Tariffs as Bargaining Chips: A Quantitative Analysis of the U.S.–China Trade War*

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Abstract

Non-cooperative tariffs change outside options and thus affect welfare outcomes in potential tariff negotiations. We focus on the U.S.–China trade war from 2018 through 2019 and examine whether such tariffs can serve as leverage to improve U.S. post-negotiation welfare. With a multi-country, multi-sector quantitative trade model, we simulate negotiations from two starting points: the 2017 baseline and the 2019 trade-war equilibrium. Our results show that, across reasonable estimates of U.S. bargaining power, imposing trade-war tariffs before the negotiations consistently enhances U.S. post-negotiation welfare.

Keywords: tariff bargaining, U.S.–China trade war, quantitative trade policy

JEL codes: F13, F51, C70

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I Introduction

During the 2016 U.S. presidential campaign, Donald Trump denounced the U.S.–China trade relationship and repeatedly vowed to increase tariffs on Chinese imports. After winning the 2016 election, he kept his promise by imposing a series of wide-ranging increases in tariffs from 2018 through 2019. As documented in Bown (2021), the average U.S. tariff on China rose to more than 19% by January 2021, up from 3% before the trade war. At the same time, China retaliated by increasing its average tariff on U.S. goods from 8% to more than 20%. During the subsequent presidential campaign, Joe Biden attacked the trade war as reckless and irresponsible, and stated that he would remove the Trump tariffs.[1] However, Joe Biden did not keep his word after he won the 2020 election, and the Trump tariffs remained in place throughout Biden's presidency.

Since 2021, there have been several explanations for the Biden administration's reluctance to remove the Trump tariffs, including lobbying pressure from firms that had benefited from the Trump tariffs, concern about appearing weak on China, and campaign considerations for the 2024 presidential election. Acknowledging the merits of these theories, we do not seek to determine which one is the most probable. Instead, we focus on an argument that has been substantiated by U.S. government officials: these tariffs could be used as bargaining chips in later trade negotiations with China. In testimony before a U.S. Senate Appropriations subcommittee in June 2022, U.S. Trade Representative Katherine Tai stated, "The China tariffs are, in my view, a significant piece of leverage – and a trade negotiator never walks away from leverage." In this paper, we conceptualize this argument within a quantitative framework and investigate whether non-cooperative tariffs can be used as bargaining chips to improve a country's post-negotiation welfare.

We first introduce a simple theoretical framework with two possible tariff negotiation scenarios to illustrate our research question. Starting from a baseline equilibrium within the global efficiency frontier, two countries can negotiate over their bilateral tariffs to improve welfare through Nash bargaining. In the first scenario, negotiations begin directly from the baseline equilibrium. In the second scenario, the two countries initially engage in a trade war and impose non-cooperative tariffs before negotiating from the trade-war equilibrium. We show that existing theories cannot predict which scenario will lead to a greater improvement in national welfare. Therefore, a quantitative trade model is required for numerical analysis to examine whether tariffs can be used as bargaining chips to improve welfare.

We then develop a multi-country, multi-sector trade model that features input-output linkages as in Caliendo and Parro (2015) to analyze whether the Trump tariffs can be used as leverage to improve U.S. post-negotiation welfare. In the model, the U.S. and China can engage in bilateral tariff

[1] For example, on August 3, 2019, Joe Biden wrote on Twitter that "...Trump doesn't care about the farmers, workers, and consumers that are being crushed by his irresponsible trade war with China... I will reverse his senseless policies."

negotiations, and the bargaining outcome depends on both the tariff levels before the negotiation and the relative bargaining power of the two countries. Following the method of moments estimation introduced in Bagwell, Staiger and Yurukoglu (2021), we estimate the bilateral bargaining power between the U.S. and China by examining China's accession to the World Trade Organization (WTO) in 2001. The estimated Nash bargaining weight of the U.S. in the bilateral tariff negotiation with China ranges from 0.58 to 0.84, which indicates that the U.S. had more bilateral bargaining power in the negotiation with China. This result is consistent with the finding in Bown, Caliendo, Parro, Staiger and Sykes (2023) that China's tariff reductions after its accession to the WTO exceeded the norm of reciprocity.

With the calibrated model, we use the method of mathematical programming with equilibrium constraints (MPEC), popularized by Su and Judd (2012), to compute the outcomes of potential tariff negotiations between the U.S. and China in two scenarios. In the first scenario, the U.S. and China engage in Nash bargaining starting from the baseline equilibrium calibrated to the 2017 fundamentals before the trade war. In the second scenario, we first apply the tariff changes observed during the trade war and then compute the cooperative tariffs starting from the trade-war equilibrium. As analyzed in previous theoretical works on trade policy cooperation, bilateral tariff negotiations usually result in mutual tariff reductions.[2] The results of our simulation, which uses the reasonably comprehensive general equilibrium model, are consistent with these theoretical predictions: in both scenarios, the resulting cooperative equilibrium always involves one country imposing zero tariffs. However, as the total welfare change in the second scenario also incorporates the welfare change due to trade-war tariffs, existing theories cannot predict which scenario will lead to the greater welfare improvement for the U.S.

One key result from our quantitative analysis is that, given the estimated range of the U.S. bargaining power, the U.S. always experiences a greater welfare increase relative to the 2017 baseline in the second scenario. In other words, compared to moving directly to the cooperative equilibrium from low tariffs, imposing trade-war tariffs before negotiating with China consistently results in greater U.S. post-negotiation welfare gains. This finding can be explained by the theoretical analysis of tariff bargaining in Bagwell and Staiger (1999) and Ossa (2011): the bilateral tariff negotiation between the U.S. and China involves reciprocal tariff reductions, and the U.S. welfare gain from the tariff negotiation starting from the 2017 baseline equilibrium is limited due to low U.S. tariff rates. For the same reason, the tariff negotiation starting from high tariffs in the trade-

[2]For example, Bagwell and Staiger (1999) show that, in a two-country, neo-classical trade model in which non-cooperative tariffs can be imposed to improve terms of trade, both countries can benefit from a mutual reduction in tariffs. In addition, if political incentives are absent and governments simply use tariffs to maximize national income, the tariff negotiation will lead to an efficient equilibrium in which at least one country imposes zero tariffs. Ossa (2011) derives the same result in a Krugman (1980)-style environment in which tariffs can be used to improve welfare through production relocation.

war equilibrium can substantially improve the U.S. welfare. Our simulation shows that, even after taking the welfare effects of the trade war into consideration, the negotiation starting from trade-war tariffs leads to a greater improvement in U.S. welfare than the negotiation starting from low tariffs before the trade war. This result is robust to numerous alternative specifications, such as extending the analysis to a multi-period framework, incorporating political weights into the objective function of the U.S., using Nash tariffs as the outside options of the negotiation, allowing negative tariffs (import subsidies), fixing trade deficits between countries, and using alternative estimates of trade elasticities.

While the U.S. gains more when the negotiation begin from the trade-war equilibrium, China is always worse off compared to negotiating directly from the 2017 low-tariff baseline. To understand this outcome more clearly, we conduct a counter-factual analysis in which China sets welfare-maximizing tariffs during the trade war instead of the actual retaliatory tariffs it imposed. Our analysis reveals that China's optimal retaliatory tariffs are generally higher than the tariffs it actually imposed. These suboptimal tariffs not only failed to maximize China's welfare during the trade war but also gave the U.S. more room for tariff reductions in later negotiations. Had China retaliated optimally, the U.S. bargaining weight threshold above which U.S. welfare gains would exceed those in the first scenario would have risen from 0.1 to 0.55.

Our main analysis is based on the premise that the U.S. and China maximize their respective welfare, measured by either real expenditure or sectoral income weighted by political incentives, in tariff negotiations. Given the rising tensions between the two countries in recent years, many topics with diverging interests could be brought to the negotiation table alongside tariffs. As an extension, we incorporate a key geopolitical issue – the Russia–Ukraine conflict – into our analysis. Specifically, we integrate Russia's welfare loss into the U.S. objective function, following de Souza, Hu, Li and Mei (2024), and allow the U.S. to pressure China to impose sanction tariffs on Russian goods. Notably, we find that pushing China to sanction Russia through trade negotiations results in a greater welfare loss for Russia than that caused by unilateral U.S. sanctions.

By quantifying the impact of the U.S.–China trade war on potential tariff bargaining outcomes, this paper contributes to the growing body of literature on quantitative trade policy. Ossa (2014, 2016) initiated the study of non-cooperative and cooperative tariffs in multi-region quantitative trade models. Other papers in this strand of literature have analyzed the welfare effects of cooperative and non-cooperative trade policies either through numerical optimization (Mei, 2020; Bagwell et al., 2021; Beshkar, Chang and Song, 2024; Ritel, 2022; de Souza et al., 2024; Mei, 2024) or through analytical characterization of optimal trade policy (Beshkar and Lashkaripour, 2020; Lashkaripour, 2021; Lashkaripour and Lugovskyy, 2023; Bartelme, Costinot, Donaldson and Rodríguez-Clare, 2024). Most closely related to our work are Bown et al. (2023) and Beshkar et al. (2024), both of which focus on reciprocal tariff reductions among WTO member countries.

Our analysis not only corroborates Katherine Tai's claim that the Trump tariffs could be used as bargaining chips, but also quantitatively illustrates how non-cooperative tariffs can influence the outcome of tariff negotiations in broader settings.

Our work also complements the theoretical literature that analyzes the welfare outcomes of trade negotiations. In addition to Bagwell and Staiger (1999) and Ossa (2011), Bagwell and Staiger (2004, 2018), Bagwell, Staiger and Yurukoglu (2020), and Beshkar and Lee (2022) also study the implications of different institutional features for tariff bargaining outcomes. By contrast, we examine the effect of changing initial tariffs on the welfare outcome of bilateral negotiations. Our numerical analysis using the calibrated comprehensive general equilibrium model also substantiates previous results derived theoretically from simpler trade models.

Finally, this paper contributes to a burgeoning body of literature that studies the impact of the trade war initiated by the Trump administration. Previous works have mainly focused on the impact on U.S. prices and welfare (Amiti, Redding and Weinstein, 2019; Waugh, 2019; Fajgelbaum, Goldberg, Kennedy and Khandelwal, 2020; Amiti, Redding and Weinstein, 2020; Handley, Kamal and Monarch, 2020; Bown, 2021; Cavallo, Gopinath, Neiman and Tang, 2021), responses from China (He, Mau and Xu, 2021; Ma, Ning and Xu, 2021; Benguria, Choi, Swenson and Xu, 2022; Jiao, Liu, Tian and Wang, 2022; Jiang, Lu, Song and Zhang, 2023; Chor and Li, 2024), and U.S. election outcomes (Che, Lu, Pierce, Schott and Tao, 2022; Choi and Lim, 2023; Blanchard, Bown and Chor, 2024).[3] Our paper is distinct from these works by considering the Trump tariffs as bargaining chips, thereby providing the first quantitative study of the potential outcomes of negotiation between the U.S. and China.

The rest of the paper is structured as follows: we first introduce a simple theoretical framework before developing a Caliendo and Parro (2015)-style quantitative trade model in Section III. After presenting data and calibrations in Section IV, we present simulation results of tariff negotiations in Section V. Section VI presents some extensions, and Section VII provides the robustness checks. The last section concludes.

II Theoretical Framework

In this section, we develop a simple theoretical framework to guide our quantitative analysis. Consider a static trade model in which governments can use tariffs to improve welfare, measured by either real expenditure or sectoral income weighted by political incentives. The economy comprises N countries, but our focus is on the potential bilateral cooperative and non-cooperative tariffs between country i and country n. Let U_n represent the welfare of country n. Assuming that all the

[3] See Fajgelbaum and Khandelwal (2022) for a comprehensive review of the literature on the impact of the U.S.–China trade war on aggregate welfare and distributional consequences for the U.S., China, and other countries.

other countries' tariffs are exogenously given, we have $U_n \equiv U_n(\boldsymbol{t}_{n,i}, \boldsymbol{t}_{i,n})$, where $\boldsymbol{t}_{n,i}$ represents the vector of country n's tariffs on country i's products.[4]

The bilateral interaction between countries i and n starts from a baseline equilibrium with initial tariff profile $\{\boldsymbol{t}^0_{n,i}, \boldsymbol{t}^0_{i,n}\}$. To make our analysis meaningful, we restrict the baseline equilibrium to be inside the efficiency frontier, so that reciprocal tariff negotiation is still possible. Starting from the baseline equilibrium, the two countries can negotiate over their bilateral tariffs through the protocol of Nash bargaining. Given the context of the U.S.–China trade war, we consider two possible scenarios. In the first scenario, the two countries jointly select the bilateral tariff profile, denoted by $\{\boldsymbol{t}^{co-1}_{n,i}, \boldsymbol{t}^{co-1}_{i,n}\}$, to maximize the Nash product of their welfare improvement:

$$
\begin{aligned}
\max_{\{\boldsymbol{t}^{co-1}_{n,i}, \boldsymbol{t}^{co-1}_{i,n}\}} \; & \left[U_n\left(\boldsymbol{t}^{co-1}_{n,i}, \boldsymbol{t}^{co-1}_{i,n}\right) - U_n\left(\boldsymbol{t}^{0}_{n,i}, \boldsymbol{t}^{0}_{i,n}\right)\right]^{\psi} \left[U_i\left(\boldsymbol{t}^{co-1}_{i,n}, \boldsymbol{t}^{co-1}_{n,i}\right) - U_i\left(\boldsymbol{t}^{0}_{i,n}, \boldsymbol{t}^{0}_{n,i}\right)\right]^{1-\psi} \\
\text{s.t.} \quad & U_n\left(\boldsymbol{t}^{co-1}_{n,i}, \boldsymbol{t}^{co-1}_{i,n}\right) \geq U_n\left(\boldsymbol{t}^{0}_{n,i}, \boldsymbol{t}^{0}_{i,n}\right), \\
& U_i\left(\boldsymbol{t}^{co-1}_{i,n}, \boldsymbol{t}^{co-1}_{n,i}\right) \geq U_i\left(\boldsymbol{t}^{0}_{i,n}, \boldsymbol{t}^{0}_{n,i}\right),
\end{aligned}
$$

where ψ denotes the bilateral bargaining power of country n relative to country i. To simplify notation, we use $\hat{U}^{co-1}_n(\psi) \equiv U_n(\boldsymbol{t}^{co-1}_{n,i}, \boldsymbol{t}^{co-1}_{i,n})/U_n(\boldsymbol{t}^0_{n,i}, \boldsymbol{t}^0_{i,n})$ to denote country n's welfare change relative to the baseline equilibrium for given bargaining weight ψ.

In the second scenario, starting from the baseline equilibrium, the two countries first engage in a trade war by imposing tariffs $\{\boldsymbol{t}^{war}_{n,i}, \boldsymbol{t}^{war}_{i,n}\}$. Note that the trade-war tariffs can be either Nash tariffs that the two countries simultaneously impose to maximize their own welfare given the other country's tariffs, or some form of non-cooperative tariffs observed in reality.[5] Next, starting from the trade-war equilibrium, the two countries engage in tariff negotiation through Nash bargaining by solving:

$$
\begin{aligned}
\max_{\{\boldsymbol{t}^{co-war}_{n,i}, \boldsymbol{t}^{co-war}_{i,n}\}} \; & \left[U_n\left(\boldsymbol{t}^{co-war}_{n,i}, \boldsymbol{t}^{co-war}_{i,n}\right) - U_n\left(\boldsymbol{t}^{war}_{n,i}, \boldsymbol{t}^{war}_{i,n}\right)\right]^{\psi} \left[U_i\left(\boldsymbol{t}^{co-war}_{i,n}, \boldsymbol{t}^{co-war}_{n,i}\right) - U_i\left(\boldsymbol{t}^{war}_{i,n}, \boldsymbol{t}^{war}_{n,i}\right)\right]^{1-\psi} \\
\text{s.t.} \quad & U_n\left(\boldsymbol{t}^{co-war}_{n,i}, \boldsymbol{t}^{co-war}_{i,n}\right) \geq U_n\left(\boldsymbol{t}^{war}_{n,i}, \boldsymbol{t}^{war}_{i,n}\right), \\
& U_i\left(\boldsymbol{t}^{co-war}_{i,n}, \boldsymbol{t}^{co-war}_{n,i}\right) \geq U_i\left(\boldsymbol{t}^{war}_{i,n}, \boldsymbol{t}^{war}_{n,i}\right),
\end{aligned}
$$

where $\{\boldsymbol{t}^{co-war}_{n,i}, \boldsymbol{t}^{co-war}_{i,n}\}$ are the cooperative tariffs starting from the trade war equilibrium. We analogously define $\hat{U}^{co-2}_n(\psi) \equiv U_n(\boldsymbol{t}^{co-war}_{n,i}, \boldsymbol{t}^{co-war}_{i,n})/U_n(\boldsymbol{t}^0_{n,i}, \boldsymbol{t}^0_{i,n})$ as country n's combined welfare change in the second scenario. If $\hat{U}^{co-2}_n(\psi) > \hat{U}^{co-1}_n(\psi)$, the trade war improves country n's post-negotiation

[4]Since the quantitative analysis focuses on the episode of the U.S.–China trade war, we allow tariffs to be country-specific, which are not consistent with WTO's most-favored-nation (MFN) principle.

[5]In the quantitative analysis, we consider both the applied tariffs under the U.S.–China trade war and the computed Nash tariffs when analyzing how these non-cooperative tariffs affect the post-negotiation welfare outcomes.

welfare outcome.[6]

It is worth noting that existing theories on trade policy cannot predict which scenario will lead to a greater welfare improvement. To see this, we can rewrite the welfare change of country n in the second scenario, $\hat{U}_n^{co-2}(\psi)$, as the product of two fractions:

$$\hat{U}_n^{co-2}(\psi) = \frac{U_n\left(\boldsymbol{t}_{n,i}^{war}, \boldsymbol{t}_{i,n}^{war}\right)}{U_n\left(\boldsymbol{t}_{n,i}^{0}, \boldsymbol{t}_{i,n}^{0}\right)} \frac{U_n\left(\boldsymbol{t}_{n,i}^{co-war}, \boldsymbol{t}_{i,n}^{co-war}\right)}{U_n\left(\boldsymbol{t}_{n,i}^{war}, \boldsymbol{t}_{i,n}^{war}\right)},$$

where the first fraction is country n's welfare change during the trade war relative to the baseline equilibrium, and the second fraction is its welfare change from the post-trade-war negotiation relative to the trade-war equilibrium. Existing theoretical studies typically find that both countries are worse off when imposing Nash tariffs in a bilateral trade war (Bagwell and Staiger, 1999; Ossa, 2011), although Johnson (1953) shows that it is also possible for a bilateral trade war to have a winner.[7] In other words, $\frac{U_n\left(\boldsymbol{t}_{n,i}^{war}, \boldsymbol{t}_{i,n}^{war}\right)}{U_n\left(\boldsymbol{t}_{n,i}^{0}, \boldsymbol{t}_{i,n}^{0}\right)}$ can be either greater or smaller than 1. The second fraction, $\frac{U_n\left(\boldsymbol{t}_{n,i}^{co-war}, \boldsymbol{t}_{i,n}^{co-war}\right)}{U_n\left(\boldsymbol{t}_{n,i}^{war}, \boldsymbol{t}_{i,n}^{war}\right)}$, is always greater than or equal to 1 because of the Nash bargaining protocol we assumed. However, the exact magnitude of the welfare gain from tariff negotiation depends not only on the bargaining weight ψ, but also on the trade patterns, trade elasticities, and initial tariffs in the pre-negotiation equilibrium. Therefore, to compare $\hat{U}_n^{co-2}(\psi)$ with $\hat{U}_n^{co-1}(\psi)$, we need to conduct a numerical analysis that uses a quantitative trade model, which we set up in the next section.

