Essays on international trade and economics of conflict

by

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B.A., Moulay Ismail University, 2003
M.A., Western Illinois University, 2014

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Economics
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Abstract

The first chapter is motivated by the recent territorial disputes, in South China Sea and the Middle East, over external territories rich in natural resources. The objective of the study is to understand why political disputes over external territories sustain or persist despite that the countries engaged in conflict are trading partners. This chapter presents a game theoretical model to analyze the impact of bilateral trade on the economic and political behavior of the two contending countries. The analytical results suggest that greater trade openness (by lowering trade cost) reduces conflict intensity when the contending countries are symmetric in their national endowments. This finding is consistent with the liberal peace hypothesis that trade reduces conflict. For the case where there are differences in national resource endowments, the analysis shows that the overall conflict may increase despite greater trade openness. This chapter has policy implications on the role of bilateral trade and size of an economy for conflict resolution.

The second chapter considers trade regionalism and the endogeneity of security policy. Using a sequential-move game, this chapter is the first to characterize the endogeneity of security and trade policies in a three-country framework with two adversaries and a neutral third party. It has been shown that an FTA between two adversaries (i.e., “dancing with the enemy” in trade regionalism) has the strongest pacifying effect, followed by worldwide free trade. Second, the pacifying effect of worldwide free trade is stronger than that of the protectionist regime. Third, relative to all other regimes, an FTA between one of the adversaries and a neutral third party is conflict-aggravating. Furthermore, this chapter compares conflict intensities when instead there is a customs union (CU) and identify differences in implications between CU and FTA for interstate conflicts.

The third chapter investigates the scenario of two enemy countries that do not engage in trade. The objective is to analyze what would be their optimal arming allocations for national defense when a politically neutral third party forms a free trade agreement (FTA) with only one of the adversaries (Single FTA), as compared to the case when the third party forms an FTA with each of them (Multiple FTAs). The major finding is that an FTA between a neutral third country and each of the adversary countries (despite that they do not trade) has a pacifying effect since the overall conflict intensity decreases. However, an FTA between the third country and only one of the adversaries is conflict-aggravating as the overall conflict intensity increases.

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Dedication

To my wonderful wife, Safae, without your support and love, I would not achieve my goals.

To my daughter, Chams, my mother, Fadma, and my father, El Mustapha.

Chapter 1 - A game Theoretical analysis of International Trade and Political Conflict over external territories

1. Introduction

How does greater trade openness affect the arming decisions of large open countries that have political disputes over external territories (e.g., overseas islands or fishing grounds near coastal waters) whose property rights are not well defined or enforced, especially when the territories have a rich abundance of natural resources? Viewed from a different angle, how do conflicts over external resource-rich territories affect the trading relationship between two adversaries? In this paper, we attempt to explore those questions by developing a game-theoretic model of trade wherein two adversaries may engage in armed confrontation over resources in external territories. The scenario characterized by both economic interdependence through trade and political disputes about overseas resources serves as a heuristic framework for investigating the liberal peace hypothesis that trade has pacifying effects on interstate conflicts.

The present study is motivated by the renewed interest in the trade-conflict nexus associated with recent (or historical) interstate disputes over the sovereignty of certain external or overseas territories. One recent case of interest concerns China and Vietnam. Vietnam's imports from China represent more than 30% of her total volume of imports. Also, China represents one of Vietnam's most important trading partners. Yet their dispute over the parcels of land in the South China Sea, which are rich in valuable resources such as minerals and fishing grounds, has been in the headlines of political discussions between the two countries' officials for decades. Another case of interest involves the political conflict between Japan and Russia in connection with the southern Kuril Islands, which are rich in natural resources and have a sizable source of income from tourism. Despite the fact that Japan counts among the largest trading partners of

Russia, their disputes over the islands have not yet been resolved. The third case is an historical one relating to the Falklands Conflict (also known as the Falklands War) between Argentina and the United Kingdom over British overseas territories in the South Atlantic. Those territories are rich in oil and gas, among other valuable resources. These three cases, despite their differences when viewed from the political perspectives of territorial expansion and geopolitics, share two things in common from the economic perspectives of resource appropriation and international trade. One issue concern how conflict over external territories affect the trading relationship between two adversary countries, and the other concerns how greater trade openness affects the intensity of conflict (measured as the aggregate expenditures on armaments) between the adversaries. We make no attempt to analyze the historical origins or specific causes of territorial or resource conflicts. Rather, we wish to identify conditions under which the liberal peace proposition is valid when trading nations have conflicts over external territories rich in natural resources.

Our analysis can be viewed as a subset of the broader picture regarding how globalization fostered by lower trade costs (i.e., a greater degree of economic interdependence owing to trade) affects interstate armed conflicts.[1] Empirical research to study the correlation between international trade and political conflicts begins with Polachek (1980). Using panel data on 30 countries for a period of ten years, the author shows that trade among nations significantly reduces the intensities of their conflicts. Following Polacheck's (1980) seminal work, numerous researchers have turned their attentions to analyzing the general validity of the liberal peace

[1]See, e.g., Findlay and O'Rourke (2010), who discuss the general issues of natural resources, conflict and trade from an historical perspective. For other contributions that investigate resource-based disputes, see, e.g., Acemoglu, Golosov, Tsyvinski and Yared (2012), and Garfinkel, Skaperdas and Syropoulos (2015).

hypothesis.[2] The empirical findings in the literature do not reveal a high degree of consensus on the trade-conflict nexus, however.[3] As a theoretical underpinning, Skaperdas and Syropoulos (2001) develop a conflict model of trade when two small open countries have disputes over a valuable resource (e.g., oil) indispensable for producing tradable goods. The authors show that when international price of the contested resource exceeds its autarkic price, the opportunity cost of arming declines. In that case, bilateral trade prompts competition for the disputed resource, causing each contending country's arming to increase. Garfinkel, Skaperdas and Syropoulos (2015) present a variant of the Heckscher-Ohlin model to analyze interstate disputes over resources. They find that if trade promotes adversary countries to export goods that are intensive in disputed-resource, it may intensify interstate conflict so much that autarky is preferable to free trade. In analyzing the trade causes of war, Martin, Mayer and Thoenig (2008) find that expanding the number of member countries within a regional trade bloc reduces the economic dependency between any pair of adversaries which, in turn, makes war between them more likely.

Starting with a conflict-theoretic framework of trade and external resource appropriation, we derive several new results that are summarized as follows. (i) For two large open countries that

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[2]For studies that present empirical evidence on the correlation between trade, conflict and related issues, see, e.g., Polachek (1992), Barbieri (1996), Barbieri and Levy (1999), Reuveny and Kang (1998), Polachek, Robst and Chang (1999), Barbieri and Schneider (1999), Anderton and Carter (2001), Mansfield and Pollins (2001), (2002), Levy and Barbieri (2004), Kim and Rousseau (2005), and Glick and Taylor (2010).

[3]The book by Mansfield and Pollins (2003) contains studies of the trade and conflict debate. The contribution by Oneal and Russet (1999) supports Polacheck (1980) and shows that strengthening the extent of trade openness between contending countries effectively can reduce their conflicts in terms of overall armament expenditures. Nevertheless, some studies (e.g., Kim and Rousseau 2005) find that the pacifying effect of greater trade openness can be neutral; other studies (e.g., Barbieri 1996) find that extensive trade linkages may increase the probability of armed conflicts. Barbieri and Levy (1999) show that war does not have significant impacts on trading relationships between adversaries.

have disputes over external territories rich in natural resources, each country's arming has three different effects. The first is an export-revenue effect since arming causes export prices and revenue to go up. The resulting increase in export revenue reflects the marginal revenue (MR) of arming. The second is an import-expenditure effect since arming cause import prices and spending to increase. The third is an output-distortion effect which causes domestic production of consumption goods to fall. The aggregation of the second and third effects reflects the marginal cost (MC) of arming. In a conflict equilibrium, each country's arming is determined endogenously by equating marginal revenue (MR) with marginal cost (MC). (ii) Based on the MR=MC conditions for determining the arming decisions of two resource-conflict countries, we show that greater trade openness (by lowering trade costs) reduces conflict intensity when the adversaries are symmetric in all dimensions (e.g., national endowments, production technology and consumer preferences). This finding provides a theoretical justification for the liberal peace hypothesis that trade reduces conflict. (iii) For the case where there are differences in national resource endowments, we show the existence of an asymmetric equilibrium at which arming by the more endowed country exceeds that by the less endowed country. The two adversaries respond to lower trade costs differently: the more endowed country cuts back on arming, whereas the less endowed country may increase arming. We find that, under resource endowment asymmetry, the overall intensity of arming may increase despite greater trade openness.

The remainder of the paper is organized as follows. Section 2 presents a conflict-theoretic model of trade between two countries having disputes over an external territory rich in resource inputs. We determine equilibrium arming for each country under symmetry in all aspects. In Section 3, we characterize trade and conflict equilibrium when two adversaries are different in terms of national resource endowments. We then study how the resulting asymmetric equilibrium is affected by greater trade openness. Section 4 concludes.

2. The analytical framework

2.1 Basic assumptions

We consider a world of two countries (denoted *A* and *B*) having disputes over the property rights of a territory, which is located outside their respective national boundaries. The territory is either an island, a parcel of external land, or a newly discovered maritime fishing ground. This external territory is rich in valuable natural resource (e.g., minerals, fish and wildlife, natural gas, or oil), which can be used as an intermediate input by each country to produce a country-specific final good for domestic consumption or for exportation. We assume that the "undetermined" status of the external territory constitutes the primary cause of conflict between the two large open countries. [4] Our aim is to see how the adversaries determine their productive and appropriative activities, as well as the relationship between conflict and trade.

Owing to their political disputes over the undetermined territory, country *A* (respectively, country *B*) chooses to produce G_A (respectively, G_B) guns for occupying the territory and, hence, obtaining the resource input for final good production. In the event of appropriation, the probability that each country is able to obtain the contested resource is represented by a canonical "contest success function" (CSF) that reflects the technology of conflict (see Tullock 1980; Hirshleifer 1989; Skaperdas 1996) as follows:

[4]The modeling approach herein thus stands in contrast to the traditional assumption of "small open economies" in neoclassical international trade analysis, wherein trading nations accept the prices of tradable goods in their world markets under perfect competition.

$$\Psi_A = \frac{G_A}{G_A + G_B} \text{ and } \Psi_B = \frac{G_B}{G_A + G_B} \text{ for } G_A + G_B > 0; \tag{1a}$$

$$\Psi_A = \Psi_B = \frac{1}{2} \text{ for } G_A = G_B = 0. \tag{1b}$$

Let the amount of natural resource endowment possessed by country $i (i = A, B)$ be given as R_i, which is inalienable. Assume that the total amount of resource input in the external territory is $Z (> 0).$ That resource input can be used by country A to produce a consumption good, denoted as X; on the other hand, the resource input can be used by country B to produce a different consumption good, denoted as $Y.$ In other words, either A or B can utilize the external resource as an intermediate input in producing a country-specific product. The setup is analogous to the Ricardian world in which a single resource input is used by two countries to produce different tradable goods.

For analytical simplicity and tractability, we assume that one unit of each country's resource endowment is required to produce either one unit of its consumption good or one unit of armaments. In addition, one unit of the resource input is able to produce one unit of a country-specific final good. Given the CSF in (1a) and in the event of fighting to acquire Z, country A's total production of final good X is:

$$X_A = R_A - G_A + (\frac{G_A}{G_A + G_B})Z, \tag{2a}$$

where the last term measures the amount of the good produced from the appropriated resource input. Given the CSF in (1b), country B's total output of final good Y is:

$$Y_B = R_B - G_B + (\frac{G_B}{G_A + G_B})Z, \tag{2b}$$

where the last term is the amount of the good produced from the appropriated resource input.

As for consumer preferences in country A, we consider a symmetric quadratic utility function: $U(D_X, M_Y) = \alpha(D_X + M_Y) - (D_X^2 + M_Y^2)/2$, where D_X is consumption of the final good X produced domestically and M_Y is consumption of the final good Y imported from country B. Corresponding to the quadratic preferences, market demands for the domestic good X and the imported good Y in country A are:

$$D_X = \alpha - P_X \text{ and } M_Y = \alpha - P_Y, \tag{3a}$$

where $\alpha(>0)$ is the quantity intercept, and P_X and P_Y are, respectively, the domestic prices of final goods X and Y in the country. We assume that α is greater than the quantity of the endowed resource R_A when market prices are zero, that is, $\alpha > R_A$.

Likewise, we consider a symmetric quadratic utility function for country B as $V(D_Y, M_X) = \alpha(D_Y + M_X) - (D_Y^2 + M_X^2)/2$, where D_Y is consumption of the final good Y produced domestically and M_X is consumption of the final good X imported from country A. Corresponding to the quadratic preferences, market demands for the domestic good Y and for the imported good X in country B are:

$$D_Y = \alpha - H_Y \text{ and } M_X = \alpha - H_X, \tag{3b}$$

where α is the quantity intercept, and H_Y and H_X are, respectively, the domestic prices of goods Y and X in the country. We again assume that α is greater than the quantity of the endowed resource R_B when market prices are zero, that is, $\alpha > R_B$.

Based on the market demands in (3a) and (3b), we calculate benefits to consumers in the two countries in terms of consumer surplus as follows:

$$CS_A = \frac{1}{2}(D_X^2 + M_Y^2) \text{ and } CS_B = \frac{1}{2}(D_Y^2 + M_X^2). \tag{4}$$

Producer surplus in country *A* (respectively, country *B*) is measured by the total value of final good production, $P_X X_A$ (respectively, $P_Y Y_B$). We have from X_A in (2a) and Y_B in (2b) that

$$PS_A = P_X[R_A - G_A + (\frac{G_A}{G_A + G_B})Z] \text{ and } PS_B = P_Y[R_B - G_B + (\frac{G_B}{G_A + G_B})Z]. \tag{5}$$

In the event of fighting between countries *A* and *B* for external resources, each country determines an arming allocation G_i to maximize its Social Welfare (SW_i), which is specified as

$$SW_i = CS_i + PS_i, \tag{6}$$

where CS_i and PS_i (for $i = A, B$) are given in (4) and (5). We consider a simultaneous-move game in which countries *A* and *B* independently determine G_A and G_B

2.2 Trade and conflict equilibrium under symmetry

We proceed to examine trade equilibrium in the presence of conflict over the external territory where resource Z is located. In the analysis, we incorporate the CSFs as specified in (1) into the Bagwell-Staiger (1997) framework of international trade between two large open economies.

For country *A*, the production of good *X*, X_A, minus domestic consumption, D_X, yields the amount of the good that country *B* imports, M_X. It follows from (2a), (3a) and (3b) that

$$[R_A - G_A + (\frac{G_A}{G_A + G_B})Z] - (\alpha - P_X) = (\alpha - H_X). \tag{7}$$

For country *B*, the total production of good *Y*, Y_B, minus domestic consumption, D_Y, yields the amount of the good that country *A* imports, M_Y. It follows from (2b), (3a) and (3b) that

$$[R_B - G_B + (\frac{G_A}{G_A + G_B})Z] - (\alpha - H_Y) = (\alpha - P_Y). \tag{8}$$

Denote t_i as trade cost (per unit of output) that country i $(i = A, B)$ incurs when exporting a final good to the market in its rival. To maintain the trade patterns as described, we note the comparative advantage principle that a country exports a good whose price in its own domestic market plus unit trade cost can never exceed the good's price in an importing country's market. To satisfy this principle, we follow Bagwell and Staiger (1997) to impose the non-arbitrage conditions for bilateral trade in final goods *X* and *Y*:

$$P_X + t_X \leq H_X \text{ and } H_Y + t_Y \leq P_Y. \qquad (9) \& (10)$$

Making use of (7)-(10) and considering the equality conditions in (9)-(10) along with the symmetric assumption that $t_X = t_Y = t,$ we solve for the equilibrium prices of the final goods:

$$H_X = \frac{2\alpha - X_A + t}{2}, \quad P_X = \frac{2\alpha - X_A - t}{2}, \quad H_Y = \frac{2\alpha - Y_B - t}{2}, \quad P_Y = \frac{2\alpha - Y_B + t}{2}, \qquad (11)$$

where X_A and Y_B are given in (2a) and (2b). As shown in Appendix A-1, we can further derive the equilibrium prices of the final goods, consumer surplus, and producer surplus in terms of arming by the two countries, G_A and G_B.

Substituting the market price P_X from (11) back into the market demand D_X in (3a) and making use of X_A in (2a), we calculate country *A*'s domestic consumption of good *X*:

$$D_X = \alpha - (\frac{2\alpha - X_A - t}{2}) = \frac{X_A}{2} + \frac{t}{2} = \frac{1}{2}[R_A + (\frac{G_A}{G_A + G_B})Z - G_A] + \frac{t}{2}.$$

It follows that

$$\frac{\partial D_X}{\partial G_A} = -\frac{(G_A + G_B)^2 - G_B Z}{2(G_A + G_B)^2} < 0 \quad \text{if} \quad Z < \frac{(G_A + G_B)^2}{G_B}. \qquad (12)$$

Equation (12) shows that country *A*'s arming has a negative effect on domestic consumption of good *X*, under the inequality condition that $Z < (G_A + G_B)^2 / G_B$. It is plausible to assume that this inequality holds.[5] The economic reason why the derivative $\partial D_X / \partial G_A$ has a negative sign should be explained. When country *A* allocates more resources to arming, it has fewer resources available for producing good *X*. A reduction in the production of good *X* causes the good's market price to go up. Country *A*'s consumption of good *X* thus declines along with its arming.

Substituting the market price P_Y from (11) into the demand function $M_Y = \alpha - P_Y$ in (3a), making use of Y_B in (2b), we calculate country *A*'s import demand for good *Y*:

$$M_Y = \alpha - (\frac{2\alpha - Y_B + t}{2}) = \frac{1}{2}Y_B - \frac{t}{2} = \frac{1}{2}[R_B + (\frac{G_A}{G_A + G_B})Z - G_B] - \frac{t}{2}.$$

It follows that

$$\frac{\partial M_Y}{\partial G_A} = -\frac{\partial P_Y}{\partial G_A} = -\frac{G_B Z}{2(G_A + G_B)^2} < 0. \tag{13}$$

Equation (13) indicates that country *A*'s arming negatively affects the consumption of good *Y* imported from its adversary. The economic reason is as follows. An increase in arming by country *A* forces country *B* to increase its arming. Country *B* then has fewer resources with which to produce its final good *Y*. The price of good *Y* will increase to reflect its scarcity. As a result, country *A*'s import demand for good *Y* falls, explaining why *A*'s arming affects its import demand negatively.

Following CS_A in (4), we see that the effect of country *A*'s arming on consumer surplus is:

$$\frac{\partial CS_A}{\partial G_A} = D_X \frac{\partial D_X}{\partial G_A} + M_Y \frac{\partial M_Y}{\partial G_A} < 0, \tag{14}$$

[5]For the case of symmetry in all dimensions that shall be discussed in the latter part of this section, we see that this inequality condition implies that $Z < 4G$, where $G = G_A = G_B$. The inequality condition then indicates that $G > Z/4$. That is, each country's arming is strictly greater than a quarter of the nation's overall resource endowment.

where the negative sign in (14) follows directly from (12) and (13). The result in (14) implies that *A*'s arming affects domestic consumers negatively.

As for the effect of *A*'s arming on domestic producers, we have from PS_A in (5) that

$$\frac{\partial PS_A}{\partial G_A} = P_X \frac{\partial X_A}{\partial G_A} + X_A \frac{\partial P_X}{\partial G_A}, \tag{15}$$

Where

$$\frac{\partial X_A}{\partial G_A} = -\frac{(G_A+G_B)^2 - G_B Z}{(G_A+G_B)^2} < 0 \text{ and } \frac{\partial P_X}{\partial G_A} = \frac{(G_A+G_B)^2 - G_B Z}{2(G_A+G_B)^2} > 0 \text{ if } Z < \frac{(G_A+G_B)^2}{G_B}. \tag{16}$$

When allocating more resources to arming, country *A* has fewer resources available for producing good *X*. The export price of good *X* will rise owing to its scarcity. The two derivatives in (16) are opposite in sign, causing the derivative $\partial PS_A/\partial G_A$ in (15) to be indeterminate. We cannot conclude unambiguously how domestic producers in country *A* is affected by its arming.

2.3 Decomposing the impact of a country's arming

We proceed to analyze how arming affects the social welfare for each country. We look at country *A* first. Making use of $\partial CS_A/\partial G_A$ in (14) and $\partial PS_A/\partial G_A$ in (15), we show in Appendix A-2 the detailed derivation for the impact of country *A*'s arming on its social welfare (SW_A) and record the result as follows:

$$\frac{\partial SW_A}{\partial G_A} = \underbrace{E_X \frac{\partial P_X}{\partial G_A}}_{\substack{\text{Export-revenue effect} \\ \text{of arming} \\ (+)}} + \underbrace{M_Y\left(-\frac{\partial P_Y}{\partial G_A}\right)}_{\substack{\text{Import-expenditure effect} \\ \text{of arming} \\ (-)}} + \underbrace{P_X \frac{\partial X_A}{\partial G_A}}_{\substack{\text{Output-distortion effect} \\ \text{of arming} \\ (-)}} \tag{17}$$

where $E_X \equiv (X_A - D_X)$ is the amount of the final good *X* exported from *A* to *B*.

Following from (17), we find that a country's arming contains three different terms. (i) The first term shows that country *A*'s arming increases its export revenue since $E_X = (X_A - D_X) > 0$ and $\partial P_X / \partial G_A > 0$. This first term measures the marginal revenue of arming. (ii) The second term shows that country *A*'s arming increases its expenditure on imports from the rival country since the import price increases, $\partial P_Y / \partial G_A > 0$. (iii) The third term shows that country *A*'s arming reduces final good production since $\partial X_A / \partial G_A < 0$. The sum of the last two terms (in absolute value) measure the marginal cost of arming. We thus have

PROPOSITION 1. *For the case of bilateral trade and conflict over an external territory rich in a valuable resource input, the impact of a country's arming contains three separate effects. The first is an export-revenue effect since arming causes export prices and revenue to go up. This effect constitutes the marginal revenue of arming* (MR_i^{Arms}). *The second is an import-expenditure effect since arming causes export prices and spending to increase. The third is an output-distortion effect since arming reduces domestic production of consumption goods. The last two effects constitute the marginal cost of arming* (MC_i^{Arms}).

Proposition 1 indicates that arming by each contending country to maximize its social welfare is determined where marginal revenue equals marginal cost. That is, $MR_i^{Arms} = MC_i^{Arms}$. It is straightforward to see the following corollary:

Corollary 1: *For two adversaries, the best option is not to fight over an external territory if arming is such that* $MR_i^{Arms} < MC_i^{Arms}$. *The result is a corner solution with* $G_A = G_B = 0$. *This corner solution arises when the export-revenue effect is more than offset by the import-expenditure effect plus the output-distortion effect.*

Proof: See Appendix A-3. Q.E.D.

The implication of Corollary 1 is as follows. Under the circumstances where $MR_i^{Arms} < MC_i^{Arms}$, the best strategy for two adversary countries is to maintain the "status quo" without claiming the property rights of an external territory and its resources. This may help explain why not all disputes over external territories (with undetermined property rights) give rise to militarized interstate conflicts.

We consider the case of symmetry in endowed resources $(R_A = R_B = R)$ and trade costs $(t_A = t_B = t)$ when there is an interior solution for arming. Using the FOCs for countries *A* and *B* and the $MR_i^{Arms} = MC_i^{Arms}$ conditions (see Appendix A-2), we solve for the Nash equilibrium level of arming for each country under symmetry $(G_A = G_B = G)$. This exercise yields

$$G^* = \frac{6R + 5Z - 8\alpha + 2t + \sqrt{K}}{12}, \tag{18}$$

where $K = 36R^2 + 12RZ + 24Rt - 96R\alpha + Z^2 + 20Zt - 32Z\alpha + 4t^2 - 32t\alpha + 64\alpha^2$. It can be verified that $G^* > 0$ if $2R + Z > 2\alpha$, which implies that $R > \alpha - Z/2$. We assume that this inequality condition holds.[6]

2.4 Comparative statics of the equilibrium arming under symmetry

It is instructive to see how each country's equilibrium arming is affected by exogenous changes in the values of *Z*, *R*, and *t*. Making use of G^* in (18), we show the following results (see detailed derivatives in Appendix A-4):

[6]At the equilibrium level of arming where $G^* > 0$, we also verify that the equilibrium prices and quantities of the final goods produced and consumed are all positive under symmetry.

$$\frac{\partial G^*}{\partial Z} > 0, \; \frac{\partial G^*}{\partial R} > 0, \text{ and } \frac{\partial G^*}{\partial t} > 0.$$

The economic implications of the derivatives are summarized in the second proposition:

PROPOSITION 2. *Under symmetry, the equilibrium arming by each contending country increases with the amount of the contested resource in an external territory, increases with each country's national endowment, but decreases with the size of trade costs.*

Given trade costs, we see from Figure 1.1 that point *E* is the intersection of country *A*'s arming reaction curve, denoted as $G_A^S(G_B)$, and country *B*'s arming reaction curve, denoted as $G_B^S(G_A)$.[7] The symmetric arming equilibrium occurs at point *E*, $\{G_A^*, G_B^*\}$, which is lying on the 45-degree degree line. An exogenous increase in the amount of the contested resource Z causes country *A*'s arming reaction curve to shift outward and country *B*'s arming reaction curve to shift upward. In equilibrium, the contending countries increase their arming allocations, i.e., $G_A^{'} > G_A^*$ and $G_B^{'} > G_B^*$.

[7]Note that country *A*'s arming reaction curve, $G_A^S(G_B)$, is implicitly defined by its FOC that $\partial\Pi_A/\partial G_A = 0$ and country *B's* arming reaction curve, $G_B^S(G_A)$, is implicitly defined by its FOC that $\partial\Pi_B/\partial G_B = 0$.

