OPTIMAL TARIFFS AND FDI IN THE PRESENCE OF POLITICAL PRESSURE

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Abstract

In this paper, I modify an industry-specific partial equilibrium model featuring Bertrand competition and tariff-jumping FDI. The model examines how tariff jumping impacts the ability of the government to use temporary tariff protection to protect a sector struggling from import competition, both for sectors with political influence and without. I show that even if the temporary tariff increase leads to tariff-jumping FDI, there are still parameter values for which the government benefits from increasing the tariff temporarily. I also demonstrate that the presence of political economy pressure typically results in a higher temporary tariff rate (unless the tariff hits the upper limit for the remedy of a 50 percent increase). Finally, I show how exploiting observed tariff changes in the data could allow a researcher to calibrate the political economy weight for use in other analysis.

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1 Introduction

Governments can use trade policy to increase competitiveness of domestic producers by temporarily lessening the flow of imports in response to a shock to an industry. A common result of increased tariffs, which may seem contradictory to the goals of an increased tariff rate, is tariff-jumping inbound foreign direct investment (FDI) by exporters trying to access the market: with high tariff barriers in place, it may be more profitable for larger foreign firms to serve the market through local affiliate production. In this paper, I examine if an increase in the tariff rate can both facilitate the adjustment of domestic production and also encourage inbound FDI in the sector receiving increased tariff protection. I do this analysis both with and without the presence of political economy motives factoring into the government's tariff-setting decision.

Then, I demonstrate that a researcher working to understand the impact of tariffs on trade in this scenario (with the shock to foreign producer's marginal cost of production leading to an increased tariff and the potential for inbound FDI) can use the methods developed in this paper to calibrate an estimate of how much additional weight a government places on the welfare of domestic producers when making tariff decisions. This is a key contribution of the model due to the fact that this aspect of the government's decision-making problem is not directly observable and generally is estimated using observable aspects of political pressure like lobbying contributions or political organization within a sector.

In the first section of the paper, I develop an industry-specific model of trade policy and solve for the optimal tariff rate in three different scenarios: (i) when the government's objective is to maximize social welfare, (ii) when the government's objective is to maximize social welfare plus an additional weight on the welfare of domestic firms adversely affected by the shock to the industry, and (iii) when the government's objective is to maximize social welfare plus an additional weight on all domestic production in the industry, including domestic firms and firms established previously through FDI. The model is at the firm level, assumes imperfect competition, and uses the method developed in Riker and Schreiber (2019a) to calibrate the fixed costs of FDI and to determine if it is profitable for a foreign exporting firm to switch modes of supply to local affiliate FDI. The model also builds from Mueller and Schreiber (2021) to calculate the optimal tariffs and to calibrate marginal costs before and after the shock.

In this model I use an additively separable government objective function following Grossman and Helpman (1994). This form is a strong assumption about what the government values and may or may not accurately reflect the value that real-world governments place on each part of social welfare. The model is a four period, finite model, in which an increased tariff on imports is in place for one period and then removed. As a result, this model is *not* intended to be prescriptive regarding how a government *should* use tariff protection. The model instead explores the interaction between tariffs and inbound FDI and considers how the substitutability of varieties, relative wage between the home country and the exporting country, and other factors might be contributing to this outcome.

Because this model builds from the work by Riker and Schreiber (2019a) and Mueller and Schreiber (2021), the model maintains the beneficial feature of having limited data requirements, allowing the calibration of many unobserved parameters. Calibrated parameters include the fixed costs of FDI mode-switching, the pre-shock production costs of foreign firms, the post-shock production costs of firms in the industry, and the political economy weight the government places on the domestic producers.

Simulations of the theoretical model demonstrate how the model functions through variation in two key parameters: how substitutable varieties of goods in the shock-receiving industry are and the relative wage of the home country compared to the exporting country. Simulation results indicate that an optimal tariff policy frequently results in tariff jumping through inbound FDI from large exporting firms for the set of parameters I examine. Results show that when there is no political economy weight on the domestic industry, the optimal tariff level always leads to tariff jumping inbound FDI by large exporting firms.

I also consider the welfare implications of the temporary increase in tariff protection, both from the perspective of the domestic producers and the government. The model demonstrates that even with inbound FDI resulting from the temporary increase in the tariff level, the domestic producer can still benefit from the increase in protection. The government's benefit from the providing a temporary increase in tariff protection is then tied to the welfare of producers, including any inbound FDI that occurs from the tariff jumping, resulting in the range of parameters for which the government benefits from the policy being larger than the range of parameters for which the domestic firm benefits.

The rest of the paper proceeds as follows: first, Section 2 describes the theory behind the model. Section 3 runs illustrative simulations to show how the model works, providing examples for each of the three simulations outlined above, for a hypothetical industry. Section 4 concludes.

2 Model

The model below is built to find an "optimal" tariff level to maximize government welfare while domestic producers adjust their production following increased import competition. This paper builds from the optimal tariff model in Mueller and Schreiber (2021) with three key modifications: (i) this model adds a maximum tariff rate, reflecting a tariff line in which the initial tariff rate is below the binding agreed to in a trade agreement, allowing the government to adjust the tariff rate in response to the shock; (ii) in this paper, the shock occurs to the foreign supply to the domestic market (instead of affecting domestic producers directly); and (iii) the shock is no longer "undone" by an exogenous adjustment (as was the case in Mueller and Schreiber (2021), where there was a shock to marginal cost of domestic producers that was reversed after the high-tariff period), but instead the shock to foreign producers remains in place and domestic producers make adjustments in order to lower their prices and recover market share.

In Section 2.1, I describe the basic model setup for firms and consumers, including how tariff-jumping FDI is incorporated into the model. This section is relatively unchanged from Mueller and Schreiber (2021), building on the model used by Riker and Schreiber (2019b). Section 2.2 then defines the government's welfare function, also following Mueller and Schreiber (2021) closely. Section 2.3 outlines the timing of the model. I then describe the initial tariff level and how it relates to the post-shock economy, identifying data that allow me to calibrate both the pre-shock production costs of exporting firms and the political economy weight the government places on domestic producers' welfare in Section 2.4. Finally, I describe the government's choice of optimal tariff level given the dynamics of the model in Section 2.5.

As will be evident from the sections below, for this model to be applied to an industry, it must be true that there is (1) domestic production, (2) existing FDI in the domestic market, (3) at least one firm exporting into the home market, and (4) the total number of firms must be small enough to fit the assumption of Bertrand competition.

2.1 Basic Model

In this model, there are a small number of firms, N, that produce unique varieties of a differentiated good and sell to a single market. The home country imposes a most-favored-nation (MFN) tariff, τ, on all imports of the differentiated good from its trading partners.

Total utility from consumption of two goods, good 0 and good 1, is Cobb-Douglas with the price of good 0 normalized to one.

$$U = (q_0)^{\alpha}(q_1)^{1-\alpha}, \text{ with} \tag{1}$$

$$q_1 = \left(\sum_{n \in N} b_n^{\frac{1}{\sigma}} (q_{1n})^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}. \tag{2}$$

Consumers spend a constant share of income, α, on good 0 and share $1-\alpha$ on the composite of good 1 varieties. Demand for varieties of the differentiated good is constant-elasticity of substitution (CES) with elasticity of substitution $\sigma > 1$ and with taste parameter b_n. I normalize b_1 to one without loss of generality. In the model, the shock occurs to firms exporting varieties of good 1 to the home country, lowering their marginal cost of production. After the shock occurs, the government can choose to temporarily increase the tariff level to relieve domestic producers from the increase in competition while domestic producers make adjustments.

There are four types of firms producing good 1: type-1 firms are local affiliates of foreign firms that were established through inbound FDI, type-2 firms are large producers abroad exporting to the home market that will consider jumping any increase in the tariff level, type-3 firms are domestic producers, and type-4 firms are small exporters abroad. The foreign producers (type-2 and type-4 firms) receive a favorable shock to their marginal cost of production. Type-3 firms are those which work to adjust their own production costs to recover following the shock. For simplicity, I assume there are $N = 3 + N_4$ firms: one type-1 firm, one type-2 firm, and one type-3 firm, with $N_4 \geq 1$ type-4 firms which supply exports to the home country if the type-2 firm decides to tariff jump. The total number of firms over the time span of the model is fixed. Generalizing the model to a different N (such as allowing for multiples of each type of firm) is straightforward.

Corresponding to the utility functions, price indexes in the home country are

$$P = (P_0)^{\alpha} (P_1)^{1-\alpha}, \text{ and} \tag{3}$$

$$P_1 = \left(\sum_{n \in N} b_n \left((1+\tau_n) p_{1n} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{4}$$

where p_{1n} is the producer price of variety n of good 1, with τ_n equal to the tariff rate faced by firm n. For a firm that initially exports to the foreign market, $\tau_n = \tau^0$, with τ^0 equal to the initial tariff rate. For a domestic producer or for a firm that initially supplies the market through local affiliate FDI, τ_n is zero.

Given total expenditure on the combination of good 0 and good 1 is $v > 0$, demand for good 1 is a constant share of total expenditure:

$$d_1(P_1) = (1-\alpha) \frac{v}{P_1}. \tag{5}$$

The demand for variety n of good 1 is then calculated by maximizing the consumption index subject to the consumer's budget constraint:

$$d_{1n}(P_1, p_{1n}) = k \, b_n \left((1+\tau_n) \, p_{1n} \right)^{-\sigma} (P_1)^{\sigma-1}. \tag{6}$$

where $k \equiv (1-\alpha) \, v$ is a demand parameter representing market size.

