Does Trade Integration Contribute to Peace?*

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Abstract

We investigate the effect of trade integration on interstate military conflict. Our empirical analysis, based on a large panel data set of 243,225 country-pair observations from 1950 to 2000, confirms that an increase in bilateral trade interdependence significantly promotes peace. It also suggests that the peace-promotion effect of bilateral trade integration is significantly higher for contiguous countries that are likely to experience more conflict. More importantly, we find that not only bilateral trade but global trade openness also significantly promotes peace. It shows, however, that an increase in global trade openness reduces the probability of interstate conflict more for countries far apart from each other than it does for countries sharing borders. The results also show that military conflict between countries significantly reduces not only bilateral trade interdependence but also global trade integration. The main finding of the peace-promotion effect of bilateral and global trade integration holds robust when controlling for the natural and geopolitical characteristics of dyads of states that may influence the probability of military conflict and for the simultaneous determination of trade and peace.

Keywords: Trade, Globalization, Military conflict, Peace, War
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1. Introduction

"The great extent and rapid increase of international trade, in being the principal guarantee of the peace of the world, is the great permanent security for the uninterrupted progress of the ideas, the institutions, and the character of the human race." (John Stuart Mill, *Principles of Political Economy,* London: Longmans, 1909, p.582)

Globalization has been one of the most salient features of the world economy over the last century. Emerging markets and developing countries continue to integrate into the global trading system. World trade has increased rapidly, particularly since World War II—from 17.8% of world GDP in 1960 to 47.4% in 2005.

There has been a long tradition among social scientists to try to understand the economic, political, and social consequences of globalization. It has always been a hotly-debated topic—not merely within academia but among the general public as well—whether globalization significantly affects economic growth, income inequality, national identity, and so on.

This paper focuses on the effect of trade integration on international relations, specifically military conflict between individual states (interstate conflict). Recent literature shows that military conflict can be extremely disruptive to economic activity and impede long-term economic performance (Davis and Weinstein, 2002, Blomberg, Hess and Orphanides, 2004, and Barro, 2006). In particular, they empirically study the effect military conflict has on international trade. They find that conflict between countries significantly reduces international trade and thus seriously damages national and global economic welfare (Glick and Taylor, 2005, and Blomberg and Hess, 2006). However, the opposite relationship between international trade and the probability of interstate military conflict—whether international trade has any significant impact on conflict—is still controversial.

There is ongoing debate among scholars whether the increase of bilateral economic interdependence reduces interstate conflict. The "liberal peace" view in political science—traced back to Montesquieu, Kant, Angell, and Schumpeter—emphasizes that mutual economic interdependence can be a conduit of peace. It suggests that a higher degree of bilateral economic interdependence limits the incentive to use military force in interstate relations. For instance, a more trade-dependent state is less likely to fight a partner because of the larger opportunity cost

associated with the loss of trade. Business elites—who gain most from an increased economic interdependence—will also lobby the state to restrict the use of military force against an important trading partner.

While the "liberal peace" view is convincing, there are numerous counter-arguments. For instance, the dependency theorists (Wallerstein, 1974) and neo-Marxists (Emmanuel, 1972), argue that asymmetric economic interdependence could lead to negative consequences in a country—such as exploited concession and threatened national autonomy—thereby creating interstate tensions and conflicts (Dos Santos, 1970 and Keohane and Nye, 1973). Many conflicts in the mercantilist era evolved out of trade disputes.[1]

Empirical studies have also investigated whether bilateral trade interdependence increases or reduces the likelihood of military conflict between trading partners. Similar to theoretical literature, the findings of these studies are ambiguous. Earlier studies, such as Polachek (1980) and Polacheck, Robst, and Chang (1999), show that there is negative relationship between bilateral trade volume and the frequency of interstate military conflict. However, Barbieri (1996, 2002) investigates the relationship between various measures of bilateral trade links and military conflict. She finds that a measure of bilateral trade interdependence has a significantly positive impact on military conflict. In reverse, subsequent research—including Oneal and Russett (1999) and Gartzke and Li (2003)—show that with the use of a different measure of bilateral trade interdependence, the interdependence appears to reduce military conflict.

In contrast to the numerous studies on the impact of bilateral trade interdependence on military conflict, there are only a few studies examining the role of global trade integration.[2] If global trade integration increases trade interdependence uniformly with all bilateral trade partners, the distinction between bilateral and global trade integration is not critical. However, deeper integration into global markets can take place unevenly, lowering trade interdependence with some trading partners. The overall impact of trade integration on interstate conflict is likely to depend not only on the change in bilateral trade interdependence but also on global trade integration.

[1] See Ronald Findlay and Kevin O'Rourke, *Power and Plenty: Trade, War, and the World Economy in the Second Millennium*, Princeton University press, 2007

[2] The phrase "global trade integration" implies "trade openness," which is often measured by the ratio of total trade to GDP at the aggregate national level.

An increase in global trade openness is expected to reduce the probability of military conflict as it leads to an increase in the extent of bilateral trade interdependence. However, when the level of bilateral trade interdependence is controlled, the effect of increased global trade openness on the probability of bilateral conflict is not clear. Barbieri and Peters (2003) find "trade openness" has a significantly negative impact on the probability of military conflict. In contrast, a recent study by Martin, Mayer and Thoenig (2008)—henceforth, MMT—shows that "multilateral trade openness," that is, global trade openness, increases the probability of inter-state military conflicts.

In general, as long as bilateral conflicts increase trade costs not only in bilateral trade but in multilateral trade, dyads of states—or specific pairs of states—that are more dependent on the world economy are more inclined to avoid a war. Open states can be more peaceful because they become more susceptible to political freedom and democracy, and better practice international law and apply good governance. Trade openness can also lead to an "expansion of bureaucratic structure," which is concerned about economic interests in addition to security interests—and thus less likely to resort to military actions (Domke, 1988). However, MMT argue that countries more open to global trade have a higher probability of dyadic conflict because an increase in multilateral trade openness reduces relative bilateral dependence to any given country and thus lowers the opportunity cost of military conflict.

The effect of trade integration on interstate conflict can also vary depending on characteristics of dyads of states. For instance, a war might have a more disastrous impact on nations geographically close than distant states. If so, an increase in bilateral and global trade integration may affect the probability of conflict between dyads of states differently depending on geographical distance. In addition, interstate economic and political relations tend to be more important for neighboring countries. Then, greater bilateral trade interdependence can be more helpful in promoting peace for countries closer geographically by preventing disputes from escalating into military conflicts.

While several empirical studies have investigated the effect of bilateral trade integration on military conflict between countries, there is little systematic empirical research assessing the peace-promotion effect of both bilateral and global trade integration (MMT 2008)—and how it relates to the geographical characteristics of states. There remains a lack of consensus in these findings. This paper attempts to fill this gap and produces novel results.

An empirical assessment of the impact of trade integration on military conflict is done based on regressions utilizing a panel data set of dyadic observations from 1950 to 2000. The results show that an increase in bilateral trade interdependence and global trade integration significantly promotes peace between countries. The strong positive effect of global trade openness on peace is a novel finding, contrasting the result of MMT. We also find that the impact of trade integration on military conflict varies depending on the geographical proximity between countries. Bilateral trade interdependence promotes peace more significantly for contiguous countries, whereas global trade openness contributes more to peace between distant countries. The results also show that geopolitical factors—such as bilateral distance, joint democracy, relative military capability, UN voting correlation, oil exports, religious similarity, and economic institutions like FTA/RTA—influence the probability of military conflict among dyads of states.

The paper is organized as follows. Section 2 briefly discusses the conceptual framework that explains the effect of bilateral trade interdependence and global trade integration on military interstate conflict. In Section 3, we explain data and the empirical methodology for evaluating the effects of bilateral and global trade integration on the probability of military conflict. Section 4 presents and discusses estimation results. Section 5 analyzes the impact of military conflict on bilateral and global (multilateral) trade integration. Concluding remarks follow in Section 6.

2. The Conceptual Framework

2.1. The Impact of Trade Integration on Conflict

There are several frameworks that explain the occurrence of military conflict. The "expected utility model" focuses on the gain and loss incurred by a conflict and suggests that a decision between cooperation and conflict by engaging parties can be explained based on a cost-benefit analysis (Polachek, 1980 and Polachek et al., 1999). This framework is in general based on a decision theory focused on "one" agent problem.

In contrast, game theory-based models focus on the interaction by two or more agents. The Nash equilibrium surmises a foreign policy function (reaction function) for countries. Establishing a bargaining protocol makes it possible to examine a country's behavior and to

analyze the conditions for a peaceful settlement of disputes. Powell (2002) says that a Rubinstein-type bargaining model contributes much to the analysis of international relations, and its bargaining solution draws a Pareto-optimal outcome under complete information about each agent. Also, bargaining is more an option under the multi-agent set-up. When more than two agents settle disputes through bargaining, more solutions are available. Each agent is able to bandwagon (or build a coalition) as well as balance a power at equilibrium (Wagner, 1986, and Niou and Ordeshook, 1990). The possibility that a third party intervenes in a conflict is considered as well (Werner, 2000).

However, even though a bargaining solution can guarantee a Pareto-superior outcome, bargaining often breaks down. And war, the most inefficient outcome, still pervades across the globe. Fearon (1995) suggests a "rationalist view of war"—that asymmetric information can be behind this perplexing situation. Agents can have incomplete or imperfect information about who benefits more from an agreement, thus leading to a breakdown in negotiations. Moreover, Fearon (1995) and Lake and Powell (1999) suggest that states often fail to agree to the most efficient outcome for both—as opposed to fighting—because they are unable to make a credible commitment to uphold a settlement. Grossman (2003) examines examples of wars to find out why some disputes are peacefully settled, whereas others are not.

Only a few studies use theoretical models to investigate the role of trade in interstate conflicts.[3] Polachek (1980) and Polachek et al. (1999), using the expected utility model, explain that trade makes conflict between countries more costly—thus a high level of bilateral trade makes the optimal level of conflict lower. Trade between countries is also considered as a net pay-off (opportunity cost of war) or commitment under the bargaining model. Trade and economic interdependence between countries contributes to peaceful resolutions of disputes by raising the opportunity cost of conflict. Based on the rationalist view of war, MMT formulate a war-escalating mechanism under asymmetric information, and combine this with new trade theory to shed light on how trade liberalization affects peace. They explain how increased trade costs and labor loss as the result of conflict affects the incentive to escalate war. They argue that bilateral trade liberalization reduces the probability of war, whereas multilateral trade integration can provoke war.

[3] Skaperdas and Syropoulos (2001) and subsequent research examine the role of trade in "domestic conflict." See Garfinkel and Skaperdas (2007) for a survey.

In this paper, we propose a simple conceptual framework based on expected utility model that examines the effect of trade on conflict. In order to examine the effect of trade on conflict, we focus on the welfare loss by conflict as the factor that affects the probability of war rather than the bargaining rule itself—who escalates war and why? and what mechanism can explain war even if war is costly. Therefore, we formulate a simple equation: the probability of conflict ($\Pr(conflict)$) as a function of the welfare loss (L) from engaging in a military conflict as opposed to remaining at peace.

$$\Pr(conflict_{ij}) = P(L), \qquad \partial \Pr / \partial L < 0 \text{ and } L = \frac{dU(\cdot)/d(\cdot)}{U(\cdot)/(\cdot)} \text{ [4]} \tag{1}$$

Moreover, we assume that the utility function of a country consists of three main variables—total production (y_i) and bilateral and multilateral trade costs (t_{ij}, t_{ih})—in order to examine the marginal effect of trade integration on conflict.[5] The utility of country i is defined by four arguments, $x = (y_i, y_j, t_{ij}, t_{ih})$. Also, it is assumed that bilateral conflicts between i and j cause x to be damaged as $x(1-\Delta)$, where $\Delta = (\lambda_i, \lambda_j, -\tau_{bil}, -\tau_{multi})$. λ is the loss of production by conflict (%), τ_{bil} is an increase in bilateral trade cost (%) by conflict and τ_{multi} is an increase in the multilateral trade cost (%) by conflict.

The welfare loss by bilateral conflict between i and j is described by

$$L = L(\lambda_i, \lambda_j, -\tau_{bil}, -\tau_{multi}) = L_{y_i}\lambda_i + L_{y_j}\lambda_j - L_{t_{bil}}\tau_{bil} - L_{t_{mul}}\tau_{mul} \tag{2}$$

where L_X is the elasticity of the welfare loss(L) with respect to X.

We introduce a Dixit-Stiglitz type monopolistic competition model for trade to measure the welfare of the state in terms of production and trade cost. The utility function is a constant elasticity of substitution (CES) utility function and c_{ih} is the consumption by consumers in country i of goods from each country h of the N countries worldwide. Consumers in country i maximize the utility function such as,[6]

[4] For ease in interpretation, we define the welfare loss as the percent change in utility (U), which is represented in the form of elasticity.
[5] This framework and notations follow MMT very closely.
[6] This is a derivation of the monopolistic competition model with trade cost. See the theoretical foundation of the gravity model. (Anderson and van Wincoop 2003).

$$U_i = C_i = \left[\sum_{h=1}^{N} c_{ih}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \qquad (3)$$

where σ is the constant elasticity of substitution among the consumption goods. The consumer's budget constraint is described by,

$$\sum_{h=1}^{N} p_{ih} c_{ih} = y_i \qquad (4)$$

where y_i is nominal income of country i, p_{ih} is the price of country h goods for country i consumers: $p_{ih} = p_h t_{ih}$, where p_h is the exporter's supply price. Price differences between countries are due to iceberg trade costs (t_{ih}), which are embedded by exporters. The nominal value of imports by i from h is $m_{ih} = p_{ih} c_{ih}$. The total income of country h is $\sum_{i=1}^{N} m_{ih} = y_h$, which is the market clear condition from the perspective of exporters.

We solve the optimization problem (3) subject to (4) by assuming trade barriers are symmetric.[7] With a market-clearing condition, we derive the gravity equation in terms of imports, $m_{ij} = \frac{y_i y_j}{y_{world}} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\sigma}$ and substitute this into (3), resulting in the following equation at equilibrium,

$$U_i = y_{world}^{\frac{\sigma}{1-\sigma}} \left(\frac{y_i}{P_i^{1-\sigma}} \right) \left[\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h \right]^{\frac{\sigma}{\sigma-1}} \qquad (5)$$

At equilibrium, the utility of country i is positively associated with total production of each country and the utility decreases with trade costs. Substituting (5) into (1) and assuming a "symmetric" equilibrium between two countries, we solve for L, which is a percent change(decrease) of welfare by conflict (see Appendix 1).[8]

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[7] The total demand for country *j* goods by country i is solved as $m_{ij} = \left(\frac{p_j t_{ij}}{P_i} \right)^{1-\sigma} y_i$ where, P_i is the consumer price index of country i, given by $P_i = \left[\sum_{h=1}^{N} (p_h t_{ih})^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$

[8] This condition is similar to that in MMT (2008, equation 9), which derived the following war probability in terms of change in trade costs and loss of effective labor by conflict

$$\Pr(escalation_{ij}) = 1 - \frac{1}{V^2} \left\{ \frac{\sigma\lambda}{\sigma-1} + \tau_{bil} \frac{m_{ij}}{E_i} - \left(\frac{\lambda}{\sigma-1} - \tau_{multi} \right) \sum_{h \neq i,j}^{N} \frac{m_{ih}}{E_i} \right\}^2$$

$$L = \left[(1 + \frac{\sigma}{\sigma - 1}) \cdot \lambda + \sigma \cdot \tau_{bil} M_{ij} + \sigma \left(\tau_{multi} - \frac{\lambda}{\sigma - 1} \right) \left(\sum_{h \neq i,j}^{N} M_{ih} \right) \right] \qquad (6)$$

where $M_{ij} = \left(\frac{m_{ij}}{y_i} \right), M_{ih} = \left(\frac{m_{ih}}{y_i} \right)$

Therefore, if L—the collateral damage of the utility by conflict—is sufficiently high, countries will be willing to avoid conflict as much as possible, which means an increase in L decreases the probability of conflict ($\partial \Pr(conflict_{ij}) / \partial L < 0$). In other words, under the assumed conflict mechanism, the smaller the negative deviation of utility by conflict (the lower the value of L), the higher the probability of conflict.

