maximum cooperation phase in a pooling equilibrium where* $p_1 \geq \hat{p}_1$ *and* $p_2 \geq \hat{p}_2$ *.*

In order to derive the optimal cooperation explicitly, we employ two characteristics of the game: Home government selects the highest possible cooperation level that ex-ante satisfies its incentive constraint based on the subjective belief in each period[5]. This implies that home government is indifferent between betraying and cooperating in each period. Moreover, being indifferent between cooperation and betrayal in two consecutive periods implies being indifferent between betraying in the first period and cooperating in the first but betraying in the second period[6]. We take advantage of this property to characterize the optimal increment in level of cooperation. In an arbitrary period t we formally show this as:

$$q_t w^d(\alpha_t) + (1-q_t)w^N(\alpha_t) + \delta V^N = q_t\left[w^c(\alpha_t) + \delta[q_{t+1}w^d(\alpha_{t+1}) + (1-q_{t+1})w^N(\alpha_{t+1}) + \delta V^N]\right]$$

---

[5] Otherwise, it could increase the cooperation level and get a higher payoff without violating incentive constraints of foreign government, which contradicts with optimality condition.

[6] A simple example helps elaborate this. Assume there is a two period game with discounting (discount factor δ) where a player faces the problem of choosing between left (L) and right (R) in both periods. In the first period, L ends the game, whereas R starts the second period. Choosing L and R gives the same payoff in the second period, call this π. In order for the player to be indifferent between L and R in the first period, L needs to earn him $\zeta + \delta\pi$ whereas R gives ζ plus the discounted payoff from second period. In this case, strategies of playing L in the first period and R in the first period and L in the second period both earns him $\zeta + \delta\pi$.

$$+ (1 - q_t) \cdot [w^{-d}(\alpha_t) + \delta V^N]$$

Where the left hand side shows the home government's payoff on deviation, including possibility of foreign government betraying simultaneously. The right hand side describes the payoff generated by cooperation in current period and betrayal in next one, with the payoffs associated with possible betrayal by foreign country in current period or the next one. Plugging definitions of welfares in, and employing gains from actions notation, we get the explicit correlation between two consecutive cooperation levels:

$$\alpha_t = \alpha_{t+1} \cdot q_t \cdot q_{t+1} \frac{\delta[\Omega^d + \Omega^c]}{\Omega^d} \tag{3.7}$$

Note that this relationship is relevant only in gradual cooperation phase. Once the maximum level of cooperation is attained, additional beliefs favoring cooperation only increases expected future payoffs slightly. However, this correlation gives us a well-defined path of optimal cooperation until it reaches a maximum. Setting $\alpha_t = \alpha_{t+1} = \overline{\alpha}$, (*3.9*) gives us the level of belief sufficient to reach maximum cooperation: $\mu_{\bar{t}} = \frac{\Omega^d - \delta p_2^2(\Omega^d + \Omega^c)}{\delta(1-p_2^2)\cdot(\Omega^d + \Omega^c)}$. It is immediate that $\mu_{\bar{t}}$ decreases in p_2. Therefore, the smaller is probability of type-2 foreign government experiencing a political economy shock, the faster maximum cooperation is reached in a pooling equilibrium.

3.2. Bicycle Theory and "Testing" the Foreign Government

Both types of foreign government stay in cooperative relationship unless a shock is realized, and this is common knowledge in pooling case described in previous section. Therefore, home government does not need to provide intertemporal incentives to keep foreign government in the relationship. We now investigate a case where current degree of liberalization is not enforceable without further liberalization in the future.