III Model

To guide our analysis of trade-war and cooperative tariffs, we build a multi-country general equilibrium quantitative trade model that consists of the multi-sector version of Eaton and Kortum (2002) with intermediate goods following Caliendo and Parro (2015). We consider a global economy comprising N countries, indexed by i or $n \in \{1, \ldots, N\}$, and J sectors, indexed by j or $k \in \{1, \ldots, J\}$. Each country is endowed with a fixed number of households, L_n, that are freely mobile across the sectors within a country but cannot move across borders. Producers employ labor and composite intermediate goods with input-output linkages. All markets are perfectly competitive. This trade model is then embedded into an equilibrium model of tariff bargaining in

[6] The analysis in this section and the quantitative exercise in Section V are based on a static framework. In Section VI.1, we incorporate the time dimension and consider a two-period setup. See also Appendix A.3 for an extension with infinite periods.

[7] Mei (2020) quantifies welfare changes of bilateral trade wars in a multi-country, multi-sector trade model. Among the 45 country pairs studied, 11 of them have one country with a welfare improvement.

which bilateral tariff negotiations are modeled in the spirit of the Nash bargaining protocol.[8]

III.1 Households

In country n, the preference of the representative household is a Cobb–Douglas function of sector-level consumption goods:

$$U_n = \prod_{j=1}^{J} \left(C_n^j\right)^{\alpha_n^j},$$

where C_n^j is the consumption of final goods from sector j in country n and α_n^j is the final consumption share, with $\sum_{j=1}^{J} \alpha_n^j = 1$. To maximize utility, the representative household chooses the vector of final consumption bundle $\left\{C_n^j\right\}_{j=1}^{J}$ subject to the budget constraint,

$$I_n = \sum_{n=1}^{N} \sum_{j=1}^{J} P_n^j C_n^j$$

where P_n^j is the ideal price index of final goods of sector s in country j and I_n is the representative household's income. Income in each location is derived from two sources: households supply one unit of labor inelastically at wage w_n and receive transfers on a lump-sum basis (including both tariff revenues and transfers accounting for trade imbalances, which will be discussed in more detail later). Given the Cobb–Douglas preference, the aggregate consumption price index in country n is given by

$$P_n = \prod_{j=1}^{J} \left(\frac{P_n^j}{\alpha_n^j}\right)^{\alpha_n^j}.$$

III.2 Technology

The production technology closely follows Eaton and Kortum (2002) and Caliendo and Parro (2015). Final goods can be used for consumption or as inputs for the production of intermediate goods, the latter of which are referred to as "materials." In each sector, final goods are produced using a continuum of intermediate goods in that sector. Intermediate goods are produced using labor and composite intermediate goods from all the sectors.

The intermediate goods firms in sector j produce a continuum of varieties $\mu^j \in [0, 1]$ in each

[8] In Appendix A.5, we extend the model by disaggregating the U.S. economy into eight regions. In the extended model, firms in each U.S. region demand labor, local factors, and materials from all other markets in the economy, as in Caliendo, Parro, Rossi-Hansberg and Sarte (2017). Incorporating these features does not significantly change the post-negotiation tariff and welfare patterns. Furthermore, because of the additional computational burden, we have to reduce the number of countries to three (the U.S., China, and Rest of the World). For these reasons, we decide to use the trade model for our main analysis.

country n. Each firm is assumed to draw its productivity z_n^j independently from a Fréchet distribution with shape parameter θ^j and location parameter T_n^j as in Eaton and Kortum (2002). The production of a variety associated with idiosyncratic efficiency of production level z_n^j is given by

$$q_n^j(z_n^j) = z_n^j \left[l_n^j(z_n^j) \right]^{\gamma_n^j} \prod_{k=1}^{J} \left[M_n^{jk}(z_n^j) \right]^{\gamma_n^{jk}},$$

where $l_n(\cdot)$ denotes the demand for labor and $M_n^{jk}(\cdot)$ denotes the demand for materials from sector k to produce intermediate goods in sector j in country n. γ_n^j is the share of value added and $\gamma_n^{jk} \geq 0$ is the share of composite intermediate inputs from sector k used in the production in sector j. The production function exhibits constant return to scale, so that $\sum_{k=1}^{J} \gamma_n^{jk} = 1 - \gamma_n^j$.

With perfectly competitive markets, firms set their prices at the unit cost, x_n^j/z_n^j. Denoting x_n^j as the cost of an input bundle for intermediate goods production in sector j and country n, we have

$$x_n^j = B_n w_n^{\gamma_n^j} \prod_{k=1}^{J} \left[P_n^k \right]^{\gamma_n^{jk}}, \tag{1}$$

where $B_n = [\gamma_n^j]^{-\gamma_n^j} \prod_{k=1}^{J} [\gamma_n^{jk}]^{-\gamma_n^{jk}}$ is a constant.

Final goods in each location are produced using intermediate goods sourced from the lowest cost suppliers across countries. The production technology of final goods in sector j and country n is a constant elasticity of substitution (CES) aggregator given by

$$Q_n^j = \left[\int_{\mathcal{R}_+^N} \tilde{q}_n^j(z^j)^{(\eta_n^j - 1)/\eta_n^j} \phi^j(z^j) dz^j \right]^{\eta_n^j/(\eta_n^j - 1)},$$

where η_n^j is the elasticity of substitution across intermediate goods within sector j in country n, and $\tilde{q}_n(z^j)$ is the demand for an intermediate good of a given variety such that the vector of productivity drawn from each location for that variety is $z^j = (z_1^j, z_2^j, \ldots, z_{N+M}^j)$. The joint density function for the vector z^j is denoted by $\phi^j(z^j) = \exp\{-\sum_{n=1}^{N+M} T_n^j (z_n^j)^{-\theta^j}\}$, with marginal densities given by $\phi_n^j(z_n^j) = \exp\{-T_n^j (z_n^j)^{-\theta^j}\}$. For non-tradable sectors, the producers only use locally produced intermediate goods.

III.3 International Trade Costs And Prices

We assume that trade in intermediate goods is costly due to iceberg shipping costs and ad-valorem tariffs. In particular, $d_{ni}^j \geq 1$ units of tradable intermediate goods in sector j need to be shipped from location i for one unit to arrive in location n, with $d_{nn}^j = 1$. In addition, sector j goods imported by country n from country i incur the tariff t_{ni}^j. Combining both iceberg shipping costs and ad-valorem tariffs, we define trade cost as $\kappa^j_{ni} = \tau^j_{ni} d^j_{ni}$, where $\tau^j_{ni} = 1 + t^j_{ni}$. Non-tradable sectors have infinite trade costs, so $\kappa^j_{ni} = \infty$.

After we take trade costs into consideration, the price of intermediate goods in country n is

$$p^j_n(z^j_i) = \min_i \left\{ \frac{x^j_i \kappa^j_{ni}}{z^j_i} \right\}.$$

Following the probabilistic representation of technologies in Eaton and Kortum (2002), we can derive the price index for sector j's composite intermediate goods in country n as

$$P^j_n = \Gamma\left(\frac{1-\eta^j_n}{\theta^j} + 1\right)^{1/(1-\eta^j_n)} \left[\sum_{i=1}^{N} T^j_i \left(x^j_i \kappa^j_{ni}\right)^{-\theta^j}\right]^{-1/\theta^j}, \tag{2}$$

where $\Gamma(.)$ is the Gamma function. When j refers to a non-tradable sector, the sectoral price index becomes $P^j_n = \Gamma(\frac{1-\eta^j_n}{\theta^j} + 1)^{1/(1-\eta^j_n)} [T^j_n (x^j_n)^{-\theta^j}]^{-1/\theta^j}$.

We can also derive country n's expenditure on the intermediate goods of sector j purchased from country i. We use $X^j_n = P^j_n Q^j_n$ as the total expenditure on sector j goods in country n and X^j_{ni} as the expenditure of location n on sector j goods from country i. The expenditure share $\pi^j_{ni} = X^j_{ni}/X^j_n$ is given by

$$\pi^j_{ni} = \frac{T^j_i \left[x^j_i \kappa^j_{ni}\right]^{-\theta^j}}{\sum_{h=1}^N T^j_h \left[x^j_h \kappa^j_{nh}\right]^{-\theta^j}}. \tag{3}$$

III.4 General Equilibrium

Income level in country n is the sum of labor income and tariff revenue, minus trade surplus:

$$I_n = w_n L_n + \Lambda_n - S_n,$$

where $\Lambda_n = \sum_{j=1}^J \sum_{i=1}^N t^j_{ni} X^j_n \frac{\pi^j_{ni}}{\tau^j_{ni}}$ denotes country n's tariff revenue on goods from all the countries, and $S_n = \sum_{j=1}^J S^j_n$ is the national trade surplus, which aggregates trade imbalances across sectors. Sectoral trade surplus is defined as $S^j_n = \sum_{i=1}^N \left(X^j_i \frac{\pi^j_{in}}{\tau^j_{in}} - X^j_n \frac{\pi^j_{ni}}{\tau^j_{ni}} \right)$.

Total expenditure on final goods in sector j and country n is the sum of the expenditure on composite intermediate goods by firms and the expenditure on final consumption by households:

$$X^j_n = \sum_{k=1}^J \gamma^{j,k}_n \sum_{i=1}^N X^k_i \frac{\pi^k_{in}}{\tau^k_{in}} + \alpha^j_n I_n. \tag{4}$$

Using the definitions of trade surplus and expenditure, we have the trade balance condition:

$$\sum_{j=1}^{J}\sum_{i=1}^{N+M} X_n^j \frac{\pi_{ni}^j}{\tau_{ni}^j} + S_n = \sum_{j=1}^{J}\sum_{i=1}^{N+M} X_i^j \frac{\pi_{in}^j}{\tau_{in}^j}. \tag{5}$$

General Equilibrium. Given the exogenous parameters $\{\alpha_n^j, \theta^j, T_n^j, \gamma_n^j, \gamma_n^{jk}, \eta_n^j, d_{ni}^j\}$ and labor supplies $\{L_n\}_{n=1}^N$, a general equilibrium under given tariff structure $\boldsymbol{t}$ for this economy is a set of wages $\{w_n\}_{n=1}^N$ and prices $\{P_n^j\}_{n=1,j=1}^{N,J}$, which satisfy equilibrium conditions 1, 2, 3, 4, and 5 for all sectors $j \in \{1, \cdots J\}$ and countries $n \in \{1, \cdots, N\}$.

In practice, we solve the model using the exact hat algebra approach, as in Dekle, Eaton and Kortum (2007), to avoid calibrating unchanged underlying parameters. We present the corresponding equilibrium conditions in Appendix Section A.1. In addition, as discussed in Ossa (2014), the presence of aggregate trade imbalances between countries can generate extreme general equilibrium adjustments in response to trade policy changes. Accordingly, we follow the exercise in Dekle et al. (2007) to construct a trade flow matrix for 2017 without trade imbalances. All later simulations of tariff negotiations in the main analysis will treat this purged trade flow data as the 2017 baseline equilibrium.[9] Nevertheless, in Section VII, we also consider an alternative setup that fixes the 2017 factual trade imbalances as a robustness check.

III.5 Tariff Negotiation

As illustrated in Section II, we assume that the U.S. and China negotiate their bilateral tariffs through the Nash bargaining protocol. In particular, the two countries jointly select the bilateral tariff profile, denoted by $\{\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}\}$, to maximize the Nash product of their welfare gains, namely,

$$\begin{aligned}
\max_{\{\boldsymbol{t}_{US,chn},\boldsymbol{t}_{chn,US}\}} & \left[U_{US}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}\right) - U_{US}\left(\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}\right)\right]^{\psi} \\
& \left[U_{chn}\left(\boldsymbol{t}_{chn,US}, \boldsymbol{t}_{US,chn}\right) - U_{chn}\left(\boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{US,chn}\right)\right]^{1-\psi} \\
\text{s.t. } & \text{equilibrium conditions 1, 2, 3, 4, and 5 are satisfied, and} \\
& U_{US}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}\right) \geq U_{US}\left(\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}\right), \\
& U_{chn}\left(\boldsymbol{t}_{chn,US}, \boldsymbol{t}_{US,chn}\right) \geq U_{chn}\left(\boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{US,chn}\right),
\end{aligned} \tag{6}$$

[9] This approach has been adopted in several existing works on quantitative trade policy, such as Ossa (2014) and Bagwell et al. (2021). Ossa (2016) discusses the implications of various approaches for managing trade deficits in counter-factual analysis.

where ψ denotes the bargaining power of the U.S. relative to China. When $\psi = 1$, the U.S. maximizes its own welfare while keeping China's welfare non-decreasing. In particular, $\boldsymbol{t}_{US,chn}$ refers to the predicted vector of cooperative tariffs imposed by the U.S. on Chinese goods across all sectors, and $\boldsymbol{t}_{chn,US}$ is the vector of cooperative tariffs imposed by China on U.S. goods. $U_{US}\left(\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}\right)$ and $U_{chn}\left(\boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{US,chn}\right)$ denote the initial welfare levels of the U.S. and China under the pre-negotiation tariff profile $\left\{\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}\right\}$ that will prevail if the two countries fail to reach an agreement.

We rely on the Nash bargaining problem (6) to compute the post-negotiation equilibria in our main analysis presented in Section V. We also consider several alternative setups of the bargaining problem in later sections. For example, we incorporate sanction tariffs on Russia into the tariff negotiation in Section VI. As a robustness check, we allow the objective function of the U.S. and China in the tariff negotiation to incorporate political weights, as in Ossa (2014), in Section VII. In the same section, we also conduct a quantitative exercise in which the outside option involves both countries imposing computed Nash tariffs instead of pre-negotiation tariffs.

Throughout this paper, we refer to the solution to the Nash bargaining problem (6) as cooperative tariffs or post-negotiation tariffs. In practice, we also adopt the exact hat algebra approach to solve the Nash bargaining problem, and the corresponding hat-algebra equilibrium details are presented in Appendix A.2.

IV Data, Calibration, and Some Empirical Facts

In this section, we first present the data and the calibration of parameters used in the quantitative exercise. We then discuss the estimation of two remaining key parameters: the relative bargaining power between the U.S. and China ψ, and the elasticity of substitution θ^j. In the last part of the section, we present some basic facts of the U.S.–China trade war.

IV.1 Data

In our quantitative analysis, we consider 10 major economies: the U.S., China, the Association of Southeast Asian Nations (ASEAN), Canada, the European Union (EU), India, Japan, Korea, Mexico, and Russia.[10] The remaining countries are grouped into one entity known as the Rest of

[10] We define the ASEAN as consisting of the 10 members, including Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. Since the United Kingdom (UK) only officially withdrew from the EU on 31 January 2020, the EU in our analysis consists of 28 members, including Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the UK.

the World (ROW). Twelve tradable sectors are organized as shown in the left column of Table 1. We combine non-tradable sectors into a single service sector.

Table 1: Elasticity of Substitution and Political Economy Weight Estimates

Sector	θ^j	σ^j_{US}	σ^j_{CHN}
Chemical	2.49	0.98	1.04
Computer, electronic and electrical equipment	2.35	**1.12**	0.88
Food, beverages and tobacco	3.67	0.84	**1.19**
Machinery	2.73	**1.11**	1.00
Mineral	1.92	0.98	1.00
Miscellaneous	3.05	1.01	0.90
Petroleum	3.96	0.70	**1.10**
Primary and fabricated metal	2.62	1.01	**1.05**
Rubber	2.76	1.00	0.94
Service	2.82	1.00	1.00
Textiles	3.08	**1.24**	0.92
Transportation	2.92	1.08	1.01
Wood and paper	2.27	0.94	0.97
Mean	2.82	1.00	1.00

Note: The entries under θ^j are the estimates of elasticity of substitution. The entries under σ^j_{US} and σ^j_{CHN} are the estimates of political economy weights for the U.S. and China, respectively, which are scaled to have a mean of 1. The bold entries highlight the sectors with the three highest values of political weights for each country. Parameter estimates are reported by sector in alphabetical order.

We use the economy in 2017 as the pre-trade-war baseline to analyze the Nash bargaining over tariffs and the economy in 1997 to estimate the relative bargaining power between the U.S and China. For each year, we need to separately calibrate parameters $\{\gamma^j_n, \gamma^{jk}_n, \alpha^j_n\}$. We start by obtaining bilateral international trade flow data from the OECD Inter-Country Input-Output (ICIO) database. This database also provides information about trade flows on intermediate goods for each origin-destination sector pair in each country, as well as the trade values used for final consumption. Consequently, we can directly back out input-output coefficients, γ^{jk}_n, and value-added shares in gross production, γ^j_n, from the database. Lastly, by using the market-clearing condition for intermediate goods (4), we can compute the consumption expenditure share in each country for each sector as follows:

$$\alpha^j_n = \frac{1}{I_n}\left(\sum_{i=1}^{N} X^j_n \pi^j_{ni} - \sum_{k=1}^{J}\sum_{i=1}^{N} \gamma^{kj}_i \frac{\pi^k_{in}}{\tau^k_{in}} X^k_i\right).$$

IV.2 Estimation of Bargaining Power

We estimate the relative bargaining power between the U.S. and China by examining the episode of China's accession to the WTO in 2001. After China joined the WTO, it significantly reduced its MFN tariff rates on goods from other WTO member countries. At the same time, the tariffs on China applied by the U.S. remained largely unchanged.[11] This is because the U.S. had already granted China normal trade relations (NTR) status in 1980, significantly reducing the tariffs on Chinese products to MFN levels. The U.S. Congress voted annually throughout the 1990s on a bill to renew China's NTR status. If China's NTR status had been revoked, Chinese exports to the U.S. would have been subject to "column 2 tariffs," the non-cooperative tariffs applied to U.S. imports from non-WTO member countries (Ossa, 2014). This trade policy uncertainty associated with U.S. tariffs on Chinese goods lasted until 2001 when China gained permanent NTR status after joining the WTO.[12]

We estimate the bargaining power parameter ψ using a method of moments estimation that closely follows the approach introduced in Bagwell et al. (2021). In particular, given the estimated parameters of the trade model, we can predict post-negotiation tariffs with any bargaining weight and outside options by solving the Nash bargaining problem (6). We can then numerically search over ψ to minimize the distance between the post-negotiation tariffs predicted by our model and the factual bargaining outcomes that we discuss in more detail later. We use the world economy in 1997 and 2005 to approximate the equilibrium before and after China's accession to the WTO, respectively.

