Trade Agreements in the Shadow of Lobbying[a]

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Abstract

This paper presents a model of international trade agreements in which the executive branches of each government negotiate agreements while the legislative branches, subject to political pressure from firms, can disrupt them. Lobbying is in the style of Grossman and Helpman (1994) with a new feature: all actors face uncertainty arising from the complexity of the legislative process. I demonstrate that the higher the executives set tariffs in a trade agreement, the less effort lobbies put forth to prevent its ratification. Thus trade agreements act as a domestic political commitment device: executives set relatively high tariffs to discourage lobbying and increase the chance that the agreement will be ratified. The model sheds light on the empirical puzzle surrounding governments' welfare weights in the Grossman and Helpman (1994) model and **provides a new explanation for failures to ratify trade agreements**.

JEL classification: D72, D80, F13, F53, F55

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1 Introduction

Much of trade policy is determined in the context of international agreements that must be ratified by some domestic body. This paper sheds light on such a policy-making process by incorporating Protection-for-Sale (Grossman and Helpman 1994, hereafter PFS) style lobbying into a model of trade agreements in which the executive branches of the governments set tariff levels in anticipation of political pressure upon a ratifying body, assumed here to be a legislature. Important realism is achieved not only through the addition of the ratification constraint but also by the incorporation of political uncertainty into the model.

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I show that the probability that the trade agreement is derailed increases in lobbying effort and decreases in the trade agreement tariff. Further, the lobby decreases its effort as the trade agreement tariff rises: it has less to lose the higher is the trade agreement tariff. When choosing the trade agreement tariffs, the executives therefore trade off the welfare they receive under the agreement with the probability that the agreement remains in force. Ultimately, I find that observed lobbying effort may often be low because the executives set trade agreement tariffs sufficiently high to reduce political pressure on the legislatures.

To see how this works, let's begin by considering the case of political certainty. I assume the executive to be more pro-social than the legislature, as has been the case throughout the post-war period in the United States. Lobbies, assumed for simplicity to represent import-competing interests only, would like to prevent or derail a trade agreement that would reduce their tariff protection.[1] They work toward this end by exerting effort to convince their respective legislatures to vote against the trade agreement.

For any trade-agreement tariff set by the executives, a lobby can calculate the effort level required to shift the preferences of the median legislator just far enough so that he will choose the non-cooperative tariffs over the trade agreement tariffs. Because the lobby will pay this price so long as its benefit outweighs the cost, a trade war will occur unless the executives set the trade-agreement tariff so that lobbying is not worthwhile.

Thus, any trade agreement under political certainty involves a tariff high enough to disengage the lobby completely; that is, even welfare-maximizing executives set high tariffs and induce zero contributions in equilibrium because they set policy in the shadow of a ratification decision influenced by lobbying. Careful modeling of the political process demonstrates that the relationship between deadweight loss calculations and the tariffs that are provided in a trade agreement are mediated in important ways by a ratification constraint.

The fact that zero contributions are predicted in equilibrium is not particularly satisfying. The model becomes more realistic and delivers additional intuition when I allow all actors to be uncertain about the weight the median legislator places on the profits of the lobbying industry. **Similar to probabilistic voting models that incorporate policy motivation as in Roemer (1997),** this represents the idea that the lobbying and voting "game" that goes on within legislatures is often complex enough that none of the actors know precisely what the outcome will be—that is, no one can predict exactly which legislator will be the median and therefore what weight will be placed on import-industry profits at the time of the vote.

One can conceptualize this uncertainty as being a result of the lobby's strategic choice to engage with only some key members of the legislature. For instance, the lobbied legislators may promise to deliver the votes of their non-lobbied colleagues but may not be able to do so with certainty because those colleagues are subject to cross-pressuring from various sources.

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[1]In this model, non-ratification is equivalent to breaking a trade agreement once in place. Likewise, the non-cooperative tariffs that result from failing to ratify the trade agreement are the same as the tariffs that would arise in trade war, so this model applies to both situations.

In the face of this political uncertainty, lobbies respond to higher trade agreement tariffs by decreasing effort and in turn the legislatures disrupt trade agreements with a lower probability. Since they prefer low tariffs, the executives must trade off the level of social welfare derived while a trade agreement is in force with the chances that the agreement will remain in force.

One contribution of this model is that it shows how trade agreements can act as a domestic political commitment device in a broad set of environments. The executives set trade-agreement tariffs with an eye to discouraging lobbying activity and the accompanying probability of abrogation. In addition to the standard terms-of-trade internalization, the executive's agenda-setting power allows it to reduce tariffs until lobbying activity is at the optimal level relative to a non-cooperative setting, reducing the amount of political pressure faced by the legislatures and the resultant expected tariffs.

This is not a time inconsistency à la Maggi and Rodríguez-Clare (2007) where the welfare of the unitary policymaker is improved via commitment to a trade agreement by changing firms' investment decisions. Instead, it is an inconsistency between the preferences of the executive and legislative branches. Although the legislatures have the final word, the executives use the trade agreement to reduce lobbying effort to mute the legislature's protectionist bias and bring the outcome more in line with their relatively liberal preferences.

A further contribution is the demonstration that lobbying effort and the probability of trade disruptions vary in nuanced ways with the amount of political uncertainty present. Lobbying incentives are crucial but their impact is not necessarily as straightforward as predicted by models with unitary governments. Gawande, Krishna and Olarreaga (2009) provide cross-country empirical evidence that measures such as the number of checks and balances on the power of the legislature have predictive power for the PFS "welfare-mindedness" parameter. Thus, although empirical tests are outside the scope of this paper, there is suggestive evidence that political uncertainty is indeed an important factor empirically.

To the best of my knowledge, this is also the first attempt to model lobbying specifically aimed at derailing trade agreements. Although this kind of politically-driven failure is not rare, prior models have not allowed exploration of the endogenous dynamics behind them.

The addition of a rich structure of government, tailored carefully to the trade policy making process, also helps shed light on the empirical puzzle surrounding the PFS model. Empirical tests of the model[2] have consistently found the weight governments place on social welfare to be many times that which they place on lobbying effort, while estimates indicate that the deadweight losses caused by trade distortions are several orders of magnitude larger than lobbying expenditures.[3] This raises the question: how could governments

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[2]cfr. Goldberg and Maggi (1999); Gawande and Bandyopadhyay (2000); Mitra, Thomakos and Ulubasoglu (2002); McCalman (2004).

[3]Feenstra (1992) assembles estimates from the mid-1980s that place a floor of $8 billion per year on the deadweight losses from protection, whereas Bombardini and Trebbi (2012) find that total annual lobbying expenditure on trade issues in 1999-2001 when this data first became available was about $200 million.

value social welfare so highly, yet grant these quantities of protection at such a low price?

Attempts to more fully model the lobbying process have reduced the parameter estimates for the government's welfare considerations somewhat, but they still indicate that the U.S. government, for instance, values social welfare at least twenty times as much as contributions.[4] Taking a different approach, Gawande and Hoekman (2006) suggest that one can reconcile the empirical results with the model by acknowledging the complexity of the policy-making process and the uncertainty that arises from it.

In the non-unitary government model, these estimates and the stylized facts are not inconsistent. The "missing contributions," (Gawande and Hoekman 2006), can be explained as an equilibrium phenomenon arising from the agenda-setting power of the executive branch. In particular, in this model, there is no inconsistency for the 15% or so of sectors that receive protection but apparently put forth no lobbying effort. In this framework, even a welfare-maximizing executive and lobbying effort at zero can be reconciled with high tariff levels.

Although the political process here most closely matches that of the United States in the post-war era,[5] the model is broadly applicable because the central dynamic that emerges—that trade agreements are formed in the *shadow* of lobbying pressure instead of in direct response to it—appears to be present in a wide range of countries. The results apply beyond separation-of-powers presidential systems because the presence of veto points is what is essential for this dynamic to occur. Although the number of formal veto points tends to be lower in, for instance, parliamentary systems, veto points are typically not absent altogether (Henisz and Mansfield 2006). In reality, constraints on the executive are almost always present in democratic regimes, although they may operate in different ways.

1.1 Related Literature

The foundations of this work rest on Grossman and Helpman's (1994) 'Protection for Sale.' Two related papers 'Trade Wars and Trade Talks' (Grossman and Helpman (1995b)) and 'The Politics of Free-Trade Agreements' (Grossman and Helpman (1995a)) first employed the PFS approach in the study of trade agreements. The first considers "Trade Wars" and "Trade Talks" separately, whereas my approach allows the "Trade Talks" to be influenced by the desire to avoid a "Trade War" and thus views the "Trade War" as a crucial subgame. Their model of preferential trade agreements (Grossman and Helpman (1995a)), although treating the government as a unitary actor, is closer to this approach.

Another related literature considers the impact of exogenously-determined political uncertainty on the potential for trade cooperation. These studies (e.g. Feenstra and Lewis (1991); Milner and Rosendorff (2001);

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[4]cfr. Gawande, Krishna and Robbins (2006); Mitra, Thomakos and Ulubasoglu (2006); Bombardini (2008); and Gawande, Krishna and Olarreaga (2012) among others. Gawande and Magee (2012) provide a summary of the extensive literature, while Imai, Katayama and Krishna (2009) argue that many of the classification schemes present serious challenges for the validity of results.

[5]In particular, the legislatures' decision to abide by or break the trade agreement is modeled on the "Fast Track / Trade Promotion Authority" that the U.S. Congress periodically grants to the Executive branch.

Bagwell and Staiger (2005); Beshkar (2010); Horn, Maggi and Staiger (2010); Beshkar and Bond (2012); Amador and Bagwell (2013)) derive various implications for the design of international trade agreements using a Baldwin (1987)-style government welfare function with exogenous shocks to the political-pressure parameter.

Since trade policies are overwhelmingly determined within the context of trade agreements, it is useful to have a framework to bring together the endogenous political pressure of PFS-style modeling with the trade agreements approach. The government objective function introduced in this paper is intended to be a bridge between the two. The objective function I introduce starts from the Baldwin (1987) government objective function and adds flexibility: the weight the legislature places on profits is endogenous (PFS), potentially non-linear (Findlay and Wellisz 1982; Dixit, Grossman and Helpman 1997) and stochastic. Buzard (2016) is an example of how this modeling approach can be used to integrate endogenous political activity and exogenous shocks into the analysis of questions regarding optimal trade agreement design.

