Trade policy in the shadow of war: A quantitative toolkit for geoeconomics *

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Abstract

This paper presents a quantitative toolkit for investigating the interplay between international trade and interstate war. A generic modeling framework is first constructed based on two core elements: (i) a structural gravity model of trade and (ii) a game of diplomatic negotiation that aims to deescalate geopolitical tensions and prevent armed conflicts. Methodologically, the setup extends the conventional quantitative procedures of trade policy evaluation to incorporate endogenous conflict risk. A series of empirically relevant scenarios is then simulated to assess the welfare gains of trade in a context of heightened conflict risk. Finally, the framework is used to structure a survey of the existing literature on trade and war.

Keywords: international trade, interstate conflict, opportunity cost of war, geography of import sourcing, economic interdependence, geoeconomic welfare gains

JEL Codes: F1, F5

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1 Introduction

The war in Ukraine and tensions in the Pacific region force economists to move beyond the purely mercantile view of globalization that has prevailed since the 1990s. The vulnerability of global value chains to local disruptions and the intricate consequences of economic sanctions in an interconnected world show that, in the shadow of high-intensity warfare, the design and objectives of trade policy must be reconsidered. In this regard, globalization is gradually shifting from a liberal paradigm to a realist one. Yet, many questions remain open regarding the management of conflict risk in international trade: What is the best strategy for sourcing imports? Is it worth engaging in trade relations that could be disrupted by war, or should risk diversification be favored? Can trading with geopolitical rivals have a pacifying effect?

Montesquieu's view of *Doux Commerce* is arguably a seminal and influential perspective on the trade and war question (Montesquieu, 1748). It is based on the mechanism that trade, by increasing the opportunity cost of war (OCW), contributes to deescalating geopolitical tensions and avoiding military conflicts. In essence, the mechanism is natural, if not obvious. However, the question of its empirical relevance is less clear. Can trade losses associated with war-induced disruption, even if they amount to billions of dollars, truly be equated with the casualties and destruction that occur in war? Can economic calculations really counterbalance the political calculus of big powers? The answer is not trivial and primarily hinges on quantitative analysis.

This paper adopts the perspective of geoeconomics, which can be defined as the study of the interaction between trade, diplomacy and geopolitics. It brings together and organizes insights from a fragmented literature that interssg-lds:tics. internatio-2opw252(traed)-241(an,)-295(tn,)7(geuestecon5(tn,)-217(4 of escalation to armed conflict.

In a second step, the workhorse quantitative trade model, called structural gravity in the litterring the escalation of geopolitical disputes into armed conflicts by exerting discipline during negotiations. However, if negotiations fail, the opportunity cost transforms into the actual cost of war, creating a fundamental tension. On the other hand, countries may be inclined to diversify their import sources and secure supply chains to mitigate the risk of war-induced disruptions. Paradoxically, such diversification reduces economic interdependencies with rivals and can further elevate the risk of conflict. At the global level, this logic can lead to a positive feedback loop between deglobalization and geopolitical risk. The question of which strategy policy makers should pursue remains complex and contingent upon the context. Nonetheless, the quantitative tools presented in this paper prove to be valuable in formulating an answer.

The paper is structured as follows. Section 2 presents some facts on trade and war in the his-border significantly increases trade flows (

Figure 2: Global Trade and Military Spending

Source: Military expenditures are measured in % of GDP and come from the Stockholm International Peace Research the accuracy of their findings. One of the limitations is their focus on politically significant cases involving major powers or neighboring nations. This exclusion of country-pairs with a low likelihood of conflict leads to sample selection biases. Moreover, these studies often fail to consider both the contemporaneous and lagged effects of war on trade or the third-party impacts of bilateral conflict. Additionally, most of these early studies use pooled estimators without pair-specific fixed effects and thus fail to account for the panel dimension of the data.

Empirical studies that use modern techniques from the gravity literature in international trade, such as those conducted by Blomberg and Hess (2006); Martin et al. (2008a,b) and Glick and Taylor (2010), provide precise estimates of the disruptive impact of war on trade. Among them, Glick and Taylor's study covers a particularly long period, spanning from 1870 to 1997, including the two major wars of the twentieth century. Their Figure 1 summarizes the key findings: during a conflict, trade is substantially reduced not only between belligerent nations (85% drop) but also with nations that are not directly involved in the conflict (12% drop). In both cases, trade gradexamine how firm-level trade was affected by the deterioration of France-US relations following the French government's opposition to the US government's request for a UN Security Council mandate to use military force against Iraq in 2002-2003. Despite the absence of risk of bilateral war, economic sanctions, or formal trade barriers, the authors estimate that the change in attitudes led to a reduction in France-US bilateral trade of approximately 9 percent. Similar empirical patterns are documented in the other papers that use disaggregated data to analyze trade disruption caused by violence (Pandya and Venkatesan, 2016; Amodio and Di Maio, 2018; Ksoll et al., 2021).

A quantitative puzzle: the contribution of trade disruption to OCW. The second premise of the *Doux Commerce* argument is that war-induced trade disruption significantly contributes to increasing the opportunity cost of war. Upon initial examination, one might assume that trade losses due to war are insignificant compared to the vast economic and human costs of conflict. Existing research suggests that the welfare costs of interstate conflict are massive (Auray and Eyquem, 2019; Rohner and Thoenig, 2021). In contrast, the typical estimates of the welfare gains from trade are significantly smaller (Costinot and Rodríguez-Clare, 2014; Head and Mayer, 2014).

Surprisingly, there have been few attempts in the literature to assess the contribution of trade disruption to the OCW. To my knowledge, such an exercise has only been conducted by Glick and Taylor (2010). Their analysis shows that trade disruption substantially increased the cost of World War I and II. For example, averaging across all belligerents, they found that the cost of WWII amounted to 6.6% of their permanent flow GDP, while lost trade represented an average of 2.5% of their permanent GDP. This means that for those countries, foregone trade raised the cost of World War II by roughly one-third (2.5/6.6). It is worth noting that their estimates have been obtained with a methodology that predates the general equilibrium framework of structural gravity presented in the next section. Importantly, structural gravity is well suited for quantifying the contribution of trade flows to the OCW, thus filling a gap in the literature.

3.2 A quantitative model of trade and war

In this section, I build a generic model of international trade and interstate war that combines a structural gravity model of trade with a diplomatic game of escalation to conflict. The former provides a robust data-fed method to quantitatively assess the economic impact of war and policy shocks, while the latter addresses a conceptual challenge known as the paradox of war. This paradox captures why rational leaders, given the substantial costs of war, are not always able to deescalate tensions and prevent conflicts. Overall, this generic model streamlines and generalizes the approach of Martin et al. (2008a), which will be referred to as MMT henceforth. In particular, the results on the geoeconomic factors are not covered in their paper.

In the model, the escalation from geopolitical disputes to military conflict is conceptualized as a breakdown in diplomatic negotiations. Out of the many causes for interstate wars, I focus specifically on bargaining failure, for three reasons. First, according to Powell (2006), unresolved which encompasses the widespread uncertainty surrounding tactical military operations, their economic and human costs, the strategic development of the conflict, and its future political resolution. Second, the consideration of commercial interests is an essential component of any negotiation between states, even when the primary objective of the negotiation relates to geopolitical matter. Therefore, diplomacy is a natural margin through which trade acts on conflict. Third, the existing theoretical literature on the interaction between trade and the other causes of interstate wars is limited, with the notable exception of the paper by Bonfatti and O'Rourke (2018) on commitment.

3.2.1 Setup

There are N countries engaged in international trade, which is subject to spatial frictions that hamper the ability of workers to ship their production to non-local markets. These frictions give rise to a gravity equation of trade, which is essential for quantifying the opportunity cost of war. The specific details of the trade model are discussed in Section 3.2.3.

The occurrence of a geopolitical dispute between two potential belligerent countries, labeled i and j, is assumed. The dispute escalates into a war if diplomatic negotiations between their leaders fail. The remaining third countries, denoted as $n \neq i, j$, are considered neutral and do not interfere with the negotiation process to avoid the complexity of modeling third-party intervention. In the model, disputes are treated as exogenous factors, while the likelihood of escalation is endogenous.

The timing of the model is composed of the following stages: (0) dispute arises; (1) leaders of countries i and j choose an optimal negotiation protocol; (2) private information is revealed; (3) depending on the negotiation outcome, either peace or war between countries i and j occurs; (4) production, trade, and consumption are realized for all countries.