Given the institutional background of China's accession to the WTO, we introduce three institutional constraints when solving the Nash bargaining problem numerically to estimate the U.S. bargaining power ψ. The first constraint is about the outside option of the U.S.: since the U.S. had already reduced tariffs on Chinese imports to MFN levels in 1980, setting $\boldsymbol{t}^0_{US,chn}$ as the U.S. applied tariffs in 1997, as in Bagwell et al. (2021), may not accurately reflect the threat point of the U.S in the negotiation with China. In fact, since the U.S. tariffs remained largely unchanged, the U.S. bargaining power computed from this setup should be considered the upper bound of ψ. As noted in Bagwell et al. (2021), a country tends to be assigned a larger bargaining power in a bilateral bargaining pair if the country's tariff reductions are smaller than those of its negotiating

[11] As documented in Dorsey (2003), "China will reduce tariffs on nonagricultural products (which account for 95% of its imports) to 8.9% by 2005, and tariffs on agricultural products to 15% by January 2004." In Figure A.1 of the Appendix, we plot the U.S. and China tariff rates at sector level in 1997 and 2005. The U.S. tariff rates on Chinese imports remained almost the same with only a slight decline. Meanwhile, China significantly lowered its tariffs on U.S. imports after joining the WTO.

[12] As discussed in Handley and Limão (2017), China never lost its NTR status, but it came close: "In the 1990s, after the Tiananmen Square protests, Congress voted on a bill to revoke MFN status every year and the House passed it three times." As shown in Figure A.2 of the Appendix, the U.S. "column 2 tariffs" are substantially higher than the U.S. applied tariffs on Chinese goods.

partner. The lower bound of ψ, meanwhile, is computed by setting $\boldsymbol{t}^0_{US,chn}$ as the "column 2 tariffs" of the U.S., the outside option that would bring the largest tariff reductions on the U.S. side.

Second, because the applied MFN tariff rates imposed by the U.S. on most WTO members remained relatively stable between 1997 and 2005, we assume that China was fully aware of the U.S. post-negotiation tariff rates throughout the negotiation process. In other words, $\boldsymbol{t}_{US,chn}$ in (6) is pinned down by the U.S. applied MFN tariff rates in 2005, and we only need to compute $\boldsymbol{t}_{chn,US}$ to solve the Nash bargaining problem. We believe that this setup more accurately reflects the tariff bargaining environment during China's accession to the WTO. Nevertheless, we also consider the alternative setup in which $\boldsymbol{t}_{US,chn}$ and $\boldsymbol{t}_{chn,US}$ are both adjustable during the negotiation. The computed results are presented in Section VII.8 as a robustness check.

Third, we treat the bilateral applied MFN tariffs in 2005 between the U.S. and the other countries, as well as between China and the other countries, as given when estimating the relative bargaining power between the U.S. and China. Unlike the Uruguay Round, which involved a collection of inter-connected bilateral bargains (Bagwell et al., 2021), the U.S.–China bilateral agreement is generally regarded as the core of the negotiation on China's accession to the WTO (Dorsey, 2003). Therefore, by focusing on the negotiation between the U.S. and China only, we do not need to consider the complications from the Nash-in-Nash approach adopted in Bagwell et al. (2021), which is substantially more computationally demanding than our current approach.

Given these assumptions, we estimate the bargaining power by searching for a value of ψ that minimizes the distance between the factual level of China's tariffs after joining the WTO and the solution to China's cooperative tariffs given this value of ψ. Formally, the bargaining power of the U.S. relative to China is backed out by solving

$$\min_{\psi}\left(\boldsymbol{t}_{chn,US}(\psi)-\boldsymbol{t}^{2005}_{chn,US}\right)'\left(\boldsymbol{t}_{chn,US}(\psi)-\boldsymbol{t}^{2005}_{chn,US}\right),$$

where $\boldsymbol{t}_{chn,US}(\psi)$ is the vector of the predicted cooperative tariffs imposed by China on U.S. exports given the bargaining power ψ from solving (6), and $\boldsymbol{t}^{2005}_{chn,US}$ is the unilateral vector of the applied MFN tariff rates of China on the U.S. in the year 2005. Using the grid search method, we obtain the lower and upper bounds of the U.S. bargaining power relative to China: $\hat{\psi} = 0.58$ when setting $\boldsymbol{t}^0_{US,chn}$ as "column 2 tariffs," and $\hat{\psi} = 0.84$ when setting $\boldsymbol{t}^0_{US,chn}$ as the U.S. applied tariffs on Chinese goods in the year 1997.

Our estimates of $\psi \in [0.58, 0.84]$ indicate that the U.S. had more bilateral bargaining power in the negotiation with China. Bown et al. (2023) also study the same event but focus on reciprocal tariff reductions that keep the terms of trade between the two countries unchanged (Bagwell and Staiger, 1999). Bown et al. (2023) find that, contrary to recent accusations against China, the tariff reductions by China after its accession to the WTO actually exceeded the norm of reciprocity. This finding is consistent with our estimated value of the U.S. bargaining power: as noted in Bagwell et al. (2021), a country tends to be assigned a smaller bargaining power in bilateral bargaining if its tariff reductions will be larger than those of its negotiating partner.

IV.3 Elasticity of Substitution

The elasticity of substitution, θ^j, is estimated using the well-known method first described by Feenstra (1994) and documented in Feenstra (2010). Data used for bilateral trade flow and quantity are from CEPII's BACI database, covering the time period from 1996 to 2016 for the most countries in the world. Instead of focusing on single importers, we use all available trade flows to a collection of importers across the 10 major economies considered in our analysis, as in Ossa (2014). For each tradable sector, China is used as the reference exporting country.

The estimated elasticities are reported in the second column in Table 1. The average of estimated elasticities of substitution is 2.82, which is similar to the estimated average of 2.80 in Mei (2024) and falls within the range of previous findings in the literature.[13] In Section VII, we also use estimates of elasticity of substitution from Caliendo and Parro (2015) as a robustness check.

IV.4 Trade-War Tariffs

We obtain the tariff data from the World Integrated Trade Solution (WITS) at the country–product (HS 6-digit) level and aggregate the data by sector based on trade volume weight. As in Jiao et al. (2022), the bilateral trade war tariff data are calculated as the MFN tariff rates applied before the trade war plus the changes in tariff rates caused by each round of the U.S–China trade war until the end of 2019. Tariff changes in each round are obtained from the Peterson Institute for International Economics (PIIE). Following the approach in Fajgelbaum, Goldberg, Kennedy, Khandelwal and Taglioni (2024), the tariff changes are scaled by the total time in effect over the two-year window.

In Figure 1, we show the factual tariff rates before and after the trade war by sector. As can be seen from the left panel, the average U.S. tariffs on Chinese goods increased from 2.78% to 12.56%. At the same time, Chinese tariffs on U.S. goods increased from 6.79% to 14.78%.[14] The U.S. raised tariffs on Chinese goods in all sectors, and China did the same, with the exception of transportation. This is because China had reduced the MFN tariffs on motor vehicles in July 2018. China later retaliated against the U.S. Section 301 Investigations by raising tariffs on the

[13] Ossa (2014) uses the GTAP database with trade data from 1994 to 2008, and the average of estimated elasticities is 3.42 with a range from 1.19 to 10.07. This larger range is because the sectors in Ossa (2014) are more granular, and agricultural sectors such as wheat and rice exhibit greater elasticity of substitution.

[14] Despite using the same data source, the average tariff changes we calculate differ from those in Bown (2021) because we first aggregate tariffs at the sector level before taking the simple average.

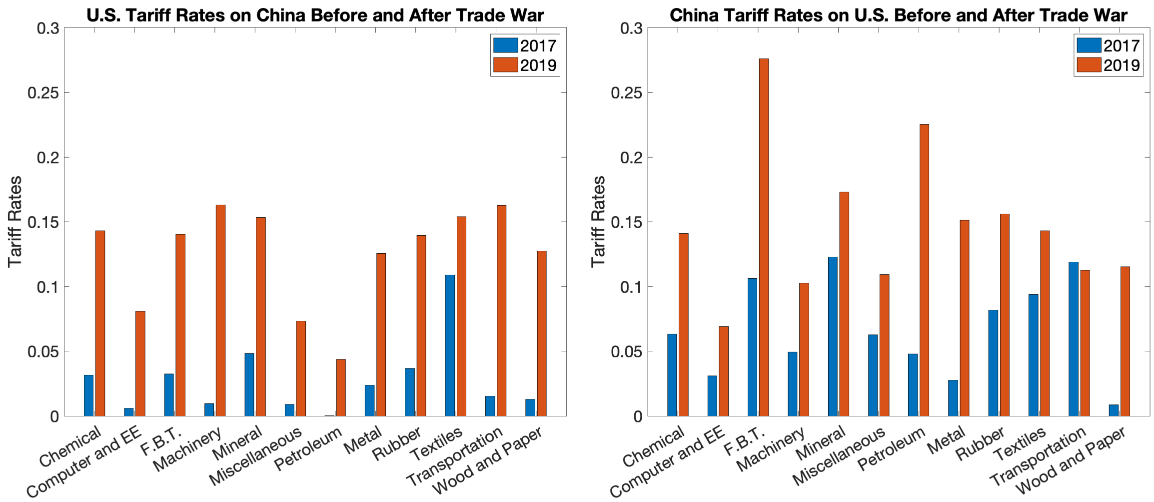

Figure 1: Tariff Rates Applied During the U.S.—China Trade War

Note: The figure plots the factual bilateral tariff rates between the U.S. and China in 2017 (before the trade war) and at the end of 2019 (after the trade war). Tariff data are aggregated by sector based on trade volume. Sectors are arranged in alphabetical order.

transportation industry, but the retaliatory tariffs were suspended on January 1, 2019. The reduction in MFN tariffs on motor vehicles also led to a slight decrease in Chinese tariffs on goods from other countries, with the average tariff level decreasing from 7.26% to 5.79%. Meanwhile, the U.S. tariffs applied to goods from other countries remained stable throughout the trade war, with the average tariff rate changing from 2.40% before the trade war to 2.58% after the trade war.

V Main Results

In this section, we first describe the procedure used to implement the framework discussed in Section II in the context of the U.S.–China trade war. Next, we present the computed cooperative tariffs as a result of negotiations and the corresponding welfare changes.

V.1 Procedure

As elaborated in Section II, we focus on two scenarios to analyze whether the trade war improves the U.S. post-negotiation welfare. In the first scenario, the U.S. and China negotiate directly from the 2017 baseline equilibrium. Denoting this scenario by superscript 17, we first use the MPEC algorithm to compute the two countries' cooperative tariff profile – $\boldsymbol{t}_{US,chn}^{co-17}$ and $\boldsymbol{t}_{chn,US}^{co-17}$, respectively – by solving the Nash bargaining problem (6) given bargaining power ψ, with $\boldsymbol{t}_{US,chn}^{0}$ and $\boldsymbol{t}_{chn,US}^{0}$ set to be the observed tariffs of the two countries in 2017. Country n's corresponding welfare change relative to the baseline equilibrium in the first scenario is denoted by $\hat{U}_n^{co-17}(\psi)$.

In the second scenario, we first apply the trade-war tariffs $\boldsymbol{t}_{US,chn}^{war}$ and $\boldsymbol{t}_{chn,US}^{war}$ observed in 2019 to the 2017 baseline equilibrium. The resulting welfare change of country n in the trade-war equilibrium relative to the 2017 baseline is denoted by $\hat{U}_n^{war}$. Next, starting from the equilibrium with trade-war tariffs, we can again use the MPEC approach to compute cooperative tariffs $\boldsymbol{t}_{US,chn}^{co-war}$ and $\boldsymbol{t}_{chn,US}^{co-war}$ given ψ. In this case, $\boldsymbol{t}_{US,chn}^{0}$ and $\boldsymbol{t}_{chn,US}^{0}$ are set to be the trade-war tariffs of the two countries, respectively, in 2019 when solving for the Nash bargaining problem. The corresponding welfare change of country n is denoted by $\hat{U}_n^{co-war}(\psi)$. We use $\hat{U}_n^{co-19}(\psi)$ to denote the country's combined welfare change relative to the baseline equilibrium in the second scenario. In the benchmark analysis, $\hat{U}_n^{co-19}(\psi) = \hat{U}_n^{co-war}(\psi) \times \hat{U}_n^{war}$.

By comparing $\hat{U}_{US}^{co-19}(\psi)$ with $\hat{U}_{US}^{co-17}(\psi)$, we can quantitatively evaluate whether the Trump tariffs can be used as bargaining chips in future tariff negotiations: if $\hat{U}_{US}^{co-19}(\psi) > \hat{U}_{US}^{co-17}(\psi)$, then the trade war improves the U.S. welfare from the tariff negotiation with China relative to the negotiation outcome using 2017 as the starting point.

V.2 Post-Negotiation Equilibrium

Figure 2 displays the average cooperative tariff rates of the U.S. and China in both pre- and post-war tariff negotiations given different bargaining powers. The two lines in the left panel represent the simple average of bilateral cooperative tariff rates between the U.S. and China, $\boldsymbol{t}_{US,chn}^{co-17}$ and $\boldsymbol{t}_{chn,US}^{co-17}$, when the bilateral tariff negotiation starts from the 2017 equilibrium. Irrespective of the U.S. bargaining power, the average cooperative tariff of the U.S. is always zero when the negotiation starts from the 2017 equilibrium. At the same time, the computed cooperative tariff for China is always positive, although the tariff level decreases as the bargaining power of the U.S. increases. At our estimated range of $\psi = [0.58, 0.84]$, the average cooperative tariff of China declines from 2.85% to 2.24%. Even when we set $\psi = 1$ and the U.S. gains all of the bargaining power relative China, the average of China's predicted cooperative tariff rates is still 1.85%.

The solid lines in the right panel of Figure 2 present $\boldsymbol{t}_{US,chn}^{co-war}$ and $\boldsymbol{t}_{chn,US}^{co-war}$, the two countries' average bilateral cooperative tariffs in the second scenario when the tariff negotiation starts from the 2019 trade-war equilibrium. We can see that when $\psi < 0.6$, the U.S. cooperative tariff is zero and China's cooperative tariff is positive, similar to when the negotiation starts from the 2017 equilibrium. However, when the bargaining power increases, the U.S. cooperative tariff becomes positive and that of China reaches zero. When $\psi = 0.58$ (the lower bound of our estimate), China's post-negotiation tariff rate is 0.03%, which is lower than 2.85% in the previous scenario indicated by the red solid line. When $\psi = 0.84$, the average tariff rate for the U.S. is 1.62%.

Previous works on cooperative tariffs (Bagwell and Staiger, 1999; Ossa, 2011) have theorized

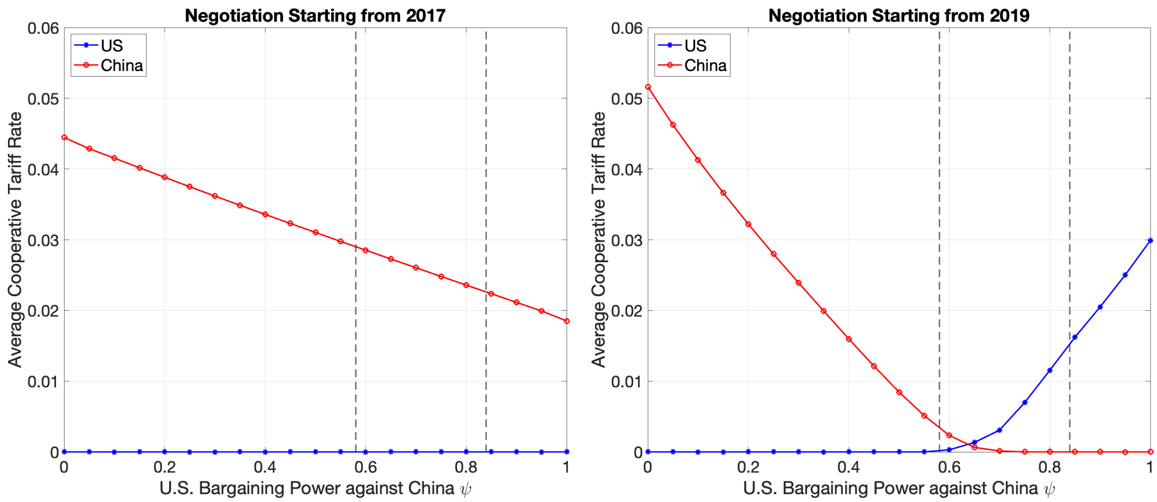

Figure 2: Average Post-Negotiation Tariffs for the U.S. and China

Note: This figure plots the simple average of post-negotiation tariffs across sectors for the U.S. and China. The left panel shows predicted tariffs when the negotiation starts from the 2017 baseline equilibrium, whereas the right panel shows predicted tariffs when the negotiation starts from the trade-war equilibrium. The two vertical dashed lines indicate the lower bound (0.58) and upper bound (0.84) of the estimated bargaining power of the U.S. relative to China.

that if political incentives are absent and governments simply use tariffs to maximize their own welfare, tariff negotiations will lead to an efficient equilibrium in which at least one country imposes zero tariffs.[15] The post-negotiation tariffs illustrated in Figure 2 are consistent with this theoretical prediction: the post-negotiation equilibrium always involves one country having zero tariffs, regardless of the tariff profile from which the negotiation starts. However, previous theoretical studies cannot predict which of the two countries will impose zero tariffs. In fact, we can see from Figure 2 that the level of resulting cooperative tariffs depends on both the bargaining power ψ and the pre-negotiation tariff profile $\{\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}\}$.[16]

Comparing the cooperative tariffs in the two scenarios shown in Figure 2 also reflects the change in the U.S. bargaining position. For any given ψ, the average U.S. post-negotiation tariff starting from the trade-war equilibrium is always equal to or higher than the post-negotiation outcomes starting from the 2017 baseline equilibrium. Meanwhile, the average Chinese post-negotiation tariff starting from the 2019 trade-war equilibrium is lower if the U.S. bargaining power exceeds 0.10. This pattern can be explained by the improved bargaining position of the U.S. after the trade war. Prior to the trade war, the tariff rates applied by the U.S. are on average lower than

[15] In Section VII, we consider a setup that allows for negative tariffs or import subsidies. In this case, zero tariffs are no longer guaranteed in the cooperative equilibrium. However, the welfare outcomes discussed later in the main text still hold.