Modeling the objective function so closely on the standard in the trade agreements literature allows for direct comparisons to the large body of work that studies exogenous shocks only, revealing cleanly the effects of the addition of endogenous lobbying. To preview, this model is closest to that of Bagwell and Staiger (2005), with two main changes: in place of their unitary government signing a trade agreement and having different preferences ex-ante and ex-post, this model has two branches of government with differing preferences, where the political economy weights of the legislature are determined endogenously.

Several papers have studied the impact of executive/legislative interactions on international agreements in the case of exogenously-determined preferences. Mansfield, Milner and Rosendorff (2000) construct a model in which democracies trade more with each other because the domestic legislature's influence requires the foreign government to make deeper tariff cuts to ensure its cooperation. Dai (2006) argues that a country's legislative constraint assists its own executive in maintaining higher barriers. Ethier (2002) treats the effect of a separation of powers between trade negotiators and the government officials who administer protection.

The above work is patterned on Milner and Rosendorff (1997), who explore how uncertainty can affect trade policy and ratification failure when political preferences, and therefore uncertainty, are exogenous. Le Breton and Salanie (2003) study lobbying when the lobby is uncertain about the preferences of a unitary decision maker. Le Breton and Zaporozhets (2007) replace the unitary decision maker with a legislature with multiple actors. In Song (2008), policy-making power is shared between an executive and a unitary legislature where lobbies are able to endogenously influence the political preferences of the legislature in a context of unilateral policy making with no uncertainty, and Coates and Ludema (2001) study trade policy leadership in a model with endogenous lobbying in the presence of political uncertainty with imperfect monitoring.

2 The Model

2.1 The Basic Setup

I begin by describing the basic economic setting within which trade occurs. It is a three-good model with two countries: home (no asterisk) and foreign (asterisk). In each country, preferences are linear in good N, which is denoted the numeraire, while the demand functions for X and Y are assumed strictly decreasing and twice continuously differentiable. Further, the demand functions for X and Y are taken to be identical and denoted $D(P_i)$ in home and $D(P_i^*)$ in foreign. P_i denotes the home price of good $i \in \{N, X, Y\}$ and P_i^* denotes the foreign price of good i.

Good N is produced with labor alone with constant returns to scale technology so that $Q_N = l_N$. I assume the aggregate labor supply l is large enough to ensure that the output of good N is large enough to guarantee balanced trade. The supply functions for good X are $Q_X(P_X)$ and $Q_X^*(P_X^*)$ and are assumed strictly increasing and twice continuously differentiable for all prices that elicit positive supply. I also assume $Q_X^*(P_X) > Q_X(P_X)$ for any such P_X so that the home country is a net importer of good X. The production structure for good Y is taken to be symmetric, with both demand and supply such that the economy is separable in goods X and Y. It is assumed that the production of goods X and Y requires, in addition to labor, the possession of a sector-specific factor that is available in inelastic supply and is non-tradable so that the income of owners of the specific factors is tied to the price of the good in whose production their factor is used.

For simplicity, I assume each government's only trade policy instrument is a specific tariff on its import-competing good: the home country levies a tariff τ on good X while the foreign country applies a tariff τ^* to good Y. Local prices are then $P_X = P_X^W + \tau$, $P_X^* = P_X^W$, $P_Y = P_Y^W$ and $P_Y^* = P_Y^W + \tau^*$ where a W superscript indicates world prices. Equilibrium prices are determined by the market clearing conditions

$$M_X(P_X) = D(P_X) - Q_X(P_X) = Q_X^*(P_X^*) - D(P_X^*) = E_X^*(P_X^*)$$

$$E_Y(P_Y) = Q_Y(P_Y) - D(P_Y) = D(P_Y^*) - Q_Y^*(P_Y) = M_Y^*(P_Y^*)$$

where M_X are home-county imports and E_X^* are foreign exports of good X and E_Y are home-county exports and M_Y^* are foreign imports of good Y. Given the production technology and no trade taxes, the price of the numeraire is equal to one in both countries and on the world market.

P_X^W and P_Y^W are decreasing in τ and τ^* respectively, while P_X and P_Y^* are increasing in the respective domestic tariff. This gives rise to a standard terms-of-trade externality. As profits and producer surplus (identical in this model) in a sector are increasing in the price of its good, profits in the import-competing sector are

also increasing in the domestic tariff. This economic fact, combined with the assumptions on specific factor ownership, is what motivates political activity by import-competing lobbies.

I now turn to describing the strategic players in the game. Each country's government is composed of two branches: an executive who can conclude trade agreements and a legislature that has final say on trade policy. In order to focus attention on protectionist political forces, **highlight the model's central mechanisms and minimize the number of actors that must be modeled**, I assume that only the import-competing industry in each country is politically-organized.[6] Further, I assume that this industry is represented by a single lobbying organization.

Figure 1 illustrates the timing of the game from the perspective of the home country.[7] First, the executives set trade policy cooperatively within the context of an international agreement, that is they choose the trade agreement tariffs $\boldsymbol{\tau^a} = (\tau^a, \tau^{*a})$. After the trade agreement is concluded, the lobbies attempt to persuade the legislators in their respective countries to vote "no" on the ratification of the agreement; or alternatively, if there is no ratification hurdle, to break the trade agreement.[8] They do this by choice of lobbying effort e_b, which can take on any non-negative value.

Next, nature determines with probabilities o and o^* whether each legislature will have the opportunity to take a vote to break the agreement. I assume that these probabilities are less than one-half and mutually exclusive.[9] This allows me to focus on the key interaction between the domestic actors and abstract from the strategic interaction between the lobbies in the two countries.[10]

After this, the uncertainty about the the median legislator's identity is resolved. This is modeled as the realization of a random variable θ_b, the value of which all players observe simultaneously. The "break stage" concludes with the legislature making a choice to abide by the agreement or to break the agreement.

In the event that the trade agreement does not enter into or remain in force, there is a final stage of lobbying, resolution of the uncertainty surrounding this decision, and voting to set the trade-war tariffs.[11] Once all

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[6]The model's central insights do not depend on this structure and can be extended to the case of multiple lobbies. In particular, adding an export lobby in the simplest case of no uncertainty predicts that import lobbies will remain disengaged while the executive will be able to reduce tariffs by recruiting support from exporters. The Panama Trade Promotion Act seems to follow this pattern, where there was virtually no lobbying against, significant lobbying in favor, and numerous industries receiving import tariff protection.

[7]This extensive form is for the case where the foreign legislature does not break the trade agreement.

[8]As will be seen shortly, these two interpretations are equivalent in this setting because tariffs in a "trade war" are assumed to be set non-cooperatively in the same manner as if there were no trade agreement. For simplicity, I refer to this as the "break" decision throughout.

[9]While this assumption is made for purposes of exposition and tractability, one can think of o and o^* as being determined by events beyond the executives' or legislatures' control that determine whether or not the legislatures will be willing to consider the lobby's request; for example, they would be affected by the occurrence of an economic crisis that diverts the legislature's attention from less-pressing matters.

[10]When the legislatures in both countries have an opportunity to break the agreement simultaneously, an incentive for each lobby to free ride on the effort of the other makes the optimization problem of the executives more complex as they are faced with the problem of how best to exploit the free-riding dynamic. **Alternatively, one can take the break decisions in the two countries to be sequential with the executives behind a veil of ignorance about which legislature will move first. In that set up, the end results are the same as in the current model but additional intermediate results are needed.**

[11]Alternatively, one can model the lobbying for the ratification decision as determining the potential non-cooperative tariff; this changes behavior slightly but does not change the fundamental dynamics. Yet another possibility is to replace the trade-war phase with the ex-ante status quo, which would most naturally be the non-cooperative equilibrium. This is precisely the outcome that obtains in the trade-war phase, so the results of the model are unaltered.
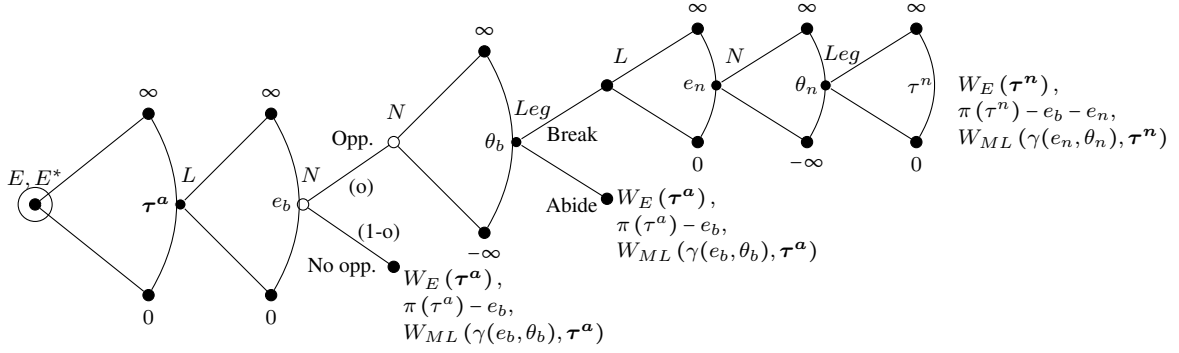
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L N Leg

e_n θ_n τ^n $W_E(\boldsymbol{\tau^n})$,

$\pi(\tau^n) - e_b - e_n$,

N Leg $W_{ML}(\gamma(e_n, \theta_n), \boldsymbol{\tau^n})$

Opp. θ_b Break

E, E^* L N (o)

τ^a e_b Abide $W_E(\boldsymbol{\tau^a})$,

$\pi(\tau^a) - e_b$,

(1-o) $W_{ML}(\gamma(e_b, \theta_b), \boldsymbol{\tau^a})$

No opp. $W_E(\boldsymbol{\tau^a})$,

0 0 $-\infty$ $\pi(\tau^a) - e_b$,

$W_{ML}(\gamma(e_b, \theta_b), \boldsymbol{\tau^a})$

0 $-\infty$ 0

Figure 1: Extensive Form

political decisions are taken, producers and consumers make their decisions.