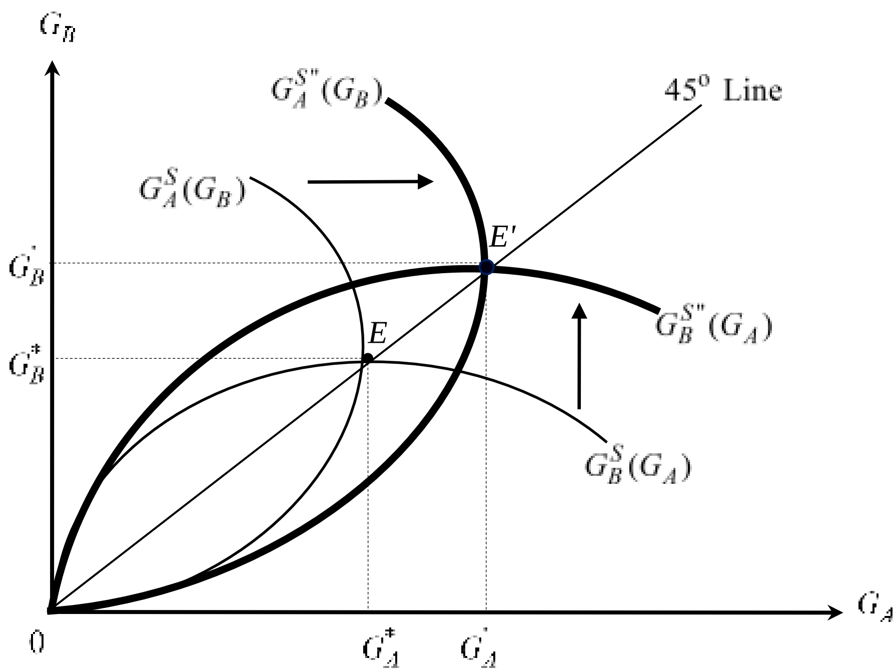

Figure 1.1 An external territory with a greater amount of resource causes each country's arming to increase under symmetry

Figure 1.2 presents a graphical interpretation of the result that decreases in trade costs reduce the intensity of conflict. When trade costs are lower, *A*'s arming reaction curve shifts leftward and *B*'s arming reaction curve shifts download. The equilibrium arming allocations of the two adversaries are such that $G_A^{"} < G_A^*$ and $G_B^{"} < G_B^*$. These results suggest that the equilibrium arming allocations under symmetry are fundamentally "strategic complements" in response to lower trade costs. Figure 1.2 thus illustrates the validly of the liberal peace proposition that greater trade openness reduces conflict intensity and hence promotes peace.

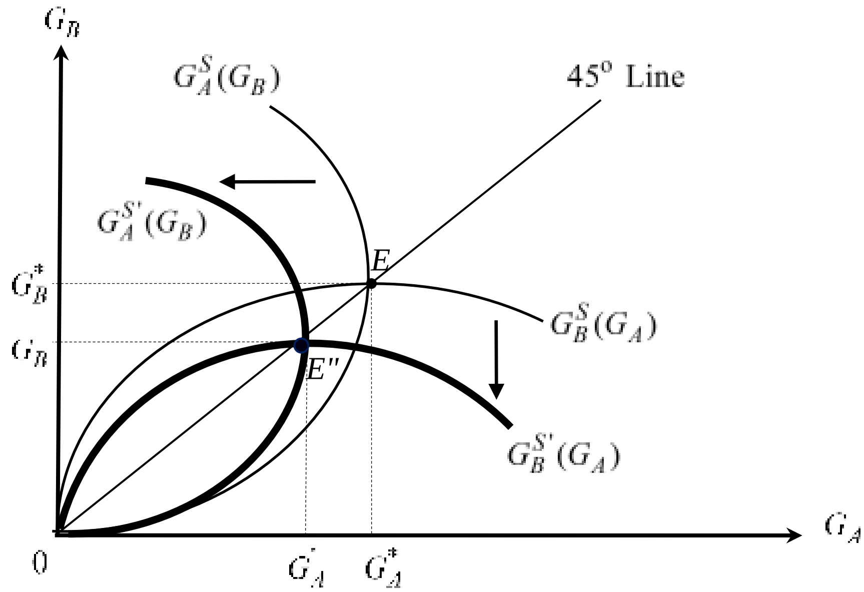

Figure 1.2 Decreases in trade barriers cause each country's arming to decline under symmetry

3. Trade and conflict under asymmetry in national resource endowments

No countries are identical in terms of national resource endowments. In this section, we analyze the more general case where two adversaries fighting for an external resource-rich territory differ in their endowments of resources. In terms of the notations in our analysis, we have $R_A \neq R_B$. Two questions we wish to answer: one is how the resource endowment asymmetry affects the arming decisions of two contending countries, the other is how the resulting equilibrium is affected by greater trade openness owing to lower trade costs. Answers to these questions have implications for whether the liberal peace proposition continues to hold under asymmetry in national resource endowments.

3.1 Effects of resource endowment asymmetry on arming and conflict intensity

Without loss of generality, we introduce a new parameter δ by assuming that $R_A = (R_o + \delta)$ and $R_B = (R_o - \delta)$, where R_o denotes the average endowment of the two-country world and $\delta(>0)$. The difference between R_A and R_B is then given as $R_A - R_B = 2\delta > 0$, which implies the assumption that country *A* is relatively more endowed country *B*.[8] An increase in the value of $\delta(>0)$ reflects that the degree of endowment asymmetry increases.

As in Section 2, we continue to assume that the adversary countries engage in trade. Substituting the conditions that $R_A = (R_o + \delta)$ and $R_B = (R_o - \delta)$ into the consumer and producer surplus functions of the two countries (see equations a.5 and a.6 in Appendix A-1), we show in Appendix A-5 their social welfare functions: $SW_A(G_A, G_B; \delta)$ and $SW_B(G_A, G_B; \delta)$. The countries determine arming levels to maximize their respective social welfare functions. The FOCs are:

$$\frac{\partial SW_A(G_A, G_B; \delta)}{\partial G_A} = 0 \quad \text{and} \quad \frac{\partial SW_B(G_A, G_B; \delta)}{\partial G_B} = 0. \qquad \text{(19a) \& (19b)}$$

The FOC in (19a) defines *A*'s arming reaction function to the arming level chosen by *B*, that is, $G_A = G_A(G_B; \delta)$. The FOC in (19b) defines *B*'s arming reaction function to the arming level chosen by *A*, that is, $G_B = G_B(G_A; \delta)$. Given the value of δ, the two reaction functions determine the equilibrium arming allocations, $\{\tilde{G}_A, \tilde{G}_B\}$, of countries *A* and *B* under asymmetry.

Next, we evaluate the asymmetric equilibrium, $\{\tilde{G}_A, \tilde{G}_B\}$, using the symmetric equilibrium as the baseline. This is due to the analytical intractability of finding the reduced-form solutions for $\tilde{G}_A$ and $\tilde{G}_B$. For δ being equal to zero such that $R_A = R_B = R_o$, we have the symmetric arming allocations chosen by *A* and *B*, $\{G_A^*, G_B^*\}$, where $G_A^* = G_B^*$. Figure 1.3 illustrates this symmetric

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[8]The parameter δ may be used to represent the country size differential between *A* and *B* in that the higher the value of δ the greater the size of country *A* relative to country *B*.

equilibrium at point E which lies on the 45-degree degree line. Point E is the intersection of A's arming reaction curve, $G_A^S(G_B)$, and B's arming reaction curve, $G_B^S(G_A)$.

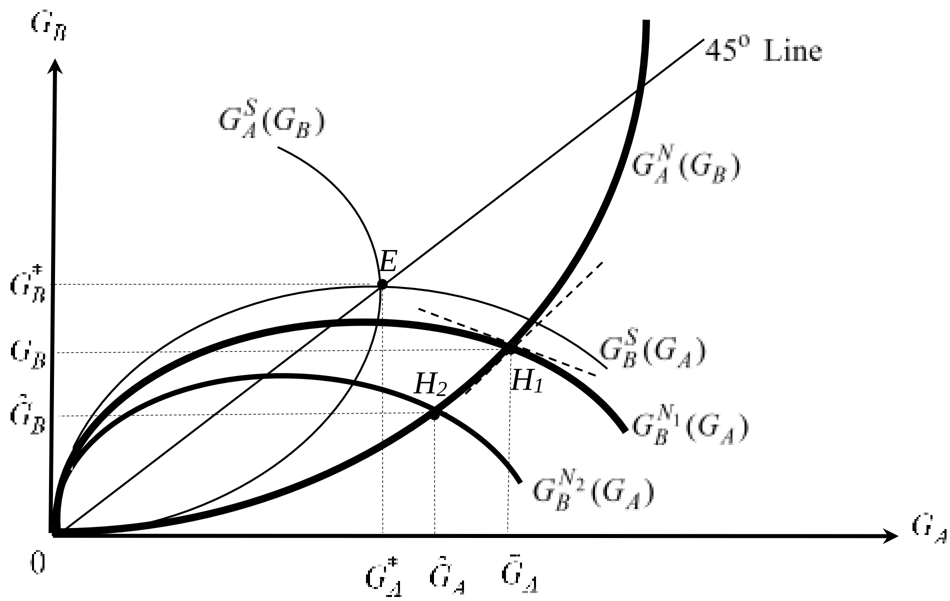

Figure 1.3 Conflict intensity may increase under national endowment asymmetry

Under endowment asymmetry $(\delta > 0)$, we need to determine what effects an exogenous increase in δ have on the two derivatives: $\partial SW_A(G_A, G_B; \delta)/\partial G_A$ and $\partial SW_B(G_A, G_B; \delta)/\partial G_B$. Making use of $SW_A(G_A, G_B; \delta)$ in Appendix A-5, we find that

$$\frac{\partial}{\partial \delta}\left(\frac{\partial SW_A(G_A, G_B; \delta)}{\partial G_A}\right) = \frac{3(G_A + G_B)^2 - 2G_B Z}{4(G_A + G_B)^2} > 0. \tag{20}$$

The positive sign in (20) indicates that country A's marginal benefit of arming, $\partial SW_A(G_A, G_B; \delta)/\partial G_A$, increases with δ. Country A is better off to arm more when the degree of endowment asymmetry increases, given the arming level chosen by its rival. As illustrated in Figure 3, an increase in the degree of endowment asymmetry causes country A's arming reaction curve to move rightward to the one as shown by $G_A^N(G_B)$.

On the other hand, making use of $SW_B(G_A, G_B; \delta)$ in Appendix A-5, we find that

$$\frac{\partial}{\partial \delta}\left(\frac{\partial SW_B(G_A, G_B; \delta)}{\partial G_B}\right) = -\frac{3[(G_A + G_B)^2 - G_A Z]}{4(G_A + G_B)^2} < 0. \tag{21}$$

The negative sign in (21) indicates that country *B*'s marginal benefit of arming, $\partial SW_B(G_A, G_B; \delta)/\partial G_B$, decreases with δ. Country *B* is better off by reducing arming when the degree of endowment asymmetry increases, given the arming level chosen by its rival. As can be seen from Figure 3, an exogenous increase in δ causes country *B*'s arming reaction curve to move downward to the one as shown by either $G_B^{N_1}(G_A)$ or $G_B^{N_2}(G_A)$.

There are two interesting possibilities for the asymmetric equilibrium, depending on the relative shifts of the two countries' arming reaction curves. For illustration, we let *A*'s arming reaction curve be given as $G_A^N(G_B)$. The two possible cases of interest are:

<u>Case 1</u>: The asymmetry equilibrium occurs at point H_1, which is the intersection of $G_A^N(G_B)$ and $G_B^{N_1}(G_A)$. This implies that $\tilde{G}_A > G_A^*$, $\tilde{G}_B < G_B^*$, and $\tilde{G}_A + \tilde{G}_B > G_A^* + G_B^*$.

<u>Case 2</u>: The asymmetry equilibrium occurs at point H_2, which is the intersection of $G_A^N(G_B)$ and $G_B^{N_2}(G_A)$. This implies that $\hat{G}_A > G_A^*$, $\hat{G}_B < G_B^*$, and $\hat{G}_A + \hat{G}_B < G_A^* + G_B^*$.

Conflict intensity is relatively lower in Case 2, but is relatively higher in Case 1. Note that, irrespective of the possible outcomes, the asymmetric equilibrium always occurs at a point below the 45-degree line such that $\tilde{G}_A > \tilde{G}_B$ and $\hat{G}_A > \hat{G}_B$. We thus have

PROPOSITION 3. *Under asymmetry in national resource endowments between two adversaries, other things being equal, the equilibrium arming is <u>greater</u> for the relatively more-endowed country than for the relatively less-endowed country. The overall conflict intensity under the* *endowment asymmetry is greater than that under endowment symmetry, provided that the increase in arming by the relatively more-endowment country outweighs the decrease in arming by the relatively less-endowment country.*

Proposition 3 implies that national endowment asymmetry does not necessarily lower the intensity of conflict. This suggests that whether a world with two asymmetric adversaries is "safer" than a world with two symmetric adversaries cannot be determined unambiguously.

3.2 Effects of greater trade openness under endowment asymmetry

We proceed to analyze how an asymmetric equilibrium is affected by lowers trade costs. First, we see that the derivative of $\partial SW_A(G_A,G_B;\delta)/\partial G_A$ with respect to t is:

$$\frac{\partial}{\partial t}\left(\frac{\partial SW_A(G_A,G_B;\delta)}{\partial G_A}\right)=\underbrace{-\frac{(G_A+G_B)^2-G_BZ}{4(G_A+G_B)^2}}_{\substack{\text{Export-revenue effect}\\ \text{of arming as } t \text{ decreases}\\ (-)}}+\underbrace{\frac{G_BZ}{4(G_A+G_B)^2}}_{\substack{\text{Import-expenditure effect}\\ \text{of arming as } t \text{ decreases}\\ (+)}}+\underbrace{\frac{(G_A+G_B)^2-G_BZ}{2(G_A+G_B)^2}}_{\substack{\text{Output-distortion effect}\\ \text{of arming as } t \text{ decreases}\\ (+)}},\quad \text{(22a)}$$

where $SW_A(G_A,G_B;\delta)$ is given in Appendix A-5. Combining the terms on the RHS of (22a) yields

$$\frac{\partial}{\partial t}\left(\frac{\partial SW_A(G_A,G_B;\delta)}{\partial G_A}\right)=\frac{1}{4}>0. \qquad \text{(22b)}$$

It follows from (22b) that the slope $SW_A(G_A,G_B;\delta)$ with respect to G_A decreases as t decreases. This impels that, when lower trade costs are lower, the export-revenue effect of arming is dominated by the import-expenditure effect plus the output-distortion effect of arming. In other words, lower trade costs will reduce the marginal benefit of arming relative to the marginal cost. As a result, country *A*'s incentive to arm decreases. In Figure 4, the decrease in arming by country *A* is illustrated by a leftward shift of its reaction curve from $G_A^N(G_B)$ to $G_A^{N'}(G_B)$.

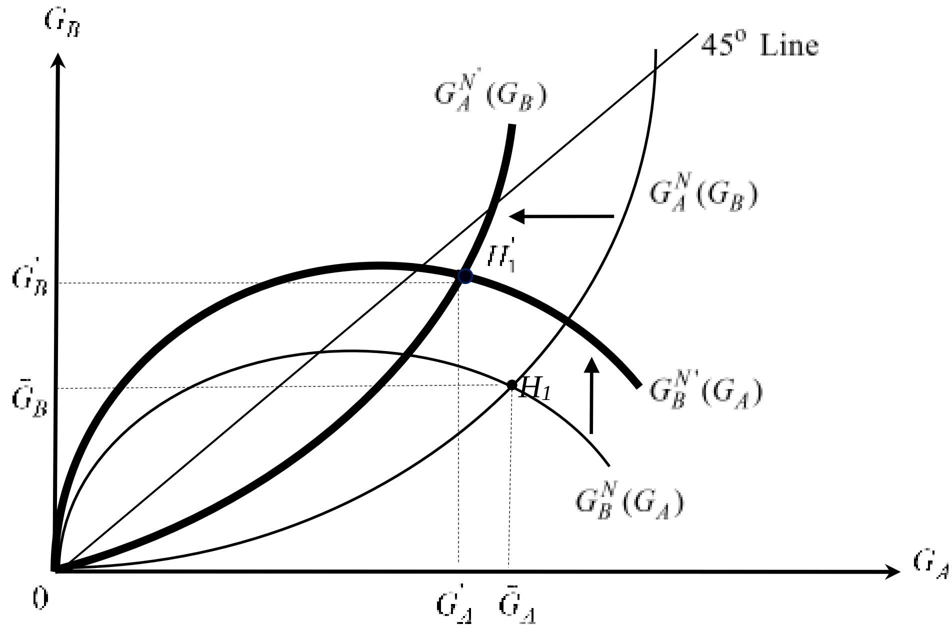

Figure 1.4 Greater trade openness may increase conflict intensity under national endowment asymmetry

Second, we examine how country B's arming affects its social welfare owing to lower trade costs and calculate the derivative of $\partial SW_B(G_A, G_B; \delta)/\partial G_B$ with respect to t

$$\frac{\partial}{\partial t}\left(\frac{\partial SW_B(G_A,G_B;\delta)}{\partial G_B}\right) = \underbrace{-\frac{\left(G_A+G_B\right)^2 - G_A Z}{4\left(G_A+G_B\right)^2}}_{\substack{\text{Export-revenue effect}\\ \text{of arming as } t \text{ decreases}\\ (-)}} + \underbrace{\frac{G_A Z}{4\left(G_A+G_B\right)^2}}_{\substack{\text{Import-expenditure effect}\\ \text{of arming as } t \text{ decreases}\\ (+)}} \underbrace{-\frac{\left(G_A+G_B\right)^2 - G_A Z}{2\left(G_A+G_B\right)^2}}_{\substack{\text{Output-distortion effect}\\ \text{of arming as } t \text{ decreases}\\ (-)}}. \quad (23a)$$

where $SW_B(G_A, G_B; \delta)$ is given in Appendix A-5. Combining the terms on the RHS of (23a) yields

$$\frac{\partial}{\partial t}\left(\frac{\partial SW_B(G_A,G_B;\delta)}{\partial G_B}\right) = -\frac{3\left(G_A+G_B\right)^2 - 4G_A Z}{4\left(G_A+G_B\right)^2} > (=)(<)\ 0. \quad (23b)$$

It follows from (23b) that the sign of the derivative cannot be determined unambiguously. This implies that the slope of $SW_B(G_A, G_B; \delta)$ with respect to G_B may increase or decrease as t

decreases. Accordingly, greater trade openness may cause country *B*'s arming reaction curve to shift upward or downward, depending on the degree of endowment asymmetry.

When trade costs are lower, we cannot rule out the possibility that the sum of the output-distortion effect and the export-revenue effect is dominated by the import-revenue effect. If the marginal benefit of arming $(\partial SW_B(G_A, G_B; \delta)/\partial G_B)$ *increases* when *t* decreases, the best strategy for country *B* is to increase arming. Figure 4 illustrates the case where country *B*'s arming reaction curve shifts upward from $G_B^N(G_A)$ to $G_B^{N'}(G_A)$. The reaction curves $G_A^{N'}(G_B)$ and $G_B^{N'}(G_A)$ determine the new asymmetric equilibrium at a point like $H_1^{'}$. Comparing $H_1^{'}$ to the original equilibrium at H_1, we see that $G_A^{'} < \tilde{G}_A$, $G_B^{'} > \tilde{G}_B$, and $G_A^{'} + G_B^{'} > \tilde{G}_A + \tilde{G}_B$. In this case, *A* reduces arming whereas *B* increases arming. Moreover, the intensity of conflict increases despite lower trade costs. Although there is a decrease in arming by *A* (the more-endowed country), its arming continues to exceed the arming level by *B* (the less-endowed country). We, therefore, have

PROPOSITION 4. *Under asymmetry in national resource endowments, greater trade openness resulting from lower trade costs causes the more endowed country (A) to cut back on its arming. But the effect on the arming level of the less endowed country (B) can be positive, zero, or negative. The impact of greater trade openness on conflict intensity is then indeterminate.*

The economic implications of Proposition 4. is as follows. In a world where conflicting countries differ in their resource endowments, they respond to lower trade costs differently. The relatively more abundant country reduces arming. But the relatively less abundant country may increase it. This result emerges when the decrease in the marginal revenue of arming is more than offset by the decrease in the marginal cost. Consequently, the overall conflict intensity could increase despite greater trade openness. The liberal peace hypothesis that trade reduces conflict may not be observed under resource endowment asymmetry.

4. Concluding remarks

In this paper, we have presented a game-theoretic analysis to investigate how political disputes over an external territory affects the trading relationship between two resource-conflict countries and how greater trade openness affects the intensity of arming. Instead of imposing the small-open-economy assumption, we consider trade between two large open economies under resource conflict when terms of trade are endogenously affected by their arming decisions. We show that a country's arming raises its revenue from exports, increases its spending on imports, and lowers the production of civilian goods for domestic consumption. These three different effects of arming jointly determine how resource conflict affects the equilibrium volumes of imports and exports between two adversaries, and how greater trade openness affects their optimal arming choices. For the case in which two adversaries are symmetric in all aspects, our analysis demonstrates the validly of the liberal peace proposition that trade reduces conflict.

We further analyze how conflict equilibrium is affected by differences in national resource endowments. The result is an asymmetric equilibrium such that the more endowed country arms more than the less endowed country. But the two adversaries respond to lower trade costs differently: the more endowed country is interested in arms reduction, whereas the less-endowed country may be interested in arms buildup. Under endowment asymmetry, conflict intensity could increase despite greater trade openness.

It should be mentioned that the analysis with this paper is a subset of the broader issues concerning how movement toward globalization through trade affect international conflicts. In our model, we look at the effect that conflict over external territories has on trade in final goods between two adversaries, without considering the possibility of trade in resources or intermediate inputs. This research question remains open for future investigation. The present model of conflict and trade adopts the simple assumption that one unit of resource or intermediate input is required to make one unit of a country-specific final product. In reality, two contending countries may not have the same capacity to utilize resource. Admittedly, we focus our analysis only on the case of endowment asymmetry without considering the aspect of capacity asymmetry. One interesting extension is to see how differences in the capacity of resource utilization would affect the validity of the liberal peace hypothesis. Another dimension we ignore is the strategic intervention of a third country into the two-country trade and conflict over external resources.[9] We wish to pursue all these issues in our future research.

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[9] Garfinkel and Syropoulos (2015) examine the case where two adversaries do not trade with each other but do engage in trade with a third country. For issues on how the equilibrium outcome of a two-party conflict is altered by the strategic involvement of an outside party, see Chang, Potter, and Sanders (2007), Chang and Sanders (2009), Sanders and Walia (2014). But these three studies do not consider the possibility of bilateral trade between adversaries.

Chapter 2 - Endogenous Security, Optimal Tariffs, and Regional Trade Agreements: Is Trade Regionalism a Double-Edged Sword?

1. Introduction

The post-World War II era has witnessed an unprecedented proliferation of regional trade agreements (RTAs), particularly in the types of free trade agreements (FTAs) and customs unions (CUs).[10] Voluminous studies in the economics literature have contributed to our understanding of RTAs. Baldwin (1997) and Whalley (1998) analyze the economic determinants of forming or joining RTAs. Vicard (2009) shows empirically that forming any RTAs granting trade preferences to member states significantly increases bilateral trade.[11] Carrere (2006) documents that RTAs have increased the volume of trade for member states, but at the expense of non-member states. Baldwin and Jaimovich (2012) investigate whether FTAs contribute to the rapid spread of regionalism and find no significant evidence of slowing down multilateralism. Bagwell, Bown, and Staiger (2016) present a systematic review of issues related to preferential trade agreements, as well as on the perils and promise facing the world trading system. This important strand of the literature on forming trade institutions stresses, among other things, the deeper integration benefits associated with RTAs from the perspective of international economics.[12]

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[10] Under either an FTA or a CU, member countries enjoy duty-free access to each other's markets within the trade bloc. An FTA allows member states to independently set external tariffs on imports from non-member states (i.e., outsiders), but members of a CU jointly determine a common external tariff on imports from outsiders.

[11] The pioneering work of Viner (1950) provides economic insights into the trade-creation and trade-diversion effects of a customs union. Balassa (1961) indicates that there are four different stages of economic integration - free trade area or arrangement, customs union, common market, and economic union. Depending on the depth of economic integration through forming RTAs, Vicard (2009) examines four different types: preferential arrangements, free trade agreements, customs unions, and common markets.

[12] For other studies on economic integration through RTAs and related issues see, e.g., Bhagwati and Panagariya (1996), Bagwell and Staiger (1997, 1989), Ethier (1998), Krishna (1998), Mansfield (1998), Mansfield and Milner (1999), Panagariya (2000), Baier and Bergstrand (2004), Baier and Bergstrand (2007), Egger and Larch (2008), Freund and Ornelas (2010), Chang and Xiao (2013, 2015), Anderson and Yotov (2016), Bergstrand, Egger, and Larch (2016), and Braymen, Chang, and Luo (2016).

During the post-World War II period over which many states are moving toward globalization as reflected by to the rapid growth in the number of RTAs, there is a somewhat steady but essentially declining trend of militarized interstate disputes.[13] This observation prompts one to analyze whether trade regionalism is a double-edged sword: it increases the opportunity costs of going to war and, in the meanwhile, raises a nation's capacity to wage war for more resources. Given that RTAs are institutional arrangements across different countries, the other strand of the literature on trade regionalism further look at issues on interstate disputes, national security, democratization, arms race, and alliances. The work of Mansfield and Bronson (1997) is among the first to show that allied nations engage in a higher volume of trade than those non-allied. The authors further find that the relatively higher trade volume also increases when the allies form RTAs. Investigating the relationship between trade institutions and military conflicts, Mansfield and Pevehouse (2000) document that member states of RTAs are less likely to have armed conflicts than non-member states. Liu and Ornelas (2014) show empirically that a country's participation in FTAs enhances the sustainability of its democracy. The authors indicate that the mechanism behind the positive relationship between trade regionalism and consolidated democracy is “the destruction of rents in FTAs” associated with a member state's change in its political regime. Martin, Mayer, and Thoenig (2008, 2012) analyze the causes of trade for war and find that enlarging the number of members in a regional trade arrangement reduces the economic interdependence between any pair of rival states which, in turn, increases the likelihood of bilateral war.[14] A recent study by Hadjiyiannis, Heracleous, and Tabakis (2016) shows how an RTA (either

[13] See, for example, the detailed discussions in Harrison and Wolf (2012) and Gleditsch and Pickering (2014).

[14] For studies that empirically analyze the correlation between trade and conflict-related issues see, e.g., Polacheck (1980), Polachek (1992), Barbieri (1996), Barbieri and Levy (1999), Reuveny and Kang (1998), Polachek, Robst, and Chang (1999), Barbieri and Schneider (1999), Anderton and Carter (2001), Mansfield and Pollins (2001), Reuveny (2002), Levy and Barbieri (2004), Kim and Rousseau (2005) and Polachek and Seiglie (2007), Glick and Taylor (2010). The book by Mansfield and Pollins (2003) contains a collection of interesting studies on trade and conflict debate. The seminal work of Polacheck (1980) shows that strengthening the extent of trade openness between contending countries can effectively reduce their conflicts in term of overall armament expenditures. This result is also found in Oneal and Russet (1999). Nevertheless, some studies such as Kim and Rousseau (2005) find that the pacifying effect of greater trade openness can be neutral. Other studies such as Barbieri (1996) find that extensive links through trade may increase the probability of armed conflicts. Barbieri and Levy (1999) show that war does not have significant impact on trading relationships between adversaries. It seems that there is no consensus on the trade-conflict nexus. For theoretical investigations on the relationship between trade and conflict see, e.g., Skaperdas and Syropoulos (2001), Garfinkel, Skaperdas, and Syropoulos (2009, 2015), and Garfinkel and Syropoulos (2017).

an FTA or a CU) between two contending countries or between one of the contending countries and a third neutral state affect the likelihood of war.