From equation (6), we can examine the effect of trade integration on conflict. First, bilateral trade integration—defined by an increase in M_{ij}—reduces the probability of conflict. This is clear under the assumption that $\tau_{bil} > 0$: conflict increases bilateral trade costs.

$$\frac{\partial \Pr(conflict_{ij})}{\partial M_{ij}} = \frac{\partial \Pr}{\partial L} \frac{\partial L}{\partial M_{ij}} = \frac{\partial \Pr}{\partial L} (\sigma \cdot \tau_{bil}) < 0 \qquad (7)$$

Second, the effect of multilateral trade integration—defined as unilateral increase in M_{ih} for all $h \neq i, j$—on conflict is less clear. It depends on whether or not the below parenthesis in (8), $\left(\tau_{multi} - \frac{\lambda}{\sigma - 1} \right)$>0. Multilateral trade integration decreases the probability of conflict when $\left(\tau_{multi} - \frac{\lambda}{\sigma - 1} \right)$>0,

$$\frac{\partial \Pr(conflict_{ij})}{\partial M_{ih}} = \frac{\partial \Pr}{\partial L} \frac{\partial L}{\partial M_{ih}} = \frac{\partial \Pr}{\partial L} \cdot \sigma \cdot \left(\tau_{multi} - \frac{\lambda}{\sigma - 1} \right) < 0 \qquad if \left(\tau_{multi} - \frac{\lambda}{\sigma - 1} \right) > 0 \qquad (8)$$

Thus, our conceptual framework reaches a parameterization problem to determine whether or not $\tau_{multi} > \frac{\lambda}{\sigma - 1}$, which is the same as that of MMT. Through empirical analysis, we will show below that globalization promotes peace, which implies that $\left(\tau_{multi} - \frac{\lambda}{\sigma - 1} \right) > 0$.

A bilateral war substantially increases multilateral trade costs, so the opportunity cost of a war increases with the level of multilateral trade openness. Thus, a higher level of multilateral trade openness is an incentive to avoid war. On the other hand, as argued by MMT, multilateral trade openness would also help compensate for the loss of consumption goods production in conflicting countries. Some countries, which depend relatively more on international markets or third countries would have less incentive to avoid a war with bilateral partners. Therefore, the prediction that globalization decreases a probability of conflict derives from the assumption that the effect of direct welfare loss from increasing multilateral trade costs by bilateral conflict outweighs the welfare gain from the role of multilateral trade as a potential substitute for bilateral trade flows. This implies relatively high values of τ_{multi}, low λ, and a high σ.

However, MMT assumes that $\tau_{multi} < \frac{\lambda}{\sigma - 1}$ and predicts that a high level of multilateral trade has a positive impact on the probability of conflict. MMT argues that multilateral trade openness reduces bilateral dependence on any given country and thus lowers the opportunity cost of military conflict. Their model assumes that a bilateral military conflict between countries destroys a substantial part of the combatants' "effective labor" —high λ. They further assume that the increase in multilateral trade costs following a conflict is relatively small—low τ_{multi}.

However, in most small-scale bilateral military conflicts—where there is merely a display of force or the threat of force—the loss of either effective labor or domestic production would be small relative to the increase in multilateral trade costs.[9] Also, multilateral trade costs often increase significantly if borders are closed during a military conflict.

[9] In the model, the effective labor force equals total expenditure. We try to estimate λ as the growth rate of GDP at the time a conflict begins, and τ_{multi} as the growth rate of multilateral trade flows during the conflict. The following table displays the mean growth rate of GDP and multilateral trade of countries who underwent MID(over hostility level 4).

	The mean growth of GDP(-λ) of country pairs	The mean growth of multilateral trade flow(-τ)
Conflict at t	-0.123(%)	-3.690(%)
Conflict at t-1	-5.024(%)	-8.782(%)

Moreover, a war provoked by a state against one trading partner can lead to a reaction from one or more other trading partners, which means τ_{multi} can be large. As long as other trading partners in global markets prefer to do business with a "peaceful" partner, a dyadic conflict would hurt the dyad's trade with global partners. This suggests that global trade openness of the dyad can in fact reduce the incentive to provoke a bilateral conflict. Figure 1 shows the change of bilateral and multilateral trade flows of eight warring dyads before, during, and after the conflict between them. The bilateral conflicts between countries were typically followed by a decrease, not only in bilateral trade flows, but also in multilateral trade (the long term trend of multilateral trade is plotted in red). During military conflicts, multilateral trade declined quite noticeably in both states. In terms of post-conflict multilateral trade, the state that lost the war—as judged by international perception—suffered a more significant decline. While this data are merely suggestive, we will use more formal empirical analysis to assess the effects military conflict has on multilateral trade (see Section 5).

2.2. Geographic Proximity and the Peace-promotion Effect

We show that bilateral trade and global trade integration can have a significant impact on peace. In addition, the peace-promotion effect of trade can vary depending on geographic proximity between dyads of states.

First, a war might have a more disastrous impact on neighboring states than those geographically distant, which means that the size of reduction in domestic production (λ) and increase in bilateral trade cost by conflict (τ_{bil}) are negatively associated with the distance between dyads of state in conflict, i and j, $\lambda = \lambda(\overset{(-)}{d_{ij}})$ and $\tau_{bil} = \tau_{bil}(\overset{(-)}{d_{ij}})$. One would expect that there would be less damage to domestic production the more distant the two countries in conflict. It is also plausible that geographically distant countries in conflict find smaller increases in bilateral trade costs.[10]

Therefore, we conjecture that τ_{multi} is greater than λ. With differed lags of conflicts, λ and τ_{multi} still have very similar absolute values. If we consider the value for elasticity of substitution (σ) ranging 8-12, τ_{multi} should be larger than $\lambda /(\sigma\text{-}1)$.

[10] Suppose that countries underwent the same amount of increase in trade cost due to a conflict. The percent change in bilateral trade costs between distant countries in conflict is relatively lower than those of countries geographically closer, particularly if more distant countries have relatively higher trade costs than those geographically proximate.

In equation (7), when the bilateral cost of conflict (τ_{bil}) decreases with bilateral distance, the absolute value of the partial derivative ($\left|\frac{\partial \Pr(conflict)}{\partial M_{ij}}\right|$) becomes larger for geographically proximate countries. Therefore, the peace-promotion effect of trade is much higher for neighboring countries than it is for geographically distant nations.

On the contrary, in equation (8), when the production loss of conflict (λ) decreases with bilateral distance, the absolute value of the partial derivative ($\left|\frac{\partial \Pr(conflict)}{\partial M_{ih}}\right|$) becomes smaller for geographically proximate countries. Hence, an increase in multilateral trade openness tends to reduce the probability of conflict more for distant nations than it does for neighboring countries.

On the other hand, given the welfare loss (L), the probability that a dispute escalates into a military conflict—which is denoted by ($\frac{\partial \Pr}{\partial L}$) in equation (1)—can be different. If interstate economic and political relations tend to be more important for neighboring countries, countries closer geographically would be more inclined to prevent disputes from escalating into military conflicts. This implies that the absolute value of ($\frac{\partial \Pr}{\partial L}$) increases with bilateral distance in equations (7) and (8). In that case, greater bilateral and global trade interdependence can be more helpful in promoting peace for geographically proximate countries.

3. Empirical Specification and Data

We investigate the impact of trade integration (bilateral and global) on military conflict based on regression equations utilizing panel data of dyadic observations from 1950 to 2000:

$$MID_{ijt} = \alpha + \beta_1 \cdot Bilateral\ \ trade\ openness_{ijt} + \beta_2 \cdot Global\ trade\ openness_{ijt} + \gamma \cdot X_{ijt} + \delta \cdot Year_t + u_{ijt} \quad (9)$$

where: the dependent variable, $MID_{ijt,}$ equals unity if states i and j are engaged in a military conflict against each other at time t and equals zero otherwise; *Bilateral trade openness*$_{ijt}$ is a measure of bilateral trade interdependence between the dyad of states i and j at time t; *Global trade openness*$_{ijt}$ is a measure of trade dependence of the dyad on global markets (except the

bilateral partner), the vector X_{ijt} comprises the other important determinants of interstate conflicts; and $Year_t$ denotes a set of binary variables that are unity in year t.

The measure of military conflict is constructed from the database of the "Correlates of War (COW)" project.[11] This data set codes all Military Interstate Disputes (MID) with a level of hostility ranging from 1 to 5 (1= no militarized action, 2= threat to use force, 3= display of force, 4= use of force, 5= war).[12] The MID dataset (version 3.02) is transformed to dyadic events with corrections made by Zeev Maoz (Maoz, 2005).[13]

Table 1 shows the characteristics of the data set. In the sample of 572,246 dyadic observations from 1950 to 2000, MID events of levels 3, 4, and 5 total 2,286, out of which wars of hostility level 5 comprise only 264.[14]

Our sample for regressions is restricted because of the limited availability of explanatory variables. In the sample of 243,225 observations, MID events of levels 3, 4, and 5 total 1,246, with 50 wars. For our measure of the dependent variable, we use the concept of military conflicts—comprising MID events of hostility levels 3, 4, and 5 only.[15] The indicator used to

[11] http://www.correlatesofwar.org/

[12] The COW project collected historical militarized incidents and categorized each military dispute into 5 hostility levels according to the magnitude of each type of military action. Jones, Bremer and Singer (1996) provide how to categorize each dispute. First, the 'threat to use force' (level 2) is defined as "verbal indications of hostile intent." Second, the 'display of force' (level 3) includes alerting with armed forces and nuclear forces, purposely displaying troops, planes and ships outside the territory of a targeted state, fortifying the border and so on. Jones et al. (1996) mention that the "displays of force involve military demonstrations but no combat interaction." Third, the 'use of military force' (level 4) indicates the common active military operation such as blockades, clashes, occupation of territory, which, by the nature of the action, have a direct effect on the receiving state. Lastly, the 'war' (level 5) is defined as a military combat in which there are a minimum of 1,000 total battle deaths (For the detailed definition and coding rule, see Jones, Bremer and Singer, 1996).

[13] The data set and codebook are available from (http://psfaculty.ucdavis.edu/zmaoz/dyadmid.html). In fact, the existing versions of COW dataset do not provide the dyadic level of disputes: The dataset that is available(either on the PSSI website or the EUGENE website) consists of two types of observations: (i) dispute level, which provides general information about the military dispute such as its name, the number of participants, starting and end dates, and hostility level, (ii) individual participants level, which includes information on each dispute participant—the disputes in which they are engaged, the hostility level, the entry and exit dates from disputes, and which side they support. Therefore, generating bilateral and multilateral disputes for dyads with these two types of observations is necessary for analyzing the effect of interstate relations on disputes. However, combining these data for making multilateral disputes may cause a large number of errors—miscoding country pairs involved in the military conflict, reporting inaccurate levels of hostility, and so on—so that this combination needs to be carefully performed. Zeev Maoz corrected possible procedural errors and generated a MID dyadic dataset that is widely used in recent political science and economic research (see the details in Maoz 2005).

[14] We adopt a skewed logit regression to control for this skewed distribution of the dependent variable for the robustness check of the empirical results in section 4.4.

[15] In general, trade and peace researches in political science use MID events ranging from 2 to 5 as dependent variables (Oneal and Russett 1999 and Gartzke and Li 2003). They seem to consider any international political tension that could be caused by trade and democracy. MMT (2008) uses MID events of levels 3, 4 and 5. The regressions in the next sections show qualitatively similar results when MID events of levels 2, 3, 4, and 5 are used.

capture bilateral trade interdependence is the geometric average of bilateral trade flows over GDP of two countries. For global trade openness, we use the geometric average of total trade (excluding their bilateral trade flows) over GDP of two countries. Data on trade measured in current US dollars for 1948–2000 are from Gleditsch (2002),[16] which originate from the International Monetary Fund's (IMF) *Direction of Trade* database and other sources. Data on GDP in current US dollars are from IMF, *International Financial Statistics* and, Barbieri (2002) Dataset[17] for 1950–1965, and World Bank, *World Development Indicators* for 1965–2000. We use values lagged 2 years to limit simultaneity problems.

The specification also controls the other important determinants of interstate conflicts that are identified by previous literature. These control variables include geographical proximity, relative military power, and political, historical, and cultural factors.[18] Military conflicts are expected to occur more often between neighboring countries because they are more likely to be engaged in disputes and they can mobilize military resources against each other more quickly. To measure geographical proximity, we use two variables—(i) the log of bilateral distance between countries and (ii) a binary variable for contiguity (by land and by sea up to 150 miles) between them. These variables are from the COW database.

Relative military capabilities between states have a significant impact on the probability of military conflict. But it is not clear in theory whether power preponderance or power balance is more conducive to peace. Empirical studies also provide controversial views that states more equally balanced in military power are less inclined to engage in military conflict (Siverson and Tennefoss, 1984), preponderance power is more peaceful (Kim, 1991), or distribution of power has no significant effect on peace (Bueno de Mesquita and Lalman, 1988). To measure national capabilities, we use the COW military capabilities index (version 3.02) composed (in equal weights) of a country's share of the system's total population, urban population, energy consumption, iron and steel production, military manpower, and military expenditures (Singer 1987). The relative military capability ratio is made by taking a logarithm of the ratio of the higher state's capability index to that of the lower index in each dyad.

Spolaore and Wacziarg (2009) use only level 4 and 5 events for analyzing the effects of a genetic distance on interstate wars. The choice of dependent variable may vary subjectively due to the purpose of the research.

[16] http://privatewww.essex.ac.uk/~ksg/exptradegdp.html

[17] http://people.cas.sc.edu/barbierk/databases.html

[18] A recent paper by Spolaore and Wacziarg (2009) investigates the link between human's genetic distance and the occurrence of interstate conflicts. They find that genetically closer populations are more likely to make a war with each other because the populations have shared a more common history and issues of interest over which they fight.

In addition, the role of "major power" countries is considered. States with strongest military power are more likely to undertake military action against less powerful states to exploit concession, or to interfere and mediate conflicts in the world. A binary variable for a group of major power countries is added for the five permanent United Nations (UN) Security Council members—People's Republic of China, France, United Kingdom, United States, and USSR (Russia Federation).

Political factors that affect the probability of military conflict include characteristics of political institutions such as democracy. In political science literature, including those of the "liberal peace" view, nations with higher levels of democracy are less likely to engage in war. The democratic process necessitates more discussion and majority support from the public and the legislature in making major decisions such as war (Dixon 1993, and Oneal et al. 1997). For measurement, an index for joint democracy is used (Bremer, 1993). The raw data is from Polity IV database,[19] which assesses each country's level of democracy ranging from full autocracy (-10), to full democracy (+10). The joint democracy variable is constructed by multiplying two countries' indexes and then rescaling them to range from 0 to 1, with unity indicating dyads with two full democracies.

Political proximity between two countries can be a possible determinant of military conflict. It is the "affinity of nations" index (Gartzke, 2000), which is constructed by using UN voting data.[20] It is assumed that the more UN voting patterns of two nations are alike, their political interests would be more similar. The index ranges from -1 (most dissimilar) to 1 (most similar). It is expected that countries that share similar political interests are less likely to engage in military conflicts. We also include a binary variable for the presence of formal security alliances for dyads. This variable comes from the COW database.

Cultural and religious factors are often argued as the root cause of interstate conflict. In his book, *The Clash of Civilizations and the Remaking of World Order* (1996), Samuel Huntington argues that in the post-Cold War world, conflicts between different civilizations increasingly replaced those of differing ideologies. Religious difference often leads to interstate

[19] The Polity IV Project (Political Regime Characteristics and Transitions, 1800–2004), under the direction of Monty G. Marshall at George Mason University, carries data and analysis through 2006 (http://www.cidcm.umd.edu/polity/data).

[20] We use data on UN roll-call votes on resolution in the United Nations General Assembly collected by Erik Voeten (http://www9.georgetown.edu/faculty/ev42/UNvoting.htm). Barro and Lee (2005) used the UN voting data to investigate the influence of the US and major powers on IMF lending decisions.

conflict due to fundamentalism and "securitization of faith" (Lausten and Wæver, 2000). Recent conflicts such as the US-Iraq war and the Kosovo conflict support these arguments. Several empirical studies investigate the relationship between religious similarity and interstate conflict and provide mixed results. Early studies by Henderson (1997, 1998) show that religious similarity tends to reduce the frequency of interstate wars. In contrast, Russet et al. (2000) and Chiozza (2002) find civilization differences do not have a significant impact on interstate militarized disputes.

While these previous studies adopt a measure of religious similarity based on detailed religion categories, we construct a new measure of religious similarity between dyads by focusing on nine major religions (k=Catholic, Protestant, Other Christianity, Orthodox, Islam, Buddhism, Hinduism, "Eastern" religions, and Judaism). The index is defined as

$$1-\sum_{k}\left|R_i^k-R_j^k\right|$$

where R_i^k and R_j^k denote the fraction of the religion k in the population of country i and j respectively.[21] The index is similar to the 'S' index (Signorino and Ritter, 1999) or the 'affinity of nations' index (Gartzke, 2000) and measures the extent to which two countries share the same religious affiliations. It ranges between -1 (most dissimilar) and 1 (most similar). The raw data comes from Barrett (1982) and Barrett et al. (2001) [22] and Barro (2006). By considering only the nine major religions, we assume that the differences in nonreligious and other religion populations do not influence conflicts between states. Moreover, we add an index for common language and a dummy variable for country pairs with a history of colonialization and for a common colonizer to control for cultural and/or historical factors that might affect the occurrence of conflicts.