As for production, the numeraire good, good 0, is produced using only labor, $q_0 = l_0$, which pins down the wage in the home country at one. Good 1 is also produced using only labor, with constant unit-labor-input requirement, c_n, such that $q_{1n} = (1/c_n) \, L_{1n}$. Given that the wage is pinned down at one, this means that c_n is also the constant marginal cost of production of variety n.

The variable portion of firm n's operating profits is $\pi_{1n} = (p_{1n} - c_n) \, q_{1n}$, which can be rewritten plugging in the definition of demand from equation (6) and the definition of the price index from equation (4), giving

$$\pi_{1n} = (p_{1n} - c_n)\, k\, ((1+\tau_n)\, p_{1n})^{-\sigma}\, b_n \left(\sum_{m \in N} b_m\, ((1+\tau_m)\, p_{1m})^{1-\sigma} \right)^{-1}. \tag{7}$$

Because firm n maximizes profits taking the other $n-1$ prices as given, the profit-maximizing producer price is

$$p_{1n} = c_n \frac{\sigma - (\sigma-1)\left[\frac{v_n}{v_1+v_2+v_3+N_4\, v_4}\right]}{\sigma - (\sigma-1)\left[\frac{v_n}{v_1+v_2+v_3+N_4\, v_4}\right] - 1}, \tag{8}$$

with v_n equal to the expenditure on variety n of the differentiated good.

In addition to the standard Bertrand pricing decision, exporting firms (firm 2 and the type-4 firms) must also choose a mode of supply: they can either continue to export, or choose to change production locations to the home country.

The interest in modeling inbound FDI in part stems from the challenge of constructing a model that predicts new FDI as a result of a temporary increase in tariff levels. Modeling market entry through FDI typically requires knowing fixed costs in addition to introducing a discontinuity in firms' decision making. Because I do not observe fixed costs, I use the methodology presented in Riker and Schreiber (2019b) to calculate bounds on fixed costs based on the observed initial equilibrium, in which there is at least one firm that exports to the domestic and one firm that has already chosen to establish a local affiliate through FDI. To calculate bounds on fixed costs, they first define variable profits a firm would earn if it had deviated from its status quo strategy, holding the other firm strategies as fixed:

$$\pi^*_{1n}(\tau^*_n) = \frac{\left(p^*_{1n} - \frac{c_n}{\omega}\right)\, k\, \left(p^*_{1n}\,(1+\tau^*_n)\right)^{-\sigma} b_n}{b_n \left(p^*_{1n}\,(1+\tau^*_n)\right)^{1-\sigma} + \sum_{i \neq n} b_i \left(p_{1i}\,(1+\tau_i)\right)^{1-\sigma}}, \tag{9}$$

where ω is a relative wage parameter that allows the model user to increase or decrease marginal costs after switching production locations.[1] An asterisk (*) label indicates that the variable is a deviation from the initial status quo strategy. If firm n was initially an exporting firm and switched to local affiliate production, then π_n^* represents deviation profits from local affiliate FDI, τ_n^* is zero, and $i \neq n$ are initial equilibrium values because firm n holds the other firm's strategies as fixed.

To calculate bounds on fixed costs of switching to FDI, Riker and Schreiber (2019b) first solve for optimal prices and calculate optimal profits for the firm originally exporting (firm 2) and for the firm serving through local affiliate FDI (firm 1). Equation (10) then provides an upper bound and a lower bound for the fixed costs in an industry:

$$\pi^*_{12}(\tau^*_2 = 0) - \pi_{12}(\tau_2 = \tau^0) < f < \pi_{11}(\tau_1 = 0) - \pi^*_{11}(\tau^*_1 = \tau^0), \tag{10}$$

where the tariff level faced by firm n is denoted by τ_n and the deviation tariff value for firm n is τ_n^*. This provides a bound on the fixed costs of switching modes of supply to local affiliate FDI. Setting up equation (10) provides a way to calibrate fixed costs in applications of the model and determine whether or not firm 2 will tariff jump due to the temporarily increased tariff, τ_n^*.[2] In the model simulations, I assume the actual fixed cost of a firm choosing FDI is the average of the upper and lower bound established by equation (10).[3] With this average value of the fixed cost, I am then able to solve the government's dynamic optimization problem taking into account that the optimal tariff level will potentially induce exporting firms to tariff jump.

[1] For the purposes of interpreting ω, when $\omega > 1$ the home (tariff-imposing) country's wage is higher than the exporting country's wage.

[2] Given the four firm-type setup of the model presented here, this means that the incentive constraint in equation (10) also applies to type-4 firms. Since I assume firm 2 is the larger exporter, however, firm 2's incentive constraint will generate the binding constraint on the bounds of the fixed cost.

[3] This is similar to assuming the fixed cost of a firm choosing FDI is drawn from a uniform distribution between the upper and lower bound established by equation (10).

2.2 Government Optimization Problem

Following the setup of Mueller and Schreiber (2021), the government sets the optimal tariff level to maximize the sum of social welfare and politically weighted profits of the domestic producers. Government welfare is defined as:

$$G = a\,[CS + \Pi_0 + \tau\,M_1 + w\,L] + \psi\,\Pi_{11} + \Pi_{13}, \tag{11}$$

where $CS \equiv U - q_0 - P_1 q_1$ is consumer surplus given good 0 is the numeraire good; $\Pi_0 = q_0 - w\,L_0$ is the profits from good 0; $\Pi_{1n} = \pi_{1n} - f_n = p_{1n}\,q_{1n} - w\,L_{1n} - f_n$ is profits of variety n of good 1 (with π_{1n} representing firm n's operating profits) and f_n is the fixed cost firm n must pay to participate in their preferred mode of supply (i.e. $f_n = f$ for a firm choosing to tariff jump, otherwise $f_n = 0$); $M_1 = p_{12}\,q_{12} + N_4\,p_{14}\,q_{14}$ is revenue from imports of good 1, which are subject to ad valorem tariff $\tau > 0$ for all varieties; and $w\,L$ is labor income; and where firm $n \in \{2, 4\}$ will enter the government's objective function only if it chooses to tariff jump.

The final two parameters of interest in equation (11) are the two political economy weights: a and ψ. The traditional political economy weight, $a \in [0, 1]$, is defined in the manner of Grossman and Helpman (1994) such that $a < 1$ implies the government places additional weight on the domestic producers' (firm 1 and firm 3's) welfare. The second political economy parameter, $\psi \in [a, 1]$, is an additional level of flexibility in the model which allows the government to value the domestic firm's (firm 3's) welfare differently from the firm established through FDI (firm 1). When $\psi = a$, the government places no political economy weight on profits of firm 1. When $\psi \in (a, 1)$, the government places a political economy weight on profits of firm 1 that is less than the weight it places on firm 3. When $\psi = 1$, the government places the same political economy weight on firm 1's profits as it does the domestic firm. In the model simulations, I assume $\psi \in (a, 1)$. This functional form of government welfare is drawn from the Grossman and Helpman (1994) model.

The government objective function can be simplified by plugging in the definitions of consumer surplus, demand, and imports; given that there are four firm types in the sector; and given that the government's choice of tariff will influence whether or not firms exporting to the market decide to tariff jump. The resulting government welfare equation is

$$\begin{aligned} G = a\Bigg[& \left((q_0)^{\alpha}(q_1)^{1-\alpha} - v\right) + \mathbb{I}_{\text{Jump},2}\Big(\left(p_{12} - \omega\, c_2\right)\, q_{12} - f\Big) \\ & + \mathbb{I}_{\text{Jump},4}\; N_4 \Big(\left(p_{14} - \omega\, c_4\right)\, q_{14} - f\Big) + \left(1 - \mathbb{I}_{\text{Jump},2}\right) \tau\, p_{12}\, q_{12} \\ & + \left(1 - \mathbb{I}_{\text{Jump},4}\right) N_4\, \tau\, p_{14}\, q_{14}\Bigg] + \psi\left(p_{11} - c_1\right) q_{11} + \left(p_{13} - c_3\right) q_{13}, \end{aligned} \tag{11'}$$

where any profits from good 0 are ignored in this equation due to their independence from the tariff on good 1. The indicator, $\mathbb{I}_{\text{Jump},n}$, is equal to one if firm n decides to tariff jump.

2.3 Timing of the Model

As detailed in the introduction, this model looks at a temporary adjustment to applied tariff rates following a shock in an industry that makes domestic producers less competitive in the market. To simplify the timing of the model as much as possible, I consider a tariff increase that is in place for one period and then removed.

The timing of the tariff changes and the adjustments by firms are as follow:

- **Period -1: Pre-shock stage.** Domestic market is in equilibrium, tariff τ^0 optimizes government welfare;

- **Period 0: Initial state.** Domestic producer, firm 3, loses market share from a shock lowering exporters' (firm 2 and type-4 firms) production costs while τ^0 remains in place. The government chooses a temporary tariff, $\tau^{'}$, that will enter into force the following period to protect producers from the surge in competition and to maximize the government's expected welfare for the remaining two periods, period 1 and period 2;

- **Period 1: High-tariff period.** Increased tariff is put in force on imported varieties of good 1, exporting firms choose whether or not to tariff jump to avoid the new higher tariff level;

- **Period 2: Post-recovery period.** Firm 3 exogenously reduces its marginal cost of production to recover some fraction of its lost market share, tariff returns to τ^0.

A key point to note is that the government's dynamic optimization problem maximizes welfare given the potential for the increased tariff level causing an influx of FDI from foreign firms. Additional richness to the model could be introduced by allowing the government to choose how long to increase the tariff following the shock or by modeling the cost adjustment process for the domestic producer.