[16] The role of initial tariff profile in trade policy cooperation has been emphasized by Ossa (2014) in the computation of world cooperative tariffs.

the Chinese rates, as shown in Figure 1. Starting from this equilibrium, the U.S. does not have much room for mutual tariff reductions, and China is always able to impose positive tariffs in the post-negotiation equilibrium. However, the difference in pre-negotiation tariffs shrinks after the two countries raise their tariffs amid the trade war. Starting from the trade-war equilibrium, the U.S. has more room to reduce tariffs. In this case, China has to provide more tariff concessions, which results in lower cooperative tariffs in the post-negotiation equilibrium.

V.3 Welfare Outcomes

It is worth noting that the improved bargaining position of the U.S. after the trade war does not automatically imply that engaging in a trade war with China will improve the post-negotiation welfare of the U.S. This is because, as illustrated in Section II, the U.S. needs to transition from the 2017 equilibrium to the trade-war equilibrium in order to achieve an improved bargaining position. In other words, while the U.S. may benefit from a stronger bargaining position if tariff negotiations begin at the trade-war equilibrium, the costs of engaging in a trade war could be substantial enough to offset any additional gains from post-war tariff negotiations. Therefore, we should use $\hat{U}_n^{co-19}(\psi) = \hat{U}_n^{co-war}(\psi) \times \hat{U}_n^{war}$ to measure the total U.S. welfare change in the second scenario. Consequently, we need to compare $\hat{U}_{US}^{co-19}(\psi)$ with $\hat{U}_{US}^{co-17}(\psi)$ to examine whether the Trump tariffs can improve the post-negotiation welfare of the U.S. In this way, the welfare change in both scenarios is relative to the 2017 baseline equilibrium.

Figure 3 illustrates the post-negotiation welfare changes (relative to the 2017 baseline) of the two scenarios for the U.S. and China. In both panels, the blue lines represent $\hat{U}_{US}^{co-17}(\psi)$ and $\hat{U}_{chn}^{co-17}(\psi)$, the welfare change when the tariff negotiation starts from the 2017 equilibrium. The red lines represent $\hat{U}_{US}^{co-19}(\psi)$ and $\hat{U}_{chn}^{co-19}(\psi)$, the total welfare change combining the welfare impact of the tariff negotiation starting from the trade-war equilibrium in 2019 and the welfare change from the 2017 baseline to the trade-war equilibrium. As expected, the U.S. post-negotiation welfare change is always increasing with the U.S. bargaining power ψ, and the opposite pattern is observed for China's post-negotiation welfare change.

One important result observed in Figure 3 is that, as long as $\psi > 0.1$, it is always the case that $\hat{U}_{US}^{co-19}(\psi) > \hat{U}_{US}^{co-0}(\psi)$. In other words, unless the relative bargaining power of the U.S. is very small, the U.S. always enjoys greater welfare improvement by starting the tariff negotiation from the trade-war equilibrium. Given our estimated range of ψ, the difference in U.S. post-negotiation welfare improvement relative to the 2017 baseline is from 0.020% (when $\psi = 0.58$) to 0.029% (when $\psi = 0.84$). Meanwhile, China almost always experiences a smaller welfare improvement or even welfare loss when the negotiation starts from the trade-war tariff profile. For example, when $\psi = 0.84$, China enjoys a welfare improvement of 0.003% if the tariff negotiation starts from the

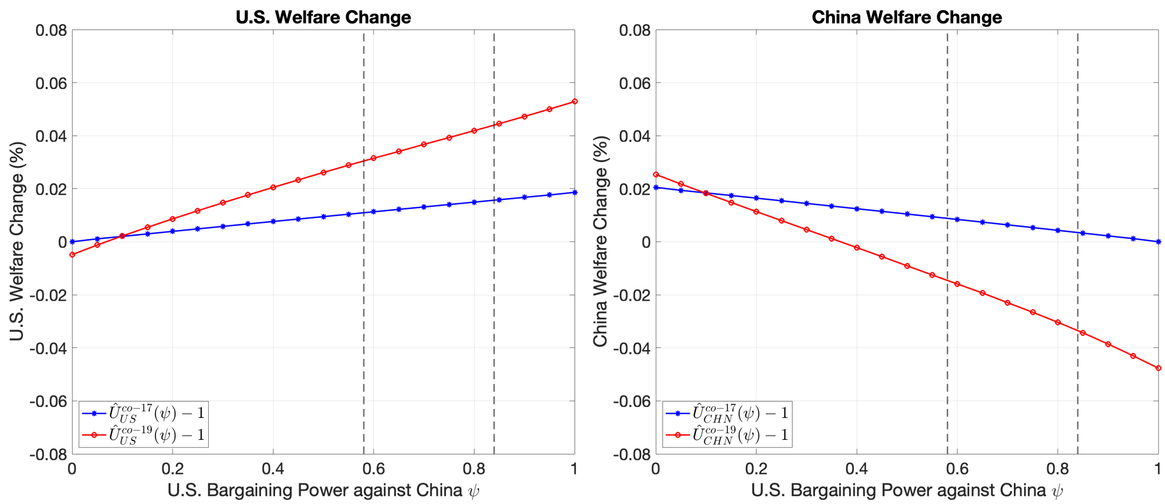

Figure 3: Post-Negotiation Welfare Change

Note: The blue lines refer to the percentage welfare changes when the tariff negotiation starts from the 2017 tariff profile relative to the 2017 baseline equilibrium. The red lines refer to the percentage welfare changes when the tariff negotiation starts from the 2019 tariff profile relative to the 2017 baseline equilibrium. The two vertical dashed lines indicate the lower bound (0.58) and upper bound (0.84) of the estimated bargaining power of the U.S. relative to China.

2017 baseline, but suffers a welfare loss of 0.034% if the negotiation takes place after engaging in the trade war. As we show later, China incurs an overall welfare loss in the second scenario because its welfare improvement from the tariff negotiation $\hat{U}^{co-war}_{chn}(\psi)$ is not sufficient to cover the welfare loss from the trade war $\hat{U}^{war}_{chn}$.

We also observe the increasing welfare difference in the two scenarios for both the U.S. and China with greater U.S. bargaining power. Note that since $\hat{U}^{war}_{US}$ and $\hat{U}^{war}_{chn}$ do not depend on ψ, this pattern must be driven by the negotiation outcomes of the two scenarios. This is because the tariff negotiation starting from the 2017 baseline always results in zero U.S. cooperative tariffs due to the low U.S. tariff level prior to the negotiation. In this way, the potential welfare improvement from the tariff negotiation is constrained when ψ increases. By contrast, the room for mutual tariff reductions is greater when the tariff negotiation starts from the trade-war equilibrium. Consequently, the U.S. is able to reap more welfare improvement as ψ increases.

Table 2 summarizes the computed welfare changes in various scenarios for all 11 economies. To maintain conciseness in the table, we only report values based on $\psi = 0.58$ and $\psi = 0.84$ for welfare changes involving tariff negotiations. From column (3), we can see that China's percentage welfare loss in the trade war is almost a magnitude larger than that of the U.S. At the same time, by engaging in the trade war with China, the U.S. moves to a better bargaining position with limited cost. In Section VI, we further explore whether China can retaliate more effectively to reduce its welfare loss in the trade war and hence improve its post-negotiation welfare outcome in the second scenario.

As shown in columns (1), (2), (4), and (5) of Table 2, tariff negotiations between the U.S. and China typically lead to a small welfare loss in other countries. When the trade-war tariffs are applied, however, third countries in general experience a welfare improvement as evidenced in column (3). These results are consistent with the trade diversion mechanism highlighted in previous works on trade conflicts and preferential trade agreements. Mexico, as the other top trading partner of the U.S., is the country most affected by the changes in tariffs applied by the U.S. and China on each other: Mexico experiences the largest percentage welfare gain in the trade war, as well as the largest welfare loss in tariff negotiations starting from the trade-war equilibrium. Because Mexico benefits substantially from trade diversion in the trade-war equilibrium, its overall post-negotiation welfare improvement is the largest among third countries.[17]

Table 2: Welfare Changes in Selected Scenarios

	2017 cooperation $\hat{U}^{co-17}-1$		Trade war $\hat{U}^{war}-1$	Post-war cooperation $\hat{U}^{co-war}-1$		Post-war combined $\hat{U}^{co-19}-1$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ψ	0.58	0.84	All	0.58	0.84	0.58	0.84
US	0.011	0.016	−0.005	0.036	0.049	0.032	0.045
China	0.008	0.003	−0.048	0.032	0.013	−0.016	−0.034
ASEAN	−0.011	−0.010	0.007	−0.016	−0.015	−0.009	−0.008
Canada	0.002	0.003	0.006	−0.001	0.002	0.005	0.007
EU	−0.001	−0.001	0.001	−0.002	−0.002	−0.001	−0.001
India	−0.007	−0.006	0.006	−0.009	−0.007	−0.003	−0.001
Japan	−0.001	−0.001	0.002	−0.003	−0.002	−0.001	−0.001
Korea	−0.004	−0.006	−0.005	−0.006	−0.011	−0.011	−0.017
Mexico	−0.002	0.001	0.040	−0.028	−0.014	0.012	0.027
Russia	0.000	0.001	0.002	0.001	0.002	0.002	0.003
ROW	−0.005	−0.005	0.000	−0.007	−0.008	−0.007	−0.008

Note: All entries are percentage welfare changes. ψ is the bargaining power of the U.S. relative to China, ranging from 0.58 to 0.84 in our estimates from China's accession to the WTO in 2001. In the first two columns, we compute the percentage welfare changes when the tariff negotiation starts from the 2017 factual tariff profile, relative to the 2017 baseline. The third column reports the percentage welfare changes from the trade-war tariffs, relative to the 2017 baseline. The fourth and fifth columns show the percentage welfare changes when the tariff negotiation starts from the trade-war equilibrium. In the last two columns, we compute the overall percentage welfare changes from post-war negotiations, relative to the 2017 baseline.

In sum, we compute the outcomes of potential tariff negotiations between the U.S. and China in two scenarios using the model constructed in Section III. In the first scenario, the U.S. and China

[17] Our finding that Mexico and ASEAN countries benefit most from the trade war is consistent with the empirical analysis in Fajgelbaum et al. (2024), which shows that Mexico, Vietnam, and Thailand are among the largest export winners.

engage in Nash bargaining starting from the 2017 baseline equilibrium. In the second scenario, we first apply tariff changes observed during the trade war and then compute the cooperative tariffs starting from the trade-war equilibrium. Our simulation indicates that, as long as the Nash bargaining weight of the U.S. is larger than 0.1, the U.S. always enjoys a greater welfare increase relative to the 2017 baseline in the second scenario.

VI Extensions

In this section, we complement the analysis in Section V with several extensions. First, we incorporate the dynamic consideration of tariff negotiation by studying a two-period setup. We then examine whether China can achieve better post-negotiation outcomes by imposing a different set of retaliatory tariffs during the trade war. Next, we explore the possibility that the negotiation between the U.S. and China involves sanctions on Russia.

VI.1 Multi-Period Setup

The main analysis in Section V is based on a static framework in which future gains from tariff negotiations are not discounted. We now introduce a simple extension that incorporates the time dimension. In particular, we develop a two-period model with the 2017 equilibrium considered to be "period 0".[18] When $t = 1$, the U.S. and China either impose cooperative tariffs with welfare changes $\hat{U}^{co-17}$ (scenario one) or enter the trade-war equilibrium with welfare changes $\hat{U}^{war}$ (scenario two). In the next period, the cooperative tariffs are maintained if they enter scenario one. Otherwise, the two countries in scenario two engage in tariff negotiation with welfare changes $\hat{U}^{co-war}$ relative to the trade-war equilibrium. For both scenarios, the welfare levels are discounted by a common discount factor β^t.

Using $\hat{U}_n^{total-17}(\psi)$ to denote the total welfare change of country n in the first scenario when the U.S. and China engage in the tariff negotiation from the 2017 equilibrium and maintain the cooperative tariffs in the next period, we have:

$$\hat{U}_n^{total-17}(\psi) = \hat{U}_n^{co-17}(\psi) + \beta^t \hat{U}_n^{co-17}(\psi). \tag{7}$$

Similarly, we can define $\hat{U}_n^{total-19}(\psi)$ to be country n's total welfare change in scenario two when the two countries first impose trade war tariffs and then engage in tariff negotiation in period 2:

$$\hat{U}_n^{total-19}(\psi) = \hat{U}_n^{war} + \beta^t \hat{U}_n^{war} \hat{U}_n^{co-war}(\psi). \tag{8}$$

[18]In Appendix A.3, we also consider an extension with infinite periods, and the main results from the two-period setup still hold qualitatively.

We can further define $\Delta\hat{U}_n^{total}(\psi) \equiv \hat{U}_n^{total-19}(\psi) - \hat{U}_n^{total-17}(\psi)$ to be the difference in total welfare change of country n between the two scenarios. A positive $\Delta\hat{U}_{US}^{total}(\psi)$ indicates that the U.S. enjoys greater total welfare improvement in scenario two in this two-period setting.

Figure 4 presents $\Delta\hat{U}_{US}^{total}(\psi)$ and $\Delta\hat{U}_{chn}^{total}(\psi)$ for various values of discount factor β^t. The two lines in the left panel represent $\Delta\hat{U}_{US}^{total}(0.58)$ and $\Delta\hat{U}_{US}^{total}(0.84)$, respectively. We can see that both $\Delta\hat{U}_{US}^{total}(0.58)$ and $\Delta\hat{U}_{US}^{total}(0.84)$ are positive if $\beta^t > 0.81$, a threshold that is lower than most commonly used values of the discount factor. In other words, consistent with the main analysis in Section V, the total U.S. welfare improvement is larger when the U.S. first starts a trade war with China and then engages in tariff negotiation in the next period. Meanwhile, the two lines representing $\Delta\hat{U}_{chn}^{total}(0.58)$ and $\Delta\hat{U}_{chn}^{total}(0.84)$ are always below zero in the right panel, suggesting that China suffers a welfare loss from the post-negotiation equilibrium when starting from the trade-war tariff profile.

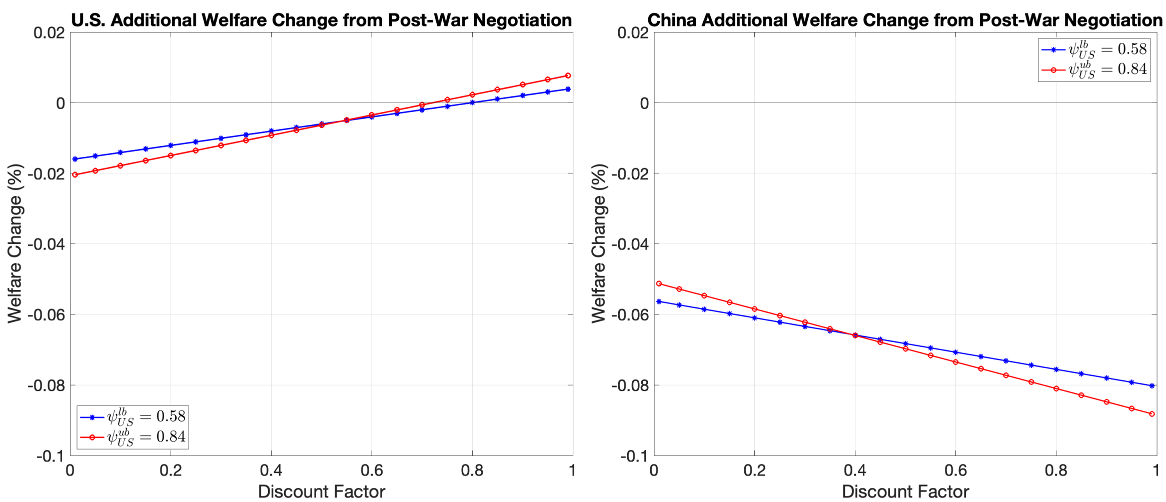

Figure 4: Dynamic Welfare Change in a Two-Period Setup

Note: This figure plots $\Delta\hat{U}_n^{total}(\psi)$ for the U.S. and China in the two-period setup. For each country, we consider the lower and upper bound of our estimated U.S. bargaining power ψ (0.58 and 0.84, respectively).

Another feature revealed in Figure 4 is that the blue line representing $\Delta\hat{U}_{US}^{total}(0.58)$ is above the red line representing $\Delta\hat{U}_{US}^{total}(0.84)$ when the discount factor is small but below the red line when the discount factor is large. Note that in the main analysis in Section V, the welfare difference grows as U.S. bargaining power ψ increases. This is because in the static setting, the welfare difference only captures the difference between the second term in (7) and (8), $\hat{U}_n^{war}\hat{U}_n^{co-war}(\psi) - \hat{U}_n^{co-17}(\psi)$. In the two-period setting, however, $\Delta\hat{U}_{US}^{total}(\psi)$ also depends on the difference in the welfare change in period 1 captured by the first term in the two equations: $\hat{U}_{US}^{co-17}(\psi)$ in the first scenario versus $\hat{U}_{US}^{war}$ in the second scenario. Since $\hat{U}_{US}^{co-17}(\psi)$ is increasing in ψ and $\hat{U}_{US}^{war}$ does not depend on ψ, the period 1 welfare difference $(\hat{U}_{US}^{war} - \hat{U}_{US}^{co-17}(\psi))$ is actually decreasing in ψ. The difference in period

1 welfare changes outweighs the discounted difference in period 2 welfare changes when β^t is small. However, as the discount factor increases and period-2 differences become more significant, the effect reverses, resulting in the intersection of $\Delta\hat{U}_{US}^{total}(0.58)$ and $\Delta\hat{U}_{US}^{total}(0.84)$ in the figure. Nevertheless, this new pattern characterizing the role of ψ in the two-period setting is consistent with our main finding that the U.S. enjoys a larger welfare improvement by first engaging in the trade war before negotiating with China.

VI.2 Can China Do Better?

Our analysis in Section V suggests that China's bargaining position deteriorated after the trade war. One natural question that follows is what could China have done to avoid this situation? To answer this question, we consider a counter-factual scenario in which China retaliates optimally during the trade war. In this scenario, we compute the unilateral optimal tariffs by China that maximize its welfare in response to the U.S. trade-war tariffs. As shown in Figure 5, China's optimal retaliatory tariffs are in general higher than the observed tariffs, with the exception of "Food, beverages and tobacco" and "Petroleum." This pattern is expected, as the higher tariffs on these two sectors probably aim to have a more negative impact on Republican-leaning counties (Fajgelbaum et al., 2020).