2.2 Preferences

As the economy is fully separable and the economic and political structures are symmetric, I focus throughout the paper on the home country and the X-sector. The details are analogous for Y and foreign.[12]

I specify the welfare function of the home legislature as

$$W_{ML} = CS_X(\tau) + \gamma(e, \theta) \cdot PS_X(\tau) + CS_Y(\tau^*) + PS_Y(\tau^*) + TR(\tau) \tag{1}$$

where CS is consumer surplus, PS is producer surplus, $\gamma(e, \theta)$ is the weight placed on producer surplus (profits) in the import-competing industry, e is lobbying effort, θ is a random variable, and TR is tariff revenue.[13] I model the decisions of the legislature as being taken by a median legislator. Notice that the weight the median legislator places on the profits of the import-competing industry, $\gamma(e, \theta)$, is affected by the level of lobbying effort and a random variable θ. I make the following assumptions on $\gamma(e, \theta)$:

Assumption 1. $\gamma(e, \theta)$ *is increasing and concave in e for every $\theta \in \Theta$.*

Assumption 2. $\gamma(e, \theta)$ *is increasing in θ.*

Assumption 1 formalizes the intuition that the legislature favors the import-competing industry more the higher is its lobbying effort, but that there are diminishing returns to lobbying activity.[14] It allows the political uncertainty inherent in θ to be correlated in interesting ways with the level of e, ruling out only (i) that higher

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[12] These are the relevant sectors for analysis because they are the sectors in which there are lobbies.

[13] Labor income l could also be included in both median legislator and executive welfare. I omit it because its inclusion alters none of the results and only serves to complicate the exposition.

[14] The diminishing returns here take the form of declining increments to the lobby's influence as effort increases; in Ethier (2012), the returns to lobbying decline as the level of protection increases.

effort levels make lower γ-weights more likely and (ii) that effort and uncertainty are correlated in such a way that increasing lobbying effort changes the structure of uncertainty so that higher γ-weights become more likely at an accelerating pace. Assumption 2 **simply provides for an intuitive labelling so that** larger realization of the uncertainty variable θ increase the value of the political economy weight.

Given its expectations and the legislature's preferences, the home lobby chooses its lobbying effort (e_b to influence the break/ratification decision, which for simplicity, I will refer to henceforth simply as "break," and e_n to influence the trade war tariff) to maximize the welfare function:

$$\mathbb{E}[U_L] = \Pr[\text{TradeWar}(\boldsymbol{\tau^a}, e_b, e_n)][\pi(\tau^n) - e_n] + \Pr[\text{TradeAgreement}(\boldsymbol{\tau^a}, e_b, e_n)]\pi(\tau^a) - e_b \quad (2)$$

where $\pi(\cdot)$ is the current-period profit and τ^a (τ^n) is the home country's tariff on the import good under a trade agreement (war). I use the convention throughout of representing a vector of tariffs for both countries (τ, τ^*) as a single bold $\boldsymbol{\tau}$.

In the first stage of the game, the executives choose the trade agreement tariffs $\boldsymbol{\tau^a} = (\tau^a, \tau^{*a})$ via a negotiating process that I assume to be efficient. In this symmetric environment, it therefore maximizes the expected joint payoffs:

$$\mathbb{E}[W_E(\boldsymbol{\tau^a})] + \mathbb{E}[W_E^*(\boldsymbol{\tau^a})] = \Pr[\text{TradeWar}(\boldsymbol{\tau^a})][W_E(\boldsymbol{\tau^n}) + W_E^*(\boldsymbol{\tau^n})] +$$
$$\Pr[\text{TradeAgreement}(\boldsymbol{\tau^a})][W_E(\boldsymbol{\tau^a}) + W_E^*(\boldsymbol{\tau^a})] \quad (3)$$

I model the executives' choice via the Nash bargaining solution where the disagreement point is the executives' welfare resulting from the Nash equilibrium in the non-cooperative game (i.e. in the absence of a trade agreement) between the legislatures.

The home executive's welfare is specified as follows:

$$W_E = CS_X(\tau) + \gamma_E \cdot PS_X(\tau) + CS_Y(\tau^*) + PS_Y(\tau^*) + TR(\tau)$$

Note that this is identical to the welfare function for the legislature aside from the weight γ_E the executive places on the profits of the import industry, which is not a function of lobbying effort. **This setup does not strictly require that the executives are not lobbied, only that the extent to which the executives favor this industry cannot be *directly* influenced by lobbying effort. The assumption is innocuous as long as the executives' preferences are not directly altered in a significant way by lobbying over trade.**

I make one more assumption on $\gamma(e, \theta)$:

Assumption 3. $\gamma(e, \theta) \geq \gamma_E \geq 1 \ \forall e, \theta.$

That is, even for the least favorable outcome of the lobbying process, the legislature will be at least slightly more protectionist than the executive regardless of the lobby's effort choice. This assumption is not essential, but it simplifies the analysis considerably, ensuring that trade agreement tariffs are less than trade war tariffs. It matches the empirical findings that politicians with larger constituencies are less sensitive to special interests and seems to represent particularly well the post-war U.S. where Congress has consistently been significantly more protectionist than the President.[15]

2.3 Information and Equilibrium Selection

I examine a simple class of equilibria that have the following features.

First, on information. Although uncertainty is present, information about it is symmetric. However, in line with the literature, I assume the lobby's contribution is not observable to the foreign legislature. The implication is that the lobby can directly influence only the home legislature, and so the influence of one country's lobby on the other country's legislature occurs only through the tariffs selected.[16] Given the game's structure and the assumption that lobbying effort is not observable across international borders, players in the same country can take advantage of more information than those who are in different countries. That is, the solution concept employed here is perfect public equilibrium (PPE).

Second, whenever there is a possibility of multiple equilibria, I focus on the one that maximizes the welfare of the executives. Given the assumption that the executives are social welfare maximizers, this selection criterion puts results in terms of the maximal level of trade policy cooperation that is possible. It also allows the question of whether governments use trade agreements as political commitment devices to be answered in a straightforward way.

Finally, I assume that an external authority can ensure enforcement of the agreement in the one-shot game analyzed here.[17]

3 Main Results

To understand how the executives optimally structure trade agreements, we must first examine the incentives of the lobbies and how the legislatures make decisions regarding breach of the trade agreement, including how

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[15]cfr. Lohmann and O'Halloran (1994) for the general argument, Destler (2005) on U.S. trade politics, and Grossman and Helpman (2005) for a formal model.

[16]cfr. Grossman and Helpman (1995b), page 685.

[17]Buzard (2015) considers a similar model in a repeated-game context and can therefore remove this restriction.

trade-war tariffs are set. The symmetric, separable structure of the model permits restriction of attention to the home country.

3.1 Trade-War Tariffs

In the event that the trade agreement is broken, the legislature sets its tariff τ unilaterally by maximizing Equation 1 given τ^*. Because there are no interactions between the home and foreign tariffs, the home and foreign trade-war tariffs are independent and the home country's tariff in a trade war maximizes weighted home-country welfare in the X-sector only. The foreign legislature's decision problem is analogous, and unilateral optimization leads to what I refer to as the (expected) Nash or trade-war tariffs τ^n as the solution to the following first order condition:[18]

$$\frac{\partial CS_X(\tau)}{\partial \tau^n} + \gamma(e_n, \theta_n) \cdot \frac{\partial PS_X(\tau)}{\partial \tau^n} + \frac{\partial TR(\tau)}{\partial \tau^n} = 0. \tag{4}$$

In the event of a trade war, the lobby chooses its effort e_n given this tariff-setting behavior by maximizing its profits net of effort: $\pi\left(\tau^n\left(\gamma\left(e_n, \theta_n\right)\right)\right) - e_n$. This implies a first order condition for the lobby of

$$\frac{\partial \pi(\tau^n)}{\partial \tau^n} \frac{\partial \tau^n}{\partial \gamma} \frac{\partial \gamma}{\partial e_n} = 1 \tag{5}$$

That is, at this stage, the lobby chooses the level of effort that equates its expected marginal increase in profits with its marginal payment.

In accordance with intuition, because profits are increasing in the tariff, trade war tariffs are increasing in the weight attached to the profits of the import-competing industry. This can be seen by rearranging Equation 5 as

$$\frac{\partial \tau^n}{\partial \gamma} = \frac{1}{\frac{\partial \pi(\tau^n)}{\partial \tau^n} \frac{\partial \gamma}{\partial e_n}} \tag{6}$$

since $\frac{\partial \gamma}{\partial e_n}$ is positive by Assumption 1 and profits are increasing in prices which are in turn increasing in the tariff. This expression can also demonstrate that the second order condition for the legislature's problem is always satisfied. By the implicit function theorem, $\frac{\partial \tau^n}{\partial \gamma} = -\frac{\frac{\partial \text{Equation 4}}{\partial \gamma}}{\frac{\partial \text{Equation 4}}{\partial \tau^n}} = -\frac{\frac{\partial \pi(\tau^n)}{\partial \tau^n}}{SOC}$ where "SOC" stands for 'Second Order Condition', the second derivative of the legislature's objective function which should be everywhere negative. Setting this expression equal to Equation 6, the second order condition must be satisfied since $\frac{\partial \gamma}{\partial e_n}$ is positive by Assumption 1.

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[18]Note that the random variable in the median legislator's weight on import profits is written as θ_n at this stage to distinguish it from θ_b at the break stage: as two separate votes are taken, there are two distinct realizations of uncertainty. It is not necessary to restrict them to come from the same distribution, although in applications it would seem unlikely that the distribution would change.

3.2 To Break or Not to Break?

With trade-war decisions specified, we can proceed by backward induction to analyze the incentives regarding the legislature's decision to uphold or break the trade agreement. I assume that the form of the political weighting function is the same regardless of the break decision, but the model could be extended to allow the two to differ. What is in principle different are the lobbying efforts toward influencing the break decision, denoted e_b at this stage to distinguish them from those that are made to influence the Nash tariff, e_n. The realization of uncertainty about the median legislator's identity will similarly be denoted θ_b so as to distinguish it from θ_n at the trade-war stage.

The legislature will break the agreement and set the tariff at τ^n if the median legislator's utility from the Nash tariffs is higher than his utility from the trade agreement tariffs, i.e. if

$$W_{ML}(\boldsymbol{\tau^n}, \gamma(e_b, \theta_b)) > W_{ML}(\boldsymbol{\tau^a}, \gamma(e_b, \theta_b)) \tag{7}$$

Recall that a bold $\boldsymbol{\tau}$ represents a vector of tariffs for both countries (τ, τ^*).

The legislature's decisions are stochastic, so the outcome of the vote on whether or not to break the trade agreement, as well as the level at which the tariff will be set in the case of a disruption, is not known to *any* player until the uncertainty over the identity of the median legislator is resolved at the moment the vote takes place on each issue.[19] I represent the probability that the home legislature breaks the trade agreement and sets the tariff at τ^n as:

$$b(e_b, \boldsymbol{\tau^a}, \boldsymbol{\tau^n}) = \mathbb{E}_{\gamma|e_b} \mathbf{1}[W_{ML}(\boldsymbol{\tau^n}, \gamma(e_b, \theta_b)) > W_{ML}(\boldsymbol{\tau^a}, \gamma(e_b, \theta_b))]$$
$$= \Pr[W_{ML}(\boldsymbol{\tau^n}, \gamma(e_b, \theta_b)) > W_{ML}(\boldsymbol{\tau^a}, \gamma(e_b, \theta_b))|e_b] \tag{8}$$

Note that the legislature's best response functions—both for whether to break the agreement, and at what level to set the tariff if it does—will be affected by the shape of $\gamma(e, \theta)$. I suppress the Nash tariffs in the expression of the break probability since they do not vary from the point of view of earlier stages.