The specification also considers the impact of natural resource endowment on interstate conflict by including an oil-exporter dummy variable. The argument that conflicts are often

[21] Guiso et al.(2005), and Helpman et al.(2008) also consider only major religions in constructing a measure of religious similarity. But their measure is constructed by adding up the multiplications of two countries' population shares across each religion category. Hence, the index ranges from 0 (most dissimilar) and 1 (most similar). This measure is problematic because, for instance, for a majority of dyads consisting of a country that has very small population shares in all four major religions, it has a value always very close to 0 (most dissimilar) regardless of the religions in the other country, predicting counter-intuitively that the dyads are most likely to engage in interstate conflict (as much as other dyads in which two countries are completely different in major religions). In contrast, our measure will have different values based on the degree of similarity between dyads in nine categories.

[22] http://worldchristiandatabase.org/wcd/default.asp

linked by control over ownership of resources or the means to access and to market them (such as trade routes) has a long history—since the era of mercantilism and colonialism. In particular, energy resources such as oil have been a major cause of interstate conflict, for example, the 1980–1988 Iran-Iraq war (Klare, 2001). The oil-exporter dummy is 1 if one of the dyads belongs to OPEC. Oil-net exporters are likely to be exposed to more conflicts involving their resources.

In order to consider the effect of economic institution on conflicts, the specification also has a preferential trade area—Free Trade Agreement (FTA) and Regional Trade Agreement (RTA)—dummy, a binary variable which is unity if *i* and *j* belong to the same FTA/RTA. The FTA/RTA data comes from MMT (2008). Moreover, either or both GATT membership dummy as coded 1 if either country of dyads is in GATT or two countries are both GATT signatories during the observation year (*t*).

We also control the possible spillover effects of military conflicts in the specification. The existence of other conflicts can simultaneously influence both an occurrence of a bilateral military conflict and bilateral trade flows between a dyad of states. In addition, we include a zero trade dummy for all country pairs for which there was no trade between them to control, whether or not the two countries have an economic relationship.

The regression includes the number of peace years as an additional variable. Previous studies also include the number of peace years (since the last MID) variable to the regression to control "temporal dependence" between conflict events (Beck et al, 1998). An occurrence of a military conflict not only can have an immediate impact on bilateral trade, but can also influence the probability of military conflicts at any future moment. The temporal dependence problem indicates an auto-correlated binary dependent variable that can mislead the result of logit analysis. For instance, military conflicts, which can last more than a year, can occur with different probabilities if they run in succession. Beck et al. (1998) propose a solution: for this persistence of a dependent variable, they include cubic splines of peace years in the regression to control the temporal dependence. We also include cubic splines of the number of peace years in the regressions to further control for the potential "temporal dependence" problem.[23]

Lastly, the regression includes time dummies to control for common effects of external

[23] The qualitative results are similar with or without this additional variable. Beck et al.(1998) suggest to add cubic splines of the number of peace years, as well as the number of peace years variable, to correct for a temporal dependence bias. The other solution is to include a dummy variable, $K_t (t=1,2,...)$ which is coded as unity according to the length (t) of sequence of zeros that precede the current observations. This is exactly the same as including every lagged conflict (dependent) variable.

factors such as the end of the Cold War. The variable u_{ijt} is a random error term. All time-varying variables are lagged by 2 years to limit simultaneity problems. The data set has a feature of panel structure consisting of 243,225 annual observations clustered by 11,195 country pair groups from 1950 to 2000. The number of observations varies by year. Because a conflict is a binary-choice variable, we use pooled logit model to explain the variable. To estimate these systems, we allow for clustering for common country-pair observations of the error terms over time.

Table 2 reports the top 15 countries that were most frequently involved in military interstate dispute (MID) events from 1950 to 2000. The top three countries—US, Russia (USSR and Russian Federation), and PRC—belong to the "major power" category. The other two major powers are ranked 11th (United Kingdom) and 15th (France). Also, Middle East countries ranked high—Iran (4th), Israel (5th), Iraq (6th), Syria (8th), Turkey (9th), and Egypt (10th). They have been involved in more conflicts because of religious differences, resources, and geopolitical factors. India and Pakistan, which differ in major religion and are embroiled in a dispute over Kashmir, rank 7th and 13th respectively. Thailand (12th) and Korea (tied with Pakistan for 13th) are also involved in many conflicts, mostly with adjacent countries. The top 15 countries participated in 813 out of 1,458 total MIDs during the period. The table shows that geopolitical factors, major power, religion, and oil exports are important factors for military conflicts.

Summary statistics for the entire data used in the estimation are presented in column (1) in Table 3. Of all the observations in the sample, 1,246 country-pairs (about 0.51%) belong to a conflict and 241,979 (about 99.49%) to non-conflict or peace. Columns (2) and (3) of Table 3 report summary statistics for each sub-sample.

In Table 3, we observe that conflicts have been more frequent among dyads of states sharing a common land border or are geographically closer. The mean of contiguity index (the logarithmic distance) is higher (smaller) in column (2) than that in column (1). The mean of (lagged) bilateral trade interdependence measure in column (2) is three times higher than that in column (1), indicating that the bilateral trade between dyads in conflict is much higher than the average bilateral trade in the entire sample. On the other hand, the mean of (lagged) global trade openness measure in column (2) is slightly smaller than that in column (1), which implies that conflicts have occurred more frequently among dyads of states relatively more open with each other but less open to the global economy. This casual observation does not imply that greater bilateral trade interdependence or lesser global trade openness leads to more conflict between

dyads. When the relationship between each variable and conflict is discussed, the other variables should be appropriately controlled. For example, the shorter distance between dyads in conflict naturally leads to greater bilateral trade interdependence and smaller global trade openness.

Our specification assumes that the impact of bilateral or global trade openness on the probability of military conflict is the same for all country pairs independent of other country-pair characteristics. But trade patterns (bilateral and global trade openness) may affect the probability of military conflict differently for different subsets of countries, depending in particular on the geographical distance between them. As discussed in section 2, an increase in bilateral trade integration may decrease the probability of conflict more significantly between neighboring states, whereas an increase in global trade integration can decrease the probability of conflict more significantly between geographically distant states. In order to test this predication, the basic specification (9) can be extended by including the interaction terms of trade variables with bilateral distance or contiguity variables:

(9.1)

$$MID_{ijt} = \alpha + \beta_1 \cdot Bilateral\ \ trade\ openness_{ijt} + \beta_2 \cdot Global\ trade\ openness_{ijt} + \gamma \cdot X_{ijt} + \delta \cdot Year_t$$
$$+ \beta_3 \cdot Dist(or\ Contiguity) \times Bil.trade\ open_{ijt} + \beta_4 \cdot Dist(or\ Contig.) \times Global\ trade\ open_{ijt} + u_{ijt}$$

4. Empirical Results

4.1. Basic Results

Table 4 presents estimation results for the logit model for the probability of conflict. Consider first the results in columns (1)–(3). Column (1) includes bilateral trade interdependence variable. Column (2) substitutes the global trade openness for the bilateral trade interdependence. Column (3) includes both of these trade integration variables.

Column (1) of Table 4 shows that the model fits the data well, explaining a substantial part of the variation in the occurrence of military conflict. Contiguity, bilateral distance, relative military capabilities, major-powers, joint-democracy, UN voting, oil-exporters, FTA/RTA and both GATT members dummy variables are individually significant at the 1% critical level. The significantly negative estimated coefficient for the bilateral distance and the significantly

positive one for contiguity explain that geographically proximate countries are more likely to engage in military conflict. The negative estimate for the relative military capability ratio supports the contention that states unequally balanced in military capability are less likely to engage in military conflict. On the other hand, the positive estimated coefficient on major-power variable explains that these countries tend to fight more. The negative estimate for joint democracy confirms that the probability of military conflicts is significantly lower for dyads composed of states that are more democratic. The positive estimate for oil exporters means that oil exporters are involved with military conflicts more frequently. The estimated coefficient of FTA/RTA dummy is negative that countries in the same FTA/RTA blocs are less prone to provoke military conflicts.

In column (1), the estimated coefficient on bilateral trade interdependence is negative and statistically significant at the 5% critical level (-8.968, s.e.=4.487), indicating that bilateral trade dependence significantly decreases the probability of military conflicts. Most importantly, this estimation result holds true with all other important controlled variables. For instance, distance negatively affects both bilateral trade and conflict probability.[24]

In column (2) of Table 4, the estimated coefficient on global trade openness is negative and statistically significant at the 1% critical level (-1.692, s.e.=0.427). Dyads of states more dependent on the world economy tend to have fewer conflicts than those less dependent. Hence, this result contrasts with that of MMT, in which countries more open to global trade have a higher probability of war. Our finding holds quite robust, whereas that of MMT does not, in the larger sample or more controlling variables as discussed later. As our specification includes a time dummy variable separately, this significant coefficient may not be caused by global factors such as the end of Cold War or peace-promotion efforts of international organizations that are common to all countries.

In column (3) of Table 4, in which both global trade openness and bilateral trade interdependence are included, global trade openness has individually significantly negative effects at the 1% critical level (-1.661, s.e.=0.429). The estimated coefficient on bilateral trade interdependence is negative, but turns out be slightly insignificant. Broadly speaking, the

[24] The omission of distance in the regression yields a biased (toward a positive value) estimate of the impact of bilateral trade interdependence on conflict. A positive estimate of the impact of bilateral trade interdependence on conflicts—often obtained by several researchers, such as Barbieri (1996) and Barbieri and Peters (2003)—can be attributed to this bias.

findings of columns (1), (2), and (3) suggest that both bilateral and global trade dependence promote peace between bilateral trade partners.

4.2. Quantification and methodological issues

In the logit model, the dependent variable is defined as the log-odds ratio and the parameters do not correspond to the marginal effects of independent variables. The marginal effects can be calculated at the means of regressors by using the estimate.[25] Then, we can compute the response of the probability of military conflict to a one-standard-deviation change of each explanatory variable, gauging the relative importance of each explanatory variable in influencing the probability of military conflict.

For example, based on column (3) of Table 4, an increase in the bilateral trade dependence by one standard deviation of 0.007 (starting from the sample mean) decreases the probability of military conflict by 0.003 percentage point, with other variables held constant. This implies that if bilateral trade volume increases 10% from the world mean value, the mean probability of military conflict between the two trading partners decreases by about 0.16% from its predicted mean probability of conflict evaluated at the means of explanatory variables. On the other hand, an increase in the global trade openness (by one standard deviation, or 0.370) decreases the probability of military conflict by 0.037 percentage point, other variables remaining constant. This implies that an increase in global trade openness by 10% from the world mean value decreases the probability of the dyad's military conflict by about 7.7 % from its predicted mean of conflict evaluated at the means of explanatory variables. Hence, global trade openness, compared with bilateral trade dependence, has a relatively large impact on the probability of conflict with the bilateral trading partner.

Geographic proximity also has a large impact on the probability of military conflict. An increase in the log of bilateral distance by 0.829 (its standard deviation) is associated with a decrease of the likelihood that a pair of countries is engaged in a conflict by 0.021 percentage point. Because the contiguity variable is an indicator variable, its marginal impact is calculated for its change from 0 (no common land or distant by sea above 150 miles) to 1 (common border

[25] The log of odds ratio is $\ln\left(\frac{P(y=1|x)}{1-P(y=1|x)}\right)$, where $P(y=1|x)=\frac{e^{\beta' x}}{1+e^{\beta' x}}=\Lambda(\beta' x)$. The marginal effect ($\frac{\partial P(y=1|x)}{\partial x}$) is derived by $\frac{\partial P(y=1|x)}{\partial x}=\Lambda(\beta' x)[1-\Lambda(\beta' x)]\beta$ (see Greene, 2002, Chapter 21).

or distant by sea up to 150 miles). The corresponding response to this change is an increase in the probability of military conflict by 0.443 percentage point. Hence, the probability of a military conflict is substantially higher for contiguous countries.

An increase in the relative military capability ratio (by one standard deviation or 1.694) generates a decrease in the probability of conflict by 0.023 percentage point. The corresponding response to an increase in the joint-democracy index (by one standard deviation or 0.336) is a decrease in the probability of military conflict by 0.022 percentage point. The marginal impact of religious similarity (by one standard deviation or 0.577) decreases the probability of conflict by 0.01 percentage point.

The marginal impacts of the major-powers, oil-exporters and FTA/RTA variables correspond to the change of these dummy variables from 0 to 1. The probability of military conflict increases by 0.231 percentage point responding to the change in the major-power variable and by 0.049 percentage point when at least one of dyads is an oil exporter. Hence, the probability of military conflict is substantially higher between dyads involving a major power. The impact of dyads belonging to the same FTA/RTA(from 0 to 1) decrease the probability of conflict by 0.033 percentage point, which means joining a preferential trade area decreases the probability of military conflicts with other entries by about 6.7% from its predicted mean of conflict.

The empirical technique used assumes that there is no unobserved country-specific factor. When random-effects models are adopted to control country–specific factors, we obtain similar results, although the bilateral trade interdependence becomes less statistically significant. These results are not emphasized here because the conditions needed for the satisfactory implementation of random-effects logit models seem unlikely to hold (Wooldridge, 2001).

We have also adopted the "conditional" fixed-effects logit estimation technique which controls for unobserved country-pair fixed effects. The estimated results do not provide any significant predictions for the impact of trade integration on conflict.[26] Although fixed-effects estimation is often preferred by many researchers, the fixed-effects technique also has drawbacks. Because the fixed-effect estimator exploits only the variation over time, the estimates for time-invariant factors such as distance, contiguity, oil-exporters, major power dummy, common language, and colonial relationship cannot be obtained. By eliminating entire

[26] Results of fixed logit and fixed linear probability (FE LPM) model are available from the authors upon request.

information from cross-section variations, the estimation relies on a smaller information set, which the regression sample shrinks to only 12,828. In addition, it may exacerbate the bias due to measurement errors in variables.

4.3. Peace-promotion effect depending on geographical proximity

Columns (4) and (5) of Table 4 present the results from estimation of specification (9.1) to test whether the impact of bilateral or global trade openness on the probability of military conflict depends on bilateral distance or contiguity between dyads.

First, two interaction terms of bilateral distance with the bilateral and global trade integration variables are introduced to the regression. The estimated result in column (4) confirms that the impact of bilateral trade openness varies depending on the distance between countries. While the estimated coefficient on bilateral trade dependence, (-82.594 s.e.=24.514) is negative and statistically significant, the estimated coefficient on the interactive term between bilateral trade interdependence and distance (11.789, s.e.=3.03) is positive and statistically significant. These two estimates combined suggest that the closer two countries are, the greater is the peace-promotion effect from an increase in bilateral trade. In fact, the overall marginal effect of bilateral trade interdependence on the probability of military conflict is negative between proximate countries and then positive between distant ones. The two estimated coefficients imply that the switch occurs at log of bilateral distance of 7.01 (=1108 km), which is below the sample median of 8.77 (=6438 km). The strong negative relation between bilateral trade interdependence and the probability of military conflict in dyads with smaller bilateral distance seems to support the argument that greater bilateral trade interdependence can help prevent disputes—especially between geographically closer states—from being escalated into military conflicts.

However, the positive relation between bilateral trade interdependence and the probability of military conflict in the upper range of bilateral distance is puzzling. This may reflect that the strong bilateral trade between distant states often comes from more asymmetric trade links, which is often related to exploitation and economic conflicts, leading to more military conflicts between them.

The estimation result in column (4) also confirms that the impact of global trade openness varies depending on the distance between countries. The estimated coefficient on the interactive

term between global trade openness and distance (-0.42, s.e.=0.171) is significantly negative at the 5% critical level, while the estimated coefficient on global trade openness, (1.963, s.e.= 1.195), is positive but insignificant. The two point estimates for global trade and its interaction terms imply that the overall marginal effect of global trade openness on the probability of military conflict is negative for almost entire range of the sample. Only for the countries where bilateral distance ranges below 4.67 (=107 km), which is less than 0.05% of the dyads in the sample, the marginal impact of global trade openness can be positive.[27] The strong peace-promotion effect of global trade openness for all country pairs regardless of their geographical distance contrasts the negative relation between bilateral trade dependence and peace for the group of geographically distant country pairs.

The significantly negative interactive term between global trade openness and distance indicates that the peace-promotion impact of global trade openness is higher for geographically distant countries. An increase in global trade openness likely decreases the probability of conflict less for proximate countries than for distant countries. This may reflect that greater global trade integration can be more helpful to promote peace for dyads of distant countries, for which the opportunity cost of war that derives from increased cost or loss of production can be relatively lower than those geographically closer.

In Figure 2, we quantify the peace-promotion effects of bilateral and global trade integration using our estimation result in column (4) of Table 4. We separate the sample into three country-pair groups depending on their bilateral distance; within 200 km, between 200 and 7000 km, and more than 7000 km. Then, we simulate the effect of changes in bilateral and multilateral trade openness on the predicted mean probability of conflict, holding other variables constant. We explore, for instance, what happens if bilateral and multilateral trade openness decrease by 10% from their mean.