The present paper belongs to the second strand of the literature on interstate conflicts and trade institutions. We analyze several questions that appear not to have been explored analytically in the economics literature. Under different trade regimes (e.g., RTAs, worldwide free trade, and trade protectionism), how do optimal military decisions of resource-conflict countries affect their terms of trade, export revenues, import demands, and tariff revenues? Given that forming trading blocs negatively affects non-member states economically (Carrere, 2006), how would RTAs affect conflict intensity between member and non-member countries that are enemies to each other? Do commitments to regional economic integration arrangements through trade have a role in reducing conflict intensity between enemy countries within a trade bloc? That is, does the relationship between military conflict and trade hinge on the form of trading institutions (either an FTA or a CU) for economic integration? Under the shadow of resource appropriations, would the world be much safer (that is, conflict intensity is relatively lower) when there is worldwide free trade than when there is an RTA? We wish to present an economic analysis that combines elements of interstate disputes and trade to identify conditions under which trade regionalism may or may not be a double-edged sword. Furthermore, among the alternative trade regimes to be analyzed, we wish to identify the one that exhibits the most substantial pacifying effect (i.e., conflict intensity is at the lowest level in equilibrium).

The present paper departs from the conflict and trade regionalism literature in some important aspects. First, we present a game-theoretic framework of conflict and trade to characterize the *endogeneity* of arming decisions and trade policies optimally chosen by two adversary countries in a sequential-move game. Second, the endogenous security approach makes it possible to rank conflict intensities for different trade regimes. We investigate the equilibrium arming decisions of two adversaries in trade regionalism, as compared to their arming allocations under the protectionist regime (without RTAs of any form) or under worldwide free trade. Third, the analysis helps clarify some similarity or difference in implications between FTAs and CUs for the endogeneity of conflict intensities. Treating arming as an endogenously-determined decision in the shadow of conflict, we show for the protectionist regime (the benchmark case) that a country's arming affects its social welfare in four different channels. The first is an export-revenue effect, which increases welfare as an increase in arming causes its export price and revenue to go up. The second is a resource-appropriation effect, which increases welfare as allocating more resource to arming increases the appropriation of final good for domestic consumption. The third is a tariff-revenue *cum* import-spending effect, which reduces welfare as an increase in arming raises import price, lowers import demand, and reduces tariff revenue net of import spending. The fourth is an output-distortion effect, which reduces welfare as increasing arming causes the production of civilian goods to go down.[15]

We show that conflict intensities, measured by aggregating the arming allocations of the adversaries, are ranked from <u>low</u> to <u>high</u> for the different trade regimes: (i) a free trade agreement (FTA) between two adversaries, (ii) worldwide free trade, (iii) tariff protectionism, and (iv) an FTA between one of the adversaries and a neutral third country. These results have implications for conflict and trade. First, an FTA between two adversaries (i.e., "dancing with the enemy" in trade regionalism) has the strongest pacifying effect, followed by worldwide free trade. Second, the pacifying effect of worldwide free trade is stronger than that of the protectionist regime. Third, relative to all other regimes, an FTA between one of the adversaries and a neutral third country is *conflict-aggravating* as the aggregate intensity of arming the highest. We further compare conflict intensities when there is a customs union (CU) instead and identify differences in implications between CU and FTA for interstate conflicts. We find that conflict intensity remains at the lowest level (i.e., the pacifying effect is the strongest) whether two contending countries form an FTA or a CU. We also find that the conflict-escalating effect associated with an FTA between one of the adversaries and a neutral third country may disappear when there is instead a CU.

We organize the remainder of the paper as follows. In Section 2, we first lay out a three-country model of conflict and trade and then characterize the equilibrium under trade protectionism. In Section 3, we examine the scenario where two contending countries form an FTA to access each other's market duty-free. In Section 4, we focus on the case of worldwide free trade. Section 5 discusses the conflict-trade equilibrium when there is an FTA between one contending country and a neutral third party. We present a systematic ranking of optimal arming and conflict intensities for the alternative trade regimes. In Section 6, we analyze and compare the

[15] The first two effects constitute the marginal revenue (MR) of arming, whereas the last two effects measure the marginal cost (MC) of arming.

equilibrium levels of conflict intensities for the trade regimes when RTA takes the form of a CU. Section 7 concludes.

2. The Analytical Framework of a Three-Country World

2.1 Basic assumptions on conflict, market equilibrium, and domestic welfare

We consider a world of three countries, *A*, *B*, and *C*, where *A* and *B* are "enemies" as they contest part of each other's resources, and *C* is a neutral third party. Each country possesses R units of a unique resource input exclusively used in the production of a country-specific consumption good. We wish to incorporate elements of conflict into a standard framework of international trade for analyzing trade among the three large opening economies.[16] This approach permits us to investigate how optimal arming decisions of two resource-conflict countries affect the equilibrium terms of trade across the three trading nations.[17]

We assume that there are three different consumption goods: a, b, and c. Each country specializes in the production of a tradable good in its country name, and imports two other products from abroad. For example, country *A* produces good a and imports goods b and c, respectively, from countries *B* and *C*. Country *C* produces good c and imports goods a and b. For each country's production technology, we adopt the simple case that one of a unique resource input produces one unit of final good in its specialization.

Given that countries *A* and *B* are each other's enemies, they transform fractions of their endowments into military weapons for national defense. We consider a simple military technology that one unit of an endowed resource produces one unit of guns. Denote $G^A(\geq 0)$ and $G^B(\geq 0)$ as the amounts of resources allocated to arming by *A* and *B*, respectively. A country's national security policy is a broader concept to include such dimensions as military, economics, environment,

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[16] This differs from the assumption of "small open economies" in the standard trade analysis, where trading nations accept as given the prices of tradable goods in their competitive world markets. The models of international trade developed by Bagwell and Staiger (1997, 1999) are examples of trade among large open economies. Chang and Sellak (2018) analyze the behavior of conflict over external territories between two large open countries in which their optimal arming decisions affect the equilibrium terms of trade.

[17] Polachek (1980) is among the first to contend that conflict is supposed to affect terms of trade between nations.

energy, technology, and so forth. For analytical simplicity, we use the conflict-related arming allocation of a contending country to represent its security policy. To measure the likelihood of a country in retaining its endowed resource after fighting, we use a canonical "contest success function" (CSF) to reflect the technology of conflict (see, e.g., Tullock 1980; Hirshleifer 1989; Skaperdas 1996). The CSFs for the two adversaries, *A* and *B*, are:

$$\Psi^i = \frac{G^i}{G^A + G^B} \text{ for } G^A + G^B > 0;\ \Psi^i = \frac{1}{2} \text{ for } G^A = G^B = 0. \tag{1}$$

In the event of resource predation, country *A* loses K^A units of good *a* and country *B* loses K^B units of good *b*.[18] Taking into account arming allocations and the associated destruction costs, we calculate the quantities of goods a and b that countries *A* and *B* supply to the competitive markets. That is,

$$Z_a^A = (\frac{G^A}{G^A + G^B})R - G^A - K^A \text{ and } Z_b^B = (\frac{G^B}{G^A + G^B})R - G^B - K^B. \tag{2}$$

Note that in (2), we take into account the CSFs in (1).

As for to preferences over the final goods in consumption, we assume for analytical simplicity and model tractability that market demand for good $i \in \{a,b,c\}$ in the country $j \in \{A,B,C\}$ is taken to be linear:[19]

$$Q_i^j = \alpha - \beta P_i^j, \tag{3a}$$

where P_i^j is the price of good i in country j, the parameter $\alpha(> R)$ is a measure of market size, and $\beta > 0$. Corresponding to the demands in (3a), we have consumer surplus (*CS*) for country *j* as follows:

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[18] As in Hadjiyiannis et al (2016), we assume that K^A and K^B are fixed costs of destruction to *A* and *B*.

[19] As in the competing importers framework of Bagwell and Staiger (1997, 1999), we assume away income effects in demand for each good as well as substitutability between traded goods. It should be mentioned that there is implicitly a freely traded numeraire good that leads to in the derivation of linear demands. The assumption of linear demands makes the present analysis tractable in terms of deriving optimal arming and tariffs for some symmetric cases. That is, the simple assumption makes it possible to analyze the endogeneity of both security and trade policies under resource appropriation possibilities. We make no attempt to present a general analysis due to its complexity, which would be an interesting extension for future research.

$$CS^j = \frac{1}{2\beta}[(\alpha - \beta P_a^j)^2 + (\alpha - \beta P_b^j)^2 + (\alpha - \beta P_c^j)^2]. \qquad (3b)$$

The *CS* measure in (3b) reveals that the benefits of consumers in each country depend not only on products domestically produced, but also products from two other countries (either through imports or via appropriation for the enemy countries). From the perspective of consumer benefits, this reflects "economic interdependence" in consumption through trade and/or appropriation.

As for the benefits of producers in each country, we look at producer surplus (*PS*). Consider first the adversaries *A* and *B*. Including the appropriated amounts of consumption goods, $\Psi^A R$ for *A* and $\Psi^B R$ for *B*, the *PS* measures for *A* and *B* are given, respectively, as

$$PS^A = P_a^A Z_a^A + P_b^A[(\frac{G^A}{G^A + G^B})R] \text{ and } PS^B = P_b^B Z_b^B + P_a^B[(\frac{G^B}{G^A + G^B})R], \qquad (4)$$

where Z_a^A and Z_b^B are given in (2) as the quantities of goods a and b respectively produced by *A* and *B*. Country C, not an enemy to *A* and *B*, produces and supplies R units of good c to the market such that its producer surplus is:

$$PS^C = P_c^C R. \qquad (5)$$

As in the economics literature, the objective of country *j* is to maximize its domestic social welfare (SW^j), which is taken to be the sum of consumer surplus, producer surplus, and tariff revenues (TR^j). That is,

$$SW^j = CS^j + PS^j + TR^j \text{ for } j \in \{A, B, C\}, \qquad (6)$$

where CS^j and PS^j are given in (3)-(5). The total tariff revenues TR^j depend on the trading relationships among the three countries, which are the focal points of our subsequent analyses.

To analyze the endogeneity of security and trade policies, we consider a four-stage game. Stage one is a trade regime commitment stage at which (i) two countries that form an RTA agree members duty-free access to each other's market, or (ii) the three countries agree upon either free trade or trade protectionism. Stage two is an optimal security stage at which the two adversaries, *A* and *B*, independently and simultaneously determine their arming allocations.[20] Stage three is a tariff stage at which each country determines its tariff structure on imports, depending on whether

[20] This stage of determining optimal resources to be allocated to arming can be referred to as the arming stage. This excludes country *C* which is not an enemy to *A* and *B*.

any two of the three countries form an FTA, whether there is worldwide free trade (under which tariff rates are zero), or whether there is trade protectionism.[21] At the fourth and last stage of the game, the three countries engage in trade. We use backward induction to derive a sub-game perfect equilibrium for each trade regime. We first focus on the protectionist regime.

2.2 Trade protectionism

In the absence of economic integration through cooperative trading arrangements, we have a protectionist regime under which each country determines an optimal tariff structure for restraint imports. Denote τ_i^j as the specific tariff that country j imposes on its import of good i. We wish to derive the trade and conflict equilibrium under the protectionist regime with resource conflict between countries *A* and *B*. This case serves as the benchmark to evaluate equilibrium outcomes under alternative trade regimes.

To maintain the patterns of trade and the specialization of production as described earlier, we note the comparative advantage principle that a good's price in an exporting country plus a specific tariff imposed on the good by an importing country can never be lower than the good's price in the importing country. This principle excludes the possibilities of arbitrage in the three-country world (Bagwell and Staiger, 1997, 1999). For good *a* that country *A* produces and exports, we have the following no-arbitrage conditions:

$$P_a^A + \tau_a^B = P_a^B \text{ and } P_a^A + \tau_a^C = P_a^C, \tag{7}$$

where τ_a^B and τ_a^C are specific tariffs respectively imposed by countries *B* and *C* on good *a*.[22] We solve the equilibrium price of the consumption good in country *A* by equating the good's aggregate demand with its aggregate supply. That is, trade equilibrium for good *a* requires that

$$(\alpha - \beta P_a^A) + (\alpha - \beta P_a^B) + (\alpha - \beta P_a^C) = 3 - G^A - K^A. \tag{8}$$

[21] This stage of determining optimal tariffs can be referred to as the trade stage.

[22] Given that τ_a^B and τ_a^C are all positive under the protectionist regime, the non-arbitrage conditions imply that $P_a^A < P_a^B$ and $P_a^A < P_a^C$. These imply that country *A* has the comparative advantage in producing and exporting good *a* to other countries.

In (8),[23] we assume that the value of R equals 3 as in Hadjiyiannis et al. (2016) for analytical tractability. Substituting P_a^B and P_a^C in terms of P_a^A from (7) into the equilibrium condition in (8), we solve for the market price of good *a* in country *A*:

$$P_a^A = \frac{3\alpha - \beta(\tau_a^B + \beta\tau_a^C) - (3 - G^A - K^A)}{3\beta}. \tag{9a}$$

Using P_a^A in (9a) and the conditions in (7), we calculate the market prices of good *a* in *B* and *C*:

$$P_a^B = \frac{3\alpha + 2\beta\tau_a^B - \beta\tau_a^C - (3 - G^A - K^A)}{3\beta},\ P_a^C = \frac{3\alpha - \beta\tau_a^B + 2\beta\tau_a^C - (3 - G^A - K^A)}{3\beta}. \tag{9b}$$

Similarly, for good *b* that country *B* produces and exports, the no-arbitrage conditions are:

$$P_b^B + \tau_b^A = P_b^A \text{ and } P_b^B + \tau_b^C = P_b^C, \tag{10}$$

where τ_b^A and τ_b^C are specific tariffs imposed by countries *A* and *C* on good *b*. Trade equilibrium for good *b* requires that

$$(\alpha - \beta P_b^A) + (\alpha - \beta P_b^B) + (\alpha - \beta P_b^C) = 3 - G^B - K^B. \tag{11}$$

Substituting P_b^A and P_b^C in terms of P_b^B from (10) into the market equilibrium condition in (11),[24] we solve for the price of good b in country *B*:

$$P_b^B = \frac{3\alpha - \beta(\tau_b^A + \tau_b^C) - (3 - G^B - K^B)}{3\beta}. \tag{12a}$$

Using P_b^B in (12a) and the non-arbitrary conditions in (10), we have the market prices of good *b* in *A* and *C*:

$$P_b^A = \frac{3\alpha + 2\beta\tau_b^A - \beta\tau_b^C - (3 - G^B - K^B)}{3\beta} \text{ and } P_b^C = \frac{3\alpha - \beta\tau_b^A + 2\beta\tau_b^C - (3 - G^B - K^B)}{3\beta}. \tag{12b}$$

As for good c, trade equilibrium requires that

$$(\alpha - \beta P_c^A) + (\alpha - \beta P_c^B) + (\alpha - \beta P_c^C) = 3, \tag{13}$$

[23] An alternative approach leading to the same trade equilibrium condition as in (8) can be found in Appendix B-1.

[24] An alternative approach leading to the same trade equilibrium condition as in (11) can be found in Appendix B-2.

where P_c^A and P_c^B satisfy the non-arbitrary conditions:

$$P_c^C + \tau_c^A = P_c^A \text{ and } P_c^C + \tau_c^B = P_c^B. \quad (14)$$

Making use of (13) and (14), we calculate the market prices of good c in the three countries as

$$P_c^A = \frac{3\alpha + 2\beta\tau_c^A - \beta\tau_c^B - 3}{3\beta},\ P_c^B = \frac{3\alpha - \beta\tau_c^A + 2\beta\tau_c^B - 3}{3\beta},\ P_c^C = \frac{3\alpha - \beta(\tau_c^A + \tau_c^B) - 3}{3\beta}. \quad (15)$$

The above analysis constitutes the fourth and last stage of the four-stage game at which the three countries engage in trade.

We proceed to the third stage at which the three countries independently and simultaneously determine their optimal tariffs. For country *A*, the total amount of revenues from imposing tariffs, $\{\tau_b^A, \tau_c^A\}$, on goods *b* and *c* is:

$$TR^A = \tau_b^A M_b^A + \tau_c^A M_c^A, \quad (16a)$$

where M_b^A and M_c^A are the quantities of the goods imported. That is,[25]

$$M_b^A = [(\frac{G^B}{G^A + G^B})3 - G^B - K^B] - (\alpha - \beta P_b^B) - (\alpha - \beta P_b^C), \quad (16b)$$

$$M_c^A = 3 - (\alpha - \beta P_c^B) - (\alpha - \beta P_c^C). \quad (16c)$$

Substituting market prices of the three goods from (9), (12), and (15) into CS^A in (3), PS^A in (4), and TR^A in (16a), we calculate country *A*'s social welfare $SW^A (= CS^A + PS^A + TR^A)$ in terms of tariff rates, $\{\tau_b^A, \tau_c^A, \tau_a^B, \tau_c^B, \tau_a^C, \tau_b^C\}$, and arming allocations, $\{G^A, G^B\}$. All else being unchanged, country *A* determines its tariff structure, $\{\tau_b^A, \tau_c^A\}$, to maximize domestic welfare, SW^A. Using the first-order conditions (FOCs) that $\partial SW^A / \partial \tau_b^A = 0$ and $\partial SW^A / \partial \tau_c^A = 0$, we calculate the optimal tariffs which are:

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[25] For equilibrium in trade, M_b^A in (16b) is the amount of good *b* exported by country *B* and M_c^A in (16c) is that of good *c* exported by country *C* to country *A*.

$$\tau_b^A = \frac{\beta\tau_b^C - K^B}{8\beta} + \frac{(3 - G^A - G^B)G^B - 6G^A}{8\beta(G^A + G^B)} \text{ and } \tau_c^A = \frac{\tau_c^B}{8} + \frac{3}{8\beta}. \tag{17}$$

For country *B*, its total revenue from imposing tariffs, $\{\tau_a^B, \tau_c^B\}$, on goods *a* and *c* is:

$$TR^B = \tau_a^B M_a^B + \tau_c^B M_c^B, \tag{18a}$$

where M_a^B and M_c^B are given, respectively, as[26]

$$M_a^B = [(\frac{G^A}{G^A + G^B})3 - G^A - K^A] - (\alpha - \beta P_a^A) - (\alpha - \beta P_a^C), \tag{18b}$$

$$M_c^B = 3 - (\alpha - \beta P_c^A) - (\alpha - \beta P_c^C). \tag{18c}$$

Substituting market prices of the three goods from from (9), (12), and (15) into CS^B in (3), PS^B in (4), and TR^B in (18a), we calculate country *B*'s social welfare $SW^B (= CS^B + PS^B + TR^B)$ in terms of tariff rates, $\{\tau_b^A, \tau_c^A, \tau_a^B, \tau_c^B, \tau_a^C, \tau_b^C\}$, and arming allocations, $\{G^A, G^B\}$. All else being unchanged, country *B* determines an optimal tariff structure, $\{\tau_a^B, \tau_c^B\}$, to maximize its social welfare: SW^B. The FOCs are: $\partial SW^B / \partial \tau_a^B = 0$ and $\partial SW^B / \partial \tau_c^B = 0$. We calculate the optimal tariffs which are:

$$\tau_a^B = \frac{\beta\tau_a^C - K^A}{8\beta} + \frac{(3 - G^A - G^B)G^A - 6G^B}{8\beta(G^A + G^B)} \text{ and } \tau_c^B = \frac{\tau_c^A}{8} + \frac{3}{8\beta}. \tag{19}$$

For country *C*, its total revenue from imposing tariffs, $\{\tau_a^C, \tau_b^C\}$, on goods *a* and *b* is:

$$TR^C = \tau_a^C M_a^C + \tau_b^C M_b^C, \tag{20a}$$

where M_a^C and M_b^C are given, respectively, as[27]

$$M_a^C = (\alpha - \beta P_a^C) \text{ and } M_b^C = (\alpha - \beta P_b^C). \tag{20b}$$

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[26] Trade equilibrium indicates that M_a^B in (18b) is the amount of good *a* exported by country *A* and M_c^B in (18c) is that of good *c* exported by country *C* to country *B*.

[27] In (20b), trade equilibrium indicates that M_a^C is the amount of good *a* exported by country *A* and M_b^C in is that of good *b* exported by country *B* to country *C*.

Substituting market prices of the three goods from (9), (12), and (15) into CS^C in (3), PS^C in (5), and TR^C in (20a), we calculate social welfare for country *C*, $SW^C(=CS^C+PS^C+TR^C)$, in terms of tariff rates, $\{\tau_b^A, \tau_c^A, \tau_a^B, \tau_c^B, \tau_a^C, \tau_b^C\}$, and arming allocations, $\{G^A, G^B\}$. All else being unchanged, country *C* sets an optimal tariff structure, $\{\tau_a^C, \tau_b^C\}$, to maximize its social welfare: SW^C. The FOCs are: $\partial SW^C / \partial \tau_a^C = 0$ and $\partial SW^C / \partial \tau_b^C = 0$. Solving for the optimal tariffs yields

$$\tau_a^C = \frac{\tau_a^B}{8} + \frac{3-G^A-K^A}{8\beta} \text{ and } \tau_b^C = \frac{\tau_b^A}{8} + \frac{3-G^B-K^B}{8\beta}. \tag{21}$$

Making use of (17), (19), and (21), we calculate the optimal tariffs set by the three countries under the protectionist regime (*PR*):

$$\tau_b^{A,PR} = \frac{(3-G^A-G^B)G^B-5G^A}{7\beta(G^A+G^B)} - \frac{K^B}{7\beta},\ \tau_a^{B,PR} = \frac{(3-G^A-G^B)G^A-5G^B}{7\beta(G^A+G^B)} - \frac{K^A}{7\beta},$$

$$\tau_a^{C,PR} = \frac{2G^B+(3-G^A-G^B)G^A}{7\beta(G^A+G^B)} - \frac{K^A}{7\beta},\ \tau_b^{C,PR} = \frac{2G^A+(3-G^A-G^B)G^B}{7\beta(G^A+G^B)} - \frac{K^B}{7\beta},$$

$$\tau_c^{A,PR} = \frac{3}{7\beta},\ \tau_c^{B,PR} = \frac{3}{7\beta}. \tag{22a}$$

We show in Appendix B-3 the following comparative-static derivatives:

$$\frac{\partial \tau_b^{A,PR}}{\partial G^A} < 0,\ \frac{\tau_b^{A,PR}}{\partial G^B} < 0,\ \frac{\partial \tau_a^{B,PR}}{\partial G^A} < 0,\ \frac{\partial \tau_a^{B,PR}}{\partial G^B} < 0,\ \frac{\partial \tau_a^{C,PR}}{\partial G^A} < 0,\ \frac{\partial \tau_a^{C,PR}}{\partial G^B} < 0,\ \frac{\partial \tau_b^{C,PR}}{\partial G^A} < 0,$$

$$\frac{\partial \tau_b^{C,PR}}{\partial G^B} < 0,\ \tau_c^{A,PR} > \tau_a^{C,PR},\ \tau_c^{B,PR} > \tau_b^{C,PR}. \tag{22b}$$

We summarize the economic implications of the results as follows:

Lemma 1. *Under the protectionist regime in a three-country world with two adversaries and a neutral third party, we have the following:*

(i) Optimal tariffs set by the adversaries on their imports from the neutral third country are <u>*independent*</u> *of their arming allocations. For all other scenarios (such as trade between the two adversaries and the neutral third country's imports), optimal tariffs are negatively related to the conflict-related arming allocations by the adversaries.*

(ii) Each of the adversaries sets a <u>*higher*</u> *tariff on import from the third country than the tariff set by the third country on its imports.*

Given that country C is not an enemy of A and B, the arming allocations of the two adversaries do not affect their optimal tariffs on imports from the neutral country. Owing to the conflict between A and B, increasing arming by either one lowers its endowed resource available for production, which is welfare-reducing. In response to this, A and B find it optimal to reduce tariffs on each other's imports. Raising tariffs on imports while allocating more resources to arming would aggravate the welfare-reducing effect of arming on production. This explains why the optimal tariffs set by A and B are negatively related to their arming allocations. Although the tariffs set by A or B on their imports from C are independent of their arming allocations, either A or B sets a higher tariff than the tariff set by country C. The reason is to mitigate the production-distortion effect of arming which affects welfare negatively.

Next, we proceed to the security stage at which the contending countries, A and B, independently and simultaneously determine their optimal arming allocations. Under symmetry, we have $G^{A,PR} = G^{B,PR} = G^{PR}$. This exercise yields

$$G^{PR} = \frac{\sqrt{38416\alpha^2 + 4312\alpha - 22319 + K(17424K + 51744\alpha - 28248)}}{264} - \frac{49}{66}\alpha - \frac{1}{2}K + \frac{35}{24}. \qquad (23)$$

It is easy to verify that G^{PR} in (23) is positive for $\alpha > R = 3$.

It is instructive to examine in detail how arming by a contending country affects its domestic social welfare. Using country, A as an example (under the assumption of symmetry), we show in Appendix B-4 the following welfare decomposition:

$$\begin{aligned}\frac{\partial SW^A}{\partial G^A} = &\underbrace{\left[Z_a^A - (\alpha - \beta P_a^A)\right]\frac{\partial P_a^A}{\partial G^A}}_{\substack{\text{Export-revenue effect}\\(+)}} + \underbrace{\frac{\partial(APP_b^A)}{\partial G^A}P_b^A}_{\substack{\text{Resource-appropriation effect}\\(+)}} \\ &+ \underbrace{\left[\tau_b^A\frac{\partial M_b^A}{\partial G^A} + M_b^A\frac{\partial \tau_b^A}{\partial G^A}) - M_b^A\frac{\partial P_b^A}{\partial G^A}\right]}_{\substack{\text{Tariff-revenue plus import-spending effect}\\(-)}} + \underbrace{\frac{\partial Z_a^A}{\partial G^A}P_a^A}_{\substack{\text{Output-distortion effect}\\(-)}} = 0\end{aligned} \qquad (24)$$

where $APP_b^A = [G^A/(G^A + G^B)]R$ for $R = 3$ is the amount of good b appropriated by country A. We summarize the economic implications of the welfare decomposition as follows:

Lemma 2. *Under the protectionist regime in a three-country world with two adversaries and a neutral third party, the impact that an adversary country's arming has on its welfare contains four different effects. (i) The first is an export-revenue effect, which increases welfare as increasing* *arming causes export price and revenue to go up. (ii) The second is a resource-appropriation effect, which increases welfare as increasing arming increases the appropriation of final good for domestic consumption. (iii) The third is a tariff-revenue plus import-spending effect, which lowers welfare as increasing arming raises import price, lowers import demand, and reduces tariff revenue net of import spending. (iv) The fourth is an output-distortion effect, which reduces welfare as increasing arming cause domestic production to go down.*

Note that the first two effects (*i* and *ii*) constitute the marginal revenue (MR) of arming, and the last two effects (*iii* and *iv*) measure the marginal cost (MC) of arming. The above analysis promotes us to investigate how the optimal arming, G^{PR}, under the protectionist regime is affected by different types of trade relationships (e.g., an FTA between two adversaries between one of the adversaries and a neutral third party). We shall see that the endogenous security analysis permits us to compare conflict intensities associated with differential trade regimes. We proceed to investigate the scenario where there is an FTA between two adversaries.

