# When does coordination for free trade regimes fail? ☆

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## ABSTRACT

This paper examines why the recent efforts to arrange free trade regimes have failed repeatedly focusing on the increased uncertainties in economic fundamentals and the asymmetric political economic characteristics of trading countries reflected in the hawkish trade retaliatory tendencies. We demonstrate that, under informational barriers due to economic uncertainties, a slight negative change in economic fundamentals as well as the signals about the economic fundamentals can lead to the collapse of free trade regimes. Moreover, the fear of a trading partner's deviation to protectionist policies might trigger preemptive protectionist measures resulting in a trade war when trade policies show strategic complementarity. However, a free trade regime is more likely to be sustained when it is commonly known that each country has strong symmetric retaliatory tendencies in case trade friction occurs. Nonetheless, if the asymmetry in retaliatory tendencies of trading countries increases the preemptive incentive, a free trade regime is more likely to collapse to a trade war.

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## 1. Introduction

After the launch of the WTO in 1995, efforts to make progress in multilateral trade liberalization have been repeatedly thwarted due to continuous deadlock of the Doha Development Agenda (DDA) since negotiations started in 2001. The deadlock in multilateral trade liberalization has been aggravated by the latest advent of the global financial and fiscal crisis and the resulted increased uncertainty in economic fundamentals since the global financial crisis in 2008 and the European fiscal crisis in 2011. The increased uncertainty in economic fundamentals due to the financial and fiscal crisis initiated a vicious circle of protective trade policies and the resulted trade wars within the downgrading economic fundamentals.

To mitigate the vicious circle between the worsening economic fundamentals and protectionist trade policies and to avoid the global trade war, a wide range of international efforts have been made to arrange credible enforcement mechanisms for countries involved in trade agreements to prevent their deviation to non-cooperative policies such as protectionist trade policies and non-cooperative devaluation of currencies in the format of G20 for an example. Notwithstanding these global efforts to arrange an international coordination mechanism to prevent the deviation to protectionist trade policies, deviation to non-cooperative policies, as well as the resulting collapse of coordination mechanisms, has often been observed. Recent examples include the 2011 non-cooperative currency intervention by the government of Switzerland to devalue Swiss currency against competing countries, as well as frequent import restrictions under the forms of anti-dumping and safeguard measures.

This paper examines the sources of repeated failures to make progress in trade liberalization under the DDA regime by focusing on economic uncertainty in economic fundamentals and the related informational barriers that have been aggravated by recent financial and fiscal crisis. This study discusses factors underlying the disappointing performance of international trade regimes, even though the WTO has established both a forum for repeated games for trade negotiations and a mechanism for trade disputes settlement that is considered to be stronger than the GATT system. We examine the impacts of informational barriers on each country's trade policies, as well as the overall impact on equilibrium trade regimes. Given the strong strategic complementarities of trade policies, we investigate preemptive incentives to choose protectionist trade policies that are motivated exclusively by the fear of trading partner's possible aggressive policies under informational barriers among trading partners.

Traditional approaches to examine the sources of non-cooperative trade policies include literature that focuses on terms of trade effect of protectionist trade policies and strategic trade policies as in Brander and Spencer (1985). Earlier studies on strategic trade policies, however, do not address the impact of informational barriers that causes the failures of policy coordination in arranging free trade regime.

Given the strong strategic complementarities of trade policies, it is highly likely that the trade policy game might end up with multiple

equilibria, including the case of non-cooperative protectionist trade policy regimes. A groundbreaking contribution to handle the problem of multiple equilibria with strategic complementarities was made by the seminal paper by Carlsson and Damme (1993). Subsequent to that study, there have been significant advances in efforts to explain the coordination failure considering the impacts of informational barriers with global game theoretic approaches.[2] Carlsson and Damme (1993) define a global game as an incomplete information game where the actual payoff structure is determined by a random draw from a given class of games, and one in which each player makes a noisy observation of the selected game. The study shows that, when the noise vanishes, iterated elimination of dominated strategies in the global game forces the players to conform to risk-dominance criterion a la Harsanyi and Selten (1988).

A study by Baliga and Sjostrom (2009) examines how the uncertainty about the conflicts in the multiple equilibria can be reduced to a unique equilibrium considering two types of strategies such as strategic substitutes and strategic complements. Chassang and Miquel (2010) examine the determinants of cooperation, as well as the effectiveness of deterrence when fear is a motive for conflict. They focus on the incentive for preemptive attacks that work only under strategic risk, which is created when payoffs from cooperative peace strategies are not commonly known. Although these studies have made significant contributions to explain coordination failures considering informational barriers, they do not consider the strategic aspects of trade policy coordination issues under informational barriers. This paper fills the gap between the global game theoretic efforts to explain coordination failures and the issues of trade policy coordination focusing on the impact of informational barriers and strategic incentives in international trade policy regimes.