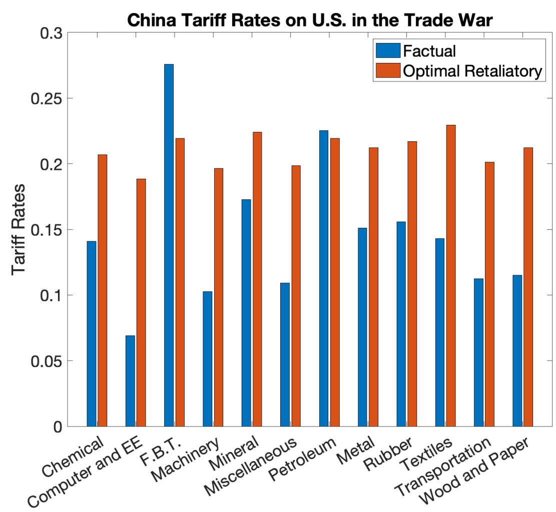

Figure 5: Optimal Retaliatory Tariffs from China

Note: The figure plots China's factual trade-war tariff rates and optimal retaliatory tariffs on the U.S. during the trade war. Sectors are arranged in alphabetical order.

The fact that Chinese optimal retaliatory tariffs are on average higher than the observed trade-war tariffs is consistent with our explanation of the quantitative results discussed in Section V. The sub-optimal factual retaliatory tariffs not only fail to maximize China's welfare in the trade-war equilibrium, but also leave the U.S. greater room for tariff reductions. As shown in Table 2, the first effect only damages the U.S. trade-war welfare by -0.005% relative to the 2017 baseline but leads to a welfare drop of 0.048% for China, whereas the second effect improves the country's gain from tariff negotiation $\hat{U}_{US}^{co-war}(\psi)$. As a result, the U.S. enjoys a greater overall welfare improvement compared to negotiating from the 2017 baseline.

Starting from the counter-factual equilibrium in which China retaliates optimally, we can simulate the tariff negotiation between the U.S. and China as in the main analysis. The green lines in Figure 6 show the welfare outcomes of this counter-factual scenario. We can see that, contrary to the results shown in Figure 3, the trade war can reduce the post-negotiation welfare outcome of the U.S., even when $\psi > 0.1$. In fact, when China retaliates optimally during the trade war, the U.S. post-negotiation welfare is worse than negotiating from the 2017 baseline when $\psi \leq 0.55$. Nevertheless, for our estimated range $\psi \in [0.58, 0.84]$, the main results analyzed in Section V still hold. At the same time, China's post-negotiation welfare is still worse than negotiating from the 2017 baseline.[19]

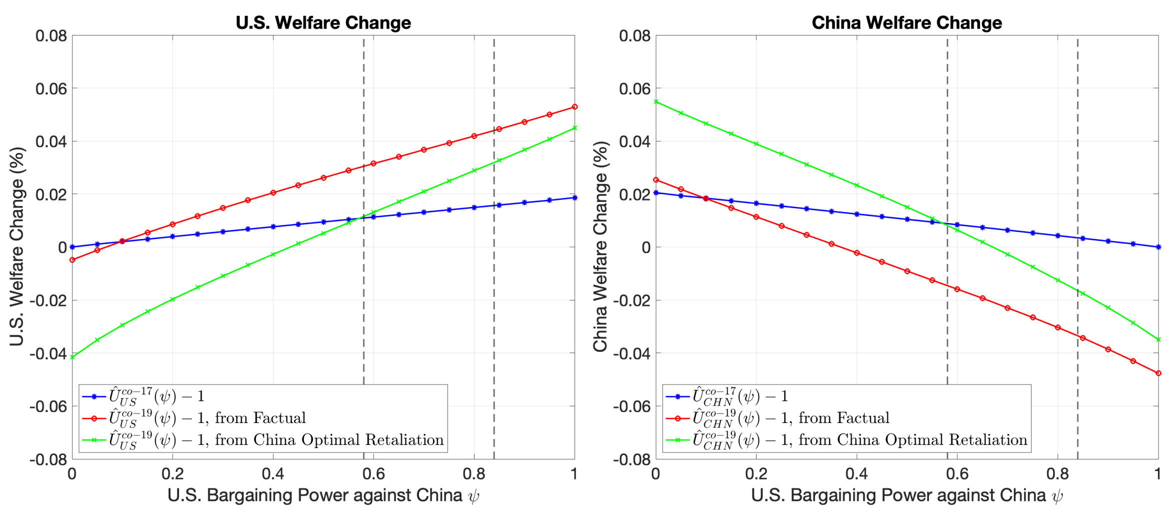

Figure 6: Post-Negotiation Welfare Change with Optimal Retaliatory Tariffs from China

Note: The blue lines refer to the percentage welfare changes when the tariff negotiation starts from the 2017 tariff profile. The red lines refer to the percentage welfare changes when the tariff negotiation starts from the 2019 factual trade-war tariff profile. The green lines refer to the percentage welfare changes when the tariff negotiation starts from China's optimal retaliatory tariffs. The two vertical dashed lines indicate the lower bound (0.58) and upper bound (0.84) of the estimated bargaining power of the U.S. relative to China.

[19] We also consider another counter-factual scenario in which China does not retaliate at all but simply maintains the 2017-level tariffs. In this case, the U.S. is in a better bargaining position than under the factual trade-war equilibrium: when the tariff negotiation starts from this counter-factual equilibrium, the U.S. cooperative tariff rate becomes positive even when $\psi = 0$. By comparison, the U.S. cooperative tariff starting from the trade-war equilibrium becomes positive when $\psi \geq 0.6$, as shown in the right panel of Figure 2. However, the post-negotiation welfare outcomes for both countries are very similar to the patterns shown in Figure 3.

VI.3 Negotiating Sanctions on Russia

Our analysis so far is based on the premise that the U.S. and China care about their respective real expenditures in tariff negotiations. In recent years, we have observed interests diverging between these two countries with respect to many issues beyond the trade war, ranging from technology restrictions to AI and semiconductors. These areas of contention are all potential topics for discussion at the negotiating table. As an extension, we examine one important and relevant geopolitical issue alongside the trade war: the Russia–Ukraine conflict. Specifically, we incorporate Russia's welfare loss into the U.S. objective function and allow the U.S. to pressure China to impose sanction tariffs on Russian goods. Accordingly, the tariff profile as the policy outcome of the Nash bargaining becomes $\{\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\}$, where $\boldsymbol{t}_{chn,rus}$ is the vector of Chinese sanction tariffs on Russian imports. We can then follow de Souza et al. (2024) and define the U.S. objective function in the bargaining problem as

$$G_{US}^{sanction}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\right) = \rho U_{US}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\right) - (1-\rho) U_{rus}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\right),$$

where ρ quantifies the U.S. willingness to pay for sanctions on Russia.[20] The Nash bargaining problem between the U.S. and China then becomes:

$$\begin{aligned}
\max_{\{\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\}} & \left[G_{US}^{sanction}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\right) - G_{US}^{sanction}\left(\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{chn,rus}\right)\right]^{\psi} \\
& \left[U_{chn}\left(\boldsymbol{t}_{chn,US}, \boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,rus}\right) - U_{chn}\left(\boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,rus}\right)\right]^{1-\psi} \\
\text{s.t. } & \text{equilibrium conditions 1, 2, 3, 4, and 5 are satisfied, and} \\
& G_{US}^{sanction}\left(\boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,US}, \boldsymbol{t}_{chn,rus}\right) \geq G_{US}^{sanction}\left(\boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{chn,rus}\right), \\
& U_{chn}\left(\boldsymbol{t}_{chn,US}, \boldsymbol{t}_{US,chn}, \boldsymbol{t}_{chn,rus}\right) \geq U_{chn}\left(\boldsymbol{t}^0_{chn,US}, \boldsymbol{t}^0_{US,chn}, \boldsymbol{t}^0_{chn,rus}\right).
\end{aligned} \tag{9}$$

Figure 7 plots the post-negotiation welfare change of the three countries in the two scenarios for various values of the willingness to pay parameter ρ. To maintain conciseness and readability, we only plot the negotiation outcomes with $\psi = 0.71$, the mean value of our estimated range. We can see that, in both scenarios, the U.S. welfare change increases with ρ, whereas the opposite pattern is observed for China. This is because as the U.S. willingness to pay for sanctions increases, the U.S. foregoes its own welfare improvement in exchange for Russia experiencing a greater welfare loss. Nevertheless, the negotiation starting from trade-war tariffs in scenario two leads to a greater U.S. welfare improvement as long as $\rho > 0$. When $\rho = 0$, the U.S. only aims to minimize Russia's welfare and does not consider its own welfare when negotiating with China. In this case, the U.S.

[20] This formulation of the objective function implies that the U.S. is willing to pay $\$\frac{1-\rho}{\rho}$ for every \$1 of consumption forgone in Russia. As discussed in de Souza et al. (2024), willingness to pay, trade elasticities, and initial import share jointly determine a country's cost-efficient sanction tariffs in a Caliendo and Parro (2015)-style trade model.

has no welfare improvement from the tariff negotiation. Because of the additional welfare loss from the trade war, the combined welfare change for the U.S. in the second scenario is therefore more negative than the welfare change in the first scenario.

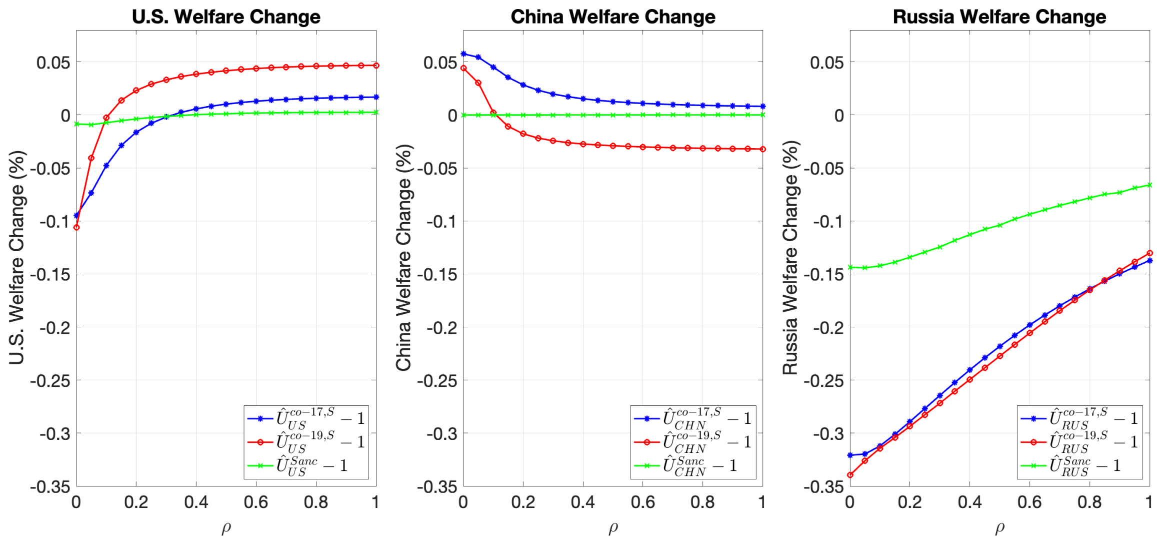

Figure 7: Welfare Change with Sanctions on Russia under Negotiation

Note: This figure plots the percentage welfare changes for different levels of willingness to pay for sanctions on Russia, ρ, when Russia's welfare loss is taken into consideration in the U.S.–China negotiation. The blue lines refer to the scenario when the tariff negotiation starts from the 2017 tariff profile. The red lines refer to the scenario when the tariff negotiation starts from the 2019 tariff profile. The green lines refer to the scenario when the U.S. optimally imposes sanctions on Russia. The bargaining power of the U.S. relative to China is set to be the mean value of our estimates, $\psi = 0.71$.

For comparison purposes, we also include a third scenario in which the U.S. directly sanctions Russia. In this case, the U.S. maximizes $G_{US}^{sanction}$ unilaterally using its tariffs on Russian imports. The corresponding welfare changes of the three countries are shown as the green lines in Figure 7. Compared with the two scenarios involving the negotiation with China, Russia experiences a smaller welfare loss from unilateral sanction tariffs by the U.S.: when $\rho = 0$, the U.S. can push China to cause a welfare loss of 0.321% or 0.340% through tariff negotiation. However, its own sanction tariffs can only lead to a Russian welfare loss of 0.144%. This result is consistent with the finding in de Souza et al. (2024) that the ability of the U.S. to unilaterally sanction Russia through tariffs is very limited.

VII Robustness

In this section, we perform a series of checks to establish the robustness of our findings discussed in previous sections.

VII.1 Political Weights

Throughout the analysis presented in Section V, we assume that the U.S. and China only care about welfare measured by real income in tariff negotiations. We now consider the possibility that each country's objective function incorporates political economy considerations. In particular, country n's welfare in the Nash bargaining equation (6) now becomes

$$U_n^{pol} = \sum_{j=1}^{J} \sigma_n^j W_n^j, \tag{10}$$

where $W_n^j \equiv I_n^j / P_n$ is the welfare of sector j measured by real income, and $\sigma_n^j \geq 0$ is the political economy weight of sector j. Following Ossa (2014), we scale σ_j such that $\sum_{j=1}^{J} \sigma_n^j / J = 1$.[21]

The calibration of σ_j also closely follows the approach introduced in Ossa (2014). Specifically, we rely on a method of simulated moments to minimize the residual sum of squares between the model-predicted unilateral optimal tariffs and observed non-cooperative tariffs after controlling for their respective means. Since the trade-war tariffs between the U.S. and China are obviously non-cooperative and politically motivated, we use them as the matching targets in the calibration of political weights σ_n^j. The estimated political weights are reported in the last two columns of Table 1 where the highest three values of each country are highlighted in bold. We believe that these calibrated values are plausible: the three most favored sectors are textiles, machinery, and computer, electronic and electrical equipment in the U.S., and food, beverage and tobacco, primary and fabricated metal, and petroleum in China. Similarly, Ossa (2014) also finds that textiles in the U.S. and beverage and tobacco products in China are the most protected sectors.

Figure A.3 in the Appendix presents the corresponding welfare changes when political economy is taken into consideration in the U.S.–China tariff negotiation, and the results are similar to the situation without political weights. We can see that the main message from Figure 3 still holds: given the large range of relative bargaining power between the U.S. and China, the U.S. enjoys greater welfare improvement by starting the tariff negotiation from the trade-war equilibrium. Meanwhile, China always suffers additional welfare loss in the post-war negotiation scenario, regardless of the U.S. bargaining power. We also re-calibrate the U.S. bargaining weight from China's accession to WTO by using the politically weighted objective function. The estimated range for ψ is $[0.55, 0.95]$, which is close to the benchmark estimate. Given the new range of ψ, the difference in U.S. post-negotiation welfare improvement relative to the 2017 baseline is from 0.006% to 0.013%.

[21] The equilibrium condition in relative changes is reported in Section A.4 of the Appendix.

VII.2 Nash Tariffs as the Outside Option

Following existing quantitative research on tariff negotiations,[22] our main analysis considers each country's pre-negotiation tariff profile as the outside option of the Nash bargaining problem. We now consider an alternative setup that treats bilateral Nash tariffs as the outside option of the bargaining problem if the two countries fail to reach an agreement in the tariff negotiation. In particular, we first compute Nash tariffs $\{\boldsymbol{t}^{Nash}_{US,chn}, \boldsymbol{t}^{Nash}_{chn,US}\}$ that the U.S. and China simultaneously choose to maximize their own welfare given the other's strategy. As shown in Figure A.4 of the Appendix, the computed Nash tariffs for both countries are in general higher than the observed factual trade-war tariffs. In this full-flown bilateral trade war, the U.S. faces a welfare loss of 0.035%, while China faces a loss of 0.076%.

Figure A.5 shows the post-negotiation welfare outcomes when we set different outside options of the Nash bargaining problem. The newly added green lines represent each country's welfare change in the first scenario, taking the equilibrium with computed Nash tariffs as the outside option. We can see that, relative to the same setup using the pre-negotiation tariffs as the outside option, using the Nash tariffs as the outside option amplifies the effect from a country's bargaining weight. In particular, the U.S. now experiences a greater post-negotiation welfare gain if $\psi > 0.35$ but suffers a greater welfare loss for smaller values of ψ. The opposite pattern is observed for the post-negotiation welfare of China. Nevertheless, the welfare implication of our main results still holds for the estimated range of ψ.

VII.3 Incorporating Spatial Features of the U.S. Economy

Our main analysis in Sections V and VI relies on the quantitative trade model developed in Section III. We now extend the model by disaggregating the U.S. economy into eight regions. As discussed in more detail in Appendix Section A.5, firms in each U.S. region demand labor, local factors, and materials from all other markets in the economy, as in Caliendo et al. (2017). With this extended model that features both interregional and international trade, the calibrated U.S. bargaining power is $\psi \in [0.47, 0.70]$. In addition, both the computed cooperative tariffs and the welfare outcomes of the two scenarios closely resemble the results shown in Section V. From this exercise, it appears that incorporating spatial features of the U.S. economy does not play a determining role in our main results.

[22]See Ossa (2014) and Bagwell et al. (2021), for example.

VII.4 Allowing for Subsidies

In the baseline analysis in Section V, we restrict the post-negotiation tariffs to be non-negative, as in previous theoretical works. Figure A.6 displays the averages of the predicted cooperative tariffs for the U.S. and China when we allow negative tariffs or import subsidies. When negative tariffs are permitted, neither country imposes zero tariffs after the tariff negotiation. However, we can still infer from Figure A.6 that the U.S. bargaining position improves if the tariff negotiation starts from the trade-war equilibrium. Similar to the results in Ossa (2014), the restricted post-negotiation tariffs displayed in Figure 2 resemble a truncated version of the unrestricted cooperative tariffs shown in Figure A.6. Figure A.7 presents the corresponding welfare changes for the U.S. and China in the two negotiation scenarios. We can see that the welfare outcomes are very similar to the case without negative tariffs. Comparing this figure with Figure 3 reveals that allowing for negative tariffs makes very little difference from a welfare perspective.

VII.5 Fixed Deficit

In the main analysis, we follow the approach of Ossa (2014) and treat the purged trade data without imbalances as the 2017 baseline. We also experiment with an alternative setup as a robustness check: instead of removing trade imbalances across countries, we now fix the international trade imbalances at the 2017 level when simulating the tariff negotiation under the two scenarios. In addition, we also apply the factual trade imbalances of the trade war in 2019 to the post-war tariff bargaining problem. As can be seen in Figures A.9 and Figure A.10, the key welfare results from the main analysis in Section V still hold.