3. An FTA between Two Contending Countries (*A* and *B*)

It is instructive to examine equilibrium arming when countries *A* and *B* form an FTA and access each other's market duty-free, despite their disputes over valuable resources. This analysis allows one to see how FTA formation between adversaries affects their arming decisions under resource appropriations. One issue of interest is: Would each contending country allocate more or less resource to arming under the FTA regime (for "dancing with the enemy" in trade regionalism) than under the protectionist regime?

As in the analysis under the protectionist regime, we use a four-stage game structure to characterize the sub-game perfect equilibrium for the FTA between *A* and *B*, denoted the *FTA(A&B)* regime. At stage one, *A* and *B* commit to the *FTA(A&B)* regime. At stage two, the two countries independently and simultaneously determine their optimal arming allocations that maximize their domestic welfare. At stage three, *A* and *B* set zero tariffs $(\tau_b^A = \tau_a^B = 0)$ on each others' imports and independently determine their tariffs τ_c^A and τ_c^B on imports from country *C*. At stage three, country *C* sets an optimal tariff structure, $\{\tau_a^C, \tau_b^C\}$, on imports from *A* and *B*. At stage four, the three countries engage in trade.

Given that $\tau_b^A = \tau_a^B = 0$ under the *FTA(A&B)* regime, we substitute zero tariff rates into the price equations in (9), (12), and (15) to obtain the market prices of goods *a*, *b*, and *c*:

$$P_a^{A,FTA(A\&B)} = P_a^{B,FTA(A\&B)} = \frac{3\alpha - \beta\tau_a^C - (3 - G^A - K^A)}{3\beta},$$

$$P_b^{A,FTA(A\&B)} = P_b^{B,FTA(A\&B)} = \frac{3\alpha - \beta\tau_b^C - (3 - G^B - K^B)}{3\beta},$$

$$P_a^{C,FTA(A\&B)} = \frac{3\alpha + 2\beta\tau_a^C - (3 - G^A - K^A)}{3\beta}, \; P_b^{C,FTA(A\&B)} = \frac{3\alpha + 2\beta\tau_b^C - (3 - G^B - K^B)}{3\beta},$$

$$P_c^{A,FTA(A\&B)} = \frac{3\alpha + 2\beta\tau_c^A - \beta\tau_c^B - 3}{3\beta}, \; P_c^{B,FTA(A\&B)} = \frac{3\alpha - \beta\tau_c^A + 2\beta\tau_c^B - 3}{3\beta},$$

$$P_c^{C,FTA(A\&B)} = \frac{3\alpha - \beta(\tau_c^A + \tau_c^B) - 3}{3\beta}. \tag{25}$$

Note that the tariff rates, $\{\tau_a^C, \tau_b^C\}$, in the price equations remain to be determined by the countries at the third stage of the four-stage game. For calculating an optimal tariff that country *A* imposes on good *c*, denoted as $\tau_c^{A,FTA(A\&B)}$, we note the import demand equation: $M_c^{A,FTA(A\&B)} = \alpha - \beta P_c^{A,FTA(A\&B)}$, where $P_c^{A,FTA(A\&B)}$ is given in (25). After substitution, we have

$$M_c^{A,FTA(A\&B)} = \alpha - \beta P_c^{A,FTA(A\&B)} = \frac{\beta\tau_c^{B,FTA(A\&B)} - 2\beta\tau_c^{A,FTA(A\&B)} + 3}{3}.$$

Given the prices of the three goods in (25), country *A*'s consumer and producer surplus are:

$$CS^{A,FTA(A\&B)} = \frac{1}{2\beta}[(\alpha - \beta P_a^{A,FTA(A\&B)})^2 + (\alpha - \beta P_b^{A,FTA(A\&B)})^2 + (\alpha - \beta P_c^{A,FTA(A\&B)})^2],$$

$$PS^{A,FTA(A\&B)} = P_a^{A,FTA(A\&B)}[(\frac{G^A}{G^A + G^B})3 - G^A - K^A] + P_b^{A,FTA(A\&B)}[(\frac{G^A}{G^A + G^B})3],$$

The social welfare function of country *A* is:

$$SW^{A,FTA(A\&B)} = CS^{A,FTA(A\&B)} + PS^{A,FTA(A\&B)} + \tau_c^{A,FTA(A\&B)} M_c^{A,FTA(A\&B)}$$

and its FOC is:

$$\frac{\partial SW^{A,FTA(A\&B)}}{\partial \tau_c^{A,FTA(A\&B)}} = \frac{\beta\tau_c^{B,FTA(A\&B)}}{9} - \frac{8\tau_c^{A,FTA(A\&B)}}{9} + \frac{1}{3} = 0.$$

Solving for the optimal tariff set by country *A*, we have

$$\tau_c^{A,FTA(A\&B)} = \frac{\tau_c^{B,FTA(A\&B)}}{8} + \frac{3}{8\beta}. \tag{26a}$$

To calculate country *B*'s optimal tariff on good *c*, we note that the import demand equation is: $M_c^{B,FTA(A\&B)} = \alpha - \beta P_c^{B,FTA(A\&B)}$, where $P_c^{B,FTA(A\&B)}$ is given in (25). After substitution, we have

$$M_c^{B,FTA(A\&B)} = \frac{\beta\tau_c^{A,FTA(A\&B)} - 2\beta\tau_c^{B,FTA(A\&B)} + 3}{3} = 0.$$

Given the prices of the three goods in (25), country *B*'s consumer and producer surplus are:

$$CS^{B,FTA(A\&B)} = \frac{1}{2\beta}[(\alpha - \beta P_a^{B,FTA(A\&B)})^2 + (\alpha - \beta P_b^{B,FTA(A\&B)})^2 + (\alpha - \beta P_c^{B,FTA(A\&B)})^2],$$

$$PS^{B,FTA(A\&B)} = P_b^{B,FTA(A\&B)}[(\frac{G^B}{G^A + G^B})3 - G^B - K^B] + P_a^{B,FTA(A\&B)}[(\frac{G^B}{G^A + G^B})3].$$

The social welfare function of country *B* is:

$$SW^{B,FTA(A\&B)} = CS^{B,FTA(A\&B)} + PS^{B,FTA(A\&B)} + \tau_c^{B,FTA(A\&B)} M_c^{B,FTA(A\&B)}$$

and its FOC is:

$$\frac{\partial SW^{B,FTA(A\&B)}}{\partial \tau_c^{B,FTA(A\&B)}} = \frac{\beta\tau_c^{A,FTA(A\&B)}}{9} - \frac{8\tau_c^{B,FTA(A\&B)}}{9} + \frac{1}{3} = 0.$$

Solving for the optimal tariff for country *B*, we have

$$\tau_c^{B,FTA(A\&B)} = \frac{\tau_c^{A,FTA(A\&B)}}{8} + \frac{3}{8\beta}. \tag{26b}$$

As for country *C*, it determines an optimal tariff structure on imports from *A* and *B* to maximize its social welfare:

$$SW^{C,FTA(A\&B)} = CS^{C,FTA(A\&B)} + PS^{C,FTA(A\&B)} + TR^{C,FTA(A\&B)},$$

where

$$CS^{C,FTA(A\&B)} = \frac{1}{2\beta}[(\alpha - \beta P_a^{C,FTA(A\&B)})^2 + (\alpha - \beta P_b^{C,FTA(A\&B)})^2 + (\alpha - \beta P_c^{C,FTA(A\&B)})^2],$$

$$PS^{C,FTA(A\&B)} = 3P_c^{C,FTA(A\&B)},$$

$$TR^{C,FTA(A\&B)} = \tau_a^{C,FTA(A\&B)}[\alpha - \beta P_a^{C,FTA(A\&B)}] + \tau_b^C[\alpha - \beta P_b^{C,FTA(A\&B)}].$$

The FOCs for country *C* are:

$$\frac{\partial SW^{C,FTA(A\&B)}}{\partial \tau_a^{C,FTA(A\&B)}} = \frac{(3-G^A-K^A)-8\beta\tau_a^{C,FTA(A\&B)}}{9} = 0,$$

$$\frac{\partial SW^{C,FTA(A\&B)}}{\partial \tau_b^{C,FTA(A\&B)}} = \frac{(3-G^B-K^B)-8\beta\tau_b^{C,FTA(A\&B)}}{9} = 0,$$

which imply that the optimal tariffs on goods *a* and *b* are:

$$\tau_a^{C,FTA(A\&B)} = \frac{3-G^A-K^A}{8\beta} \text{ and } \tau_b^{C,FTA(A\&B)} = \frac{3-G^B-K^B}{8\beta}. \tag{26c}$$

Making use of (26a)-(26c), we solve for the optimal tariffs:

$$\tau_c^{A,FTA(A\&B)} = \tau_c^{B,FTA(A\&B)} = \frac{3}{7\beta},$$

$$\tau_a^{C,FTA(A\&B)} = \frac{3-G^A-K^A}{8\beta},\ \ \tau_b^{C,FTA(A\&B)} = \frac{3-G^B-K^B}{8\beta}. \tag{27a}$$

From (27a), it follows that

$$\frac{\partial \tau_a^{C,FTA(A\&B)}}{\partial G^A} = \frac{\partial \tau_b^{C,FTA(A\&B)}}{\partial G^B} = -\frac{1}{8\beta} < 0,$$

$$\tau_c^{A,FTA(A\&B)} > \tau_a^{C,FTA(A\&B)} \text{ and } \tau_c^{B,FTA(A\&B)} > \tau_b^{C,FTA(A\&B)}. \tag{27b}$$

Under the *FTA(A&B)* regime, optimal tariffs set by countries *A* and *B* on imports from country *C* are independent of their conflict-related arming decisions. However, tariffs set by country *C* on its imports from *A* and *B* are *decreasing* functions of the arming allocations. Moreover, either *A* or *B* sets a higher tariff on its import of good *c* than the tariff rate set by country *C*. These qualitative results in (27) are similar to those as shown in Corollaries 1 and 2 for the protectionist regime.

We proceed to the second stage at which the contending countries *A* and *B* independently and simultaneously determine their optimal arming decisions. Substituting the optimal tariffs in (26) back into the welfare functions of *A* and *B*, we have $SW^{A,FTA(A\&B)}$ and $SW^{B,FTA(A\&B)}$ as functions of G^A and G^B. The FOCs for *A* and *B* are:

$$\frac{\partial SW^{A,FTA(A\&B)}}{\partial G^A} = 0 \text{ and } \frac{\partial SW^{B,FTA(A\&B)}}{\partial G^B} = 0.$$

Denote the Nash equilibrium levels of arming as $\{G^{A,FTA(A\&B)}, G^{B,FTA(A\&B)}\}$. The assumption of symmetry implies that $G^{A,FTA(A\&B)} = G^{B,FTA(A\&B)} = G^{FTA(A\&B)}$. Solving for the optimal arming, we have

$$G^{FTA(A\&B)} = \frac{\sqrt{4096\alpha^2 - 3159 + K(1521K + 4992\alpha - 3510)}}{78} - \frac{32\alpha}{39} - \frac{K}{2} + \frac{3}{2}. \qquad (28)$$

Evaluating the slope $\partial SW^{A,FTA(A\&B)} / \partial G^A$ at the point where $G^A = G^{PR}$,[28] we find that

$$\frac{\partial SW^{A,FTA(A\&B)}}{\partial G^A}\Big|_{G^A = G^{PR}, \alpha > 3, K = 0.2} < 0.$$

The strict concavity of the social welfare function implies that

$$G^{FTA(A\&B)} < G^{PR}.^{29} \qquad (29a)$$

Equation (29a) indicates that both adversary countries allocate fewer resources to arming under the *FTA(A&B)* regime than under the protectionist regime. As in the conflict literature, we define conflict intensity (*CI*) under a trade regime as $CI \equiv G^A + G^B$. It follows from (29a) that under symmetry we have

$$CI^{FTA(A\&B)} < CI^{PR}. \qquad (29b)$$

Given the results in (29a) and (29b), we compare optimal tariffs under the protectionist regime to those under the *FTA*(*A*&*B*) regime as shown in (22a) and (27a). It follows that

$$\tau_a^{C,FTA(A\&B)} < \tau_a^{C,PR} \text{ and } \tau_b^{C,FTA(A\&B)} < \tau_b^{C,PR}.$$

We present economic implications as follows. Moving from the protectionist regime to the *FTA(A&B)* regime, countries *A* and *B* become intra-bloc members whereas country *C* is an outsider. In response, country *C* finds it optimal to set <u>lower</u> tariffs in the face of the *FTA(A&B)* regime than those under the protectionist regime. This result is consistent with the "tariff complementarity effect" associated with an FTA as shown in the international trade literature (Bagwell and Staiger, 1999). The *FTA(A&B)* regime thus helps generate improvements of terms-of-trade benefits for countries *A* and *B* vis-à-vis country *C*. Moreover, the member countries *A* and

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[28] Note that we assign some plausible values for K (i.e., $K = 0.2$) in evaluating the derivative.

[29] The inequality relationship in (28) can also be reached by a direct comparison between $G^{FTA(A\&B)}$ in (28) and G^{PR} in (23) under symmetry and the same values of exogenous variables.

B benefit from duty-free access to each other's market, which encourages them to increase productions of their products for exports within the trade bloc. It provides a positive incentive for each country to allocate fewer resources to arming. Consequently, there is a conflict-reducing effect associated with the formation of an FTA between the adversaries.

The results as shown in (29) imply that, under the *FTA(A&B)* regime, the positive resource-appropriation effect of arming on welfare is not strong enough to outweigh the economic benefits from the two factors. One is the elimination of trade barriers between *A* and *B*. The other is the tariff complementarity effect which improves the trading positions of both *A* and *B* relative to *C*. We, therefore, have

PROPOSITION 1. *In a three-country world with two adversaries and a neutral third party, forming an FTA between the adversary countries (A and B) allows access to each other's market duty-free. Consequently, the FTA(A&B) regime reduces conflict intensity and has a stronger pacifying effect than the protectionist regime.*

Proposition 1 indicates that the commitment of forming an FTA between adversaries has an important policy implication for interstate conflicts. The formation of an FTA makes it possible for two adversary countries to become members of a trade institution. The adversaries become likely to engage in military aggression since the FTA causes the overall conflict intensity to decline. In other words, FTA constitutes a conflict-reducing trade institution for two enemy countries. Our endogenous security analysis thus provides a theoretical justification for the empirical finding of Mansfield and Pevehouse (2000). The authors document that joint memberships in preferential trade agreements significantly reduce hostility between intra-bloc members.

One interesting and important issue that appears not to have been examined in the conflict and trade literature concerns wither forming an FTA between adversaries makes the three-country world "safer" (in terms of conflict intensity) than the case when there is worldwide free trade without the FTA. To compare conflict intensity between these alternative trade regimes, we proceed to examine conflict equilibrium in the case of free trade worldwide.

4. Worldwide Free Trade

The next case of interest is when there is worldwide free trade (denoted the *WFT* regime) in that the tariff rates set by countries *A*, *B*, and *C* at the third stage of the game are all zero. That is, $\tau_i^{j,WFT}=0$ for $i\in\{a,\ b,c\}$ and $j\in\{A,\ B,\ C\}$. It follows from (9), (12), and (15) that the market prices of goods *a*, *b*, and *c* under the *WFT* regime are:

$$P_a^{A,WFT}=P_a^{B,WFT}=P_a^{C,WFT}=\frac{3\alpha-(3-G^A-K^A)}{3\beta},$$

$$P_b^{A,WFT}=P_b^{B,WFT}=P_b^{C,WFT}=\frac{3\alpha-(3-G^B-K^B)}{3\beta},\ \ P_c^{A,WFT}=P_c^{B,WFT}=P_c^{C,WFT}=\frac{\alpha-1}{\beta}.$$

At the second stage, both countries *A* and *B* determine their optimal arming allocations. For country *A*, its social welfare function is: $SW^{A,WFT}=CS^{A,WFT}+PS^{A,WFT}$, where

$$CS^{A,WFT}=\frac{1}{2\beta}[(\alpha-\beta P_a^{A,WFT})^2+(\alpha-\beta P_b^{A,WFT})^2+(\alpha-\beta P_c^{A,WFT})^2],$$

$$PS^{A,WFT}=P_a^{A,WFT}[(\frac{G^A}{G^A+G^B})3-G^A-K^A)]+P_b^{A,WFT}[(\frac{G^A}{G^A+G^B})3].$$

For country *B*, its social welfare function is: $SW^{B,WFT}=CS^{B,WFT}+PS^{B,WFT}$, where

$$CS^{B,WFT}=\frac{1}{2\beta}[(\alpha-\beta P_a^{B,WFT})^2+(\alpha-\beta P_b^{B,WFT})^2+(\alpha-\beta P_c^{B,WFT})^2],$$

$$PS^{B,WFT}=P_a^{B,WFT}[(\frac{G^B}{G^A+G^B})3-G^B-K^B)]+P_b^{B,WFT}[(\frac{G^B}{G^A+G^B})3].$$

The FOCs for *A* and *B* are: $\partial SW^{A,WFT}/\partial G^A=0$ and $\partial SW^{B,WFT}/\partial G^B=0,$ which lead to the Nash equilibrium levels of arming, denoted as $\{G^{A,WFT},G^{B,WFT}\}$. Under symmetry in all dimensions, we have $G^{A,WFT}=G^{B,WFT}=G^{WFT}$. This exercise allows us to calculate the optimal arming as follows:

$$G^{WFT}=\frac{\sqrt{81\alpha^2-45+K(25K+90\alpha-60)}}{78}-\frac{9\alpha}{10}-\frac{K}{2}+\frac{3}{2}. \qquad (30)$$

Evaluating the slopes $\partial SW^{A,WFT} / \partial G^{A}$ and $\partial SW^{B,WFT} / \partial G^{B}$ at the point where $G^{A} = G^{B} = G^{FTA(A\&B)}$,[30] we have

$$\left.\frac{\partial SW^{A,WFT}}{\partial G^{A}}\right|_{G^{A}=G^{FTA(A\&B)},\alpha>3,K=0.2} > 0 \text{ and } \left.\frac{\partial SW^{B,WFT}}{\partial G^{B}}\right|_{G^{B}=G^{FTA(A\&B)},\alpha>3,K=0.2} > 0.$$

The strict concavity of social welfare function for each country implies that

$$G^{FTA(A\&B)} < G^{WFT}. \tag{31}$$

We further evaluate the slopes $\partial SW^{A,WFT} / \partial G^{A}$ and $\partial SW^{B,WFT} / \partial G^{B}$ at the point where $G^{A} = G^{B} = G^{PR}$. This yields

$$\left.\frac{\partial SW^{A,WFT}}{\partial G^{A}}\right|_{G^{A}=G^{PR},\alpha>3,K=0.2} < 0 \text{ and } \left.\frac{\partial SW^{B,WFT}}{\partial G^{B}}\right|_{G^{B}=G^{PR},\alpha>3,K=0.2} > 0.$$

The strict concavity of the social welfare function for each country implies that

$$G^{WFT} < G^{PR}. \tag{32}$$

Following the results in (31) and (32), we thus have[31]

$$G^{FTA(A\&B)} < G^{WFT} < G^{PR} \text{ or } CI^{FTA(A\&B)} < CI^{WFT} < CI^{PR}. \tag{33}$$

Moving from the *PR* regime to the *WFT* regime, all the countries can enjoy economic benefits from accessing each other's markets duty-free. The contending countries are better off by lowering their arming to produce more of final goods for consumption and exports. There is a resource appropriation effect of arming which is welfare-improving. However, the resource appropriation effect of arming is more than offset by the gains from free trade, causing arming to decline under the *WFT* regime.

In comparing arming allocations for a regime move from *FTA*(*A*&*B*) to *WFT*, we use a welfare decomposition approach to explain why the optimal arming increases. We show in Appendix B-5 that

$$\left.\frac{\partial SW^{WFT}}{\partial G^{A}}\right|_{G^{A}=G^{B}=G^{FTA(A\&B)}} = \frac{[31(G^{FTA(A\&B)})^{2} - 93G^{FTA(A\&B)} + 31G^{FTA(A\&B)}K - 36K + 108]}{576\beta G^{FTA(A\&B)}} > 0.$$

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[30] Note that we assign some plausible values for K (i.e., $K = 0.2$) in evaluating the derivative.

[31] The inequality relationship in (31c) can also be reached by a direct comparison among $G^{FTA(A,B)}$ in (28), G^{PR} in (23), G^{WFT} in (30) under symmetry and the plausible values of exogenous variables.

The slope of each adversary's welfare function with respect to its arming under the *WFT* regime, when evaluated at $G^A = G^B = G^{FTA(A\&B)}$, is strictly positive. Figure 1 is a graphical illustration of this result. As shown in the welfare decomposition analysis in A-5, the strict positivity of this derivative is because the export-revenue effect plus the resource-appropriation effect, which define the marginal revenue of arming, exceed the output-distortion effect, which defines the marginal cost of arming. Moving from the *FTA*(*A*&*B*) regime to the *WFT* regime, we find that the marginal revenue of arming is higher than its marginal cost. In response to this, countries *A* and *B* increase their arming allocations. We thus have the following proposition:

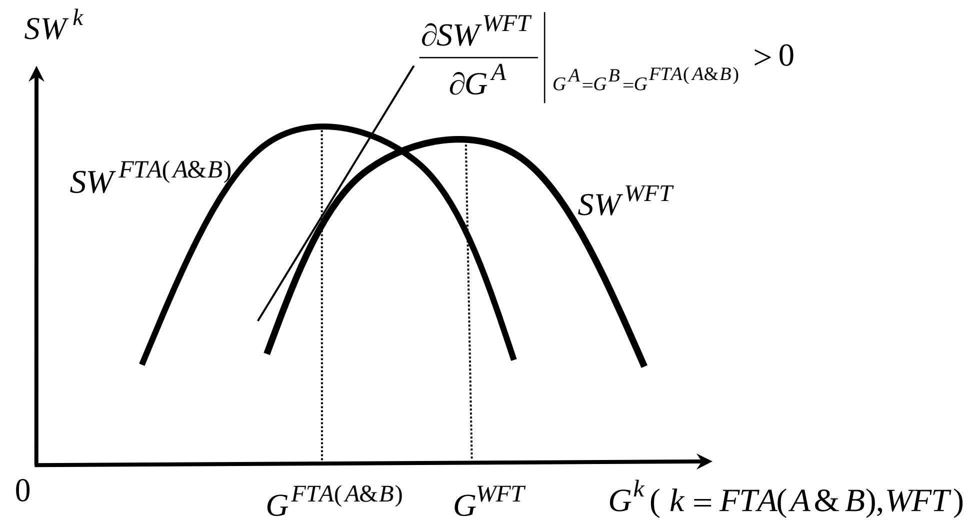

Figure 2.1 Optimal arming is lower under FTA(A&B) than under worldwide free trade

PROPOSITION 2: *In a three-country world with two contending countries and a neutral third state, each contending country's optimal arming is lower under the FTA(A&B) regime than under the WFT regime. A move in trade regime from FTA(A&B) to WFT will cause arming to increase since the marginal revenue of arming (resulting from the export-revenue effect and the appropriation effect) exceeds the marginal cost of arming (resulting from the output-distortion effect). Thus, forming an FTA between the adversaries lowers conflict intensity and has a stronger pacifying effect than the WFT regime*.

The results in Propositions 1 and 2 suggest that “dancing with the enemy” through the formation of an FTA is conflict-reducing. From the perspective of conflict over resources, our analysis shows that forming a trade institution such as FTA between two adversaries reduces interstate military tensions as compared to worldwide free trade. Under such a circumstance, an FTA between adversaries is, in essence, not a double-edged sword. To the best of our knowledge, this theoretical finding has not yet been shown in the existing literature on interstate conflict and trade regionalism.

5. An FTA between Countries *A* and *C*

We proceed to examine the case where one of the contending countries (say, *A*) forms an FTA with the neutral third country *C* in order to enjoy free-duty access to each other's market. Under such a free trade arrangement, denoted as the *FTA*(*A*&*C*) regime, we have:

$$\tau_c^{A,FTA(A\&C)} = \tau_a^{C,FTA(A\&C)} = 0.$$

At the trade policy stage, countries *A* and *C* independently and simultaneously determine optimal tariffs, τ_b^A and τ_b^C, on their imports of good *b*. In the meanwhile, country *B* sets an optimal tariff structure, $\{\tau_a^B, \tau_c^B\}$, on its imports of goods *a* and *c*.