Based on a global game theoretic approach, we demonstrate that trade regimes can collapse to non-cooperative trade regimes, wherein different countries pursue protectionist policy measures given a slight negative change in signals about economic fundamentals under informational barriers. The intuition behind this result is that when a country's trade policies are heavily influenced by the trade policies of trading partners in the same direction with strategic complementarity, a sudden change of trade regimes might happen due to slight deterioration of economic fundamentals or signals about them under informational barriers. The failure of DDA to reach at a cooperative multilateral trade liberalization including the areas such as trade in agricultural commodities and trade in services can be explained by the increased suspicion among negotiating parties due to wide spread informational barriers with deteriorating economic fundamentals as explained by the model in this paper. Moreover, the fear of a trade partner's deviation to protective policies will trigger preemptive protective measures, resulting in a trade war when the initial asymmetry of trade openness between trading partners is relatively large under the informational barriers on economic fundamentals.

This paper is organized as follows. Section 2 describes the framework and model to examine the impact of economic uncertainty and resulted informational barriers on equilibrium trade regime considering the strategic complementarity of trade policies based on iterated equilibrium dominance concept as the equilibrium refinement criterion. Section 3 examines the impact of trade retaliation measures adopted in case trade conflicts occur on equilibrium trade regimes. We demonstrate that if each country takes the hawkish strategy of more aggressive retaliation in case trade conflicts occur in a symmetric way, the cooperative free trade regime is more likely to be sustained. Section 4 determines the impact of asymmetric hawkish trade retaliation strategies between trading countries on the equilibrium trade regime. Section 5 concludes and discusses policy implications.

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[2] Refer to Angeletos et al. (2007a, 2007b), Baliga and Sjostrom (2004) and Chassang and Miquel (2010) for the latest research about the impact of noisy signals on equilibrium with strategic complements. Harsanyi and Selten (1988) provide a classic discussion on the role of risk-dominance in equilibrium selection. Moreover, Morris and Shin (2003) provide a comprehensive review of the global game theoretic perspective applied to various issues. Rochet and Vices (2004) analyze coordination failure based on theoretic global game approaches.

## 2. The model

We consider a trade policy game where each government has two trade policy options, free trade policies and protectionist trade policies.[3] The payoff matrix from each trade regime is given as follows: <Payoffs from each trade regime>

|  |  | Country $j$ | |
|---|---|---|---|
|  |  | F (Free trade policy) | P (Protectionist trade policy) |
| Country $i$ | F (Free trade policy) | $\pi_i + \delta_i V_i, \pi_j + \delta_j V_j$ | $S_i, F_j$ |
|  | P (Protectionist trade policy) | $F_i, S_j$ | $W_i, W_j$ |

where $\pi_i$ denotes the payoff of country $i$ from free trade policies, while $\delta_i$ represents the discount factor of country $i$ and $V_i$ is the continuation payoff from mutually cooperative trade policies. $S_i$ represents the payoff from taking a unilateral free trade policy while the competitor chooses non-cooperative trade policies, while $F_i$ is the payoff from the opposite case. $W_i$ denotes the payoff from the trade war in which both countries choose protectionist trade policies. When both countries choose free trade policies, the game takes the form of a repeated game with continuation payoffs. On the other hand, the game ends up as a one-shot game when either of the countries deviates to protectionist trade policies.

To determine the impact of economic uncertainties and informational barriers on the equilibrium trading regime, we examine the complete information case with no uncertainty in economic fundamentals as a benchmarking discussion. When there is uncertainty in economic fundamentals, the payoffs from each trade regime can be known only with probabilistic distribution. We assume that the uncertainty in economic fundamentals are reflected in the uncertain payoffs from free trade regime, $\pi_i$.[4]

### 2.1. A benchmarking discussion: complete information case

As a benchmarking discussion, we examine the case where the payoff from mutual cooperative free trade policies, $\pi_i$, is commonly known to be $\pi \in \left[ \underline{\pi}, \bar{\pi} \right]$. The payoffs from other cases are assumed to be always commonly known parameters, given as $F_i > W_i > S_i$, implying that trade policies are strategic complements, analogous to stag-hunt games. Moreover, the payoff from unilateral deviation to protectionist trade policies (i.e., unilateral betrayal) is higher than the payoff from trade war (i.e., mutual betrayal). Furthermore, the payoff from trade war is higher than the payoff from being unilaterally betrayed.[5]

In this case with complete information, the free trade regime can be an equilibrium regime when the payoff from mutual free trade policies is higher than the deviation payoff, as follows: $\left( \frac{1}{1-\delta} \right) \pi_i - F_i \geq 0$. When the net gain from deviation to non-cooperative trade policies is negative,

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[3] Protectionist trade policies are defined as non-cooperative Nash equilibrium strategies in a one-shot game that maximize a country's own individual welfare without caring trading partners' welfare. In the same context, free trade policies are defined as cooperative trade policies to maximize the joint-welfare of trading countries.

