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Trade Policy-Making in a Model of Legislative Bargaining*

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Abstract

We construct a dynamic model of legislative trade policy-making. Each industry resides in one or more electoral districts; each district is represented by a legislator in Congress; tariffs are set by sequential bargaining *à la* Baron and Ferejohn (1989). Some surprising results emerge: bargaining can be Pareto-worsening; legislators may vote for bills that make their constituents worse off; identical industries receive very different levels of tariff. The results pose a challenge to empirical work: equilibrium trade policy depends not only on economic fundamentals but also on political variables at time of negotiations – including random realizations of mixed bargaining strategies.

Keywords: Trade Policy; Multilateral Legislative Bargaining; Political Economy; Distributive Politics.
JEL classification: C72, C78, D72, F13.

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1 Introduction

> *"But to introduce a tariff bill into a congress or parliament is like throwing a banana into a cage of monkeys. No sooner is it proposed to protect one industry than all the industries that are capable of protection begin to screech and scramble for it. They are, in fact, forced to do so, for to be left out of the encouraged ring is necessarily to be discouraged."* – Henry George (1886).

Attempts by economists to understand the process of trade policy formation[1] have evolved from approaches based on electoral competition (Mayer, 1984), through lobbying (Findlay and Wellisz, 1982) and influence-peddling (Grossman and Helpman, 1994), to more recent work focussed on the workings of legislative assemblies (such as Grossman and Helpman, 2005 and Willmann, 2004).

In this paper, we add an important element to the analysis: *dynamic, non-cooperative congressional bargaining*. Models that focus on congressional decision making assume a unified majority party writes and passes a bill, such as Grossman and Helpman (2005), or that implicit cooperative congressional bargaining maximizes joint utility of representatives, as in Willmann (2004). These approaches provide simplicity by clearing away by assumption many of the features that make trade policy complicated in practice. By contrast, in the model we propose here, in order to move tariffs from the *status quo*, the member of the Congress who can set the agenda must propose a trade bill and find a majority coalition willing to support it. In choosing how to vote, each member considers the uncertainty over who will have agenda-setting power next, and thus over what tariff bill will emerge down the road if the current bill fails. In this setting, a number of features emerge that are quite different from what other models offer:

(i) The trade policy that emerges will depend on which member of the Congress has agenda-setting power, apart from the fundamentals generally accounted for in empirical

[1] There is an extensive literature on trade policy formation; see Rodrik (1995) and Nelson (1999) for a review.

work – both economic fundamentals (industry size, elasticities of demand, and so on) and institutional fundamentals (political organization of the industry). Indeed, since omnibus trade bills are passed infrequently, this implies that, at any given date, the structure of tariffs across industries can be largely the result of who chaired what committee, for no matter how brief a period, many years ago.

(ii) The equilibrium of the bargaining game is typically in mixed strategies (at least in the case with patient legislators). Conditional on fundamentals and the identity of the agenda-setter, the outcome is random because the agenda setter chooses randomly between industries to attract to the winning coalition. The randomness of this choice is a deep feature of the model that results from the dynamic nature of the game – specifically, the possibility of multiple rounds of bargaining after the current round if no bill passes; a static game would have no reason for randomness. As a result, even conditional on fundamentals *and* also on the identity of congressional leadership at the time of the bill's passage, empirical work explaining the determinants of tariffs might need to control for the identity of the winning coalition, perhaps proxied by the members who voted in favor.

(iii) Because of the uncertainty about the future agenda setter and future proposals that will come to the table, in many cases a member of the Congress will vote for a bill that is *worse* for her constituents than the *status quo*. Again, this is a feature of the dynamic nature of the model and would disappear in a static version.

Empirical Applicability. Our contribution is to clarify the logical implications of congressional bargaining in the context of trade policy, and how they are distinct from unitary decision making or a static congressional model. This is a theoretical, not an empirical, contribution. However, this theoretical exercise can be useful in interpreting the real world of trade-policy setting in a number of ways. First, *directly*, it can help understand some of the dynamics of trade policy setting in countries and times in which trade policy is set by assemblies with agenda-setting power that changes over time. Second, *indirectly*, it can help understand incentives for legislatures to create institutions, such as international agreements, delegation of trade-policy authority, and the like, to *avoid* such congressional bargaining. We comment on *direct* applicability below, while we defer the discussion of *indirect* applicability to the Conclusion section.

For examples of the *direct* applicability of the model, we can examine cases of countries whose legislatures have not delegated trade policy setting either to an executive or to an international agreement, for example, the US before Congress routinely delegated trade authority to the executive branch through the Reciprocal Trade Agreements Act of 1934 or the later Fast Track Authority. Given this interpretation, the key elements of the model can be seen in the rough and tumble of trade-bill formation in historical practice. Consider the 1880's in the United States, a period in which trade policy was perhaps the most contentious and vigorously debated issue of the day and the issue on which at least one national election was decided. Consider four central elements to our story, each of which requires a dynamic model. (i) *Uncertainty about the agenda setter.* The main agenda setter in the US House of Representatives for trade bills is the chair of the Ways and Means Committee, appointed by the Speaker of the House. In 1883, the Speaker was Samuel Randall, a Democrat from Pennsylvania, an ardent protectionist allied with iron and other industries of his home state. He was challenged in that year for the position of Speaker by John Carlisle of Kentucky, a Democrat from a rural area committed to much lower tariffs all around. The battle for the chairmanship was intense, and Carlisle surprised everyone by pulling an upset victory (Tarbell, 1911, p. 137). Carlisle appointed a moderate free-trader, William Morrison of Illinois, to the Chairmanship of Ways and Means. Later, the agenda-setter changed unpredictably once again, when Morrison in 1886 lost his re-election campaign and was replaced at Ways and Means by a stauncher free trader, Roger Mills of Texas (Tarbell, 1911, p. 155). The agenda-setter changed more dramatically in 1888, when Republicans won a majority in the House, and staunch protectionists seized control from the ardent free traders. Thus, in just a few years, the agenda-setting power changed hands several times, among politicians with very different policy preferences. (ii) *The proposed trade bill changes dramatically with the identity of the agenda setter.* Several different trade bills were proposed during this period, and the proposed bills changed character rapidly with changes in the agenda setter. For example, the Mills bill of 1888 lowered tariffs across the board, while the McKinley tariff bill passed by the new Republican house in 1890 raised tariffs sharply for almost every industry (Tarbell, 1911, pp. 188-206). (iii) *The coalition supporting a proposed bill does not depend merely on party, but on the contents of the bill.* Randall, for example, had built a coalition of supporters for his protectionist agenda that included a wide range of Republicans and a number of Democrats willing to buck their party's dominant free-trade ideology (Tarbell, 1911, p. 137). (iv) *Members of the Congress vote strategically, sometimes voting for a proposal that will make things worse for their constituents, because they are concerned that the next proposal might be even worse.* This can be seen in the decision by Randall's supporters in the House to support the Mills tariff reduction bill 'with heavy hearts' as likely the best they could obtain, although it reduced tariffs rather than raised them as their constituents desired (Tarbell, 1911, pp. 164-165).[2]

The model in more detail. We consider a small open economy that accommodates four industries, one that produces *numeraire* homogeneous good using labor alone and three manufacturing industries that employ sector-specific capital alone. There are N electoral districts (constituencies), each of which hosts one manufacturing industry along with the *numeraire* good industry. Individuals who reside in the same district are identical and each one is endowed with one unit of labor and one unit of capital to be used in the manufacturing industry located in that district. As a result, there is a potential conflict among districts based on (manufacturing) industry attachment.[3]

Each district is represented by a legislator in the legislature (Congress). Each legislator cares only about the welfare of her own district, and the welfare of a district is closely related to the industry located in it. In our model, trade policy implies any tariff or subsidy levied on any sector's output.[4] This setup is consistent with distributive politics since an increase

[2]Examples from other countries can be found in our working paper Celik, Karabay and McLaren (2011).

[3]Magee (1978), in his study of testimony on trade legislation, finds strong evidence for sector-based political activity. Moreover, in other studies, capital and labor are found to be relatively immobile over politically plausible time horizons; see Nelson (2007), footnote 4.

[4]Here, we use tariffs as a measure of protection. In reality, non-tariff barriers (NTBs) are also used and are very closely related to tariffs as documented by Ray (1981) and Marvel and Ray (1983).

in the price of a particular good (say, due to protection) will be beneficial only to those districts that produce it, but will be costly to the whole economy due to its negative effect on consumption.

We analyze the legislative game as a sequential model of multilateral bargaining with a simple majority rule *à la* Baron and Ferejohn (1989). This approach to congressional bargaining has borne much fruit in the political economy of public finance (see, among others, Baron, 1993; Primo, 2006 and Battaglini and Coate, 2007), but to our knowledge it has not yet been used to analyze trade policy. Each period, a legislator is selected randomly to propose a tariff bill.[5] To pass a bill, the proposer must create a coalition of supporting legislators large enough to form a majority, in which case the bill goes into effect and the legislature adjourns. Otherwise, the *status quo* trade policy prevails and the process is repeated with a new legislator (possibly the same as in the previous period). In her voting, a legislator compares the benefits accruing to her district from the current proposal to the value of continuing to the next stage. As is common in this type of multi-member bargaining games, there are many subgame perfect equilibria (SPE) that can be supported with infinitely-nested punishment strategies. Therefore, following the literature, we focus on *stationary* subgame perfect equilibrium (SSPE). Stationarity is a restrictive assumption such that it can even eliminate the efficient equilibrium; we will discuss stationarity and equilibrium selection in Section 3 and Section 4.