Preferences. Leaders care about welfare of the population and balance economic interests against geopolitical considerations when deciding to engage in war. Their utility criterion encompasses the (log of) real consumption C of a representative agent, supplemented by v that represents a state-

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$$U_k(\text{peace}) = \log C_k(\text{peace}) + v_k(\text{peace}), \tag{1}$$

$$\tilde{U}_k(\text{war}) = \log C_k(\text{war}) + v_k(\text{war}) + \tilde{u}_k, \tag{2}$$

where real consumption C_k is determined endogenously by the trade equilibrium, as described in Section 3.2.3. The terms $v_k(\text{peace})$ and $v_k(\text{war})$ represent the exogenous endowments of geopolitical valence in peace and war, respectively. To simplify notation, and without loss of generality, I set $v_k(\text{war}) = 0$ and $v_k(\text{peace})=$

for country i (and symmetrically for country j) as the logarithmic difference in its aggregate consumption between peace and war:

$$OCW_i \equiv \log C_i(\text{peace}) - \log C_i(\text{war}). \tag{5}$$

Quantitatively, OCW_i can be interpreted as the war-induced drop in aggregate consumption expressed in percentage-points. I also define the utility cost of war as $UCW_i \equiv U_i(\text{peace}) - \tilde{U}_i(\text{war})$. This random variable adds the geopolitical valence and the war shock to the OCW. Combining (1), (2) and (5) yields

$$UCW_i = OCW_i + v_i - \tilde{u}_i. \tag{6}$$

3.2.2 A game of diplomatic negotiation

The avoidance of war hinges on a diplomatic agreement. The leaders of countries i and j must reach a consensus on a sharing rule for their joint surplus under peace (right-hand side of Equation 4), which they implement through a bilateral transfer of geopolitical valence denoted as T.

To understand the logic of the negotiations, let's start by discussing their functioning under perfect information, assuming that war shocks are publicly observed by both leaders. In this case, the dispute is peacefully resolved when leaders agree on a transfer T that improves the welfare of both countries compared to war

$$U_i(\text{peace}) - T > \tilde{U}_i(\text{war}) \quad \text{and} \quad U_j(\text{peace}) + T > \tilde{U}_j(\text{war}), \tag{7}$$

where $T > 0$ implies that i transfers utility to j (and vice versa for $T < 0$). By combining these two participation constraints, I obtain the condition that characterizes the set of transfers T which maintain peace

$$-UCW_j < T < UCW_i. \tag{8}$$

It follows from condition (4) that this set is non-empty. In other words, because peace Pareto-dominates war, there always exists a peace-maintaining transfer. Under perfect information, geopolitical disputes should never escalate to war, which is in line with the paradox of war mentioned previously.

In presence of asymmetric information regarding the war shock and the true cost of war, negotiations may fail despite peace Pareto dominating war. Indeed, since leaders privately observe UCW they have a strong incentive to strategically misreport it during negotiations. Intuitively, they should report a value that is lower than their true cost in order to extract more concessions from the other leader. To understand this, let's consider Equation (8): by announcing a small UCW_i the leader of country i intends to lower the peace-compatible transfer that should be conceded to the other leader. Conversely, by announcing a small UCW_j the leader of j signals that she expects to receive a larger transfer. This strategic behavior reduces the range of peace-compatible transfers. In the extreme case, both leaders may deflate their reported utility cost of war to such an extent that the set of peace-compatible transfers becomes empty.

Modeling diplomacy. A key insight in MMT is the modeling of diplomacy in a manner that is both general and tractable, allowing for easy integration with a trade model. They build upon one of the most influential frameworks in the mechanism design literature, namely the bargaining game under asymmetric information developed by Myerson and Satterthwaite (1983). To align the framework with the reality of diplomatic interstate negotiations, they introduce a few additional features:

- Diplomacy is unconstrained. This means that countries' leaders have the freedom to choose *any type* of diplomatic protocol for conducting the negotiation, without any restrictions. This includes options such as an ultimatum (i.e. a unilateral take-or-leave offer), a one-shot conference to settle peace, or a pre-determined sequence of meetings with offers and counter-offers. Ultimately, rational leaders will select the protocol that is most efficient in maximizing their utility before observing their private information. This assumption of unconstrained diplomacy adds realism to the model, and methodologically, it allows for theoretical results that are robust to specific modeling choices regarding the diplomatic institutional setting.

- Disagreement payoffs, which represent the utilities in war, are negatively correlated. This is reasonable because losses experienced by one country may partially correspond to gains for the other. Therefore, when leaders observe their own private information, it allows them to update their beliefs regarding the disagreement payoff of the other country. To capture this idea, MMT assume that $\tilde{u}_i$ and $\tilde{u}_j$ are jointly uniformly distributed over a triangle in $\mathbb{R}^2$ with a shape that implies a negative correlation between the two variables (the triangle MM_AM_B in Figure 3 of MMT). I follow the same approach and specify in addition that $\tilde{u}_i$ and $\tilde{u}_j$ vary within the domain $[0, 3h/4]$ where h is a positive parameter that captures the extent of informational asymmetry.[4]

- Leaders can always choose to unilaterally quit the negotiation table and enter into conflict, regardless of any attempts to prevent them. This feature implies weaker commitment mechanisms compared to the original model proposed by Myerson and Satherwaite.

Solving the game. A conceptual appeal of this diplomatic negotiation game is that, in spite of its inherent richness, the equilibrium of the game remains simple. I report below only the main equilibrium relationships and relegate all the computational details to Appendix A. Specifically, MMT show that the second-best protocol—the one that is optimally adopted by the two countries under imperfect information—is a Nash bargaining that takes the following form:

1. Leader of country $k \in \{i, j\}$ announces a utility cost of war $\widetilde{UCW}_k^a$. Note that in Equation (6), only the war shock is privately observed while the other two components are public information. Therefore, leaders can and will strategically misreport their true $\widetilde{UCW}_k$. This is why their

[4] Setting the bounds of the domain of variations of the war shocks is a matter of normalization in all formulas and has no consequence on the analysis. Assuming a zero lower bound implies $\max \widetilde{UCW}_i(\text{war}) = \; OCW_i + v_i \quad \min \tilde{u}_i = \; OCW_i + v_i$.

variables are scaled in percentage-points of real consumption. Therefore, the probability of peace is a-dimensional and corresponds to a ratio of squared percentage-points. The interpretation is straightforward. Any increase in the OCW or geopolitical valence for one of the countries translates into better chances to settle the dispute and avoid war. By contrast, more dispersed private information harms the odds of a successful negotiation and makes peace less likely. Conversely, for a low enough dispersion of private information, negotiation always succeeds and peace is maintained with certainty.

Geoeconomic factors. The computations of the geoeconomic factors are detailed in Appendix A. The discussion above shows that a peaceful settlement is reached whenever the realization of $\widetilde{OCW}$ is large. It is only for the bottom of the distribution that disputes escalate into war. In other words, even when they fail to settle peace, diplomatic negotiations have the virtue of avoiding the most destructive forms of wars. This translates into the property that the average utility cost of war, conditional on escalation to war, is smaller than its unconditional average:[6]

$$E\left[\widetilde{OCW}_{ij} \mid war\right] = E\left[\widetilde{OCW}_{ij}\right] - WIM_{ij} \tag{12}$$

where $WIM_{ij} \geq 0$ stands for the *War Intensity Mitigation* effect of diplomacy

$$WIM_{ij} = \frac{1}{4} \frac{\left(OCW_{ij} + OCW_{ji} + v_i + v_j\right)^2}{h + OCW_{ij} + OCW_{ji} + v_i + v_j}. \tag{13}$$

Note that WIM_{ij} is defined only when war has a non-zero probability of occurence, namely for $s_{ij} < 1$ in Equation (11).

Whenever diplomacy is successful, one country has to concede some utility transfer to the other. Using (9), one obtains the expected value of the transfer from *i* to *j* conditional on peace—a variable that is denoted hereafter *Peace-Keeping Cost*:

$$E\left[\tilde{\tau}_{ij} \mid peace\right] \equiv PKC_{ij} = \frac{OCW_{ij} + v_i - OCW_{ji} - v_j}{2}. \tag{14}$$

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with Equation (12), one obtains:

$$E\tilde{U}_i = U_i(\text{peace}) - s_{ij}\,\text{PKC}_i - (1 - s_{ij})\left[\text{OCW}_i + v_i\,\frac{h}{4}\,\text{WIM}_i\right]. \tag{15}$$

In the preceding relation, the variables $\{s_{ij}, \text{WIM}_i, \text{PKC}_i\}$ can be all derived from OCW_i through the relations (11), (13) and (14). In the rest of the paper, these four variables are referred to as the vector of *geoeconomic factors*, and most of the quantitative analysis aims to quantify their relative strength. The relation also highlights the multi-faceted welfare impact for country i of increasing OCW_i, namely its opportunity cost of war with j. First, it reduces welfare simply because the costs are larger in wartime.[7] Second, it diminishes country i's diplomatic negotiation power, and the country is compelled to make more concessions to maintain peace. This peace-keeping channel also reduces welfare. Third, it raises the probability of a peaceful settlement, thereby enhancing welfare.

3.2.3 Trade Equilibrium

The model is closed by plugging the diplomatic game into a general equilibrium model of trade, drawing upon the extensive literature on structural gravity surveyed by Costinot and Rodríguez-Clare (2014) and Head and Mayer (2014). Despite variations in their micro-foundations, this broad class of models shares two key features: (i) they model trade flows in general equilibrium within a multi-country world, which is crucial for our purposes as it allows countries to diversify their import sources and reduce dependence on a single partner; (ii) a central component of these models is the gravity equation, which is used to derive the aggregate gains of trade and the OCWs.