2.4 Calibrating Unobserved Parameters Using the Initial State of Domestic Market

This section outlines how I use the observed initial state of the domestic industry to infer how the shock to the market for good 1 impacted its marginal cost of production. I also describe how the initial state of the economy can be used to estimate the political economy weight the government places on the welfare of the domestic firm.

The model assumes a few things about the initial state in the home economy: first, initial production is at equilibrium levels. Second, the initial tariff, τ_0, is a commitment from before a shock occurred. The shock is an exogenous decrease in the foreign exporters' (firm 2 and type-4 firms) marginal cost of production resulted in a loss of market share for the domestic producers (firm 1 and firm 3).

The initial tariff level is the result of a static optimization problem that is unobserved within the model. By the point I reach period 0, the negative shock has already occurred to foreign production costs. As a result, the government's welfare, G, is not maximized: the initial tariff level, τ^0, falls below the level that would maximize period 0 welfare. In other terms, the period 0 first-order condition of government welfare is

$$\begin{aligned}\left.\frac{dG^0}{d\tau}\right|_{\tau=\tau^0} &= a\left[\frac{\partial CS^0}{\partial \tau}\right] \\ &\quad + \psi\left(p^0_{11} - c_1\right)\left(\frac{dq_{11}}{dP^0_1}\frac{\partial P^0_1}{\partial \tau^0}\right) + \left(p^0_{13} - c_3\right)\left(\frac{dq_{13}}{dP^0_1}\frac{\partial P^0_1}{\partial \tau^0}\right) > 0,\end{aligned} \tag{12}$$

where the total derivative of operating profits, $\pi_{1n} = (p_{1n} - c_n)\, q_{1n}$, with respect to p_{1n} is equal to zero by the envelope condition from the firm's profit maximization problem; and with the derivative of consumer surplus and of imports defined as follows:

$$\begin{aligned}\frac{\partial CS}{\partial \tau} &= \sum_{n\in N}(1-\alpha)\left(\frac{q_0}{q_1}\right)^{\alpha}(b_n\, q_1)^{\frac{1}{\sigma}}(q_{1n})^{-\frac{1}{\sigma}}\left(\frac{dq_{1n}}{dp_{1n}}\frac{dp_{1n}}{d\tau} + \frac{dq_{1n}}{dP_1}\frac{dP_1}{d\tau}\right), \\ \frac{\partial M_1(\tau)}{\partial \tau} &= \sum_{n\neq 1,3}\left(p_{1n}\frac{dq_{1n}}{dp_{1n}}\frac{dp_{1n}}{d\tau} + p_{1n}\frac{dq_{1n}}{dP_1}\frac{dP_1}{d\tau}\right).\end{aligned}$$

Also note that given that τ^0 is below the equilibrium level, the second-derivative of the welfare equation at τ^0 must be negative.

The shock leading to the need for the tariff increase directly affects the marginal cost of production for the imported varieties of good 1. Assuming that the market was in equilibrium before the shock occurred, I am able to calibrate the pre-shock marginal costs for the exporters and the political economy weight placed on the welfare of domestic producers using three pieces.

First, I leverage the assumption that the market was in equilibrium before the shock. If the market was in equilibrium, then in period -1 the tariff level, τ^0, must optimize government welfare given $c_2 = c_2^{-1}$ and $c_4 = c_4^{-1}$. Therefore, it must be true that

$$\begin{aligned}\frac{dG^{-1}(\tau^0,\mathbf{c}^{-1})}{d\tau} &= a\left[\frac{\partial CS^{-1}(\tau^0,\mathbf{c}^{-1})}{\partial\tau^0} + M_1^{-1}(\tau^0,\mathbf{c}^{-1}) + \tau^0\frac{\partial M_1^{-1}(\tau^0,\mathbf{c}^{-1})}{\partial\tau^0}\right] \\ &\quad + \psi\,(p_{11}^{-1} - c_1)\,\frac{dq_{11}^{-1}}{dP_1}\,\frac{dP_1(\tau^0,\mathbf{c}^{-1})}{d\tau^0} + (p_{13}^{-1} - c_3^{-1})\,\frac{dq_{13}^{-1}}{dP_1}\,\frac{dP_1(\tau^0,\mathbf{c}^{-1})}{d\tau^0} = 0,\end{aligned} \tag{13}$$

where the set of marginal costs in period -1 is $\mathbf{c}^{-1} = \{c_1, c_2^{-1}, c_3^0, c_4^{-1}\}$, and the marginal costs in period -1 are such that $c_2^{-1} > c_2^0$ and $c_4^{-1} > c_4^0$. Additionally, in period -1 the exporting firms must have no incentive to tariff jump:

$$\pi_{1n}(\tau^0, c_3^{-1}|\mathbb{I}_{\text{Jump},n} = 0) \geq \pi_{1n}(\tau^0, c_3^{-1}|\mathbb{I}_{\text{Jump},n} = 1) - f, \tag{14}$$

for $n \in \{2,4\}$, where f is the fixed cost to a firm of setting up operations in the home country.

Second, using information on how much the market share of the domestic firm has fallen, I can solve for the marginal cost of production before the shock occurred to foreign producers. The pre-shock market share of domestically produced varieties was $\delta \in (0,1)$ larger in period -1 than the observed share in period 0. Given the market share reduction is the result of a shock to foreign marginal costs of production, this means

$$\frac{p_{13}^{-1}(\tau^0, c_3^{-1})\,q_{13}^{-1}(\tau^0,\mathbf{c}^{-1})}{\sum_{n\in N}(1+\tau_n)\,p_{1n}^{-1}(\tau^0, c_n^{-1})\,q_{1n}^{-1}(\tau^0,\mathbf{c}^{-1})} = (1+\delta)\,\frac{p_{13}^{0}(\tau^0, c_3^{0})\,q_{13}^{0}(\tau^0,\mathbf{c}^{0})}{\sum_{n\in N}(1+\tau_n)\,p_{1n}^{0}(\tau^0, c_n^{0})\,q_{1n}^{0}(\tau^0,\mathbf{c}^{0})}, \tag{15}$$

where the set of marginal costs in period -1 is $\mathbf{c}^{-1} = \{c_1, c_2^{-1}, c_3^0, c_4^{-1}\}$, and in period 0 is $\mathbf{c}^0 = \{c_1, c_2^0, c_3^0, c_4^0\}$.

Third, I assume the shock impacts foreign producers proportionally, such that for $\varepsilon \in (0,1)$, the marginal costs are $c_2^{-1} = \varepsilon\, c_2^0$ and $c_4^{-1} = \varepsilon\, c_4^0$.

Combining these three pieces, I can use the observed value of δ to calibrate the value of ε and then solve for the marginal costs before the shock using equation (15). The calibrated values of c_2^{-1} and c_4^{-1} are then used in equation (13) to solve for the political economy weight, a, that is consistent with τ^0 being the solution to equation (13).

2.5 Optimization of the Temporary Tariff Level Increase

The government chooses a temporary tariff, $\tau^{'} > \tau^0$, to maximize the present discounted value of its stream of welfare, given the tariff level in period 1 is the temporary tariff, τ', and that the tariff returns to its original value, τ^0, in period 2:

$$V(\tau') = G^1(\tau', \mathbf{c}^0) + \beta\, G^2(\tau^0, \mathbf{c}^2 | \tau^1 = \tau'), \tag{16}$$

where $\beta \in (0,1)$ is the discount factor, and the set of marginal costs in period 1 and period 2 are denoted by $\mathbf{c}^1 = \mathbf{c}^0 = \{c_1, c_2^0, c_3^0, c_4^0\}$ and $\mathbf{c}^2 = \{c_1, c_2^0, c_3^2, c_4^0\}$, respectively. Note that the welfare in period 2, G^2, is dependent on the tariff level in period 1, because the period 1 tariff is what determines whether or not exporters will choose to tariff jump and begin operations in the home country instead of continuing to export. In period 1 when the temporary tariff increase is in place, firms exporting to the home market are operating at their lower post-shock marginal costs of production, while the domestic producer is continuing to operate at its original pre-adjustment marginal cost. In period 2, the adjustment to the domestic firm's marginal cost is assumed to be complete and the temporary tariff increase is reversed, returning to the original tariff level, τ^0.

To optimize the present-discounted value of welfare, the government's optimal tariff, τ', must solve

$$
\begin{aligned}
\frac{dV(\tau')}{d\tau} = a \Bigg[& \frac{\partial CS^1(\tau', \mathbf{c}^0)}{\partial \tau} + \beta \, \frac{\partial CS^2(\tau^0, \mathbf{c}^2 | \tau^1 = \tau')}{\partial \tau} + M_1^1(\tau', \mathbf{c}^0) + \tau' \frac{\partial M_1^1(\tau', \mathbf{c}^0)}{\partial \tau} \\
& + \beta \, M_1^2(\tau^0, \mathbf{c}^2 | \tau^1 = \tau') + \beta \, \tau^0 \, \frac{\partial M_1^2(\tau^0, \mathbf{c}^2 | \tau^1 = \tau')}{\partial \tau} \\
& + \sum_{n \neq 1,3} \mathbb{I}_{\text{Jump,n}} (p_{1n}^1 - c_n) \frac{dq_{1n}^1}{dP_1} \, \frac{dP_1(\tau', \mathbf{c}^0)}{d\tau} \\
& + \beta \sum_{n \neq 1,3} \mathbb{I}_{\text{Jump,n}} (p_{1n}^1 - c_n) \frac{dq_{1n}^1}{dP_1} \, \frac{dP_1(\tau^0, \mathbf{c}^2 | \tau^1 = \tau')}{d\tau} \Bigg] \\
& + \psi \, (p_{11}^1 - c_1) \frac{dq_{11}^1}{dP_1} \, \frac{dP_1(\tau', \mathbf{c}^0)}{d\tau} + \psi \, \beta \, (p_{11}^2 - c_1) \frac{dq_{11}^2}{dP_1} \, \frac{dP_1(\tau^0, \mathbf{c}^2 | \tau^1 = \tau')}{d\tau} \\
& + (p_{13}^1 - c_3^0) \frac{dq_{13}^1}{dP_1} \, \frac{dP_1(\tau', \mathbf{c}^0)}{d\tau} + \beta \, (p_{13}^2 - c_3^2) \frac{dq_{13}^2}{dP_1} \, \frac{dP_1(\tau^0, \mathbf{c}^2 | \tau^1 = \tau')}{d\tau} = 0,
\end{aligned}
\tag{17}
$$