A closer look at our findings yields the following observations. We focus here on the case of patient legislators, which we will argue is more realistic (see in particular footnote 18), although we also treat the case of impatient legislators in the main text. First, the *ex ante* expected benefit an industry receives from congressional bargaining is affected by the industry's dispersion (i.e., the number of electoral districts an industry operates in). To focus on the pure dispersion effect, consider the thought experiment in which each industry

[5] Random recognition is a convenient way to model the uncertainty that legislators face, i.e., they do not know exactly which coalitions will form in the future if the current coalition fails to enact the legislation. Although the purely random selection is of course an abstraction, the uncertainty regarding the agenda setter is important in practice, as illustrated by the historical example discussed above, and this convenient abstraction is used in an enormous literature following Baron and Ferejohn (1989).

produces the same output, but they differ in the number of districts in which they operate. We show first that, independent of other factors, trade protection is higher for industry i than industry j if industry i representatives constitute a majority in the Congress. This makes sense; if an industry is dispersed enough to have a majority representation in the Congress, then it will receive more protection due to its agenda-setting power.

However, we show that if no industry has a majority in the Congress, more disperse industries have no advantage *ex ante* over less disperse industries. The reason is that a more disperse industry has a better chance of holding agenda-setting power (since it controls more seats), and so it can drive a harder bargain *when it is in a coalition*. Consequently, when it is not the agenda setter, it has a much lower probability of being included in a coalition. This is a subtlety that as far as we know has not been investigated in empirical work.

Second, in case no industry has majority representation in the Congress, the *ex ante* expected benefit an industry receives from Congressional bargaining is determined by that industry's total output. In particular, larger industries that produce more output tend to benefit less from congressional negotiations over tariffs than smaller industries. The reason is that such an industry will generate fewer imports (since it will satisfy more of domestic demand from domestic production), and so the tariff revenue produced by a given tariff will be small; but this means that if a large industry is a member of the coalition that forms the tariff bill, the coalition partner will receive little benefit from a tariff on the large industry, and so will be unwilling to agree to a high tariff.

Third, in addition to these factors, the *status quo* tariffs also matter.[6] In particular, if the initial protection for an industry is already high compared to other industries, then there is less room for that industry to improve over its *status quo* welfare since it is closer to its ideal protection level than others.

This paper draws on a number of related contributions. Obviously, we have derived the overall bargaining structure from Baron and Ferejohn (1989), which appears not to have been

[6] The *status quo* tariffs matter for welfare effects even though in the limiting case where the members of the Congress are very patient, they do not matter for the final levels of tariffs. The effect of historical patterns of protection on current protection is documented by Lavergne (1983) and Ray and Marvel (1984).

used in international economics previously. It should be emphasized, however, that extending their model of pure distribution to trade policy is not straightforward. Distortionary trade policy affects not only the division of the pie, but the size of the pie, and indeed we will see that payoffs are concave in the tariffs, so the randomization created by congressional bargaining tends to reduce welfare for all. In addition, considerable complexity is created by the presence of a non-trivial *status quo* (given by trade with initial tariffs, which may differ across industries), unlike in the original models. We are able to show that in the limit with very patient players (but only in the limit) these *status quo* tariffs do not matter for the outcome.

Our model is also closely related to Willmann (2004), McLaren and Karabay (2004) and Grossman and Helpman (2005). Willmann (2004) models the trade policy determination as a joint welfare maximization of all legislators whereas Grossman and Helpman (2005) model it as a joint welfare maximization of majority party legislators. On the other hand, McLaren and Karabay (2004) employ an election framework in which trade policy is predetermined. The common property of all of these papers is that there is not much scope for legislative procedures. In contrast, non-cooperative legislative bargaining is the core force behind trade policy formation in our model.

The rest of the paper is organized as follows. In the next section, we describe the basic model. In Section 3, equilibrium is characterized. We discuss possible extensions in Section 4. Section 5 concludes the analysis.

2 Model

Consider a small open economy populated with a unit measure of individuals living in N districts (where $N \geqslant 3$ and divisible by 3). There are $M = 4$ industries: one that supplies a homogeneous *numeraire* good (good 0) produced with labor alone, and three others, each of which supplies a homogenous manufacturing good (good i, where $i = 1, 2, 3$) produced with sector-specific capital alone. In particular, we assume that the production technology for good 0 yields 1 unit of output per unit of labor input, and the technology for each manufacturing good takes the following form: $f_i(K_i) = \theta K_i$, where K_i and θ denote the amount of the sector-specific capital used in sector i and the economy-wide productivity parameter, respectively.

Each district is composed of a homogeneous population; each individual residing in a given district is endowed with one unit of labor and also one unit of the same type of sector-specific capital. Let the number of districts producing good i be denoted by n_i such that $n_1 + n_2 + n_3 = N$. Without loss of generality, we assume that $n_1 \geq n_2 \geq n_3$. Districts that produce the same manufacturing good are populated by the same number of individuals. To save on notation, we let K_i denote both the total amount of type-i capital in a type-i district and the total number of individuals residing in a type-i district. Given that the population is of unit mass, $\sum_{i=1}^{3} n_i K_i = 1$. Let q_i denote the amount of good i produced in a district that hosts industry i, and Q_i denote the total amount of good i produced in the economy. Therefore, we have $q_i = \theta K_i$ and $Q_i = n_i q_i$.[7] This implies that $\sum_{i=1}^{3} Q_i = \theta \sum_{i=1}^{3} n_i K_i = \theta$. In addition, let p_i^* and p_i represent, respectively, the exogenous world price of good i and its domestic price. On the other hand, the *numeraire* good, good 0, has a world and domestic price equal to 1 (see footnote 11). Thus, the total rent that accrues to capital in district i is $p_i q_i = \theta p_i K_i$, and the total labor income earned in district i is K_i.

Each individual has an identical, additively separable quasi-linear utility function given by

$$u = c_0 + \sum_{i=1}^{3} u_i\left(c_i\right),$$

where c_0 is the consumption of good 0 and c_i represents the consumption of good $i = 1, 2, 3$. We assume that $u_i\left(c_i\right) = R_i c_i - (c_i^2/2)$, where $R_i > 0$ and assumed to be sufficiently large.[8] With these preferences, the domestic demand for good i, implicitly defined by $u_i'\left(d(p_i)\right) = p_i$, is given by $d(p_i) = R_i - p_i$. The linearity of demand is not crucial for the main results of our

[7] To make things simple and analytically tractable, aggregate output of each industry is perfectly inelastic in our setup. There is also some evidence that supply elasticities tend to be quite low in practice; see Marquez (1990) and Gagnon (2003). We conjecture that if supply could respond to price in each industry, equilibrium tariffs in each industry would be lower *ceteris paribus* for industries with a more elastic supply response.

[8] To be more precise, we require $R_i > p_i^* + \theta - Q_i$ for all $i = 1, 2, 3$. This ensures that demand for good i is positive at all prices that may occur in legislative bargaining. We also require $p_i^* \geqslant Q_i$ for each price to be positive. See Section 3 for the determination of optimal tariffs (hence optimal prices).

paper, but it simplifies the analysis and permits a closed-form solution. The indirect utility of an individual with income y is $y + s(\mathbf{p})$, where $\mathbf{p} = (p_1, p_2, p_3)$ is the vector of domestic prices,[9] and $s(\mathbf{p}) = \sum_{i=1}^{3} [u_i(d(p_i)) - p_i d(p_i)]$ is the resulting consumer surplus.

Each district is represented by a single legislator who is concerned only with the welfare of her own district. A district's welfare is the aggregate utility of all individuals in that district, which is equal to the total income plus the district's share in total consumer surplus and total tariff revenue (or subsidy cost) for each good. Hence, we can express the total welfare of a district that produces good i as (for $i \neq j \neq k$)

$$W_i(\mathbf{p}) = K_i + p_i\theta K_i + K_i \sum_{l=i,j,k} \frac{(R_l - p_l)^2}{2} + K_i \sum_{l=i,j,k} [(p_l - p_l^*)(R_l - p_l - Q_l)], \qquad (1)$$

where the first term is the district's labor income (equal to one unit of good 0 output per person), the second term is the capital rent, the third term is the consumer surplus captured by that district (recall that K_i also represents the population share of a district that produces good i), and the last term is its share of tariff revenue (or subsidy cost).[10] In addition, we denote $w_i(\mathbf{p})$ as the welfare of an individual with a stake in industry i, hence

$$w_i(\mathbf{p}) = 1 + p_i\theta + \sum_{l=i,j,k} \frac{(R_l - p_l)^2}{2} + \sum_{l=i,j,k} [(p_l - p_l^*)(R_l - p_l - Q_l)]. \qquad (2)$$

Before proceeding with the other details of our model, we would like to clarify the particular ways in which we use index letters to refer to industries. Unless specified otherwise, we use the index letters (i, j, k) only for the manufacturing goods. Moreover, when used in the same statement, each one of (i, j, k) refers to a distinct manufacturing good, so $i \neq j \neq k$. If we want to refer to a particular one of (i, j, k), then we will commonly say industry $l \in \{i, j, k\}$, and when necessary, industry $m \neq l$. The working of most of these can be seen in the per capita welfare function given above in equation (2).

Now, to continue with the model, we consider an infinite-horizon model. Every period, there is a set of prices at which individuals make their production and consumption decisions,

[9] We restrict the domestic price of good i to satisfy: $0 \leq p_i < \overline{p}_i$, where $\overline{p}_i = p_i^* + \frac{(R_i - p_i^*)^2 + (\theta - Q_i)^2}{2(\theta - Q_i)}$. These limits ensure that we get an interior solution in prices.

[10] We assume that tariff revenue (or subsidy cost) is distributed equally as a lump-sum transfer to each individual.

and enjoy the resulting welfare. The legislature can change the prevailing *status quo,* $\mathbf{p}^s = (p_1^s, p_2^s, p_3^s)$, by changing the domestic price of any good via legislative bargaining. We restrict the set of policy instruments available to the legislature and allow only for trade taxes and subsidies. A domestic price in excess of the world price implies an import tariff for an import good and an export subsidy for an export good. Domestic prices below world prices correspond to import subsidies and export taxes.[11]

The timing of the trade policy formation game in our model is based on the Baron-Ferejohn bargaining framework. This is a game of complete information. At the start of each period (before any production or consumption takes place),[12] a legislator is selected randomly (with equal probability for each legislator) to propose a tariff vector.[13] If the proposal receives a simple majority, it is immediately implemented and the legislature adjourns. Each district's welfare thereafter is evaluated at the new prices.[14] If the proposal does not receive a majority, the process is repeated with another legislator (possibly the same as in the previous period) to propose a new tariff bill. Bargaining continues until a bill is implemented.Districts continue to receive their *status quo* welfare in every period until an agreement is reached.