Given that $\tau_c^{A,FTA(A\&C)} = \tau_a^{C,FTA(A\&C)} = 0$, we have from equations (9), (12), and (15) that the prices of three goods under the *FTA*(*A*&*C*) regime are:

$$P_c^{A,FTA(A\&C)} = P_c^{C,FTA(A\&C)} = \frac{3\alpha - \beta\tau_c^B - 3}{3\beta},\ P_a^{B,FTA(A\&C)} = \frac{3\alpha + 2\beta\tau_a^B - (3 - G^A - K^A)}{3\beta},$$

$$P_b^{A,FTA(A\&C)} = \frac{3\alpha + 2\beta\tau_b^A - \beta\tau_b^C - (3 - G^B - K^B)}{3\beta},$$

$$P_b^{B,FTA(A\&C)} = \frac{3\alpha - \beta\tau_b^A - \beta\tau_b^C - (3 - G^B - K^B)}{3\beta},$$

$$P_b^{C,FTA(A\&C)} = \frac{3\alpha - \beta\tau_b^A + 2\beta\tau_b^C - (3 - G^B - K^B)}{3\beta},\ P_c^{B,FTA(A\&C)} = \frac{3\alpha + 2\beta\tau_c^B - 3}{3\beta}.$$

At the third stage of determining optimal tariffs, country *A* sets a specific tariff on the import of good *b* to maximize its social welfare:

$$SW^{A,FTA(A\&C)} = CS^{A,FTA(A\&C)} + PS^{A,FTA(A\&C)} + \tau_b^A M_b^{A,FTA(A\&C)},$$

where

$$CS^{A,FTA(A\&C)} = \frac{1}{2\beta}[(\alpha-\beta P_a^{A,FTA(A\&C)})^2 + (\alpha-\beta P_b^{A,FTA(A\&C)})^2 + (\alpha-\beta P_c^{A,FTA(A\&C)})^2],$$

$$PS^{A,FTA(A\&C)} == P_a^{A,FTA(A\&C)}[(\frac{G_A}{G_A+G_B})3 - G_A - K_A] + P_b^{A,FTA(A\&C)}[(\frac{G_A}{G_A+G_B})3],$$

$$M_b^{A,FTA(A\&C)} = [\alpha-\beta P_b^{A,FTA(A\&C)}] - (\frac{G^A}{G^A+G^B})3.$$

The FOC for country *A* implies that the optimal tariff on good *b* is:

$$\tau_b^{A,FTA(A\&C)} = \frac{G^B(3-G^A-G^B)-6G^A+(\beta\tau_b^C-K^B)(G^A+G^B)}{8\beta(G^A+G^B)}. \quad (34)$$

As for country *B*, it determines an optimal tariff structure to maximize its domestic welfare:

$$SW^{B,FTA(A\&C)} = CS^{B,FTA(A\&C)} + PS^{B,FTA(A\&C)} + \tau_a^B M_a^{B,FTA(A\&C)} + \tau_c^B M_c^{B,FTA(A\&C)}.$$

The FOCs for country *B* implies that the optimal tariffs are:

$$\tau_a^B = \frac{G^A(3-G^A-G^B)-6G^B-K^A(G^A+G^B)}{8\beta(G^A+G^B)} \text{ and } \tau_c^B = \frac{3}{8\beta}. \quad (35)$$

Country *C* decides on an optimal tariff, which maximizes its social welfare:

$$SW^{C,FTA(A\&C)} = CS^{C,FTA(A\&C)} + PS^{C,FTA(A\&C)} + \tau_b^C M_b^{C,FTA(A\&C)},$$

where M_b^C is given in (20c). The FOC for country C implies that its optimal tariff on good *b* is:

$$\tau_b^{C,FTA(A\&C)} = \frac{(3-G^B-K^B)+\beta\tau_b^A}{8\beta}. \quad (36)$$

Making use of (34)-(36), we solve for the equilibrium tariffs as follows:

$$\tau_b^{A,FTA(A\&C)} = \frac{G^B(3-G^A-G^B)-5G^A}{7\beta(G^A+G^B)} - \frac{K^B}{7\beta},$$

$$\tau_a^{B,FTA(A\&C)} = \frac{G^A(3-G^A-G^B)-6G^B}{8\beta(G^A+G^B)} - \frac{K^A}{8\beta},$$

$$\tau_b^{C,FTA(A\&C)} = \frac{G^B(3-G^A-G^B)+2G^A}{7\beta(G^A+G^B)} - \frac{K^B}{7\beta}, \quad \tau_c^{B,FTA(A\&C)} = \frac{3}{8\beta}. \quad (37)$$

We proceed to the second stage of the game at which countries *A* and *B* determine their security policies. Country *A* determines an optimal arming, denoted as $G^{A,FTA(A\&C)}$, that maximizes $SW^{A,FTA(A\&C)} = CS^{A,FTA(A\&C)} + PS^{A,FTA(A\&C)} + \tau_b^A M_b^{A,FTA(A\&C)}$.

Evaluating the slope $\partial SW^{A,FTA(A\&C)} \big/ \partial G^A$ at the point where $G^A = G^{A,PR}$ we have[32]

$$\frac{\partial SW^{A,FTA(A\&C)}}{\partial G^A}\Big|_{G^A = G^{A,PR}} > 0.$$

The strict concavity of the social welfare function implies that

$$G^{A,FTA(A\&C)} > G^{A,PR}. \tag{38a}$$

Similarly, we have

$$\frac{\partial SW^{B,FTA(A\&C)}}{\partial G^B}\Big|_{G^B = G^{B,PR}} > 0,$$

which implies that

$$G^{B,FTA(A\&C)} > G^{B,PR}. \tag{38b}$$

The result in (36b) indicates that *B* allocates more resource to arming when *A* forms an FTA with country *C*, relative to the case when there is a protectionist regime. It follows from (38a) and (38b) that

$$CI^{FTA(A\&C)} > CI^{PR}. \tag{38c}$$

In the *FTA*(*A*&*C*) regime, there is an improvement of terms-of-trade benefit for country *A* (an insider) vis-à-vis country *B* (an outsider). Moreover, country *A* can enjoy duty-free access to country *C's* market. When *A* increases its arming, the resulting welfare-reducing effect of arming on domestic production is more than offset by its gains from trade, the latter of which come from the terms-of-trade improvement and the integration benefit with country *C*. Besides, there is a welfare-increasing effect of arming for country *A* due to gains from appropriation. As for country *B*, the adversary excluded from the FTA to be an outsider, we see a terms-of-trade deterioration for *B* vis-à-vis *A* and *C*. Nonetheless, the output-appropriation effect of arming encourages country *B* to increase arming since it is welfare-increasing. These results may explain why we have the inequalities in (38a) and (38b). We, therefore, can state the following proposition:

[32] Note that we assign some plausible values for K (i.e., $K = 0.2$) in evaluating the derivative.

PROPOSITION 3. *Relative to the conflict equilibrium under the protectionist regime, the optimal conflict-related arming allocation by each of the adversary countries is strictly* <u>*higher*</u> *when one of the contending countries and the neutral third party form an FTA.*

Taken together all the equilibrium outcomes (see equations 30, 33c, and 38) as shown above, we have a systematic ranking of conflict-related arming allocations or conflict intensities associated with the alternative trade regimes. That is,

$$G^{FTA(A\&B)} < G^{WFT} < G^{PR} < G^{FTA(A\&C)} \text{ or } CI^{FTA(A\&B)} < CI^{WFT} < CI^{PR} < CI^{FTA(A\&C)}. \quad (39)$$

The results in (39) permit us to establish the following proposition:

PROPOSITION 4. *In the world of three countries we consider, we have the following results:*

(i) The formation of an FTA between two adversaries has the most substantial pacifying effect in that the aggregate conflict intensity is the lowest among the four trade regimes;

(ii) The second lowest conflict intensity is when there is worldwide free trade;

(iii) The pacifying effect of the worldwide free trade regime is stronger than that of the protectionist regime;

(iv) Relative to the protectionist regime, an FTA between one of the adversaries and a neutral third country is conflict-aggravating for the member and non-member states that are each other's enemies.

Based on the results of Proposition 4, we find it straightforward to discuss the scenario where two adversaries fail to establish an FTA. Under this circumstance, a global free-trade regime turns out to be an option for making the world relatively "safer." The reason is that the resulting conflict intensity is relatively lower than that under the protectionist regime or in an FTA which includes one of two adversary countries but excludes the other adversary.

6. The Ranking of Conflict Intensities When RTA Takes the Form of CU

We have analyzed and compared equilibrium outcomes for conflict intensities under four different types of trade regimes when regional trade agreement is an FTA. The next issue of interest concerns how the ranking of conflict intensities is affected when there is a CU. For the formation of CU between the adversary countries *A* and *B*, referred to as the *CU(A&B)* regime, we show in Appendix B-6 that

$$G^{A,CU(A\&B)} = G^{A,FTA(A\&B)} \text{ and } G^{B,CU(A\&B)} = G^{B,FTA(A\&B)}. \tag{40}$$

Combining the results in (33) that $G^{FTA(A\&B)} < G^{WFT} < G^{PR}$, we have from (40) that

$$G^{A,CU(A\&B)} < G^{A,WFT} < G^{A,PR} \tag{41a}$$

and

$$G^{B,CU(A\&B)} < G^{B,WFT} < G^{B,PR}. \tag{41b}$$

Thus, under either *FTA*(*A*&*B*) or *CU*(*A*&*B*), countries *A* and *B* allocate less of their endowed resources to arming, compared to their arming allocations under the protectionist regime. Note that the main difference between *CU*(*A*&*B*) and *FTA*(*A*&*B*) lies in their different decisions in setting external tariffs to the non-member country, *C*. Under the *CU*(*A*&*B*) regime, a common external tariff on imports from the third country is relatively lower than the external tariffs under the *FTA*(*A*&*B*) regime. Given that the arming allocations of countries *A* and *B* do not affect their tariff policies on imports from the neutral third country,[33] we have under symmetry that $G^{CU(A\&B)} = G^{FTA(A\&B)}$.

We show in Appendix B-7 that the striking differences in optimal arming decisions between the adversary countries occur in the scenario where there is a CU between one of the adversaries (say, *A*) and a neutral third country (*C*). We denote this as the *CU*(*A*&*C*) regime. For country *A*, we find that

$$\frac{\partial SW^{A,CU(A\&C)}}{\partial G^{A}}\Big|_{G^{A}=G^{A,PR}} > 0,$$

which implies that

$$G^{A,CU(A\&C)} > G^{A,PR}. \tag{42}$$

That is, country *A* allocates more resource to arming under the *CU(A&C)* regime than under the protectionist regime. Combining the results in (40)-(42), we have

$$G^{A,CU(A\&B)} < G^{A,WFT} < G^{A,PR} < G^{A,CU(A\&C)}. \tag{43}$$

For country *B*, however, we find that

$$\frac{\partial SW^{B,CU(A\&C)}}{\partial G^{B}}\Big|_{G^{B}=G^{B,PR}} < 0,$$

[33] See equation (26.a) for the case of the *FTA(A&B)* regime and equation (a.6) for that of the *CU(A&B)* regime.

which implies that

$$G^{B,CU(A\&C)} < G^{B,PR}. \tag{44}$$

That is, country *B*'s optimal arming is lower under the *CU(A&C)* regime than under the protectionist regime. It follows from (41b) and (44) that

$$G^{B,CU(A\&B)} < G^{B,WFT} < G^{B,PR} \text{ and } G^{B,CU(A\&C)} < G^{B,PR}. \tag{45}$$

Given the findings in (43) and (45), we cannot predict unambiguously whether conflict intensity under the *CU*(*A&C*) regime, $CI^{CU(A\&C)} = G^{A,CU(A\&C)} + G^{B,CU(A\&C)}$, is higher, equal to, or lower than that under the protectionist regime, $CI^{PR} = G^{A,PR} + G^{B,PR}$. That is,

$$CI^{CU(A\&C)} > (=)(<) CI^{PR}.$$

We thus have

PROPOSITION 5. *In the three-country world of conflict and trade,*

(i) The CU(A&B) regime and the FTA(A&B) regime between two adversaries are equally effective in that they have the stronger pacifying effect than worldwide free trade or the protectionist regime;

(ii) Compared to the FTA(A&B) regime, country A's optimal arming allocations under the alternative regimes are: $G^{A,FTA(A\&B)} = G^{A,CU(A\&B)} < G^{A,WFT} < G^{A,PR} < G^{A,CU(A\&C)}$. *As an outsider of the RTA, country B's optimal arming allocations under the alternative regimes are:* $G^{B,CU(A\&B)} < G^{B,WFT} < G^{B,PR}$ and $G^{B,CU(A\&C)} < G^{B,PR}$.

(ii) Relative to the protectionist regime, the CU(A&C) regime <u>may</u> <u>not</u> be conflict-aggravating for the member and non-member countries, A and B, that are each other's enemies.

The results in Propositions 4 and 5 reveal that there are similarities and differences between CU and FTA in affecting the equilibrium intensities of conflict (relative to the protectionist regime with no regionalism). The conflict-reducing effect associated with the *FTA*(*A&B*) regime continues to emerge under the *CU(A&B)* regime. Nevertheless, under the *CU*(*A&C*) regime, the common external tariff that countries *A* and *C* impose on good *b* is unambiguously <u>lower</u> than the optimal tariffs that country *B* imposes goods *a* and *c*. The tariff complementarity effect allows country *B* to enjoy economic benefits from producing and exporting more of its consumption good to the markets in *A* and *C*. As such, the tariff complementarity effect may provide a positive incentive for country *B* to lower its arming under the *CU*(*A&C*) regime. This result suggests that the conflict-aggravating effect associated with the $FTA(A\&C)$ regime may not show up for the $CU(A\&C)$ regime.

7. Concluding Remarks

Voluminous studies in the literature on regional trading agreements have contributed to our understanding about differences between FTAs and CUs from the perspective of international economics. Moreover, there are tremendous efforts to resolving the longstanding debates about the links between trade and conflict. This paper is the first to allow for the endogeneity of both security and trade policies in analyzing the relationship between interstate conflict and trade institutions. With resource appropriation possibilities, it is imperative for each state to determine a "grand" strategy that encompasses both trade policy option and an optimal arming decision. This paper is a new attempt in this direction to develop an economic model of trade regionalism and armed conflict. Our analyses are based on the observations that regional trading agreements involve elements of economic interdependence, political power, strategic military buildups between adversaries, and resource appropriations.

Our endogenous security analysis compares the equilibrium levels of conflict intensity associated with different trade regimes. The comparison of the differing conflict intensities is not forthcoming when arming is exogenously-given. The contributions of our study lie in stressing the endogeneity of both security and trade policies in affecting conflict equilibrium when two adversaries may opt to form an FTA or when one of them and a neutral third party form an FTA. This approach permits us to see how the equilibrium intensity of regional conflict is directly related to trade regimes. For different trade regimes, the ranking of conflict intensities from <u>low</u> to <u>high</u> is: (i) an FTA between two adversaries, (ii) worldwide free trade, (iii) trade protectionism without regional trade agreements of any form, and (iv) an FTA between one of the adversaries and a neutral third country. The policy implications of the trade-conflict analysis are profound. First, forming an FTA between two adversaries has the strongest pacifying effect, followed by worldwide free trade. Second, the pacifying effect of the worldwide free trade regime is stronger than that of the protectionist regime without regionalism. Third, compared to the protectionist regime, an FTA between one of the adversaries and a neutral third country is *conflict-aggravating* for the member and non-member states that are each other's enemies. However, we may or may not observe such a conflict-aggravating effect associated with an FTA when the preferential trading agreement takes the form of a CU.

Given the growing tensions in the international arena resulting from interstate disputes and resource appropriation, our theoretical findings help shed some lights on how trade regionalism affects the intensity of the regional conflict. However, we admittedly recognize that we present the trade-conflict analysis upon some simplifying assumptions. One possible extension is to see how differences in production technologies affect the trade equilibrium of two contending countries and their optimal arming decisions. It may also be interesting to consider the possibility of trade in resources or intermediate inputs. Another potentially interesting extension is to introduce the endogeneity of conflict-related destructions into the analysis.[34] In this case, resource and output destructions affect the production and consumption of final goods and hence the equilibrium terms of trade and the volumes of imports and exports. We want to pursue all these issues in our future research.

[34]For studies on conflict that takes into account the endogeneity of destruction costs see, e.g., Sanders and Walia (2014), and Chang, Sanders, and Walia (2015), and Chang and Luo (2013, 2017).

Chapter 3 - Free Trade Agreements and The Role of Third Party in Interstate Conflict

1. Introduction

The role that third party plays in influencing interstate conflict has been an important research topic of interest to policy makers, economists, and political scientists. Regan (2002) finds empirically that third party intervention attempts to limit interstate dispute. Chang and Shane (2007) show in a game-theoretic analysis that intervention by a third party can be either peace breaking or peace creating. These studies and others[35] examine the role of third party, as a conflict manager or a military supporter, in aggravating or reducing interstate conflict. Another strand in the literature investigates the role that third party plays through the formation of preferential trade agreement on interstate conflict. Peterson (2011) shows that third-party trade increases interstate hostility in the presence of political dissimilarity between contending countries. In addition, Peterson shows empirically that third-party trade with the defender country is conflict-aggravating than the third-party trade with the potential aggressor. Considering third-party trade ties with a potential aggressor and war initiator, Kinne (2014) shows that a third party has an incentive to reduce hostility or conflict between two adversary countries by threatening them through credible signaling such as sanctions, embargo, or blockades when trade ties are larger with both of the contending countries. Hadjiyiannis, Heracleous, and Tabakis (2016) investigate regionalism and conflict. In their theoretical analysis, the authors assume that each contending country's conflict-related arming is *exogenously-given* and trade with a neutral or friendly country. The authors show that forming a free trade agreement or customs union between one of two adversaries and a friendly third party is conflict aggravating. When the two contending countries form a free trade agreement or a customs union, the conflict hostility reduces. In other word two contending countries will decide to settle their political dispute through peaceful means. Mansfield and Pevehouse (2000)

[35] For studies that analyze the role of third party in interstate conflict see, e.g., Chang, Potter and Shane (2007), Amegashie (2010), Amegashie (2014), Amegashie and Kutsoati (2007), Rupen (2002), Cunningham (2016), Arman (2010), Sawyer, Katherine, Kathleen Gallagher Cunnningham, and William Reed (2015).

document that member states of RTAs are less likely to have armed conflicts than non-member states. Liu and Ornelas (2014) show empirically that a country's participation in FTAs enhances the sustainability of its democracy. The authors indicate that the mechanism behind the positive relationship between trade regionalism and consolidated democracy is "the destruction of rents in FTAs" associated with a member state's change in its political regime. Martin, Mayer, and Thoenig (2008, 2012) analyze the causes of trade for war and find that enlarging the number of members in a regional trade arrangement reduces the economic interdependence between any pair of rival states which, in turn, increases the likelihood of bilateral war.[36]

The present paper contributes to the trade regionalism literature by examining the impact of third-party trade on interstate conflict. What are optimal arming allocations for national defense when a neutral third party forms a free trade agreement (FTA) with only one of the two adversaries, Single FTA, as compared to the case when the third party forms a FTA with each of them, multiple FTA? What are the conflict-related arming allocations when the bilateral trade is characterized by a protectionist regime (with most-favored-nation tariffs)? We wish to analyze these questions by developing a trade and conflict model which emphasize the role of third-party trade. First, we develop a conflict-trade framework that explicitly characterizes the *endogeneity* of national security and international trade policies optimally chosen by two nation-state adversaries in a four-stage game. Second, we characterize the equilibrium level of arming and conflict intensity under three different trade regimes. A single FTA where the third party form a free trade agreement with one single country among the contending countries. A multiple FTA where the third party form a free trade agreement with both contending countries. This permits us to investigate how the

[36]For studies that empirically analyze the correlation between trade and conflict-related issues see, e.g., Polachek (1980), Polachek (1992, 1999), Barbieri (1996), Barbieri and Levy (1999), Reuveny and Kang (1998), Polachek, Robst, and Chang (1999), Barbieri and Schneider (1999), Anderton and Carter (2001), Mansfield and Pollins (2001), Reuveny (2002), Levy and Barbieri (2004), Kim and Rousseau (2005) and Polachek and Seiglie (2007), Glick and Taylor (2010). The book by Mansfield and Pollins (2003) contains a collection of interesting studies on trade and conflict debate. The seminal work of Polacheck (1980) shows that strengthening the extent of trade openness between contending countries can effectively reduce their conflicts in term of overall armament expenditures. This result is also found in Oneal and Russet (1999). Nevertheless, some studies such as Kim and Rousseau (2005) find that the pacifying effect of greater trade openness can be neutral. Other studies such as Barbieri (1996) find that extensive links through trade may increase the probability of armed conflicts. Barbieri and Levy (1999) show that war does not have significant impact on trading relationships between adversaries. It seems that there is no consensus on the trade-conflict nexus. For theoretical investigations on the relationship between trade and conflict see, e.g., Skaperdas and Syropoulos (2001), Garfinkel, Skaperdas, and Syropoulos (2009, 2015), and Garfinkel and Syropoulos (2017).

optimal arming decisions of adversaries is affected by the third-party trade, as compared to the equilibrium under the protectionist regime.

Treating national security and international trade policies as endogenous, our results show that an increase in arming by each adversary on its domestic welfare contains three effects. The first is an "export-revenue effect" of arming, which is welfare increasing since an increase in arming increases the prices and revenues of the exported good. The second is "an output-distortion effect" of arming which is welfare-reducing since allocating more resource to arming unambiguously decreases its final good production for consumption. The third is a "resource-appropriation effect" of arming which is welfare-increasing because an increase in arming increases the amount of final good appropriated from its rival country for domestic consumption.

We further analyze and compare equilibrium arming allocations of the contending countries and the overall conflict intensity under different trade regimes. The main findings are summarized as follows. First, the formation of an FTA between a neutral third-party state with each of the adversaries leads them to lower their arming allocations despite that they do not trade. Thus, third-party trade in the form of multiple FTAs reduces conflict intensity and has a stronger pacifying effect than the protectionism regime. Relative to the scenario with multiple FTAs, third-party trade in the form of a single FTA induces the non-member (or excluded) country to increase its arming. Whereas the member country allocates the same level of arming as that under the scenario of protectionism regime. The overall allocation of arming is higher under the single PTA regime than under the multiple FTA regime. Thus, the single FTA regime is conflict-aggravating.

The remainder of the paper is organized as follows. Section 2 presents the three-country model of trade and conflict. We determine the equilibrium arming and the intensity of conflict under the protectionism regime. Using the latter as benchmark, In Section 3, we analyze the scenario where the third country form a multiple FTAs that includes both contending countries. Section 4 examines the case where the third party form a single FTAs which exclude one of the contending countries. Section 4 concludes.

2. The Analytical Framework

2.1 Basic assumptions and the structure of the game

We consider a world consists of three large countries, *A*, *B*, and *C*, where *A* and *B* are "enemies" in that they appropriate each other's resources without trade and country *C* is a politically neutral third party engaging in bilateral trade with *A* and *B*. Each country is endowed with R units of resource (or intermediate input) that can be used to produce a country-specific final good for consumption or exportation. Our objective is to analyze how the two adversary countries (*A* and *B*) determine their productive and appropriative activities when the third party (*C*) may decide to sign a preferential trade agreement with one of the adversary countries or both.

Each of the three countries specializes in the production of a final good in its own country name. That is, *A*, *B*, and *C*, produce country-specific goods a, b, and c, respectively. For bilateral trade between *C* and *A* or between *C* and *B*, we consider an import competing scenario. In our analysis, country *A* produces good a, appropriates good b from country *B*, and imports good c from country C. Similarly, country *B* produces good b, appropriate good a from country *A*, and import good c from country C. The neutral country, *C*, produces good c and imports both goods a and b. We adopt a linear production technology for each country that one of a specific resource (or input) is required to produce one unit of final good in its specialization.

Owing to resource appropriation possibilities under interstate conflict, countries *A* and *B* arm for national security or defense by allocating certain amounts of their endowment resources. We consider a simple military technology that one unit of an endowed resource produces one unit of an armament. Let $G^A(\geq 0)$ and $G^B(\geq 0)$ represent resources allocated to the production of weapons by *A* and *B*, respectively. The national security policy of a country is a broader concept to include such dimensions as military, economics, environment, energy, technology, etc. For analytical simplicity, a country's national security policy is captured by its conflict-related arming allocation. The probability that each contending country is able to retain its resource in the event of fighting is represented by a canonical "contest success function" (CSF) that reflects the technology of conflict (see, e.g., Tullock 1980; Hirshleifer 1989; Skaperdas 1996) as follows:

$$\Psi^A = \frac{G^A}{G^A + G^B} \text{ and } \Psi^B = \frac{G^B}{G^A + G^B} \text{ for } G^A + G^B > 0; \tag{1a}$$

$$\Psi^A = \Psi^B = \frac{1}{2} \text{ for } G^A = G^B = 0. \tag{1b}$$

While engaging in appropriation activities, countries A and B incur a fixed exogenous destruction cost K. Country A loses K^A units of good a and country B loses K^B units of good b.[37] Given the CSF in (1), the amount of final good a that country A produces is:

$$X_a^A = (\frac{G^A}{G^A + G^B})R - G^A - K^A, \tag{2a}$$

where the first term on the right-hand side represents the amount of the domestic resource retained after fighting against B. Similarly, the expected amount of final good b that country B produces is:

$$X_b^B = (\frac{G^B}{G^A + G^B})R - G^B - K^B \tag{2b}$$

where the first term in the right-hand side represents the amount of the domestic resource retained after fighting against A.

Since country C is a neutral third-party, it engages in bilateral trade with A and B. As such, the total production of final good c is equal to R.

With respect to preferences over the final goods for consumption, we assume that demand for good $i(i = a,b,c)$ in the country $j(j = A,B,C)$ is taken to be linear:

$$Q_i^j = \alpha - \beta P_i^j, \tag{3a}$$

where P_i^j is the price of good i in country j, $\alpha(> R)$, and $\beta > 0$. Corresponding to the market demands in (3a), it is easy to verify that consumer surplus (CS) for country j is:

$$CS^j = \frac{1}{2\beta}[(\alpha - \beta P_a^j)^2 + (\alpha - \beta P_b^j)^2 + (\alpha - \beta P_c^j)^2]. \tag{3}$$

As for producer surplus, we first look at the adversary countries, A and B. Considering the resource appropriation possibilities, we have producer surplus for A and B as follows:

$$PS^A = P_a^A X_a^A + P_b^A(\frac{G^A}{G^A + G^B})R \text{ and } PS^B = P_b^B X_b^B + P_a^B(\frac{G^B}{G^A + G^B})R. \tag{4}$$

[37] As in Hadjiyiannis et al (2016), we assume that K^A and K^B are fixed costs of destruction to A and B.

The first term on the LHS of each equation in (4) is the market value of a good produced domestically, noting that X_a^A and X_b^B are given in (2). The second term on the LHS of each equation measures the market value of a good that is appropriated from an enemy country. Since C is a neutral country, its producer surplus is measured by the market value of the final good c that the country produces using its own endowment R. That is,

$$PS^C = P_c^C R. \tag{5}$$

Under the shadow of resource appropriation, countries A and B determine their optimal arming allocations (security policy) and tariffs (trade policy) to maximize their respective social welfare (SW^j). Country C, however, determine only an optimal trade policy, to maximize its social welfare. As in the literature, social welfare for each country is taken as the sum of consumer surplus, producer surplus, and tariff revenues (TR^j). That is,

$$SW^j = CS^j + PS^j + TR^j \text{ for } j \in \{A, B, C\}, \tag{6}$$

where CS^j and PS^j are given in (3)-(5). The total amount of tariff revenues depends on the trade regime adopted by each country, and the amounts of resources allocated to arming for the two adversaries.

To analyze how third-party trade in the form of a free trade agreement affects the optimal arming decisions of the adversaries, we consider a sequential-move game. At stage one, country C may commit to form a free trade agreement with one of the adversary countries or both, or the third-party trade may take the form of a protectionist regime (with most-favored-nation tariffs). At stage two, the two adversaries determine optimal arming allocations to maximize their respective social welfare. At stage three, the three countries set their tariffs (depending on the regime type adopted in the first stage of commitment) and engage in trade. To derive the sub-game perfect equilibrium for each trade regime, we use backward induction.

2.2 Third-party trade in the form of a protectionist regime

The protectionism regime will serve as a benchmark for evaluating two alternative regimes. One is when country C forms a preferential trade agreement with each of the adversary countries. The other is when country C forms an FTA with only one of the adversaries. Under protectionism regime, denote τ_i^j as the tariff rate that each j imposes on its import of final good i.

We begin our analysis with the fourth and last stage of the game at which the two contending countries, A and B, engage in bilateral trade for final goods with Country C.