Results are shown in Figure 2. In the panels (a), (b) and (c) of Figure 2, the first bar indicates the baseline mean probability of a military conflict for each group. In the first bar of Figure 2 (a), the baseline mean probability of a military conflict is 13.13% for the country pairs located within 200km of each other. In the second bar in Figure 2 (a), we simulate the effect of a

[27] This threshold distance that changes the sign of the coefficient of multilateral openness on conflict, 4.75(=115km), is smaller than MMT's threshold distance, 8.04(=3000 km), of base specification, column (4) of Table 3 of MMT. A higher distance threshold in MMT might be caused by an "omitted variable" problem. See the discussion in the section 4.6.

10% decrease in bilateral trade dependence on the mean probability of conflict. The mean probability of a military conflict is predicted to increase to 13.39%, an increase of around 1.98%. The third bar in Figure 2 (a) shows the effect of a decrease in multilateral trade openness on the mean probability of a conflict. A 10% decrease in multilateral openness reduces the predicted mean probability of a conflict to 13.04%. This negative impact of multilateral openness on peace supports the MMT's finding. However, it occurs only in the small sample of countries that are separated by less than 200 km. The sample includes only 19 pairs, which constitutes 0.08% of the total observations.[28] The effect of a 10% decrease in both bilateral and multilateral openness is depicted in the fourth bar. The mean probability of conflict increases to 13.29% as the effect of a decrease in bilateral openness on conflict dominates the effect of multilateral openness.

The panels (b) and (c) of Figure 2 present the results of the similar simulation exercises for the other two groups. The baseline mean probability of military conflicts are 0.7794% for the country-pair group with a bilateral distance between 200 and 7000 km and 0.193% for the group with a bilateral distance larger than 7000 km, which shows the mean probability of conflicts decrease with bilateral distance. A 10% decrease in multilateral trade openness increases the predicted mean probability of military conflicts from 0.7794% to 0.7862%, an increase of around 0.87%, in the panel (b), and from 0.193% to 0.1934%, an increase of around 0.21%, in the panel (c).[29] Hence, an increase in multilateral trade openness has peace-promotion effect for country-pairs in the intermediate and long distance samples of the country-pairs with a bilateral distance larger than 200 km (which is 99.92% of the total observations). The result confirms that global trade integration generally promotes peace. This contrasts the overall positive impact of multilateral openness on military conflicts of MMT (see Figure 6 of MMT, 2008).

In Figure 2 (b), a 10% decrease in bilateral trade dependence also increases the mean probability of military conflicts for countries with a bilateral distance between 200 and 7000 km. On the contrary, in Figure 2 (c), a decrease in bilateral trade dependence reduces the mean probability of military conflicts for countries farther than 7000 km apart.

[28] The threshold of distance that changes the sign of the coefficient of multilateral openness on conflict is 4.75 (=115 km)

[29] In this case, we simulate the effect of unilateral 10% decrease in multilateral openness from its mean regardless of standard deviation (s.d.) of sub-sample. Thus, the peace promotion effect of multilateral openness turns out to be larger for countries between 200 and 7000 km than those more than 7000 km apart. However, when we consider one s.d. change from the mean of each sub-sample, the peace-promotion effect becomes larger for countries more distant.

In order to confirm the validity of quantifying the peace-promotion effect of trade integration depending on geographical proximity, we also use contiguity variable as a different geographic proximity measure for the interaction terms with both trade openness measures. Column (5) of Table 4 introduces the interaction terms of the bilateral and global trade integration variables with contiguity by substituting for their interaction terms with bilateral distance. The estimated coefficient on bilateral trade interdependence, (23.919, s.e.=4.638) is significantly positive and the estimated coefficient on the interactive term between bilateral trade dependence and contiguity (-34.552, s.e.= 6.246) is significantly negative.

Hence, the overall effect of bilateral trade dependence on the probability of military conflict hinges on contiguity. The peace-promotion effect of bilateral trade dependence appears to be significantly higher for contiguous countries. But, the estimates indicate that the relation between bilateral trade dependence and the probability of military conflict can be positive in non-contiguous countries, which is consistent with the result in column (4).

On the other hand, the estimated coefficient on the interaction term between contiguity and global trade openness (1.192, s.e.=0.585) is positive and significant. The estimated coefficient on global trade openness (-1.671, s.e.=0.548) is significantly negative. Hence, the two estimated coefficients imply that the overall marginal effect of global trade openness on the probability of military conflict is always negative for countries regardless of contiguity between them. Greater global trade integration can help promote peace for all dyads, which is also consistent with the result in column (4).

Whether countries are geographically contiguous or not, the pacifying effect of trade integration varies. The peace-promotion effect of bilateral trade integration is significantly higher for contiguous countries that are likely to experience more conflicts. For example, an increase of 10% in bilateral trade volume of contiguous groups lowers the probability of military conflict between two contiguous states by about 1% from the predicted mean of military conflict evaluated at the mean of explanatory variables, which the pacifying effect of bilateral trade integration is about 6.3 times for contiguous countries more than for all countries.

Moreover, the peace-promotion effect of global trade openness is significantly higher for non-contiguous countries that are relatively distant from each other. An increase of 10% in multilateral trade volume of non-contiguous groups lowers the probability of military conflict between two non-contiguous states by about 8.8% from the predicted mean of military conflict

evaluated at the mean of variables. Thus, the results in columns (4) and (5) support the prediction of our conceptual framework—equations (7) and (8). The peace-promotion effect of trade integration varies depending on the geographical proximity.

4.4. Robustness of the Results

We check for the robustness of the basic results of Table 4—about the effect of bilateral and global trade dependence on conflict.

In order to minimize the simultaneous correlation problem between trade variables and military disputes, columns (1)–(3) of Table 5 present estimation results with 3-year lagged trade integration variables. The main results are similar to those in Table 4. But, the 3-year lagged bilateral trade interdependence variable becomes insignificant in column (1) of Table 5.

We also investigated different trade integration measures, including the log of arithmetic averages, rather than geometric averages, of bilateral or global trade integration of the two countries.[30] The estimation results of Columns (4)–(6) in Table 5 show that they are very similar to those in Tables 4.

For the skewed binary dependent variable, we also use a skewed logit regression for the robustness. Nagler (1994) proposes 'scobit' (skewed-logit) estimation as an alternative to the logit regression by allowing a skewed response curve with a skewness parameter in the density of the logit model. Under the probit and logit regression, it is automatically assumed that the maximal impact of any independent variable occurs when Pr[*Dependent variable*(y)=1 or 0] = 0.5, in other words, that the probability distribution of a disturbance is symmetric. Thus, in our empirical analysis, logit and probit models might underestimate the sensitivity of going to war for a country with high war probability. However, when we use Nagler's skewed logit regression, the estimation results are both qualitatively and quantitatively very similar to those in Table 4.

Conducting the accurate statistical inference is important for empirical research because wrong statistical inference (under-estimated S.E.) leads to over-rejection of the null hypothesis. We implement the Cameron et al. (2006) multi-way clustering method as well as one-way dyadic pair clustering—to determine robust standard errors of the results. One-way dyadic pair clustering relies on the distributional assumptions; errors are independent but not identically

[30] To keep the zero observations when making the log transformation of bilateral trade dependence measure, we use log (1+x).

distributed across clustered pairs and can have general patterns of within cluster correlation and heteroskedasticity. However, each pair consists of two individual countries for which clustering needs to be accounted. For example, suppose there are two country pairs such as the US-France and the US-Korea. Dyadic pair clustering assumes errors of two pairs are orthogonal, but the US, a common country of pairs, affects that error terms of two pairs are correlated. In this case, the Cameron et al. (2006) two-way clustering is useful to infer robustness. We apply their method in our base regression, columns (1)-(5) of Table 4 and confirm that the S.E. hardly changes and the reported statistical inferences by one-way dyadic clustering are preserved.[31]

4.5. Instrument Variable Estimation

The empirical investigation of the effects of trade integration on military conflicts encounters standard endogeneity problems. The causality can run in the opposite direction: military conflicts have a negative effect on trade (Glick and Taylor, 2005, Blomberg and Hess, 2006, and MMT 2008). It is also plausible that the negative effects of trade may reflect any omitted dyadic characteristics that influence the probability of military conflicts. The logit estimates may not therefore reveal the true effect of trade integration on military conflicts. We have used lagged trade variables to reduce endogeneity of trade as an explanation of military conflicts to the certain extent.

In this section, we implement an instrument variable approach to control potential endogeneity problems. We use as instrument variables the European Union Generalized System of Preference (GSP) scheme interacted with distance and an index of economic remoteness measure of dyads as suggested by MMT. However, we slightly change these two instrument variables and add one more instrument variable for effectively controlling endogeniety and drawing the robust results.

The Generalized System of Preference (GSP) scheme is tariff preferences granted by developed countries to developing countries. In 1968, UNCTAD recommended the creation of GSP under which industrialized countries would grant autonomous trade preferences to all developing countries. Under GSP schemes, selected products originating in developing countries

[31] The two-way clustering method is the following: first, obtain three different clustered robust "variance" matrices for the estimator by one-way clustering in, respectively, the first country, the second country, and by the intersection of the first and second dimensions, and then add the first two variance matrices and subtract the third. The results of two-way clustering are available from authors upon request.

are granted reduced or zero tariff rates over the most favored nation (MFN) rates. Also, the least developed countries (LDCs) receive preferential treatment for a wide range of products and deeper tariff cuts. Romalis (2003) shows that GSP program increases Least Developed Countries' (LDC) trade significantly by facilitating LDC's access to markets of rich and distant developed countries. Therefore, GSP scheme could promote increase in trade of beneficiary countries with preference-giving countries.

There are currently 13 national GSP schemes. The following countries grant GSP preferences: Australia, Belarus, Bulgaria, Canada, Estonia, the European Union (EU), Japan, New Zealand, Norway, the Russian Federation, Switzerland, Turkey and the US. There are no specific political conditions for countries to be granted GSP, so that a country's participation in GSP has no direct relationship with whether it has conflicts or not. Even though a GSP scheme is orthogonal to occurring conflicts, we only choose GSP programs implemented by the EU as an instrument. This is because the EU's GSP scheme—which includes 176 developing countries and territories (especially, 50 LDCs) as beneficiaries—is mostly indifferent to political ties with the EU. This guarantees the validity of instruments for examining the effect of trade integration on conflict.[32] We also multiply the EU GSP by the geographical proximity from EU member countries to the recipients of the EU GSP program in order to exclude any possibility that GSP relationship could affect propensity to conflicts between them. We lag this variable by 6 years, which is the time required for GSP to affect the trade structure of beneficiary countries at t-2.[33] GSP participation is expected to increase global trade openness while its relation to bilateral trade is ambiguous due to the distance multiplier. We use GSP program data from Rose (2005).

The second instrumental variable is the measure of remoteness of dyads from the rest of world. This variable is routinely used in trade literature as an important determinant of bilateral trade flows (i.e. Baier and Bergstrand, 2004).[34] This remoteness variable not only represents multilateral trade costs by capturing distance to all bilateral trade partners except j of country i,

[32] "There was no unified foreign policy at the European level; hence, it is hard to believe that EU GSP scheme is used by the different members for their own foreign policy."(MMT 2008, p.890) For example, in terms of US GSP scheme, the political relationship between US and beneficiary countries seemed to affect the program and vice versa (see MMT 2008).

[33] Thus, the instrument variable is 4 year lagged for the endogenous regressors, the same as MMT (2008).

[34] The remoteness of dyad *(i,j)* is defined as $\ln\left(\sum_{k\neq i,j}^{N_t}\frac{\text{distance}_{ik}}{N_t-1}\right)+\ln\left(\sum_{k\neq i,j}^{N_t}\frac{\text{distance}_{jk}}{N_t-1}\right)$ This variable is time variant because new countries have come into being almost every year during the 1950–2000 period. Alesina et al.(2000) show the number of countries drastically increased from 74 countries in 1946 to 192 in 2000.

but also "relative" bilateral trade costs between *i* and *j*. Because the remoteness variable is constructed by the outside information of country pair (*i, j*), it is expected that remoteness is not affected by the probability of bilateral conflicts between *i* and *j*. When constructing the remoteness variable, we exclude any third country (*k*) that had military conflicts with one of dyads at any moment in history. We also lag this variable by 2 years. An increase in remoteness of dyads is expected to increase bilateral trade of dyads, but decreases global trade.

The third instrumental variable is the number of trading countries of dyads (lagged by 2 years). This new variable is added to strengthen the validity of instrumental variable estimation. This variable is constructed by adding up the number of each country's trading partners whose trade flow is not missing and greater than zero. In counting the number of trading partners, we exclude any third country (*k*) which had military conflicts with one of dyads at any moment in history. If a country trades with a larger number of partners, its global trade integration is expected to be larger. On the contrary, an increase in total trading partners of dyads can have an ambiguous effect on bilateral trade: it can divert the bilateral trade between two countries to other global partners so that bilateral trade decreases, while an increase in the number of trading partners of dyads implies that dyads are integrated more with global markets and thus their overall trade volume increases.

Because there is no standard IV estimation methodology in the logit framework with clustered dyads, we follow one of solutions provided by Wooldridge (2001), which is to use an IV linear probability model with clustered errors. The logit model is non-linear, so we also use an IV probit model to check robustness of the instrumental variable approach and to reinforce the results.

Table 6 shows the first stage regression of IV estimation. Columns (1) and (2) show the instrumentation of GSP, remoteness and number of trading partners on bilateral trade interdependence, and global trade openness respectively. As expected, GSP has a positive effect on global trade openness. Remoteness has a significantly positive effect on bilateral trade dependence and a significantly negative effect on global trade openness. The estimates of number of trading partners on bilateral trade and global trade integration are both significantly positive. The existing econometric literature defines weak instruments based on the strength of the first-stage equation (Staiger and Stock, 1997, and Stock and Yogo, 2002). Cragg-Donald (1993) statistic for testing the null hypothesis—such that the instruments are weak when there

are multiple endogenous regressors—is 56.37. These test statistics are well above the critical values (13.43 at 10% maximal IV size) for weak instruments as reported by Stock and Yogo (2002). This implies that, according to the test for weak instruments, our first stage has good power and instruments are not weak.

Table 7 presents the results of the second stage instrumental variable (IV) regressions.[35] Column (1) of Table 7 shows the results of IV linear probability model regressions and column (2) displays the result of IV probit regressions using the clustered bootstrap method.[36] The results are broadly consistent with the logit estimation results. Column (1) shows that an increase in both bilateral trade interdependence and global trade openness significantly promotes peace respectively at 10% and 1% critical levels. Column (2) also shows global trade integration reduces the probability of conflicts and other coefficients are qualitatively same as column (1). Hence, the negative effects of trade integration on military conflicts in the logit estimation do not reflect the reverse causality that runs from military conflicts to trade or the influence of any omitted characteristics. Moreover, other controls have similar results with our base specification, column (3) of Table 4. In particular, in column (1) of Table 7, the estimated coefficient of a security-alliance turns out to be significantly negative following the theory's prediction, and the coefficient of both GATT members becomes insignificantly negative.

Columns (3) and (4) add the interactive terms of bilateral and global trade openness with the geographical proximity variables. The IV estimation results broadly support the basic result of logit estimation by confirming that the coefficients of bilateral and global trade openness depending on the geographical proximity of countries are also qualitatively the same as the coefficients of logit model.

We find no evidence of an over-identification problem. The joint-null hypothesis for Sargan-Hansen's over-identification test—which implies that instruments are uncorrelated with

[35] Table 6 shows the first-stage regression of column (1) of Table 7

[36] IV probit estimation with clustered standard errors is not allowed and the error that "initial values are not feasible" shows up in STATA in this case. Therefore, we use the clustered bootstrap method, which constructs a number of re-samples of the observed data by dyads (clustered pairs) and then estimates by IV probit method. The bootstrap method is useful in reducing a finite sample bias. It is also used to get accurate statistical inference of the model when parametric inference is impossible or requires complicated formulas for calculating standard errors (Horowitz 2001).

the error term—cannot be rejected. The test statistic of 0.898 (p-value is 0.343) in the case of specification of column (1) supports the exogeneity hypothesis of our instruments.[37]

4.6. Comparison with MMT (2008) and SW (2009)

In section 4.4, we point out the main differences of our results from MMT's results. In particular, MMT show that an increase in bilateral openness reduces the probability of conflict while an increase in multilateral openness raises the probability of conflict. However, figure 2 shows in most cases, multilateral openness serve as a conduit of peace. In this section, we replicate MMT's regression in their table 3 and determine why MMT's results of globalization on peace are the opposite of ours.[38] Columns (1) and (2) replicate regressions (1) and (2) in table 3 of MMT respectively. Through the regressions, MMT show the effect of multilateral trade openness on military conflicts is positive among geographically proximate country groups—contiguous pairs and contiguous less than 1000km groups. However, these regressions are problematic due to "omitted variables" which should be controlled. Including more explanatory variables with MMT's controls, we report column (1)-1 and (2)-1 which show that the coefficient of multilateral openness of MMT could be contaminated with omitted variable bias. We use all basic control variables that MMT used, except log product land area (sum of log land area) variable. It seems that sum of log land area is not a good control variable because there is a land size asymmetry of countries. When summing the land size within a county-pair, it ignores a country's asymmetric land size which influences the probability of conflicts (i.e. larger countries have more diverse ethnic groups, more borders adjacent to others and more territory to be disputed, while smaller countries do not). Thus, the difference of land size between countries can be a more appropriate control for the military disputes. Instead, we use the relative military capability measure, which can gauge the country's power or size effect on conflicts. Consequently when we add possible factors which affect the probability of war, we nullify the positive effect of multilateral openness on conflict.