There are a couple of things to note. First, it is straightforward to show that the aggregate welfare, $W(\mathbf{p}) = \sum_{i=1}^{3} n_i W_i(\mathbf{p})$, is maximized at the free trade prices of the three goods. Hence, if the prices were set by a central authority (such as a President), free trade would prevail forever. Second, from equation (1), a manufacturing good affects (through its price) a district's welfare via three channels. The first one, the rent that accrues to the specific factor, is present if that good is produced in that district. The second one is the consumer surplus attained from the consumption of that good. The last one is the tariff revenue (or subsidy

[11] Without loss of generality, we assume that the tariff/subsidy on good 0 is equal to 0. Any tariff vector $\boldsymbol{\tau}'$ yielding domestic prices $\mathbf{p}' = \mathbf{p}^* + \boldsymbol{\tau}'$ with $\tau_0' \neq 0$ can be replaced by $\boldsymbol{\tau}'' \equiv \frac{1}{p_0'}[\boldsymbol{\tau}' - \tau_0' \mathbf{p}^*]$ yielding $\mathbf{p}'' = \mathbf{p}^* + \boldsymbol{\tau}''$ without changing relative prices or any real values. Given that good 0 is the *numeraire*, this implies that $p_0'' = p_0^* = 1$.

[12] To simplify, we assume that a period in the legislative game coincides with a production/consumption period.

[13] Therefore, the probability that the proposer represents industry i is equal to $\frac{n_i}{N}$.

[14] Note that once a proposal is accepted, the game ends so that there will be no future proposals. In practice, there is an opportunity cost to a legislature's time, and after a major trade bill is passed there is likely to be public pressure to move on to other issues for a considerable period of time before trade policy is once again placed on the legislative agenda. We discuss how to relax this assumption in Section 4.

cost) due to trade. The effect of price through the first channel is always positive whereas it is always negative through the second channel. Its effect through the third channel, on the other hand, can be positive or negative (in fact the third channel is concave in all three prices).

For the remainder of the analysis, we let $\boldsymbol{\tau} = (\tau_1, \tau_2, \tau_3)$, where $\tau_i = p_i - p_i^*$. Therefore, we can rewrite equation (2) as

$$w_i(\boldsymbol{\tau}) = 1 + (p_i^* + \tau_i)\theta + \sum_{l=i,j,k} \frac{(R_l - p_l^* - \tau_l)^2}{2} + \sum_{l=i,j,k} \tau_l \left(R_l - p_l^* - \tau_l - Q_l\right). \tag{3}$$

Notice that, given our parameter restrictions (see footnotes 8 and 9), the per capita welfare function given in equation (3) is concave in tariffs.

Also, let $\boldsymbol{\tau}^s = (\tau_1^s, \tau_2^s, \tau_3^s)$ describe the vector of *status quo* trade taxes (or subsidies). It will prove helpful to write down the per capita welfare change from the *status quo* when the Congress agrees on a tariff bill $\boldsymbol{\tau}$. To do so, simply evaluate equation (3) at $\boldsymbol{\tau} = \boldsymbol{\tau}^s$ and subtract it from $w_i(\boldsymbol{\tau})$, which leads to

$$w_i(\boldsymbol{\tau}) - w_i(\boldsymbol{\tau}^s) = \theta(\tau_i - \tau_i^s) - \frac{1}{2} \sum_{l=i,j,k} \left[(\tau_l + Q_l)^2 - (\tau_l^s + Q_l)^2\right]. \tag{4}$$

The first term on the right-hand side of equation (4) is the per capita change in capital rent while the second term indicates the per capita change in consumer surplus plus tariff revenue.

The first-best for each legislator is to maximize her district's welfare without any constraints. For a legislator representing industry i, let $\boldsymbol{\tau}^{U_i}$ denote the vector of trade taxes that the unconstrained maximization problem leads to, i.e., $\boldsymbol{\tau}^{U_i} = \arg\max_{\boldsymbol{\tau}} w_i(\boldsymbol{\tau})$. Maximizing equation (4) with respect to τ_i, τ_j and τ_k yields the following lemma.

Lemma 1. *Unconstrained maximization of* $w_i(\boldsymbol{\tau})$, $i = 1, 2, 3$, *yields (for* $i \neq j \neq k$*)*

$$\begin{aligned} \tau_i^{U_i} &= \theta - Q_i, \\ \tau_j^{U_i} &= -Q_j, \\ \tau_k^{U_i} &= -Q_k. \end{aligned}$$

Thus, a recognized (selected) legislator would ideally demand an import tariff (or an export subsidy) for the good her district produces (thereby protecting that industry) whereas an import subsidy (or an export tax) for the other goods.[15] Moreover, a producer in a sector that produces higher aggregate output Q_i will prefer a lower tariff (or export subsidy) for her own product than a producer in a sector that produces lower aggregate output. The reason is as follows. Focus for now on the case of an imported good. Recall the three channels discussed before through which the price of good i affects the per capita welfare of producers in industry i. Aggregate output, Q_i, in this case does not affect the first two channels (the rent and consumer surplus channels – of course, a higher Q_i implies higher total rent, but not higher rent per capital owner in industry i). What it does affect is the third channel, tariff revenue. A higher value for Q_i implies a weaker tariff revenue effect since, at a given price and the other parameters, a higher value of Q_i implies fewer imports, hence a lower marginal tariff revenue for a given increase in tariff.[16] Therefore, a higher value of Q_i implies a lower marginal benefit of the tariff, and a lower optimal tariff, from the point of view of a sector-i producer. Parallel reasoning holds for an exported good.

It is natural to assume that the *status quo* prices are in the range defined by the unconstrained maximization problem. For example, a legislator representing a district that produces good i has no reason to set τ_i above $\theta - Q_i$. Similarly, she has no reason to set $\tau_{j \neq i}$ below $-Q_j$. Hence, we make the following assumption.

Assumption 1. *The status quo prices satisfy the following:* $-Q_l \leq \tau_l^s = p_l^s - p_l^* \leq \theta - Q_l$, *for* $l = 1, 2, 3$.

Hence, a value of $\tau_i^s = \theta - Q_i$ corresponds to the case in which the *status-quo* tariff of good i is at its optimum for the districts that produce good i, while $\tau_i^s = -Q_i$ corresponds

[15] Since $Q_1 + Q_2 + Q_3 = \theta$, $\theta - Q_i > 0$ for all manufacturing goods.

[16] The same conclusion holds for a comparison between two industries i and j even if, although $Q_i > Q_j$, the demand parameter R_i is sufficiently higher than R_j that at a common tariff, imports of good i exceed those of good j. The reason is that an increase in R_i, holding all prices and other parameters constant, raises industry i imports, increasing the marginal tariff revenue from the tariff on good i, but at the same time raises domestic consumption of good i, raising the marginal consumer surplus loss from the tariff on good i. The two effects cancel each other out, with the result that the demand parameters R_i have no effect on tariff preferences.

to the case in which it is at its optimum for the districts that produce good $j \neq i$.

We can also write the *ex post* change in per capita payoffs by plugging the tariffs given in Lemma 1 into equation (4)

$$\begin{aligned} w_i(\boldsymbol{\tau}^{U_i}) - w_i(\boldsymbol{\tau}^s) &= \theta\left[(\theta - Q_i) - \tau_i^s\right] - \frac{\theta^2 - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2}{2}, \\ w_m(\boldsymbol{\tau}^{U_i}) - w_m(\boldsymbol{\tau}^s) &= -\theta\left[Q_m + \tau_m^s\right] - \frac{\theta^2 - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2}{2}, \text{ for } m = j, k. \end{aligned} \tag{5}$$

For a given value of θ and given Assumption 1, it is clear from these expressions that the per capita welfare change each industry obtains positively depends on its own tariff and negatively on other two tariffs, regardless of which industry's first-best we are in. In other words, $w_l(\boldsymbol{\tau}^{U_i}) - w_l(\boldsymbol{\tau}^s)$ is decreasing in τ_l^s and increasing in $\tau_{m\neq l}^s$ for $l, m \in \{i, j, k\}$. For an individual who has a stake in industry l, a low value of τ_l^s corresponds to the case in which the *status quo* tariff for good l is significantly different than its optimum value, and hence, there is room for welfare improvement. As τ_l^s increases, the potential welfare gain via the change in the price of good l gradually diminishes and reaches zero when $\tau_l^s = \theta - Q_l$. This is the case in which the *status quo* tariff for good l is already at its optimum for industry l agents. A parallel argument can be made for $\tau_{m\neq l}^s$. For an individual who has a stake in industry l, a high value of $\tau_{m\neq l}^s$ means that there is a big room for welfare improvement by lowering the price of good m. As $\tau_{m\neq l}^s$ goes down, the potential improvement via the change in the price of good m becomes lower and reaches zero when $\tau_{m\neq l}^s = -Q_m$. Again, this is the case when the *status quo* tariff for good m is already at its optimum for industry l agents.

Furthermore, $w_l(\boldsymbol{\tau}^{U_i}) - w_l(\boldsymbol{\tau}^s)$ is decreasing in Q_l and increasing in $Q_{m\neq l}$ for $l, m \in \{i, j, k\}$. As stated before, aggregate output of each industry affects individual welfare via the third channel, namely the tariff revenue effect. We know from Lemma 1 that each individual prefers a price above the world price for the good in which she has a direct stake and a price below the world price for the other goods. Consider imported goods for the moment. This implies that each individual receives a tariff revenue for its own industry's good and incurs a subsidy cost for other goods. A higher value of Q_l ($Q_{m\neq l}$) implies fewer imports, hence a lower tariff revenue (subsidy cost). A similar reasoning holds for exported goods.