With the aim of streamlining the exposition, I employ one of the simplest quantitative trade models, namely the one originally derived by Anderson (1979). However, it is important to note that the tools introduced in this section can be refined and applied to a variety of economic environments.

Each country i, populated by L_i workers, produces a single variety of a tradable good, and is the sole source of this variety. Consumers in country n have a CES utility over all available varieties, given by

$$U_n = \left(\sum_i (q_{in})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \tag{16}$$

with $\sigma > 1$. I further assume perfect competition and iceberg trade costs τ_{in}, the market price being

$$p_{in} = \frac{\tau_{in} w_i}{A_i}, \tag{17}$$

with w_i and A_i representing wage and productivity, respectively. The consumer price index asso-

[7] Computations show that the term $(\text{OCW}_i - \text{WIM}_i)$ is an increasing function of OCW_i.

countries i and j (counterfactual). Methodologically, techniques introduced by the trade literature are used for conducting this counterfactual analysis, commonly known as exact hat algebra. This approach, popularized by Dekle et al. (2008), leverages the CES structure of the model to express proportional changes (indicated by the hat notation) in import shares and real consumption resulting from war as a function of the import shares observed in peacetime, along with a concise set of structural parameters. An appealing aspect of this approach is that it does not necessitate solving the model in levels, thereby reducing data requirements signi cantly.

War damages. Essential to the analysis is the modeling of how war affects the economy, and there are various degrees of freedom in doing so. To strike a balance between simplicity and realism, I adopt the following parameterization for war damages:

- Human losses: belligerents have casualties. The wartime over peacetime population ratio is equal to $\hat{L}_i < 1$ and $\hat{L}_j < 1$.
- Economic damages: belligerents experience a drop in productivity. Wartime over peacetime ratio of productivity is equal to $\hat{A}_i < 1$ and $\hat{A}_j < 1$.
- Trade logistics disruption: In line with empirical evidence surveyed in section 3.1, trade frictions increase between belligerents and with the rest of the world. Wartime over peacetime ratios of frictions are equal to: $\hat{t}_{ij} = \hat{t}_{ji} = \hat{t}_{bil} > 1$ and $\hat{t}_{ni} = \hat{t}_{nj} = \hat{t}_{mul} > 1$. Frictions between third countries are assumed to be unaffected: $\hat{t}_{nm} = 1$ for $n, m \neq i, j$. Because war increases spatial frictions, it induces a partial move back to autarky. Therefore, the foregone trade gains become a signi cant component of the costs associated with war.

These assumptions are natural and general, but it is important to note that the model can be extended to accommodate more complex scenarios.

Exact Hat Algebra. Below I outline the computation of OCW_i, noting that the same procedure applies to OCW_j. The core of the procedure is dedicated to computing the consumption change between peace (factual) and war (counterfactual scenario). This change is then plugged into Equation (5) to determine OCW_i, which, in turn, is used in Equations (11), (13), and (14) to obtain the other geoeconomic factors. Despite the complexity of economy,573 Tween economy14) to -364(co-278(The)-2tn)]TJ(theIIn

By applying this formula to the factual and counterfactual scenarios under consideration, one can calculate the war-induced loss in real consumption

$$\frac{C_i(\text{war})}{C_i(\text{peace})} = \frac{\hat{A}_i}{\hat{\pi}_{ii}^{1/(\sigma-1)}} \tag{24}$$

where $\sigma - 1 > 0$ is often referred to in the literature as the trade elasticity and $\hat{\pi}_{ii}$ represents the wartime over peacetime ratio of internal trade. The previous relation essentially translates the well-known welfare formula discovered by

In Equation (25), wage changes are still unknown at this stage of the procedure. They are obtained as a solution to the general equilibrium system of equations (21) expressed in hat-algebra

$$\hat{w}_i = \frac{1}{w_i L_i \hat{L}_i} \sum_{n=1}^{N} \frac{\pi_{in}\left(\frac{\hat{\tau}_{in}\hat{w}_i}{\hat{A}_i}\right)^{1-\sigma}}{\sum_k \pi_{kn}\left(\frac{\hat{\tau}_{kn}\hat{w}_k}{\hat{A}_k}\right)^{1-\sigma}} \hat{w}_n \hat{L}_n w_n L_n. \tag{26}$$

This provides a system of N equations with N unknowns corresponding to the vector of wage changes $\hat{\mathbf{W}} \equiv \{\hat{w}_i\}$. The damage parameters $\{\hat{\tau}, \hat{L}, \hat{A}\}$ and the trade elasticity $\sigma > 1$ are given; peacetime import shares (the πs) are observed, as is peacetime aggregate income wL.

<u>Quantification of geoeconomic factors: Full procedure</u>

The method for calculating the geoeconomic factors involves the following steps:

1. Retrieve the war damages parameters and trade elasticity from external calibration or gravity estimates (see Section 3.5). These values may vary depending on the type of war under consideration (e.g., high- vs low-intensity, symmetrical or asymmetrical, etc.).

2. Along with the value of aggregate income ($w_i L_i$), the trade share matrix observed in peacetime (π_{in}), plug the damage parameters of step 1 into Equation (26). Using an iterated fixed point procedure with a dampening factor, find the vector of wage changes $\hat{\mathbf{W}} \equiv \{\hat{w}_i\}$ that solves Equation (26).

3. Substitute the wage changes into Equation (25) to recover the change in internal trade $\hat{\pi}_{ii}$.

4. Combine Equations (5) and (24) to obtain $OCW_i = -\log \hat{A}_i + \frac{1}{\sigma - 1} \log(\hat{\pi}_{ii})$.

5. Use Equations (11), (13) and (14) to compute $\{\phi_{ij}, WIM_i, PKO_i\}$.

It is important to acknowledge that this analytical framework has certain limitations and omissions. One notable omission is the lack of sector-level heterogeneity and input-output linkages in the model. Specifically, sectors such as weapons, electronics, and energy play a critical role in the conduct of warfare, and disruptions in trade involving these sectors can have a significant impact on the OCW. Another limitation is the assumption that trade costs between third countries are unaffected by the bilateral conflict.

3.4 Geography of Import Sourcing

I now examine the impact of external trade dependence on the OCW and other geoeconomic factors of the countries i and j. The analysis will reveal that the relevant dimension for geopolitics is not the overall level of trade openness, but rather the geography of import sourcing (GIS) of the country-pair.[9] GIS is defined as the relative shares of bilateral and multilateral imports in aggregate expenditure observed during peacetime. Equation (25) highlights the role of GIS by connecting the war-induced change in i's internal trade to the shares of bilateral imports (π_{ji}) and multilateral imports ($\sum_{n \neq i,j} \pi_{ni}$). Interpreting this connection is challenging as it involves changes in relative prices, which are influenced by the endogenous wage changes $\hat{w}$. And wage changes are themselves determined through the system of non-linear equations in (21).

First-order approximation. To make progress, it is useful to rely on an approximated version of Equation (25). The approach is based on the consistent observation by previous quantitative trade models based on a structural gravity framework, similar to ours, that the endogenous changes in incomes or wages tend to have a marginal impact on the results of counterfactual simulations. This observation holds for various empirically relevant trade shocks and policies, such as regional trade agreements (RTAs), the European Union (EU), the North American Free Trade Agreement (NAFTA), and the adoption of a common currency, among others. The point was first highlighted in the seminal paper by Anderson and van Wincoop (2004), where the counterfactual scenario involved a significant shock, namely the removal of the Canada-US border. Subsequent studies, such as Head and Mayer (2014) in their Table 3.6, provide further systematic evidence supporting this finding by considering a wide range of trade shocks and policies. Based on these considerations, Head and Mayer demonstrate that incorporating price index changes along with the trade shocks, is sufficient for obtaining precise enough quantification. Their Modular Trade Impact (MTI) approach is basically a first-order approximation of the counterfactual equilibrium where the price index is endogenously adjusted but all the changes in wages $\hat{w}$ are neglected. Many papers simulate counterfactuals using MTI and Glick and Taylor (2010) have applied this methodology to quantify the costs of military conflicts (see the discussion on page 8). Applying the MTI approach to Equation (25) and combining with (24), one obtains the following first-order approximation of OCW (see Appendix C):

Quantification of geoeconomic factors: Approximated procedure

Along with the trade share matrix observed in peacetime (π), plug the damage parameters into the following equation:

$$OCW_{ij} = \alpha_i + \pi_{ji}\left(\tau_{bil} - \alpha_i + \alpha_j\right) + \sum_{n \neq i,j} \pi_{ni}\left(\tau_{mul} - \alpha_i\right), \quad (27)$$

where, for notational convenience, all war damage parameters (now without the hat notation) are scaled in % change: $1 - \alpha_i \quad \hat{A}_i$, $1 - \alpha_j \quad \hat{A}j$

Equation (27) highlights the first-order channels through which trade openness affects OCW. This equation also has a straightforward quantitative interpretation, with all variables scaled in percentage-points:

- Trade logistics disruption: Because bilateral and multilateral imports are all disrupted during war, larger shares of both types of imports increase the opportunity cost of war (OCW). For instance, a 1 percentage-point increase in the share of bilateral (resp. multilateral) imports in country i's consumption basket results in a t_{bil} (resp. t_{mul}) percentage-point drop in consumption during wartime, which is equivalent to an increase in the OCW.