VII.6 Accounting for Third-Party Tariff Changes

In the main analysis, the applied tariff rates between the two countries and the other countries are fixed at their 2017 levels. To rule out the potential impact of the third-party tariff changes during the trade war, we now incorporate the changes in U.S., China, and other countries' bilateral tariffs from the 2017 baseline to the 2019 post-war levels and present the resulting welfare outcomes in Figure A.8. The welfare outcomes displayed in Figure A.8 are very similar to those in Figure 3.

VII.7 Alternative Estimates of Elasticity of Substitution

In the main analysis, we use the popular approach developed by Feenstra (1994) to estimate the elasticities of substitution. Caliendo and Parro (2015) estimate the same elasticities using the variation in tariffs and trade volumes before and after the North American Free Trade Agreement, and their estimates are on average larger than estimates using the Feenstra (1994) method. We repeat the simulation with the estimated elasticity of substitution from Caliendo and Parro (2015), and the corresponding welfare results are reported in Figure A.11. We can see that, for both countries, the welfare improvement from the tariff negotiation is greater than it is in Figure 3. A similar pattern is also observed in Ossa (2014) when computing the world cooperative tariffs with different elasticities of substitution. From Figure A.11, we still find that the U.S. always enjoys greater welfare improvement when the tariff negotiation starts from the trade-war equilibrium.

VII.8 Estimation of Bargaining Power

When we calibrate the U.S. bargaining weight ψ in Section IV, we assume that China is fully aware of the U.S. post-negotiation tariffs after China's accession to the WTO. We also estimate ψ without this assumption. That is, China and the U.S. simultaneously bargain over tariffs still using the same starting point as in Section IV.2. In this case, ψ is estimated by solving

$$\min_{\psi}\left[\left(\boldsymbol{t}_{chn,US}(\psi)-\boldsymbol{t}^{2005}_{chn,US}\right)'\left(\boldsymbol{t}_{chn,US}(\psi)-\boldsymbol{t}^{2005}_{chn,US}\right)+\left(\boldsymbol{t}_{US,chn}(\psi)-\boldsymbol{t}^{2005}_{US,chn}\right)'\left(\boldsymbol{t}_{US,chn}(\psi)-\boldsymbol{t}^{2005}_{US,chn}\right)\right].$$

When using the 1997 applied tariffs as the threat point for the U.S., the estimated bargaining power of the U.S. relative to China is $\psi = 0.08$. This result is consistent with the estimates in Bagwell et al. (2021), who also assume that both countries bargain simultaneously over tariffs.[23] The small U.S. bargaining weight is again because of the negligible U.S. tariff changes after China's accession to the WTO. As argued in Bagwell et al. (2021), a country tends to be assigned a smaller bargaining power in a bilateral bargaining pair if the tariffs of this country under negotiation are reduced to a greater degree than those of its negotiating partner. However, the very small estimate of U.S. bargaining power computed from this specification is inconsistent with the widely accepted perception that the U.S. had the stronger position in the bilateral negotiation with China.

In the main analysis, we provide the estimated upper and lower bounds of U.S. bargaining power ψ because the U.S. has two possible threat points in the WTO accession negotiation with China. Handley and Limão (2017) estimates a 0.13 probability of transition from China's temporary MFN status to "column 2 tariffs." Using this estimated probability, a back-of-envelope calculation generates an expected U.S. bargaining power of $\psi = 0.69$. However, we do not consider this value to be the point estimate from our method of simulated moments because this back-of-envelope calculation may not be consistent with the solution of the Nash bargaining with two possible threat points.

[23]Focusing on the Uruguay Round of tariff bargaining, the estimated bargaining weights of the U.S. relative to the EU, South Korea, and Japan in Bagwell et al. (2021) are 0.01, 0.01, and 0.05, respectively.

VIII Conclusion

We focus on the U.S.–China trade war and examine the potential role of the Trump-era tariffs imposed in 2018 and 2019 as bargaining chips for subsequent trade negotiations with China. After introducing a simple theoretical framework to illustrate our research question, we develop a Caliendo and Parro (2015)-style quantitative trade model for the numerical analysis. In the model, the U.S. and China can engage in bilateral tariff negotiations, and the bargaining outcome depends on both the tariff levels before the negotiation and the relative bargaining power of the two countries. Given the estimated range of the U.S. bargaining power, imposing trade-war tariffs before negotiating with China consistently results in greater U.S. post-negotiation welfare gains. This result is consistent with U.S. Trade Representative Katherine Tai's claim that the Trump-era tariffs could be used as leverage in later tariff negotiations with China.

The framework we rely on can flexibly accommodate alternative specifications. For example, we conduct a counter-factual analysis in which China sets its welfare-maximizing tariffs instead of the actual retaliatory tariffs during the trade war. We also explore the possibility that the U.S. pressures China to impose sanction tariffs on Russian goods alongside tariff negotiations. Moreover, we consider a scenario in which the Nash tariffs, rather than the pre-negotiation tariffs, serve as the outside option in the Nash bargaining problem. Given the complexity of the U.S.–China rivalry, several areas of contention can be incorporated to study the interaction with tariffs at the negotiation table.

By quantifying the impact of the U.S.–China trade war on tariff bargaining outcomes, this paper connects two separate but related strands of literature. On the one hand, existing research on cooperative tariffs has mostly focused on the reciprocal tariff reductions among WTO member countries. On the other hand, previous studies on the U.S.–China trade war have primarily focused on the impact of higher tariffs on economic activities in the U.S. and China. By contrast, we examine tariffs as bargaining chips and present the first quantitative study on the potential outcomes of tariff negotiation between the U.S. and China.

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A Appendix

A.1 Equilibrium in Relative Changes

To solve the competitive general equilibrium, we adopt the exact hat algebra approach, as in Dekle et al. (2007), to avoid calibrating unchanged underlying parameters. We define a variable with a hat "$\hat{x}$" as the relative change of the variable, namely $\hat{x} = x'/x$. For given tariff changes from $\boldsymbol{t}$ to $\boldsymbol{t}'$, the equilibrium conditions in relative changes satisfy:

Cost of the input bundles:

$$\hat{x}_n^j = (\hat{w}_n)^{\gamma_n^j} \prod_{k=1}^{J} \left(\hat{P}_n^k\right)^{\gamma_n^{jk}}$$

Price index:

$$\hat{P}_n^j = \left[\sum_{i=1}^{N} \pi_{ni}^j \left(\hat{\tau}_{ni}^j \hat{x}_i^j\right)^{-\theta^j}\right]^{-1/\theta^j}$$

Expenditure shares:

$$\hat{\pi}_{ni}^{j\prime} = \left(\frac{\hat{x}_i^j}{\hat{P}_n^j} \hat{\tau}_{ni}^j\right)^{-\theta^j}$$

Aggregate price index:

$$\hat{P}_n = \prod_{j=1}^{J} \left(\hat{P}_n^j\right)^{\alpha_n^j}$$

Labor market clearing:

$$\hat{w}_n w_n L_n = \sum_j \gamma_n^j \sum_i \frac{\pi_{in}^{j\prime}}{\tau_{in}^{j\prime}} X_i^{j\prime}$$

Market clearing in final goods:

$$X_n^{j\prime} = \sum_{k=1}^{J} \gamma_n^{k,j} \sum_{i=1}^{N} \frac{\pi_{in}^{k\prime}}{\tau_{in}^{k\prime}} X_i^{k\prime} + \alpha^j I_n',$$

where $I_n' = \hat{w}_n w_n L_n + \sum_{j=1}^{J} \sum_{i=1}^{N} t_{ni}^{j\prime} \frac{\pi_{ni}^{j\prime}}{\tau_{ni}^{j\prime}} X_n^{j\prime} - S_n$.

In addition, the utility level in relative change is given by

$$\hat{U}_n = \frac{\hat{I}_n}{\hat{P}_n}.$$

A.2 Tariff Negotiation Equilibrium in Relative Changes

We use the exact hat algebra approach to solve the tariff negotiation problem (6) stated in the main text to avoid calibrating unchanged underlying parameters. The equivalent exact-hat-algebra version of the cooperative tariff bargaining problem is as follows:

$$\max_{\{\boldsymbol{t}_{US,chn},\boldsymbol{t}_{chn,US}\}} \left[\hat{U}_{US}\left(\boldsymbol{t}_{US,chn},\boldsymbol{t}_{chn,US}\right)-1\right]^{\psi}\left[\hat{U}_{chn}\left(\boldsymbol{t}_{US,chn},\boldsymbol{t}_{chn,US}\right)-1\right]^{1-\psi},$$

subject to competitive equilibrium conditions in relative changes, as in A.1, and $\hat{U}_{US}\left(\boldsymbol{t}_{US,chn},\boldsymbol{t}_{chn,US}\right)\geq 1$ and $\hat{U}_{chn}\left(\boldsymbol{t}_{US,chn},\boldsymbol{t}_{chn,US}\right)\geq 1$.

A.3 Extending to Infinite Periods

In addition to the two-period setup discussed in Section VI.1, we also consider an alternative setup with infinite periods. Similar to the two-period setup, the U.S. and China either impose cooperative tariffs with welfare changes $\hat{U}^{co-17}$ (scenario one) or enter the trade-war equilibrium with welfare changes $\hat{U}^{war}$ (scenario two) when $t=1$. In scenario two, the two countries further engage in tariff negotiation from the trade-war equilibrium. Once the two countries engage in tariff negotiation, the resulting cooperative tariffs will remain in all future periods. In this setup, the two countries' total welfare change relative to the 2017 baseline in period 0 is:

$$\hat{U}_n^{total-17}(\psi)=\frac{\beta^t}{1-\beta^t}\hat{U}_n^{co-0}(\psi)$$
$$\hat{U}_n^{total-19}(\psi)=\hat{U}_n^{war}+\frac{\beta^t}{1-\beta^t}\hat{U}_n^{war}\hat{U}_n^{co-war}(\psi).$$

Figure A.12 presents $\Delta\hat{U}_{US}^{total}(\psi)$ and $\Delta\hat{U}_{chn}^{total}(\psi)$ for discount factor $\beta^t\in[0.60,0.99]$. We can see that, similar to the two-period setup, both $\Delta\hat{U}_{US}^{total}(0.58)$ and $\Delta\hat{U}_{US}^{total}(0.84)$ are positive. When $\beta^t=0.97$, $\Delta\hat{U}_{US}^{total}(0.58)=0.64\%$ and $\Delta\hat{U}_{US}^{total}(0.84)=0.91\%$. At the same time, $\Delta\hat{U}_{chn}^{total}(0.58)$ and $\Delta\hat{U}_{chn}^{total}(0.84)$ are always negative for the range of β^t shown.

A.4 Tariff Negotiation Equilibrium with Political Weights

We rewrite the cooperative tariff bargaining problem in relative changes to account for governments maximizing their politically weighted welfare defined in (10). All the equilibrium conditions in relative changes in A.2 remain the same, except for the change in the polically weighted welfare, which is equal to the following:

$$\hat{U}_n^{pol}=\sum_{j=1}^{J}\frac{\sigma_n^j I_n^j}{\sum_{k=1}^{J}\sigma_n^k I_n^k}\frac{I_n^{j\prime}/I_n^j}{\hat{P}_n},$$

where $I_n^j=X_n^j+(\gamma_n^j-1)\sum_{i=1}^{N}X_i^j\pi_{in}^j/\tau_{in}^j$ and $I_n^{j\prime}=X_n^{j\prime}+(\gamma_n^j-1)\sum_{i=1}^{N}X_i^{j\prime}\pi_{in}^{j\prime}/\tau_{in}^{j\prime}$.

A.5 Incorporating Spatial Features of the U.S. Economy

In this section, we follow Caliendo et al. (2017) and develop a quantitative model that features both international trade and the U.S. economy disaggregated by region and sector. We consider a total of $N+M$ locations, in which N is the number of regions in the U.S. and M is the number of other countries. Locations are indexed by i or $n \in \{1, \ldots, N, N+1, \ldots N+M\}$, whereas sectors are indexed by j or $k \in \{1, \ldots, J\}$. The consumers have the same preference as in the main text. The production technologies and equilibrium conditions in changes are stated as follows.

Technologies

In addition to labor, land and structures are also a factor input in the production of intermediate goods. The land and structures, H_n, are immobile across regions and can be used by any sector. The production of a variety within the U.S. associated with productivity level z_n^j is given by

$$q_n^j(z_n^j) = z_n^j \left[\left[h_n^j(z_n^j) \right]^{\beta_n} \left[l_n^j(z_n^j) \right]^{(1-\beta_n)} \right]^{\gamma_n^j} \prod_{k=1}^{J} \left[M_n^{jk}(z_n^j) \right]^{\gamma_n^{jk}}, \text{ for } n \in \mathcal{US} = \{1, \ldots, N\},$$

where h_n, l_n, and M_n^{jk} denote demand for structures, labor, and materials from sector k, respectively. For locations outside of the U.S., we abstract from the fixed factor and assume that the technologies are the same as in the main text:

$$q_n^j(z_n^j) = z_n^j \left[l_n^j(z_n^j) \right]^{\gamma_n^j} \prod_{k=1}^{J} \left[M_n^{jk}(z_n^j) \right]^{\gamma_n^{jk}}, \text{ for } n \in \overline{\mathcal{US}} = \{N+1, \ldots, N+M\}.$$

The cost of the input bundle for intermediate goods in location n, sector j is given by $x_n^j = B_n \left[r_n^{\beta_n} w_n^{1-\beta_n} \right]^{\gamma_n^j} \prod_{k=1}^{J} \left[P_n^k \right]^{\gamma_n^{jk}}$ with $B_n = [\gamma_n^j (1-\beta_n)^{(1-\beta_n)} \beta_n^{\beta_n}]^{-\gamma_n^j} \prod_{k=1}^{J} [\gamma_n^{jk}]^{-\gamma_n^{jk}}$ for $n \in \mathcal{US}$, and $x_n^j = B_n' w_n^{\gamma_n^j} \prod_{k=1}^{J} \left[P_n^k \right]^{\gamma_n^{jk}}$ with $B_n' = [\gamma_n^j]^{-\gamma_n^j} \prod_{k=1}^{J} [\gamma_n^{jk}]^{-\gamma_n^{jk}}$ for $n \in \overline{\mathcal{US}}$.

Turning to final goods production, firms use the CES aggregator to produce final goods in each location and sector by purchasing intermediate goods from the lowest cost suppliers around the world, as in the main text.

Regional Trade Imbalance and Income

To address the regional trade imbalances within the U.S., we assume that the local factors are partly owned by local governments and the rents are redistributed to local residents. The rest of the rents are collected by central government, forming a national portfolio that is redistributed to all the agents within the U.S. In particular, we assume that a fraction of $\iota_n, n \in \{1, \ldots, N\}$ of the local factor rents is collected by the central government, forming the national portfolio. All residents within the U.S. hold an equal share of the national portfolio. The $(1 - \iota_n)$ fraction of the return is redistributed to local residents equally. The difference between the remittances to the central government and the local factor income generates imbalances across regions within the U.S.:

$$\Upsilon_n \equiv \iota_n r_n H_n - \chi L_n, \text{ for } n \in \mathcal{US},$$

where r_n is the rental rate for the fixed factor, and $\chi = \sum_{i=1}^{N} \iota_i r_i H_i / \sum_{i=1}^{N} L_i$ is the share of national portfolio received by each resident in the U.S.

The excess income generated by these imbalances in region n is spent by agents on local final goods. The magnitude of these across-region imbalances will change in the model with the change of tariff, as it will affect the wages and the rental rates of land and structures. The tariff revenues are distributed as lump-sum payments to all residents, along with the unaddressed trade surplus across countries. The income for residents in location n within the U.S. is

$$I_n = w_n + \chi + (1 - \iota_n) r_n H_n / L_n + \lambda_n - s_n, \text{ for } n \in \mathcal{US},$$

where w_n is the wage rate, $r_n H_n / L_n$ is per capita income of land and structure rents in region n, λ_n is the per capita tariff revenue received by agents, and s_n is the per capita trade surplus generated by the country-wide trade imbalances. Similarly, the income for residents in other countries is given by $I_n = w_n + \lambda_n - s_n$ for $n \in \overline{\mathcal{US}}$.