where period 2 welfare is again dependent on the history of the tariff level, given that firm n chooses to tariff jump in period 1 (denoted by the indicator variable $\mathbb{I}_{\text{Jump},n}^1 = 1$) in response to the tariff increase if

$$
\begin{aligned}
& \pi_{1n}(\tau' | \mathbb{I}_{\text{Jump},n}^1 = 1) + \beta \, \pi_{1n}(\tau^0 | \mathbb{I}_{\text{Jump},n}^1 = 1) - f_n \\
& \qquad > \pi_{1n}(\tau' | \mathbb{I}_{\text{Jump},n}^1 = 0) + \beta \, \pi_{1n}(\tau^0 | \mathbb{I}_{\text{Jump},n}^1 = 0),
\end{aligned}
\tag{18}
$$

with $\tau_n^1 = \tau'$ and $\tau_n^2 = \tau^0$ if variety n is imported to the home country, and where $\tau_n^t = 0$ if n is a domestically-produced variety of good 1.[4] In addition to equation (17) holding, the second derivative of welfare with respect to the tariff level must be negative at τ' for the policy to be welfare maximizing.

Because the assumed purpose of the temporary tariff increase is to allow a firm to adjust in response to a shock, in the model the domestic producer has an opportunity to improve the efficiency of domestic production and reduce its costs. This cost does not immediately

[4]Note that if firm n is indifferent between tariff jumping and not, it chooses to maintain "status quo" and not tariff jump.

take effect, so the temporary tariff increase provides relief to the domestic producer until it can be implemented. Specifically, during period 1 the domestic firm takes the necessary steps to ensure that its parameter, c_3, improves enough to recover some targeted amount of its market share. In other terms, domestic producers go from c_3^{-1} (in periods -1, 0 and 1) to c_3^2 in period 2. This means the domestic producer adjusts its marginal cost such that

$$(1+\rho)\frac{p^0_{13}(\tau^0, c_3^{-1})\, q^0_{13}(\tau^0, \mathbf{c}^0)}{\sum_{n\in N}(1+\tau_n)\, p^0_{1n}(\tau^0, c_n^0)\, q^0_{1n}(\tau^0, \mathbf{c}^0)} \\ = \frac{p^1_{13}(\tau', c_3^2)\, q^2_{13}(\tau', \mathbf{c}^2|\tau^1=\tau')}{\sum_{n\in N}(1+\tau_n)\, p^2_{1n}(\tau', c_n^2)\, q^2_{1n}(\tau', \mathbf{c}^2|\tau^1=\tau')}. \tag{19}$$

where the set of marginal costs in period 0 is $\mathbf{c}^0 = \{c_1, c_2^0, c_3^{-1}, c_4^0\}$ (with $c_3^{-1} = c_3^0$), and in period 1 is $\mathbf{c}^2 = \{c_1, c_2^0, c_3^2, c_4^0\}$.

For model calibrations, the target recovery of market share, ρ, is an input, and the new value of the marginal cost of production for the domestic firm, c_3^2, is calibrated. If $\rho = \delta$, then the targeted recovery of domestic producers is to return to the pre-shock market share it had (its period -1 market share). If $\rho < \delta$ (the scenario I use in the simulations), then the adjustment to firm 3's marginal cost will not recover the entire share of the market it lost due to the initial shock. This reflects a scenario in which the government uses temporary relief from import competition (by way of the temporary increase in tariff protection) to allow domestic producers to adjust to new market conditions.

3 Illustrative Simulations

In this section, I present the results of a series of simulations to illustrate how the model works. First, below I outline the parameter values used in model simulations. Then, in Section 3.1, I lay out the aspects of the model that are calibrated and how they relate to the theory presented earlier.

Table 1: Parameter Inputs for Illustrative Simulations

Parameter	Value
Share of good 1 varieties in total expenditure, α	1/2
Elasticity of substitution, σ	$\{2, 2.5, 3\}$
Relative wage parameter, ω	$\{0.45, 0.85\}$
Discount factor, β	0.95
Initial tariff rate on imports, τ^0 (%)	5.0
Trade friction (%)	5.0
Bound tariff rate (maximum tariff remedy), (%)	55.0
Initial expenditure on each firm type ($\{v_1, v_2, v_3, v_4\}$)	{500, 400, 450, 150}
Number of type-4 firms	5
Loss of market share from shock, δ (%)	50
Target recovery of firm 3's market share, ρ (%)	25

The final two sections provide model results for the three different scenarios outlined in the introduction: Section 3.2 provides simulation results assuming the government does not place any political economy weight on the welfare of domestic producers, but instead chooses the optimal tariff to maximize the unweighted social welfare function. In other terms, Section 3.2 assumes that $a = \psi = 1$ in equation (11). Section 3.3 provides the simulation results when the government places political economy weight on the welfare of domestic producers and producers established through FDI, allowing both a and ψ to take on values other than 1. In both sections, I report model results for a small grid of elasticity of substitution, σ, and relative wage, ω, values as well as graphical results for a larger grid of σ and ω values.

All model simulations use the same set of parameters, outlined in Table 1. The first parameters worth noting are the values of σ and ω, which provide a grid of model results. The small grid I use features three values of the elasticity of substitution ($\sigma \in \{2, 2.5, 3\}$) and two relative wage parameters ($\omega \in \{0.45, 0.85\}$). Note that for $\omega < 1$, the home country's wage is lower than the wage in the exporting country. The relative wage parameter enters into the model when exporting firms tariff jump and face a new cost of hiring labor.

Values in the second half of the table—the initial tariff level, trade frictions, and the initial market share of each firm in the home country—are largely observable. I use an initial tariff rate of 5 percent and a 5 percent trade friction (the trade friction can be thought of as transportation costs). I also impose a tariff binding equal to 55 percent, assuming that the applied tariff in the sector is currently below the binding. The values I choose for the initial market shares present a scenario in which there is a domestic producer (the domestic firm, firm 3), a large firm that chose to tariff jump sometime before period 0 (firm 1), a large exporter that has not yet tariff jumped in period 0 (firm 2), and a small number of exporters (type-4 firms) that have also not yet chosen to tariff jump.[5] The increase in import competition leading to the loss of market share by the domestic firm, δ, is set to 50 percent. Finally, during the high-tariff period, I assume the domestic firm's target is to recover its market share by $\rho = 25\%$.

3.1 Model Calibration and Tariff Solutions

Following Riker and Schreiber (2019b), I set initial firm prices to one without loss of generality, which allows me to calibrate the marginal costs and the taste parameters. Using this assumption and elasticity parameter values, I calibrate model parameters $\{k,\, b_n,\, c_n^0\}$.

In Section 2.1, I discussed how the bounds of the fixed costs of tariff jumping are calibrated using the methodology of Riker and Schreiber (2019b): because I assume firm 1 did tariff jump at the initial equilibrium tariff level, τ^0, and firms 2 and 4 did not, I can pin down the possible range of the fixed cost of tariff jumping (equation (10)). I then assume the actual fixed cost is the midpoint of the range corresponding to the fixed cost bounds and use this value for the model simulations.

In Section 2.4, I show that using equation (15), I can calibrate the pre-shock marginal cost of production for the exporting firms, $c_2^{-1} = \varepsilon\, c_2^0$ and $c_4^{-1} = \varepsilon\, c_4^0$, by solving for the value

[5] The shares I use imply that domestic production (firm 1 and firm 3) accounts for about 45 percent of domestic sales and that the firm 3 accounts for about 47 percent of domestic production.

of ε that corresponds to the δ increase in market share for exporters between period -1 and period 0. I report the results for the marginal cost calibration for the simulation with social-welfare maximization in Section 3.2 and with politically-weighted welfare maximization in Section 3.3. Given that the shock led to a decrease in market share for firm 3, the calibrated value of ε should be greater than one, consistent with the marginal cost of production falling for exporters between period -1 and period 0.

In Section 2.4, I also showed that for the scenarios in which the government's objective function includes political economy motivations, the political economy weight, a, can be calibrated using the government's period -1 welfare maximization problem (equation (13)). I report these results in Section 3.3.

In Section 2.5, I showed that with equation (19), I can calibrate the marginal cost of production for the domestic firm after the tariff returns to its original value and the firm has made the effort to recover, c_3^2. The calibrated values of the domestic firm's marginal cost is reported for the scenarios with and without political economy pressure in Sections 3.2 and 3.3, respectively.

In Section 2.5, I showed that the optimal temporary tariff level must maximize the present-discounted-value of government welfare for periods 1 and 2, given that firm 2 may choose to tariff jump and firm 3 uses the high-tariff period to recover its market share to the original level. Therefore, equation (17) must hold subject to the constraint defined in equation (18). The results of the tariff optimization are reported for the scenarios with and without political economy pressure in Sections 3.2 and 3.3, respectively.