- Consumption Insurance: The decrease in wartime productivity leads to an increase in the relative price of goods produced by the belligerents compared to those produced in third countries. As a result, multilateral import sourcing serves as a form of insurance for the consumption basket, reducing OCW by the amount $p_{ni} a_i$. On the other hand, for bilateral import sourcing, this insurance effect comes into play only if destruction affects the domestic economy more than the enemy's economy, that is, when $a_i + a_j < 0$.

- It is important to note that the parameters representing human losses do not appear in Equation (27). However, in the full computational procedure of OCW, population losses do affect income changes (the term $\hat{L}$ in Equation 26), which in turn impact internal trade and OCW ($\hat{w}$ in Equation 25). The wage channel being neglected in the approximation procedure, human losses are not included in the equation.

GIS and high-intensity symmetrical warfare. To further refine the analysis, I now focus on symmetrical warfare, which refers to conflicts where the belligerents possess comparable military capabilities. This type of war is commonly observed in interstate conflicts involving major powers and is often characterized by high-intensity violence. [10] In line with this view, the analysis is restricted to the following regime of war damage parameters: $a_i = a_j = a$ and $a > t_{mul}$. The first condition captures the requirement for symmetry in military power; the second condition assumes that high-intensity warfare results in significant economic damages that overturn the disruption of multilateral trade. It is worth noting that the latter condition is often met based on the parameter values commonly observed in the literature (see Table 1). Plugging these parameter restrictions into (27) and combining with (11

The preceding relation highlights how the GIS influences peace: bilateral sourcing facilitates diplomacy (positive impact of $(\pi_{ji} + \pi_{ij})$), while multilateral openness goes against it (negative impact of $\sum_{n\neq i,j}(\pi_{ni} + \pi_{nj})$). MMT originally derived this theoretical prediction in a less general modeling setup. The current analysis shows that their finding can be extended to the broad class of structural gravity models. Empirical tests of the prediction have been performed in several papers, which are surveyed in Section 4.

One direct implication of this result is that the impact of regional and multilateral trade liberalization on the prevalence of war can differ significantly. While RTAs between a group of countries may lower the incidence of regional conflicts, they may increase conflicts with other regions. On the other hand, multilateral trade liberalization may lead to an increase in the occurrence of bilateral conflicts. These findings have important policy implications and highlight the need for careful quantification of the potential unintended consequences of trade liberalization initiatives in a conflict-prone context. I refer to these consequences as the *geoeconomic welfare gains* attached to trade policy. Their analysis and quantification are presented in Section 5.

The case of low-intensity asymmetrical warfare. The case of asymmetric warfare is less relevant for our purpose of studying interstate war as it typically involves a standing, professional army against an insurgency or resistance movement militias. It is often associated to low-intensity violence (for the reasons discussed in footnote 10). To model this type of warfare, I set the parameters such that all the economic costs are incurred by i instead of being equally split: $\alpha_i = \alpha$ and $\alpha_j = 0$ and $\alpha - \tau_{mul} > 0$. The probability of a successful deescalation of disputes in the shadow of asymmetrical warfare is given by:

$$\sigma_{ij} = \frac{1}{\eta^2}\left[\alpha + (\tau_{bil} - \alpha)\,\pi_{ji} + \tau_{bil}\,\pi_{ij} - (\alpha - \tau_{mul})\sum_{n\neq i,j}\pi_{ni} + \tau_{mul}\sum_{n\neq i,j}\pi_{nj} + V_{ij}\right]^2. \quad (29)$$

The relationship between GIS and peacekeeping is more nuanced in the context of asymmetric warfare. There is an ambiguity regarding the sign of $(\tau_{bil} - \alpha)$. However, the calibrated parameters in Table 1 suggest that this difference is indeed positive. Therefore, the conclusion regarding bilateral sourcing remains unchanged: bilateral sourcing facilitates diplomacy. However, in the case of multilateral sourcing, the effect differs depending on whether it is the "weak" side (country i) or the "strong" side (country j). Multilateral sourcing of the weak side hinders diplomacy, while multilateral sourcing of the strong side facilitates it.

3.5 Quantification of geoeconomic factors.

In this section, the preceding numerical procedure is applied to quantify the geoeconomic factors related to prominent country-pairs. The objective is to illustrate the method and document empirically how the GIS impacts geopolitics. For simplicity, I make use of the approximated formula (27) in the numerical analysis. However, it is recommended that future studies aiming to compute precise estimates of OCWs use the full (non-approximated) procedure as described on page 19.

Calibration of the parameters. Table 1 presents the calibrated parameters that are essential for the numerical procedure. For the sake of brevity, I focus solely on the case of high-intensity symmetrical warfare. Below, a summary of how these parameters are recovered is provided.

The trade disruption parameters are retrieved from Glick and Taylor (2010) who analyze a sample covering the two world wars. Their gravity estimates indicate that trade between belligerent countries declines by 85% compared to gravity-predicted trade, and by 12% with neutral countries. To match these numbers, I set t_{bil} and t_{mul} such that $0.15 = (1 + t_{bil})^{1 \quad s}$ and $0.88 = (1 + t_{mul})^{1 \quad s}$. From the meta-analysis in Head and Mayer (2014) the trade elasticity is set to $1 \quad s = \quad 5$.

Economic damages are obtained from Chupilkin and Kóczán (2022

Table 1: Calibration of war damages

parameter	1 s	t_{bil}	t_{mul}	a	l_{pop}	h	v
value	-5	0.461	0.026	0.08	0.08	0.16	0

Note: see the text for the informational sources and the calibration procedure.

Valence of Peace that is equal to PVP_{ij} h $OCW_i + OCW_j$. In Equation (11), this corresponds to the cutoff value of geopolitical valence above which diplomacy always manages to secure peace. Mathematically, for all valences such that $v_i + v_j$ PVP_{ij}, the probability of diplomatic success is $s_{ij} = 1$. Intuitively, when $PVP_{ij} > 0$, peace can be enforced with certainty ona37(thI435 Td [I-276.30.25tuitG90(

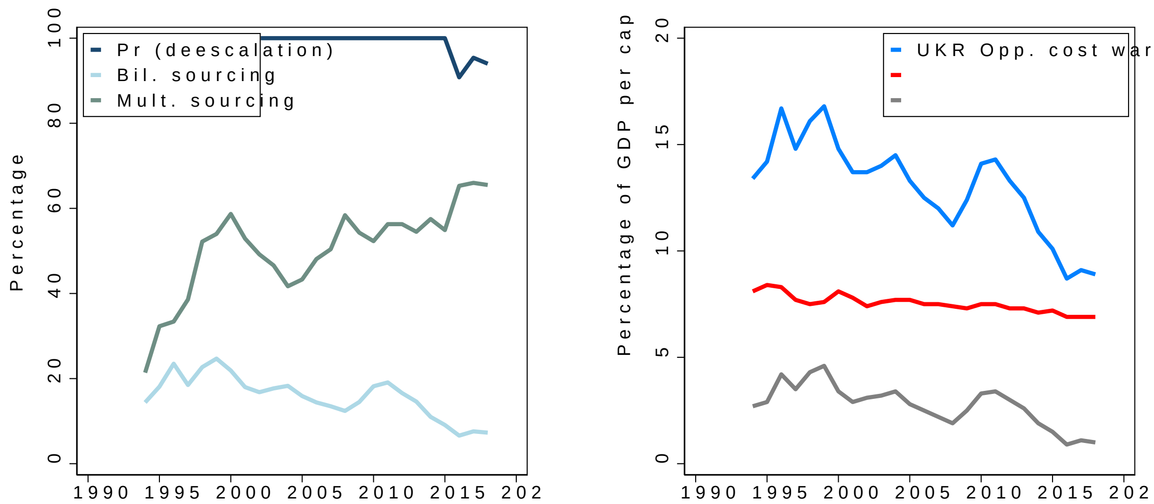
Table 2: Estimates of geoeconomic factors in 2018

		Import Shares		OCW		PKC	WIM	s_{ij}	PVP
		Bilateral	Multilateral	Ctry 1	Ctry 2				
IND	PAK	.8	45.2	6.8	7.1	.1	1.6	73.1	2.4
ISR	EGY	.5	100	4.9	5.9	.5	1.1	44.1	5.5
ZAF	AGO	2.4	80.9	6.2	6.5	.2	1.4	60.8	3.6
ECU	PER	2.7	65.7	6.6	7.1	.2	1.6	70.4	2.6
GRC	TUR	2.3	93.3	6	6.1	0	1.3	54.4	4.3
CHN	USA	8.6	37.8	7.9	10	1.1		100	-1.6
RUS	UKR	7.3	65.5	6.9	8.9	1	1.9	94	.5
FRA	DEU	27.3	105.4	13.9	9	-2.4		100	-6.6
Prox.	Pairs	3.6	105	6.1	5.9	-.1	1.1	53.4	4.3

Note: Each row reports the geoeconomic factors attached to a dispute (susceptible to escalate into an armed conflict) between the two countries of the pair under consideration. Numbers represent percentage points. Bilateral and multilateral import sourcing are obtained by summing within the country-pair bilateral import shares in expenditures and total import shares net of bilateral imports (2018 trade data from Head and Mayer (2021

Time-evolution of geoeconomic factors. The previous analysis is now extended to the entire period covered in the Head and Mayer (2021) dataset for Russia and Ukraine on the one hand, and China and USA on the other hand—two emblematic country-pairs that experienced contrasting evolutions in their bilateral trade dependence.