Moreover, in light of the assumed range for the *status quo* tariffs, it is possible to rank the welfare change from the best to worst across individuals with stakes in different industries. Note that, for a given τ_j^s and τ_k^s, $w_i(\boldsymbol{\tau}^{U_i}) - w_i(\boldsymbol{\tau}^s)$ attains its minimum at $\tau_i^s = \theta - Q_i$. Evaluated at this value, $w_i(\boldsymbol{\tau}^{U_i}) - w_i(\boldsymbol{\tau}^s) = \frac{\left(\tau_j^s + Q_j\right)^2 + \left(\tau_k^s + Q_k\right)^2}{2} \geqslant 0$, so there is always a welfare gain for individuals who have a stake in industry i.[17] On the other hand, for individuals associated with industries j and k, whether there is a welfare gain or loss depends on the values of τ_l^s, $\forall l$. Given that $-Q_l \leq \tau_l^s \leq \theta - Q_l$, it is easy to see that the maximum value of $\left[w_j(\boldsymbol{\tau}^{U_i}) - w_j(\boldsymbol{\tau}^s) + w_k(\boldsymbol{\tau}^{U_i}) - w_k(\boldsymbol{\tau}^s)\right]$ is zero, implying that at least one of the two must be negative (except for when $(\tau_i^s, \tau_j^s, \tau_k^s) = (\theta - Q_i, \theta - Q_j, \theta - Q_k)$ or $(\theta - Q_i, -Q_j, -Q_k)$, in which case both of them are zero). Moreover, if $\tau_j^s + Q_j > \tau_k^s + Q_k$, then $w_j(\boldsymbol{\tau}^{U_i}) - w_j(\boldsymbol{\tau}^s) < w_k(\boldsymbol{\tau}^{U_i}) - w_k(\boldsymbol{\tau}^s)$ (and vice versa). However, per capita welfare gain accruing to industry i is at least as much as any possible welfare gain accruing to other industries. This is due to the agenda-setting power of the legislators representing industry i.

3 Characterization of equilibrium

In this section, we will initially investigate the properties of the bargaining outcome. Next, we will focus on two scenarios. First, as a benchmark, we will assume that the legislators are very impatient such that their common discount factor (denoted by δ) approaches 0 in the limit. After that, we will consider the opposite scenario in which legislators are very patient so that δ approaches 1 in the limit. The former scenario will show us the equilibrium under the static game whereas the latter scenario will show us the equilibrium under the dynamic game. Later, in Section 4, we discuss the case of intermediate values of δ. Which value of δ is most realistic is an empirical question; however, if we interpret a 'period' to be a congressional term (which is two years in the US context), then the most natural

[17] When $\tau_i^s = \theta - Q_i$, $\tau_j^s = -Q_j$ and $\tau_k^s = -Q_k$, the *status quo* tariffs coincide with the optimal tariffs; i.e., $\boldsymbol{\tau}^s = \boldsymbol{\tau}^{U_i}$. In this case, the welfare change will be zero.

interpretation of δ is the re-election rate for a typical member. Since re-election rates tend to be quite high, this interpretation argues for a high value for δ as more realistic than a low one.[18]

As common in multi-person bargaining problems, there are many subgame perfect equilibria (SPE) in this game.[19] We focus on stationary subgame perfect equilibrium (SSPE) whereby the continuation payoffs for each structurally equivalent subgame are the same.[20] In a stationary equilibrium, a legislator who is recognized to make a proposal in any two different sessions behaves the same way in both sessions (in the case of a mixed-strategy equilibrium, this means choosing the same probability distribution over offers). Hence, stationary equilibria are history-independent.

Let the per-period equilibrium welfare of a district producing good i, evaluated at the beginning of a period, before the proposer has been selected, be denoted as V_i. This is also the per-period equilibrium welfare (net of *status quo* welfare) a district expects in the following period in the event that the period ends without a bill passed, and so loosely speaking, we will also call it the 'continuation payoff.' Since a random proposer is selected every period, the outcome of legislative bargaining depends on the identity of the proposer. In this sense, the outcome is *ex ante* uncertain. Hence, we use the *ex ante* expected per-person welfare change due to bargaining as the basis for comparison among individuals with stakes in different sectors. To this purpose, let v_i denote the continuation payoff of an individual with a stake in industry i, thus $v_i = \frac{V_i}{K_i}$.

When a legislator is recognized to make a proposal, she has an incentive to propose a tariff bill that will be accepted, since if rejected, she faces the risk that her district might be worse off with a bill adopted in the future. In equilibrium, in accordance with the "Riker's (1962)

[18] According to figures from OpenSecrets.org, from 1964 to 2010 the average re-election rate for members of the US House of Representatives was 93%.

[19] Baron and Ferejohn (1989) show that any outcome (in their game that means any division of the dollar) can be supported as an SPE using infinitely nested punishment strategies as long as there are at least five players and the discount factor is sufficiently high. Li (2009) shows that even with three players, there is a vast multiplicity of SPE.

[20] Baron and Kalai (1993) argue that stationarity is an attractive restriction since it is the "simplest" equilibrium such that it requires the fewest computations by agents. We comment on limitations of stationarity in Section 4.

size principle," any proposal will be accepted with the minimal number of industries that constitute a quorum of districts. In other words, the proposer forms a 'minimum winning coalition' by choosing at most one 'coalition partner.'

We assume that a legislator votes yes to a proposal *if and only if* the benefits accruing to her district from the current proposal is at least as high as the expected payoff it obtains in case the proposal does not pass. In other words, we rule out weakly dominated strategies. Suppose a legislator who represents a district that produces good i is recognized to make a proposal and she proposes a tariff vector $\boldsymbol{\tau}^i$. Then, legislators who represent districts that produce good $j \neq i$ would say yes if and only if[21]

$$\frac{w_j(\boldsymbol{\tau}^i)}{1-\delta} \;\geq\; w_j(\boldsymbol{\tau}^s) + \frac{\delta v_j}{1-\delta},$$

or

$$w_j(\boldsymbol{\tau}) \;\geq\; (1-\delta)w_j(\boldsymbol{\tau}^s) + \delta v_j. \tag{6}$$

The left-hand side of the above inequality indicates the per capita discounted total welfare a district that produces good j obtains at the proposed prices, whereas the right-hand side is the expected per capita discounted payoff if bargaining is carried over to the following period (the *status quo* welfare for the current period and the continuation welfare thereafter).

The continuation values v_1, v_2 and v_3 are endogenous, as they are determined by the equilibrium tariff bill and the equilibrium probability of being in a winning coalition. However, any recognized legislator will take them as given when designing the tariff bill.

3.1 Scenario 1: $\lim \delta \to 0$

In the limit as δ goes to 0, the constraint given in equation (6) becomes $w_j(\boldsymbol{\tau}) \geq w_j(\boldsymbol{\tau}^s)$. Hence, the recognized industry-i representative's maximization problem can be stated as

$$\max_{\boldsymbol{\tau}} w_i(\boldsymbol{\tau}) \text{ s.t. } w_j(\boldsymbol{\tau}) \geq w_j(\boldsymbol{\tau}^s). \tag{7}$$

We will see that in this case different industries receive very different tariffs in equilibrium, even if they have the same economic characteristics, a feature in common with the case in

[21] Note that districts that accommodate the same industry are identical, so if this inequality holds for one, then it also holds for all.

which δ approaches 1 analyzed below. However, there is no randomness in the choice of coalition partners, and the proposer will always choose tariffs to make itself better off than the *status quo* – in both respects a contrast with the case as δ approaches 1, as we shall see.

Since the legislators do not care about the future, the problem is static. If industry i represents a majority in the Congress, i.e., $\frac{n_i}{N} > \frac{1}{2}$, there is no need for another industry to support the current proposal. Therefore, the problem turns into the unconstrained maximization problem analyzed in Lemma 1. On the other hand, if industry i does not constitute a majority in the Congress, it will choose as a coalition partner the industry that is easiest to persuade, which turns out to be the industry $j \neq i$ with the lowest size-adjusted *status-quo* tariff. The results can be summarized as follows. The proof of this proposition, and of all subsequent propositions (with the exception of Proposition 3) is omitted here but can be found in the working paper Celik, Karabay and McLaren (2011).

Proposition 1. *Consider the limiting case as δ approaches 0. A selected legislator representing a district which produces good i proposes $\boldsymbol{\tau}^i = \boldsymbol{\tau}^{U_i}$ in the unique SSPE if industry i represents a majority in the Congress or if there is another industry $l \neq i$ for which $w_l(\boldsymbol{\tau}^{U_i}) \geq w_l(\boldsymbol{\tau}^s)$. Otherwise, she chooses industry j as a coalition partner, where $\tau_j^s + Q_j < \tau_k^s + Q_k$, $j, k \neq i$,[22] and proposes tariffs $\tau_i = \sqrt{D} - Q_i$, $\tau_j = \theta - \sqrt{D} - Q_j$, and $\tau_k = -Q_k$, where $D = \frac{1}{2}\left[\theta^2 - 2(\tau_j^s + Q_j)\theta + \sum_{l=i,j,k}(\tau_l^s + Q_l)^2\right]$ and $D \in [\frac{\theta^2}{4}, \theta^2]$. The first proposal receives a majority vote, so the legislature adjourns after the first session. If the proposer has a majority (or the constraint in expression (7)) does not bind), it receives its unconstrained maximum payoff; otherwise, the proposer and coalition partner receive at least their status quo payoffs, and the industry left out of the coalition receives at most its status quo payoff.*

As a result, when industry i has a majority in the Congress or when the constraint in the maximization problem (7) does not bind when evaluated at $\boldsymbol{\tau} = \boldsymbol{\tau}^{U_i}$ for one of the other two industries, the industry-i representative can achieve its first best. Otherwise, in order

[22] In the knife-edge case in which $\tau_j^s + Q_j = \tau_k^s + Q_k$, either industry j or industry k can be chosen as a coalition partner.

to obtain the support of the coalition partner, compared to its first best, the proposer needs to compromise by proposing a lower tariff for her own industry and a higher tariff for the coalition industry. Nevertheless, controlling for the industry size, the tariff is the highest for the industry represented by the proposer and lowest for the excluded industry.