To maintain the patterns of trade and final good specialization, we note the comparative advantage principle that the price of a good in an exporting country plus a specific tariff imposed on the good by an importing country can never be lower than the good's price in the importing country. This principle excludes the possibilities of arbitrage activities in the three-country world (Bagwell and Staiger, 1997, 1999). For good a that country A manufactures and exports, we have the following no-arbitrage condition:

$$P_a^A + \tau_a^C = P_a^C, \tag{7}$$

where τ_a^C is tariff imposed by countries C on good a. We solve for the equilibrium price of good a in country A by equating the good's aggregate demand with its aggregate supply. That is, trade equilibrium for good a requires that

$$(\alpha - \beta P_a^A) + (\alpha - \beta P_a^C) = (\frac{G^A}{G^A + G^B})3 - G^A - K^A. \tag{8}$$

For analytical tractability, in (8), we assume that R is equals 3 as in Hadjiyiannis et al (2016). Substituting P_a^C in terms P_a^A from (7) into the equilibrium condition in (8), we solve for the market price of good a in country A. This yield

$$P_a^A = \frac{1}{2\beta}\{2\alpha - \beta\tau_a^C - [(\frac{G^A}{G^A + G^B})3 - G^A - K^A]\}. \tag{9a}$$

Using P_a^A in (9a) and the conditions in (7), we calculate the market price of good a in country C

$$P_a^C = \frac{1}{2\beta}\{2\alpha + \beta\tau_a^C - [(\frac{G^A}{G^A + G^B})3 - G^A - K^A]\}. \tag{9b}$$

The market price of good a in country B is determined by setting the amount of good a that country B appropriates to be equal to its demand for the good. That is $(\alpha - \beta P_a^B) = (\frac{G^B}{G^A + G^B})3,$ which implies that

$$P_a^B = \frac{1}{\beta}[\alpha - (\frac{G^B}{G^A + G^B})3]. \tag{9c}$$

Similarly, for good b that country *B* manufactures and exports, the no-arbitrage condition is:

$$P_b^B + \tau_b^C = P_b^C, \tag{10}$$

where τ_b^C is tariff that country, *C* imposes on good b. Trade equilibrium for good b requires that

$$(\alpha - \beta P_b^B) + (\alpha - \beta P_b^C) = (\frac{G^B}{G^A + G^B})3 - G^B - K^B. \tag{11}$$

Substituting P_b^C in terms of P_b^B from (10) into the equilibrium condition in (11), we solve for the equilibrium market price of good b in country *B*:

$$P_b^B = \frac{1}{2\beta}\{2\alpha - \beta\tau_b^C - [(\frac{G^B}{G^A + G^B})3 - G^B - K^B]\}. \tag{12a}$$

Using P_b^B in (12a) and the conditions in (10), we have the equilibrium market price of good b in country *C*:

$$P_b^C = \frac{1}{2\beta}\{2\alpha + \beta\tau_b^C - [(\frac{G^B}{G^A + G^B})3 - G^B - K^B]\}. \tag{12b}$$

The market price of good b in country *A* is determined by setting the amount of good b that country A appropriates to be equal to its demand for the good. That is, $(\alpha - \beta P_b^A) = (\frac{G^A}{G^A + G^B})3$, which implies that

$$P_b^A = \frac{1}{\beta}[\alpha - (\frac{G^A}{G^A + G^B})3]. \tag{12c}$$

As for good c in country *C*, trade equilibrium requires that

$$(\alpha - \beta P_c^A) + (\alpha - \beta P_c^B) + (\alpha - \beta P_c^C) = 3, \tag{13}$$

where P_c^A and P_c^B satisfy the non-arbitrary conditions:

$$P_c^C + \tau_c^A = P_c^A \quad \text{and} \quad P_c^C + \tau_c^B = P_c^B. \tag{14}$$

Making use of (13) and (14), we calculate the market prices of good c in the three countries as

$$P_c^A = \frac{3\alpha + 2\beta\tau_c^A - \beta\tau_c^B - 3}{3\beta},\ P_c^B = \frac{3\alpha - \beta\tau_c^A + 2\beta\tau_c^B - 3}{3\beta},\ P_c^C = \frac{3\alpha - \beta(\tau_c^A + \tau_c^B) - 3}{3\beta}. \tag{15}$$

In the third stage, the three countries independently and simultaneously determine their optimal tariffs. Given that the enemy countries do not trade, country *A*'s total revenue from imposing tariffs, τ_c^A, on goods *c* is:

$$TR^A = \tau_c^A Q_c^A, \tag{16a}$$

where Q_c^A is *A*'s import demand for the good. That is, $Q_c^A = (\alpha - \beta P_c^A)$.

3.3 The Endogeneity of Security and Trade Polices

Substituting the goods' prices from (9), (12), and (15) into CS^A in (3), PS^A in (4), and TR^A in (16a), we can calculate country *A*'s social welfare $SW^A (= CS^A + PS^A + TR^A)$ in terms of tariff rates, $\{\tau_c^A, \tau_c^B, \tau_a^C, \tau_b^C\}$, and arming allocations, $\{G^A, G^B\}$. In the third-party trade between *A* and *C*, the government of country *A* determines an optimal tariff, τ_c^A, on good c to maximize its domestic welfare, SW^A. The optimal tariff is determined by solving the first-order condition: (FOC): $\partial SW^A \big/ \partial \tau_c^A = 0$, which yields

$$\tau_c^A = \frac{\tau_c^B}{8} + \frac{3}{8\beta}. \tag{17}$$

As for country *B*, its total revenue from imposing tariffs, τ_c^B, on goods *c* is:

$$TR^B = \tau_c^B Q_c^B, \tag{18}$$

where Q_c^B is B's import demand for the good. That is, $Q_c^B = (\alpha - \beta P_c^B)$. Substituting the goods' prices from (9), (12), and (15) into CS^B in (3), PS^B in (4), and TR^B in (18a), we can calculate country *B*'s social welfare $SW^B (= CS^B + PS^B + TR^B)$ in terms of tariff rates, $\{\tau_c^A, \tau_c^B, \tau_a^C, \tau_b^C\}$, and the arming allocations, $\{G^A, G^B\}$. In the third-party trade between *B* and *C*, the government of country *B* determines an optimal tariff, τ_c^B, on good c to maximize its domestic welfare, SW^B. The optimal tariff is determined by solving the FOC: $\partial SW^B \big/ \partial \tau_c^B = 0$, which yields

$$\tau_c^B = \frac{\tau_c^A}{8} + \frac{3}{8\beta}. \tag{19}$$

Country *C's* total revenue from imposing tariffs, $\{\tau_a^C, \tau_b^C\}$, on goods *a* and *b* is:

$$TR^C = \tau_a^C Q_a^C + \tau_b^C Q_b^C, \tag{20a}$$

where Q_a^C and Q_b^C are given, respectively, as

$$Q_a^C = (\alpha - \beta P_a^C) \text{ and } Q_b^C = (\alpha - \beta P_b^C). \tag{20b}$$

Substituting the market prices of the goods from (9), (12), and (15), into CS^C in (3), PS^C in (5), and TR^C in (20a), Country B determine the optimal tariff τ_c^B that maximize SW^B in (6) taken as given the arming allocations of the contending countries at the second stage and two other countries' tariff rates at the third stage of the four-stage game, The FOC yields the following tariffs:

$$\tau_a^C = \frac{G^A(3 - G^B - G^A)}{3\beta(G^A + G^B)} - \frac{K^A}{3\beta} \text{ and } \tau_b^C = \frac{G^B(3 - G^B - G^A)}{3\beta(G^A + G^B)} - \frac{K^B}{3\beta}. \tag{21}$$

Making use of (17), (19), and (21), the optimal tariffs set by the three countries under the protectionist regime (*PR*):

$$\tau_a^{C,PR} = \frac{G^A(3 - G^B - G^A)}{3\beta(G^A + G^B)} - \frac{K^A}{3\beta}, \quad \tau_b^{C,PR} = \frac{G^B(3 - G^B - G^A)}{3\beta(G^A + G^B)} - \frac{K^B}{3\beta},$$

$$\tau_c^{A,PR} = \frac{3}{7\beta}, \quad \tau_c^{B,PR} = \frac{3}{7\beta}. \tag{22}$$

The results in (22) suggest that tariffs imposed by two enemy countries on their imports from a third party are independent of their arming allocations (for national defense or resource appropriations) and the destructiveness of war (as measured by the parameter *K*). This is consistent with our presumption that the third party is a political neutral country such that the trade policy decisions of two adversaries with a neutral country are isolated from their arming decisions. In contrast, the neutral country's trade policy depends on the amount of arming allocated by the two contending countries and the destruction cost.

It is easy to verify the following comparative statics:

$$\frac{\partial \tau_a^{C,PR}}{\partial G^A} < 0, \quad \frac{\partial \tau_a^{C,PR}}{\partial G^B} < 0, \quad \frac{\partial \tau_b^{C,PR}}{\partial G^A} < 0, \quad \frac{\partial \tau_b^{C,PR}}{\partial G^B} < 0, \quad \frac{\partial \tau_a^{C,PR}}{\partial K^A} < 0, \quad \frac{\partial \tau_b^{C,PR}}{\partial K^B} < 0, \tag{23}$$

The findings in (23) can be summarized by the first proposition as follows:

PROPOSITION 1. *Under the protectionist regime in a three-country world where two countries appropriate each other's resources without trade, but each has a bilateral trade relationship with a politically neutral third country, the most-favored-nation tariffs imposed by the latter are* <u>*lower*</u> *the higher the arming allocations of the two adversaries and the higher the destructiveness of armed conflict.*

Proposition 1 shows that, all else being equal, third party reacts to arming increase of the two adversaries by reducing tariffs on imports from them. The economic intuitions behind such tariff reductions are as follows. An increase in arming by each of the two enemy countries lowers the amounts of their resources available to produce the country-specific consumption goods (*a* and *b*). This implies that the international prices of the consumption goods will be higher. To mitigate the possible increase in the domestic prices of the consumption goods imported from the two contending countries, it is to the economic benefit of Country *C* not to increase but to lower the tariffs.

We proceed to the security stage where the adversary countries, *A* and *B*, determine arming allocations to maximize their social welfare. Under symmetry in all aspects (i.e., $G^{A,PR} = G^{B,PR} = G^{PR}$ and $K^A = K^B = K$), we solve for the optimal arming as follows:

$$G^{PR} = \frac{\sqrt{81\alpha^2 + 108\alpha - 288 + K(64K + 144\alpha - 96)}}{16} - \frac{9}{16}\alpha - \frac{1}{2}K + \frac{9}{8}. \tag{24}$$

It follows that

$$G^{PR} > 0 \ \text{ when } \ \alpha > \frac{17}{12} - \frac{4}{9}K.$$

The last inequality condition holds when market demand for a good is sufficiently large and the destruction cost is critically low. We assume that this condition holds.

It is easy to verify the following comparative-static derivatives:

$$\frac{\partial G^{PR}}{\partial \alpha} > 0 \ \text{ and } \ \frac{\partial G^{PR}}{\partial K} < 0.$$

When two enemy countries face higher costs of destruction in fighting, the opportunity costs of increasing arming dominate the economic gains from trade. As a result, the enemy countries tend to allocate less resources to arming. In contrast, the enemy countries allocate more resources to arming when the size of market for each consumption good is large.

It is instructive to investigate how a conflicting country's arming affects its social welfare. Using Country, *A* as an example (under the assumption of symmetry), we show in Appendix C-1 the following welfare decomposition:

$$\frac{\partial SW^A}{\partial G^A} = \underbrace{[X_a^A - (\alpha - \beta P_a^A)]\frac{\partial P_a^A}{\partial G^A}}_{\substack{\text{Export-revenue effect}\\ \text{of arming}\\ (+)}} + \underbrace{\frac{\partial X_a^A}{\partial G^A} P_a^A}_{\substack{\text{Output-distortion effect}\\ \text{of arming}\\ (-)}} + \underbrace{\frac{\partial APP_B}{\partial G^A} P_b^A}_{\substack{\text{Resource-appropriation effect}\\ \text{of arming}\\ (+)}} = 0. \quad (25)$$

where $APP_B = [G^A/(G^A + G^B)]R$ for $R = 3$ is the expected amount of good b that country *A* appropriates from country *B*. The impact that each adversary's arming on its domestic welfare is summarized by the following proposition:

PROPOSITION 2. *Under the protectionism regime in a three-country world where two* adversary *countries appropriate each other's resources and engage in trade only with a neutral third party, an increase in arming by each adversary on its domestic contains three effects. The first is an export-revenue effect of arming, which is welfare increasing. The second is an output-distortion effect, which is welfare decreasing. The third is a resource-appropriation effect which is welfare increasing*.

The first is an “export-revenue effect” of arming, which is welfare increasing since an increase in arming increases the prices and revenues of the exported good. The second is an “output-distortion effect” of arming, which is welfare-reducing since allocating more resource to arming unambiguously decreases its final good production for consumption. The third is a “resource-appropriation effect” of arming, which is welfare-increasing because an increase in arming increases the amount of final good appropriated from its rival country for domestic consumption. Both the export-revenue effect and the resource-appropriation effect reflect the marginal revenue while the output-distortion effect constitutes the marginal cost. The equilibrium level of arming that maximizes the overall welfare for each contending country is determined where the marginal benefit of arming equals the marginal cost.

Using the protectionism regime as a benchmark, we analyze how the socially optimal arming level, G , as well as the intensity of conflict, which is measured by the sum of the level of arming by the two contending countries are affected when the third party engage in a discriminatory PTA with one of the contending countries. Next, we will analyze the scenario where the neutral third party forms a free trade agreement separately with each of the adversary countries.

3. Third-Party Trade in the form of Multiple FTAs

We proceed to examine how the arming decisions of two adversary countries are affected when third-party trade takes the form of multiple FTAs, denoted as $"M"$. As the analysis under the protectionism regime, we consider a three-stage game. At stage one, the third party (*C*) commits to form a multiple FTA with each of the adversary countries (*A* and *B*). At stage two, countries *A* and *B* determine their optimal arming allocations. At stage three, member countries of an FTA enjoy duty-free access to each other's markets and engage in third-party trade. We use backward induction to solve for the Sub-game perfect Nash equilibrium under multiple FTAs.

We begin with the third stage of the game by substituting zero tariffs back into equations (9), (12), and (15) to obtain the prices of goods *a*, *b*, and *c* in their markets:

$$P_a^{A,M} = P_a^{C,M} = \frac{1}{2\beta}(2\alpha - \frac{3G^A}{G^A+G^B} + G^A + K^A),\ P_a^{B,M} = \frac{\alpha}{\beta} - \frac{3G^B}{\beta(G^A+G^B)},$$

$$P_b^{B,M} = P_b^{C,M} = \frac{1}{2\beta}(2\alpha - \frac{3G^B}{G^A+G^B} + G^B + K^B),\ P_b^{A,M} = \frac{\alpha}{\beta} - \frac{3G^A}{\beta\left(G^A+G^B\right)},$$

$$P_c^{A,M} = P_c^{B,M} = P_c^{C,M} = \frac{\alpha-1}{\beta}. \tag{26}$$

At the second stage, each contending country determines an arming allocation that maximizes its domestic welfare. Making use of the prices in (26), country *A's* social welfare function is: $SW^{A,M} = CS^{A,M} + PS^{A,M}$, where consumer surplus and producer surplus respectively are:

$$CS^{A,M} = \frac{1}{2\beta}[(\alpha - \beta P_a^{A,M})^2 + (\alpha - \beta P_b^{A,M})^2 + (\alpha - \beta P_c^{A,M})^2],$$

$$PS^{A,M} = P_a^{A,M}[(\frac{G^A}{G^A+G^B})3 - G^A - K^A)] + P_b^{A,M}[(\frac{G^A}{G^A+G^B})3].$$

Country *B*'s social welfare function is: $SW^{B,M} = CS^{B,M} + PS^{B,M}$, where consumer surplus and producer surplus respectively are:

$$CS^{B,M} = \frac{1}{2\beta}[(\alpha - \beta P_a^{B,M})^2 + (\alpha - \beta P_b^{B,M})^2 + (\alpha - \beta P_c^{B,M})^2],$$

$$PS^{B,M} = P_a^{B,M}[(\frac{G^B}{G^A+G^B})3 - G^B - K^B)] + P_b^{B,M}[(\frac{G^B}{G^A+G^B})3].$$

The FOCs for *A* and *B* are: $\partial SW^{A,M} / \partial G^{A} = 0$ and $\partial SW^{B,M} / \partial G^{B} = 0,$ which lead to the Nash equilibrium levels of arming, denoted as $\{G^{A,M}, G^{B,M}\}$. Under symmetry in all dimensions, we have $G^{A,M} = G^{B,M} = G^{M}$. The optimal arming level is calculated as follows:

$$G^{M} = \frac{\sqrt{256\alpha^{2} + 288\alpha - 783 + K(144K + 384\alpha - 216)}}{24} - \frac{2}{3}\alpha - \frac{1}{2}K + \frac{9}{8}. \tag{27}$$

Evaluating the derivative $\partial SW^{A,M} / \partial G^{A}$ and $\partial SW^{B,M} / \partial G^{B}$ at the point where $G^{A} = G^{B} = G^{PR}$,[38] we have

$$\frac{\partial SW^{A,M}}{\partial G^{A}}\bigg|_{G^{A}=G^{PR},\alpha>3,K=0.2} < 0 \text{ and } \frac{\partial SW^{B,M}}{\partial G^{B}}\bigg|_{G^{B}=G^{PR},\alpha>3,K=0.2} < 0.$$

Strict concavity of each country's social welfare function implies that

$$G^{M} < G^{PR}. \tag{28}$$

Equation (28) indicates that multiple FTAs (with the neutral third party forming a free trade agreement separately with each of the adversary countries) reduces each adversary's arming. Defining conflict intensity (*CI*) as the aggregation of arming allocations by the two adversaries, i.e., $CI = G^{A} + G^{B}$, we have under symmetry that

$$CI^{M} < CI^{PR}. \tag{29}$$

We, therefore, can state the following:

PROPOSITION 3. *In a three-country world with two adversary countries and a neutral third state, the formation of a PTA between the third-party state with* <u>*each*</u> *of the adversaries leads them to lower their optimal arming* allocations *despite that they do not trade. Thus, multiple PTAs reduces conflict intensity and has a stronger pacifying effect than the protectionism regime*.

A move from trade protectionism to the third-party trade regime with multiple FTAs provides an economic incentive for two enemy countries to cut back on their arming allocations. Consequently, the overall conflict intensity decreases. To explain the economic intuition behind this result, we use the social welfare decomposition developed in section 2. The slope of each contending countries social welfare with respect to the level of arming under protectionism regime is strictly negative as indicated in equation (28). The strict negativity of the derivative is caused

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[38]Note that we assign some plausible values for K (i.e., $K = 0.2$) in evaluating the derivative.

by the fact that the output-distortion effects, which represent the marginal cost of arming is greater than the export-revenue effect and the appropriation effect which constitute the marginal revenue. These results derivation can be found in Appendix C-2.

4. Third-Party Trade in the form of a Single FTA

The next step is to analyze how arming decisions of contending countries is affected when the third party forms a single FTA with one of the contending countries, A or B. One is interested to know how members and non-members allocate their resource to arming under a single FTA. As the analysis under the protectionist regime, we consider a four-stage game structure to characterize the sub-game perfect equilibrium for the single FTA formed between countries *A* and *C*, denoted as the "S" regime. At stage one, Country C commits to form an FTA with A. At stage two, the two contending countries independently and simultaneously determine optimal arming allocations that maximize their own domestic welfare. At stage three, *A* and *C* set zero tariffs $(\tau_c^A = \tau_a^C = 0)$ on their imports from each other and, in the meanwhile, Simultaneously and independently Country *C* sets an optimal tariff τ_b^C on imports from country *B*. The latter sets an optimal tariff τ_c^B, on imports from *C*. At stage four, Countries A and B engage in trade for final goods with country *C*.

We make use of equation (9), (12), (15), and $(\tau_c^A = \tau_a^C = 0)$, the equilibrium market prices of goods *a*, *b*, and *c* are:

$$P_a^{A,S} = P_a^{C,S} = \frac{1}{3\beta}\{2\alpha - [3(\frac{G^A}{G^A+G^B}) - G^A - K^A]\},\ P_a^{B,S} = \frac{\alpha}{\beta} - \frac{3G^B}{\beta(G^A+G^B)},$$

$$P_b^{B,S} = \frac{1}{2\beta}\{2\alpha - [3(\frac{G^B}{G^A+G^B}) - G^A - K^A] - \beta\tau_b^C\},$$

$$P_b^{C,S} = \frac{1}{2\beta}\{2\alpha - [3(\frac{G^B}{G^A+G^B}) - G^A - K^A] + \beta\tau_b^C\},\ \ P_c^{A,S} = P_c^{C,S} = \frac{3\alpha - \beta\tau_c^B - 3}{3\beta},$$

$$P_c^{B,S} = \frac{3\alpha + 2\beta\tau_c^B - 3}{3\beta}. \tag{30}$$

We proceed to the third stage at which country *B* sets its optimal tariff τ_c^B on good c and country *C* sets its optimal tariff τ_b^C on good $b.$ Given that country *A* does not engage in trade with country *B* but forms an FTA with country *C*, we have zero tariffs $\tau_c^A = \tau_a^C = 0.$ Making use of the prices in (30) and the social welfare function in (6), we can determine the welfare-maximizing tariff, $\tau_c^{B,S}$, the country *B* imposes on good $c.$ We note that the amount of good c imported for consumption is: $Q_c^{B,S} = \alpha - \beta P_c^{B,S},$ where $P_c^{B,S}$ is given in (30). After substitution, we have

$$Q_c^{B,S} = \alpha - \beta P_c^{B,S} = 1 - \frac{2\beta\tau_c^{B,S}}{3}.$$

Consumer and producer surpluses are:

$$CS^{B,S} = \frac{1}{2\beta}[(\alpha - \beta P_a^{B,S})^2 + (\alpha - \beta P_b^{B,S})^2 + (\alpha - \beta P_c^{B,S})^2],$$

$$PS^{B,S} = P_b^{B,S}[(\frac{G^B}{G^A + G^B})3 - G^B - K^B] + P_a^{B,S}[(\frac{G^B}{G^A + G^B})3].$$

Country *B*'s social welfare function is:

$$SW^{B,S} = CS^{B,S} + PS^{B,S} + \tau_c^{B,S} Q_c^{B,S}$$

and its FOC is:

$$\frac{\partial SW^{B,S}}{\partial \tau_c^{B,S}} = \frac{1}{3} - \frac{8\tau_c^{B,S}}{9} = 0.$$

Solving for the optimal tariff for country *B* yields

$$\tau_c^{B,S} = \frac{3}{8\beta}. \tag{31a}$$

Next, we calculate the welfare-maximizing tariff that country *C* imposes on good $b.$ Note that the amount of good b imported for consumption is: $Q_b^{C,S} = \alpha - \beta P_b^{C,S},$ where $P_b^{C,S}$ is given in (30). After substitution, we have

$$Q_b^{C,S} = \frac{1}{2}[3(\frac{G^B}{G^A + G^B}) - G^B - K^B - \beta\tau_b^{C,S}] = 0.$$

Consumer and producer surpluses are:

$$CS^{C,S} = \frac{1}{2\beta}[(\alpha - \beta P_a^{C,S})^2 + (\alpha - \beta P_b^{C,S})^2 + (\alpha - \beta P_c^{C,S})^2],$$

$$PS^{C,S} = 3P_c^{C,S},$$

where the prices of the goods are given in (30). Country *C*'s social welfare function is:

$$SW^{C,S} = CS^{C,S} + PS^{C,S} + \tau_b^{C,S} Q_b^{C,S}$$

and its FOC is:

$$\frac{\partial SW^{B,S}}{\partial \tau_b^{C,S}} = \frac{G^B(3 - G^B - G^A)}{3(G^A + G^B)} - \frac{K^B}{4} - \frac{3\beta\tau_b^{C,S}}{4} = 0.$$

Solving for the optimal tariff by country *B* yields

$$\tau_b^{C,S} = \frac{G^B(3 - G^B - G^A)}{3\beta(G^A + G^B)} - \frac{K^B}{3\beta}. \quad \text{`(31b)}$$

We proceed to the second stage of national security at which countries *A* and *B* independently and simultaneously determine their optimal arming allocations. Substituting the optimal tariffs from (31) back into the social welfare functions of *A* and *B*, we have their FOCs:

$$\frac{\partial SW^{A,S}}{\partial G^A} = 0 \text{ and } \frac{\partial SW^{B,S}}{\partial G^B} = 0.$$

Evaluating the derivative of $SW^{A,S}$ with respect to G^A at the point where $G^A = G^{A,PR}$,[39] we have

$$\frac{\partial SW^{A,S}}{\partial G^A}\Big|_{G^A = G^{A,PR}} < 0.$$

The strict concavity of the social welfare function implies that

$$G^{A,S} < G^{A,PR}. \quad (32a)$$

We also have

$$\frac{\partial SW^{B,S}}{\partial G^B}\Big|_{G^B = G^{B,PR}} > 0,$$

which implies that

$$G^{B,S} > G^{B,PR} \quad (32b)$$

Equation (32a) indicates that the FTA-member country allocates less resources to arming relative the scenario where there is protectionism without any form of trade regionalism. Whereas,

[39]Note that we assign some plausible values for K(i.e., $K = 0.2$) in evaluating the derivative.

equation (32b) imply that the FTA-non-member country allocate more resources to arming relative the protectionism regime.

We further evaluate the derivative of $SW^{A,S}$ with respect to G^A at the point where $G^A = G^{A,M}$, we have

$$\frac{\partial SW^{A,S}}{\partial G^A}\Big|_{G^A=G^{A,M}} = 0.$$

which implies that

$$G^{A,S} = G^{A,M}. \tag{33a}$$

Moreover, we have

$$\frac{\partial SW^{B,S}}{\partial G^B}\Big|_{G^B=G^{B,M}} > 0,$$

which implies that

$$G^{B,S} > G^{B,M}. \tag{33b}$$

Equation (33a) indicates that the FTA-member country allocates the same level of arming whether the third party forms a single or a multiple FTA. Relative to the regime with multiple FTAs, equation (33b) imply that the FTA-non-member country allocate more resources to arming. Under symmetry in all dimension, we have the following:

$$CI^S > CI^M. \tag{34}$$

We therefore have:

PROPOSITION 4. *Relative to the institutional setting of multiple FTAs between a third party with each of the adversary countries, a single FTA in the form of an FTA between the third party and only one of the adversaries induces the non-member or excluded country to increase its optimal level of arming. Whereas the member country allocates the same level of arming. The overall allocation of arming is higher under the single FTA regime than under the multiple FTA regime. Thus, the single FTA regime is conflict-aggravating*

The economic intuition in proposition 4 is straightforward. Using the welfare decomposition approach developed in Section 2. The slope of the FTA-non-member country social welfare with respect to the level of arming under multiple FTAs is strictly positive as explained in Appendix C-3. The strict positivity of the derivative is caused by the fact that the export-revenue effect and the resource-appropriation effect which constitute the marginal revenue exceed the output-distortion effects, which represent the marginal cost of arming.