We are now in a position to examine the legislature's decision more closely. Of central concern is how the probability that the legislature will break the trade agreement varies with lobbying effort:

Result 1. *The probability that the legislature breaks a trade agreement is increasing and concave in e_b.*

All proofs are in the Appendix.

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[19]We might think of the trade-war tariff as being set in the legislation before a vote takes place in the case of administered protection for instance; the results are robust to this variant.

Lobbying affects only the weight the legislature places on the profits of the import-competing industry. These profits are higher in a trade war than under a trade agreement, so given Assumption 1, the expectation of γ is increasing in lobbying effort, implying that the legislature becomes more favorably inclined toward the high trade-war tariff and associated profits as lobbying increases and therefore more likely to break the trade agreement. However, there are decreasing returns for the lobby: increasing effort leads to less than proportional increases in the probability that the trade agreement will be broken.

The probability of a trade war, just like the trade-war tariffs, is increasing in γ, so it's the natural assumption that γ is increasing in lobbying effort that implies that the lobby can increase both its trade war tariff and the probability of a trade war by raising its lobbying effort.

Turning to the effects of the trade-agreement tariffs on the probability that the agreement will be abrogated, it is straightforward that the legislature always prefers lower levels of the foreign tariff:

Lemma 1. *Holding lobbying effort constant, the probability the legislature breaks a trade agreement is weakly increasing in τ^{*a}.*

Because the home country is an exporter of good Y, the lower world price for Y has a negative effect on producer surplus that is larger than the positive effect on consumer surplus. Thus the net effect of an increase in foreign trade-agreement tariffs on both home legislative and home total social welfare is negative, leading to an increased probability that the trade agreement will be broken.

The relationship between the home country's trade-agreement tariff τ^a and the legislature's probability of breaking the agreement is slightly more complex because τ^a interacts directly with $\gamma(e_b, \theta_b)$. The intuition is as follows. The median legislator will vote to break the agreement if it receives higher welfare from the trade war tariff than the trade agreement tariff. For any given level of effort e_b, when the trade agreement tariff is very low, only a small set of realizations of θ_b that lead to the lowest values of $\gamma(e_b, \theta_b)$ will lead to approval of the trade agreement. Thus the break probability is high. As the trade agreement tariff rises, larger values of $\gamma(e_b, \theta_b)$ are consistent with approving the trade agreement, so the set of θ_b's that lead to trade agreement approval is larger. That is, the break probability decreases as τ^a increases. Even if the trade agreement tariff is so high that it is disliked by most, or even all, potential median legislators, it is preferable to the — even higher — trade war tariff, so the probability of breaking either becomes zero or continues to decrease in τ^a.

Lemma 2. *Holding lobbying effort constant, the probability the legislature breaks a trade agreement is weakly decreasing in τ^a.*

In the symmetric equilibria that are focal in the analysis that follows, any increase in τ^a will be accompanied by an equal increase in τ^{*a}, so it is useful to state a result about the combined impact of the home and foreign tariff when the two are constrained to be equal:

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Lemma 3. *Holding lobbying effort constant, the probability the legislature breaks a trade agreement is weakly decreasing in $\boldsymbol{\tau^a}$ (i.e. $\frac{\partial b(e, \boldsymbol{\tau^a})}{\partial \tau^a} + \frac{\partial b(e, \boldsymbol{\tau^a})}{\partial \tau^{*a}} \leq 0$).*

When any change in one of the trade agreement tariffs must be met with an equal change in the other (as in a symmetric agreement), the negative impact on the legislature's propensity to break the trade agreement of raising the home tariff always outweighs the positive impact of raising the foreign tariff because of the legislature's bias toward the import-competing industry.

3.2.1 Lobby

The lobby chooses its level of effort e_b as a function of $\boldsymbol{\tau^a}$, given the implications of that choice on the legislature's probability of breaking the agreement. The lobby's decision is taken according to

$$\max_{e_b} b(e_b, \boldsymbol{\tau^a}) \left[\pi(\tau^n) - e_n \right] + \left[1 - b(e_b, \boldsymbol{\tau^a}) \right] \pi(\tau^a) - e_b$$

The lobby simply maximizes probability-weighted profits net of effort. From its first order condition, we can see that the lobby balances the cost of an extra dollar of lobbying expenditure with the higher profits from a trade war weighted by the increase in the probability of receiving the higher profit level that expenditure induces:

$$\frac{\partial b(e_b, \boldsymbol{\tau^a})}{\partial e_b} \left[\pi(\tau^n) - e_n - \pi(\tau^a) \right] = 1 \tag{9}$$

The second order condition is satisfied given Assumption 3 and Result 1. However, the solution is not guaranteed to be interior, for which we need

$$\frac{\partial b(0, \boldsymbol{\tau^a})}{\partial e_b} \left[\pi(\tau^n) - e_n - \pi(\tau^a) \right] > 1. \tag{10}$$

For instance, if the executives were to set $\tau^a = \tau^n$, there would be no incentive for the lobby to make a positive contribution. We will see that there are some cases in which it may be in the executives' joint interest to set trade agreement tariffs so as to completely disengage the lobby. The following results thus only hold when Condition 10 is satisfied, that is, when the marginal impact of the first lobbying dollar on the break probability is sufficiently high to make engaging in the political process worthwhile for the lobby.[20]

We can now proceed to the central result concerning the lobby's behavior.

Result 2. *When the trade agreement remains in force with positive probability, lobbying effort is weakly decreasing in trade agreement tariffs.[21]*

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[20]This is primarily a condition on the curvature of the political weighting function but also involves the production and demand structure.
[21]See Section 5.3 for a detailed account of behavior when the lobby is able to induce a trade war with probability 1.

Raising the trade agreement tariff decreases the benefit of inducing a break in the trade agreement by raising profits under the trade agreement. This is in many ways the key result of this paper: the executives can reduce lobbying effort by setting higher tariffs in their trade agreement. We will see in the next section how this shapes the executives' joint decision.

Note that the symmetric increase in the foreign tariff does not impact profits in the import-competing industry, but it can impact lobbying incentives through the break probability. However, there is an analogous effect on the break probability from raising τ^a and the net effect is negative given Assumption 1 on the probability distribution function of $\gamma(e, \theta)$, which ensures that the effect of lobbying effort on the break probability does not increase as $\boldsymbol{\tau^a}$ increases. This assumption can be significantly weakened: this effect can be positive as long as it is smaller in absolute value than the negative effect on trade agreement profits.

3.3 The Trade Agreement

The executives choose trade agreement tariffs $\boldsymbol{\tau^a} = (\tau^a, \tau^{*a})$ to maximize Equation 3. I call the maximized joint value $MV(\boldsymbol{\tau^a})$ and write the division of surplus according to the Nash bargaining solution, which, due to symmetry, can be simplified from its general multiplicative form as

$$V_E(\boldsymbol{\tau^a}) + t = W_E(\boldsymbol{\tau^n}) + \frac{1}{2}\left(MV(\boldsymbol{\tau^a}) - W_E(\boldsymbol{\tau^n}) - W_E^*(\boldsymbol{\tau^n})\right)$$

$$V_E^*(\boldsymbol{\tau^a}) - t = W_E^*(\boldsymbol{\tau^n}) + \frac{1}{2}\left(MV(\boldsymbol{\tau^a}) - W_E(\boldsymbol{\tau^n}) - W_E^*(\boldsymbol{\tau^n})\right)$$

where expectation operators have been dropped for convenience and t is an intergovernmental transfer.[22] The solution to this system of equations determines the tariffs $\boldsymbol{\tau^a}$ that will be set in the trade agreement.

I simplify the problem by assuming that political constraints prevent the executives from choosing asymmetric tariffs. This restricts attention to symmetric solutions in the fully symmetric environment under consideration, which means that the trade agreement tariffs for which we're looking are simply those that maximize the joint welfare of the executives.[23] In order to solve for them, I represent the probability that the trade agreement will be broken as $B(\boldsymbol{\tau^a}) = b(e(\boldsymbol{\tau^a}), \boldsymbol{\tau^a})$ where $e(\boldsymbol{\tau^a})$ is the best response function implicit in Equation 9, the lobby's first order condition.

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[22]While direct monetary transfers have to date rarely been used in practice, it seems appropriate to interpret linked concessions on non-trade issues as indirect transfers (Klimenko, Ramey and Watson (2008); Maggi and Staiger (2011)). Here, transfers do not occur as long as the full set of symmetry assumptions are maintained but are an important consideration in asymmetric environments.

[23]I have assumed that $W_E(\tau) = W_E^*(\tau) \;\forall \tau$; further in a symmetric equilibrium, $\tau^n = \tau^{*n}$ and $\tau^a = \tau^{*a}$, so

$$V_E(\boldsymbol{\tau^a}) + t = W_E(\boldsymbol{\tau^n}) + \frac{1}{2}\left(MV(\boldsymbol{\tau^a}) - W_E(\boldsymbol{\tau^n}) - W_E^*(\boldsymbol{\tau^n})\right) = W_E(\boldsymbol{\tau^n}) + \frac{1}{2}\left(MV(\boldsymbol{\tau^a}) - 2W_E(\boldsymbol{\tau^n})\right) = \frac{1}{2}\mathbb{E}MV(\boldsymbol{\tau^a})$$

The problem then becomes to maximize the following modified version of Equation 3:

$$\{o \cdot B(\tau^a) + o^* \cdot B^*(\tau^a)\} W_E(\tau^n) + \{1 - o \cdot B(\tau^a) - o^* \cdot B^*(\tau^a)\} W_E(\tau^a) \tag{11}$$

where I have written the sum of the home and foreign executives' utilities as $W_E(\cdot)$. Here o and o^* are the probabilities that the home and foreign legislatures, respectively, will have the opportunity to break the trade agreement; these are assumed to be mutually exclusive events that are realized after the conclusion of the trade agreement.