[4] The uncertainty of the payoffs from each trade regime due to uncertainty in economic fundamentals can be found in any type of trade regimes. For simplicity of discussion, we assume that the payoff uncertainty is found only from free trade regime. Even in case where the payoff uncertainty is found from other trade regime, the major findings of this paper are not affected.

[5] As pointed out by an anonymous referee, the assumption of strategic complementarity of the trade policies implies the mercantilist interpretation of the welfare impact of trade policies. When trade policies are strategic substitutes, unilateral trade liberalization might improve social welfare while a trading partner country imposes a protective trade policy. Such a case of welfare improvement via unilateral trade liberalization is possible when we assume a small economy with consumers heavily dependent on imported consumption goods while the export industries take a very small portion of the economy. However, this type of economy is an exceptional case not that often observed in reality. In addition, the real world trade negotiation is proceeded mainly by the reciprocity principle of trade liberalization. In that context, strategic complementarity of the trade policies is assumed in this paper.

there is no incentive to deviate from free trade strategies to a predatory protectionist policy, and in this context, we can say that there is no predatory incentive. Under complete information about the payoffs of cooperative trade regimes, we obtain multiple equilibria, i.e., two Nash equilibria, $(F, F)$ and $(P, P)$ given the assumption of $F_i > W_i > S_i$.

The criterion of risk-dominance a la Harsanyi and Selten (1988) is used to select a unique equilibrium from multiple equilibria, as in the stag hunt type game.[6] $(F, F)$ is the risk-dominant equilibrium if $\left(F_i - \frac{1}{1-\delta_i}\pi_i\right)\left(F_j - \frac{1}{1-\delta_j}\pi_j\right) \geq (S_i - W_i)(S_j - W_j)$, while $(P, P)$ is the risk-dominant equilibrium in the opposite case.[7]

### 2.2. The impact of informational barriers on equilibrium trade regimes

When the actual level of payoff from free trade regime is not publicly known due to unknown economic fundamentals, the trade policy game is structured as follows: The payoff from cooperative trade regime, $\pi_i$, is decided by nature with the mean value, $\theta$, and the finite variance $1/\alpha$. In other words, nature first draws $\pi_i$ from a normal distribution $N(\theta, 1/\alpha)$. Moreover, each country receives a private noisy signal about $\pi_i$, $x_i = \pi_i + \sigma$, where $\sigma \sim N(0, 1/\beta)$ is noise.

Given the noisy signal on unknown payoffs from free trade regime, $\pi_i$, the equilibrium is defined as follows: It is a strictly dominant strategy to choose a free trade policy when private signals on payoffs from free trade regime are higher than the critical value, $\bar{x}$, where $\bar{x}$ solves $Pr(\pi \leq \bar{\pi}|\bar{x}) = \frac{(1-\delta)F_i}{\pi_i}$. In addition, it is a dominant strategy to choose a protectionist trade policy when the private signal is lower than $\underline{x}$, where $\underline{x}$ solves

$$Pr\left(\pi \leq \underline{\pi}|\underline{x}\right) = \frac{(1-\delta)F_i}{\pi_i}. \tag{1}$$

Suppose that there is a threshold level of private signals, $\hat{x}$, such that players will choose a cooperative trade policy only if $x \geq \hat{x}$. The probability that each country chooses a free trade policy increases in $\pi_i$, and is defined as $Pr(x \geq \hat{x}|\pi) = D\left(\sqrt{\beta}(\pi - \hat{x})\right)$, where $D$ is the cumulative distribution function of the standard normal distribution. For each country, the choice of a free trade policy becomes the equilibrium strategy only when $\pi \geq \hat{\pi}$ where $\hat{\pi}$ solves

$$\hat{\pi} = D\left(\sqrt{\beta}(\hat{\pi} - \hat{x})\right). \tag{2}$$

The posterior belief about the payoff from cooperative trade policies conditional on a private signal, $x$, is given as the normal distribution with the mean $\frac{\beta x}{\alpha+\beta} + \frac{\alpha\theta}{\alpha+\beta}$ and the precision $\alpha + \beta$. Therefore, the posterior probability for the free trade policy to be chosen is given as

$$Pr\left(\pi \geq \hat{\pi}|x\right) = D\left(\sqrt{\alpha+\beta}\left(\hat{\pi} - \frac{\beta x}{\alpha+\beta} - \frac{\alpha\theta}{\alpha+\beta}\right)\right). \tag{3}$$

Because the probability is monotonous to $x$, it is optimal for each country to choose the free trade policy if and only if $x \geq \hat{x}$, where $\hat{x}$ solves $Pr(\pi \geq \hat{\pi}|\hat{x}) = \frac{(1-\delta)F_i}{\hat{\pi}}$, or equivalently

$$D\left(\sqrt{\alpha+\beta}\left(\hat{\pi} - \frac{\beta\hat{x}}{\alpha+\beta} - \frac{\alpha\theta}{\alpha+\beta}\right)\right) = \frac{(1-\delta)F_i}{\hat{\pi}}. \tag{4}$$

A unique equilibrium is determined satisfying Eqs. (2) and (4), as described in Proposition 1.