Figure 3: Evolution of geoeconomic factors for the pair Russia-Ukraine



(a) Geography of Import Sourcing

(b) OCW and PKC

Figure 3 illustrates the time-series evolution of geoeconomic factors for the RUS-UKR country-pair from 1994 to 2018. In the left panel, it can be observed that bilateral dependence between the two countries was initially high following the collapse of the Soviet Union but steadily decreased over time, primarily driven by a significant increase in multilateral sourcing. As a result of this substantial bilateral disengagement, the right panel shows that the opportunity cost for Ukraine of a high-intensity war with Russia has decreased from 18ppt (of consumption) in the mid-1990s to less than 9ppt in 2018. A similar pattern, albeit less pronounced, can be observed for Russia. Consequently, the costs and concessions made by Ukraine to maintain peace with Russia, which were historically significant due to the stark asymmetry in OCWs within the country-pair, have decreased from 4.6 percentage points in 1999 to 1 percentage point in 2018. As a consequence, their diplomatic relationship gradually deteriorated and the probability of deescalation of disputes (left panel) which had remained consistently equal to 1 until 2014, declined thereafter.

The case of the CHN-USA pair is presented in Figure 4, covering a longer period from 1970 to 2018. Their geoeconomic factors followed a path that was the reverse of the one observed for the RUS-UKR pair. The reason is the significant increase in their bilateral dependence, particularly after China's accession to the WTO in 2001 (dashed line on both panels). This trend was driven by the threefold increase in the share of Chinese imports in US expenditure, reaching 7.5% in 2018. On the other hand, US imports as a share of Chinese expenditure declined, although not strongly enough to offset the previous trend, decreasing from 2.9% to 1.1% over the period. Consequently, the OCW for the USA increased while it remained relatively stable for China (right panel). Overall, the probability of deescalation increased and remained consistently equal to 1 after 2001. However, maintaining peace came at a cost. The asymmetrical evolution of import sourcing dependency resulted in a substantial increase in US Peace Keeping Costs. These costs were negative until 2000, indicating that, on average, China had to make concessions to maintain peace. However, they turned positive after 2001 and continued to increase, suggesting that the diplomatic bargaining game is now disadvantageous for the USA.

Let conclude this section by emphasizing that the results presented in Table 2 and Figures 3 and 4 are intended to illustrate the method rather than provide definitive calculations. Further research is needed to refine the calibration of the parameter set and use the non-approximated method for all OCW computations.

Figure 4: Evolution of geoeconomic factors for the pair China-USA

(a) Geography of Import Sourcing

(b) OCW and PKC

3.6 Additional mechanisms

In this section, I survey additional theoretical arguments that have been put forward in the literature on how international trade impacts the likelihood of interstate conflict.

3.6.1 Trade Diplomacy

Governments engage in trade agreements not only for economic reasons, but also for political motivations. Scholars in the field of international relations have developed the argument of issue linkage, which sheds light on the implications of linking security policies, not only with trade agreements but also with sanctions and foreign aid (Maggi, 2016, for a recent survey). There are two main channels through which trade agreements can potentially influence global security. Firstly, agreements reshuffle economic interdependencies and alter the OCWs. Through fostering trade among member countries and redirecting trade away from non-member ones, Preferential Trade Agreements (PTAs) prompt a reshaping of the geography of import sourcing. Secondly, supranational bodies established in conjunction with trade agreements serve as diplomatic platforms that aid in mitigating information asymmetry during interstate negotiations, thereby helping to diffuse resolution of disputes than the interests of protectionist lobbies. As a consequence, one should expect that the risk of disputes escalating into conflicts is influenced by the relative capacity of pro- and anti-trade lobbies to mobilize in order to influence political outcomes.[11] A future research direction is to model how trade lobbying interacts with armed conflicts and their resolution.

3.7 Trade and the intensity of conflict

A strand of the theoretical literature pioneered by Skaperdas and Syropoulos (2001) takes the state of war as given and is interested in modeling how international trade affects the *intensity* of war efforts. These so-called “Guns and Butter” models typically assume that inter-state conflict is about contesting a productive resource, the mapping between war efforts and successful appropriation being modeled with a Contest Success Function.

Within this framework, Garfinkel et al. (2015) and Garfinkel et al. (2020) compare the effects of autarky and free trade on the intensity of competition between countries (through arming) over the contested resource as well as on their welfare. In their analyses, the effects are channeled by the world relative price of the contested resource—a terms of trade effect—that makes war efforts trade-regime dependent. One theoretical prediction common to all these papers is that expanded trade opportunities with a third country can, under certain parameters regime, intensify conflict between two adversaries. This result is similar in essence to some of the theoretical conclusions drawn from the discussion of the geopolitical impact of GIS in Section 3.4.

By assuming a world of anarchy and appropriation, the guns-and-butter framework does not attempt to model the reasons why countries fail to negotiate Pareto-dominant peace. Therefore, it is not suitable for explaining the fundamental out-of-equilibrium nature of war, namely why, in reality, countries allocate significant funds towards military expenditures but often refrain from engaging in actual interstate conflict. While most of these papers provide theoretical contributions, I will review in the next section a few empirical papers that apply the guns-and-butter framework to real-world data.

4 Survey of the Empirical Literature

The impact of trade on war is a controversial and longstanding topic in international relations and political scientists have produced a voluminous body of empirical research on this question. Polachek’s pioneering paper on "Conflict and Trade" (1980) is the first to perform a quantitative analysis based on a reasonably large dataset (841 country-pairs over 10 years for 15 categories of conflict). He provides evidence supporting the hypothesis that mutual dependence between trading partners reduces the probability of conflict. Many of the subsequent empirical studies con-

[11] The vast literature on protection for sale argues that firms seeking for protection are more likely to select into lobbying than exporting firms (Grossman and Helpman, 1994). However, this argument is typically made in the context of unilateral sector-specific trade policies. By contrast, conflict-induced trade disruption affects all sectors, making lobbying for peace equivalent to lobbying for reciprocal trade facilitation covering all sectors. Recent evidence from Blanga-Gubbay et al. (2020) suggests that pro-trade lobbies are, in fact, more effective in shaping multi-sector trade policies than anti-trade lobbies.

firmed this initial finding, 8(95(thiod95(findinfurtheritial)supportis)-294ois)-294(eis)-29hypo4(esinitial)thatisomo

whether they have a low or high probability of disputes. The literature has proposed various solutions to address this issue. For instance, Vicard (2012), in the context of regionalism, uses a bivariate probit model with censoring. This approach involves jointly estimating two equations: one explaining the initiation of the dispute and the other explaining the escalation of the dispute into war. Martin et al. (2008a) take a simpler approach by emphasizing bilateral distance as a powerful predictor of disputes. This view is supported by the data: Table 4 shows that the frequency of MIDs is much larger for pairs of countries with a bilateral distance below 1000 km. However, this probability drops nearly to zero for countries separated by more than 1000 km. Therefore, they restrict the sample to country-pairs with a border or with a bilateral distance below 1000 km. This strategy has two drawbacks: First, the sample size is significantly reduced. Second, it assumes that within the restricted sample, the coefficients of interest remain constant. An alternative strategy is to retain the full sample of countries and introduce interaction terms between distance and the import sourcing variables. This approach is a natural choice considering the multiplicative form in Equation (31).

2. Endogeneity: Serious endogeneity issue pertains to the relationship between military conflicts and import sourcing. To address this concern, several approaches have been considered in the literature: (i) lagging bilateral and multilateral import sourcing to mitigate contemporaneous reverse causality; (ii) controlling for potential co-determinants of conflicts and trade patterns (see model 4 in Table 3 of Martin et al. (2008a) for the full list); (iii) adding country-pair fixed effects in a panel setting; (iv) instrumenting import sourcing.

4.2 GIS and war: estimation results

Combining the COW dataset with DOTS trade data, Martin et al. (2008a) estimate the model (30) over the 1950–2000 period across a large set of specifications and robustness tests. Overall, their empirical results support the theoretical prediction: bilateral import sourcing tends to decrease the probability of MID while multilateral sourcing raises it. Quantitatively, the effects are sizeable for proximate countries —the ones for which disputes are presumably more frequent. Since this initial contribution, several empirical papers, looking at alternative types of conflicts and / or trade data, have confirmed these findings. I now briefly review them.