Furthermore, MMT do not display the effect of bilateral and multilateral integration on peace without interaction term of trade integration and distance in their full sample. Columns (3)-(5) report the effect of bilateral and multilateral trade openness on peace with other controls

[37] Other over-identification test also cannot reject the null hypothesis. The J statistics of Sargan-Hansen test are 2.742(p-value=0.1) in column (2), 5.03(0.08) in column (3) and 1.333(0.513) in column (4).
[38] MMT data is available on the website (http://team.univ-paris1.fr/teamperso/mayer/data/data.htm).

from MMT's full regression sample. The coefficients of multilateral openness on conflict are significantly negative, which means that an increase in multilateral trade integration supports peace. This shows that interestingly, even MMT's data and specification support the pacifying effect of globalization.

Column (6) shows that the impact of bilateral and global trade openness varies depending on the distance between countries in MMT's full sample. In column (6), we also include the important control variables, such as relative military capability, major powers, oil-exporters, and religious similarity, that affect the likelihood of interstate conflict, but are omitted in the MMT's base specification (see column (4) of table 3, MMT 2008). Particularly, the estimated coefficient on the interactive term between global trade openness and distance (-0.174, s.e.=0.055) is significantly negative, while the estimated coefficient on global trade openness, (1.274, s.e.=0.438) is positive. The two point estimates for global trade and its interaction terms imply that the overall marginal effect of multilateral trade openness on the probability of military conflict is negative for almost entire range of the sample. In fact, the log distance threshold that changes the sign of the effect of multilateral trade openness on conflict decreases from 8.03 (=3000 km) to 7.31 (=1495 km) as we include more control variables in the MMT's specification. Only for the countries for which bilateral distance ranges below 7.31 (=1495 km), which is less than 8% of the dyads in MMT's sample, the marginal impact of multilateral trade openness can be positive. The strong peace-promotion effect of global trade openness for most of all country pairs is confirmed, contrasting with the negative effect of bilateral trade openness on peace for the group of geographically distant country pairs.

In column (7), we further control temporal correlation using cubic splines which controls all past war dummies during the 1950–2000, while MMT use 20 dyadic past war dummies (see the discussion of Beck et al. 1998). The estimation result in column (7) also confirms that the impact of multilateral trade openness varies depending on the distance between countries. The estimated coefficient on the interactive term between global trade openness and distance (-0.131, s.e.=0.071) is significantly negative at the 10% level, while the estimated coefficient on multilateral trade openness, (0.866, s.e.=0.548), is positive but statistically insignificant. Therefore, we confirm again the strong peace-promotion effect of multilateral trade openness.

In fact, our result of peace-promotion effect of multilateral trade openness is also supported by a recent study by Spolaore and Wacziarg (2009)—henceforth, SW. SW replicates

MMT's baseline specification with a genetic distance variable for the 1950-2000 period. They include MMT's trade variables (4 year lagged bilateral trade openness and multilateral trade openness) which are possibly correlated with the genetic distance in order to control omitted variable bias and to verify the significant effect of the genetic distance on conflicts. In column (2) of their table 9, two interaction terms of bilateral distance and the bilateral and multilateral trade openness variables are introduced into the specification.

The estimated result in column (2) confirms that the impact of log multilateral trade openness varies depending on the distance between countries as in MMT and this paper. However, when we gauge the effect of multilateral openness on conflicts based on the estimated parameters, SW's result supports our conclusion that multilateral trade openness promotes peace. In SW's column (2) of table 9, the estimated coefficient on the interactive term between the multilateral trade openness and distance (-0.0093, t-stat.=2.656) is significantly negative at 1% critical level, while the estimated coefficient on multilateral trade openness, (0.0552, t-stat.=1.993) is significantly positive. The two point estimates for multilateral trade openness and its interaction terms imply that the overall marginal effect of multilateral trade openness on the probability of military conflict is negative for almost entire range of the sample (more than 99.4% of the dyads in MMT's sample).

Column (3) of SW's table includes additional trade institution terms such as FTA and numbers of GATT members in a country pair. The column (3) still shows the strong negative effect of multilateral trade openness. In their column (3) of table 9, the estimated coefficient on the interactive term between the multilateral trade openness and distance (-0.0098, t-stat.=2.854) is significantly negative, whereas the estimated coefficient on multilateral trade openness, (0.0595, t-stat.=2.191) is significantly positive. Thus, the log distance threshold that starts the peace promotion effect of multilateral trade openness on conflict is 6.07 (= 433 km), still very low.

5. The Impact of Military Interstate Disputes on Trade Integration

We assess the effect of trade integration on military conflicts and find that both bilateral and global trade integration contribute to peace. However, the reverse causal effect from military

conflicts to trade integration remains an issue. A number of studies have assessed the effect of military conflicts on bilateral trade flows (Glick and Taylor, 2005, Blomberg and Hess, 2006, and MMT 2008), whereas how much military conflicts affect global trade of the states concerned has not been investigated to the same extent. This section analyzes the effect of military conflicts on bilateral and global trade integration. We adopt the gravity model analysis to evaluate the trade effects of military conflicts (Anderson and van Wincoop 2003). The extended gravity model of bilateral trade takes the following form:

$$Trade\ Integration_{ijt} = \alpha + \sum_{k=0}^{5} \beta_k \cdot MID_{ij,t-k} + \gamma \cdot X_{ijt} + \delta \cdot Year_t + u_{ijt} \qquad (10)$$

where the dependent variable is a measure of bilateral trade interdependence of a dyad of states *i* and *j* at time *t*. MID_{t-k} *(k=0,…5)* are military conflict variables ranging from contemporaneous conflict to 5-year lagged conflict, and $Year_t$ denotes a set of binary variables which are unity in year *t*. X_{ijt} includes other control variables shown in the gravity equation (see Rose 2004, 2005). We include the square root of the product of the dyads' GDP, the square root of the product of their GDP per capita,[39] geographical proximity (distance, contiguity) of dyads, common language, and colonial relationship dummy variables such as common colonizers and existence of a colonial relationship. The specification also has a preferential trade area—FTA and RTA dummy, a binary variable which is unity if *i* and *j* belong to the same FTA/RTA, and a GATT membership dummy as coded 1 if two countries are both GATT signatories at observation year(*t*). A GSP dummy is also added. Lastly, we add the remoteness, and the number of trading partners, which were used as instruments for bilateral trade in the previous section. Our trade and

[39] A more detailed discussion of the gravity model is in Anderson and van Wincoop (2003).

In chapter 2, we derived $m_{ij} = \frac{y_i y_j}{y_{world}} \left(\frac{t_{ij}}{P_i P_j} \right)^{1-\sigma} = \frac{y_i y_j}{y_{world}}$, where $\left(\frac{t_{ij}}{P_i P_j} \right)^{1-\sigma}$ is "multilateral resistance(*P*)" term and "bilateral resistance(*t*)" are symmetric between *i* and *j*. We assume the multilateral resistance is constant as 1 for simplicity (however, we control this in empirical specification).

Therefore, bilateral trade flow is defined as $T_{ij} = m_{ij} + m_{ji} = 2\left(\frac{y_i y_j}{y_{world}} \right) = T_{ji}$. Our bilateral trade dependence measure is the geometric average of bilateral trade flow of GDP of i and j, which is $\sqrt{\frac{T_{ij}}{y_i}} \sqrt{\frac{T_{ji}}{y_j}} = \frac{T_{ij}}{\sqrt{y_i y_j}}$.

Therefore, we derive $\frac{T_{ij}}{\sqrt{y_i y_j}} = 2\left(\frac{\sqrt{y_i y_j}}{y_{world}} \right)$ which shows why we include square root of product of GDP of i and j.

GDP variables are in current US dollars so that wrongly deflated problem can be avoided (Baldwin and Taglioni 2006). Also, the remoteness variable possibly captures the 'multilateral resistance' that affects bilateral trade patterns.[40]

Table 9 shows the estimation results of regressing bilateral trade interdependence on military conflicts and other controls. We apply two different estimation techniques: Column (1) is estimated by pooled ordinary least squares (OLS) allowing for clustering of common country-pair error terms over time and column (2) is the result of tobit estimation to correct the bias from zero observations.[41] Column (3) reports the result by the fixed-effects estimation controlling for unobserved country-pair fixed effects. All columns (1), (2), and (3) display very similar results. First, the results confirm the significant negative effects of military conflicts on bilateral trade integration. In column (1), the coefficients of all military conflict variables are significantly negative. The estimates imply that during a bilateral military conflict, bilateral trade integration declines by 0.007 over the following 5 years, which is much larger than the predicted mean of bilateral trade dependence, 0.002.[42] In fact, in 94% of the dyads, bilateral trade dependence is lower than 0.007, so these dyads of states would lose all trade between them if a military conflict occurred and lasted over 5 years. In column (2), with a tobit method capturing possible non-linear relationships between bilateral trade dependence and conflict due to the many zero trade observations, the effect of military conflict on bilateral trade dependence is almost the same as the result of column (1). In column (3), using fixed-effects estimation, the effects of military conflicts on bilateral trade becomes smaller, but most of the estimated coefficients remain negative and statistically significant.

We also find that the conventional variables behave quite similar to model predictions, with estimated coefficients statistically significant. The estimated coefficients on the FTA/RTA membership dummy in all columns (1), (2) and (3) are positive and statistically significant. The

[40] Anderson and van Wincoop (2003) show that exports not only depend on bilateral trade costs, but also on bilateral trade costs relative to a measure of both countries' trade costs to all other countries, so called 'multilateral resistance'. Baldwin and Taglioni (2006) and Baier and Bergstrand (2009) use different methods to control 'multilateral resistance' in the gravity equation for bilateral trade flows.

[41] See Silva and Tenreyro (2006) and Helpman et al.(2008) more about zero trade problem.

[42] $\frac{\partial E(y \mid x) / E(y \mid x)}{\partial x} = -3.5$ (semi-elasticity). Therefore, bilateral trade integration decreases by 350% when military conflict occurred and lasted over 5 years. The effect of military conflicts on bilateral trade dependence is huge.

estimated coefficient on the GATT membership dummy is also positive, but statistically significant only in the fixed-effect estimation.

We slightly change the specification of the gravity model in section 2 to analyze the effect of military conflicts on global trade integration. The dependent variable is a measure of global trade integration of dyads (*i, j*) at time *t*. The specification follows the basic gravity equation with contemporaneous and lagged military conflicts. For the other control variables, we alter some bilateral variables to have a more direct relationship with global trade patterns of dyads. For example, we include square root of the product of GDP (and GDP per capita) with all other trading partners of *i* and *j* ($\sqrt{\sum_{k\neq i,j}^{N} y_{k,t}} \times \sqrt{\sum_{m\neq i,j}^{N} y_{m,t}}$). [43] The GATT dummy variable is coded as 1 when only one country in any dyad is a GATT member. This is because a country of any dyad that joins GATT is likely to trade more with other GATT members. Thus, we can expect this dummy variable to be positively related to global trade integration. We also include the sum of the number of countries using a common language with *i* and *j*. This variable controls cultural proximity of each country in a dyad with other countries, which can be related to the global trade cost of each country in the dyad. The number of other conflicts in *t* is included to control the externality of conflicts among countries that could affect a dyad's global trade integration. The specification also includes each country's remoteness, and the number of trading partners, and the EU GSP with distance variables that were used as instruments for global trade as outlined in the previous section.

Table 10 displays the estimation results of global trade integration on military conflicts and other controls. We find that military conflicts have a negative effect on global trade integration. In column (1), the estimated coefficients of all military conflicts are significantly negative. This implies that a bilateral military conflict of a dyad reduces global (multilateral) trade integration by 0.15 over the ensuing 5 years, which means global trade integration

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[43] Our global trade integration measure is $\sqrt{\frac{T_{i,ROW}}{y_i}} \times \sqrt{\frac{T_{j,ROW}}{y_j}}$, where $T_{i,ROW} = 2\left(\frac{y_i y_{ROW(i)}}{y_{world}}\right)$ is multilateral trade flows between *i* and rest of the world (ROW). We also derive $\sqrt{\frac{T_{i,ROW}}{y_i}}\sqrt{\frac{T_{j,ROW}}{y_j}} = 2\left(\frac{\sqrt{y_{ROW(i)} y_{ROW(j)}}}{y_{world}}\right)$ which explains why we include square root of all other trading partners GDP of *i* and *j*.

decreases by 30% [44] if a military conflict between countries occurred and lasted over 5 years. In the fixed-effect estimation of column (2), the estimated coefficients on one and two lagged military conflicts are statistically significant individually. The coefficients of other military conflict variables are negative but become statistically insignificant. The estimation results of other control variables confirm our predictions. The estimated coefficients on the square root of GDP or GDP per capita of trading-partner variables are statistically significant. The estimated coefficients on the one GATT membership dummy are also positive and statistically significant—a country's participation in GATT makes their trade increase with other GATT members while decreasing trade with non-GATT members. Lastly, the coefficients on the number of countries with common languages are significantly positive, which coincide with the conventional positive effect of common language on trade.

6. Concluding Remarks

The empirical analysis shows that an increase in bilateral trade interdependence and global trade openness significantly reduces the probability of military conflict between countries. Our empirical results are robust when controlling for the simultaneous determination of trade and peace.

Our results also show that the peace-promotion effect of trade varies depending on the geographical proximity between countries. Greater bilateral trade interdependence appears to bring about a considerably larger peace-promotion effect for neighboring countries. In contrast, greater global trade openness has a more significantly positive effect on peace for distant countries than it does on neighboring ones.

Overall, our results consistently show that trade integration has an important effect on conflict between states. A recent seminal paper in global trade and conflict (MMT, 2008) argues that globalization (increase in multilateral trade) can increase the probability of military conflict by reducing the bilateral dependence to any given country. Our empirical findings strongly

[44] $\frac{\partial E(y \mid x)}{\partial x} = -0.15$ and $E(y \mid x) = 0.48$ (the predicted mean of global trade integration between countries). Thus, $\frac{\partial E(y \mid x) / E(y \mid x)}{\partial x} = -0.3$ (semi-elasticity).

contest this argument. Our conceptual framework also shows that the critical assumptions in MMT do not hold robust in most cases.

Our results show that globalization promotes peace through two channels: one from the increased advantage peace holds for bilateral trade interdependence; and the other from a country's integration into global markets, regardless of the size of trade with each trading partner. "Globalization" has been one of the most salient features of the world economy over the past century. At the same time, the number of countries involved in world trade has also increased significantly. However, despite the increase in the number of country pairs, the probability of dyadic military conflict has decreased.

Our findings also suggest that trade integration not merely results in economic gains, but can bring about significant political gains as well—such as a peace dividend between trading partners. It also explains why economic integration, whether regional or global, is often initiated to satisfy political and security motives. For example, the *raison d'etre* behind the formation of the European Union following World War II was the desire for peace—particularly between France and Germany. Further research on quantitative assessments of peace dividends resulting from economic integration would be of great interest.