**Proposition 1.** There is a unique equilibrium in which each country chooses the free trade strategy under informational barriers if and only if $\beta \geq \alpha^2/(2\pi_i)$.

**Proof.** Each country chooses free trade policies when the payoff from the free trade regime is higher than the threshold level, $\hat{\pi}$. Therefore, $\hat{\pi}$ should solve Eq. (2), and the solution provides $\hat{x} = \hat{\pi} - \beta^{-1/2}D^{-1}(\hat{\pi})$.

Given the solution which is the threshold level of private signal, each country should be indifferent between cooperative trade policies and protectionist trade policies if the following condition is satisfied:

$$U_{F-P}(\pi) = D\left(\sqrt{\alpha+\beta}\left(\hat{\pi} - \frac{\beta\hat{x}}{\alpha+\beta} - \frac{\alpha\theta}{\alpha+\beta}\right)\right) - \frac{(1-\delta)F_i}{\hat{\pi}} \tag{5}$$
$$= D\left((\alpha+\beta)^{-1/2}\left[\alpha(\hat{\pi}-\theta) + \beta^{1/2}D^{-1}(\hat{\pi})\right]\right) - \frac{(1-\delta)F_i}{\hat{\pi}} = 0.$$

The payoff difference between free trade policies and protectionist trade policies, as shown in Eq. (5), is continuous and differentiable with $\pi \in \left(\underline{\pi}, \bar{\pi}\right)$ while $\lim_{\pi \to \bar{\pi}} U_{F-P}(\pi) > 0$ and $\lim_{\pi \to \underline{\pi}} U_{F-P}(\pi) < 0$. Therefore, there is a unique equilibrium payoff for free trade regime, $\pi$, satisfying Eq. (5), if Eq. (5) is monotone to $\pi$ as follows:

$$\frac{\partial U_{F-P}(\pi)}{\partial \pi} = (\alpha+\beta)^{-1/2}d\left((\alpha+\beta)^{-1/2}\left[\alpha(\theta-\pi) + \beta^{1/2}D^{-1}(\pi)\right]\right) \tag{6}$$
$$\times \left(\beta^{1/2}d^{-1}\left(D^{-1}(\pi)\right) - \alpha\right) > 0.$$

The monotonicity condition, as shown in Eq. (6), is satisfied if and only if $\beta^{1/2}d^{-1}(D^{-1}(\pi)) - \alpha > 0$. Therefore, if and only if $\beta \geq \alpha^2 d^{-1}(D^{-1}(\pi)) \geq \alpha^2(2\pi)^{-1}$, there is a unique equilibrium where a free trade policy is chosen if the precision of the private information is higher than the threshold point. Q.E.D.

Proposition 1 shows that when private signals, $x$, and payoffs from cooperative trade policies, $\pi$, are close to the threshold points, i.e., $\hat{x}$ and $\hat{\pi}$, then a small variation crossing the threshold points results in a large variation of trade regimes in a discontinuous way. That is, a small variation in the signal from $x \to \hat{x}^+$ to $x \to \hat{x}^-$ results in a discontinuous large-scale change from a free trade regime to a protectionist trade regime such as trade war as noted in the following:

$$\text{Equilibrium Trade Regime} \lim_{x \to \hat{x}^+}(U_{F-N}(\pi)) = (F, F), \text{ while}$$
$$\text{Equilibrium Trade Regime} \lim_{x \to \hat{x}^-}(U_{F-N}(\pi)) = (P, P). \tag{7}$$

The impact of small variation in economic fundamentals and signals on equilibrium trade regime discussed above is summarized in Corollary 1.[8]

**Corollary 1.** *When payoffs from free trade policies and private signals are close to the threshold levels, a small variation in the economic fundamentals and signals triggers a large variation in trade regimes with a discontinuity and strong nonlinearity in the equilibrium.*

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[6] Refer to Harsanyi and Selten (1988) for details about the risk-dominance criterion.

[7] Currently, we examine equilibrium based on the assumption of "$F_i > W_i > S_i$," which implies that trade policies are strategic complements. However, if $\left(\frac{1}{1-\delta}\pi_i - F_i\right)(W_j - S_j) > \left(\frac{1}{1-\delta}\pi_i - S_i\right)(W_j - F_j)$, which implies that trade policies are strategic substitutes, the trade policy game ends up with a chicken game equilibrium. In the chicken game, $(P_i, F_j)$ is the risk-dominant equilibrium if, while $(F_i, P_j)$ is the risk-dominant equilibrium in the opposite case.