Of central concern is how the break probabilities behave as a function of the trade agreement tariffs given the lobby's optimal response. Recalling the definition of the total break probability, $B(\tau^a) = b(e_b(\tau^a), \tau^a)$, we must combine the direct effect of tariffs on the legislature's break decision with the indirect effect through the impact on the lobby's choice of e_b.

The direct effect is negative by Lemma 3. The fact that the indirect effect of raising tariffs leads to a reduction in lobbying (Result 2) and therefore a further reduction in the propensity of the legislature to break the agreement (Result 1) leads to the following key result: the overall probability that the trade agreement will be broken is decreasing in the trade agreement tariffs.

Result 3. *The total probability that the trade agreement will be broken is decreasing in τ^a (i.e. $\frac{\partial B(\tau^a)}{\partial \tau^a} + \frac{\partial B(\tau^a)}{\partial \tau^{*a}} \leq 0$).*

That is, when the executives raise the trade agreement tariffs the legislature becomes less likely to abrogate the agreement, for three reasons. First, the legislature prefers a higher domestic tariff (**Lemma 2**); second, the higher tariff discourages lobbying (**Result 2**); and finally, the lower lobbying effort reduces the legislature's preferred tariff further (**Lemma 3**). Thus, beyond promising a lower tariff from the trading partner, we can think of the trade agreement as a sort of political commitment device that can be used to reduce political pressure and therefore get the legislature to maintain a lower tariff than it otherwise would.

We are now prepared to examine the executives' optimal choice of trade agreement tariffs. Because joint executive welfare is decreasing in trade agreement tariffs for τ^a above the executives' preferred tariffs, we have the following fundamental feature of the executives' problem:

Lemma 4. *The executives face the following trade off when choosing τ^a: higher tariffs decrease the probability that the trade agreement will be broken but also decrease welfare when the agreement is in force.*

I define the tariff the executives prefer in the absence of legislative constraints as τ^E and show in the Appendix that it is never optimal in a symmetric equilibrium for the executives to choose $\tau^a < \tau^E$ if there is a positive probability that the legislatures will have an opportunity to break the trade agreement. This is

the result of an envelope-like result: there are only second-order losses from raising tariffs slightly from the most-preferred level yet there are first-order gains in reducing the probability that the agreement will be broken.

The executives will also always choose $\tau^a < \tau^n$ unless the legislature breaks even agreements with tariffs very close to the Nash level with certainty, in which case the problem is not interesting so I will ignore this case. Thus there is an interior solution in all cases of interest, but this solution may be of two different forms. First, it could be at the point that maximizes the concave portion of the executives' welfare function (Equation 11). Here, the optimal tariffs are chosen to balance concerns for trade-agreement welfare against those for discouraging lobbying activity aimed at breaking the agreement.

But there is an alternative. For some specifications, high enough tariffs can disengage the lobby sufficiently so that the probability that the trade agreement will be broken is reduced to zero. Interestingly, if this occurs at a low enough tariff level, executive welfare can be maximized at this point.

Result 4. *The executives maximize their welfare by either (a) raising tariffs sufficiently high to ensure that the trade agreement will remain in force or (b) trading off reductions in the probability that the agreement will be broken with reductions in welfare under the agreement.*

This seems to accord well with observations of trade policy politics, in that some lobbies appear to exert significant effort toward disrupting trade agreements (often in the form of some kind of individual administrative remedy such as anti-dumping duties) whereas others apparently do not contest the levels of protection granted them. The current model points to differences across industries in production and demand structure, as well as political weighting (γ), to help explain these variations.

4   An Example

It is instructive to examine a simple parameterization of the model economy. The fundamentals here are chosen to match those of Bagwell and Staiger (2005). Home country demand, supply and profits are given by $D(P_i) = 1 - P_i$, $Q_X(P_X) = \frac{P_X}{2}$, $Q_Y(P_Y) = P_Y$, $\Pi_X(P_X) = \frac{(P_X)^2}{4}$, and $\Pi_Y(P_Y) = \frac{(P_Y)^2}{2}$ where P_i is the price of good i in the home country market. Foreign is taken to be symmetric.

This implies Home-country imports of X and exports of Y of $M_X(P_X) = 1 - \frac{3}{2}P_X$ and $E_Y(P_Y) = 2P_Y - 1$, with foreign imports of Y and exports of X given by $M_Y^*(P_Y^*) = 1 - \frac{3}{2}P_Y^*$ and $E_X(P_X^*) = 2P_X^* - 1$. With the only trade policy instruments being tariffs on import competing goods, world prices are $P_X = P_X^W + \tau$, $P_X^* = P_X^W$, $P_Y^* = P_Y^W + \tau^*$, and $P_Y = P_Y^W$. Market clearing implies that world and home prices of X are $P_X^W = \frac{4 - 3\tau}{7}$ and $P_X = \frac{4 + 4\tau}{7}$, symmetric for Y.

4.1 Trade War Tariffs

The median legislator's welfare can be written as

$$W_{ML}^X(\tau, \gamma(e, \theta)) + W_{ML}^Y(\tau^*) = \left\{ \frac{9}{98} - \frac{5}{49}\tau - \frac{34}{49}\tau^2 + \frac{1}{98}\gamma(e, \theta)\left[8 + 16\tau + 8\tau^2\right] \right\} + \frac{25}{98} - \frac{3}{49}\tau^* + \frac{9}{49}(\tau^*)^2.$$

When setting the trade-war tariff, the legislature maximizes $W_{ML}(\tau, \tau^*) = W_{ML}^X(\tau) + W_{ML}^Y(\tau^*)$ by choice of τ given τ^*. As there are no interactions between τ and τ^*, the legislature maximizes $W_{ML}^X(\tau)$ only (in curly braces above) and sets the trade war tariff

$$\tau^n = \frac{8\gamma(e, \theta) - 5}{68 - 8\gamma(e, \theta)}$$

I refer to this as the Nash tariff because it is the result of Nash equilibrium in the non-cooperative game between the legislatures. τ^n is increasing in e and the second order condition is satisfied for all realizations of $\gamma < 17/2$. Because $\gamma = 7/4$ is enough to achieve the prohibitive tariff of $1/6$, I will assume this condition is satisfied.

In the event of a trade war and facing this tariff-setting behavior by the legislature, the lobby maximizes $\pi\left(\tau^n\left(\gamma\left(e_n, \theta_n\right)\right)\right) - e_n$. In order to predict the Nash tariff, the political weighting function and form of political uncertainty must be specified. Take for instance $\gamma(e, \theta) = 1.25 + e^{.2} + \theta$ with θ distributed uniformly on $[-0.25, 0.25]$. Facing this specification of the political process, the lobby maximizes its objective function at $e_n = 0.00166$, which produces an expected Nash tariff of 0.129. Here net profits are 0.10239 in terms of the numeraire and lobbying effort is 1.60% of gross profits.

4.2 Break Decision

Next we move to the legislature's decision on whether or not to break the trade agreement. Figure 2 depicts the probability that the legislature will vote to break the trade agreement as a function of the tariff levels set in the trade agreement (with the restriction that $\tau^a = \tau^{*a}$) and the lobby's effort. It is strongly increasing in lobbying effort and decreasing in the level of tariffs set in the trade agreements.

Given the impact of lobbying on the legislature's break decision, the lobby's optimal contribution level is strongly decreasing in the trade agreement tariffs.

4.3 Trade Agreement

Because the probability of legislative break never reaches zero for this parameterization, the executives' welfare function is concave everywhere. Assuming that each legislature has the opportunity to vote to break the
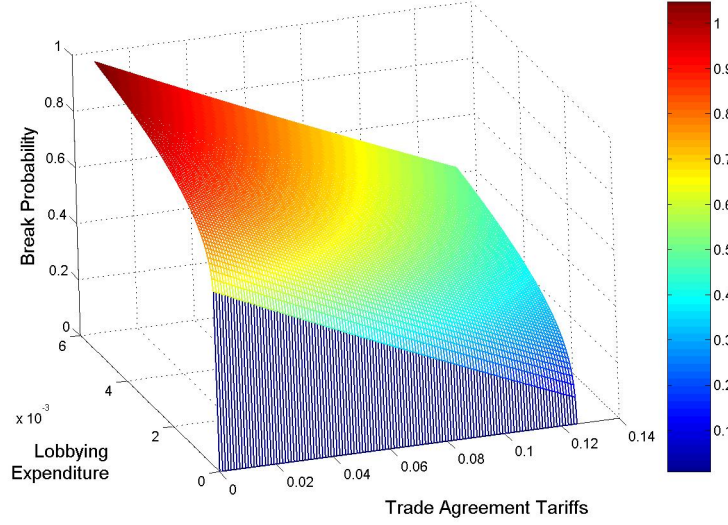
Figure 2: Probability Trade Agreement will be Broken

agreement with probability $\frac{1}{2}$ and that the executives are social-welfare maximizers (i.e. $\gamma_E = \gamma_E^* = 1$), they will set trade agreements tariffs of $\tau^a = \tau^{*a} = 0.078$, with lobbying expenditures at the trade maintence phase of 0.0007 and a total break probability of 0.505. Total lobbying expenditure is 1.54% of the expected profits of 0.98591. The expected tariff is 0.103.

We can compare this against several different benchmarks. The most stark is the trade-war outcome itself, which can also be interpreted as the outcome that would prevail in the absence of executive involvement in trade policy *and* the absence of any effort to make a trade agreement. The tariff in the executive-formed trade agreement is about 60% of the Nash tariff of 0.129, and the expected level given the probability that the agreement will be broken is 80% of the Nash level. Lobbying expenditures in the agreement-maintenance phase are about 40% of the those in the Nash game, while expected expenditures in the executive-led trade-agreement scenario are 90% of what they would be if the legislatures set tariffs unilaterally.

Although the welfare-maximizing governments here are not able to set and maintain tariffs at zero as they would like, they are able to achieve significant reductions in tariff levels through the use of the trade agreement.

Another interesting benchmark is the scenario in which no executives are involved in trade policy, but in which the politically-susceptible legislatures can make use of a trade agreement. As in Bagwell and Staiger (2005), I find when maximizing their joint welfare in a legislature-led trade agreement ($W_{ML}(\tau, \tau^*) = W_{ML}^X(\tau) + W_{ML}^Y(\tau^*)$), the cooperative tariff levels will be set at

$$\tau^L = \frac{4\gamma(e,\theta) - 4}{25 - 4\gamma(e,\theta)}, \ \tau^{*L} = \frac{4\gamma(e^*,\theta) - 4}{25 - 4\gamma(e^*,\theta)}$$

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The legislatures are able to use the agreement to internalize the terms of trade externality, making political influence more expensive for the lobbies. Indeed, I find that lobbying expenditures rise to 0.0027—60% higher than in the Nash case and 2.64% of the gross profits of 0.10204—while the agreement tariffs are set at 0.118, only slightly lower than the Nash tariffs of 0.129 and still higher than even the expected tariffs from the trade agreement scenario in which the executives choose the tariffs. Comparing net (expected profits) across the three scenarios, they are highest in the Nash game (0.1024), lowest under the trade agreement (0.9789) and intermediate when the legislatures make policy directly (0.0993).