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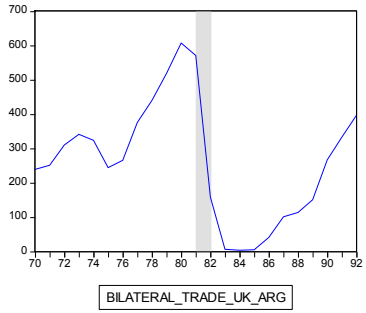
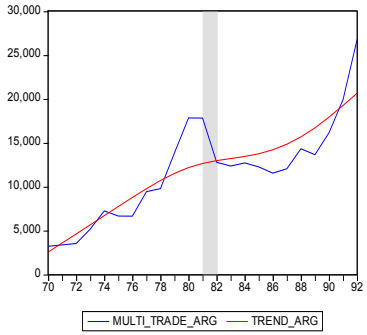
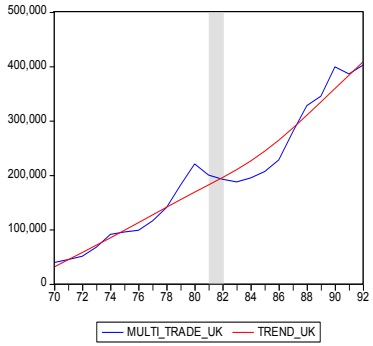
Figure 1: The Changes of Bilateral and Multilateral Trade Flows Before, During and After Selected Incidences of Militarized Interstate Disputes (current USD million)

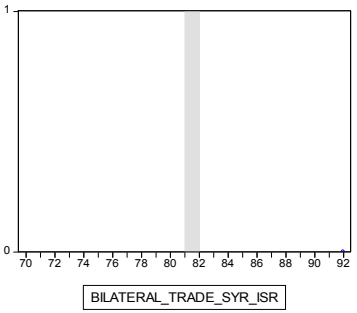
1) Faklands War(1982) (Argentina - UK)

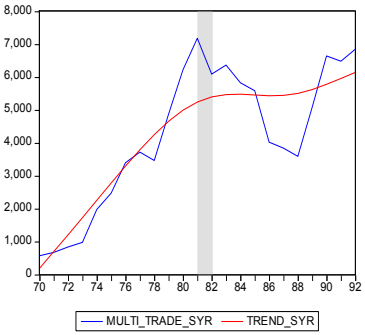


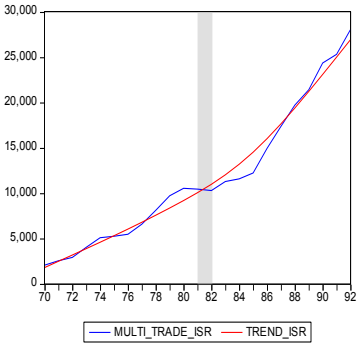




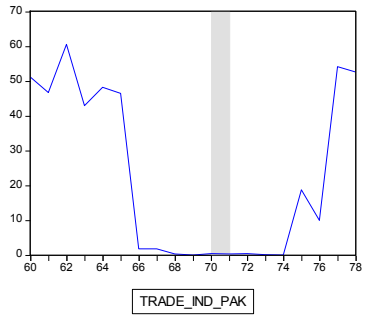
2) Lebanon War(1981) (Syria-Israel)

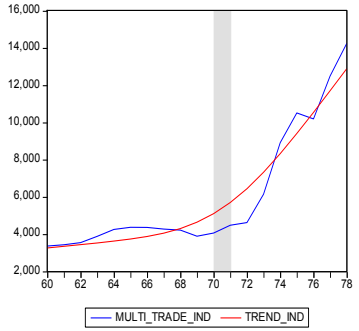


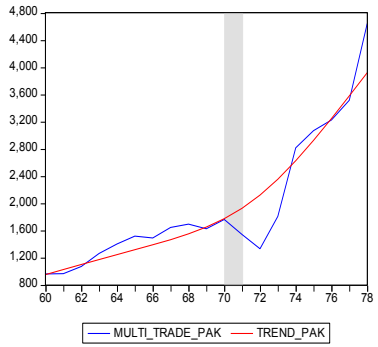




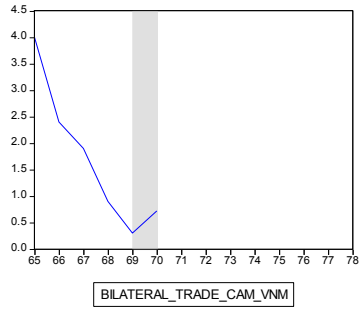
3) Bangladesh War(1970) (India - Pakistan)

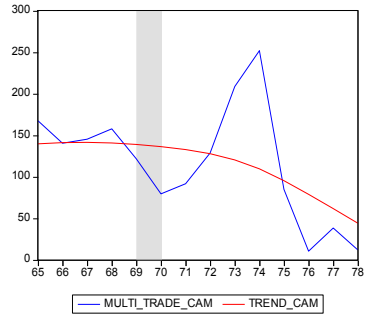


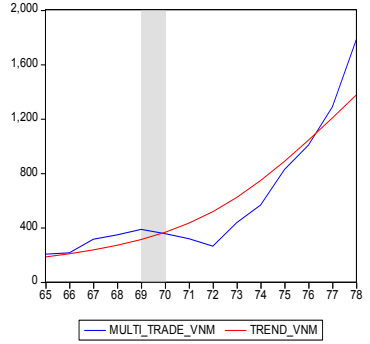




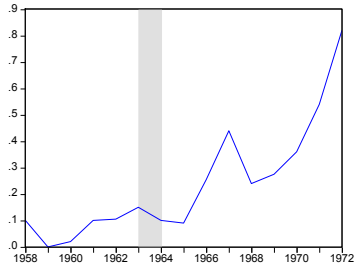
4) Cambodian Civil War (1970, Cambodia-Vietnam)

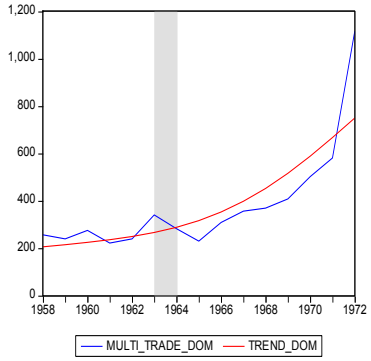


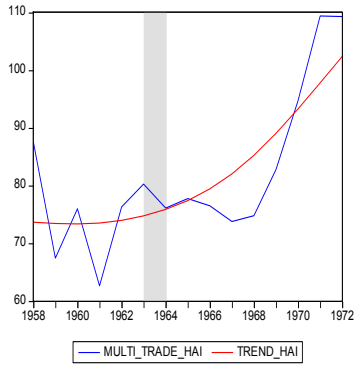




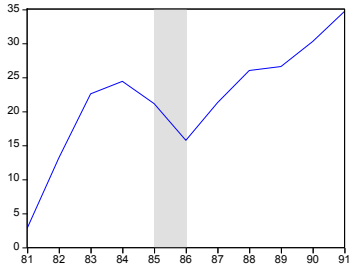
5) Dominican Republic - Haiti conflict (1963)

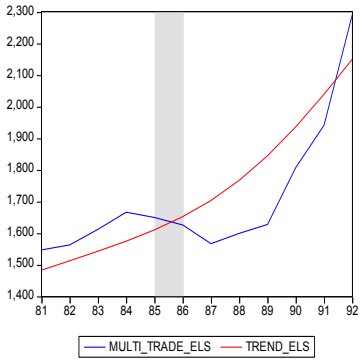


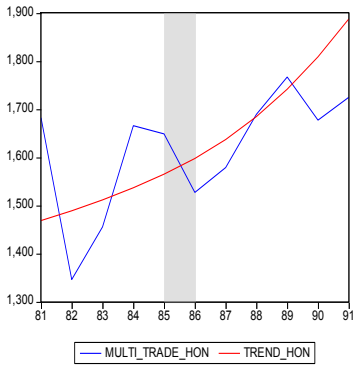




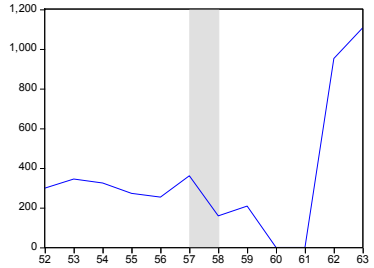
6) Honduras - El Salvador conflict (1985)

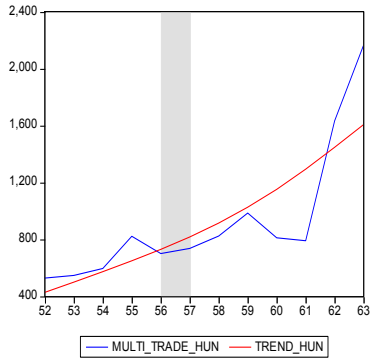


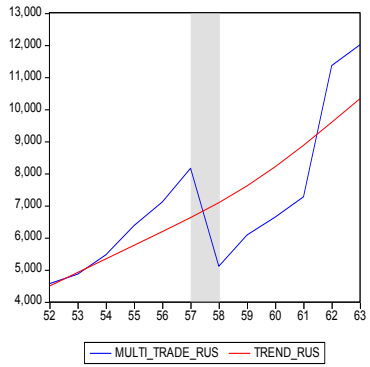




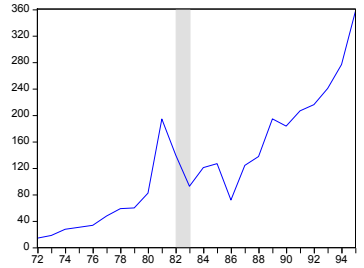
7) Hungarian Revolution (1956) (Hungary-Russia)

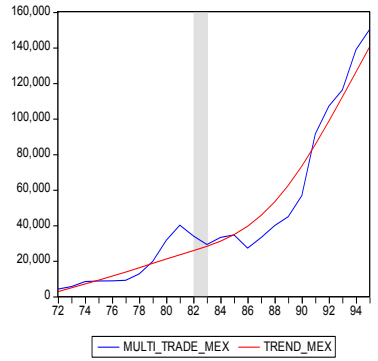






8) Mexico-Guatemala territory disputes (1982)





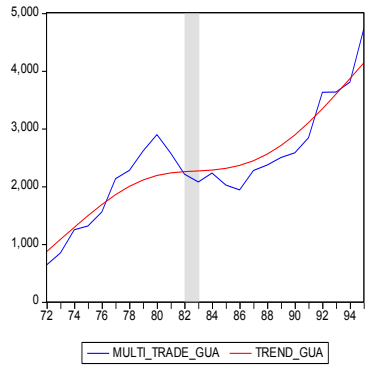
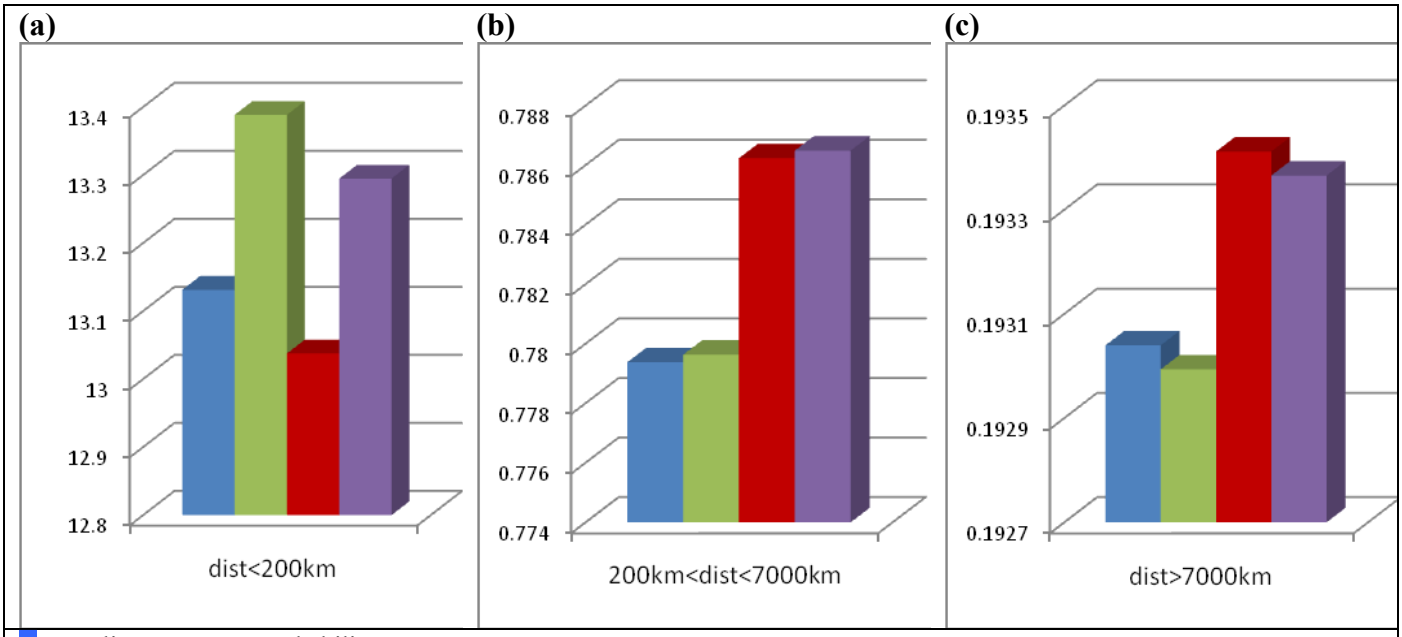


Figure2. Quantifying the impact of bilateral and global trade integration on military conflicts depending on geographical proximity (from column (4) of Table 4)



Number of observations		
198 (19 country-pairs)	131002 (5909 country-pairs)	103085 (4922 country-pairs)

Table 1: Militarized Interstate Disputes, 1950–2000

		Full Sample		Regression Sample	
		Pair-year Observations	%	Pair-year Observations	%
All dyads		572246		243225	
Non-Fighting dyads		569960		241979	
Fighting(MID) dyads		2286	100.00	1246	100.00
Hostility level	3 (Display of Force)	528	23.10	359	28.81
	4 (Use of force)	1494	65.35	837	67.17
	5 (War)	264	11.55	50	4.01

Source: Constructed from the Database of the "Correlates Of War (COW)" project with Maoz correction: Zeev Maoz (2005), Dyadic MID Dataset (version 2.0): http://psfaculty.ucdavis.edu/zmaoz/dyadmid.html

Table 2: Top 15 Countries Most Frequently Involved in the Militarized Interstate Disputes (MID), 1950–2000

No	Country	# of MIDs	5 (War)	4 (Use of Force)	3 (Display of Force)	2 (Threats)	The country's participation in total MID events (%)
1	United States	160	3	55	92	10	10.97
2	USSR/Russia	119	1	61	47	10	8.16
3	China, People's Rep. of	113	4	73	28	8	7.75
4	Iran	105	1	83	18	3	7.20
5	Israel	95	5	69	18	3	6.52
6	Iraq	84	3	69	11	1	5.76
7	India	72	3	44	19	6	4.94
8	Syria	68	4	51	12	1	4.66
9	Turkey	61	2	33	17	9	4.18
10	Egypt	60	5	33	19	3	4.12
11	United Kingdom	57	4	23	25	5	3.91
12	Thailand	46	2	27	14	3	3.16
13	Pakistan	45	2	35	5	3	3.09
13	Korea, Republic of	45	2	36	6	1	3.09
15	France	41	3	22	13	3	2.81

Table 3: Summary Statistics

	(1) All (N=243,225)			(2) Conflict (N=1,246)		(3) No-Conflict (N=241,979)	
Variable	**Mean**	**Median**	**Std. Dev.**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev.**
Military Interstate Disputes	0.0051	0	0.0714	1	0	0	0
Bilateral trade dependence (2 years lagged)	0.002	0.0003	0.0073	0.0062	0.0145	0.002	0.0073
Global trade openness (2 years lagged)	0.4849	0.4206	0.3702	0.3504	0.281	0.4856	0.3705
Contiguity	0.0412	0	0.1988	0.6051	0.489	0.0383	0.192
Distance (log)	8.6005	8.77	0.8285	7.3542	1.1773	8.6069	0.8215
Relative military capability (2 years lagged)	2.2485	1.91	1.6941	1.8587	1.5456	2.2505	1.6946
Major powers dummy	0.102	0	0.3026	0.3242	0.4683	0.1009	0.3011
Joint democracy index (2 years lagged)	0.3204	0.15	0.3359	0.2181	0.2664	0.3209	0.3361
UN voting correlation (2 years lagged)	0.6513	0.713	0.2885	0.5721	0.4320	0.6518	0.2875
Alliance (2 years lagged)	0.1057	0	0.3074	0.3042	0.4602	0.1046	0.3061
Oil exporters dummy	0.1692	0	0.3723	0.2006	0.4006	0.1661	0.3721
Religious Similarity (2 years lagged)	-0.2230	-0.348	0.5771	0.0414	0.6334	-0.2244	0.5765
Common language	0.1553	0	0.3622	0.2801	0.4492	0.1547	0.3616
Pair ever in colonial relationship	0.0211	0	0.1436	0.0811	0.2730	0.0207	0.1425
Common colonizer	0.0882	0	0.2836	0.1067	0.3089	0.0881	0.2835
FTA/RTA dummy (2 years lagged)	0.0172	0	0.1300	0.0233	0.1508	0.0172	0.1299
Either GATT members dummy (2 years lagged)	0.4420	0	0.4966	0.4687	0.4992	0.4418	0.4966
Both GATT members dummy (2 years lagged)	0.4600	0	0.4984	0.3435	0.4751	0.4606	0.4984
Zero trade dummy (2 years lagged)	0.1016	0	0.3022	0.0570	0.2319	0.1019	0.3025
Number of other conflicts at t	48.8426	45	14.2052	49.3507	13.9630	48.8400	14.2064
Number of Peace years	23.1054	23	12.9263	6.9270	11.4979	23.1887	12.8807

Note: See the text for an explanation of variables.