5. Concluding Remarks

In this paper we develop a trade-conflict model to analyze the impacts of third party through preferential trade agreement on interstate conflict. Contrary to the existing literature on trade and conflict, our paper is the first to endogenous the security and trade policies. Our results have policy implication on the formation of regional trade agreement for interstate conflict. We show that an increase in arming by each member of the two-contending countries contains three effect on the domestic welfare. The first is an “export-revenue effect” of arming, which is welfare increasing. The second is “an output-distortion effect” of arming which is welfare-reducing. The third is a “resource-appropriation effect” of arming which is welfare-increasing.

We further analyze and compare equilibrium arming allocations of the contending countries and the conflict intensity under different trade regimes. We find that the formation of an FTA between the third-party state with each of the adversaries leads them to lower their optimal arming allocations despite that they do not trade. Thus, multiple FTAs reduces conflict intensity and has a stronger pacifying effect than the protectionism regime. Relative to the institutional setting of multiple FTAs between a third party with each of the adversary countries, a single FTA in the form of an FTA between the third party and only one of the adversaries induces the non-member or excluded country to increase its optimal level of arming. Whereas the member country allocates the same level of arming as under the scenario of protectionism regime. The overall allocation of arming is higher under the single PTA regime than under the multiple FTA regime. Thus, the single FTA regime is conflict-aggravating. Our finding in this paper has policy implications on the formation of regional trade agreement on interstate conflict

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Appendix A - Appendix of Chapter 1

A-1. Equilibrium prices, consumer surplus, and producer surplus

After substituting X_A from (2a) and Y_B from (2b) into the final good prices in (11), we have:

$$P_X = \frac{G_A(G_A + G_B - Z) + (2\alpha - R_A - t)(G_A + G_B)}{2(G_A + G_B)}, \tag{a.1}$$

$$P_Y = \frac{G_B(G_A + G_B - Z) + (2\alpha - R_B + t)(G_A + G_B)}{2(G_A + G_B)}. \tag{a.2}$$

$$H_X = \frac{G_A(G_A + G_B - Z) + (2\alpha - R_A + t)(G_A + G_B)}{2(G_A + G_B)}, \tag{a.3}$$

$$H_Y = \frac{G_B(G_A + G_B - Z) + (2\alpha - R_B - t)(G_A + G_B)}{2(G_A + G_B)}, \tag{a.4}$$

Substituting these equilibrium prices into the demand equations in (3), we then use equations (4) and (5) to calculate consumer and producer surplus. For country *A*, we have

$$CS_A = \frac{1}{2}\left[\frac{G_A(Z - G_A - G_B) + (R_A + t)(G_A + G_B)}{2(G_A + G_B)}\right]^2 + \frac{1}{2}\left[\frac{G_B(Z - G_B - G_A) + (R_A - t)(G_A + G_B)}{2(G_A + G_B)}\right]^2,$$

$$PS_A = \left(\frac{(2\alpha - R_A - t)(G_A + G_B) - G_A(Z - G_A - G_B)}{2(G_A + G_B)}\right)\left[R_A - G_A + \left(\frac{G_A}{G_A + G_B}\right)Z\right]. \tag{a.5}$$

For country *B*, we have

$$CS_B = \frac{1}{2}\left[\frac{G_B(Z - G_B - G_A) + (R_B + t)(G_A + G_B)}{2(G_A + G_B)}\right]^2 + \frac{1}{2}\left[\frac{G_A(Z - G_A - G_B) + (R_A - t)(G_A + G_B)}{2(G_A + G_B)}\right]^2,$$

$$PS_B = \left(\frac{(2\alpha - R_B + t)(G_A + G_B) - G_B(Z - G_A - G_B)}{2(G_A + G_B)}\right)\left[R_B - G_B + \left(\frac{G_B}{G_A + G_B}\right)Z\right]. \tag{a.6}$$

A-2. Decomposing the effect of country A's arming

Making use of $\partial CS_A / \partial G_A$ in (14) and $\partial PS_A / \partial G_A$ in (15), the effect of country *A*'s arming on its social welfare is calculated as follows:

$$\frac{\partial SW_A}{\partial G_A} = \frac{\partial CS_A}{\partial G_A} + \frac{\partial PS_A}{\partial G_A}$$

$$= \left(D_X \frac{\partial D_X}{\partial G_A} + M_Y \frac{\partial M_Y}{\partial G_A} \right) + \left(P_X \frac{\partial X_A}{\partial G_A} + X_A \frac{\partial P_X}{\partial G_A} \right)$$

$$= D_X \frac{\partial D_X}{\partial G_A} + M_Y \frac{\partial M_Y}{\partial G_A} + P_X \frac{\partial X_A}{\partial G_A} + X_A \left(-\frac{\partial D_X}{\partial G_A} \right)$$

$$= \left[-(X_A - D_X) \frac{\partial C_X}{\partial G_A} \right] + M_Y \left(\frac{\partial M_Y}{\partial G_A} \right) + P_X \frac{\partial X_A}{\partial G_A} \quad \text{(noting that } \frac{\partial M_Y}{\partial G_A} = -\frac{\partial P_Y}{\partial G_A} \text{)}$$

$$= (X_A - D_X) \frac{\partial P_X}{\partial G_A} + \left[M_Y \left(-\frac{\partial P_Y}{\partial G_A} \right) \right] + P_X \frac{\partial X_A}{\partial G_A}$$

The above derivative can further be re-written as

$$\frac{\partial SW_A}{\partial G_A} = E_X \frac{\partial P_X}{\partial G_A} + M_Y \left(-\frac{\partial P_Y}{\partial G_A} \right) + P_X \frac{\partial X_A}{\partial G_A}.$$

Similarly, country *B* determines an arming allocation G_B that solves the following maximization problem: $\underset{\{G_B\}}{\text{Max}}\, SW_B = CS_B + PS_B$, where CS_B and PS_B are consumer and producer surplus as given in Appendix A-1. We decompose the effect of country *B*'s arming into three separate terms:

$$\frac{\partial SW_B}{\partial G_B} = \underbrace{E_Y \frac{\partial P_Y}{\partial G_B}}_{\substack{\text{Export-revenue effect} \\ \text{of arming} \\ (+)}} + \underbrace{M_X \left(-\frac{\partial P_X}{\partial G_B} \right)}_{\substack{\text{Import-expenditure effect} \\ \text{of arming} \\ (-)}} + \underbrace{P_Y \frac{\partial Y_B}{\partial G_B}}_{\substack{\text{Output-distortion effect} \\ \text{of arming} \\ (-)}}$$

where $E_Y \equiv (Y_B - D_Y)$ is the amount of the final good *Y* exported from *B* to *A*.

Alternatively, we can use (14)-(16) to decompose the effect of country *A*'s arming into three separate terms explicitly in terms of G_A and G_B as follows:

$$\frac{\partial SW_A}{\partial G_A} = \frac{\partial CS_A}{\partial G_A} + \frac{\partial PS_A}{\partial G_A}$$

$$= \left(D_X \frac{\partial D_X}{\partial G_A} + M_Y \frac{\partial M_Y}{\partial G_A} \right) + \left(P_X \frac{\partial X_A}{\partial G_A} + X_A \frac{\partial P_X}{\partial G_A} \right)$$

$$= D_X \left(-\frac{(G_A + G_B)^2 - G_B Z}{2(G_A + G_B)^2} \right) + M_Y \left(-\frac{G_B Z}{2(G_A + G_B)^2} \right)$$

$$+ P_X \left(-\frac{(G_A + G_B)^2 - G_B Z}{(G_A + G_B)^2} \right) + X_A \left(\frac{(G_A + G_B)^2 - G_B Z}{2(G_A + G_B)^2} \right)$$

$$= \underbrace{(X_A - D_X)\left[\frac{(G_A + G_B)^2 - G_B Z}{2(G_A + G_B)^2} \right]}_{\substack{\text{Export-revenue effect} \\ \text{of arming} \\ (+)}} \underbrace{- M_Y \frac{G_B Z}{2(G_A + G_B)^2}}_{\substack{\text{Import-expenditure effect} \\ \text{of arming} \\ (-)}} \underbrace{- P_X \left[\frac{(G_A + G_B)^2 - G_B Z}{(G_A + G_B)^2} \right]}_{\substack{\text{Output-distortion effect} \\ \text{of arming} \\ (-)}},$$

where X_A, D_X, M_Y, and P_X are functions of G_A and G_B. That expression implies that country *A* increases its arming up to where marginal benefit equals marginal cost, that is,

$$\underbrace{(X_A - D_X)\left[\frac{(G_A + G_B)^2 - G_B Z}{2(G_A + G_B)^2} \right]}_{\text{A's marginal revenue of arming}} = \underbrace{M_Y \frac{G_B Z}{2(G_A + G_B)^2} + P_X \left[\frac{(G_A + G_B)^2 - G_B Z}{(G_A + G_B)^2} \right]}_{\text{A's maerginal cost of arming}}.$$

As for country *B*, we have the following FOC:

$$\frac{\partial SW_B}{\partial G_B} = \underbrace{(Y_B - D_Y)\left[\frac{(G_A + G_B)^2 - G_A Z}{2(G_A + G_B)^2} \right]}_{(+)} \underbrace{- M_X \frac{G_A Z}{2(G_A + G_B)^2}}_{(-)} \underbrace{- P_Y \left[\frac{(G_A + G_B)^2 - G_A Z}{(G_A + G_B)^2} \right]}_{(-)} = 0.$$

Country *B*'s arming likewise is chosen where marginal benefit equals marginal cost, namely,

$$\underbrace{\left(Y_B - D_Y\right)\left[\frac{\left(G_A+G_B\right)^2 - G_A Z}{2\left(G_A+G_B\right)^2}\right]}_{\text{B's marginal revenue of arming}} = \underbrace{M_X\,\frac{G_A Z}{2\left(G_A+G_B\right)^2} + P_Y\left[\frac{\left(G_A+G_B\right)^2 - G_A Z}{\left(G_A+G_B\right)^2}\right]}_{\text{B's marginal cost of arming}}.$$

A.3 ***Proof of Lemma 1***

For country *A*, $\partial SW_A/\partial G_A < 0$ when $E_X\,(\partial P_X/\partial G_A)$ is less than the sum of $M_Y(-\partial P_Y/\partial G_A)$ and $P_X\,(\partial X_A/\partial G_A)$ in absolute value. That is, $MR_A^{Arms} < MC_A^{Arms}$. Similarly, $\partial SW_B/\partial G_B < 0$ when $MR_B^{Arms} < MC_B^{Arms}$. As a result, we have $G_A = G_B = 0$. Q.E.D.

A.4 ***Comparative statics of the equilibrium arming under symmetry***

Taking the derivative of G^* (18) with respect to Z, *R*, and *t*, respectively, we have the following derivatives:

$$\frac{\partial G^*}{\partial Z} = \frac{6R + Z - 16\alpha + 10t + 5\sqrt{K}}{12\sqrt{K}} > 0,\quad \frac{\partial G^*}{\partial R} = \frac{6R + Z - 8\alpha + 2t + \sqrt{K}}{2\sqrt{K}} > 0,$$

$$\frac{\partial G^*}{\partial t} = \frac{(6R + 5Z - 8\alpha + 2t + \sqrt{K})}{6\sqrt{K}} > 0.$$

A-5. ***Social welfare functions under asymmetry in national endowments***

Substituting $R_A = (R_o + \delta)$ and $R_B = (R_o - \delta)$ into (a.5) and (a.6) in Appendix A-1, we have the following social welfare functions for countries *A* and *B*:

$$\begin{aligned}
&SW_A(G_A, G_B;\delta)\\
&= CS_A(G_A, G_B;\delta) + PS_A(G_A, G_B;\delta)\\
&= \frac{1}{2}\left(\frac{G_A(Z - G_A - G_B) + (R_o + \delta + t)(G_A + G_B)}{2(G_A + G_B)}\right)^2 + \frac{1}{2}\left(\frac{G_B(Z - G_B - G_A) + (R_o - \delta - t)(G_A + G_B)}{2(G_A + G_B)}\right)^2\\
&\quad + \left(\frac{(2\alpha - R_o - \delta - t)(G_A + G_B) - G_A(Z - G_A - G_B)}{2\beta(G_A + G_B)}\right)\left[(R_o + \delta) - G_A + \left(\frac{G_A}{G_A + G_B}\right)Z\right]
\end{aligned}$$

and

$$SW_B(G_A,G_B;\delta)$$
$$=CS_B(G_A,G_B;\delta)+PS_B(G_A,G_B;\delta)$$
$$=\frac{1}{2}\left(\frac{G_B(Z-G_A-G_B)+(R_o-\delta+t)(G_A+G_B)}{2(G_A+G_B)}\right)^2+\frac{1}{2}\left(\frac{G_A(Z-G_A-G_B)+(R_o-t)(G_A+G_B)}{2(G_A+G_B)}\right)^2$$
$$+\left(\frac{(2\alpha-R_o+\delta+t)(G_A+G_B)-G_B(Z-G_A-G_B)}{2\beta(G_A+G_B)}\right)\left[(R_o-\delta)-G_B+\left(\frac{G_B}{G_A+G_B}\right)Z\right].$$

Appendix B - Appendix of Chapter 2

B-1. ***Market equilibrium condition for good a in country A***
Alternatively, we have the following equilibrium condition:

$$(\alpha-\beta P_a^A)+[(\alpha-\beta P_a^B)-(\frac{G^B}{G^A+G^B})3]+(\alpha-\beta P_a^C)=(\frac{G^A}{G^A+G^B})3-G^A-K^A. \qquad \text{(a.1)}$$

The second bracket term on the LHS of equation (a.1) is consumption of good *a* by country *B*, $(\alpha-\beta P_a^B)$, minus the quantity of the good that *B* appropriates from *A*, $[G^B/(G^A+G^B)]3$. This difference gives the amount of good a that country *B* imports from country *A*. The term on the RHS of equation (a.1) is the quantity of good *a* supplied by country *A*, which is given by Z_a^A in (2). It is easy to verify that equation (a.1) is precisely identical to equation (8).

B-2. *Market equilibrium condition for good b in country B*
Alternatively, we have the following equilibrium condition:

$$[(\alpha-\beta P_b^A)-(\frac{G^A}{G^A+G^B})3]+(\alpha-\beta P_b^B)+(\alpha-\beta P_b^C)=(\frac{G^B}{G^A+G^B})3-G^B-K^B. \qquad \text{(a.2)}$$

The first bracket term on the LHS of equation (a.2) is the consumption of good *b* by country A, $(\alpha-\beta P_b^A)$, minus the amount of the good that *A* appropriates from *B*, $[G^A/(G^A+G^B)]3$. This difference then gives the quantity of good b that country *A* imports from country *B*. The term on the RHS of equation (a.2) is the quantity of good *b* supplied by country *B* as given by Z_b^B in (2). It is easy to verify that equation (a.2) is precisely identical to equation (11).

B-3. *Comparative static results for the protectionist regime*
Based on the optimal tariffs under the protectionist regime as shown in equation (22), we have the following derivatives and results:

$$\frac{\partial\tau_b^{A,PR}}{\partial G^A}=-\frac{8G^B}{7\beta(G^A+G^B)^2}<0,\quad \frac{\tau_b^{A,PR}}{\partial G^B}=-\frac{(G^A+G^B)^2-8G^A}{7\beta(G^A+G^B)^2}<0,$$
$$\frac{\partial\tau_a^{B,PR}}{\partial G^A}=-\frac{(G^A+G^B)^2-8G^B}{7\beta(G^A+G^B)^2}<0,\quad \frac{\partial\tau_a^{B,PR}}{\partial G^B}=-\frac{8G^A}{7\beta(G^A+G^B)^2}<0,$$
$$\frac{\partial\tau_a^{C,PR}}{\partial G^A}=-\frac{(G^A+G^B)^2-G^B}{7\beta(G^A+G^B)^2}<0,\quad \frac{\partial\tau_a^{C,PR}}{\partial G^B}=-\frac{G^A}{7\beta(G^A+G^B)^2}<0,$$

$$\frac{\partial \tau_b^{C,PR}}{\partial G^A} = -\frac{G^B}{7\beta(G^A+G^B)^2} < 0, \ \frac{\partial \tau_b^{C,PR}}{\partial G^B} = -\frac{(G^A+G^B)^2 - G^A}{7\beta(G^A+G^B)^2} < 0,$$

$$\tau_c^{A,PR} - \tau_a^{C,PR} = \frac{G^A+K^A}{7\beta} + \frac{G^B}{7\beta(G^A+G^B)} > 0, \ \tau_c^{B,PR} - \tau_b^{C,PR} = \frac{G^B+K^B}{7\beta} + \frac{G^A}{7\beta(G^A+G^B)} > 0.$$

B-4. *Decomposing the welfare effect of arming for a contending country under the protectionist regime*

Under symmetry, we can look at country *A*. The country's welfare function is:

$$SW^A = CS^A + PS^A + TR^A$$
$$= \frac{1}{2\beta}[(\alpha - \beta P_a^A)^2 + (\alpha - \beta P_b^A)^2 + (\alpha - \beta P_c^A)^2] + [P_a^A(Z_a^A) + P_b^A(APP_b^A)] + (\tau_b^A M_b^A + \tau_c^A M_c^A),$$

where $APP_b^A = [G^A/(G^A+G^B)]3$ is the amount of good *b* appropriated by country *A*. Taking the derivative of SW^A with respect to G^A yields

$$\frac{\partial SW^A}{\partial G^A} = [-(\alpha - \beta P_a^A)\frac{\partial P_a^A}{\partial G^A} - (\alpha - \beta P_b^A)\frac{\partial P_b^A}{\partial G^A}] + [\frac{\partial P_a^A}{\partial G^A}Z_a^A + \frac{\partial Z^A}{\partial G^A}P_a^A + \frac{\partial P_b^A}{\partial G^A}(APP_b^A) + \frac{\partial (APP_b^A)}{\partial G^A}P_b^A]$$
$$+(\tau_b^A \frac{\partial M_b^A}{\partial G^A} + \tau_c^A \frac{\partial M_c^A}{\partial G^A} + M_b^A \frac{\partial \tau_b^A}{\partial G^A} + M_c^A \frac{\partial \tau_c^A}{\partial G^A}).$$

Note that changes in country *A*'s arming do not affect M_c^A and τ_c^A. That is $\partial M_c^A / \partial G^A = 0$ and $\partial \tau_c^A / \partial G^A = 0$. Note also that country *A*'s import demand for good *b* is given by its total consumption of good *b* minus the amount of the good appropriated, i.e., $M_b^A = (\alpha - \beta P_b^A) - A_b$. We incorporate the zero derivatives and this definition into the derivative, after re-arranging terms. This exercise yields

$$\frac{\partial SW^A}{\partial G^A} = [Z_a^A - (\alpha - \beta P_a^A)]\frac{\partial P_a^A}{\partial G^A} + [(\tau_b^A \frac{\partial M_b^A}{\partial G^A} + M_b^A \frac{\partial \tau_b^A}{\partial G^A}) - M_b^A \frac{\partial P_b^A}{\partial G^A}] + \frac{\partial Z^A}{\partial G^A}P_a^A + \frac{\partial (APP_b^A)}{\partial G^A}P_b^A. \tag{a.3}$$

This derivative contains four different terms:

(i) The first term $[Z_a^A - (\alpha - \beta P_a^A)]\frac{\partial P_a^A}{\partial G^A}$ reflects a terms-of-trade effect of arming, which is welfare-increasing since $[Z_a^A - (\alpha - \beta P_a^A)] > 0$ and $\frac{\partial P_a^A}{\partial G^A} > 0$.

(ii) The second bracket term $[(\tau_b^A \frac{\partial M_b^A}{\partial G^A} + M_b^A \frac{\partial \tau_b^A}{\partial G^A}) - M_b^A \frac{\partial P_b^A}{\partial G^A}]$ reflects the (net) effect of country *A*'s arming on tariff revenue from the import of good *b* minus import spending. Note that

$$(\tau_b^A \frac{\partial M_b^A}{\partial G^A} + M_b^A \frac{\partial \tau_b^A}{\partial G^A}) = \tau_b^A[-3\frac{G^B}{(G^A+G^B)^2}] + M_b^A[-\frac{8G^B}{7\beta(G^A+G^B)^2}] < 0.$$

We also consider how arming affects the price of good *b* in country *A* which is $\partial P_b^A / \partial G^A$. This derivative is positive since country *A*'s arming causes country *B* to raise its price for good *b*. The second bracket term

$[(\tau_b^A \frac{\partial M_b^A}{\partial G^A} + M_b^A \frac{\partial \tau_b^A}{\partial G^A}) - M_b^A \frac{\partial P_b^A}{\partial G^A}]$ is thus unambiguously negative.

(iii) The third term $\frac{\partial Z_a^A}{\partial G^A} P_a^A$ reflects an output distortion effect since allocating more resource to arming lowers the amount of resource for final good production and consumption, which is welfare-reducing.

(iv) The fourth term $\frac{\partial (APP_b^A)}{\partial G^A} P_b^A$ is a resource appropriation effect, which is welfare-increasing.

It follows from (a.3) that we can decompose the effect of country *A*'s arming on its overall welfare into four different effects as follows:

$$\frac{\partial SW^A}{\partial G^A} = \underbrace{\left[Z_a^A - (\alpha - \beta P_a^A)\right] \frac{\partial P_a^A}{\partial G^A}}_{\substack{\text{Export-revenue effect} \\ \text{of arming} \\ (+)}} + \underbrace{\frac{\partial (APP_b^A)}{\partial G^A} P_b^A}_{\substack{\text{Resource-appropriation effect} \\ \text{of arming} \\ (+)}}$$

$$+ \underbrace{\left[(\tau_b^A \frac{\partial M_b^A}{\partial G^A} + M_b^A \frac{\partial \tau_b^A}{\partial G^A}) - M_b^A \frac{\partial P_b^A}{\partial G^A}\right]}_{\substack{\text{Tariff-revenue \& import-spending effect} \\ \text{of arming} \\ (-)}} + \underbrace{\frac{\partial Z_a^A}{\partial G^A} P_a^A}_{\substack{\text{Output-distortion effect} \\ \text{of arming} \\ (-)}} = 0.$$

B-5. ***Optimal arming is lower under the FTA (A&B) regime than under worldwide free trade***

We evaluate the slopes of the welfare functions SW_i (for $i = A, B$) under the *WFT* regime at the equilibrium arming allocations under the *FTA(A&B)* regime, $\{G^{A,FTA(A\&B)}, G^{B,FTA(A\&B)}\}$. With symmetry that $G^{A,FTA(A\&B)} = G^{B,FTA(A\&B)} = G^{FTA(A\&B)}$, we just look at country *A*. Since $\tau_b^A = \tau_a^B = 0$ under the F*TA(A&B)* regime, we have from the welfare decomposition in (24) that the FOC for country A is:

$$\frac{\partial SW^{FTA(A\&B)}}{\partial G^A} = [Z_a^A - (\alpha - \beta P_a^{A,FTA(A\&B)})] \frac{\partial P_a^{A,FTA(A\&B)}}{\partial G^A} + \frac{\partial APP_b^A}{\partial G^A} P_b^{A,FTA(A\&B)}$$
$$+ \frac{\partial Z_a^A}{\partial G^A} P_a^{A,FTA(A\&B)} = 0,$$

where $APP_b^A = [3G^A/(G^A + G^B)]$ is the amount of good *b* appropriated by country *A*. Next, we derive results for each of the terms in the above FOC. Substituting $\tau_a^{A,FTA(A\&B)} = (3 - G^A - K_A)/8\beta$ from (26a) into $P_a^{A,FTA(A\&B)}$ in (25) yields

$$P_a^{A,FTA(A\&B)} = \frac{3\alpha + G^A + K^A - \beta\tau_a^C - 3}{3\beta} = \frac{8\alpha + 3G^A + 3K^A - 9}{8\beta}, \tag{a.4}$$

which implies that

$$\frac{\partial P_a^{A,FTA(A\&B)}}{\partial G^A} = \frac{3}{8\beta}. \tag{a.5}$$

The appropriation of good *b* by country *A*, $APP_b^A = [3G^A/(G^A + G^B)]$, implies that

$$\frac{\partial APP_b}{\partial G^A} = \frac{3G^B}{(G^A + G^B)^2}. \tag{a.6}$$

Country *A*'s production of good *a*, $Z_a^A = [3G^A / (G^A + G^B)] - G^A - K^A$ implies that

$$\frac{\partial Z_a^A}{\partial G^A} = \frac{3G^B}{(G^A + G^B)^2} - 1. \tag{a.7}$$

Substituting $\tau_b^C = (3 - G^B - K^B)/(8\beta)$ from (26c) into $P_b^{A,FTA(A\&B)}$ in (25) yields

$$P_b^{A,FTA(A\&B)} = \frac{3\alpha + G^B + K^B - \beta\tau_b^C - 3}{3\beta} = \frac{8\alpha + 3G^B + 3K^B - 9}{8\beta}. \tag{a.8}$$

The substitution of the results from (a.4)-(a.8) back into country A's first-order condition implies that

$$\frac{\partial SW^{FTA(A\&B)}}{\partial G^A} = \underbrace{\frac{3}{8\beta}\left[(\frac{3G^A}{G^A + G^B} - G^A - K^A) - [\alpha - \beta(\frac{8\alpha + 3G^A + 3K^A - 9}{8\beta})] \right]}_{\substack{\text{Export-revenue effect} \\ \text{of arming} \\ (+)}}$$

$$+ \underbrace{\frac{3G^B}{(G^A + G^B)^2}(\frac{8\alpha + 3G^B + 3K^B - 9}{8\beta})}_{\substack{\text{Resource-appropriation effect} \\ \text{of arming} \\ (+)}} + \underbrace{[\frac{3G^B}{(G^A + G^B)^2} - 1](\frac{8\alpha + 3G^A + 3K^A - 9}{8\beta})}_{\substack{\text{Output-distortion effect} \\ \text{of arming} \\ (-)}} = 0 \tag{a.9}$$

where $G^A = G^B = G^{FTA(A\&B)}$.