Market-Clearing Conditions

Since labor is perfectly mobile across regions., utility is equalized $U_n = U_{US}, n \in \mathcal{US}$. By defining $\omega_n \equiv [\frac{r_n}{\beta_n}]^{\beta_n} [\frac{w_n}{1-\beta_n}]^{(1-\beta_n)}$ and $u_n \equiv \frac{\Upsilon_n}{L_n} = \frac{\iota_n r_n H_n}{L_n} - \chi$ as per capita regional transfers, we can obtain the expression of regional labor input from the free mobility condition along with the labor market-clearing condition:

$$L_n = \frac{H_n \left[\frac{\omega_n}{P_n U + u_n - \lambda_n + s_n} \right]^{1/\beta_n}}{\sum_{i=1}^{N} H_i \left[\frac{\omega_i}{P_i U + u_i - \lambda_i + s_n} \right]^{1/\beta_n}} L_{US}.$$

Total expenditure on final goods j in location n, X_n^j, is the sum of the expenditure on composite intermediate goods by firms and the expenditure on final consumption by households:

$$X_n^j = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N+M} X_i^k \frac{\pi_{in}^k}{\tau_{in}^k} + \alpha_n^j I_n L_n,$$

where regional and national incomes are given by

$$I_n L_n = \omega_n (H_n)^{\beta_n} (L_n)^{1-\beta_n} - \Upsilon_n + \Lambda_n - S_n, \text{ for } n \in \mathcal{US},$$
$$I_n L_n = w_n L_n + \Lambda_n - S_n, \text{ for } n \in \overline{\mathcal{US}}.$$

In particular, $\Lambda_n = \sum_{j=1}^{J} \sum_{i=1}^{N+M} t_{ni}^j X_n^j \frac{\pi_{ni}^j}{\tau_{ni}^j}$ denotes location n's tariff revenues from all places. Sectoral trade surplus is defined as $S_n^j = \sum_{i=1}^{N+M} \left(X_i^j \frac{\pi_{in}^j}{\tau_{in}^j} - X_n^j \frac{\pi_{ni}^j}{\tau_{ni}^j} \right)$, and total trade surplus at national level is $S_n = \sum_{j=1}^{J} S_n^j$. Finally, using trade surplus and expenditure, we have the trade balance condition:

$$\sum_{j=1}^{J} \sum_{i=1}^{N+M} X_n^j \frac{\pi_{ni}^j}{\tau_{ni}^j} + \Upsilon_n + S_n = \sum_{j=1}^{J} \sum_{i=1}^{N+M} X_i^j \frac{\pi_{in}^j}{\tau_{in}^j}.$$

Equilibrium in Relative Changes

Input bundle:

$$\hat{x}_n^j = (\hat{\omega}_n)^{\gamma_n^j} \prod_{k=1}^{J} \left(\hat{P}_n^k\right)^{\gamma_n^{jk}}$$

Labor mobility condition:

$$\hat{L}_n = \frac{\left(\frac{\hat{\omega}_n}{\varphi_n \hat{P}_n \hat{U} + (1-\varphi_n)\hat{b}_n}\right)^{1/\beta_n}}{\sum_i L_i \left(\frac{\hat{\omega}_i}{\varphi_i \hat{P}_i \hat{U} + (1-\varphi_i)\hat{b}_i}\right)^{1/\beta_i}} L_{US}$$

Regional market clearing in final goods:

$$X_n^{j\prime} = \sum_{k=1}^{J} \gamma_n^{k,j} \left(\sum_{i=1}^{N+M} \frac{\pi_{in}^{k\prime}}{\tau_{in}^{k\prime}} X_i^{k\prime}\right) + \alpha^j I_n^\prime L_n^\prime,$$

where $I_n^\prime L_n^\prime = \left(\hat{\omega}_n \left(\hat{L}_n\right)^{1-\beta_n} (I_n L_n + \Upsilon_n + S_n - \Lambda_n) + \sum_{j=1}^{J} \sum_{i=1}^{N+M} t_{ni}^{j\prime} \frac{\pi_{ni}^{j\prime}}{\tau_{ni}^{j\prime}} X_n^{j\prime} - S_n^\prime - \Upsilon_n^\prime\right)$ for $n \in \mathcal{US}$,
$I_n^\prime L_n^\prime = \hat{\omega}_n \omega_n L_n + \sum_{j=1}^{J} \sum_{i=1}^{N+M} t_{ni}^{j\prime} \frac{\pi_{ni}^{j\prime}}{\tau_{ni}^{j\prime}} X_n^{j\prime} - S_n$, for for $n \in \overline{\mathcal{US}}$

Labor market clearing:

$$VA^\prime = \sum_j \gamma_n^j \sum_i \frac{\pi_{in}^{j\prime}}{\tau_{in}^{j\prime}} X_i^{j\prime},$$

where $VA_n^\prime = \hat{\omega}_n \left(\hat{L}_n\right)^{1-\beta_n} (L_n I_n + \Upsilon_n + S_n - \Lambda_n)$ for $n \in \mathcal{US}$, $VA_n^\prime = \hat{\omega}_n \omega_n L_n$ for $n \in \overline{\mathcal{US}}$

Price index:

$$\hat{P}_n^j = \left(\sum_{i=1}^{N+M} \pi_{ni}^j \left[\hat{\tau}_{ni}^j \hat{x}_i^j\right]^{-\theta^j}\right)^{-1/\theta^j}$$

Expenditure shares:

$$\pi_{ni}^{j\prime} = \pi_{ni}^j \left(\frac{\hat{x}_i^j}{\hat{P}_n^j} \hat{\tau}_{ni}^j\right)^{-\theta^j}$$

Welfare outside of the U.S.:

$$\hat{U}_n = \frac{\hat{I}_n}{\hat{P}_n}$$

Welfare within the U.S.:

$$\hat{U} = \frac{1}{L_{US}} \sum_n L_n \left(\frac{1}{\varphi_n} \frac{\hat{\omega}_n}{\hat{P}_n} \left(\hat{L}_n\right)^{1-\beta_n} - \frac{1-\varphi_n}{\varphi_n} \frac{\hat{L}_n \hat{b}_n}{\hat{P}_n}\right),$$

where $\hat{b}_n \equiv \frac{u_n^\prime + s_n^\prime - \lambda_n^\prime}{u_n + s_n - \lambda_n}$, $\varphi_n \equiv \frac{1}{1 + \frac{\Upsilon_n + S_n - \Lambda_n}{L_n I_n}}$, and $\hat{P}_n = \prod_{j=1}^{J} \left(\hat{P}_n^j\right)^{\alpha^j}$ is aggregate price index.

Quantitative Results

In this extended model with spatial features, we consider two major economies: the U.S. and China. The remaining countries are grouped into one entity known as the Rest of the World (ROW). Following the classification in the Regional Economics Information System (REIS) of the U.S. Bureau of Economic Analysis (BEA), we disaggregate the U.S. into eight regions: *New England*, *Mideast*, *Great Lakes*, *Plains, Southeast*, *Southwest*, *Rocky Mountain*, and *Far West*. Each region represents a grouping of states with similar economic and social conditions. Twelve tradable sectors and one integrated non-tradable service sector are the same as in the main text, reported in the left column of Table 1.

We first re-estimate the bargaining power of the U.S. relative to China from China's accession to the WTO, and get $\psi \in [0.47, 0.70]$, which is close to our estimates in the trade version. Then, we simulate the tariff negotiation between the U.S. and China in the two scenarios, either starting from the 2017 tariff profile or engaging in trade war and then in negotiation. Figure A.13 displays the average cooperative tariff rates of the U.S. and China in both pre- and post-war tariff negotiations given different bargaining powers. Similar to our findings in Section V, the average U.S. post-negotiation tariff starting from the 2019 trade-war equilibrium is always equal to or greater than the post-negotiation tariff starting from the 2017 equilibrium for any given ψ. Meanwhile, the average Chinese post-negotiation tariff is always lower when starting from the 2019 trade-war equilibrium than when starting from the 2017 equilibrium.

Figure A.14 illustrates the post-negotiation welfare change (relative to the 2017 baseline) of the two negotiation scenarios for the U.S. and China. We can see that the results in the spatial version are still consistent with our main findings that the U.S. enjoys a greater welfare improvement by first going to the trade-war equilibrium before negotiating with China. Quantitatively, the difference in U.S. post-negotiation welfare improvement relative to the 2017 baseline is from 0.04% (when $\psi = 0.47$) to 0.05% (when $\psi = 0.70$). Meanwhile, China's post-negotiation welfare change decreases from 0.09% to 0.10%.

A.6 Figure Appendix

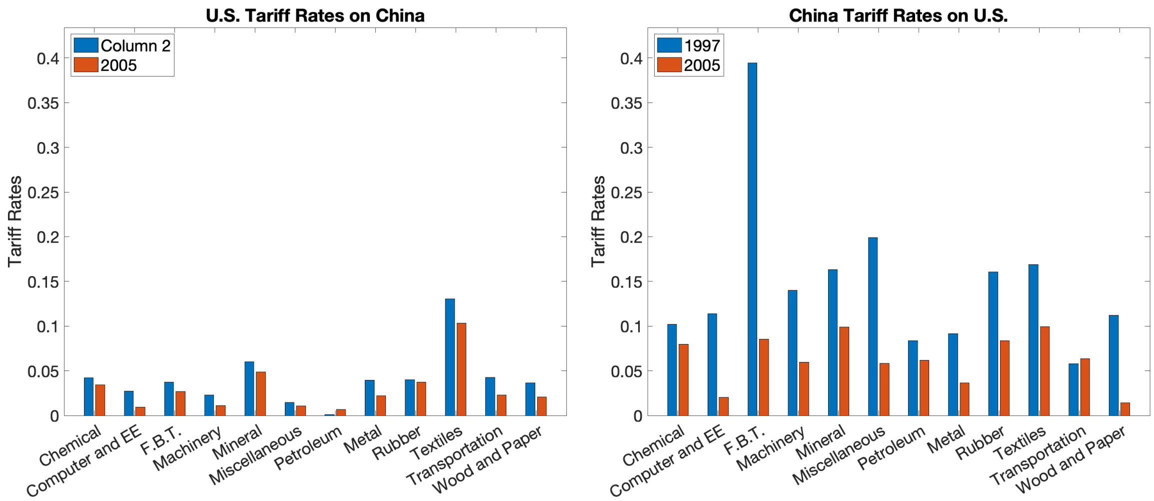

Figure A.1: Applied Tariff Rates of the U.S. and China

Note: This figure displays the applied tariff rates between the U.S. and China in 1997 (before China's accession to the WTO) and in 2005 (after China's accession to the WTO). Tariff data are aggregated by sector based on trade volume. Sectors are arranged in alphabetical order.

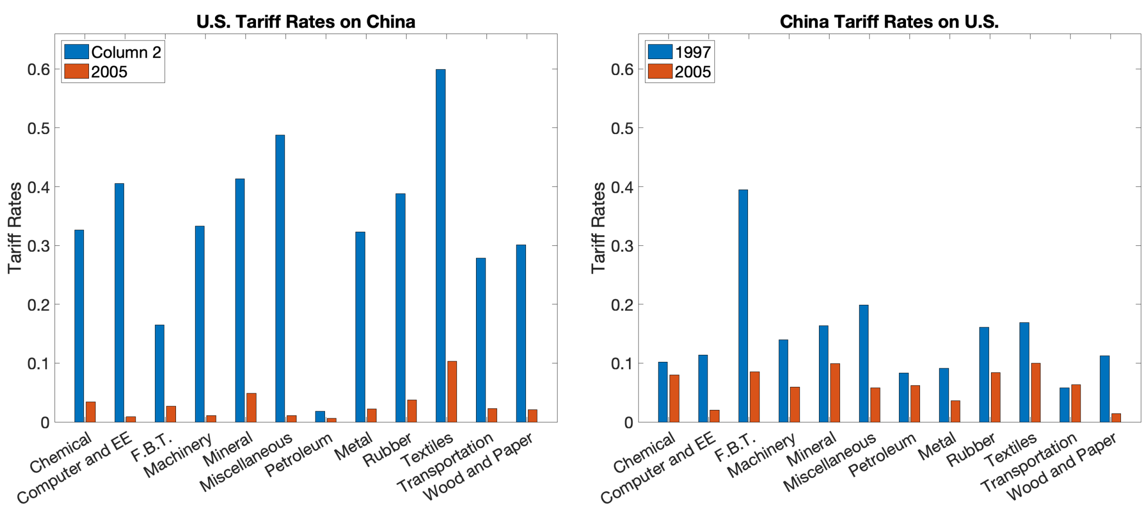

Figure A.2: Applied Tariff Rates versus U.S. "Column 2 Tariff" Rates

Note: The left panel displays U.S. "column 2 tariff" rates and the 2005 applied rates. The right panel is the same as the right panel of Figure A.1 and is shown for comparison purposes. Tariff data are aggregated by sector based on trade volume. Sectors are arranged in alphabetical order.

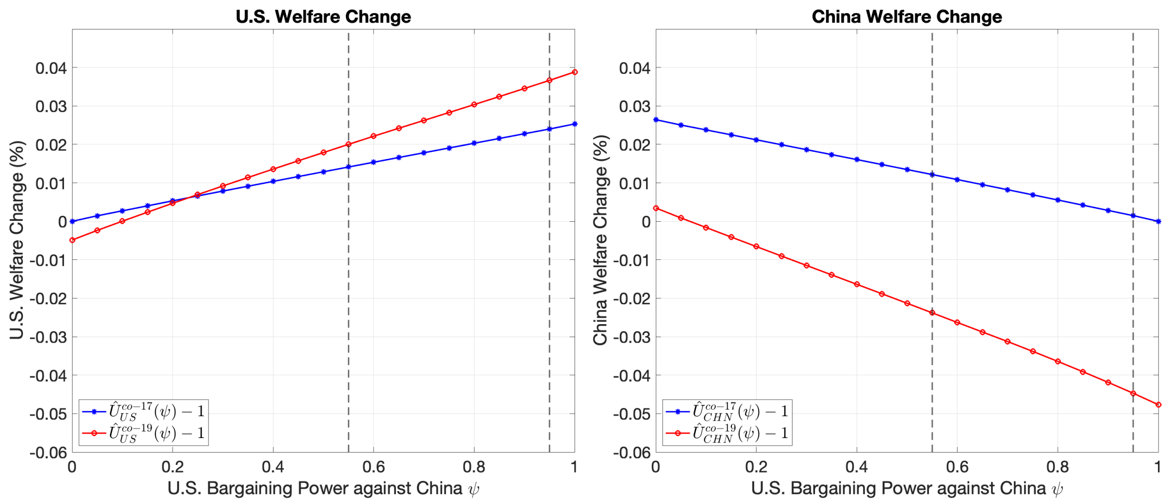

Figure A.3: Post-Negotiation Welfare Change (Political Economy Incentives)

Note: The blue lines refer to the percentage welfare changes when the tariff negotiation starts from the 2017 tariff profile. The red lines refer to the percentage welfare changes when the tariff negotiation starts from the 2019 tariff profile. The two vertical dashed lines indicate the lower bound (0.55) and upper bound (0.95) of the estimated bargaining power of the U.S. relative to China.

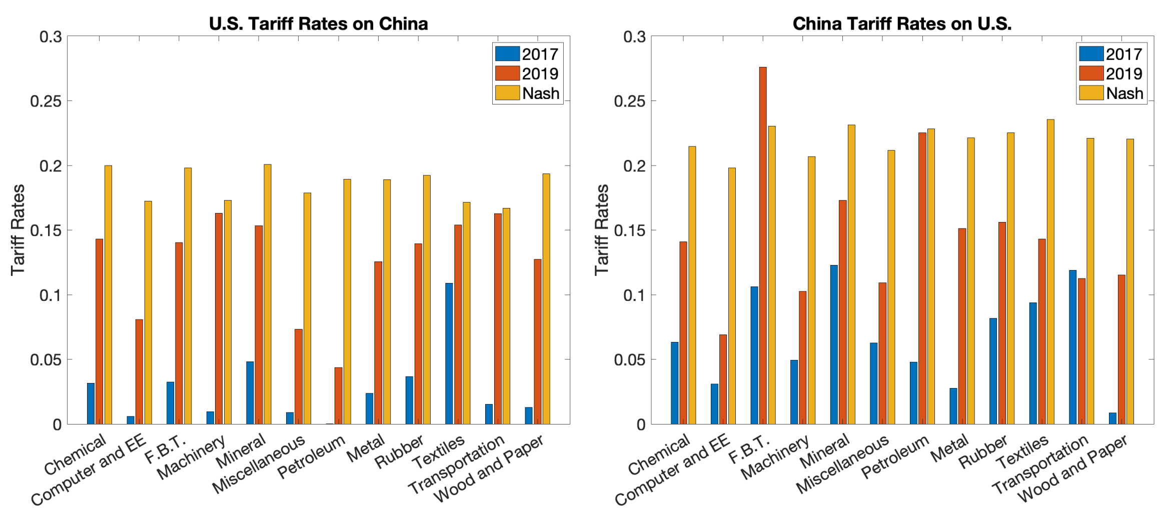

Figure A.4: Factual and Nash Tariff Rates

Note: The figure plots the factual bilateral tariff rates between the U.S. and China in 2017 (before the trade war) and at the end of 2019 (after the trade war), and the computed Nash tariffs. Factual tariff data are aggregated by sector based on trade volume. Sectors are arranged in alphabetical order.

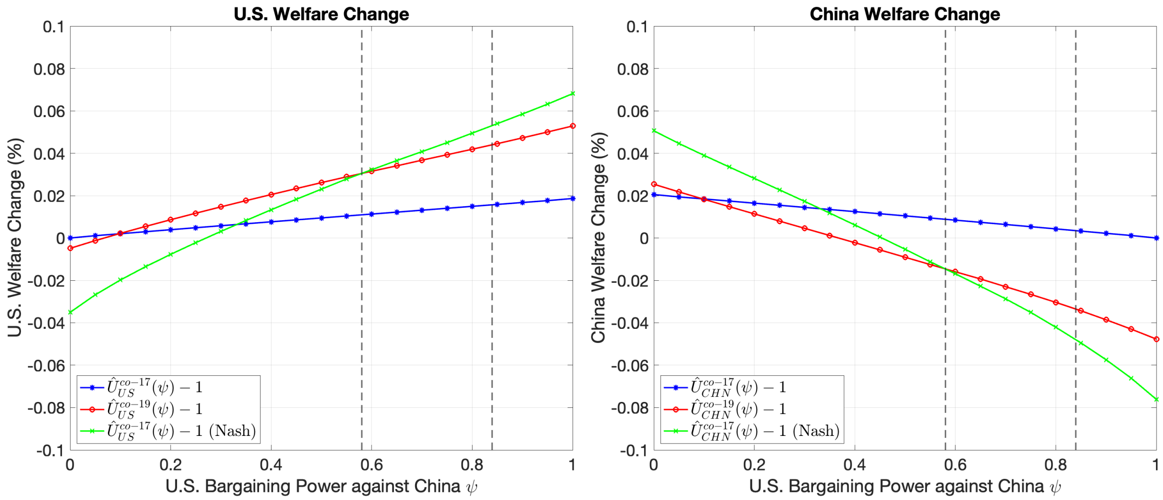

Figure A.5: Post-Negotiation Welfare Change (Nash Tariffs as Outside Option)

Note: The blue lines refer to the percentage welfare changes when the tariff negotiation starts from the 2017 tariff profile. The red lines refer to the percentage welfare changes when the tariff negotiation starts from the 2019 factual trade-war tariff profile. The green lines refer to the percentage welfare changes from the tariff negotiation if the outside option is the Nash equilibrium. The two vertical dashed lines indicate the lower bound (0.58) and upper bound (0.84) of the estimated bargaining power of the U.S. relative to China.

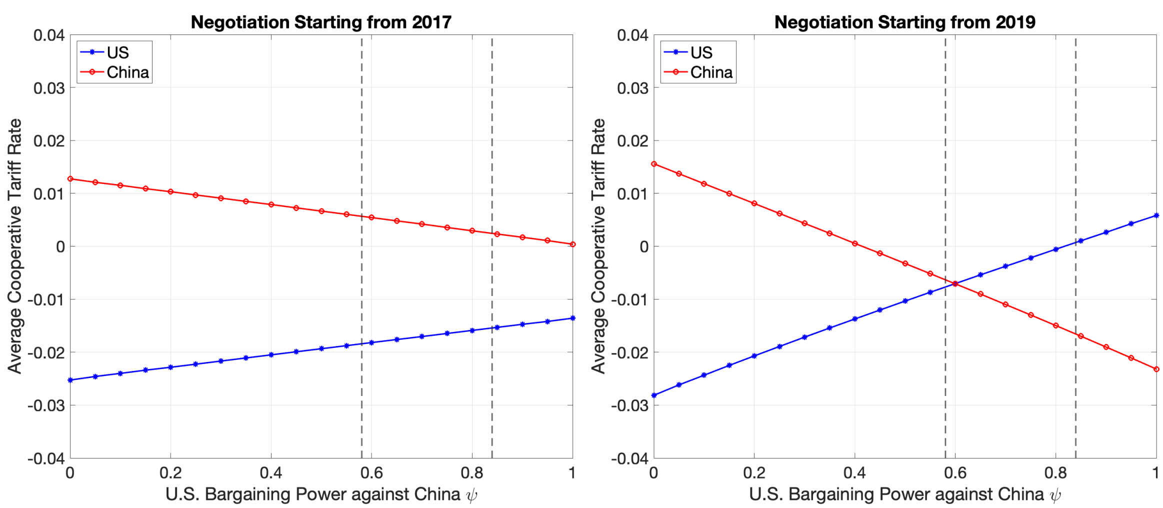

Figure A.6: Average Post-Negotiation Tariffs of the U.S. and China (Negative Tariffs Allowed)

Note: This figure plots the simple average of post-negotiation tariffs across sectors for the U.S. and China as in Figure 2, but allows for negative tariff rates.