The logic of coalition partner selection in the event that the proposer does not have a majority can be understood as follows. Let us focus on the case when $w_l(\boldsymbol{\tau}^{U_i}) < w_l(\boldsymbol{\tau}^s)$ for both $l = j, k$, so the constraint the recognized industry-i legislator faces is binding. The industry-i legislator strictly prefers industry j over industry k as a partner iff $\tau_j^s + Q_j < \tau_k^s + Q_k$. To obtain the support of the coalition partner, the proposed tariff vector must provide the coalition partner a welfare that is at least as much as the coalition partner's the *status quo* welfare. We have also established that the optimal tariff for each industry is a function of industry outputs. As a result, the resulting tariff vector will be a function of the *status quo* tariffs as well as industry outputs. Consider first the thought experiment that $Q_j = Q_k$. Since per capita *status quo* welfare is increasing in its own industry's *status quo* tariff, the industry i legislator will choose a coalition partner with a lower *status quo* tariff. Now, consider instead the case in which $\tau_j^s = \tau_k^s$. The industry i legislator will choose the smaller industry as the coalition partner since the larger industry will generate fewer imports, and so a given tariff would create a small tariff revenue. As a result, industry i would receive less benefit from a tariff on a large industry than on a small industry. As a result, from industry i's perspective, the best possible $\boldsymbol{\tau}^i$ vector can be reached by choosing the industry with the lower *status quo* tariff plus total output combination.

3.2 Scenario 2: $\lim \delta \to 1$

In the limit as δ goes to 1, the constraint given in equation (6) becomes $w_j(\boldsymbol{\tau}) \geq v_j$. It can be shown that the inequality holds with equality,[23] so the recognized industry-i representative's

[23] To be more precise, when $w_j(\boldsymbol{\tau}^s) < v_j$ ($w_j(\boldsymbol{\tau}^s) > v_j$), the proposer offers the coalition partner an *ex post* payoff that is infinitesimally below (above) v_j. In either case, $\lim_{\delta \to 1} w_j(\boldsymbol{\tau}) = v_j$. The key difference here with Scenario 1 is that in Scenario 1 the coalition partner must compare the proposal with the *status quo* tariffs, and *status quo* tariffs might happen to be very unattractive for a given coalition partner, while in Scenario 2 the *status quo* tariffs are irrelevant and the coalition partner compares the proposal with the future payoff

maximization problem can be stated as

$$\max_{\boldsymbol{\tau}} w_i(\boldsymbol{\tau}) \text{ s.t. } w_j(\boldsymbol{\tau}) = v_j. \tag{8}$$

As defined before, v_j is the welfare an individual with a stake in industry j expects at the beginning of a period; hence, it is a weighted average of possible *ex post* payoffs the individual may obtain depending on the identity of the proposer. Since the *ex post* per capita welfare function given in equation (3) is independent of *status quo* tariffs, so are the resulting equilibrium tariffs and the resulting payoffs found as a solution to equation (8). Intuitively, when legislators are very patient, they place no weight on one-period gains (or losses) regardless of how large they can be.

As mentioned earlier, a proposal will be accepted when majority support is obtained in the Congress. As a result, there are two possible cases to be considered. We first analyze the situation when one of the manufacturing goods is sufficiently dispersed across the country so that the districts producing it have a majority representation in the Congress ($\frac{n_i}{N} > \frac{1}{2}$). We next turn attention to a more even distribution of industries in which no manufacturing good has a majority representation in the Congress.

3.2.1 Case 1: $\frac{n_3}{N} \leq \frac{n_2}{N} < \frac{1}{2} < \frac{n_1}{N}$

Here, since industry 1 is sufficiently large (i.e., it has the necessary number of seats in the legislature) to set trade policy without the consent of other industries, when a legislator representing industry 1 is recognized to make a proposal, she will propose $\boldsymbol{\tau} = \boldsymbol{\tau}^{U_1}$. In contrast, legislators representing either industry 2 or 3 need the support of industry 1 for their proposals to be accepted. Each of them will optimally propose a tariff vector that will be accepted by industry 1, because in case of rejection, even though they may obtain a high *status quo* welfare for that period, they run the risk of getting $w(\boldsymbol{\tau}^{U_1})$ forever starting from the following period. In contrast, by proposing a tariff vector that will be accepted by industry 1, they can ensure an infinite stream of a positive increment over $w(\boldsymbol{\tau}^{U_1})$ for their districts. We summarize these observations in Proposition 2.

from continuing the bargaining.

Proposition 2. *When $\frac{n_1}{N} > \frac{1}{2}$, in the limit as $\delta \to 1$ any selected legislator proposes $\boldsymbol{\tau} = \boldsymbol{\tau}^{U_1}$ in the unique SSPE. The first proposal receives a majority vote, so the legislature adjourns after the first session. The equilibrium per capita continuation payoffs are $v_i = w_i(\boldsymbol{\tau}^{U_1})$, $i = 1, 2, 3$.*[24]

We show that independent of the identity of the proposer, an agreement is always reached in the first period. We do so, for $j = 2$, 3, by comparing industry j's payoff of proposing a tariff vector that will be accepted by industry 1 to proposing one that will be rejected and show that the former dominates the latter in the limit as δ goes to 1.

Here, independent of the identity of the proposer, the majority industry obtains its unconstrained maximization tariffs. This is different than the previous scenario when $\delta \to 0$, in which case the majority industry can obtain its unconstrained maximization tariffs only if it has the proposer power.

Moreover, in Case 1, the *ex ante* expected per capita payoffs are equal to the *ex post* per capita payoffs ($v_i - w_i(\boldsymbol{\tau}^s) = w_i - w_i(\boldsymbol{\tau}^s)$, $\forall i$) since in all subgames legislators propose $\boldsymbol{\tau} = \boldsymbol{\tau}^{U_1}$ as $\delta \to 1$. Therefore, the analysis of the *ex ante* expected per capita welfare change also follows our previous discussion following Lemma 1.

In short, in Case 1, the majority industry sets a positive tariff for itself and a negative tariff for all other industries, and does so without any strategic constraint since it needs no coalition partners or consent. Now we consider the more interesting case in which no manufacturing industry can control the majority of seats in the legislature, so a legislator who can propose a trade bill needs the support of the legislators representing at least one other industry. To get their votes, she has to offer them a more favorable tariff compared to the unconstrained case, which moves the final outcome away from her first-best. This is what we analyze next.

[24] To be more precise, legislators representing industries 2 and 3 propose tariff vectors that approach $\boldsymbol{\tau}^{U_1}$ in the limit as δ goes to 1. For instance, an industry-2 representative proposes $(\tau_1, \tau_2, \tau_3) = (\theta - Q_1 - \varepsilon(\delta), -Q_2 + \varepsilon(\delta), -Q_3)$, where $\lim_{\delta \to 1} \varepsilon(\delta) = 0$. Hence, continuation payoffs also satisfy $\lim_{\delta \to 1} v_i = w_i(\boldsymbol{\tau}^{U_1})$, $\forall i$.

3.2.2 Case 2: $\frac{n_3}{N} \leq \frac{n_2}{N} \leq \frac{n_1}{N} \leq \frac{1}{2}$

Here, we analyze the bargaining outcome when no industry is highly dispersed throughout the economy. In this case, unlike in Case 1, in order to attain a simple majority of the votes, a recognized industry-i legislator will have to compromise with at least one other industry, say industry j – thus leaving industry k out of the winning coalition. In order to obtain the support of the industry-j legislators, the proposal should provide industry-j districts an *ex post* welfare as high as the payoff they obtain if the bargaining is carried over to the next period.

As in Baron and Ferejohn (1989), in Case 2, in an SSPE with δ close to 1, generically there is an equilibrium in which the proposer randomizes between the two other industries in choosing a coalition partner. The proof is in the Appendix, but the crux of the idea can be summarized as follows. In an SSPE, by definition, if proposer i ever chooses industry j with probability 1, then (due to stationarity) she *always* will choose industry j with probability 1. But this means that industry j has enormous bargaining power, and consequently at any given date, it will be less attractive for i to choose j than the other industry – a contradiction. Let s denote the probability that i will choose j, and hold constant the behavior of the other players when they are proposers. A reduction in s lowers j's continuation value, hence bargaining power, and raises k's ($i \neq k \neq j$). Therefore, a critical value of s exists at which i is indifferent between the two potential coalition partners, and this is the equilibrium value. The proper proof must take into account boundary conditions as well as the fact that each player's probability over partners is endogenous, and it turns out that when all three players' probabilities are determined together, the equilibrium choice of probabilities is not unique, although the payoffs are. In the proof of Proposition 3, we first show that when $\delta \to 1$ an SSPE exists in which all legislators randomize between the other two industries. We then prove that all SSPE are payoff equivalent. We now present the main result.