Under the *WFT* regime, the slope of country *A*'s welfare function with respect to its arming is:

$$\frac{\partial SW^{WFT}}{\partial G^A} = \frac{\partial P_a^{A,WFT}}{\partial G^A}[Z_a^A - (\alpha - \beta P_a^{A,WFT})] + \frac{\partial APP_b}{\partial G^A}P_b^{A,WFT} + \frac{\partial Z_a^A}{\partial G^A}P_a^{A,WFT}, \text{ where}$$

$$P_a^{A,WFT} = \frac{3\alpha + G^A + K^A - 3}{3\beta}, \quad \frac{\partial P_a^{A,WFT}}{\partial G^A} = \frac{1}{3\beta}, \quad P_b^{A,WFT} = \frac{3\alpha + G^B + K^B - 3}{3\beta}, \quad \frac{\partial P_b^{A,WFT}}{\partial G^A} = 0,$$

$$APP_b = \frac{3G^A}{G^A + G^B}, \quad \frac{\partial APP_b}{\partial G^A} = \frac{3G^B}{(G^A + G^B)^2}, \quad Z_a^A = \frac{3G^A}{G^A + G^B} - G^A - K^A, \quad \frac{\partial Z_a^A}{\partial G^A} = \frac{3G^B}{(G^A + G^B)^2} - 1.$$

After substituting, we have

$$\frac{\partial SW^{WFT}}{\partial G^A} = \underbrace{\frac{1}{3\beta}\left[(\frac{3G^A}{G^A + G^B} - G^A - K^A) - [\alpha - \beta(\frac{3\alpha + G^A + K^A - 3}{3\beta})] \right]}_{\substack{\text{Export-revenue effect} \\ \text{of arming} \\ (+)}}$$

$$+ \underbrace{\frac{3G^B}{(G^A + G^B)^2}(\frac{3\alpha + G^B + K^B - 3}{3\beta})}_{\substack{\text{Resource-appropriation effect} \\ \text{of arming} \\ (+)}} + \underbrace{[\frac{3G^B}{(G^A + G^B)^2} - 1](\frac{3\alpha + G^A + K^A - 3}{3\beta})}_{\substack{\text{Output-distortion effect} \\ \text{of arming} \\ (-)}} \tag{a.10}$$

where $G^A = G^B = G^{WFT}$. We evaluate $\partial SW^{WFT} / \partial G^A$ in (a.10) at the *FTA(A&B)* equilibrium arming allocations where $G^A = G^B = G^{FTA(A\&B)}$, taking into account the FOC as shown in (a.9). We have

(i) Comparing *the export-revenue effect*

$$\frac{1}{3\beta}\left[(\frac{3G^A}{G^A+G^B}-G^A-K^A)-[\alpha-\beta(\frac{3\alpha+G^A+K^A-3}{3\beta})]\right]$$
$$-\frac{3}{8\beta}\left[(\frac{3G^A}{G^A+G^B}-G^A-K^A)-[\alpha-\beta(\frac{8\alpha+3G^A+3K^A-9}{8\beta})]\right]$$
$$=\frac{[7(G^A)^2+7G^AG^B-21G^A+51G^B+7(G^A+7G^B)K^A]}{576\beta(G^A+G^B)}>0.$$

(ii) Comparing *the resource-appropriation effect*

$$\frac{3G^B}{(G^A+G^B)^2}(\frac{3\alpha+G^B+K^B-3}{3\beta})-\frac{3G^B}{(G^A+G^B)^2}(\frac{8\alpha+3G^B+3K^B-9}{8\beta})$$
$$=\frac{3G^B}{(G^A+G^B)^2}(\frac{3-G^B-K^B}{24\beta})>0.$$

(iii) Comparing *the output-distortion effect*

$$[\frac{3G^B}{(G^A+G^B)^2}-1](\frac{3\alpha+G^A+K^A-3}{3\beta})-[\frac{3G^B}{(G^A+G^B)^2}-1](\frac{8\alpha+3G^A+3K^A-9}{8\beta})$$
$$=-\frac{[(G^A)^2+(G^B)^2+2G^AG^B-3G^B](3-G^A-K^A)}{24\beta(G^A+G^B)^2}<0$$

Putting together the three effects, we have under symmetry ($G^A = G^B = G^{FTA(A\&B)}$) that

$$\left.\frac{\partial SW^{WFT}}{\partial G^A}\right|_{G^A=G^B=G^{FTA(A\&B)}}=\frac{[31(G^{FTA(A\&B)})^2-93G^{FTA(A\&B)}+31G^{FTA(A\&B)}K-36K+108]}{576\beta G^{FTA(A\&B)}}>0.$$

The strict concavity of the social welfare function implies the optimal arming under the *FTA(A&B)* regime is <u>lower</u> than that the worldwide free trade regime. That is, $G^{FTA(A\&B)} < G^{WFT}$. Starting from the *FTA(A&B)* regime, a move to the *WFT* regime will encourage each contending country to increase arming since the export-revenue effect plus the resource-appropriation effect (i.e., marginal revenue of arming) exceed the output-distortion effect (i.e., the marginal cost of arming).

B-6. *Optimal arming allocations of two adversary countries that from a CU*

For the scenario where there is a CU between countries *A* and *B*, denoted as the *CU(A&B)* regime, we have $\tau_b^{A,CU(A\&B)} = \tau_a^{B,CU(A\&B)} = 0$. At the trade policy stage, *A* and *B* jointly determine a common external optimal tariff, denoted as $\tau_c^{m,CU(A\&B)}$, on their imports of good *c*. Simultaneously, country *C* sets an optimal tariff structure, $\{\tau_a^C, \tau_b^C\}$, on its imports of good *a* and *b*. Making use of the price equations in (9), (12) and (15) and considering that $\tau_b^{A,CU(A\&B)} = \tau_a^{B,CU(A\&B)} = 0$, the equilibrium prices under the *CU(A&B)* regime are:

$$P_a^{A,CU(A\&B)} = P_a^{B,CU(A\&B)} = \frac{3\alpha - \beta\tau_a^C - (3 - G^A - K^A)}{3\beta},$$
$$P_b^{A,CU(A\&B)} = P_b^{B,CU(A\&B)} = \frac{3\alpha - \beta\tau_b^C - (3 - G^B - K^B)}{3\beta},$$
$$P_a^{C,CU(A\&B)} = \frac{3\alpha + 2\beta\tau_a^C - (3 - G^A - K^A)}{3\beta},\ P_b^{C,CU(A\&B)} = \frac{3\alpha + 2\beta\tau_b^C - (3 - G^B - K^B)}{3\beta},$$
$$P_c^{A,CU(A\&B)} = \frac{3\alpha + \beta\tau_c^{m,CU(A\&B)} - 3}{3\beta},\ P_c^{B,CU(A\&B)} = \frac{3\alpha + \beta\tau_c^{m,CU(A\&B)} - 3}{3\beta},$$
$$P_c^{C,CU(A\&B)} = \frac{3\alpha - 2\beta\tau_c^{m,CU(A\&B)} - 3}{3\beta}.$$

In determining their common external tariff on the import of good *c*, countries *A* and *B* jointly maximize the aggregate social welfare:

$$SW^{A\&B,CU(A\&B)} = SW^{A,CU(A\&B)} + SW^{B,CU(A\&B)},$$

here

$$SW^{A,CU(A\&B)} = CS^{A,CU(A\&B)} + PS^{A,CU(A\&B)} + \tau_c^{m,CU(A\&B)} M_b^{A,CU(A\&B)}, \qquad \text{(a.11)}$$
$$SW^{B,CU(A\&B)} = CS^{B,CU(A\&B)} + PS^{B,CU(A\&B)} + \tau_c^{m,CU(A\&B)} M_b^{B,CU(A\&B)}. \qquad \text{(a.12)}$$

The FOC for the joint welfare maximization problem implies that the common external tariff on good *c* is:

$$\tau_c^{m,CU(A\&B)} = \frac{6}{5\beta}. \qquad \text{(a.13)}$$

Similarly, country *C* determines an optimal tariff structure, $\{\tau_a^C, \tau_b^C\}$, to maximize its domestic welfare:

$$SW^{C,CU(A\&B)} = CS^{C,CU(A\&B)} + PS^{C,CU(A\&B)} + \tau_a^{C,CU(A\&B)} M_a^{C,CU(A\&B)} + \tau_b^{C,CU(A\&B)} M_b^{C,CU(A\&B)}$$

The FOCs for country *C* imply that the optimal tariffs are:

$$\tau_a^{C,CU(A\&B)} = \frac{(3 - G^A - K^A)}{8\beta} \text{ and } \tau_b^{C,CU(A\&B)} = \frac{(3 - G^B - K^B)}{8\beta} \qquad \text{(a.14)}$$

We proceed to the security stage at which *A* and *B* independently and simultaneously determine their optimal arming decisions. Substituting the optimal tariffs from (a.13) and (a.14) into the welfare functions in (a.11) and (a.12), we have the FOCs for *A* and *B*:

$$\frac{\partial SW^{A,CU(A\&B)}}{\partial G^A} = 0 \text{ and } \frac{\partial SW^{B,CU(A\&B)}}{\partial G^B} = 0.$$

Denote the Nash equilibrium levels of arming as $\{G^{A,CU(A\&B)}, G^{B,CU(A\&B)}\}$. Under symmetry in all dimensions, have $G^{A,CU(A\&B)} = G^{B,CU(A\&B)} = G^{CU(A\&B)}$. Calculating the optimal arming yields

$$G^{CU(A\&B)} = \frac{\sqrt{4096\alpha^2 - 3159 + K(1521K + 4992\alpha - 3510)}}{78} - \frac{32\alpha}{39} - \frac{K}{2} + \frac{3}{2}.$$

It is easy to verify that $G^{FTA(A\&B)} = G^{CU(A\&B)}$.

Evaluating the slope $\partial SW^{A,CU(A\&B)} / \partial G^A$ at the point where $G^A = G^{A,PR}$, we have

$$\left.\frac{\partial SW^{A,CU(A\&B)}}{\partial G^A}\right|_{G^A = G^{A,PR}} < 0,$$

which implies that

$$G^{A,CU(A\&B)} = G^{B,CU(A\&B)} = G^{CU(A\&B)} < G^{A,PR}.$$

B-7. ***One contending country and a neutral third country form a CU***

For the scenario where there is a CU between countries *A* and *C*, denoted as the *CU(A&C)* regime, we have $\tau_c^{A,CU(A\&C)} = \tau_a^{C,CU(A\&C)} = 0.$ At the trade policy stage, countries *A* and *C* jointly determine a common external tariff, demoted as $\tau_b^{m,CU(A\&C)}$, on their imports of good *b*. Simultaneously, country *B* sets an optimal tariff structure, $\{\tau_a^B, \tau_c^B\}$, on its imports of goods *a* and *c*. Making use of the price equations in (9), (12) and (15) and considering that $\tau_c^{A,CU(A\&C)} = \tau_a^{C,CU(A\&C)} = 0,$ the equilibrium prices under the *CU(A&C)* regime are:

$$P_a^{A,CU(A\&C)} = P_a^{C,CU(A\&C)} = \frac{3\alpha - \beta\tau_a^B - (3 - G^A - K^A)}{3\beta},$$

$$P_c^{A,CU(A\&C)} = P_c^{C,CU(A\&C)} = \frac{3\alpha - \beta\tau_c^{b,CU(A\&C)} - 3}{3\beta},$$

$$P_a^{B,CU(A\&C)} = \frac{3\alpha + 2\beta\tau_a^B - (3 - G^A - K^A)}{3\beta},\quad P_b^{A,CU(A\&C)} = \frac{3\alpha + \beta\tau_b^{m,CU(A\&C)} - (3 - G^B - K^B)}{3\beta},$$

$$P_b^{B,CU(A\&C)} = \frac{3\alpha - 2\beta\tau_b^{m,CU(A\&C)} - (3 - G^B - K^B)}{3\beta},$$

$$P_b^{C,CU(A\&C)} = \frac{3\alpha + \beta\tau_b^{m,CU(A\&C)} - (3 - G^B - K^B)}{3\beta},\quad P_c^{B,CU(A\&C)} = \frac{3\alpha + 2\beta\tau_c^B - 3}{3\beta}.$$

In determining their tariff on the import of good *b*, countries *A* and *C* set a common external tariff that maximizes their aggregate welfare: $SW^{AC,CU(A\&C)} = SW^{A,CU(A\&C)} + SW^{C,CU(A\&C)}$ where

$$SW^{A,CU(A\&C)} = CS^{A,CU(A\&C)} + PS^{A,CU(A\&C)} + \tau_b^{m,CU(A\&C)} M_b^{A,CU(A\&C)},$$

$$SW^{C,CU(A\&C)} = CS^{C,CU(A\&C)} + PS^{C,CU(A\&C)} + \tau_b^{m,CU(A\&C)} M_b^{C,CU(A\&C)}.$$

The FOC for the joint welfare maximization problem is: $\partial SW^{AC,CU(A\&C)} \big/ \partial\tau^{m,CU(A\&C)} = 0.$

Solving for the optimal common external tariff yields

$$\tau_b^{m,CU(A\&C)} = \frac{2G^B(3 - G^A - G^B) - 3G^A - 2K^B(G^A + G^B)}{5\beta(G^A + G^B)}. \tag{a.15}$$

Similarly, country *B* determines an optimal tariff structure, $\{\tau_a^B, \tau_c^B\}$, to maximize its domestic welfare:

$$SW^{B,CU(A\&C)} = CS^{B,CU(A\&C)} + PS^{B,CU(A\&C)} + \tau_a^{B,CU(A\&C)} M_a^{B,CU(A\&C)} + \tau_c^{B,CU(A\&C)} M_c^{B,CU(A\&C)}$$

Making use of the FOCs for country *B*, we solve for its optimal tariffs:

$$\tau_a^{B,CU(A\&C)} = \frac{G^A(3 - G^A - G^B) - 6G^B - K^A(G^A + G^B)}{8\beta(G^A + G^B)} \text{ and } \tau_c^{B,CU(A\&C)} = \frac{3}{8\beta}. \tag{a.16}$$

We proceed to the security stage at which countries *A* and *B* independently and simultaneously make their arming decisions. Country *A* determines an optimal arming, denoted as $G^{A,CU(A\&C)}$, that maximizes its social welfare:

$$SW^{A,CU(A\&C)} = CS^{A,CU(A\&C)} + PS^{A,CU(A\&C)} + \tau_b^{m,CU(A\&C)} M_b^{A,CU(A\&C)}.$$

Evaluating the slope $\partial SW^{A,CU(A\&C)} \big/ \partial G^A$ at the point where $G^A = G^{A,PR}$, we have

$$\frac{\partial SW^{A,CU(A\&C)}}{\partial G^A}\Big|_{G^A=G^{A,PR}} > 0,$$

The strict concavity of the social welfare function implies that

$$G^{A,CU(A\&C)} > G^{A,PR}.$$

As for country *B*, it determines an optimal arming, denoted as $G^{B,CU(A\&C)}$, that maximizes its welfare:

$$SW^{B,CU(A\&C)} = CS^{B,CU(A\&C)} + PS^{B,CU(A\&C)} + \tau_c^B M_c^{B,CU(A\&C)} + \tau_a^B M_a^{B,CU(A\&C)}.$$

Evaluating the slope $\partial SW^{B,CU(A\&C)} / \partial G^A$ at the point where $G^B = G^{B,PR}$, we have

$$\frac{\partial SW^{B,CU(A\&C)}}{\partial G^B}\Big|_{G^B=G^{B,PR}} < 0,$$

which implies that $G^{B,CU(A\&C)} < G^{B,PR}$.

Appendix C - Appendix of Chapter 3

C-1. *Decomposing the welfare effect of arming for a contending country*

Under symmetry, we look at country' *A* welfare effect of arming and show that it can be decomposed into three different effects. Country *A*'s social welfare under the protectionist regime is: $SW^{A,PR} = CS^{A,PR} + PS^{A,PR} + TR^{A,PR}$, which implies that

$$SW^{A,PR} = \frac{1}{2\beta}[(Q_a^{A,PR})^2 + (APP_b)^2 + (Q_c^{A,PR})^2] + P_a^{A,PR} X_a^{A,PR} + P_b^{A,PR} APP_b + \tau_c^{A,PR} Q_c^{A,PR},$$

noting that APP_b is the amount of final good *b* appropriated by country *A* for consumption. Taking the derivative of $SW^{A,PR}$ with respect to G^A, we have

$$\frac{\partial SW^{A,PR}}{\partial G^A} = \frac{1}{\beta}\left(\frac{\partial Q_a^{A,PR}}{\partial G^A} Q_a^{A,PR} + \frac{\partial APP_b}{\partial G^A} APP_b + \frac{\partial Q_c^{A,PR}}{\partial G^A} Q_c^{A,PR}\right) + \frac{\partial P_a^{A,PR}}{\partial G^A} X_a^{A,PR} + \frac{\partial X_a^{A,PR}}{\partial G^A} P_a^{A,PR}$$
$$+ P_b^{A,PR} \frac{\partial APP_B}{\partial G^A} + APP_b \frac{\partial P_b^{A,PR}}{\partial G^A} + \tau_c^{A,PR} \frac{\partial Q_c^{A,PR}}{\partial G^A} + \frac{\partial \tau_c^{A,PR}}{\partial G^A} Q_c^{A,PR}.$$

For several terms on the right-hand side of the above equation, we note the following conditions:

(i) $\dfrac{\partial Q_a^{A,PR}}{\partial G^A} = -\beta \dfrac{\partial P_a^{A,PR}}{\partial G^A}$;

(ii) $\dfrac{\partial \tau_c^{A,PR}}{\partial G^A} Q_c^{A,PR} = \tau_c^{A,PR} \dfrac{\partial Q_c^{A,PR}}{\partial G^A} + \dfrac{\partial \tau_c^{A,PR}}{\partial G^A} Q_c^{A,PR} = 0$ since both $Q_c^{A,PR}$ and $\tau_c^{A,PR}$ are independent of G^A;

(iii) $\dfrac{\partial P_b^{A,PR}}{\partial G^A} = -\dfrac{1}{\beta}\dfrac{\partial APP_B}{\partial G^A}$ since $P_b^{A,PR} = \dfrac{1}{\beta}[\alpha - 3\dfrac{G^A}{G^A + G^B}]$ and $APP_b = \dfrac{3G^A}{G^A + G^B}$.

Taking into account of (i) - (iii), the derivative of $SW^{A,PR}$ with respect to G^A becomes:

$$\frac{\partial SW^{A,PR}}{\partial G^A} = \frac{\partial P_a^{A,PR}}{\partial G^A}(X_a^{A,PR} - Q_a^{A,PR}) + \frac{\partial X_a^{A,PR}}{\partial G^A} P_a^{A,PR} + \frac{\partial APP_B}{\partial G^A} P_b^{A,PR}.$$

The impact that an adversary country's arming on its overall welfare thus contains three different effects:

(1) the first term, $\frac{\partial P_a^{A,PR}}{\partial G^A}(X_a^A - Q_a^{A,PR}),$ represents the export-revenue effect of arming,

(2) the second term, $\frac{\partial X_a^{A,PR}}{\partial G^A} P_a^{A,PR},$ constitutes the output-distortion effect of arming, and

(3) the third term, $\frac{\partial APP_B}{\partial G^A} P_b^{A,PR},$ reflects the resource-appropriation effect of arming.

C-*2. Optimal arming is lower under multiple FTAs than under the protectionism regime*

We will evaluate the slope of the $SW^{A,M}$ under Multiple FTAs at the equilibrium arming allocations under the protectionism regime.

$$\frac{\partial SW^{A,PR}}{\partial G^A} = \frac{\partial P_a^{A,PR}}{\partial G^A}(X_a^{A,PR} - Q_a^{A,PR}) + \frac{\partial X_a^{A,PR}}{\partial G^A} P_a^{A,PR} + \frac{\partial APP_b}{\partial G^A} P_b^{A,PR}$$

(i) Comparing the export revenue effect

Evaluating the following expression:

$$\left[\frac{\partial P_a^{A,M}}{\partial G^A}(X_a^{A,M} - Q_a^{A,M}) - \frac{\partial P_a^{A,PR}}{\partial G^A}(X_a^{A,PR} - Q_a^{A,PR})\right] \tag{a.1}$$

at $G^{A,PR} = G^{B,PR} = G,$

where

$$P_a^{A,PR} = \frac{G^A(2G^A - 6 + 3\alpha) + 3\alpha G^B + 2G^A G^B + 2K^A(G^A + G^B)}{3\beta(G^A + G^B)}, \tag{a.2}$$

$$P_a^{A,MFTA} = \frac{2\alpha - \left(\frac{3G^A}{G^A + G^B}\right) - G^A - K^A}{2\beta}, \tag{a.3}$$

$$\frac{\partial P_a^{A,MFTA}}{\partial G^A} = \frac{(G^A)^2 + G^B(2G^A + G^B - 3)}{2\beta(G^A + G^B)^2},$$

$$\frac{\partial P_a^{A,PR}}{\partial G^A} = \frac{2[G^A(G^A + 2G^B) + G^B(G^B - 3)]}{3\beta(G^A + G^B)^2}.$$

After substituting (a.2) and (a.3) back into (a.1), we have under symmetry the following result:

$$\frac{\partial P_a^{A,M}}{\partial G^A}(X_a^{A,M} - Q_a^{A,M}) - \frac{\partial P_a^{A,PR}}{\partial G^A}(X_a^{A,PR} - Q_a^{A,PR}) = -\frac{(4G-3)(2G+2K-3)}{288G\beta} > 0$$

(ii) Comparing the distortion-effect of arming:

Given the following expression:

$$\frac{\partial X_a^A}{\partial G^A}(P_a^{A,M} - P_a^{A,PR}) \tag{a.4}$$

we evaluate it at the point where $G^{A,PR} = G^{B,PR} = G$
where

$$\frac{\partial X_a^A}{\partial G^A} = \frac{\partial\left(\left(\frac{3G^A}{G^A+G^B}\right) - G^A - K^A\right)}{\partial G^A} = -\frac{G^A\left(G^A+2G^B\right)+G^B\left(G^B-3\right)}{\left(G^A+G^B\right)^2}$$

Substituting the results from (a.2) and (a.3) into (a.4), we have under symmetry the following:

$$\frac{\partial X_a^A}{\partial G^A}(P_a^{A,M} - P_a^{A,PR}) = \frac{(4G-3)(2G+2K-3)}{48G\beta} < 0$$

(iii) Comparing the appropriation effect of arming:

We evaluate $\dfrac{\partial APP_B}{\partial G^A}(P_b^{A,M} - P_b^{A,PR})$ (a.5)

at $G^{A,PR} = G^{B,PR} = G$

Since $P_b^{A,M} = P_b^{A,PR} = \dfrac{1}{\beta}\left(\alpha - \dfrac{3G^A}{G^A+G^B}\right)$, then under symmetry

$$\frac{\partial APP_B}{\partial G^A}(P_b^{A,M} - P_b^{A,PR}) = 0$$

The summation of the three effects leads to

$$-\frac{(4G-3)(2G+2K-3)}{288G\beta} + \frac{(4G-3)(2G+2K-3)}{48G\beta} = \frac{5(4G-3)(2G+2K-3)}{288G\beta} < 0$$

The negative sign indicates that $G^{A,M} < G^{A,PR}$. Thus, a move from the protectionism regime to the multiple FTAs regime induces both of the adversary countries to reduce their optimal arming allocations since the export-revenue effects plus the resource-appropriation effect, which is the marginal revenue of arming, exceeds the output distortion effect, which is the marginal cost of arming.

C-3. Conflict intensity under single FTAs exceeds that under multiple FTAs.

We will evaluate the slope of the $SW^{B,S}$ under a single FTA at the equilibrium arming allocations under multiple FTAs.

(i) Comparing the export revenue effect

We evaluate this expression $\left[\dfrac{\partial P_b^{B,S}}{\partial G^B}(X_b^{B,S} - Q_b^{B,S}) - \dfrac{\partial P_b^{B,M}}{\partial G^B}(X_b^{B,M} - Q_b^{B,M})\right]$

at the point where $G^{B,M} = G^{A,M} = G$

$$P_b^{B,M} = \frac{1}{2\beta}[2\alpha - (\frac{3G^B}{G^A+G^B} - G^B - K^B)]$$

$$\frac{\partial P_b^{B,M}}{\partial G^B} = \frac{G^A(G^A-3)+G_B(2G^A+G^B)}{2\beta(G^A+G^B)^2}$$

$$\tau_b^{C,S} = -\left(\frac{G^B\left(-3+G^B+G^A\right)+G^AK_B+G^BK_B}{3\beta\left(G^A+G^B\right)} \right)$$

$$P_b^{B,S} = \frac{2\alpha-(\frac{3G^B}{G^A+G^B}-G^B-K^B)-\beta\tau_b^{C,S}}{2\beta}$$

$$= \frac{G^B(2G^B-6)+3\alpha G^A+3\alpha G^B+2G^AG^B+2G^AK^B+2G^BK^B}{3\beta(G^A+G^B)}$$

$$\frac{\partial P_b^{B,S}}{\partial G^B} = \frac{2\left(G^A\left(G^A-3\right)+G^B\left(2G^A+G^B\right)\right)}{3\beta\left(G^A+G^B\right)^2}$$

After substituting the above equations into (a.6), we have under symmetry the following result:

$$\left[\frac{\partial P_b^{B,S}}{\partial G^B}(X_b^{B,S}-Q_b^{B,S})-\frac{\partial P_b^{B,M}}{\partial G^B}(X_b^{B,M}-Q_b^{B,M})\right]=\frac{(4G-3)(2G+2K-3)}{288G\beta}$$

(ii) Comparing the output-distortion effect of arming:

We evaluate the following expression:

$$\frac{\partial X_b^B}{\partial G^B}(P_b^{B,S}-P_b^{B,M}) \qquad \text{(a.7)}$$

at the point where $G^{A,M}=G^{B,M}=G,$

noting that

$$\frac{\partial X_b^B}{\partial G^B}=\frac{\partial\left(\frac{3G^B}{G^A+G^B}-G^B-K^B\right)}{\partial G^B}=-\frac{G^B\left(G^B+2G^A\right)+G^A\left(G^A-3\right)}{\left(G^A+G^B\right)^2}.$$

Substituting the above equation (a.4), we have under symmetry the following:

$$\frac{\partial X_b^B}{\partial G^B}(P_b^{B,S}-P_b^{B,M})=-\frac{(4G-3)(2G+2K-3)}{48G\beta}$$

(iii) Comparing the appropriation-effect of arming:

We evaluate $\frac{\partial APP_a}{\partial G^B}\left(P_a^{B,S}-P_a^{B,M}\right)$ (a.5) at $G^{A,PR}=G^{B,PR}=G$

Since $P_a^{B,M}=P_a^{B,S}=\frac{1}{\beta}\left(\alpha-\frac{3G^B}{G^A+G^B}\right)$, then under symmetry

$$\frac{\partial APP_a}{\partial G^B}\left(P_a^{B,S}-P_a^{B,M}\right)=0$$

The summation of the three effects leads to

$$\frac{1}{288G\beta}(4G-3)(2G+2K-3)-\frac{(4G-3)(2G+2K-3)}{48G\beta}=-\frac{5}{288G\beta}(4G-3)(2G+2K-3)>0$$

The positive sign indicates that

$$G^{B,S} > G^{B,M} .$$

A move from multiple FTAs to a single FTA regime induce the non-member country to increase its optimal arming since the export-revenue effects plus the resource-appropriation effect, which is the marginal revenue of arming is exceeds the output distortion effect, which is the marginal cost of arming.