3.2 Results of Illustrative Simulations with Social Welfare Maximization

In this set of simulations, I assume that the government places equal weight on each component of the welfare equation, meaning both political economy weights(a and ψ) are equal to one and the government sets the tariff to maximize social welfare.

Before diving into the calibrated tariff levels and the marginal cost reduction of the domestic firm, I want to briefly outline the calibrated pre-shock marginal costs of the exporting firms. These results are in Table 2. Comparing the results for three values of σ, the percentage reduction in the exporters' marginal cost that led to the domestic firm's 50 percent market share decrease is decreasing in σ.[6] This reflects the fact that as goods become more differentiated (for higher σ), a smaller change in competitors' marginal cost is required for the domestic producer to lose market share, since consumers are more sensitive to price.

Table 2: Change in Marginal Cost Leading to Temporary Increase in Tariff Protection

σ	Shock to Exporter Marginal Cost (ε)	Calibrated Pre-shock Marginal Cost (c_2^{-1})	Marginal Cost After Shock (c_2^0)	Percent Change From Period -1 to Period 0 ($(c_2^0 - c_2^{-1})/c_2^{-1}$)
2	3.3885	1.5159	0.4474	-70.5%
2.5	2.2973	1.2598	0.5484	-56.5%
3	1.8839	1.1646	0.6182	-46.9%

Table 3 presents the optimal tariff by parameter combination. In all cases considered, the large exporting firm (firm 2) changes modes of supply to local affiliate FDI. For the values of σ reported in the table, tariff rates are increasing in the elasticity of substitution σ. This reflects the fact that a higher tariff rate is required to maximize welfare as the product under consideration becomes more substitutable with imports.

Figure 1 zooms out on the range of σ and ω values. In the figure, the red dotted

[6] Though not reported here, expanding the grid of σ's and solving for the calibrated pre-shock marginal cost demonstrates that this pattern is consistent across a larger range of σ values.

Table 3: Optimal Tariff Level

σ	ω	Firm 2 Tariff Jump?	Unconstrained Optimal $\tau^{'}$	Observed Value of $\tau^{'}$
2	0.45	True	0.169	0.169
2	0.85	True	0.396	0.396
2.5	0.45	True	0.556	0.550
2.5	0.85	True	1.138	0.550
3	0.45	True	0.663	0.550
3	0.85	True	1.670	0.550

lines delineate the maximum tariff level (equal to the tariff binding, 55 percent) and the minimum tariff level (equal to the initial applied tariff rate, 5 percent). The figure shows that the optimal tariff level is monotonically increasing in ω, but is non-monotonic in σ. The non-monotonicity of the optimal tariff for different values of σ is unsurprising given the complex way that the elasticity of substitution enters into the model.

Table 4 shows the results of the domestic firm's adjustment during the high-tariff period. As mentioned previously, the model assumes the domestic producer is able to costlessly adjust its marginal cost of production in order to recover a target amount of the lost market share in period 0. In the simulations here, I assume the domestic firm adjusts marginal cost in order to recover about half of the market share it lost due to the increase in import competition. This adjustment is costless to the firm.

Table 5 shows the effect of the tariff increase on each component of the government welfare equation, comparing the welfare from period 0 to that in period 2. The most important rows in each table are the government welfare and the firm 3 surplus rows. First, if firm 3's change in surplus is negative, it would be better off not receiving an increase in tariff protection, suggesting a firm would not bring the need for increased protection to the attention of the government in the first place. Next, the government would only choose to temporarily increase tariff protection if the effect of the tariff increase on government welfare is positive.

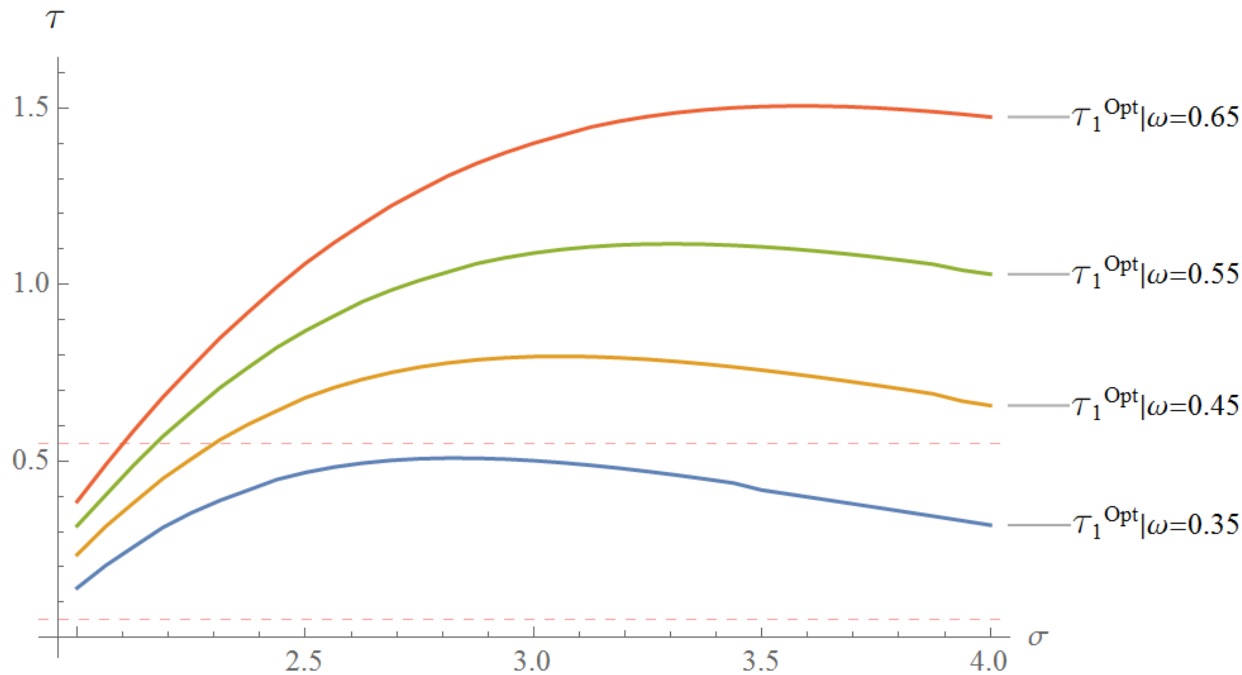


Figure 1: Optimal Tariffs for Varying σ and ω Values

Table 4: Domestic Firm Adjustment to Marginal Cost to Achieve Market Share Recovery of 25 percent

σ	ω	Firm 2 Tariff Jump	Calibrated Pre-shock Marginal Cost (c_3^0)	Marginal Cost After Recovery (c_3^2)	Percent Change From Period 1 to Period 2 ($(c_3^2 - c_3^0)/c_3^0$)
2	0.45	True	0.4400	0.2193	-50.2%
2	0.85	True	0.4400	0.2695	-38.7%
2.5	0.45	True	0.5410	0.3006	-44.4%
2.5	0.85	True	0.5410	0.3775	-30.2%
3	0.45	True	0.6111	0.3561	-41.7%
3	0.85	True	0.6111	0.4557	-25.4%

Table 5: Percentage Change in Welfare From Initial State (Period 0) to Post-Recovery Period (Period 2) (%)

	σ=2 ω=0.45	σ=2 ω=0.85	σ=2.5 ω=0.45	σ=2.5 ω=0.85	σ=3 ω=0.45	σ=3 ω=0.85
Firm 2 Tariff Jump?	True	True	True	True	True	True
Observed Tariff, τ_1^{Opt}	16.9%	39.6%	55%	55%	55%	55%
Government Welfare	177.1	135.8	-481.6	-379.1	-178.7	-137.5
Consumer Surplus	130.4	-219.5	-40.85	1.868	-33.67	-4.161
Tariff Revenue	-35.41	-31.64	-33.84	-32.02	-29.67	-32.17
Producer Surplus	-23.3	-4.612	-23.76	1.501	-30.61	4.068
Firm 3 Surplus	-18.96	0.7056	-19.43	7.135	-26.63	9.835
Firm 1 & Firm 3 Surplus	-28.62	16.82	-17.87	12.13	-37.36	-2.477

For the small grid of parameters presented in the table, there are no combinations of ω and σ for which a temporary tariff increase would be beneficial for both the government and for the domestic firm.

Solving the model over a much larger grid of parameters provides more insight as to when the temporary increase in tariff level would benefit both the domestic firm and the government. Figure 2 shows that for the grid of parameters chosen, the government and the domestic firm both benefit from a temporary increase in the tariff level for a small range of $\{\omega, \sigma\}$ pairs. This figure shows that when σ is high and when ω is low, neither the government nor the domestic producer would want a temporary increase in the tariff level.