If one interprets the addition of a second policy-making actor as consistent with a move from autocracy to democracy, this result helps to explain the extensive empirical evidence that democracies trade more with each other than autocracies (Laver and Shepsle 1991, Aidt and Gassebner 2010). In particular, Frye and Mansfield (2003) argue that the reduction in trade barriers becomes more likely as the number of veto points increases as countries move from autarky to democracy as exemplified by the transition of Communist regimes in the post-Cold-War era. Here, a more open trading stance emerged as groups with a liberal stance were integrated into the political process following the fall of the Berlin Wall.

Crucially, Henisz and Mansfield (2006) demonstrate that the impact of adding veto players depends on the status quo policy. In the case of these Communist regimes, Cold War policy was near autarkic. The additional actors had an interest in liberalization. Henisz and Mansfield's careful empirical work shows that, among democracies, systems with more veto players as in a separation-of-powers structure will be more robust to retreats from liberal policies in the face of protectionist pressures than are those with fewer veto players. Conversely, it stands to reason that protectionist separation-of-power regimes would also be less susceptible to liberalization than unitary democractic regimes, *ceteris paribus*.

5 Discussion

5.1 Separation of Powers

Consider the model of Section 3 for the case of $\theta_b = 0$—that is, no uncertainty at the break stage (as will be discussed in Section 5.3, in the case of mean-zero uncertainty, strategic behavior at the trade-war stage is not altered by uncertainty). This allows the isolation of the results that derive from the assumption that power over trade policy is shared between the executive and legislative branches. Again, we focus on the home lobby.

Now $\gamma(e_b)$ is deterministic, so the lobby knows the precise contribution it must make for any given trade agreement tariffs τ^a to induce the legislature to break the agreement (see Inequality 7). Here, the lobby's contribution *increases* in τ^a since the higher are the trade agreement tariffs, the larger is the political weight

that is required to induce the legislature to find them unsatisfactorily low. As long as trade war profits net of the required contribution are greater than trade agreement profits, the lobby will induce a trade war; otherwise, it is not in the lobby's interest to make any contribution. Facing this behavior, the executives set the lowest trade agreement tariffs that make it prohibitively expensive for the lobby to have the agreement broken.

I return to the example of Section 4 to illustrate the effects of changing the environment to one without political uncertainty. Recall that in the main example with θ distributed uniformly on $[-0.25, 0.25]$, the expected Nash tariff is 0.129 and the executive-led trade agreement tariff is 0.078, with lobbying expenditures of 0.0007 and a total break probability of 0.505. The expected tariff is then 0.103.

In this example, if the executives set the trade agreement facing no uncertainty, the tariff level is 0.106, the lobby exerts zero effort, and the agreement remain in force with probability 1. If instead the executives were to set trade-agreement tariffs of 0.105, the lobby would contribute 0.0025 and the legislature would break the agreement with probability 1. This demonstrates both the agenda-setting power of the executives and the stark discontinuities induced when political uncertainty is not an issue.

Moreover, this case highlights the manipulation of the tariff level to discourage lobbying and therefore the disconnect that can arise between the tariffs that are chosen and the preferences of the governmental actors. In the example, the executive is a social welfare maximizer and so prefers zero tariffs, while the legislators with $\gamma(e) = 1.25 + e^{.2}$ with $e_b = 0$ prefer $\tau^a = 0.05$. However, the trade agreement tariffs are set at 0.106 precisely to ensure that $e_b = 0$ so that we have a relatively free-trading legislature that upholds the agreement.

5.2 Relation to Grossman and Helpman's 'Protection for Sale'

The legislative welfare function employed in this paper permits flexibility to take account of a wide range of political processes within a non-unitary legislature; alternatively, it can be a model of a unitary policymaker when special interests face non-constant returns to lobbying activity. As noted in Section 2, the non-linear relationship between lobbying effort and tariffs follows Dixit, Grossman and Helpman (1997) and is a departure from the 'Protection for Sale' welfare function, which assumes that a unitary government maximizes the sum of contributions and some fraction, a, of social welfare.

To see the relationship between the two forms, write the PFS welfare function (replacing C with e) as

$$e + aW = e + a\left[CS_X(\tau) + PS_X(\tau) + CS_Y(\tau^*) + PS_Y(\tau^*) + TR(\tau)\right]$$

The relationship between e and the weight the legislature places on profits is endogenous; because the PFS government welfare function has such an elegant and completely specified form, it is possible to solve for equilibrium behavior to retrieve this relationship directly.

It is easy to describe the equilibrium behavior and thus how lobbying effort will be related to the weight on profits in equilibrium in the PFS model when there is one lobby who makes a take-it-or-leave-it offer. Take the case of no uncertainty and assume that the legislature chooses $\tau = 0$ in the absence of lobbying and that $\gamma(0) = 1$. For any τ that the lobby desires, it must pay according to the indifference condition $e(\tau) = a\left[W(0) - W(\tau)\right]$. That is, the lobby must pay for the a-weighted welfare loss caused by the tariff it requests.

In the model of this paper, this indifference condition, rearranged to solve for $\gamma(e)$, is

$$\gamma(e) = \frac{CS_X(0) + \pi_X(0) + CS_Y(0) + \pi_Y(0) + TR(0) - CS_X(\tau) - CS_Y(\tau^*) - \pi_Y(\tau^*) - TR(\tau)}{\pi_X(\tau)}$$

In order to match the form of the PFS framework, we must therefore have

$$\gamma(e) = 1 + \frac{e}{a\pi_X(\tau)} \tag{12}$$

Choosing the political weighting function identified in Equation 12 aligns the political objective function used in the current model with the PFS framework. Although using the γ-weighted government welfare function is a reduced-form approach in the sense that legislative dynamics are not fully modeled, a drawback of the PFS welfare function is that it embodies the restriction that returns to lobbying effort must be constant.

As noted in Dixit, Grossman and Helpman (1997), the linear form also implies transferable utility between the lobby and unitary government; this leads to equilibrium indeterminacies and an inability to speak to distributional questions, prompting them to generalize the PFS form. From their results, we have that the same equilibrium analysis holds in the more general environment.

For the trade policy literature, generalizing the linear form in a sense would obviate many of the questions that have been raised by empirical investigations of the PFS model about the relationship of the magnitude of welfare losses relative to the weight placed on social welfare by governments as the a parameter for the constant relative marginal utility provided by social welfare would no longer be present in the model.

The linear PFS form provides for an almost unmatched simplicity and elegance that is able to capture the key cross-industry predictions on import tariffs. A perhaps unintended byproduct in the subsequent literature seems to have arisen in the form of a focus on matching fine details of governments' welfare-mindedness using a model that has a very simple unitary government and is thus better suited for other purposes.

It is clear that trade policy is often shaped in a complicated process involving multiple actors (see, for instance, Destler (2005) for the U.S.). The model presented herein is a first attempt to more richly model the policy-making process and thus shed light on open questions surrounding how government preferences and

the details of political institutions impact trade policy outcomes.

5.3 The Role of Political Uncertainty

In this model, if there were no political uncertainty, there would be no lobbying in equilibrium. Thus, if nothing else, adding the realism of political uncertainty allows for positive lobbying on the equilibrium path. If we examine more closely the assumption that there is significant uncertainty surrounding the legislative lobbying process, additional insights come to light. It is most clear in the case of mean-zero uncertainty, so I will assume this throughout this section unless otherwise noted.

In the event of a trade war, the lobbies' behavior, and therefore the expected trade-war tariffs, are not altered by mean-zero uncertainty (see Equation 5).

At the earlier stage of lobbying, uncertainty alters optimizing behavior by both the lobby and the executives. In contrast to the previous section with no uncertainty, consider adding a very small amount of uncertainty to the previous example: take θ distributed uniformly on $[-0.01, 0.01]$. Here, the executives find it optimal to set the tariffs to completely disengage the lobby and ensure the agreement remains in force. However, the tariff level will be different because instead of making the decision to lobby according to the certainty condition

$$\pi(\tau^n) - e_n - \pi(\tau^a) > e_b,$$

the lobby makes this decision according to Condition 10, which can be re-written as

$$\pi(\tau^n) - e_n - \pi(\tau^a) > \left[\frac{\partial b(0, \boldsymbol{\tau^a}, \boldsymbol{\tau^n}(e_n, e_n^*))}{\partial e_b} \right]^{-1}.$$

Although the relationship between the tariff under certainty and a small amount of uncertainty will depend on the structure of the economy and the legislative process, in this case, the tariff can be reduced slightly to 0.105. As we have seen above, with significant uncertainty, the tariff in this example is reduced to 0.078. Interestingly, the optimal tariff does not decrease monotonically between these two values as uncertainty increases.

It is particularly instructive to examine the lobby's reaction function at this very low level of uncertainty as well as the intermediate level when θ is distributed uniformly on $[-0.14, 0.14]$ because it is at the latter that the executives set the highest tariff level of 0.107. For the former, when facing very little uncertainty, the range of tariff levels to which the lobby responds with an intermediate contribution that leaves open the possibility of a break is very small: only those between 0.103 and 0.104. The lobby disengages completely at $\tau^a = 0.105$ (see Figure 3).
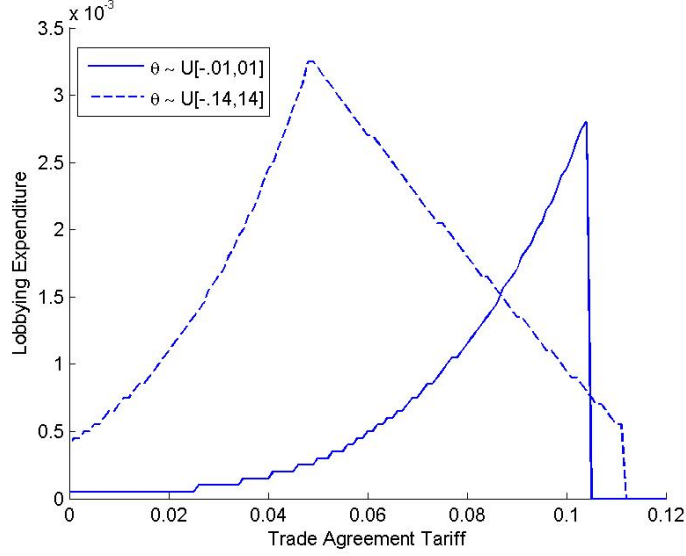
Figure 3: Lobby's Optimal Expenditure Function (Low and Intermediate Uncertainty)

In contrast, when uncertainty is increased to the interval $[-0.14, 0.14]$, the lobby begins to leave open the possibility of a break at $\tau^a = 0.048$. It disengages at 0.107 and this is the tariff level that the executives find optimal. Interestingly, at intermediate uncertainly levels, both portions of the best response curve are steeper and the lobby disengages at slightly lower tariff levels—as low as 0.099 when $\theta \sim U[-0.06, 0.06]$.