Proposition 3. *When $\frac{n_1}{N} \leq \frac{1}{2}$, in the limit as $\delta \to 1$ an SSPE exists in which a selected legislator representing a district which produces good i proposes a tariff $\tau_i = \frac{2}{3}\theta - Q_i$ for the good her district produces, a tariff $\tau_j = \frac{1}{3}\theta - Q_j$ for good $j \neq i$ where j is selected randomly,* *and a tariff $\tau_k = -Q_k$ for the remaining good k. The first proposal receives a majority vote, so the legislature adjourns after the first session. The ex post per capita payoffs are $w_i = w_i(\boldsymbol{\tau}^{\mathbf{s}}) + \theta[(\frac{2\theta}{3} - Q_i) - \tau_i^s] - \frac{\frac{5\theta^2}{9} - \sum_{l=i,j,k}\left[\left(\tau_l^s + Q_l\right)^2\right]}{2}$ for the industry the proposer represents, $w_j = w_j(\boldsymbol{\tau}^{\mathbf{s}}) + \theta[(\frac{\theta}{3} - Q_j) - \tau_j^s] - \frac{\frac{5\theta^2}{9} - \sum_{l=i,j,k}\left[\left(\tau_l^s + Q_l\right)^2\right]}{2}$ for the industry the coalition partner represents, $w_k = w_k(\boldsymbol{\tau}^{\mathbf{s}}) + \theta[-Q_k - \tau_k^s] - \frac{\frac{5\theta^2}{9} - \sum_{l=i,j,k}\left[\left(\tau_l^s + Q_l\right)^2\right]}{2}$ for the remaining industry that is outside the coalition.*

Proof. *See Appendix.*

Note also that since $\delta \to 1$, *ex ante* expected per capita payoffs for any industry i before the proposer is determined are the same as the *ex post* payoffs that industry would obtain if it was chosen *ex post* as the coalition partner, which is given by $v_i = w_i(\boldsymbol{\tau}^{\mathbf{s}}) + \theta[(\frac{\theta}{3} - Q_i) - \tau_i^s] - \frac{\frac{5\theta^2}{9} - \sum_{l=i,j,k}\left[\left(\tau_l^s + Q_l\right)^2\right]}{2}$ for $i \in \{1, 2, 3\}$.

Compared to Case 1, since the proposer needs the approval of one other industry, she compromises by proposing a lower price for her own industry and a higher price for the industry selected as the coalition partner. Below, we summarize the important properties of this SSPE.

1. For given values of θ, τ_i^s and Q_i, $\forall i \in \{1, 2, 3\}$, the continuation payoff of any district (or expected welfare change of any individual) is in between the highest and the lowest continuation payoffs obtained under Case 1. This makes sense since no industry is dispersed enough to control the legislature single-handedly. Therefore, no industry is either very strong or very weak. Thus, compared to Case 1, districts producing goods 2 and 3 have significantly higher bargaining power, which, in turn, reduces the welfare gain (may even result in welfare loss) districts that produce good 1 expect.

2. Per capita expected welfare change of each individual with a stake in industry i is decreasing in τ_i^s and Q_i and increasing in $\tau_{j\neq i}^s$ and $Q_{j\neq i}$ as in Case 1 for exactly the same reasons stated before. Moreover, depending on the values of τ_i^s, the *ex ante* expected welfare change can be positive or negative for each industry, and it can be

positive for all of them or negative for all of them.[25] In contrast, in Case 1, industry 1 always obtains a welfare gain, and, independent of $\boldsymbol{\tau}^s$, there is always at least one industry (must be either industry 2 or 3) which experiences a welfare loss.

3. The ranking of *ex ante* expected welfare gains for individuals with stakes in different industries depends only on the values of τ_i^s and Q_i, $\forall i \in \{1,2,3\}$ and are independent of industry dispersion (as long as $\frac{n_i}{N} \leq \frac{1}{2}$ for all i). This last point may be surprising: an industry that dominates twice as many congressional districts as another receives no net advantage from that fact (as long as it does not have a majority) – even though it will thereby have twice the probability that one of its representatives will be the proposer. The reason comes from the dynamic nature of the bargaining. If industry i has a large minority of the seats and thus a high probability of being the proposer, it will gain from a high tariff if it is the proposer; and in any round where i is not the proposer, the probability that it will become so in the next round is high. But the other representatives will understand that industry i will therefore drive a tough bargain if another industry is the proposer and chooses i as a coalition partner, so i will rarely be chosen as a coalition partner. Industry i's benefit from being the proposer with high probability is exactly cancelled out by its loss from being excluded from the coalition with high probability when it is not the proposer.[26]

We should note that in the mixed strategy equilibria, randomization probabilities are not unique although they all lead to the same set of payoffs (and the same tariffs conditional on proposer and coalition partner), as stated in the following proposition.[27]

[25] For instance, when $(\tau_1^s, \tau_2^s, \tau_3^s) = (\theta - Q_1, \theta - Q_2, \theta - Q_3)$, $v_i - w_i(\boldsymbol{\tau}^s) = \frac{5}{9}\theta^2 > 0$ for all i. Similarly, when $(\tau_1^s, \tau_2^s, \tau_3^s) = (\frac{\theta}{3} - Q_1, \frac{\theta}{3} - Q_2, \frac{\theta}{3} - Q_3)$, $v_i - w_i(\boldsymbol{\tau}^s) = -\frac{1}{9}\theta^2 < 0$ for all i.

[26] This can be seen formally from the proof in the Appendix. Equation (10) shows how industry j's *ex ante* expected benefit can be written in terms of probabilities of being the proposer ($\frac{n_j}{N}$) and the probability of being the coalition partner $\left(s_{ij}\frac{n_i}{N} + s_{kj}\frac{n_k}{N}\right)$ in addition to parameters. The remainder of the proof shows that these probability terms cancel out, implying that any increase in $\frac{n_j}{N}$ and corresponding decrease in $\frac{n_i}{N}$ or $\frac{n_k}{N}$ results in adjustment of s_{ij} and s_{kj} (the probability that j is picked by i or k) so that the probability of being a coalition partner falls by $1/\lambda = 2$ times as much as the increase in $\frac{n_j}{N}$.

[27] The same multiplicity is also present in the standard symmetric Baron-Ferejohn game, see Celik and Karabay (2013). Eraslan (2002) shows that all SSPE in the Baron-Ferejohn game are payoff equivalent when the recognition probabilities are asymmetric.

Proposition 4. *All SSPE are payoff-equivalent.*

More broadly, Proposition 3 provides a number of characteristics for the equilibrium that are strikingly different from characteristics of models without dynamic bargaining and that may be useful in empirical work or in interpreting tariff history. First, note that the equilibrium tariffs are a function of economic fundamentals such as industry size Q_i, but they are also a function of political variables at the time of the congressional negotiation. Note that after controlling for industry size, the tariff is highest for the industry represented by the proposer and lowest for the excluded industry. The identity of the proposer is most plausibly determined by the party with the majority in the Congress at the time of the tariff bill together with internal party competition for the leadership post; years later, even with different leadership, the tariff structure will be determined partly by the political conditions at the time of the tariff bill. Even conditional on the identity of the proposer, the tariff structure is affected very much by the identity of the coalition partner, which receives a tariff premium, and this choice is necessarily randomized due to the mixed equilibrium required by the dynamic logic of the model. In empirical work, one might imagine a number of proxies for the 'proposer,' including, in the US case, the chairmanship of the House Ways and Means Committee or the Senate Finance committee; and one might think of using an 'aye' vote on the most recent tariff bill as a proxy for the theoretical construct of the 'coalition.' Both should have a significant correlation with tariffs.

Another way of looking at this is that *the logic of congressional bargaining imposes different levels of protection for different industries even if all industries are ex ante identical.* Suppose that $K_1 = K_2 = K_3$, $n_1 = n_2 = n_3$, $p_1^s = p_2^s = p_3^s$, and $p_1^* = p_2^* = p_3^*$. Then most other models would predict $\tau_1 = \tau_2 = \tau_3$. Grossman and Helpman (2005) would predict the same tariff for each industry within the same party. However, in our model, there would be three separate levels of tariff, even for observationally equivalent industries. Thus, the empirical predictions of this model are quite different from those of other models.

Second, note that often representatives in the Congress in this model will vote for a bill that they do not like, because with the dynamic bargaining, they are afraid that if the current bill does not pass, it will be replaced with something that they like even less. This is a stark contrast not only with static models, but also with Scenario 1 of this model (in which δ approaches 0). This can be seen clearly by examining point 2 above. It is easy to find parameters such that the *ex ante* expected welfare change resulting from the bargaining is negative for each industry. For example, suppose that the *status quo* is free trade in a symmetric economy, so that $\tau_i^s = 0$ and $Q_i = \frac{\theta}{3}$, $\forall i \in \{1, 2, 3\}$. In this case, the *ex ante* expected welfare change for each industry is negative (as can be seen from the equation immediately after Proposition 3), since each industry knows that total welfare will fall as tariffs are introduced by the bargaining, but no-one knows who the *ex post* beneficiary will be. Consequently, the *ex post* welfare change for the coalition partner as a result of the bargaining will be negative. This implies that *the coalition partner will vote for a tariff bill that lowers its utility relative to the status quo* (in this case, a tariff bill that gives no tariff at all to its own products, while providing a positive tariff to the proposer and a negative one to the excluded industry). This is because it fears the possibility of being the excluded industry in the next round. It will support the bill as some members of the Congress from manufacturing districts supported the tariff-reducing Mills bill of 1888: "with heavy hearts" (Tarbell, 1911, p. 165).

Indeed, it is easy to find cases in which the *proposer* proposes and votes for a bill that lowers its utility relative to the *status quo*, because it is aware that it might not be the proposer in the next round and may face something worse. As an example, suppose that the *status quo* tariffs are close to the unconstrained optimum tariffs $\boldsymbol{\tau}^{U_i}$ for industry i from Lemma 1. In this case, industry i knows that if it is not the proposer, those tariffs will be changed and it will lose utility, so it will cut its losses and find a tariff bill that its coalition partner will agree to now. This is in the same spirit as when protectionist Republicans, following a rousing speech in which President Cleveland made the case for free trade and the political momentum was moving in that direction, struggled to come up with a strategy for reducing tariffs in a way that would blunt that momentum: "Protection must be preserved. If its operations were to be corrected, this must be done by its friends, not its enemies."