Table 4: Determinants of Militarized Interstate Disputes

	(1)	(2)	(3)	(4)	(5)
Bilateral trade dependence(t-2)	-8.968**		-7.854	-82.594***	23.919***
	[4.487]		[5.344]	[24.514]	[4.638]
Global trade Openness(t-2)		-1.692***	-1.661***	1.963	-1.671***
		[0.427]	[0.429]	[1.195]	[0.548]
Distance(log)×Bilateral trade dependence				11.789***	
				[3.030]	
Distance(log)× Global openness				-0.420**	
				[0.171]	
Contiguity × Bilateral trade dependence					-34.552***
					[6.246]
Contiguity× Global openness					1.192**
					[0.585]
Contiguity	2.424***	2.169***	2.194***	1.828***	1.626***
	[0.194]	[0.188]	[0.189]	[0.179]	[0.249]
Distance(log)	-0.368***	-0.412***	-0.426***	-0.312***	-0.397***
	[0.064]	[0.066]	[0.070]	[0.100]	[0.076]
Relative Military Capability ratio (t-2)	-0.231***	-0.215***	-0.219***	-0.166***	-0.173***
	[0.042]	[0.042]	[0.042]	[0.038]	[0.038]
Major powers dummy	1.974***	1.649***	1.706***	1.498***	1.531***
	[0.175]	[0.183]	[0.181]	[0.155]	[0.155]
Joint democracy index(t-2)	-1.160***	-1.145***	-1.072***	-1.193***	-1.170***
	[0.249]	[0.252]	[0.251]	[0.223]	[0.221]
UN voting (t-2)	-0.778***	-0.746***	-0.753***	-0.505***	-0.532***
	[0.208]	[0.198]	[0.198]	[0.179]	[0.181]
Alliance(t-2)	0.192	0.223	0.236	0.224	0.230*
	[0.171]	[0.164]	[0.163]	[0.142]	[0.135]
Oil exporters dummy	0.480***	0.638***	0.648***	0.504***	0.485***
	[0.138]	[0.136]	[0.136]	[0.117]	[0.114]
Religious Similarity(t-2)	-0.254	-0.245	-0.243	-0.2	-0.193
	[0.169]	[0.159]	[0.156]	[0.127]	[0.125]
Common Language	0.312	0.293	0.314*	0.159	0.154
	[0.193]	[0.187]	[0.187]	[0.165]	[0.159]
Pair ever in colonial relationship	0.194	0.13	0.158	0.116	0.085
	[0.242]	[0.241]	[0.233]	[0.197]	[0.196]
Common colonizer	-0.323	-0.296	-0.304	-0.144	-0.119
	[0.267]	[0.253]	[0.251]	[0.212]	[0.204]
FTA/RTA dummy(t-2)	-0.756***	-0.857***	-0.775***	-0.812***	-0.872***
	[0.229]	[0.231]	[0.223]	[0.214]	[0.206]
Either GATT member dummy(t-2)	0.237	0.21	0.195	0.19	0.197
	[0.180]	[0.175]	[0.174]	[0.145]	[0.142]
Both GATT members dummy(t-2)	0.632***	0.526***	0.520***	0.497***	0.501***
	[0.190]	[0.187]	[0.186]	[0.160]	[0.158]
Zero trade dummy(t-2)	-0.098	-0.103	-0.133	-0.168	-0.172
	[0.186]	[0.185]	[0.187]	[0.175]	[0.176]
Number of other conflicts(t)	0.202***	0.220***	0.222***	0.416***	0.420***
	[0.042]	[0.044]	[0.043]	[0.054]	[0.054]
Number of Peace years	-0.127***	-0.125***	-0.124***	-0.607***	-0.603***
	[0.008]	[0.007]	[0.007]	[0.033]	[0.034]
Year Dummy	Yes	Yes	Yes	Yes	Yes
Cubic Spline(Dyadic War lags)	No	No	No	Yes	Yes
Method	Logit	Logit	Logit	Logit	Logit
Observations	243225	243225	243225	243225	243225
R-squared	0.37	0.375	0.376	0.435	0.435

Note: The dependent variable is a binary variable for a militarized conflict between a dyad of states. All time-varying explanatory variables are lagged by 2 years. The estimation allows for clustering of the error terms over time for country pairs. Clustered robust standard errors of the estimated coefficients are reported in bracket. ***, ** and * indicate that the estimated coefficients are statistically significant at 1 %, 5 %, and 10% respectively.

Table 5: Robustness Check (Other methods and trade integration measurements)

	3 years lagged trade variables			Other Trade Dependence- The log of the arithmetic average			Skewed-logit (scobit)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bilateral trade dependence	-6.573	-82.636***	23.974***	-0.86	-13.365***	2.923***	-7.011	-93.519***	28.955***
	[5.376]	[23.743]	[4.437]	[1.257]	[3.917]	[0.398]	[6.693]	[29.193]	[6.645]
Global trade Openness	-1.483***	2.572*	-1.767***	-0.714***	0.577	-0.723***	-1.778***	3.144*	-1.511**
	[0.459]	[1.341]	[0.638]	[0.122]	[0.530]	[0.133]	[0.477]	[1.888]	[0.610]
Distance(log)×Bilateral trade dependence		11.901***			1.740***			13.853***	
		[2.922]			[0.428]			[3.771]	
Distance(log)× Global openness		-0.489**			-0.142**			-0.589**	
		[0.191]			[0.069]			[0.267]	
Contiguity × Bilateral trade dependence			-33.480***			-6.342***			-39.284***
			[5.735]			[1.322]			[8.769]
Contiguity× Global openness			1.561**			0.436***			0.868
			[0.655]			[0.164]			[0.684]
Contiguity	2.122***	1.726***	1.400***	2.125***	1.802***	2.172***	2.508***	2.449***	2.364***
	[0.193]	[0.180]	[0.269]	[0.182]	[0.178]	[0.216]	[0.208]	[0.204]	[0.320]
Distance(log)	-0.418***	-0.281***	-0.385***	-0.435***	-0.511***	-0.415***	-0.525***	-0.454***	-0.596***
	[0.071]	[0.108]	[0.076]	[0.067]	[0.096]	[0.078]	[0.101]	[0.130]	[0.086]
Relative Military Capability ratio	-0.212***	-0.153***	-0.164***	-0.188***	-0.160***	-0.180***	-0.246***	-0.204***	-0.207***
	[0.042]	[0.038]	[0.038]	[0.044]	[0.040]	[0.039]	[0.047]	[0.046]	[0.046]
Major powers	1.689***	1.456***	1.493***	1.553***	1.445***	1.467***	2.019***	1.966***	2.006***
	[0.182]	[0.156]	[0.155]	[0.184]	[0.161]	[0.159]	[0.228]	[0.188]	[0.189]
Joint democracy index	-0.986***	-1.009***	-0.988***	-1.099***	-1.154***	-1.116***	-1.264***	-1.671***	-1.678***
	[0.236]	[0.205]	[0.202]	[0.254]	[0.220]	[0.220]	[0.290]	[0.269]	[0.270]
UN voting	-0.645***	-0.343*	-0.370**	-0.768***	-0.516***	-0.526***	-0.845***	-0.749***	-0.781***
	[0.196]	[0.176]	[0.177]	[0.196]	[0.181]	[0.179]	[0.208]	[0.196]	[0.195]
Alliance	0.17	0.127	0.132	0.18	0.188	0.172	0.24	0.22	0.252
	[0.160]	[0.137]	[0.130]	[0.164]	[0.141]	[0.132]	[0.185]	[0.173]	[0.169]
Oil exporters dummy	0.660***	0.518***	0.498***	0.695***	0.583***	0.554***	0.640***	0.474***	0.459***
	[0.138]	[0.116]	[0.113]	[0.139]	[0.120]	[0.118]	[0.149]	[0.141]	[0.138]
Religious Similarity	-0.234	-0.189	-0.185	-0.234	-0.184	-0.188	-0.274*	-0.201	-0.193
	[0.154]	[0.121]	[0.120]	[0.154]	[0.124]	[0.122]	[0.161]	[0.141]	[0.140]
Common Language	0.268	0.107	0.101	0.311*	0.147	0.142	0.349*	0.251	0.248
	[0.185]	[0.161]	[0.154]	[0.189]	[0.163]	[0.156]	[0.203]	[0.182]	[0.179]
Pair ever in colonial relationship	0.194	0.159	0.137	0.196	0.199	0.136	0.11	0.066	0.02
	[0.227]	[0.183]	[0.183]	[0.244]	[0.199]	[0.197]	[0.276]	[0.272]	[0.271]
Common colonizer	-0.266	-0.086	-0.048	-0.326	-0.137	-0.134	-0.469	-0.429*	-0.421*
	[0.246]	[0.206]	[0.198]	[0.248]	[0.208]	[0.202]	[0.289]	[0.260]	[0.254]
FTA/RTA dummy	-0.867***	-0.930***	-1.006***	-0.800***	-0.839***	-0.853***	-0.974***	-1.208***	-1.257***
	[0.224]	[0.217]	[0.209]	[0.229]	[0.213]	[0.206]	[0.269]	[0.305]	[0.293]
Either GATT member dummy	0.209	0.191	0.199	0.204	0.183	0.178	0.23	0.328*	0.341**
	[0.182]	[0.154]	[0.149]	[0.175]	[0.146]	[0.140]	[0.188]	[0.168]	[0.167]
Both GATT members dummy	0.548***	0.484***	0.489***	0.530***	0.500***	0.470***	0.644***	0.725***	0.744***
	[0.189]	[0.162]	[0.159]	[0.186]	[0.161]	[0.157]	[0.216]	[0.194]	[0.195]
Zero trade dummy	-0.184	-0.171	-0.175	-0.11	-0.169	-0.183	-0.118	-0.058	-0.066
	[0.197]	[0.188]	[0.188]	[0.189]	[0.176]	[0.176]	[0.199]	[0.199]	[0.199]
Number of other conflicts(t)	0.232***	0.446***	0.449***	0.214***	0.414***	0.413***	0.263***	0.610***	0.611***
	[0.043]	[0.054]	[0.054]	[0.043]	[0.054]	[0.054]	[0.049]	[0.078]	[0.078]
Number of Peace years	-0.130***	-0.606***	-0.601***	-0.124***	-0.605***	-0.598***	-0.131***	-0.843***	-0.839***
	[0.007]	[0.032]	[0.032]	[0.007]	[0.033]	[0.034]	[0.007]	[0.050]	[0.051]
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cubic Splines (War lags)	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	233167	233167	233167	243225	243225	243225	243225	243225	243225
R-squared	0.382	0.443	0.444	0.378	0.436	0.437	--	--	--

Note: Clustered robust standard errors by dyads are reported in bracket. Intercept and year dummies are included(not reported).
Skewness parameters(α) for columns (7)-(9) are 0.223, 0.134 and 0.135 respectively.

Table 6: Instrument Variable Estimation: First Stage Regression of column (1), table 7

Dependent Variables	Bilateral Trade Dependence	Global Trade Openness
EU GSP IV	-0.00002*	0.004***
	[0.00001]	[0.0009]
Remoteness IV	0.0022***	-0.0368***
	[0.0007]	[0.0094]
Number of trading partners IV	0.00004***	0.0009***
	[0.00001]	[0.0001]
Contiguity	0.0057***	-0.1005***
	[0.0011]	[0.0141]
Distance(Log)	-0.002***	-0.0223***
	[0.0003]	[0.0045]
Relative Military Capability(t-2)	-0.0001***	0.0053***
	[0.00003]	[0.0019]
Major powers dummy	0.0034***	-0.1541***
	[0.0004]	[0.0080]
Joint democracy index(t-2)	0.0013***	0.0627***
	[0.0003]	[0.0067]
UN voting(t-2)	-0.0004**	0.0091
	[0.0002]	[0.0079]
Alliance(t-2)	-0.0003	-0.0098
	[0.0005]	[0.0094]
Oil exporters dummy	0.0015***	0.0354***
	[0.0002]	[0.0069]
Religious Similarity(t-2)	-0.0003***	-0.0003
	[0.0001]	[0.0043]
Common Language	0.00004	0.0370***
	[0.0004]	[0.0125]
Pair ever in colonial relationship	0.005***	-0.0255
	[0.0008]	[0.0167]
Common colonizer	0.0003	0.0548***
	[0.0005]	[0.0128]
FTA/RTA dummy(t-2)	0.0094***	0.0104
	[0.0014]	[0.0129]
Either GATT member dummy(t-2)	0.00003	-0.0319***
	[0.0002]	[0.0102]
Both GATT members dummy(t-2)	0.0003	-0.1100***
	[0.0002]	[0.0103]
Zero trade dummy(t-2)	-0.0006***	0.0740***
	[0.0001]	[0.0101]
Number of other conflicts(t)	-0.00005*	-0.001*
	[0.00003]	[0.0006]
Number of Peace years	0.0002***	0.0268***
	[0.00007]	[0.002]
F-test on IVs	10.15	58.49
Stock and Yogo weak IV F-statistic	56.37	
Critical value for highest quality IV (10% maximal IV size)	13.43	
Observations	219590	219590
(Uncentered) R-square	0.266	0.694

Note: Clustered robust standard errors by dyads are in brackets. The first stage regressions that include interaction terms with distance and contiguity are similar with the above results. Moreover, the results of first stage regression of IV probit are qualitatively same as the above.

Table 7: Instrument Variable Estimation: Second Stage IV Regression

	(1)	(2)	(3)	(4)
Bilateral trade dependence(t-2)	-1.088*	-16.857	-9.111**	-0.353
	[0.646]	[29.828]	[3.984]	[1.791]
Global trade Openness(t-2)	-0.050***	-1.935***	0.06	-0.051***
	[0.011]	[0.644]	[0.095]	[0.011]
Distance(log)×Bilateral trade dependence			1.185**	
			[0.584]	
Distance(log)× Global openness			-0.014	
			[0.011]	
Contiguity × Bilateral trade dependence				-1.698
				[4.232]
Contiguity× Global openness				-0.074
				[0.237]
Contiguity	0.052***	0.679***	0.059***	0.096
	[0.007]	[0.219]	[0.009]	[0.066]
Distance(log)	-0.005***	-0.247***	-0.0001	-0.005**
	[0.001]	[0.052]	[0.005]	[0.002]
Relative Military Capability ratio(t-2)	0	-0.057***	-0.0001	-0.0003
	[0.000]	[0.016]	[0.0002]	[0.0002]
Major powers	0.004	0.425***	-0.002	0.002
	[0.003]	[0.150]	[0.003]	[0.003]
Joint democracy index(t-2)	0.001	-0.219**	0.001	0.001
	[0.001]	[0.103]	[0.002]	[0.002]
UN voting (t-2)	-0.004***	-0.205***	-0.003*	-0.004**
	[0.002]	[0.072]	[0.002]	[0.002]
Alliance(t-2)	-0.004**	0.035	-0.007***	-0.005
	[0.002]	[0.065]	[0.002]	[0.003]
Oil exporters dummy	0.005***	0.296***	0.002	0.005
	[0.001]	[0.070]	[0.002]	[0.004]
Religious Similarity(t-2)	-0.001*	-0.077	-0.001	-0.001
	[0.001]	[0.047]	[0.001]	[0.001]
Common Language	0.003**	0.120*	0.004**	0.003**
	[0.001]	[0.068]	[0.002]	[0.002]
Pair ever in colonial relationship	0.006	0.118	-0.005	0.001
	[0.005]	[0.168]	[0.006]	[0.007]
Common colonizer	0.003*	0.023	0.003	0.002
	[0.002]	[0.105]	[0.002]	[0.002]
FTA/RTA dummy(t-2)	-0.004	-0.232	0.002	-0.002
	[0.006]	[0.299]	[0.007]	[0.007]
Either GATT member dummy(t-2)	0	0.031	-0.002	-0.001
	[0.001]	[0.068]	[0.002]	[0.002]
Both GATT members dummy(t-2)	-0.002	0.002	-0.005**	-0.003
	[0.002]	[0.105]	[0.002]	[0.002]
Zero trade dummy(t-2)	0.005***	0.049	0.008***	0.005**
	[0.001]	[0.092]	[0.002]	[0.002]
Number of other conflicts(t)	0.007***	0.217***	0.007***	0.007***
	[0.001]	[0.025]	[0.001]	[0.001]
Number of Peace years	-0.022***	-0.217***	-0.021***	-0.021***
	[0.002]	[0.023]	[0.002]	[0.002]
Year dummy	Yes	Yes	Yes	Yes
Cubic Spline(Dyadic war lags dummy)	Yes	Yes	Yes	Yes
Sargan-Hansen's over-identification (p-value)	0.898 (0.343)	2.742 (0.1)	5.03 (0.08)	1.333 (0.513)
Method	IV LPM	IV Probit	IV LPM	IV LPM
Observations	219590	219590	219590	219590
R-squared	0.057	--	0.028	0.043

Note: Clustered robust standard errors by dyads and bootstrap standard errors—column (2)—are reported. IV probit estimation with clustered bootstrap is reported in column (2).