3.3 Results of Illustrative Simulations with Political Economy Pressure

This section presents the results of the model when calibrating the political economy parameter, a, using the method discussed in Section 2.4. Note that although I can calibrate a, the model user must input the relative weight placed on the welfare of other firms in the industry, ψ. For the hypothetical industry I model here, I run the simulations for two

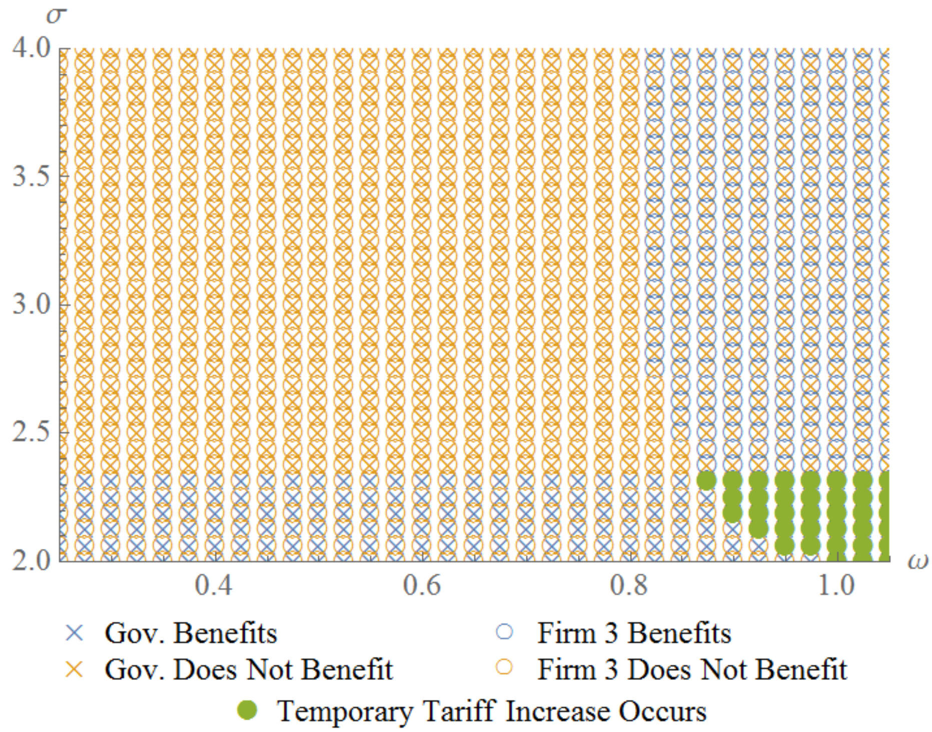


Figure 2: Parameter Grid and Potential for Temporary Tariff Increase

possible scenarios. First, I assume the government does not place any political economy weight on production by the firm established through FDI ("local affiliate production"). These results are reported in Tables 6a and 8a, as well as in the corresponding Figures 5a and 7. Next, I assume the government does place some political economy weight on the local affiliate production, but that this weight is significantly lower than the weight it places on the domestic firm: I set this parameter at $1.5\,a < 1$ in the simulations. This is equivalent to assuming the government places 1.5 times as much weight on local affiliate production when choosing the optimal tariff level as it does the rest of social welfare (whereas the government places $1/a$ times more weight on the domestic firm). These results are reported in Tables 6b and 8b, as well as in the corresponding Figure 5b.

Before getting to the results, note that the shock that precipitated the temporary tariff increase is not dependent on the government's welfare specification. Because of this, the changes in the marginal cost of the foreign exporters that precipitated the 50 percent loss of

Table 6: Simulation Results: Optimal Tariffs

(a) Political Economy Weight On Domestic Firm Welfare Only ($a = a^c$, $\psi = a^c$)

σ	ω	a^c	Firm 2 Tariff Jump?	Unconstrained Optimal τ'	Observed Value of τ'
2	0.45	0.1763	True	1.542	0.550
2	0.85	0.1763	False	(<0)	0.050
2.5	0.45	0.2539	True	1.721	0.550
2.5	0.85	0.2539	True	14.131	0.550
3	0.45	0.3041	True	1.466	0.550
3	0.85	0.3041	True	10.194	0.550

(b) Political Economy Weight On All Domestic Production ($a = a^c$, $\psi = 1.5\,a^c$)

σ	ω	a^c	Firm 2 Tariff Jump?	Unconstrained Optimal τ'	Observed Value of τ'
2	0.45	0.1940	True	1.578	0.550
2	0.85	0.1940	False	(<0)	0.050
2.5	0.45	0.2923	True	1.755	0.550
2.5	0.85	0.2923	True	15.365	0.550
3	0.45	0.3609	True	1.491	0.550
3	0.85	0.3609	True	10.752	0.550

market share for the domestic firm are unchanged from Table 2 and are not reported again in this section.

Tables 6a and 6b show the calibrated political economy weights and the optimal tariff rates for the scenarios in which political economy weight is placed on only the domestic firm and when it is placed on all domestic production (the domestic firm plus the local affiliate firm), respectively. Beginning with Table 6a, it is immediately clear that for the small grid of parameter values, the maximum tariff rate is always binding and results in a temporary tariff equal to 55 percent. The only exception to this is the parameter combination for which the large exporter does not choose to tariff jump, resulting in the optimal tariff being at the lower bound, equal to the initial tariff rate of 5 percent.

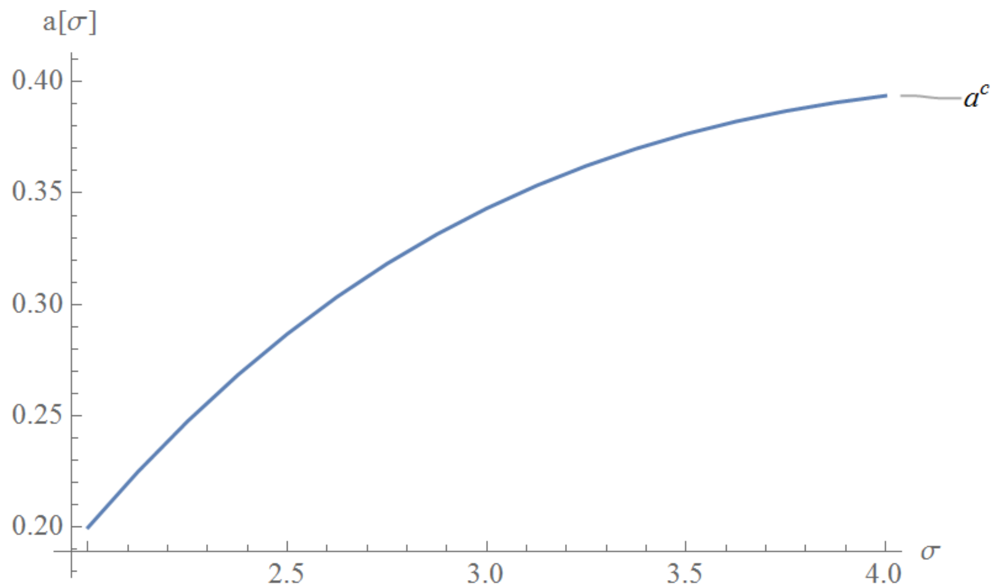


Figure 3: Calibrated Political Economy Weight on Domestic Production, Political Economy Weight on Domestic Firm Only.

Note at this point a slightly surprising result: the model calibration in table 6 shows that the political economy weight (the inverse of the political economy parameter, a^c) associated with tariff τ^0 is decreasing as goods become more substitutable. In other words, as firms become more competitive, the government's initial tariff, τ^0, can only be explained by decreasing the additional weight the government places on the welfare of the domestic firms. This seems counterintuitive: one might expect to see that as firms are more competitive, the tariff can only be explained by a larger weight on the welfare of domestic producers. However, this is an incomplete picture. We must also take into account other parameters that are being calibrated, in this case, we must account for how the exporters' (firm 2 and the N_4 type-4 firms) marginal costs interact with σ as well given the calibrated marginal cost of production factors into the calibrated value of the political economy parameter (a^c is a function of σ directly and indirectly through $c_2^{-1}(\sigma)$). Figure 3 depicts the behavior of the calibrated marginal cost of production for the exporters and the calibrated political economy weight.

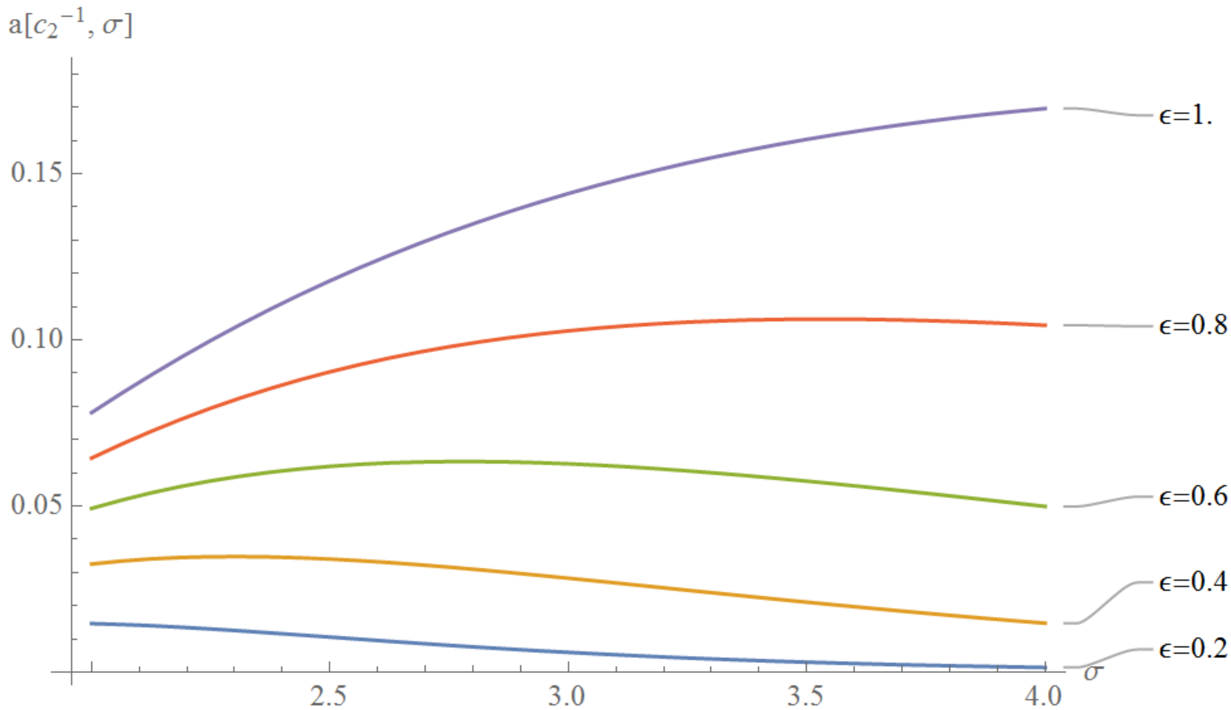


Figure 4: Alternative Calibrated Political Economy Weight, Political Economy Weight on Domestic Firm Only, Holding Constant Marginal Costs of Production.