Hegre et al. (2010) convincingly address the endogeneity of trade and conflict (point 2 above) using a system of simultaneous equations that include a gravity equation of trade and a conflict regression that factor in the dual effect of distance on both trade and conflict. Their results confirm that bilateral trade reduces the likelihood of bilateral disputes. Examining low-level disputes instead of conflicts, Kleinman et al. (2020) also find evidence in support of the prediction that bilateral economic interdependence appeases geopolitical relationship.

Morelli and Sonno (2017) revisit the model (30) by suggesting that the crucial factor to consider is bilateral dependence, which they define as the ratio of bilateral over multilateral import sourcing

$$BD_{ijt} = \frac{m_{ijt} + m_{jit}}{\sum_{n \neq i,j} m_{nit} + m_{njt}}. \tag{32}$$

They observe that bilateral and multilateral sourcing have opposite signs in Equation (30) (i.e. $a < 0$ and $b > 0$) and consequently push in the same direction when one is in the numerator and the other is in the denominator. Hence, a larger BD_{ijt} is expected to reduce the likelihood of war, particularly for contiguous countries. Morelli and Sonno (2017) also employ different trade data compared to Martin et al. (2008a), using national and bilateral trade data from Barbieri et al. (2009) and Barbieri and Keshk (2016). In their Table 1, they repeat the non-instrumented analysis conducted by Martin et al. (2008a) after replacing bilateral and multilateral imports with their measure of bilateral dependence. Across various specifications, they consistently find that bilateral dependence has a negative impact on the probability of a MID. They also observe that the effect of bilateral dependence declines with distance, a pattern which is in line with Equation (31).

Vicard (2012) makes an important methodological contribution by addressing the issue of heterogeneity in dispute occurrence across country-pairs in a compelling manner (point 1 above). He employs a bivariate probit model that accounts for selection and exploits event data from Kinsella and Russett (2002) to measure the occurrence of interstate disputes exceeding a threshold characterized by strong verbal hostility. It is important to note that Vicard's analysis does not instrument trade flows (point 2 above). Using the COW data from 1950 to 1991, he finds that multilateral import sourcing increases the probability of a dispute escalating into war, while bilateral sourcing does not exhibit a significant effect.

Hadjiyiannis et al. (2016) shift the focus from trade flows to trade agreements. Using COW data spanning the years 1958 to 2000, they address endogeneity concerns by incorporating an extensive set of controls, country-pair fixed effects, simultaneous equations modeling, and instrumental variables. Their findings indicate that PTAs reduce the likelihood of conflicts among member countries, contributing to peace creation within the agreement. However, they also observe that PTAs make it more likely for conflicts to arise between member countries and non-member countries, thus leading to peace diversion. These contrasted patterns align wn tb (

bieri and Keshk (

of GDP for various countries and years. While military conflicts are relatively rare in the modern world, countries still allocate substantial resources to defense spending. Therefore, this additional impact of trade openness on defense spending carries significant welfare implications by potentially reducing the cost of conflict containment.

Seitz et al. (2015) construct and estimate a structural model of trade, military conflicts, and defense expenditure on a sample of 181 countries between 1993 and 2001. Additionally, they conduct counterfactual experiments focusing on some of the most adversarial country-pairs. This well-designed quantitative model encompasses many aspects of the trade and war relationship. Their findings indicate that reducing trade costs between two countries prompts both countries to reduce defense spending. This reduction in defense spending subsequently has a domino effect on the defense expenditures of other countries. Their quantification exercise reveals that the additional welfare effects resulting from cuts in defense spending globally are comparable in magnitude to the direct welfare effects of increased trade, particularly when the two trading partners have a history of hostility. Using an unbalanced panel dataset comprising 67 countries from 1986 to 1999 and incorporating data on historical rivalries from Thompson (2001), Garfinkel et al. (2020) complement the findings of Seitz et al. (2015) by demonstrating that the impact of trade openness on a country's military spending is contingent upon whether trade is conducted with a rival or a friend.

4.4 Evidence on trade diplomacy

Another aspect of Vicard (2012) relates to the empirical study of the influence of RTAs on the likelihood of conflict. His aim is to investigate the trade diplomacy channel (as discussed in section 3.6.1) while accounting for the changes in economic interdependence induced by RTAs. Vicard (2012) distinguishes between two categories of RTAs: deep RTAs, which include customs unions and common markets, and shallow RTAs, encompassing partial scope and free trade agreements. The underlying premise is that the trade diplomacy channel operates primarily for deep RTAs because these agreements necessitate a substantial shared institutional framework that can facilitate the resolution of conflicts through negotiation and foster peace among member countries.

Using the COW dataset spanning the period from 1950 to 1991, Vicard estimates a modified version of the bilateral conflict regression (30) where the main explanatory variable is a binary variable indicating the presence of a trade agreement in force within the country-pair. His estimation results reveal that deep RTAs have a significant effect in reducing the likelihood of war between member countries. In contrast, shallow RTAs do not exhibit the same impact. Importantly, these results hold even after controlling for trade dependency—bilateral and multilateral import sourcing as defined in Equation (30)—suggesting that they are driven by the trade diplomacy channel. He conducts an extensive set of robustness checks, which includes the implementation of an instrumental variable approach to address endogeneity concerns on RTA formation. Quantitatively, the magnitude of the trade diplomacy effect is substantial, deep RTAs leading to a reduction of about two-thirds in the probability of a dispute escalating into war.

4.5 Micro-level evidence on trade and war

A promising and recent research avenue involves exploring the impact of trade on violence using micro-level data. Jha (2013) uncovers that a prolonged history of inter-ethnic trade has a restraining effect on conflict in the present. Based on a rich dataset collected at the town level, which encompasses South Asia's medieval and colonial eras, his research reveals that medieval ports, despite their higher ethnic diversity, exhibited a significantly lower likelihood of Hindu-Muslim riots. Specifically, between 1850-1950, these ports were five times less prone to such conflict, even after two centuries had passed since Europeans disrupted Muslim dominance in overseas trade. Furthermore, between 1950-1995, the incidence of riots in these ports remained only half as likely compared to other areas.

Amodio et al. (2021) conduct a study on the impact of security-motivated trade restrictions on economic activity and political violence. They leverage the quasi-experiment provided by the restrictions imposed by Israel on imports of selected goods to the West Bank in 2008. Following the implementation of the restrictions, they observe that localities experiencing the most severe negative economic effects are more prone to episodes of political violence. The differential effect observed accounts for approximately 16% of the violent events that took place in the West Bank between 2008 and 2012.

Amodio et al. (2023) look at the impact on violence of reduced tariffs on imports from South countries to North countries. The authors combine variations in agricultural tariffs over time with disparities in crop suitability across a wide grid of 9km 9km cells covering 27 South countries and all PTAs they signed with major North countries between 1995 and 2014. The empirical strategy is based on the observation that variations in agro-climatic conditions within a country create exogenous differences in the suitability for cultivating different crops. The findings show that in cells where crop suitability is higher for the liberalized crops, the implementation of PTAs leads to an increase in economic output as well as political violence. Looking at global trade rather than PTAs, Gallea and Rohner (2021

5.1 Geoeconomic welfare gains: theory

The existing quantitative methods for computing the welfare impact of trade policy have been designed for peacetime. My objective is to revisit them in a context of rising geopolitical tensions and non-negligible conflict risk.[14]

for changes in War Intensity Mitigation (see footnote 7). This channel is captured by the positive term ($DOCW_i$ $DWIM_i > 0$) on the RHS of Equation (34). Secondly, it undermines country *i*'s diplomatic bargaining power, forcing *i* to make greater concessions in order to maintain peace ($DPKC_i > 0$).

- This is welfare improving because a larger OCW disciplines leaders during diplomatic negotiations and increases the probability of deescalation ($Ds_{ij} > 0$).

These countervailing forces generate a fundamental tension in the design of trade policy. When the net effect is positive, $G_i / DOCW_i > 0$, increasing import sourcing from rival nations is desirable. When negative, $G_i / DOCW_i < 0$, dependence should be reduced. I come back to the details of this chain of adjustments in the quantification exercise in the next section.

5.2 Estimation of geoeconomic welfare gains: numerical procedure

The numerical procedure to estimate the geoeconomic gains G_i is now described. The approach hinges on a well-established literature interested in quantifying the welfare gains of trade. This field has been very active in the recent years and has reached a certain consensus on the modeling procedures (Costinot and Rodríguez-Clare, 2014; Head and Mayer, 2014). The so-called GETI procedure allows researchers to assess trade creation, trade diversion and welfare effects of trade policies: it combines gravity regressions with general-equilibrium simulation. The procedure exposed in Section 3.3 for computing OCW is an example of this type of method. Very importantly for our purpose, GETI quantifications provide an estimate of the changes in trade shares, the relevant metric for computing the changes in the vector of geoeconomic factors.