Table 8: Comparison with MMT (2008)

	Contiguous pairs		Contiguous pairs and <1000km		Full Sample				
	(1)	(1)-1	(2)	(2)-1	(3)	(4)	(5)	(6)	(7)
ln bil. Openness t-4	-0.09***	-0.034	-0.127**	-0.042	0.016	0.023	0.028	-0.292**	-0.488***
	[0.032]	[0.040]	[0.050]	[0.055]	[0.033]	[0.034]	[0.029]	[0.129]	[0.139]
ln mult. Opennes t-4	0.039	-0.03	0.275**	0.17	-0.288***	-0.237**	-0.153*	1.273***	0.866
	[0.106]	[0.118]	[0.124]	[0.158]	[0.093]	[0.100]	[0.093]	[0.438]	[0.548]
# of peace years	-0.07***	-0.058***	-0.060***	-0.049***	-0.054***	-0.051***	-0.182***	-0.018***	-0.179***
	[0.011]	[0.011]	[0.014]	[0.012]	[0.005]	[0.005]	[0.009]	[0.002]	[0.009]
Distance(log)	-0.088	-0.159	0.206	0.285	-0.594***	-0.635***	-0.528***	-0.578***	-0.234
	[0.111]	[0.128]	[0.222]	[0.248]	[0.089]	[0.100]	[0.081]	[0.166]	[0.202]
Contiguity					1.738***	1.806***	1.350***	1.389***	1.371***
					[0.242]	[0.263]	[0.217]	[0.186]	[0.206]
ln distance * ln mult. Openness								-0.174***	-0.131*
								[0.055]	[0.071]
ln distance * ln bil. Openness								0.045***	0.069***
								[0.017]	[0.018]
Zero trade t-4		0.303		0.448	-0.294	-0.19	-0.153	-0.283*	-0.144
		[0.231]		[0.294]	[0.196]	[0.199]	[0.181]	[0.158]	[0.177]
UN vote correlation (t-4)		-0.047		0.036	-1.224***	-1.057***	-0.803***	-0.761***	-0.701***
		[0.269]		[0.376]	[0.190]	[0.198]	[0.177]	[0.151]	[0.179]
Sum of democracy		0.445**		0.529**	-0.038	-0.064	-0.223	-0.250**	-0.211
		[0.193]		[0.242]	[0.176]	[0.178]	[0.151]	[0.125]	[0.149]
# other wars in t		0.180***		0.175***	0.245***	0.238***	0.215***	0.228***	0.216***
		[0.034]		[0.050]	[0.010]	[0.011]	[0.010]	[0.010]	[0.010]
ln distance to nearest war in t		0.061		0.113	0.217***	0.242***	0.135*	0.146**	0.143*
		[0.102]		[0.131]	[0.082]	[0.086]	[0.078]	[0.072]	[0.079]
Alliance		-0.176		-0.159	-0.07	-0.092	-0.038	0.06	-0.075
		[0.191]		[0.287]	[0.191]	[0.202]	[0.164]	[0.120]	[0.161]
Common language		0.18		-0.107	0.414**	0.468**	0.343*	0.307**	0.318
		[0.254]		[0.322]	[0.202]	[0.227]	[0.200]	[0.134]	[0.194]
Pair ever in colonial relationship		0.024		0.075	0.233	0.269	0.183	0.347*	0.195
		[0.286]		[0.393]	[0.334]	[0.333]	[0.265]	[0.202]	[0.257]
Common colonizer		0.016		-0.185	0.062	0.044	0.142	0.111	0.132
		[0.284]		[0.411]	[0.270]	[0.271]	[0.243]	[0.184]	[0.240]
Free trade area (full set)		-0.24		-0.32	-0.428	-0.653**	-0.615***	-0.375**	-0.538**
		[0.263]		[0.291]	[0.274]	[0.269]	[0.233]	[0.179]	[0.226]
# of GATT members		-0.191		-0.278*	-0.097	-0.073	0.043	0.071	0.025
		[0.129]		[0.158]	[0.107]	[0.112]	[0.098]	[0.085]	[0.096]
Major powers		-1.765***		-2.584***		0.552***	0.486**	0.666***	0.346*
		[0.488]		[0.764]		[0.208]	[0.196]	[0.152]	[0.198]
Oil exporters dummy		-0.141		0.012		0.183	0.043	0.183	0.012
		[0.275]		[0.388]		[0.173]	[0.150]	[0.123]	[0.145]
Religious Similarity (t-4)		-0.389		-0.117		-0.176	-0.138	-0.051	-0.129
		[0.250]		[0.297]		[0.189]	[0.152]	[0.096]	[0.150]
Relative Military Capability(t-4)		-0.05		-0.003		-0.126**	-0.091*	-0.085**	-0.096*
		[0.078]		[0.150]		[0.059]	[0.053]	[0.043]	[0.050]
Year dummy	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Dyadic war lags	No	No	No	No	No	No	Y(spline)	Yes	Y(spline)
Method	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Observations	7826	6780	4558	3822	227613	221334	221334	221334	221334
Pseudo- R square	0.175	0.246	0.188	0.265	0.458	0.461	0.519	0.552	0.521

Table 9: Impact of Military Conflicts on Bilateral Trade Dependence

Dependent Variable	Bilateral Trade Dependence		
	(1)	(2)	(3)
Conflict(t)	-0.00128***	-0.00122***	-0.00032
	[0.00037]	[0.00038]	[0.00023]
Conflict(t-1)	-0.00121***	-0.00123***	-0.00059***
	[0.00029]	[0.00030]	[0.00020]
Conflict(t-2)	-0.00115***	-0.00117***	-0.00052**
	[0.00028]	[0.00029]	[0.00021]
Conflict(t-3)	-0.00095***	-0.00091***	-0.00025
	[0.00027]	[0.00028]	[0.00016]
Conflict(t-4)	-0.00116***	-0.00113***	-0.00064***
	[0.00031]	[0.00032]	[0.00014]
Conflict(t-5)	-0.00160***	-0.00153***	-0.00072***
	[0.00036]	[0.00036]	[0.00019]
Square root of Product GDP	0.00986***	0.01001***	0.00465***
	[0.00137]	[0.00138]	[0.00096]
Square root of Product GDP per capita	0.12639***	0.15412***	-0.05904**
	[0.02069]	[0.02102]	[0.02899]
Remoteness	0.00173***	0.00177***	0.00285***
	[0.00046]	[0.00048]	[0.00102]
Number of trading partners	0.00002***	0.00004***	0.00003***
	[0.00001]	[0.00001]	[0.00001]
GSP dummy	0.00016	0.00055***	-0.00047***
	[0.00012]	[0.00014]	[0.00012]
Contiguity	0.00624***	0.00625***	--
	[0.00119]	[0.00119]	
Distance(log)	-0.00196***	-0.00222***	--
	[0.00022]	[0.00024]	
Log Product land areas	-0.00008**	-0.00003	--
	[0.00003]	[0.00003]	
Common language	-0.00003	0.00001	--
	[0.00040]	[0.00041]	
Common colonizers	0.00025	0.00035	--
	[0.00050]	[0.00054]	
Pair ever in colonial relationship	0.00569***	0.00605***	--
	[0.00091]	[0.00091]	
FTA/RTA dummy	0.00825***	0.00794***	0.00448***
	[0.00117]	[0.00115]	[0.00053]
Both GATT members dummy	0.00011	0.00003	0.00016*
	[0.00011]	[0.00011]	[0.00008]
Year dummy	Yes	Yes	Yes
Method	OLS	Tobit	Fixed Effect
Observations	252518	252518	252518
R-squared	0.228	--	0.796

Note: Clustered robust standard errors by dyads are in brackets. The results without the contemporaneous military conflict (t) is also qualitatively the same.

Table 10: Impact of Military Conflicts on Global Trade Integration

Dependent Variable	Global Trade Openness	
	(1)	(2)
Conflict(t)	-0.01829***	0.00641
	[0.00666]	[0.00468]
Conflict(t-1)	-0.03095***	-0.01333***
	[0.00538]	[0.00488]
Conflict(t-2)	-0.02734***	-0.00821**
	[0.00542]	[0.00351]
Conflict(t-3)	-0.02077***	-0.00258
	[0.00477]	[0.00360]
Conflict(t-4)	-0.02167***	-0.00469
	[0.00410]	[0.00313]
Conflict(t-5)	-0.02927***	-0.00610*
	[0.00543]	[0.00358]
Square root of Product GDP of Partners of dyads(*i,j*)	0.00005***	0.00002***
	[0.00000]	[0.00000]
Square root of Product GDP per capita of Partners of dyads(*i,j*)	0.03057***	-0.00425
	[0.00171]	[0.00280]
Remoteness	-0.02178***	0.55209***
	[0.00713]	[0.04187]
Number of trading partners	0.00091***	0.00338***
	[0.00010]	[0.00027]
EU GSP*Distance(t-4)	0.00183**	-0.00043
	[0.00080]	[0.00070]
Contiguity	-0.05716***	--
	[0.01351]	
Distance(log)	-0.02004***	--
	[0.00388]	
FTA/RTA dummy	-0.00483	0.01209*
	[0.00944]	[0.00633]
Number of countries in Common language with dyads(i,j)	0.00122***	0.00136***
	[0.00012]	[0.00023]
One of dyads in GATT (Excluding Both GATT)	0.05453***	0.03032***
	[0.00533]	[0.00465]
Number of other conflicts in t	-0.00601***	-0.00211***
	[0.00028]	[0.00036]
Zero trade dummy	0.05600***	0.01312*
	[0.00922]	[0.00737]
Year dummy	Yes	Yes
Method	OLS	Fixed Effect
Observations	252665	252665
R-squared	0.174	0.681

Note: Clustered robust standard errors by dyads are in brackets. The results without the contemporaneous military conflict (t) is also qualitatively the same.

Appendix 1: Derivation of Equation (6)

In order to get change in utility by conflict, we totally differentiate equation (5) with respect to x and change the elasticity form. L is a percent change(decrease) of welfare by conflict

(6) $$L = \frac{dU_i}{dx}\frac{x}{U_i} = \frac{\partial U_i}{\partial y_i}\frac{y_i}{U_i}\frac{dy_i}{y_i} + \frac{\partial U_i}{\partial y_j}\frac{y_j}{U_i}\frac{dy_j}{y_j} + \frac{\partial U_i}{\partial t_{ij}}\frac{t_{ij}}{U_i}\frac{dt_{ij}}{t_{ij}} + \frac{\partial U_i}{\partial t_{ih}}\frac{t_{ih}}{U_i}\frac{dt_{ih}}{t_{ih}}$$

$$= \frac{\partial U_i}{\partial y_i}\frac{y_i}{U_i}\lambda + \frac{\partial U_i}{\partial y_j}\frac{y_j}{U_i}\lambda + \frac{\partial U_i}{\partial t_{ij}}\frac{t_{ij}}{U_i}(-\tau_{bil}) + \frac{\partial U_i}{\partial t_{ih}}\frac{t_{ih}}{U_i}(-\tau_{mul})$$

By i') , ii') , iii') and iv')

$$= \left(1 + \frac{\sigma}{\sigma - 1}\frac{m_{ii}}{y_i}\right)\lambda + \left(\frac{\sigma}{\sigma - 1}\frac{m_{ij}}{y_i}\right)\lambda + \sigma\left(\frac{m_{ij}}{y_i}\right)\tau_{bil} + \sigma\left(\sum_{h\neq i,j}^{N}\frac{m_{ih}}{y_i}\right)\tau_{mul}$$

$$= \left[(1 + \frac{\sigma}{\sigma - 1})\cdot\lambda + \sigma\cdot\tau_{bil}M_{ij} + \sigma\left(\tau_{mul} - \frac{\lambda}{\sigma - 1}\right)\left(\sum_{h\neq i,j}^{N}M_{ih}\right)\right]$$

where national identity holds, $\frac{m_{ii}}{y_i} + \frac{m_{ij}}{y_i} + \sum_{h\neq i,j}^{N}\left(\frac{m_{ih}}{y_i}\right) = 1$, and $M_{ij} = \left(\frac{m_{ij}}{y_i}\right), M_{ih} = \left(\frac{m_{ih}}{y_i}\right)$.

i) $$\frac{\partial U_i}{\partial y_i} = \frac{U_i}{y_i} + y_w^{\frac{\sigma}{1-\sigma}}\frac{y_i}{P_i^{1-\sigma}}\left[\sum_{h=1}^{N}\left(\frac{t_{ih}}{P_h}\right)^{1-\sigma}y_h\right]^{\frac{\sigma}{\sigma-1}-1}\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{t_{ii}}{P_i}\right)^{1-\sigma}$$

$$= \frac{U_i}{y_i}\left[1 + \frac{\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{t_{ii}}{P_i}\right)^{1-\sigma}y_i}{\sum_{h=1}^{N}\left(\frac{t_{ih}}{P_h}\right)^{1-\sigma}y_h}\right]$$

Therefore,

i') $$\frac{\partial U_i}{\partial y_i}\frac{y_i}{U_i} = \left[1 + \left(\frac{\sigma}{\sigma-1}\right)\frac{\left(\frac{t_{ii}}{P_i}\right)^{1-\sigma}y_i}{\sum_{h=1}^{N}\left(\frac{t_{ih}}{P_h}\right)^{1-\sigma}y_h}\right]$$ by multiplying the second term by $p_i^{1-\sigma}$

$$= 1 + \frac{\sigma}{\sigma - 1} \frac{m_{ii}}{\sum_{h=1}^{N} m_{ih}} \quad \text{,where } m_{ii} = \left(\frac{p_i t_{ii}}{P_i} \right)^{1-\sigma} \cdot y_i \text{ and } \sum_{h=1}^{N} m_{ih} = \sum_{h=1}^{N} \left(\frac{p_i t_{ih}}{P_h} \right)^{1-\sigma} y_h$$

$$= 1 + \frac{\sigma}{\sigma - 1} \frac{m_{ii}}{y_i} \qquad (\because \sum_{h=1}^{N} m_{ih} = y_i).$$

ii) $$\frac{\partial U_i}{\partial y_j} = \frac{U_i}{y_j} \times \left(\frac{\sigma}{\sigma - 1} \right) \frac{\left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} y_j}{\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h}$$

Therefore,

ii') $$\frac{\partial U_i}{\partial y_j} \frac{y_j}{U_i} = \left(\frac{\sigma}{\sigma - 1} \right) \frac{\left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} y_j}{\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h} = \left(\frac{\sigma}{\sigma - 1} \right) \frac{m_{ji}}{\sum_{h=1}^{N} m_{ih}} \quad \text{where, } m_{ji} = \left(\frac{p_i t_{ij}}{P_j} \right)^{1-\sigma} \cdot y_j$$

$$= \left(\frac{\sigma}{\sigma - 1} \right) \frac{m_{ji}}{y_i} = \left(\frac{\sigma}{\sigma - 1} \right) \frac{m_{ij}}{y_i} \quad (\because \textit{symmetric equlibrium}).$$

iii) $$\frac{\partial U_i}{\partial t_{ij}} = y_w^{\frac{\sigma}{1-\sigma}} \frac{y_i}{P_i^{1-\sigma}} \left(\frac{\sigma}{\sigma - 1} \right) \left[\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h \right]^{\frac{\sigma}{\sigma-1}-1} (1-\sigma) y_j \cdot \frac{1}{P_j^{1-\sigma}} \cdot t_{ij}^{-\sigma}$$

$$= \frac{U_i}{t_{ij}} \times (-\sigma) \left[\frac{\left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} y_j}{\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h} \right]$$

Therefore,

iii') $$\frac{\partial U_i}{\partial t_{ij}} \frac{t_{ij}}{U_i} = -\sigma \left[\frac{\left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} y_j}{\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h} \right] = -\sigma \cdot \frac{m_{ij}}{y_i}.$$

iv) $$\frac{\partial U_i}{\partial t_{ih}} = y_w^{\frac{\sigma}{1-\sigma}} \frac{y_i}{P_i^{1-\sigma}} \left(\frac{\sigma}{\sigma - 1} \right) \left[\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h \right]^{\frac{\sigma}{\sigma-1}-1} (1-\sigma) \sum_{h \neq i,j}^{N} y_h \cdot \frac{1}{P_h^{1-\sigma}} \cdot t_{ih}^{-\sigma}$$

$$= \frac{U_i}{t_{ih}} \times (-\sigma) \left[\sum_{h \neq i,j}^{N} \frac{\left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h}{\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h} \right]$$

Therefore,

iv') $$\frac{\partial U_i}{\partial t_{ih}} \frac{t_{ih}}{U_i} = -\sigma \left[\sum_{h \neq i,j}^{N} \frac{\left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h}{\sum_{h=1}^{N} \left(\frac{t_{ih}}{P_h} \right)^{1-\sigma} y_h} \right] = -\sigma \sum_{h \neq i,j}^{N} \frac{m_{ih}}{y_i} \quad .$$