Suppose $p_2 < \hat{p}_2$, so that type-2 foreign government betrays in case of maximum cooperation even in low state of nature. Hence type-2 foreign government betrays whenever the cooperation level remains stationary for the rest of the game. This characteristic changes the structure of cooperation dramatically. If home government wants to keep a type-2 foreign government in cooperative relationship, then it needs to provide sufficient intertemporal incentives. Increasing the cooperation level through consecutive periods postpones foreign government's betrayal, but never eliminates it since the level function is bounded above. We start by deriving the cooperative path that provides intertemporal incentives and make type-2 foreign government delay betrayal. The condition $p_2 < \hat{p}_2$ implies that there is no cooperative continuation value in period $\bar{t}$, where the level of cooperation is supposed to reach a maximum level. We can write down the incentive constraint of a type-2 foreign government in period $\bar{t} - 1$ as:

$$\underline{w}^d(\alpha_{\bar{t}-1}) + \delta V^N \leq \underline{w}^c(\alpha_{\bar{t}-1}) + \delta\left[p_2 \underline{w}^d(\overline{\alpha}) + (1 - p_2)\overline{w}^d(\overline{\alpha}) + \delta V^N\right]$$

Solving this, we get the maximum value of cooperation level that makes type-2 foreign government indifferent between betraying in periods $\bar{t} - 1$ and $\bar{t}$: $\alpha_{\bar{t}-1} = \frac{\overline{\alpha}}{\underline{\Omega}^d} \delta\left[p_2(\underline{\Omega}^d + \underline{\Omega}^c) + (1 - p_2) \cdot \left(\overline{\Omega}^d + \overline{\Omega}^c\right)\right]$. It is straightforward to show that $\alpha_{\bar{t}-1} < \overline{\alpha}$. Manipulating $p_2 < \hat{p}_2$, the term inside the brackets becomes smaller than one. Solving for the maximum incentive compatible levels of cooperation backwards, we get a general rule for an arbitrary period:

$$\alpha_i = \overline{\alpha}\left[\delta \frac{p_2\left(\underline{\Omega}^d + \underline{\Omega}^c\right) + (1-p_2)\cdot\left(\overline{\Omega}^d + \overline{\Omega}^c\right)}{\underline{\Omega}^d}\right]^{\bar{t}-i} \quad (3.8)$$

This rule defines a convex path increasing in time. Intuitively, it represents the required increment in cooperation level that makes foreign government indifferent between betraying in an arbitrary period and postponing it for the next one. Following lemma summarizes our result evidencing the bicycle effect.

Lemma 4. *If $p_1 \geq \hat{p}_1$ and $p_2 < \hat{p}_2$, then current cooperation at any point in time cannot be sustained unless cooperation level increases sufficiently:* $\frac{\alpha_{t+1}}{\alpha_t} \geq \frac{\underline{\Omega}^d}{\delta\left[p_2\left(\underline{\Omega}^d + \underline{\Omega}^c\right) + (1-p_2)\cdot\left(\overline{\Omega}^d + \overline{\Omega}^c\right)\right]} > 1$.

It is straightforward to see that this requirement is decreasing in discount factor. A smaller augmentation in cooperation level is required to sustain cooperation with more patient foreign governments. As cooperation level is bounded above, this implies that relationship can last longer since future prospects will be depleted rather slowly in case of a more patient foreign government.

Terminating the relationship is as interesting as its evolution. Under the conditions $p_1 \geq \hat{p}_1$ and $p_2 < \hat{p}_2$, this is not trivial. Home government takes advantage of additional information revealed in each period to redesign the contract[7]. It follows from this fact and Proposition 1 that after a critical period, where types are separated since type-2 betrays, governments cooperate at a maximum level if partnership does not end. However, this raises issues concerning the "ratchet effect". Observing the proposed cooperation path, type-2 foreign government can gain substantially by pooling with a type-1 foreign government in the separation period. Postponing betrayal one more period provides it with betrayal payoff in maximum cooperation stage. This effect makes separation of types more costly for home government, since it needs to provide more incentives to induce trading partner reveal its type[8]. Specifically, the minimum cooperation level that separates the types is $\alpha_{\bar{t}-1}$.

We now characterize the conditions under which testing is incentive compatible with home government. We start with a special case where home government tests the foreign government in the beginning of relationship. Expected payoff from a credible-test strategy for the home government in an arbitrary is given by:

$$\mu_o\left[w^c(\alpha_{\bar{t}-1}) + \delta V^c(\overline{\alpha})\right] + (1-\mu_o)\cdot\left[w^{-d}(\alpha_{\bar{t}-1}) + \delta V^N\right] \quad (3.9)$$

[7] Assuming contract being designed at the outset of the game does not change this property. The initial contract conditions the path of cooperation on observed action profile in each period.