[8] The trade regime examined in this paper includes not only multinational trade regime as WTO, but preferential trade arrangement such as FTA or custom Union, too. The model in this paper assumed that two countries negotiate over two types of trade policies. The major results obtained in this paper can be applied not only to the case of bilateral trade regime but also to multilateral trade regime when we assume each negotiating party represent a group of homogeneous countries. Proposition 1 implies that there is a unique equilibrium of multilateral and preferential trade regime exists when the precision of the signals on economic fundamentals is higher than a critical level. In addition, Corollary 1 shows that the sudden change of the multilateral and preferential trade regime might be initiated by a slight change in the economic fundamentals or signals of countries involved in the trade regime when the economic fundamentals and signals are close to the critical levels.

## 3. The impact of hawkish retaliatory policies on international trade regimes

This section examines how equilibrium trade regime is affected when each country takes trade retaliatory measures in case trade frictions occur. When a free trade regime collapses to a trade conflict, a country can resort to various types of trade retaliation measures including tariff and non-tariff retaliation measures such as anti-dumping and safeguard measures in addition to standard and safety regulation and environmental regulatory measures. When trade conflicts occur, the level of hawkish retaliatory measures depends on each country's political economic constraints that reflect each country's industrial market power in addition to the political stability of the policy regime. Therefore, the level of hawkish trade retaliatory measures of each country differs reflecting each country's different industrial and political economic characteristics.

First, we consider the case where each country takes the symmetric level of hawkish trade retaliatory measures as a bench marking discussion. The payoff from a trade conflict, where country $i$ takes her trade retaliation measures at the level, $k_i$, against her trading partner country $j$ is defined as follows:

$$W\left(k_i, k_j\right) = \frac{k_i}{k_i + k_j} m - D\left(k_j\right) \tag{8}$$

where $k_i$ is hawkish level of trade retaliation measures taken by country $i$, such as tariff and non-tariff retaliation measures. '$m$' represents the payoff from a trade war, while $D$ represents the damages from trade war.[9] The damages from trade war increase with the trading partner country's hawkish retaliatory measures, $k_j$: $\frac{\partial D_i(k_j)}{\partial k_j} > 0$.

In the same context, the payoff from unilateral deviation to protectionist trade policies can be defined as $F_i(k_i, k_j) = W_i(\rho_F k_i, \rho_S k_j) = \frac{\rho_F k_i}{\rho_F k_i + \rho_S k_j} m - D(\rho_S k_j)$, while the payoff from unilaterally keeping the free trade policy is defined as:

$$S_i\left(k_i, k_j\right) = W_i\left(\rho_S k_i, \rho_F k_j\right) = \frac{\rho_S k_j}{\rho_F k_i + \rho_S k_j} m - D\left(\rho_F k_j\right) \text{ with } \rho_F > 1$$
$$> \rho_S \geq 0 \text{ and } D: \mathbb{R}^+ \rightarrow \mathbb{R}^+$$

is increasing and continuously differentiable to $k_j$.

Moreover, it is assumed that the payoff of each country from trade regimes increases with its own hawkish trade retaliation measure, $k_i$, while decreasing with the hawkish retaliation measures of competing countries, $k_j$. In addition, when each country takes a symmetric level of non-cooperative industrial policies, the payoff from each trade regime decreases as follows:

$$\frac{\partial F_i\left(k_i, k_j\right)}{\partial k_i} > 0, \frac{\partial F_i\left(k_i, k_j\right)}{\partial k_j} < 0, \frac{\partial F_i(k)}{\partial k} < 0. \tag{9}$$

### 3.1. Complete information case

When trading countries take symmetric level of hawkish trade retaliation measures in case trade conflicts occur, the impact of the level

of the hawkish trade retaliation measures on the equilibrium trade regime is determined as follows. First, when the payoffs from the free trade regime are commonly known to be higher than payoffs from trade war, the condition for the cooperative trade policies to be chosen as the dominant strategy is given as: $\frac{\pi}{1-\delta} - F \geq 0$. From this condition, the threshold level of the payoff from the free trade regime under complete information is given as:

$$\tilde{\pi}^{CI} = (1-\delta)F_i\left(k_i, k_j\right) = (1-\delta)\left(\frac{\rho_F k_i}{\rho_F k_i + \rho_S k_j} m - D\left(\rho_S k_j\right)\right). \tag{10}$$

When each country maintains symmetric levels of hawkish trade retaliatory measures, the threshold level for payoff from free trade regime is defined as:

$$\tilde{\pi}^{CI} = (1-\delta)F_i(k) = (1-\delta)\left(\frac{\rho_F}{(\rho_F + \rho_S)} m - D(\rho_S k)\right). \tag{11}$$

When the level of hawkish trade retaliatory measures is increased under complete information, the threshold level of payoff for the free trade regime is decreased as follows:

$$\frac{\partial \tilde{\pi}^{CI}}{\partial k} = -(1-\delta)\rho_i D' < 0. \tag{12}$$

Therefore, it is more likely that the free trade regime can be sustained as an equilibrium trade regime when each country is about to take more hawkish trade retaliatory measures in case trade conflicts occur. The intuition behind this result is that each country recognizes that free trade regime provides higher payoffs compared to a trade war case when each country is ready to take more aggressive trade retaliation strategy if trade conflicts occur.