The preceding discussion illustrates Part (a) of Result 4: here the executives maximize their welfare by raising tariffs to the point where the import-competing industry ceases to lobby and thus the agreement remains in force for sure. Note, however, that although lobbying expenditures are zero, the potential for lobbying behavior is essential in shaping the trade agreement.

When uncertainty rises above this threshold of $\theta \sim U[-0.14, 0.14]$, the executives' choices are made according to Part (b) of Result 4: that is, they trade off reductions in welfare under the agreement with reductions in the probability that the agreement will be abrogated by the legislature.

As uncertainty increases further, the general pattern is that tariffs, and therefore lobbying effort, are reduced, while the break probability increases. However, this pattern is not smooth or absolute, in contrast to the welfare level achieved by the executives, which increases monotonically in the amount of uncertainty present.

Several salient points emerge from this example. First, different amounts of uncertainty lead to very different outcomes—both in terms of the tariffs that are set in the trade agreement and the probability of disruption. Second, these outcomes vary in nuanced ways with the underlying behavior of the lobbies and the executives. The provided tariff levels are strongly influenced by lobbying incentives, but not in the straightforward ways predicted by unitary models.

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6   Conclusion

I have shown that the legislature both breaks trade agreements with a higher probability and sets higher trade war tariffs when lobbying activity increases, while the probability with which it breaks agreements (or fails to ratify them) decreases in the domestic trade agreement tariff. Because the lobby decreases its effort in response to higher trade agreement tariffs, the executives face a trade-off between the welfare derived while a trade agreement is in force and the probability with which the agreement actually enters into force.

I have also shown that in a policy-making structure in which power is shared, a less politically-motivated executive can utilize an international trade agreement to reduce the political pressure on the ratifying body and therefore increase the probability that the agreement will remain in force. Thus, in a model with a richer description of government structure, a political-commitment role for trade agreements can arise.

The executives' incentive to raise tariffs in order to reduce lobbying effort provides insight into the empirical puzzle in the Protection for Sale literature that levels of protection and associated deadweight losses are too high relative to lobbying expenditure given the high estimates for governments' weighting of social welfare. I have shown that this serves to mediate the relationship between preferences for contributions relative to social welfare and the tariffs that are provided. The intuition is clear: the observed lobbying expenditure levels may in fact be low *because* tariffs have been raised sufficiently high to prevent political pressure and the increased risk of a costly trade disruption it engenders.

That lobbying and tariff levels are related in systematic ways to the amount of political uncertainty present suggests interesting avenues for future empirical work. Several directions for future theoretical work also seem potentially fruitful, including removing the assumption of perfect enforceability and supporting cooperation through repeated interaction and generalizing the model to the case of multiple lobbies.

7   Appendix

Proof of Result 1:

Substituting from Equation 1, Equation 8 can be re-written as

$$b(e_b, \boldsymbol{\tau^a}, \boldsymbol{\tau^n}) = \Pr[CS_X(\tau^n) + \gamma(e_b, \theta_b) \cdot PS_X(\tau^n) + CS_Y(\tau^{*n}) + PS_Y(\tau^{*n}) + TR(\tau^n) >$$
$$CS_X(\tau^a) + \gamma(e_b, \theta_b) \cdot PS_X(\tau^a) + CS_Y(\tau^{*a}) + PS_Y(\tau^{*a}) + TR(\tau^a)] \quad (13)$$

Rearranging, we have $b(e_b, \boldsymbol{\tau^a}, \boldsymbol{\tau^n}) =$

$$\Pr\left[\frac{CS_X(\tau^n) + PS_X(\tau^n) + CS_Y(\tau^{*n}) + PS_Y(\tau^{*n}) + TR(\tau^n) - CS_X(\tau^a) - PS_X(\tau^a) - CS_Y(\tau^{*a}) - PS_Y(\tau^{*a}) - TR(\tau^a)}{PS_X(\tau^a) - PS_X(\tau^n)} + 1 \right.$$

$$\left. < \gamma(e_b, \theta_b) \right] \quad (14)$$

The left side of the inequality in Expression 14 does not depend on e_b. Call it Z. Thus we have $b(e_b, \boldsymbol{\tau^a}, \boldsymbol{\tau^n}) = \Pr[Z < \gamma(e_b, \theta_b)] = 1 - F_\gamma(\gamma = Z)$ where $F_\gamma(\gamma = Z) = F_\theta(\theta = h^{-1}(\gamma, e))$ by the Change of Variables Theorem and Assumption 2 with $\gamma = h(e, \theta)$ giving the change of variable.

Then $\frac{\partial b}{\partial e} = -\frac{\partial F_\theta(\theta = h^{-1}(\gamma, e))}{\partial \theta} \frac{\partial h^{-1}(\gamma, e)}{\partial e} = -f_\theta(\theta) \frac{\partial h^{-1}(\gamma, e)}{\partial e}$ and $\frac{\partial^2 b}{\partial e^2} = -f_\theta(\theta) \frac{\partial^2 h^{-1}(\gamma, e)}{\partial e^2}$. Because $\gamma = h(e, \theta)$ is increasing and concave in e $\forall \theta$ by Assumption 1, its inverse is decreasing and convex $\left(\frac{\partial h^{-1}(\gamma, e)}{\partial e} \leq 0; \frac{\partial^2 h^{-1}(\gamma, e)}{\partial e^2} \geq 0 \right)$ The pdf of θ is non-negative, so $\frac{\partial b}{\partial e} \geq 0$ and $\frac{\partial^2 b}{\partial e^2} \leq 0$. ∎

Proof of Lemma 1:

It must be shown that the left hand side of the inequality in Expression 14 is decreasing in τ^{*a}. The derivative of this quantity with respect to τ^{*a} is

$$\frac{-(PS_X(\tau^a) - PS_X(\tau^n))\left(\frac{\partial CS_Y(\tau^{*a})}{\partial \tau^{*a}} + \frac{\partial PS_Y(\tau^{*a})}{\partial \tau^{*a}} \right)}{(PS_X(\tau^a) - PS_X(\tau^n))^2} = \frac{\frac{\partial CS_Y(\tau^{*a})}{\partial \tau^{*a}} + \frac{\partial PS_Y(\tau^{*a})}{\partial \tau^{*a}}}{PS_X(\tau^n) - PS_X(\tau^a)}. \quad (15)$$

The price of good Y is decreasing in τ^{*a}, so consumer surplus is increasing and producer surplus is decreasing in τ^{*a}. Because Y is being exported, the decrease in producer surplus is larger than the increase in consumer surplus, making the numerator negative. Since producer surplus in the denominator is increasing in τ, the expression in Equation 15 is negative for all τ^{*a}. ∎

Proof of Lemma 2:

Using the logic of the proof of Lemma 1, the effect on the break probability is determined by the sign of the derivative of the left hand side of the inequality in Expression 14 with respect to τ^a; to show that the break probability is decreasing in τ^a, I must demonstrate that this derivative is positive. Labeling the numerator of that expression $[W(\boldsymbol{\tau^n}) - W(\boldsymbol{\tau^a})]$ (for the change in social welfare), this derivative can be written

$$\frac{(PS_X(\tau^n) - PS_X(\tau^a))\left(\frac{\partial CS_X(\tau^a)}{\partial \tau^a} + \frac{\partial PS_X(\tau^a)}{\partial \tau^a} + \frac{\partial TR(\tau^a)}{\partial \tau^a} \right) - [W(\boldsymbol{\tau^n}) - W(\boldsymbol{\tau^a})]\frac{\partial PS_X(\tau^a)}{\partial \tau^a}}{(PS_X(\tau^a) - PS_X(\tau^n))^2}. \quad (16)$$

$(PS_X(\tau^n) - PS_X(\tau^a))$ is always positive by Assumption 3. Because the optimal unilateral tariff for large

welfare-maximizing governments is positive (call it τ^O), $\left(\frac{\partial CS_X(\tau^a)}{\partial \tau^a} + \frac{\partial PS_X(\tau^a)}{\partial \tau^a} + \frac{\partial TR(\tau^a)}{\partial \tau^a}\right)$ is increasing up to τ^O and decreasing above it. Thus the first summand is increasing up until τ^O and decreasing thereafter.

Because total social welfare is maximized at $\tau^a = \tau^{*a} = 0$, $W(\boldsymbol{\tau^n}) - W(\boldsymbol{\tau^a})$ is always negative, whereas producer surplus is increasing in τ^a, so the second summand is positive everywhere. With a positive denominator, we thus have that the derivative is positive on $[0, \tau^O]$.