[8] We do not have further complications related with the good type partner in our model. A good type agent might "take-the-money-and-run" when principal raises incentives to separate types in a standard dynamic principal agent framework. This might make the incentive constraints bind both 'upward" and "downward". Since a type-1 foreign government prefers perpetual cooperation we do not need to worry about this.

This is basically a weighted sum of expected payoffs when foreign country is type-1 (cooperates) and type-2 (betrays) using the corresponding belief. Note that cooperative continuation value in a separating equilibrium is $V^c(\overline{\alpha}) = \sum_{i=o}^{\infty} \delta^i w^c(\overline{\alpha})$ since home government's posterior belief is equal to one after this period. It is obvious that (*3.9*) is increasing in prior belief μ_o. The more likely is foreign government a good partner, the higher is expected payoff from a testing strategy. Home government's incentive constraint completes the analysis for a condition under which testing is an equilibrium strategy:

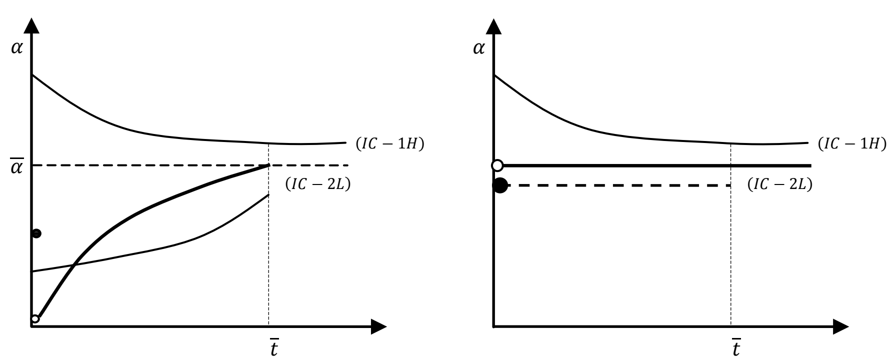
$$\mu_o[w^c(\alpha_{\bar{t}-1}) + \delta V^c(\overline{\alpha})] + (1-\mu_o)\cdot[w^{-d}(\alpha_{\bar{t}-1}) + \delta V^N]$$

$$\geq \mu_o[w^d(\alpha_{\bar{t}-1}) + \delta V^N] + (1-\mu_o)\cdot[w^N(\alpha_{\bar{t}-1}) + \delta V^N] \tag{3.10}$$

Intuitively, (*3.10*) claims credibility. Home government should not have any incentive to betray in testing period once it proposes that in the initial agreement. This condition reduces to $\mu_o \frac{\delta}{1-\delta}\overline{\alpha}\Omega^c - \alpha_{\bar{t}-1}\Omega^d \geq 0$. Plugging the value of $\alpha_{\bar{t}-1}$ we displayed before and solving for μ_o we get:

$$\mu_o \geq (1-\delta)\frac{\Omega^d}{\Omega^c}\cdot\left[\frac{p_2\left(\underline{\Omega}^d + \underline{\Omega}^c\right) + (1-p_2)\cdot\left(\overline{\Omega}^d + \overline{\Omega}^c\right)}{\underline{\Omega}^d}\right] = \overline{\mu}_0 \tag{3.11}$$

Figure 2 displays two cases for testing strategies in the beginning of relationship. Left panel shows ratchet effect baffling a non-credible test; whereas the right panel shows a successful separation in the first period of relationship. Note that if home government could fully commit to the gradual path –bold concave curve in panel a-, then a small deviation from incentive compatible path for type-2 foreign government would successfully separate the types. However, in the absence of full commitment, ex-post efficiency through renegotiation upon complete revelation of types requires a higher initial incentive to implement separation.