Therefore, each country has less incentive to deviate to non-cooperative trade policies because a trade war provides much lower payoffs due to increased damages caused by more aggressive trade retaliation measures. These results are summarized in Corollary 2.

**Corollary 2.** *When each country takes symmetric level of trade retaliatory measures in case trade conflicts occur with complete information about the payoffs of each trade regime, the free trade regime is more likely to be sustained when the level of hawkish trade retaliatory measures chosen in a trade war is increased.*

### 3.2. The case with informational barriers

When the payoff from free trade regimes, $\tilde{\pi}$, is not commonly known, the free trade regime can be sustained only when the incentive to choose the free trade policy is higher than the incentive to choose the protectionist trade policy as a pre-emptive measures against possible deviation by a trading partner. Therefore, the condition for cooperative trade policies to be the dominant strategy is defined as: $\frac{\tilde{\pi}}{1-\delta} - F \geq W - S$.

The threshold level for payoff from free trade regimes is defined as follows:

$$\tilde{\pi}^{SR}\left(k_i, k_j\right) = (1-\delta)\left(F_i\left(k_i, k_j\right) + W_i\left(k_i, k_j\right) - S_i\left(k_i, k_j\right)\right)$$
$$= (1-\delta)\left(\left(\frac{\rho_F k_i}{\rho_F k_i + \rho_S k_j} + \frac{k_i}{k_i + k_j} - \frac{\rho_S k_i}{\rho_S k_i + \rho_F k_j}\right) m - D\left(\rho_S k_j\right)$$
$$- D\left(k_j\right) - D\left(\rho_F k_j\right)\right). \tag{13}$$

We examine the case where each country chooses the symmetric level of trade retaliatory measures, $k = k_i = k_j$. With symmetric level of hawkish trade retaliation measures between trading countries,

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[9] The hawkish level of trade retaliation measures can be interpreted as a trade bargaining power which eventually determines the allocation of gains from trade as represented in Eq. (8). The actual allocation of gains from trade after the trade conflict is affected by the level of protective measures that negatively affects the trading partner while benefits the domestic firms. Therefore, an example of high hawkish level of trade retaliation measure is an import restriction including safeguard measures with tariff increase of quantity restrictions imposed by a large economy with market leadership. In the same context, an example of the lowest level of hawkish trade retaliation would be an import tariff imposed by a small open economy that eventually damages the tariff imposing country more than the trading partner.

the threshold level of the payoffs for free trade regime is reduced to the following:

$$\tilde{\pi}^{SR}(k) = (1-\delta)(F_i(k) + W_i(k) - S_i(k))$$
$$= (1-\delta)\left(\frac{3\rho_F - \rho_S}{2(\rho_F k + \rho_S k)}m - D(\rho_S k) - D(k) + D(\rho_F k)\right). \qquad (14)$$

The impact of the hawkish trade retaliation measures between trading countries on the equilibrium trade regime under informational barriers can be determined by checking how the threshold level of payoffs for the free trade regime changes with $k$, as follows:

$$\frac{\partial \tilde{\pi}^{SR}}{\partial k} = (1-\delta)(F_i'(k) + W_i'(k) - S_i'(k))$$
$$= -(1-\delta)(\rho_S D'(\rho_S k) + D'(k) - \rho_F D'(\rho_F k)). \qquad (15)$$

If the threshold level of the payoffs for the free trade regime is increased with $k$, the free trade regime is less likely to be sustained with the more hawkish trade retaliatory measures. The impact of the change in $k$ on the equilibrium trade regime depends on the sign of the follows: $F_i'(k) + W_i'(k) - S_i'(k)$. If $F_i'(k) + W_i'(k) > S_i'(k)$, the probability for the free trade regime to be sustained is diminished with the more aggressive trade retaliatory measures to be used in trade conflicts. In other words, when the preemptive incentive to choose protectionist trade policy is increased with the higher $k$, i.e., $W_i'(k) - S_i'(k) > 0$, the free trade regime is less likely to be sustained.