Figure 4 depicts the behavior of the calibrated political economy weight holding the other calibrated variable, ε where $c_i^{-1} = \varepsilon c_i^0$ for $i \in 2, 4$, constant. This allows me to show how the political economy weight changes for values of sigma holding the marginal costs of production constant. Figure 4 shows that holding the marginal cost of exporters' production constant, the political economy parameter is not *necessarily* increasing in the elasticity of substitution across varieties. Rather than being monotonic, we now see that the political economy weight is actually initially increasing in σ, but as goods become more substitutable, the calibrated political economy weight is eventually decreasing in σ.

Figures 5a and 5b show the optimal tariff rate as it relates to σ for varying levels of ω. By zooming out on the range of σ's and ω's, I am able to see that the observed pattern in Tables 6a and 6b is maintained: Figures 5a and 5b show that the slope of the optimal tariff line is non-monotonic in σ while it is monotonically increasing in ω. The non-monotonicity

Table 7: Domestic Firm Adjustment to Marginal Cost to Achieve Market Share Recovery of 25 percent, Political Economy Weight On Domestic Firm Only

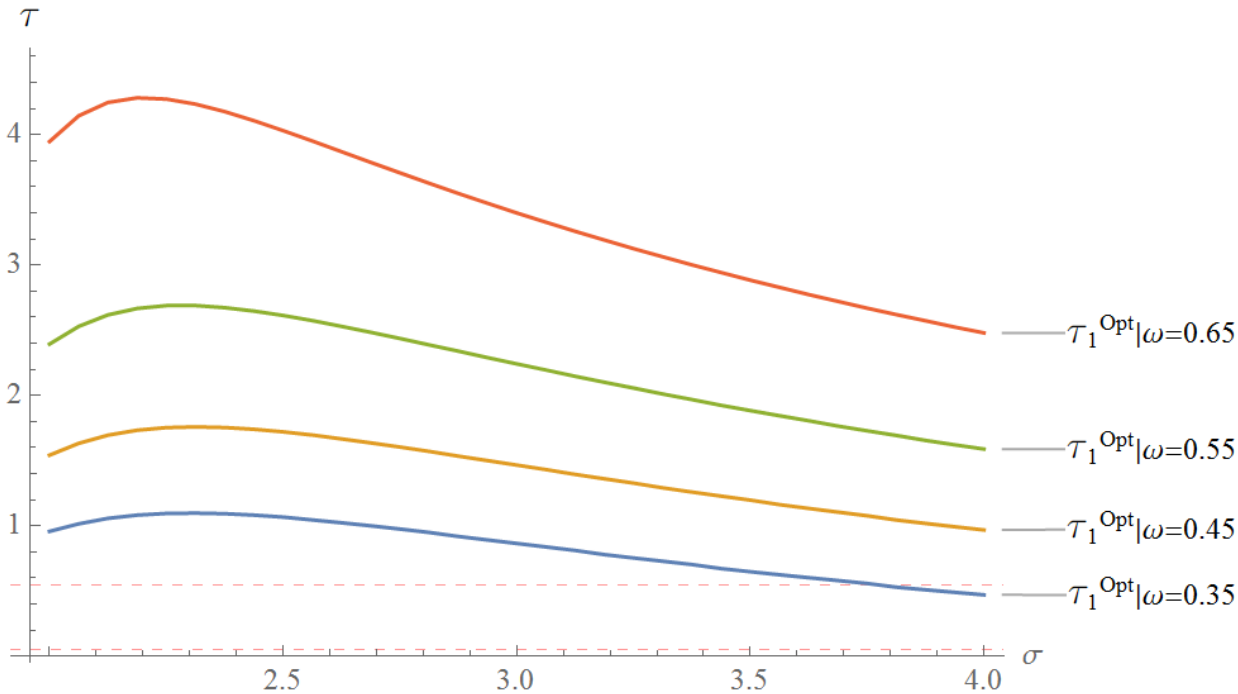
σ	ω	Firm 2 Tariff Jump	Calibrated Pre-shock Marginal Cost (c_3^0)	Marginal Cost After Recovery (c_3^2)	Percent Change From Period 1 to Period 2 ($(c_3^2 - c_3^0)/c_3^0$)
2	0.45	True	0.4400	0.2193	-50.2%
2	0.85	False	0.4400	0.2879	-34.6%
2.5	0.45	True	0.5410	0.3006	-44.4%
2.5	0.85	True	0.5410	0.3775	-30.2%
3	0.45	True	0.6111	0.3561	-41.7%
3	0.85	True	0.6111	0.4557	-25.4%

of the optimal tariff for different values of σ is unsurprising given the complex way that the elasticity of substitution enters into the model. Additionally, optimal tariff rates are highest when the government's political economy motive extends to all domestic production, including the local affiliate firm.

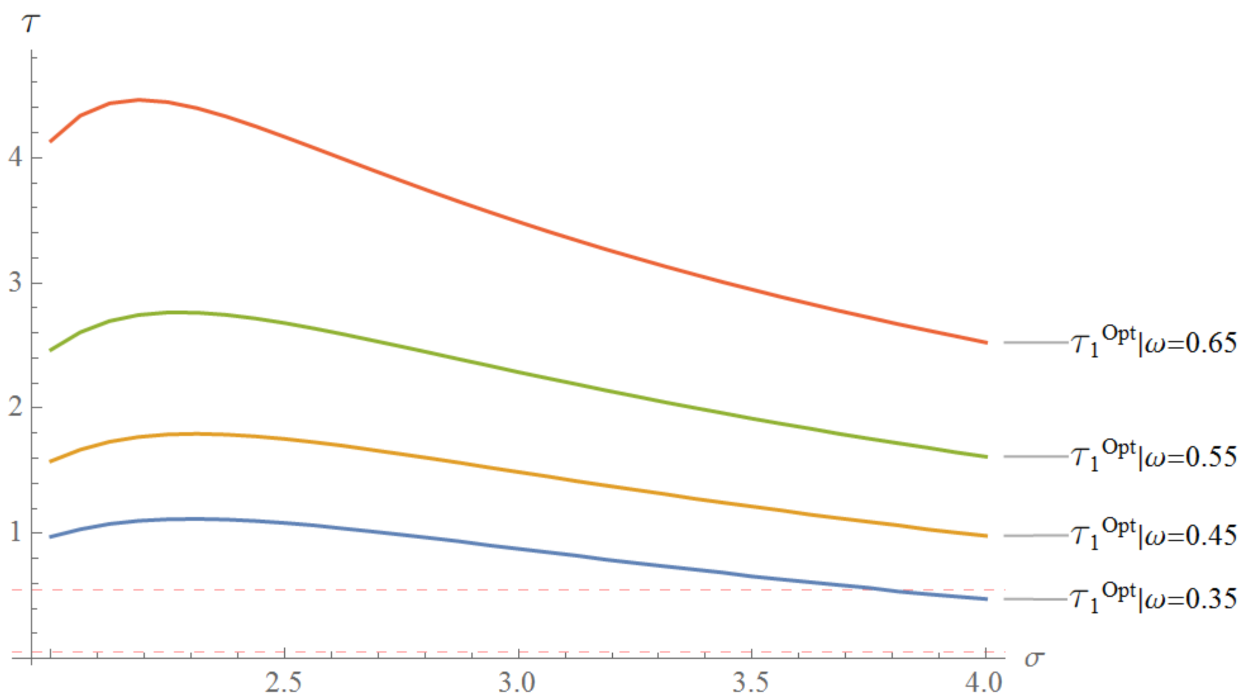
Table 7 shows the results of the domestic firm's adjustment during the high-tariff period. As was true for the simulations without political economy pressure, the domestic firm is again costlessly adjusting its marginal cost of production to recover about half of the market share it lost due to the shock. As a result, firm 3 will lower its marginal cost of production for all parameter values. These values are identical to the version of the model without political economy pressure (shown in Table 4) as long as the mode of supply is the same between simulations. Table 7 provides an example of the marginal costs when the government places the political economy weight on all domestic production. For this version of the model, firm 2 doesn't tariff jump for some combinations of the model parameters. The result, when compared to Table 4, shows that firm 3 is able to accomplish a recovery of 25 percent of its market share with a smaller reduction in its marginal cost.