(a) A Non-credible "Test"   **(b)** A Credible "Test"

Figure 2. Incentive Structure and Testing in Separating Equilibrium

Following proposition summarizes conditions for the existence of this separating equilibrium.

Proposition 3. *Given* $p_1 \geq \hat{p}_1$, $p_2 < \hat{p}_2$ *and* $\mu_o \geq \overline{\mu}_0$, *there exists a separating equilibrium where home government proposes* $\alpha_1 = \alpha_{\bar{t}-1}$ *and* $\alpha_i = \overline{\alpha}\ \forall\ i \geq 2$ *conditional on cooperative action in the first period. Therefore the type of foreign government is revealed in the first period, and cooperation continues with maximum level from second period onward if the foreign government does not betray in the first period.*

Corollary. $\overline{\mu}_0$ *is decreasing in* δ.

Result by corollary is interesting in the sense that it shows more patient governments are more likely to resolve uncertainties arising from informational asymmetry in the beginning of a relationship by eliminating bad type partners. Intuitively, gradual adjustment enables cooperation but at the same time some payoff is lost due to postponed maximum cooperation. Therefore, higher discount factor increases the discounted value of this additional payoff that can be earned by maximizing cooperation quickly.

4. Conclusion

This paper helps understand the structure of cooperation between countries in the presence of informational asymmetry. In the absence of incomplete information, home government observes the probability of foreign government to experience political economy shocks in the form of protectionism in each period. Given that this probability is low enough to satisfy foreign government's incentive constraint, and that home government is patient enough, partners start the relationship with maximum cooperation. We show that home government needs to be more patient for partnership to be sustainable, when this probability is relatively high. Nevertheless, cooperation does not exhibit dynamic variation in a complete information environment.

Non-stationary cooperation emerges when foreign government's probability of experiencing political economy shock is privately observed. We consider a case where foreign government betrays perpetually with or without political economy shock realization if probability of shock is relatively small. However, it prefers betraying when political economy shock is realized if this probability is relatively high. Home government hesitates to start cooperation at a maximum level in this case. Using the privilege to design the contract, it proposes gradually increasing cooperation level conditional on cooperative action profiles. Home government becomes more optimistic about its partner as it cooperates through periods. We show that the threshold level of belief sufficient for home government to propose maximum cooperation is increasing in the probability of shock. Hence, maximum cooperation is attained faster with low probability of shock.

We next consider a case where foreign government prefers betraying even before a shock is realized when probability of political economy shock is high enough. In this case, home government needs to provide this type of foreign government with sufficient intertemporal incentives to keep it in partnership. This is satisfied by increasing the level of cooperation. We show that this necessary increment is decreasing in discount factor: More patient governments can sustain a longer cooperative relationship as long as a shock is not realized. Home government might prefer "testing" the trading-partner in the beginning of relationship by proposing a high enough cooperation level that violates foreign government's incentive constraint if it has a high probability of shock. Interestingly, we see that the minimum prior belief that makes this testing attainable is decreasing in discount factor. The more patient is home government, the more likely it prefers resolving uncertainty in the beginning of relationship by rectifying the "bad" type partner.

A potential limitation of our analysis is its inability to refer sector-based composition of agreement under different supply schemes. We believe that non-uniform and non-asymmetric conditions in different sectors may provide significant enrichment for analysis of trade agreements. We also believe that further work is needed to understand optimal dynamic behavior of governments under asymmetric information.

Appendices

A.1. Proof of Lemma 1

Substituting the market clearing prices in (2.3) and differentiating it with respect to τ^* we obtain the Nash tariff of foreign country as a function of political economy parameter $\tau^{*N}(\gamma)$. Using this Nash tariff and market clearing price, the Nash welfare on an import good becomes:

$$W^*(\hat{P}^*, P^w) = m^{*N} = \frac{1}{2}\left[A - \hat{P}^*(\tau^{*N}(\gamma)\ )\right]^2 + \frac{a^*}{2}\gamma\left[\hat{P}^*(\tau^{*N}(\gamma)\ )\right]^2 + \tau^{*N}(\gamma)\ \ \cdot \left[M^*\left(\hat{P}^*(\tau^{*N}(\gamma)\ )\right)\right]$$