(Tarbell, 1911, p. 154.)

Of course, this paradoxical outcome cannot arise if the *status quo* tariffs were determined endogenously by a past round of the bargaining in our model.[28] In that case, the most attractive possible *status quo* for the current proposer would be the outcome of the game in the past in which that current proposer was then the proposer, so clearly she will not propose anything that will make herself worse off. However, one can think of the *status quo* tariffs as the result of bargaining in an earlier era in which the parameters of the model were different. For example, in the nineteenth century taxes were an important source of federal revenues; the introduction of income taxes fundamentally changed the mapping from tariffs to outcomes, changing the game, and there would be no reason to expect previously enacted tariffs to be outcomes of the new game.

4 Discussion

In this section, we discuss four points related to possible extensions of our model. The first one regards the number of industries. We have, for simplicity, considered only three (manufacturing) industries. It is possible to generalize this to a larger number of industries. The main intuition still holds. If one industry has majority representation, then that industry gains the most. On the other hand, if none of the industries has a majority, then it is the total production and *status quo* tariff/subsidy, $\tau_i^s + Q_i$, that determine the gains for each industry.[29] For example, consider four industries with the following distribution: $\frac{n_1}{N} = 0.4$, $\frac{n_2}{N} = 0.3$, $\frac{n_3}{N} = 0.25$, $\frac{n_4}{N} = 0.05$. In this example, industry 4 is too small to be valuable as a partner in any coalition. However, when welfare changes from bargaining are considered, it is still possible for industry 4 to benefit more (or lose less) than others as long as $\tau_4^s + Q_4$ is small enough and $\tau_i^s + Q_i$'s for $i = 1, 2, 3$ are large enough. Moreover, assuming symmetric

[28] We analyze this case in Appendix B (starting on page 57) of our working paper Celik, Karabay and McLaren (2011). With *status quo* tariffs restricted in this way, the equilibrium obtained in the limit as δ approaches 1 can be shown to hold exactly for a range $\delta \in [\tilde{\delta}, 1)$, with $\tilde{\delta} < 1$.

[29] The underlying reasons are the same as in Section 3.1. Holding Q_i constant across industries, raising an industry's *status-quo* tariff raises its *status-quo* welfare, and holding *status-quo* tariffs constant, increasing an industry's Q_i lowers its equilibrium tariff for any given coalition structure.

dispersion of industries, as the number of industries increases, the *ex post* tariffs (as well as the *ex ante* expected tariffs) decrease.[30]

The second point is about the bargaining procedure. We have assumed that once an agreement is reached, bargaining ends. Instead, assume that legislators bargain every period and that if an agreement is reached in the previous period, it constitutes the *status quo* for the current period. In the context of a three-player divide-the-dollar game, Kalandrakis (2004) shows that there is a Markov equilibrium in which, irrespective of the initial *status quo* payoffs, every proposer is able to take the whole dollar (after a few iterations of the game). The intuition is as follows. In every period, there will be a random proposer who chooses a division that will be accepted by at least one other player. However, this division will always have at least one player not receiving anything. Since this division constitutes the *status quo* for the following period, the proposer in the next period selects the player with zero payoff as the coalition partner, and is thus able to take the whole dollar for herself. The same logic is also at work in our model. In every period, one industry, say industry j, will be left out of the winning coalition, getting a tariff $\tau_j = -Q_j$, and having the lowest *status quo* payoff in the following period. Thus, if a legislator representing industry $i \neq j$ becomes the proposer in the following period, she chooses industry j as her coalition partner, and is able to appropriate higher gains. After some time in the game, whoever is the proposer (say industry i) will propose $\boldsymbol{\tau}^{U_i}$ (unconstrained maximization tariffs) and it will be accepted. This result is true irrespective of the discount factor and the *status quo* tariffs. However, although an industry is able to achieve its first-best when its representative becomes the proposer, it receives the

[30] Assume that there are M symmetrically dispersed manufacturing industries such that $\frac{n_1}{N} = ... = \frac{n_M}{N}$. To obtain majority, the support of $\frac{M-1}{2}$ other industries are required besides the industry the proposer belongs. Then, the respective *ex post* tariffs turn out to be:

$$\begin{aligned} \tau_i &= \frac{M+1}{2M}\theta - Q_i, \text{ for the proposer industry} \\ \tau_j &= \frac{1}{M}\theta - Q_j, \text{ for the } \frac{M-1}{2} \text{ partner industries} \\ \tau_k &= -Q_k, \text{ for the } \frac{M-1}{2} \text{ remaining industries.} \end{aligned}$$

We can easily see that as M increases, the *ex post* tariffs obtained by the proposer and the coalition partners decrease. The *ex ante* expected tariffs decrease as well since they are equal to what coalition partners get.

worst possible payoff in the remaining scenarios. On average, it actually does worse relative to when bargaining ends once an agreement is reached.[31] Hence, if we add an initial stage to our model where players can decide whether to play the game once or continuously, they will choose to play once. When $\frac{n_1}{N} > \frac{1}{2}$, on the other hand, legislators will agree on $\boldsymbol{\tau}^{U_1}$ either immediately if an industry-1 legislator is the first proposer, or after a few periods otherwise. In this case, the expected payoffs remain the same as in our model.

The third point is about our focus on SSPE. This is of course not innocuous. For example, it prevents consideration of optimal equilibria, in which members commit to behavior conducive to maximizing their joint surplus by establishing subgame-perfect punishments for any member who deviates from the optimum. Such an exercise would be of great interest, and would stand in the same relation to this paper as Abreu (1986) stands in relation to the original Cournot model. Such a major extension is beyond the scope of the current paper, and at any rate one needs to understand the Cournot before exploring the extremal equilibria. However, we can speculate about how such an extension would work out. Clearly, for δ sufficiently close to 0, the optimal equilibrium will be no different than the SSPE, since equilibrium is the same as for a one-period model anyway. For δ sufficiently close to 1, the optimal equilibrium with symmetric industries will always be free trade. For intermediate values of δ where free trade is not attainable, we speculate that the optimal equilibrium would still entail a proposer choosing a coalition partner and tariffs that are highest for the proposer and lowest for the outside industry, but that the tariffs would be somewhat closer to free trade than the tariffs in the SSPE.

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[31] Once the game converges to a stationary stage in which the proposer is able to achieve its first-best, industry i's per-period continuation payoff becomes:

$$v_i = w_i(\boldsymbol{\tau}^s) + \theta[(\frac{n_i}{N}\theta - Q_i) - \tau_i^s] - \frac{\theta^2 - \sum_{l=i,j,k}\left[(\tau_l^s + Q_l)^2\right]}{2}.$$

Since $\frac{n_i}{N} \leq \frac{1}{2}$, this is less than what industry i expects in our game:

$$v_i = w_i(\boldsymbol{\tau}^{\mathbf{s}}) + \theta[(\frac{\theta}{3} - Q_i) - \tau_i^s] - \frac{\frac{5\theta^2}{9} - \sum_{l=i,j,k}\left[(\tau_l^s + Q_l)^2\right]}{2}.$$

However, we believe that it would be a mistake to assume that when δ is close enough to 1 that free trade is an equilibrium, that free trade will necessarily be the result. As Baron has pointed out in another context,[32] the strategies required to sustain the optimal equilibrium in this type of model are not straightforward, and would require a great deal of coordination to implement. Consider an equilibrium in which free trade is proposed by any proposer in the first period and accepted by a majority of members. This implies that if, say, i was the proposer in period 0 and proposed a tariff vector that would make both i and j strictly better off than free trade, that j must choose to *reject* it. The only way that is possible is if j expects favorable, preferential treatment in the subsequent round, so that its expected payoff in period 1 exceeds the payoff it would have from the tariffs proposed by i in period 0, as a reward for rejecting i's offer. As a result, although with high δ free trade is *possible*, there is no guarantee that assembly members will successfully coordinate on that outcome, particularly if the membership rotates over time and these complex, history-dependent rules must be learned by each new member. Further, it is clear that in history, even though δ sometimes seems quite high in practice, legislatures have rarely coordinated on free trade, to put it mildly – recall the examples discussed in the introduction.

The fourth point is about the discount factor. For analytical convenience, we have considered the limiting cases in which δ approaches 0 or 1, but the same broad patterns would emerge with intermediate values of δ. In the context of a Baron-Ferejohn divide-the-dollar game with asymmetric recognition probabilities (as in our paper), Eraslan (2002) shows that an SSPE with fully mixed strategies does not exist when δ is below a certain threshold. This is also true in our game. When $\delta < 1$, depending on the values of $\left(\frac{n_1}{N}, \frac{n_2}{N}, \frac{n_3}{N}\right)$ and $(\tau_1^s + Q_1, \tau_2^s + Q_2, \tau_3^s + Q_3)$, one or more industries may use pure strategies in choosing their

[32] "The strategies required to support most distributions are very complex, however, and are composed of infinitely nested punishments that require members to calculate a strategy that specifies which action to take in response to every possible deviation at every possible node in the game. Those strategies also require members to have the capacity to keep track of every possible history of play. Yet in the actual play of the game (i.e., along the equilibrium path), the first proposal made receives a majority vote, and the game ends. Consequently, the infinitely nested punishments and the capacity to track every possible history are never used. This raises the issue of whether members would actually devise infinitely nested punishment strategies and develop the capacity to track every conceivable history." Baron (1991, footnote 20).

coalition partners. For instance, when $\frac{n_1}{N} = \frac{n_2}{N} = \frac{n_3}{N} = \frac{1}{3}$, the industry with the highest $\tau_i^s + Q_i$ may never be chosen as a coalition partner if δ is sufficiently low. Similarly, when $\tau_1^s + Q_1 = \tau_2^s + Q_2 = \tau_3^s + Q_3 = \psi$, the industry with the highest $\frac{n_i}{N}$ may never be chosen as a coalition partner if δ lies below a threshold (but is still strictly positive).[33] However, in both cases our qualitative results would remain true. In particular, the ranking of welfare gains remains the same; i.e., the industry with the lowest $\tau_i^s + Q_i$ does the best while the one with the highest $\tau_i^s + Q_i$ does the worst. When $\tau_1^s + Q_1 = \tau_2^s + Q_2 = \tau_3^s + Q_3 = \psi$, all industries are equally well off unless one industry is sufficiently dispersed and δ is sufficiently low so that it is never chosen as a coalition partner. In this case, that industry does better than others (namely, the benefit of being the proposer with high probability outweighs the loss from being excluded from the coalition).