The increased preemptive incentive to choose the protectionist strategy with the higher $k$, represented by $W_i'(k) - S_i'(k) > 0$, implies the increased fear of the trade war due to the more hawkish retaliation strategies. Therefore, under informational barriers about the economic fundamentals and the payoffs from free trade regime, the increased hawkish retaliatory measures increase the fear of trade war, resulting in lower probability for the free trade regime. In comparison, under complete information, the increased hawkish trade retaliatory measures to be used in the trade friction contributed to increase the probability for the free trade regime. The economic rationale for the different result is that under complete information, the increased hawkish retaliatory strategies contributed to increase the cost of deviation to protectionist trade policies while under incomplete information, the increased hawkish strategies increased the fear of trade war, eventually increasing more frequent resort to the trade war due to the increased pre-emptive incentive to use the protectionist policies. These findings are summarized in Proposition 2.

**Proposition 2.** When economic fundamentals are not commonly known with informational barriers on the payoffs from the free trade regime, the free trade regime is less likely to be sustained if the preemptive incentive to choose protectionist trade policy is increased with the more hawkish trade retaliatory measures.

The intuition behind the results in Proposition 2 is that under informational barrier about the payoffs from the free trade regime due to uncertain economic fundamentals, the free trade regime is less likely to be sustained if preemptive incentive to choose protectionist trade policies, which is equivalent to the fear of trade war, is increased with more hawkish trade retaliatory measures to be used in case trade conflicts occur. When the possible loss from the betrayal by the trading partner country is large, a country is more likely to take the preemptive protectionist policies mainly out of fear of the trade war.

## 4. The impact of asymmetric level of hawkish trade retaliatory measures on equilibrium trade regimes

Levels of hawkish trade retaliatory measures vary significantly depending on the different political economic structures of trading countries such as political influences of import competing industries and different stages of economic development and industrialization. Asymmetry in levels of hawkish trade retaliatory measures is represented as follows:

$$k_i = \mu k \text{ and } k_j = \nu k \qquad (16)$$

where, for simplicity of discussion, we assume "$\mu \geq \nu = 1$".

### 4.1. The case with no informational barriers

First, we examine how trade regimes are affected by the level of asymmetry in level of hawkish trade retaliatory measures of trading partners when economic fundamentals are commonly known. When the actual level of payoff from the free trade regime is commonly known, preemptive incentives to choose protectionist trade policies need not to be considered since fear of trade war, which is the driving force for preemptive protectionist policies, is created only when economic fundamentals are not commonly known with the resulting uncertainty about the competitors' strategies. Therefore, the impact of asymmetry in the level of hawkish trade retaliatory measures can be determined by checking how the following threshold level for free trade regimes is affected by the change in $\mu$:

$$\tilde{\pi}^{CI} = (1-\delta)F_i(k_i, k_j) = (1-\delta)\left(\frac{\mu\rho_F}{\mu\rho_F + \rho_S}m - D(\rho_S k_j)\right). \qquad (17)$$

It is straightforwardly shown that when the asymmetry in the levels of hawkish trade retaliatory measures increases, the threshold level of payoffs from the free trade regime is increased as follows:

$$\frac{\partial \tilde{\pi}^{CI}(k_i, k_j)}{\partial \mu} = \frac{(1-\delta)\rho_F \rho_S m}{(\mu\rho_F + \rho_S)^2} > 0. \qquad (18)$$

This result implies that when trading countries show a larger asymmetry in their levels of hawkish trade retaliation, the free trading regime is less likely to be sustained. The rationale behind this result is that when a country takes much more aggressive and hawkish retaliatory measures in comparison to the partner country, which is the case of a larger '$\mu$', the country has a predatory incentive to deviate to protectionist trade policies unilaterally. These findings are summarized in Proposition 3.

**Proposition 3.** Under complete information about the payoffs from the free trade regime, the higher asymmetry in the levels of hawkish trade retaliatory tendencies between trading partners makes free regimes less likely to be sustained due to increased predatory incentives to choose protectionist policies for a country with more aggressive retaliatory tendencies.

### 4.2. The case with informational barriers due to uncertainty in economic fundamentals

When the payoff from free trade regimes is not commonly known due to uncertainty in economic fundamentals, each country makes a decision on trade policies considering the possible loss from the trading partner's unilateral deviation to protectionist policies. If the possible loss from the partner country's unilateral deviation to protectionist policies is large, the preemptive incentive to choose non-cooperative policies is increased, which would be equivalent to the case to initiate trade war out of fear. Therefore, under informational barriers, the impact of asymmetry in the hawkish retaliatory tendencies of trading countries on equilibrium trade regimes is mainly decided by how preemptive incentives are affected with the asymmetry. The threshold level of the

payoff for free trade regimes under strategic risk due to uncertainty in economic fundamentals is defined as:

$$
\begin{aligned}
\tilde{\pi}^{SR}\left(k_i, k_j\right) &= (1-\delta)\left(F_i\left(k_i, k_j\right) + W_i\left(k_i, k_j\right) - S_i\left(k_i, k_j\right)\right) \\
&= (1-\delta)\left(\left(\frac{\rho_F}{\rho_F\mu+\rho_S} + \frac{\mu}{\mu+1} - \frac{\rho_S\mu}{\rho_S\mu+\rho_F}\right)m - D(\rho_S k) - D(k) \right. \\
&\quad \left. - D(\rho_F k)\right).
\end{aligned}
\tag{19}
$$