Whereas the cooperative welfare on an import good is defined as:

$$W^*(\hat{P}^*, P^w) = m^{*c} = \frac{1}{2}\left[A - \hat{P}^*(\tau^c)\right]^2 + \frac{a^*}{2}\gamma\left[\hat{P}^*(\tau^c)\right]^2 + \tau^c \cdot \left[M^*\left(\hat{P}^*(\tau^c)\right)\right]$$

Welfares of foreign country on export goods with Nash tariff and cooperative tariff are:

$$W^*(P^w) = x^{*N} = \tfrac{1}{2}[A - P^w(\tau^N)]^2 + \tfrac{a^*}{2}[P^w(\tau^N)]^2 \ \text{ and } \ W^*(P^w) = x^{*c} = \tfrac{1}{2}[A - P^w(\tau^c)]^2 + \tfrac{a^*}{2}[P^w(\tau^c)]^2$$

The results from Lemma 1 follow immediately from differentiating $\Omega^c = m^{*c} + x^{*c} - m^{*N} - x^{*N}$ and $\Omega^d = m^{*N} - m^{*c}$ with respect to γ. ■

A.3. Proof of Lemma 2

We prove this by showing that the paths that make type-1 and type-2 indifferent between cooperating and betraying in consecutive periods is necessarily downward sloping in a pooling equilibrium case. Suppose the condition $p_1 \geq \tilde{p}_1 = \frac{(1-\delta)\cdot\overline{\Omega}^d - \delta\cdot\overline{\Omega}^c}{\delta\left(\underline{\Omega}^c - \overline{\Omega}^c\right)}$ holds for type-1 foreign government in a high state of nature. We assume $\alpha_{i+1} > \alpha_i$, $\forall\ i \in [0, \hat{t} - 1]$, to show this cannot be correct. We solve the cooperation level values that satisfy $(IC - 1H)$ with equality backward from period $\hat{t}$:

$$\alpha_{t-1} = \overline{\alpha}\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d}\delta\right)\cdot\left(\frac{1}{1-\delta}\right)\cdot\left[\delta\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d} + 1\right)\right]^0$$

$$\alpha_{t-2} = \overline{\alpha}\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d}\delta\right)\cdot\left(\frac{1}{1-\delta}\right)\cdot\left[\delta\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d} + 1\right)\right]^1, \ldots$$

This pattern gives us the borderline path of incentive compatibility for cooperation level:

$$\alpha_i = \overline{\alpha}\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d}\delta\right)\cdot\left(\frac{1}{1-\delta}\right)\cdot\left[\delta\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d} + 1\right)\right]^{t-(i+1)} \qquad (A.1)$$

Now, find the condition that satisfies $\frac{\alpha_{i+1}}{\alpha_i} > 1\ \forall\ i \in [0, \hat{t} - 1]$, using $(A.1)$ we get $\delta\left(\frac{E(\Omega^c|p_1)}{\overline{\Omega}^d} + 1\right) < 1$. However, plugging in the values of expectation and solving for p_1, we get: $p_1 < \frac{(1-\delta)\cdot\overline{\Omega}^d - \delta\cdot\overline{\Omega}^c}{\delta\left(\underline{\Omega}^c - \overline{\Omega}^c\right)}$, which contradicts with our initial assumption.