Quantification of geoeconomic welfare gains: procedure

The method for calculating G_i involves the following steps:

1. Recover the trade share matrix *observed* in peace time (p_{in}) and compute the vector of geoeconomic factors f OCW_i, s_{ij},

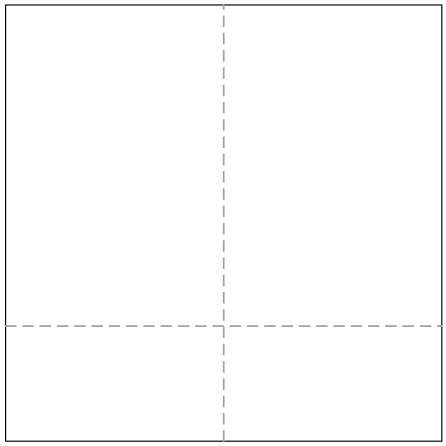
induced values of informational noise (h^0) and geopolitical valence (v_i^0) in Step 3, which would differ from their factual values used in Step 1. These parameters enter into Equations (11), (13), and (14

Table 5: Eliminating bilateral & multilateral import sourcing in 2018 (full autarky)

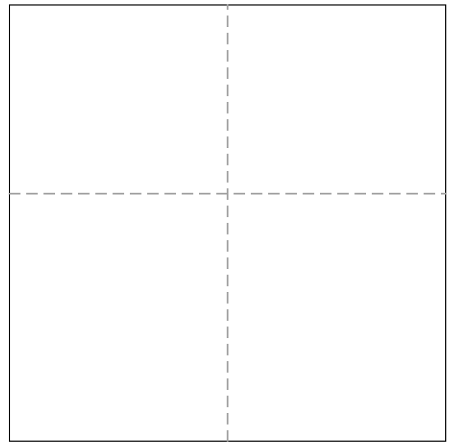
	Country 1						Country 2		
	DOCW	D log C(peace)	G	Ds_{ij}	DWIM	DPKC	DOCW	D log C(peace)	G

Figure 5: Optimal import dependence China-USA

(a) Import sourcing



(b) Geoeconomic factors



(c) Consumption & Welfare

The results are illustrated in Figure 5. As expected, increasing trade costs redirects trade flows:

when the change in trade costs exceeds +15%. As discussed on page 36, the net impact of these three forces on geoeconomic welfare gains is conceptually ambiguous. However, quantitatively, the pattern is clear: geoeconomic gains are positive and increase as long as the deescalation probability is unaffected; then, they decrease.

Welfare implications are reported on panel (c). Peacetime real consumption decreases when the US raises its bilateral trade barriers with China. While this consumption drop is welfare-reducing, it is more than offset by the evolution of the geoeconomic welfare gains. As a result, US welfare in the shadow of war—which is equal to the sum of both consumption and geoeconomic gains—first increases and reaches an optimal level for a 15% rise in trade barriers; then it declines gradually and finally passes below its factual level for a 21% increase in trade barriers.

Overall, this exercise shows that, in presence of latent geopolitical disputes susceptible to escalate into armed conflict, the welfare implications of trade policy may fundamentally differ from what is predicted by a model calibrated for peacetime only. When geopolitics matter, the relevant welfare metric must factor in real consumption *and* geoeconomic gains (Equations 33 and 34).

Table 6: EU-28 enlargement to Ukraine in 2018.

		D Import Shares		Country 1						Country 2		
		bil.	mul.	DOCW	D logC(peace)	G	Ds_{ij}	DWIM	DPKC	DOCW	D logC(peace)	G
RUS	UKR	-.83	11.12	-.02	-.02	-1.12	-11.33	-.18	-.47	-.96	4.41	-.19
AUT	UKR	.61	9.81	.12	.05	-.27	-1.87	-.04	-.25	-.37	4.41	.22
DEU	UKR	4.22	6.21	.08	.04	1.36	16.56	.28	.73	1.53	4.41	-.1
HUN	UKR	1.81	8.84	.53	.21	-.29	2.96	.06	-.35	-.17	4.41	.41
POL	UKR	2.69	7.97	.25	.14	.41	7.71	.14	.16	.56	4.41	.1
EU28	UKR	.94	9.51	.15	.06	-.16	-.25	-.01	-.19	-.23	4.41	.22

Note: Each row reports changes in the geoeconomic factors attached to a dispute (susceptible to escalate into an armed conflict) between the two countries of the pair under consideration. Numbers represent percentage-points. The trade data come from Head and Mayer (2021). Col. 3 and 4 report the changes in bilateral and multilateral import shares in joint expenditures. Col. 8-10 successively report the changes in the probability of deescalation *conditional* on a geopolitical dispute, the war intensity mitigation effect of diplomacy and the peace keeping costs from the perspective of country 2. For countries 1 and 2 respectively, are reported the change in the opportunity costs of war (col. 5 and 11), the change in peacetime consumption (col. 6 and 12), the geoeconomic welfare gains (col. 7 and 13). The bottom row reports averaged values across all pairs made of Ukraine and a EU-28 country.

under consideration. The numbers are in line with the mechanisms outlined in the preceding paragraph: the share in expenditure of Ukraine's imports from Russia is reduced by 0.8ppt and is redirected toward EU with an average 0.9ppt increase in import share from each member. Ukraine's peacetime consumption increases by 4.4ppt. From a security perspective, following the drop in bilateral dependence with Russia, the opportunity cost for Ukraine of a high-intensity war with Russia is reduced by almost 1ppt and its peace-keeping cost decreases by 0.5ppt. Nevertheless, the diplomatic relationship deteriorates with a 11.3ppt drop in the probability of deescalation. On net, Ukraine experiences a small geoeconomic welfare loss (-0.2 ppt) that is dominated by its gains in real consumption. The rest of the table illustrates the changes in geoeconomic factors of Ukraine vis-a-vis its main trading partners among EU-28 members. With Austria, the enlargement actually reduces their bilateral dependence (as Ukraine increases its trade even more toward other members) and, consequently, their escalation probability. With Germany and Poland, one observes the reverse: bilateral dependence, OCWs and diplomatic relationship improve.

This analysis highlights the risk of a deleterious impact of trade diversion on diplomacy and conflict. Following the deepening of trade agreements, some countries may experience a reshuffling of their GIS which in turn can increase the risk of inter-state war at the regional level.

5.4 The security dilemma in the data

European integration serves as an illuminating case study highlighting how trade agreements can address security threats. Spolaore (2013) documents how the creation of European Union was driven by a deep motivation to foster interdependencies susceptible to increase future opportunity cost of war between member nations. For instance, the Schuman Declaration of May 9, 1950, which laid the foundation for European integration, proposed the establishment of a common High Authority to oversee the combined production of coal and steel by France and Germany, with the potential for other European countries to participate. The objective of this plan was "*to make it plain that any war between France and Germany becomes not merely unthinkable, but materially impossible.*"

A strand of the literature has explored these geopolitical determinants of trade agreements.

Martin et al. (2012) analyze data spanning the period 1950-2000 and demonstrate that latent geopolitical tensions, as indicated by past wars between countries, increase the likelihood of PTA formation. Baldwin and Jaimovich (2012), Vicard (2012) and Eichengreen et al. (2021) consider military alliances as potential determinants of trade agreements. Moving beyond conflicts, Hinz (2023) presents evidence indicating that geopolitical factors significantly influence the selection of contracting partner countries and the extent of economic integration.

Political acceptability. Reinforcing bilateral interdependence with geopolitical rivals faces a significant obstacle in the form of the political acceptability of engaging in trade with former enemies. Empirical studies have documented the substantial political costs associated with implementing trade policies involving former adversaries. For instance, historical conflicts have been found to hinder current trust and trade between former enemies (Guiso et al., 2009) as exemplified by the minimal level of bilateral dependence between India and Pakistan (Table 2). Moreover, Martin et al. (2012) show that, in contrast with past wars, recent wars deter the formation of trade agreements. All these findings underscore the catch-22 nature of implementing peace-promoting trade agreements with former enemies.

The challenge is particularly pronounced in democracies, where leaders face electoral accountability that restricts their ability to pursue economic ties with rival nations. However, the EU's successful integration, despite a long and intense history of conflict among its member states, stands out as a remarkable example, demonstrating that windows of opportunity can be identified and political obstacles can be overcome.

A role for the multilateral approach to trade agreements. Presumably, multilateralism provides a more politically acceptable approach to facilitating trade with geopolitical rivals compared to bilateral or regional agreements. Additionally, the trade diplomacy channel relies on the existence of functional multilateral institutions that can host negotiations and disseminate information on both economic and political matters. A last element in favor of multilateralism pertains to the geopolitical risks associated with non-cooperative behaviors, as policymakers may not fully internalize the security spillovers of their trade policy. As highlighted in the previous section, trade agreements have the potential to create and divert trade flows, affecting not only the countries directly involved but also third-party nations. This redirection of trade flows impacts the GIS and the related geoeconomic factors, including conflict risk, for all country-pairs. By factoring in the interests of all the actors potentially affected by the policy, the multilateral approach is a way to address these intricate interconnections between geopolitical insecurity and trade architecture. Overall, these three arguments emphasize the importance of strengthening the multilateral trade system in a world of rising geopolitical tensions.