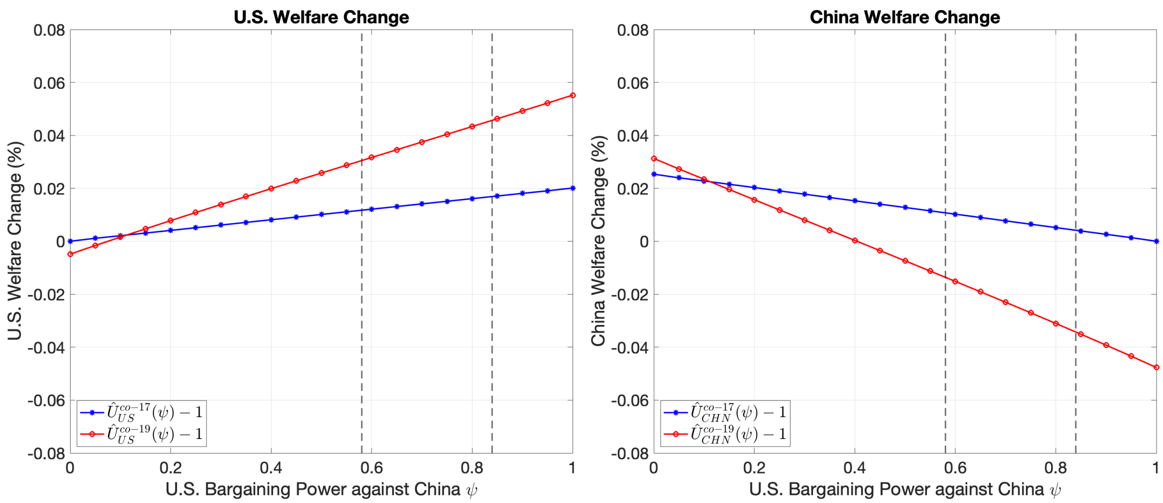

Figure A.7: Post-Negotiation Welfare Change (Negative Tariffs Allowed)

Note: This figure illustrates the post-negotiation percentage welfare changes (relative to the 2017 baseline) of the two scenarios for the U.S. and China as in Figure 3, but allows for negative tariff rates.

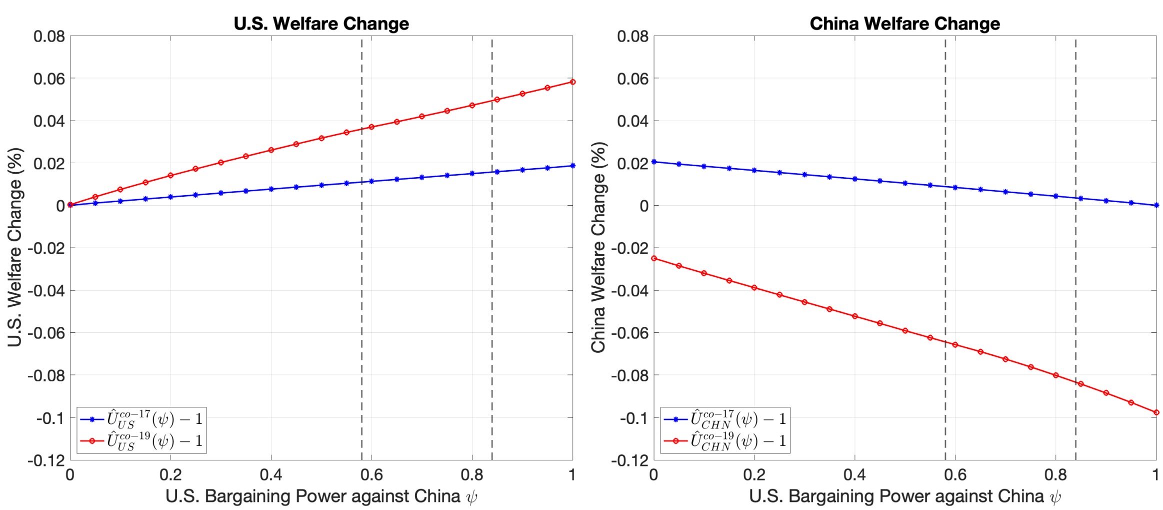

Figure A.8: Post-Negotiation Welfare Change (Accounting for Third-Party Tariff Changes)

Note: This figure illustrates the post-negotiation percentage welfare changes (relative to the 2017 baseline) of the two scenarios for the U.S. and China as in Figure 3, and also considers the changes in U.S., China, and other countries' bilateral tariffs during the trade war.

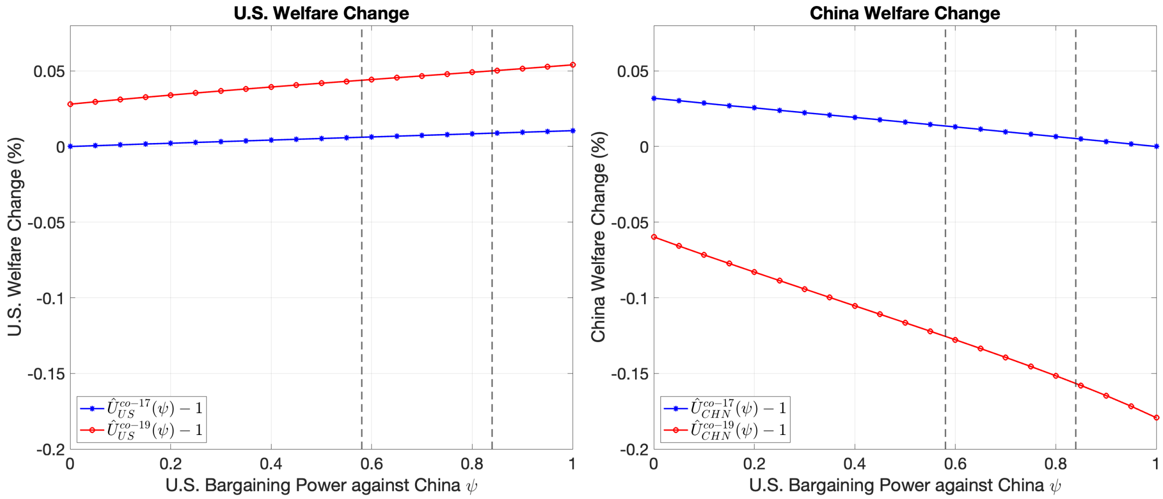

Figure A.9: Post-Negotiation Welfare Change (Fixed Trade Balances in 2017)

Note: This figure illustrates the post-negotiation percentage welfare changes (relative to the 2017 baseline) of the two scenarios for the U.S. and China as in Figure 3, but fixes the trade balance between the U.S. and China at the 2017 level.

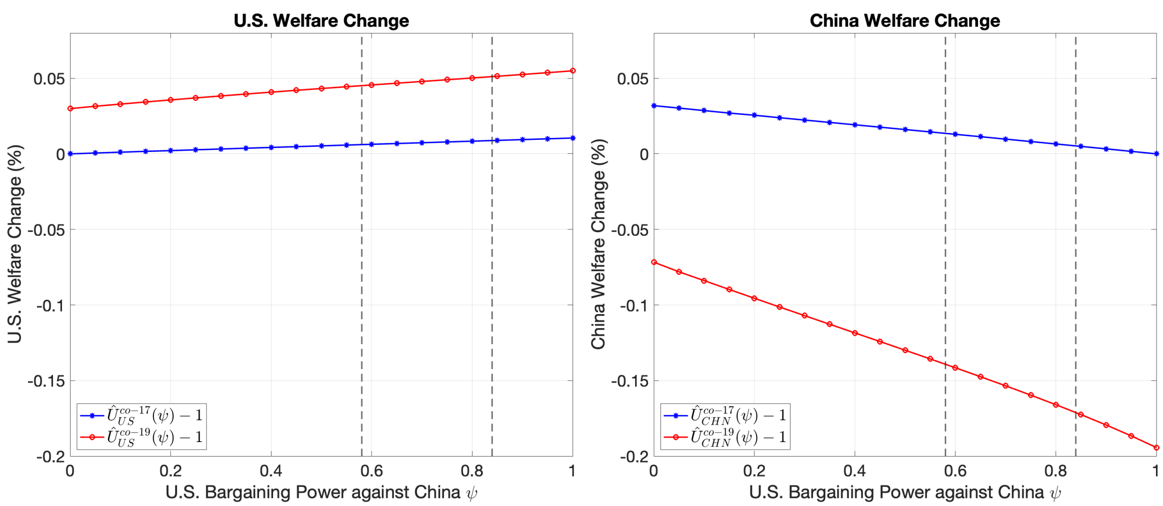

Figure A.10: Post-Negotiation Welfare Change (Fixed Trade Balances in 2019)

Note: This figure illustrates the post-negotiation percentage welfare changes (relative to the 2017 baseline) of the two scenarios for the U.S. and China as in Figure 3, but fixes the trade balance between the U.S. and China at the 2019 level.

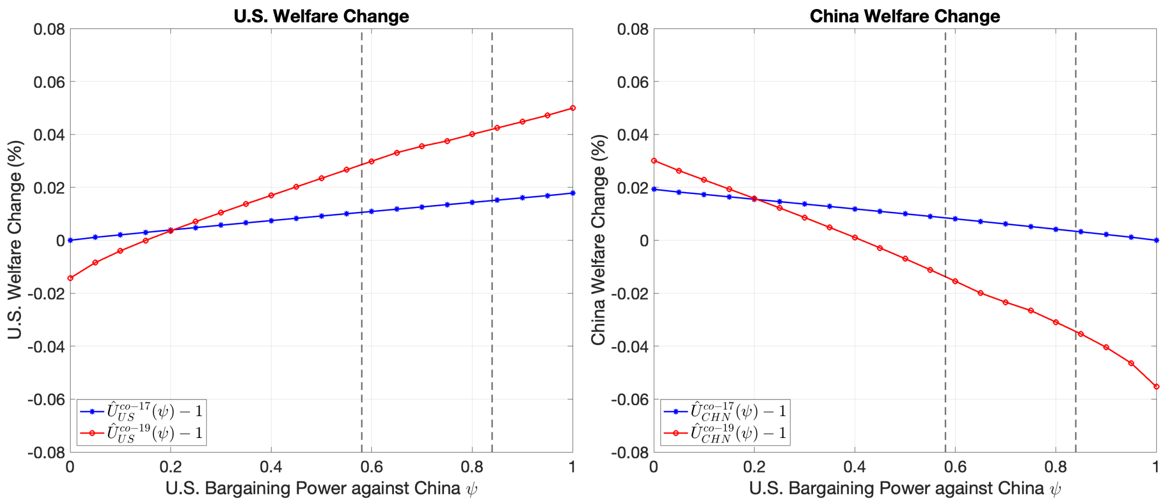

Figure A.11: Post-Negotiation Welfare Change (Elasticities from Caliendo and Parro (2015))

Note: This figure illustrates the post-negotiation percentage welfare changes (relative to the 2017 baseline) of the two scenarios for the U.S. and China as in Figure 3, but uses the elasticities of substitution from Caliendo and Parro (2015).

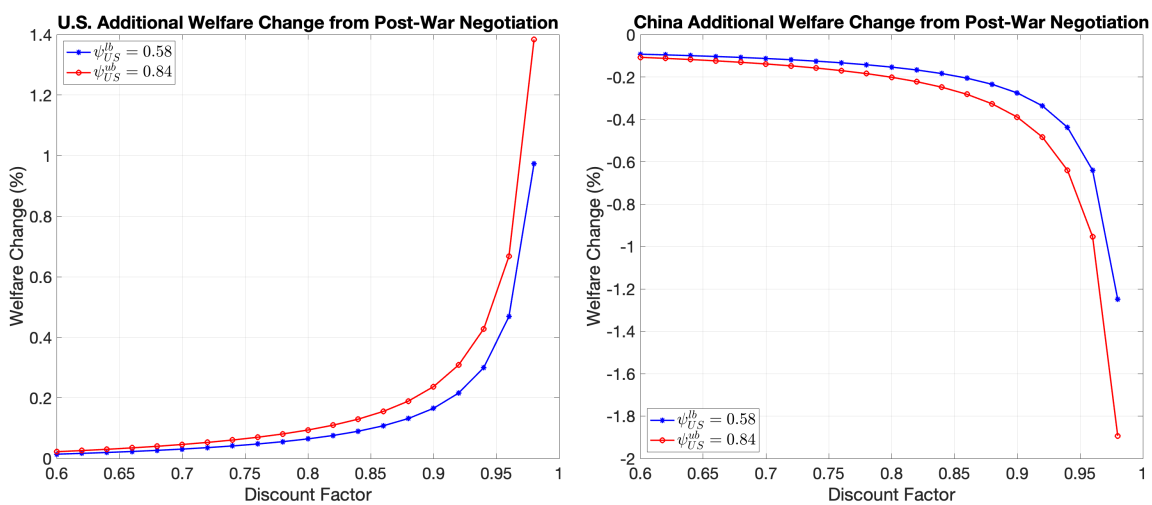

Figure A.12: Dynamic Welfare Changes in an Infinite Period Setup

Note: This figure plots $\Delta\hat{U}_n^{total}(\psi)$ for the U.S. and China in the infinite period setup. For each country, we consider the lower and upper bound of our estimated U.S. bargaining power ψ (0.58 and 0.84, respectively).

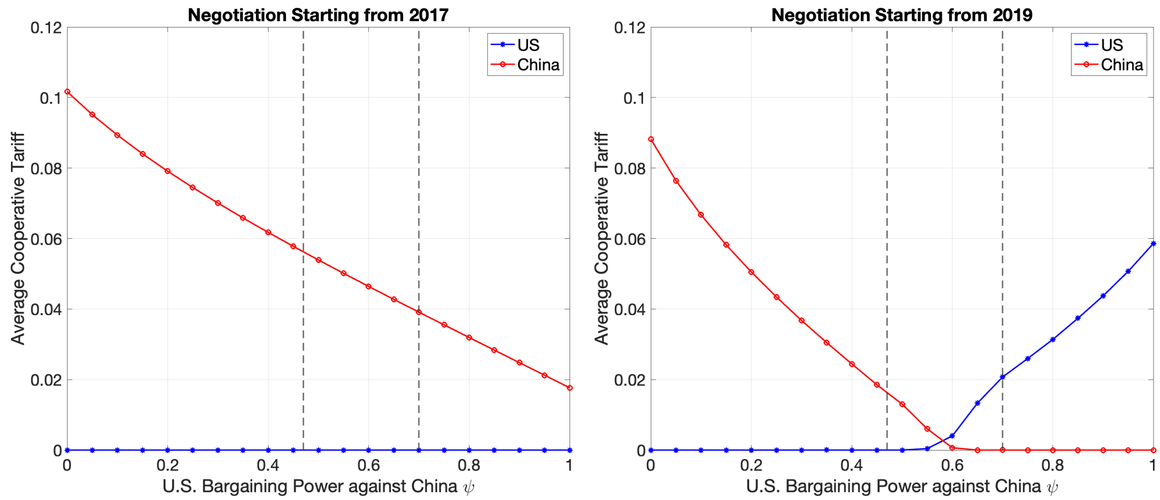

Figure A.13: Average Post-Negotiation Tariffs of the U.S. and China (with Spatial Features)

Note: This figure plots the simple average of post-negotiation tariffs across sectors for the U.S. and China. The left panel shows predicted tariffs when the negotiation starts from the 2017 baseline equilibrium, whereas the right panel shows predicted tariffs when the negotiation starts from the trade-war equilibrium. The two vertical dashed lines indicate the lower bound (0.47) and upper bound (0.70) of the estimated bargaining power of the U.S. relative to China.

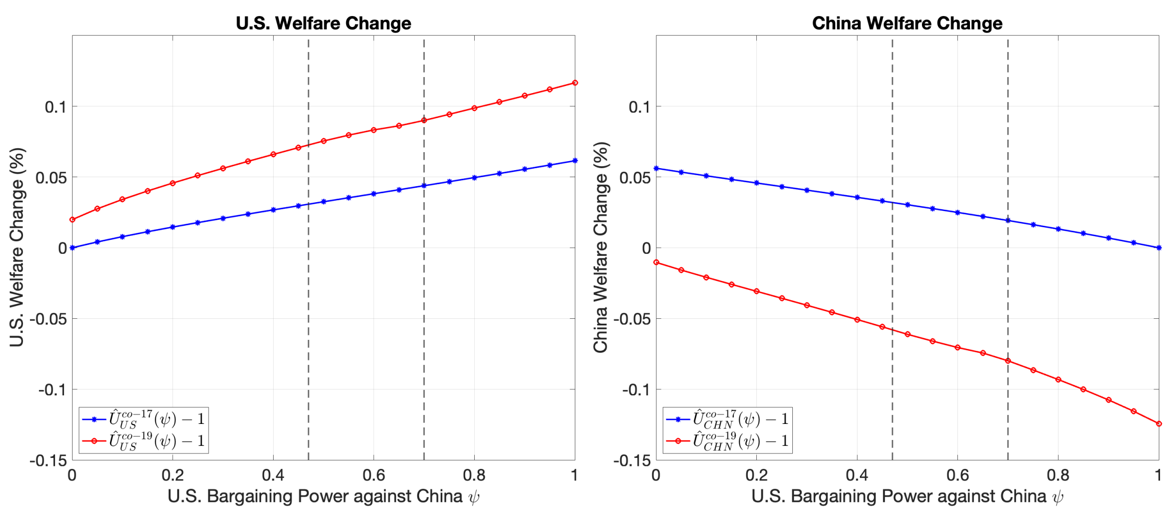

Figure A.14: Post-Negotiation Welfare Change (with Spatial Features)

Note: The blue lines refer to the percentage welfare changes when the tariff negotiation starts from the 2017 tariff profile. The red lines refer to the percentage welfare changes when the tariff negotiation starts from the 2019 tariff profile. The two vertical dashed lines indicate the lower bound (0.47) and upper bound (0.70) of the estimated bargaining power of the U.S. relative to China.