The part for type-2 foreign government is identical with the type-1 case. However, the expected future gain from betraying is included in the analysis. The path defines the sequence of cooperation levels that satisfy $(IC - 2L)$ is:

$$\alpha_i = \overline{\alpha}\left(\frac{E(\Omega^c|p_2) + (1-p_2)\overline{\Omega}^d}{\underline{\Omega}^d}\delta\right)\cdot\left(\frac{1}{1-p_2\delta}\right)\cdot\left[\delta\left(\frac{E(\Omega^c|p_2) + (1-p_2)\overline{\Omega}^d}{\underline{\Omega}^d} + 1\right)\right]^{t-(i+1)} \qquad (A.2)$$

And the necessary condition for an increasing level of cooperation, $\delta\left(\frac{E(\Omega^c|p_2)+(1-p_2)\overline{\Omega}^d}{\underline{\Omega}^d}+1\right)<1$ contradicts with our initial assumption $p_2 \geq \tilde{p}_2 = \frac{\underline{\Omega}^d-\delta\left(\overline{\Omega}^c+\overline{\Omega}^d\right)}{\delta\left[\underline{\Omega}^d+\underline{\Omega}^c-\left(\overline{\Omega}^d+\overline{\Omega}^c\right)\right]}$. ■

A.4. Proof of Lemma 3

Suppose $\alpha_i = \overline{\alpha}\ \forall\, i \geq \overline{t}$ and $\alpha_i < \overline{\alpha}\ \forall\, i < \overline{t}$. Let the periods $t \geq \overline{t}$ be maximum cooperation phase. The only non-stationary variable in this phase is the belief of the home government about the foreign governments' cooperation. Therefore, we can easily write a general rule for continuation values in this phase:

$$V^c(q_{\overline{t}}) = w^c(\overline{\alpha})\sum_{i=\overline{t}}^{\infty}\delta^{i-\overline{t}}\prod_{j=\overline{t}}^{i}q_j + [w^{-d}(\overline{\alpha})+\delta V^N]\sum_{i=\overline{t}}^{\infty}\delta^{i-\overline{t}}\left(\frac{1-q_i}{q_i}\right)\prod_{j=\overline{t}}^{i}q_j \qquad (A.3)$$

Note that this continuation value increases in q. Remembering $q_{t+1} > q_t$ as long as the foreign government does not betray, we can show this as follows: For an arbitrary $t \geq \overline{t}$, the first term on the right hand side of (3.5) increases in q_t obviously. In order to see that the second term also increases, we write down the explicit form of it:

$$(1-q_t)+\delta q_t[(1-q_{t+1})+\delta q_{t+1}(1-q_{t+2})\,...\,]$$

But, the recursive term in the brackets is the second component of $V^c(q_{t+1})$. Let ,

$$Z = [w^{-d}(\overline{\alpha})+\delta V^N]\sum_{i=0}^{\infty}\delta^i\left(\frac{1-q_{\overline{t}+i+1}}{q_{\overline{t}+i+1}}\right)\prod_{j=0}^{i}q_{\overline{t}+j}$$

Then the second component of $V^c(q_t)$ becomes $(1-q_t)+\delta q_t Z$, which is smaller than Z. To see this we use $\lim_{q_t\to 1}[(1-q_t)+\delta q_t Z] = \delta Z \ < Z$. This completes the case for maximum cooperation phase.

Let periods $t < \overline{t}$ be gradual cooperation phase. We define the continuation values in this phase with reference to the first continuation value of the maximum cooperation phase, $V^c(q_{\overline{t}})$. Solving for continuation values backwards starting from period $\overline{t}$, we get a general rule for continuation values in gradual cooperation phase with reference to $V^c(q_{\overline{t}})$:

$$V^c(q_t) = \sum_{i=t}^{\overline{t}-1}\delta^{i-t}w^c(\alpha_i)\prod_{j=t}^{i}q_j + \sum_{i=t}^{\overline{t}-1}\delta^{i-t}[w^{-d}(\alpha_i)+\delta V^N]\cdot\left(\frac{1-q_i}{q_i}\right)\prod_{j=t}^{i}q_j + \delta^{\overline{t}-t}V^c(q_{\overline{t}})\prod_{j=t}^{\overline{t}-1}q_j \qquad (A.4)$$

Comparing the explicit forms, one can easily show that $V^c(q_{t+1})$ and $V^c(q_t)$ are infinite sequences with the former having greater value in each period due to higher beliefs and cooperation levels. Therefore, discounted sum of a sequence of values that is greater in each period compared to another sequence is also greater than the discounted some of the latter. ■

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