Tables 8a and 8b show the effect of the temporary tariff increase on each component of the government welfare equation, comparing the welfare from period 0 to that in period

Figure 5: Optimal Tariffs for Different σ and ω Values



(a) Political Economy Weight On Domestic Firm Only



(b) Political Economy Weight on All Domestic Production

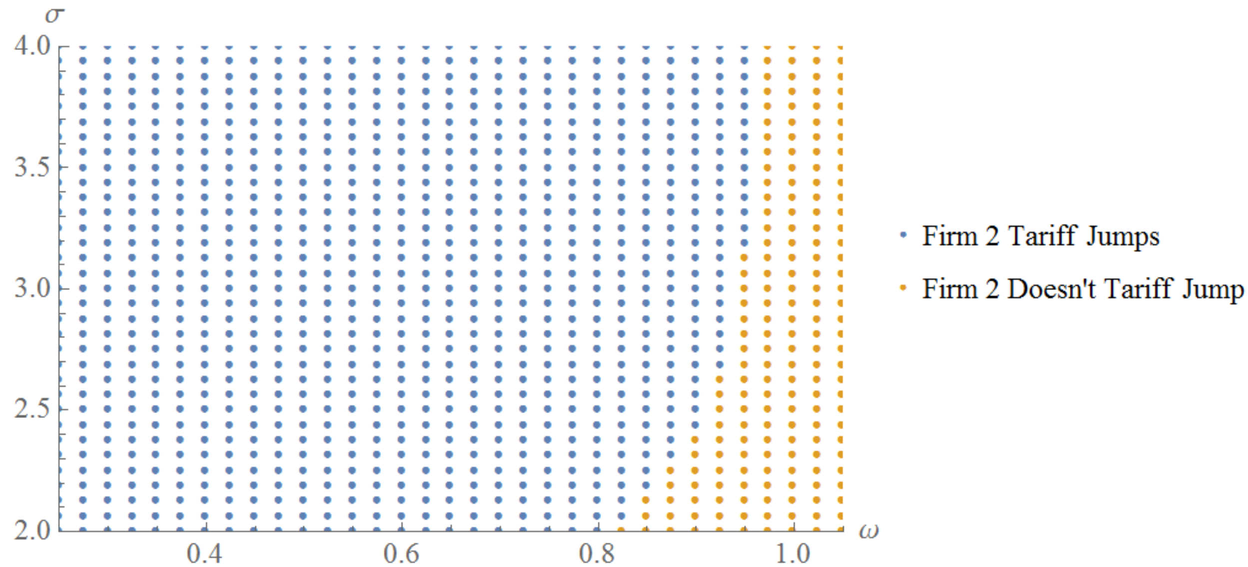


Figure 6: Parameter Grid and Large Foreign Exporter's Decision to Tariff Jump to Avoid the Tariff Increase, Political Economy Weight On Domestic Firm Only

2. As mentioned in the discussion of these results for no political economy pressure, the rows of most interest are the percentage changes in government welfare and in the producer surplus of the domestic firm (firm 3). Again, for the small number of parameter combinations reported in this table, there are no ω and σ combinations for which the domestic producer and government both benefit from a temporary tariff increase. In all cases but one, firm 2 chooses to tariff jump to avoid the tariff increase, resulting in more competition for firm 1 and firm 3 domestically.

Figure 6 shows for the large grid of parameters when the government chooses to tariff jump versus when it does not for the scenario in which the government only places political economy weight on the domestic firm.[7] The figure shows that for high enough values of ω, firm 2 never chooses to tariff jump.

Figure 7 shows the parameter combinations where the government and domestic firm

[7]I only include this figure for one of the two political economy scenarios, because for the parameters used in the simulations there is little to no difference between the tariff jumping decision when the government places political economy weight only on the domestic firm versus when it places political economy weight on all domestic production. Thus the latter figure is excluded to save space and avoid repetitiveness.

Table 8: Percentage Change in Welfare From Initial State (Period 0) to Post-Recovery Period (Period 2)

(a) Political Economy Weight On Domestic Firm Welfare Only ($a = a^c$, $\psi = a^c$)

	a=0.176 σ=2 ω=0.45	a=0.176 σ=2 ω=0.85	a=0.254 σ=2.5 ω=0.45	a=0.254 σ=2.5 ω=0.85	a=0.304 σ=3 ω=0.45	a=0.304 σ=3 ω=0.85
Firm 2 Tariff Jump?	True	False	True	True	True	True
Observed Opt. Tariff, τ_1^{Opt}	55%	5%	55%	55%	55%	55%
Government Welfare	32.34	21.16	139.2	104.5	-1956	-1469
Consumer Surplus	130.4	-219.5	-40.85	1.868	-33.67	-4.161
Tariff Revenue	113.8	117.5	61.67	63.49	45.9	43.39
Producer Surplus	-17.35	-12.83	-23.76	1.501	-30.61	4.068
Firm 3 Surplus	-12.7	-7.933	-19.43	7.135	-26.63	9.835
Firm 1 & Firm 3 Surplus	6.433	-40.06	-17.87	12.13	-37.36	-2.477

(b) Political Economy Weight On All Domestic Production ($a = a^c$, $\psi = 1.5\, a^c$)

	a=0.194 σ=2 ω=0.45	a=0.194 σ=2 ω=0.85	a=0.292 σ=2.5 ω=0.45	a=0.292 σ=2.5 ω=0.85	a=0.361 σ=3 ω=0.45	a=0.361 σ=3 ω=0.85
Firm 2 Tariff Jump?	True	False	True	True	True	True
Observed Opt. Tariff, τ_1^{Opt}	55%	5%	55%	55%	55%	55%
Government Welfare	32.89	22.22	164.8	128.8	-744.3	-581.1
Consumer Surplus	130.4	-219.5	-40.85	1.868	-33.67	-4.161
Tariff Revenue	106.4	112.2	52.68	57.62	35.37	36.96
Producer Surplus	-17.35	-12.83	-23.76	1.501	-30.61	4.068
Firm 3 Surplus	-12.7	-7.933	-19.43	7.135	-26.63	9.835
Firm 1 & Firm 3 Surplus	6.433	-40.06	-17.87	12.13	-37.36	-2.477

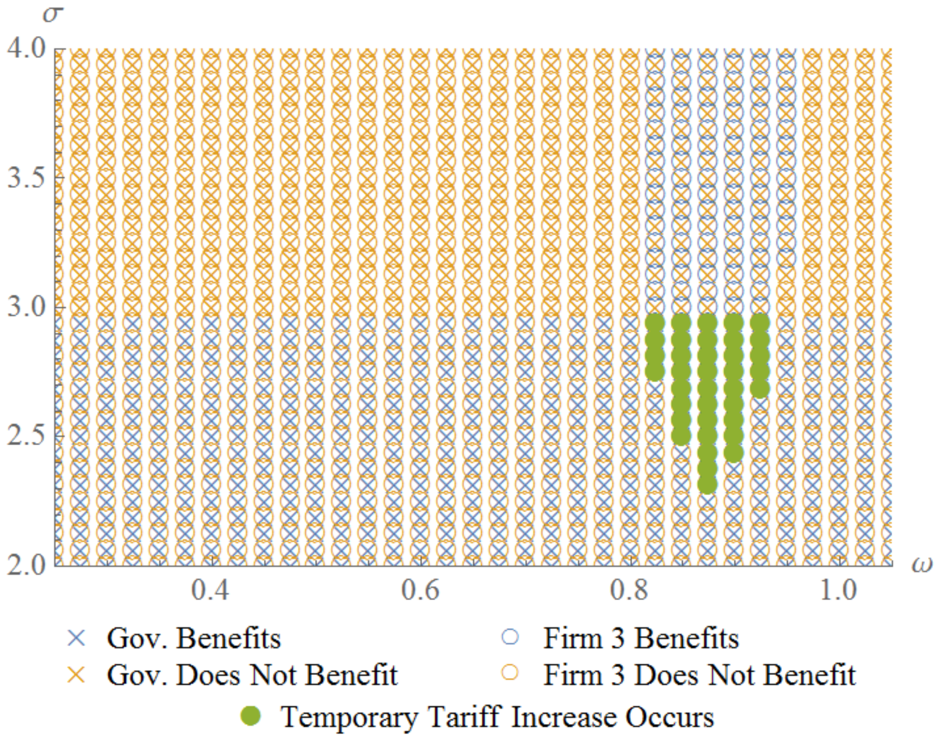


Figure 7: Parameter Grid and Potential for Temporary Tariff Increase, Political Economy Weight On Domestic Firm Only

(firm 3) both benefit from the temporary increase in the tariff level when the government only places political economy weight on the domestic firm.[8] The difference between the shape of the green region in these figures when compared to Figure 2 reflects the fact that for the political economy simulations, firm 2 no longer always chooses to tariff jump.

4 Conclusion

In this paper I solve for the optimal tariff rate following an exogenous increase in competitiveness of foreign exporters. The results demonstrate that for most outcomes, large foreign exporters benefit from tariff jumping and establishing foreign affiliates in the tariff-imposing

[8]As was true for the tariff jumping decision figures, there is little difference in the potential for mutually-beneficial tariff increases when the government places the political economy weight only on the domestic firm versus when it places political economy weight on all domestic production. Thus the latter figure is again excluded to save space and avoid repetitiveness.

country. It also demonstrates that whether or not a domestic producer benefits from a temporary increase in tariff protection is dependent on how substitutable the good is and on the relative wage of the home country compared to its trading partners. The inclusion of a political economy weight increases the size of the optimal tariff rates, as the government places less importance on the negative effects to consumer surplus and other welfare components.

In this model I also demonstrate how temporary tariff increases can be exploited to calibrate a political economy weight. This is a key feature of the model given the unobservable nature of political economy factors when estimating a model. The ability to calibrate a political economy weight has the potential to allow a research to combine the calibration approach with typical (imperfect) measures of political motivation to improve econometric estimates of models in which political economy is a factor.

The limitations to this model are similar to those in Mueller and Schreiber (2021). Specifically, the simple bounding method to determine FDI changes does not consider long-term profitability after the high-tariff period ends, which may not fit industries with substantial fixed entry costs which recover the cost of FDI over a long time horizon. Additionally, the model assumes that exporting and FDI firms come from countries with similar wage profiles, because they all share the same relative wage parameter. Another limitation is exclusion of domestic firm exports from the model.

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