5.5 Trade Sanctions

Economic sanctions are commonly observed during diplomatic disputes. Their objective is to induce a change in the policies of a foreign government by imposing harm on its economy. The Em-

Table 7: Commitment to sanction Russia in case of a war, year 2018.

		Country 1						Country 2	
		DOCW	G	s_{ij}	Ds_{ij}	DWIM	DPKC	DOCW	G
UKR	RUS	0	5.49	94.05	5.95	-1.95	5.58	11.16	-5.67
CHN	RUS	0	4.44	100	0	0	4.44	8.88	-4.44
DEU	RUS	0	4.63	70.89	29.11	-1.57	5	10.01	-5.38
POL	RUS	0	5.1	73.4	26.6	-1.61	5.59	11.17	-6.07
USA	RUS	0	4.9	69.99	30.01	-1.55	5.4	10.81	-5.91

changes in the geoeconomic factors under the sanctions scheme (counterfactual) relative to the facods employed, rather than definitive calculations. Future research aimed at obtaining more precise estimates should employ non-approximated methods, enrich the structure of the trade model, and explore more realistic scenarios. Second, an overlooked area in the literature pertains to the role of industrial lobbies and other special interest groups in the containment or escalation of tensions. Third, the paper has shed light on the fundamental security dilemma faced by policymakers. One conclusion is that the diversification of import sourcing in response to geopolitical tensions can—by reducing interdependencies with geopolitical rivals—paradoxically reinforce conflict risk. Exploring the intricate feedback loops between geopolitical insecurity and trade architecture is a crucial and unexplored question. All these topics present exciting opportunities for future research in the field. By delving deeper into these areas, scholars can contribute to a more comprehensive understanding of the relationship between trade, conflict, and geopolitical dynamics, ultimately providing valuable insights for policymakers and practitioners.

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Appendix

A Diplomatic Game

A.1 Game resolution in Martin et al. (2008a)

This section outlines the key stages and outcomes of the diplomatic game resolution, which is covered in detail in Appendix A of Martin et al. (2008a) (MMT hereafter). For a comprehensive understanding of the resolution process and the definitions of variables used in the following formulas, readers are advised to refer to the original article.

Players' outside options, $\tilde{U}_i^W$ and $\tilde{U}_j^W$, which correspond to their wartime utility, are assumed to be uniformly distributed over the triangle $\triangle MM_AM_B$ (see Figure 3 in MMT) and vary respectively over the intervals $[\underline{v}_i, \bar{v}_i]$ and $[\underline{v}_j, \bar{v}_j]$. In their footnote 27 is reported the wartime utility that player i optimally announces during the negotiation:

$$\hat{U}_i^W = \underline{v}_i + \frac{1}{4}\left(S^P - \underline{v}_i - \underline{v}_j\right) + \frac{2}{3}\left(\tilde{U}_i^W - \underline{v}_i\right), \tag{35}$$

where S^P is the joint surplus in peacetime.

Reaching an agreement requires the announcements of players i and j to be compatible in the following manner:

$$\hat{U}_i^W + \hat{U}_j^W \le S^P. \tag{36}$$

Moreover, in the case of an agreement, the post-transfer utility level of player i is given by

$$U_i(\text{peace}) - \tau_{ij} = \hat{U}_i^W + \frac{S^P - \hat{U}_i^W - \hat{U}_j^W}{2}, \tag{37}$$

where τ_{ij} represents the (positive or negative) utility transfer from i to j agreed upon by the players.

The probability of reaching an agreement corresponds to the ratio of the surface of the triangle MAB over the surface of MM_AM_B. In order to compute the surface of MAB, I use lemma 1 from

A.2 Derivation of the geoeconomic factors in Section 3.2.2

I will now explain how the preceding relationships can be utilized to derive the theoretical results presented in Section 3.2.2. It is worth noting that the results concerning the geoeconomic factors expand upon the analysis of MMT and are not covered in their paper.

Change of variables. The formulas originally derived by MMT are expressed with utility speci- ed in levels However, the model resolution in Section 3.2.2 and the related formulas emphasize the role of OCW, which essentially represents a utility difference between peace and war. Therefore, it becomes necessary to reformulate all equations from the preceding section to express them and (42)

$$\tilde{r}_{ij} = U_i(\text{peace}) \quad \hat{U}_i^W \quad S^P \quad \hat{U}_i^W \quad \hat{U}_j^W$$

Taking the difference between the unconditional and conditional expectations, and using (49), I get

$$WIM_i = \frac{\bar{u}}{3} - \frac{\bar{u}^3 - \bar{x}^3}{3(\bar{u}^2 - \bar{x}^2)} = \frac{1}{3}\frac{\bar{x}^2}{\bar{u} + \bar{x}}.$$

From parametric assumptions, $\bar{u}$ can be replaced by $(3h/4)$ and $\bar{x}$ by MA. Moreover, Equations (38), (40) and (45) imply $MA = (3/4)\left(OCW_i + OCW_j + v_i + v_j\right)$. Thus, the preceding equation can be reformulated as

$$WIM_i = \frac{1}{4}\frac{\left(OCW_i + OCW_j + v_i + v_j\right)^2}{h + OCW_i + OCW_j + v_i + v_j}, \tag{51}$$

which corresponds to Equation (13) in the text.

Expected Welfare:

I now compute the ex-ante expected welfare, at stage zero of the game, namely when the geopolitical dispute arises but the realization of the war shocks is still unknown and diplomatic negotiations are still unsettled. Making use of conditional expectations and considering the definitions of peacetime post-transfer utility and wartime UCW, I get

$$\begin{aligned} E\tilde{U}_i &= s_{ij}\, E\left(\tilde{U}_i | peace\right) + (1 - s_{ij})\, E\left(\tilde{U}_i | war\right) \\ &= s_{ij}\left(U_i(peace) - E\left[\tau_{ij} | peace\right]\right) + (1 - s_{ij})\left(U_i(peace) - E\left[UCW_i | war\right]\right) \\ &= U_i(peace) - s_{ij}\, E\left[\tau_{ij} | peace\right] - (1 - s_{ij})\, E\left[UCW_i | war\right]. \end{aligned}$$

From relations (47), (48) and (50), this leads to

$$E\tilde{U}_i = U_i(peace) - s_{ij}\, PKC_i - (1 - s_{ij})\left(OCW_i + v_i - \frac{h}{4} - WIM_i\right),$$

which corresponds to relation (15) in the text. 8311.918 Td [(i)-67(j)]TJ/F164 11.3673peace

C Approximated Procedure: Derivation of Equation (27)

Plugging (24) into the definition of OCW given by Equation (5) leads to

$$\text{OCW}_i = -\log \hat{A}_i + \frac{1}{\sigma - 1}\log \hat{\pi}_{ii}. \tag{55}$$

Let first compute $\log \hat{\pi}_{ii}$ in the preceding relation. This term corresponds to the log of Equation (25) in which, according to the MTI approach, all wage changes can be neglected

$$\log \hat{\pi}_{ii} = -\log\left[\pi_{ii} + \pi_{ji}\left(\frac{\hat{\tau}_{bil}\hat{A}_i}{\hat{A}_j}\right)^{1-\sigma} + \sum_{n\neq i,j}\pi_{ni}\left(\hat{\tau}_{mul}\hat{A}_i\right)^{1-\sigma}\right].$$

Using the accounting identity $\pi_{ii} + \pi_{ji} + \sum_{n\neq i,j}\pi_{ni} = 1$, the preceding relation can be rewritten as

$$\log \hat{\pi}_{ii} = -\log\left[1 - \pi_{ji}\left[1 - \left(\frac{\hat{\tau}_{bil}\hat{A}_i}{\hat{A}_j}\right)^{1-\sigma}\right] - \sum_{n\neq i,j}\pi_{ni}\left[1 - \left(\hat{\tau}_{mul}\hat{A}_i\right)^{1-\sigma}\right]\right]. \tag{56}$$

At this stage, for notational convenience, the war damages are scaled in % change: $1 - \alpha_i \equiv \hat{A}_i$, $1 - \alpha_j \equiv \hat{A}_j$, $1 + \tau_{bil} \equiv \hat{\tau}_{bil}$ and $1 + \tau_{mul} \equiv \hat{\tau}_{mul}$. Making use of these parameters, a first-order approximation of Equation (56) is given by

$$\begin{aligned}
\log \hat{\pi}_{ii} &\approx \pi_{ji}\left[1 - \left(\frac{\hat{\tau}_{bil}\hat{A}_i}{\hat{A}_j}\right)^{1-\sigma}\right] + \sum_{n\neq i,j}\pi_{ni}\left[1 - \left(\hat{\tau}_{mul}\hat{A}_i\right)^{1-\sigma}\right] \\
&= \pi_{ji}\left[1 - \frac{(1+\tau_{bil})^{1-\sigma}(1-\alpha_i)^{1-\sigma}}{\left(1-\alpha_j\right)^{1-\sigma}}\right] + \sum_{n\neq i,j}\pi_{ni}\left[1 - \ldots\right]
\end{aligned}$$