It is also positive over the remaining (τ^O, τ^n). To see this, add $\left(\tilde{\Gamma} - 1\right) \frac{\partial PS_X(\tau^a)}{\partial \tau^a}\left(PS_X(\tau^n) - PS_X(\tau^a)\right)$ to the first summand and subtract it from the second. For any particular value of $\tilde{\tau}^a$, one can choose the $\tilde{\Gamma}$ weight that would make $\tilde{\tau}^a$ the preferred unilateral tariff; this makes the derivative in the first summand zero. Having subtracted the same quantity from the second summand modifies the welfare difference in the second summand to be maximized at $\tilde{\tau}^a$ so that this term is always negative, thus ensuring the result. ■

Proof of Lemma 3:

Again, I want to show how the inequality in Expression 14 changes, now with respect to both τ^a and τ^{*a}, so I add the derivatives in Expressions 15 and 16 to get

$$\frac{\left(PS_X(\tau^n) - PS_X(\tau^a)\right)\left(\frac{\partial W_X(\boldsymbol{\tau^a})}{\partial \tau^a} + \frac{\partial W_X(\boldsymbol{\tau^a})}{\partial \tau^{*a}}\right) - \left[W(\boldsymbol{\tau^n}) - W(\boldsymbol{\tau^a})\right]\frac{\partial PS_X(\tau^a)}{\partial \tau^a}}{\left(PS_X(\tau^n) - PS_X(\tau^a)\right)^2}.$$

where $\frac{\partial W_X(\boldsymbol{\tau^a})}{\partial \tau^a} + \frac{\partial W_X(\boldsymbol{\tau^a})}{\partial \tau^{*a}} = \frac{\partial CS_X(\tau^a)}{\partial \tau^a} + \frac{\partial PS_X(\tau^a)}{\partial \tau^a} + \frac{\partial TR(\tau^a)}{\partial \tau^a} + \frac{\partial CS_Y(\tau^{*a})}{\partial \tau^{*a}} + \frac{\partial PS_Y(\tau^{*a})}{\partial \tau^{*a}}$ is the total derivative of social welfare. Since social welfare is maximized at $\boldsymbol{\tau^a} = (0,0)$,[24] this is negative $\forall \boldsymbol{\tau} \in (\boldsymbol{0}, \boldsymbol{\tau^n}]$; note that it is 0 at $\boldsymbol{0}$ and vanishingly small for very small tariffs.

Thus the first summand in the numerator is zero at $\boldsymbol{\tau^a} = \boldsymbol{0}$ and increasingly negative as $\boldsymbol{\tau^a}$ increases. The second summand is positive everywhere because social welfare, W, is lowest at $\boldsymbol{\tau^n}$ and producer surplus is increasing everywhere. Thus the numerator is positive at $\boldsymbol{0}$ and at least for very small $\boldsymbol{\tau^a}$

It is also positive for all other values of $\boldsymbol{\tau^a}$ strictly below $\boldsymbol{\tau^n}$. Just as in the proof of Lemma 2, one can add $\left(\tilde{\Gamma} - 1\right)\frac{\partial PS_X(\tau^a)}{\partial \tau^a}\left(PS_X(\tau^n) - PS_X(\tau^a)\right)$ to the first summand and subtract it from the second. For any particular value of $\tilde{\boldsymbol{\tau}}^a$, one can choose the $\tilde{\Gamma}$ weight that would make $\tilde{\boldsymbol{\tau}}^a$ the politically optimal tariff; this makes the derivative in the first summand zero. Having subtracted the same quantity from the second summand modifies the welfare difference in the second summand to be maximized at $\tilde{\boldsymbol{\tau}}^a$ so that this term is always negative, thus ensuring the result.

Because the denominator is positive, the entire expression is positive for all $\boldsymbol{\tau^a} < \boldsymbol{\tau^n}$. ■

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[24]Note, this is identical to the result that joint social welfare is maximized at zero tariffs because of symmetry.

Proof of Result 2:

Proof is via the Implicit Function Theorem using the lobby's first order condition, Equation 9, referred to here as FOC_L.

$$\frac{\partial e_b}{\partial \tau^a} + \frac{\partial e_b}{\partial \tau^{*a}} = -\left[\frac{\frac{\partial FOC_L}{\partial \tau^a} + \frac{\partial FOC_L}{\partial \tau^{*a}}}{\frac{\partial FOC_L}{\partial e_b} + \frac{\partial FOC_L}{\partial e_b}}\right] = \frac{\frac{\partial b}{\partial e_b}\frac{\partial \pi(\tau^a)}{\partial \tau^a} + \frac{\partial b}{\partial e_b}\frac{\partial \pi(\tau^a)}{\partial \tau^{*a}} - \left\{\frac{\partial^2 b}{\partial e_b \partial \tau^a} + \frac{\partial^2 b}{\partial e_b \partial \tau^{*a}}\right\}[\pi(\tau^n) - e_n - \pi(\tau^a)]}{\frac{\partial^2 b}{\partial e_b^2}[\pi(\tau^n) - e_n - \pi(\tau^a)]}$$

Beginning with the denominator: because $\pi(\tau)$ is increasing everywhere, $[\pi(\tau^n) - e_n - \pi(\tau^a)]$ is positive for all but very large values of τ^a, that is for all τ^a such that $\pi(\tau^n) - e_n > \pi(\tau^a)$. When τ^a rises above this level, it is no longer in the lobby's interest to ask to have the agreement broken so $e_b = 0$ and $\frac{\partial e_b}{\partial \tau^a} = 0$. $\frac{\partial^2 b}{\partial e_b^2}$ negative by Result 1, so the denominator is negative for all values of τ^a at which e_b is not constant.

$\frac{\partial b}{\partial e_b}$ is positive, $\frac{\partial \pi(\tau^a)}{\partial \tau^a}$ is positive by construction, and $\frac{\partial \pi(\tau^a)}{\partial \tau^{*a}}$ is zero: separability between the sectors implies that profits in the import-competing sector do not depend on τ^{*a}.

We can rewrite $\frac{\partial b(e,\tau^a)}{\partial \tau^a} + \frac{\partial b(e,\tau^a)}{\partial \tau^{*a}} = -\frac{\partial F_\gamma(Z(\tau^a))}{\partial \tau^a} - \frac{\partial F_\gamma(Z(\tau^a))}{\partial \tau^{*a}} = -\frac{\partial F_\gamma(Z(\tau^a))}{\partial Z(\tau^a)}\left[\frac{\partial Z(\tau^a)}{\partial \tau^a} + \frac{\partial Z(\tau^a)}{\partial \tau^{*a}}\right] = -f_\gamma\left[\frac{\partial Z(\tau^a)}{\partial \tau^a} + \frac{\partial Z(\tau^a)}{\partial \tau^{*a}}\right]$, where $F_\gamma(Z(\tau^a))$ is the CDF of γ and $f_\gamma(Z(\tau^a))$ is the pdf of γ and $Z(\tau^a)$ represents the left hand side of the inequality in Expression 14.

Then $\frac{\partial^2 b}{\partial e_b \partial \tau^a} + \frac{\partial^2 b}{\partial e_b \partial \tau^{*a}} = -\frac{\partial}{\partial e}\left(\frac{\partial F_\gamma(Z(\tau^a))}{\partial \tau^a} + \frac{\partial F_\gamma(Z(\tau^a))}{\partial \tau^{*a}}\right) = -f_\gamma\left[\frac{\partial^2 Z(\tau^a)}{\partial \tau^a \partial e} + \frac{\partial^2 Z(\tau^a)}{\partial \tau^{*a}\partial e}\right] - \left[\frac{\partial Z(\tau^a)}{\partial \tau^a} + \frac{\partial Z(\tau^a)}{\partial \tau^{*a}}\right]\frac{\partial f_\gamma}{\partial e} = -\left[\frac{\partial Z(\tau^a)}{\partial \tau^a} + \frac{\partial Z(\tau^a)}{\partial \tau^{*a}}\right]\frac{\partial f_\gamma}{\partial e}$ where the above equality holds because $Z(\tau^a)$ does not depend on e. Lemma 3 shows that $\frac{\partial Z(\tau^a)}{\partial \tau^a} + \frac{\partial Z(\tau^a)}{\partial \tau^{*a}} \geq 0$, so $\frac{\partial f_\gamma}{\partial e} \geq 0$ ensures that $\left\{\frac{\partial^2 b}{\partial e_b \partial \tau^a} + \frac{\partial^2 b}{\partial e_b \partial \tau^{*a}}\right\} \leq 0$. Thus $\frac{\partial e_b}{\partial \tau^a} + \frac{\partial e_b}{\partial \tau^{*a}} \leq 0$. ∎

Proof of Result 3:

$\frac{\partial B(\tau^a)}{\partial \tau^a} + \frac{\partial B(\tau^a)}{\partial \tau^{*a}} = \frac{\partial b}{\partial e_b}\frac{\partial e_b}{\partial \tau^a} + \frac{\partial b}{\partial e_b}\frac{\partial e_b}{\partial \tau^{*a}} + \frac{\partial b}{\partial \tau^a} + \frac{\partial b}{\partial \tau^{*a}} = \frac{\partial b}{\partial e_b}\left\{\frac{\partial e_b}{\partial \tau^a} + \frac{\partial e_b}{\partial \tau^{*a}}\right\} + \frac{\partial b}{\partial \tau^a} + \frac{\partial b}{\partial \tau^{*a}}$. $\frac{\partial b}{\partial e_b}$ is positive by Result 1. $\left\{\frac{\partial e_b}{\partial \tau^a} + \frac{\partial e_b}{\partial \tau^{*a}}\right\}$ is negative by Result 2. Taken together, the final two summands are negative by Lemma 3. Thus the entire expression is negative. ∎

Conditions for Interior Solution to Executives' Problem

The first order condition for maximizing joint surplus with respect to τ^a and τ^{*a} when the two are constrained to be equal is

$$\{1 - o \cdot B(\tau^a) - o^* \cdot B^*(\tau^a)\}\left\{\frac{\partial W_E(\tau^a)}{\partial \tau^a} + \frac{\partial W_E(\tau^a)}{\partial \tau^{*a}}\right\}$$
$$+ \left\{o \cdot \left[\frac{\partial B(\tau^a)}{\partial \tau^a} + \frac{\partial B(\tau^a)}{\partial \tau^{*a}}\right] + o^* \cdot \left[\frac{\partial B^*(\tau^a)}{\partial \tau^a} + \frac{\partial B^*(\tau^a)}{\partial \tau^{*a}}\right]\right\}[W_E(\tau^n) - W_E(\tau^a)] = 0$$

Because there is no benefit to setting τ^a below the executives' preferred level, which I will denote τ^E, I will

take the choice space to be $[\boldsymbol{\tau^E}, \boldsymbol{\tau^n}]$. Note that for $\gamma_E = 1$, $\boldsymbol{\tau^E} = 0$.

To demonstrate that the executives do not choose $\boldsymbol{\tau^a} = \boldsymbol{\tau^E}$, I must show that the left side of the above equation is positive at $\boldsymbol{\tau^a} = \boldsymbol{\tau^E}$. Assumption 3 and Result 3 combined with symmetry ensure that the first term of the second summand is negative. That executive welfare is maximized at $\boldsymbol{\tau^E}$ ensures that the term multiplying it is also negative as well as that $\frac{\partial W_E(\boldsymbol{\tau^E})}{\partial \tau^a} + \frac{\partial W_E(\boldsymbol{\tau^E})}{\partial \tau^{*a}}$ is zero. Therefore the derivative of joint executive welfare is positive at $\boldsymbol{\tau^E}$. ∎

8   References

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