The impact of the increase in the asymmetry of hawkish trade retaliatory tendencies, $\mu$, on equilibrium trade regimes under strategic risk can be determined by checking how the threshold level of payoff for cooperative trade regimes changes with $\mu$, as follows:

$$
\begin{aligned}
\frac{\partial \tilde{\pi}^{SR}}{\partial \mu} &= (1-\delta)\left(F_i{}'(\mu) + W_i{}'(\mu) - S_i{}'(\mu)\right) \\
&= (1-\delta)\left(\frac{\rho_F\rho_S}{(\rho_F\mu+\rho_S)^2} + \frac{\mu}{(\mu+1)^2} - \frac{\rho_F\rho_S}{(\rho_S\mu+\rho_F)^2}\right)m.
\end{aligned}
\tag{20}
$$

When the payoff from the free trade regime is not commonly known due to uncertain economic fundamentals, each country should consider the possible loss from the trading partner country's betrayal to choose protectionist trade policies given asymmetric hawkish trade retaliatory tendencies. Differing from the case of complete information, the impact of the asymmetry in the hawkish levels on the equilibrium trade regimes depends on how the preemptive incentive to choose protective policies is affected by the fear of the partner country's betrayal.

In case the preemptive incentives to choose protective policies increase with the asymmetry in the hawkish levels, the free trade regime is less likely to be sustained. More specifically, facing the asymmetry in the hawkish retaliatory tendencies of trading countries, the fear of the trading partner's betrayal to the protectionist policies induces a country to choose protectionist trade policies resulting in a trade war under informational barriers due to uncertainty in economic fundamentals. These findings are summarized in Proposition 4.

**Proposition 4.** Under informational barriers due to uncertainty in economic fundamentals, when the preemptive incentive to choose protectionist policies increases more with the higher asymmetry in the hawkish trade retaliatory tendencies, the free trade regime is more likely to collapse to a state of trade war.

Proposition 4 provides insights on many occasions of trade wars and other related conflicts mainly motivated by the fear of the possible betrayal of the trading partner facing informational barriers due to economic uncertainty. Especially, the proposition provides clear clues as to why recurrent protectionist trade policies and related measures such as the competitive devaluation are observed more often after the global financial crisis in 2008 that increased the informational barriers on the outcome of free trade regime due to the higher uncertainty in economic fundamentals.

## 5. Concluding remarks

Motivated by the recurrent failures in reaching agreement for trade liberalization even after the launch of the WTO, which is assumed to be an enhanced enforcement mechanism for cooperative trade regimes, this paper examines the impact on equilibrium trade regimes of informational barriers due to the uncertainty in economic fundamentals and hawkish trade retaliatory tendencies that reflect the political economic characteristics of trading countries.

When there is no informational barrier with the economic fundamentals commonly known to all countries, we demonstrated that a free trade regime is more likely to be sustained if the damages from a trade war get larger with more hawkish trade retaliatory tendencies of trading countries. However, when the economic fundamentals are not commonly known with informational barriers, the impact of the retaliatory tendencies depends on the possible loss from the betrayal of the trading partner country, which is the basis for the preemptive incentive to choose protectionist trade policies.

In addition, this paper showed that a slight negative change in economic fundamentals as well as the signals can cause the collapse of the free trade regimes to a state of trade war when each country faces the informational barriers due to uncertainty in economic fundamentals. Moreover, the fear of the damages caused by the trading partner's betrayal, i.e., the preemptive incentive, plays the major role in deciding the equilibrium trade regimes. When the fear of a trading partner's betrayal, which provides a preemptive incentive to choose protectionist trade policies, is increased with the more hawkish trade retaliatory tendencies, the free trade regime is more likely to collapse to a state of trade war.

The major findings in this paper are based on the assumption that informational barriers on the economic fundamental take the form of incomplete information with the common noisy signals. However, it is often observed that informational barriers take the form of imperfect informational structure showing asymmetry in the informational barriers among trading countries. Moreover, although we assumed strategic complementarities of trade policies as in the stag-hunt type game, trade negotiation game might take the 'chicken game' type characteristics with the strategic substitutability of trade policies. To integrate these additional features of trade policies, the introduction of asymmetric information and strategic substitutability of trade policies with the asymmetric bargaining power would provide more in-depth understanding on why the efforts for trade liberalization fail so often in the future studies.

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