5 Conclusion

We have developed a model of legislative trade policy-making in a setting of distributive politics. A small open economy has many districts, each one of which is associated with a particular industry. Thus, there is a conflict among districts hinged on industry attachment. Trade policy is determined collectively in the legislature as a result of bargaining among legislators, each of whom seeks to serve the interests of the district she represents. The legislative process is modeled as a multilateral sequential bargaining game *à la* Baron and Ferejohn (1989).

Our analysis has three characteristics that are distinct from existing studies; (1) In addition to the usual factors accounted for in empirical work, the resulting trade policy depends on the identity of the agenda setter; (2) The congressional bargaining generally has an equilibrium in mixed strategies due to its dynamic nature; and (3) Because of the uncertainty about the future, strategic voting can lead a legislator to vote for a proposal that will make

[33] It can be shown that when ψ is in between $\left[\frac{\theta}{3}(1 - \frac{\sqrt{6}}{3}), \frac{\theta}{3}(1 + \frac{\sqrt{6}}{3})\right]$, for any value of $\delta \in (0, 1)$ there is always randomization as long as $0 \leq n_i \leq \frac{1}{2}$, $\forall i$. On the other hand, if ψ is outside of the interval defined above, there will be randomization as long as each $n_i \in [\underline{n}, \overline{n}]$, where $\underline{n} > 0$ and $\overline{n} < \frac{1}{2}$ are endogenously determined as a function of (ψ, δ, θ).

her district worse off compared to the *status quo*.

In short, our model is dynamic and considers a parliamentary setting that stresses the importance of institutional structure on trade policy formation. Furthermore, it is rich enough to encompass the findings of the existing literature as well as to incorporate new elements to them by analyzing the effects of dynamic, non-cooperative congressional bargaining.

A number of natural extensions suggest themselves; here we highlight two. First, it is natural to consider how the distortionary tariff-making observed in the present model is constrained by the addition of a president with veto power and who represents the country as a whole rather than the interests of any one industry.

Second, the logic of our model shows that legislators in some situations would be very eager to find a way to avoid the bargaining process that is described in this paper, and might seek institutions that could take away their control over tariffs in order to do so. One example of an institution that might achieve this is Fast Track Authority, a legislative device that has been used on several occasions by the US Congress to delegate some of its trade policy power to the executive branch. We explore both this question and the effect of veto power in a companion paper (Celik, Karabay and McLaren, 2012).

A similar line of argument can also provide a rationale for constitutional rules that provide a president with much of the agenda-setting power, as is the case in Brazil (Alston *et al.*, 2009), in order to avoid inefficient congressional bargaining. Another possibility is that this provides an unacknowledged but potentially important motivation for a customs union, instead of a free-trade agreement, as a preferential trading bloc. For example, in approving a customs union with the European Union (EU) in 1995, the Turkish parliament effectively delegated much of its tariff-setting authority to the EU. A possible motive for such a move is to avoid the sort of inefficient bargaining that we study in this paper, but an exploration of such issues is beyond the scope of this paper. This strategic element in choosing between customs unions and free-trade agreements, together with the fast-track authority question discussed above, show that our model can illuminate a number of issues in trade agreements between countries, as well as in unilateral trade-policy setting.

Appendix

Proof of Proposition 3. In what follows, we will refer to a legislator representing industry i simply as legislator i. When legislator i is selected as the proposer and chooses industry $j \neq i$ as the coalition partner (and leaves industry $k \neq i, j$ outside the winning coalition), we denote the chosen tariffs as $\boldsymbol{\tau}^{ij}= (\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij})$. Suppose legislator i is selected as the proposer and chooses industry $j \neq i$ as the partner. Legislator i's maximization problem is

$$\max_{\tau_i^{ij},\tau_j^{ij},\tau_k^{ij}} w_i(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) \text{ s.t. } w_j(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) \geqslant (1-\delta) w_j(\boldsymbol{\tau}^s) + \delta v_j,$$

where (using equation (4)), for $l = i, j, k$,

$$w_l(\tau_i, \tau_j, \tau_k) = w_l(\boldsymbol{\tau}^s) + \left[\theta(\tau_l - \tau_l^s) - \frac{1}{2} \sum_{m=i,j,k} \left[(\tau_m + Q_m)^2 - (\tau_m^s + Q_m)^2\right]\right].$$

In the limit as $\delta \to 1$, the constraint can be rewritten as $w_j(_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) \geqslant v_j$. Hence. the Lagrangian can be expressed as

$$\mathcal{L}(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) = w_i(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) + \lambda^{ij}(w_j(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) - v_j),$$

where λ^{ij} represents the cost to the proposing legislator i of obtaining the additional votes of industry j to pass the proposal. The first-order conditions, after simplification, are

$$\tau_i^{ij} = \frac{\theta}{1+\lambda^{ij}} - Q_i, \qquad \tau_j^{ij} = \frac{\lambda^{ij}\theta}{1+\lambda^{ij}} - Q_j, \qquad \tau_k^{ij} = -Q_k.$$

We first show that, in an SSPE in which all proposers employ mixed strategies in choosing their coalition partners, $\lambda^{ij} = \lambda$ for all $i \neq j$. This follows from the following two observations. First, a selected legislator i would employ a mixed strategy only if the *ex post* payoff her district enjoys is the same whether she chooses industy j or k as a coalition partner:

$$w_i(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) = w_i(\tau_i^{ik}, \tau_j^{ik}, \tau_k^{ik})$$

$$\Leftrightarrow \theta\tau_i^{ij} - \frac{1}{2} \sum_{l=i,j,k} \left[\left(\tau_l^{ij} + Q_l\right)^2 - (\tau_l^s + Q_l)^2\right] = \theta\tau_i^{ik} - \frac{1}{2} \sum_{l=i,j,k} \left[\left(\tau_l^{ik} + Q_l\right)^2 - (\tau_l^s + Q_l)^2\right].$$

Using the equilibrium values of $(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij})$ and $(\tau_i^{ik}, \tau_j^{ik}, \tau_k^{ik})$, we have

$$\frac{\theta^2}{1+\lambda^{ij}} - \frac{1}{2}\left[\frac{\left(1+\left(\lambda^{ij}\right)^2\right)\theta^2}{\left(1+\lambda^{ij}\right)^2}\right] = \frac{\theta^2}{1+\lambda^{ik}} - \frac{1}{2}\left[\frac{\left(1+\left(\lambda^{ik}\right)^2\right)\theta^2}{\left(1+\lambda^{ik}\right)^2}\right].$$

It is easy to see that this equality holds only if $\lambda^{ij} = \lambda^{ik}$. Second, when industry j is chosen as a coalition partner, it will be offered an *ex post* welfare of v_j regardless of the identity of the proposer. Thus,

$$\begin{aligned}
& w_j(\tau_i^{ij}, \tau_j^{ij}, \tau_k^{ij}) = w_j(\tau_i^{kj}, \tau_j^{kj}, \tau_k^{kj}) \\
\Leftrightarrow\ & \theta\tau_j^{ij} - \frac{1}{2}\sum_{l=i,j,k}\left[\left(\tau_l^{ij}+Q_l\right)^2 - \left(\tau_l^{s}+Q_l\right)^2\right] = \theta\tau_j^{kj} - \frac{1}{2}\sum_{l=i,j,k}\left[\left(\tau_l^{kj}+Q_l\right)^2 - \left(\tau_l^{s}+Q_l\right)^2\right] \\
\Leftrightarrow\ & \frac{\lambda^{ij}\theta^2}{1+\lambda^{ij}} - \frac{1}{2}\left[\frac{\left(1+\left(\lambda^{ij}\right)^2\right)\theta^2}{\left(1+\lambda^{ij}\right)^2}\right] = \frac{\lambda^{kj}\theta^2}{1+\lambda^{kj}} - \frac{1}{2}\left[\frac{\left(1+\left(\lambda^{kj}\right)^2\right)\theta^2}{\left(1+\lambda^{kj}\right)^2}\right].
\end{aligned}$$

Again, this equality holds only if $\lambda^{ij} = \lambda^{kj}$. Together with the earlier observation, $\lambda^{ij} = \lambda^{kj} = \lambda^{ik}$, which implies that $\lambda^{ij} = \lambda$ for all $i \neq j$, $i, j = 1, 2, 3$.

Next, we find the equilibrium value of λ in a mixed-strategy SSPE. We first write down the equilibrium *ex post* per capita welfare of a district that produces good j in three distinct cases (when it is the proposer industry, when chosen as a partner industry, and when left outside the winning coalition):

$$\begin{aligned}
w_j^{proposer} &= w_j(\boldsymbol{\tau}^s) + \left[\frac{\theta^2}{1+\lambda} - \theta(\tau_j^s + Q_j) - \frac{1}{2}\left(\frac{\left(1+\lambda^2\right)\theta^2}{(1+\lambda)^2} - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2\right)\right], \\
w_j^{partner} &= w_j(\boldsymbol{\tau}^s) + \left[\frac{\lambda\theta^2}{1+\lambda} - \theta(\tau_j^s + Q_j) - \frac{1}{2}\left(\frac{\left(1+\lambda^2\right)\theta^2}{(1+\lambda)^2} - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2\right)\right], \\
w_j^{outside} &= w_j(\boldsymbol{\tau}^s) + \left[-\theta(\tau_j^s + Q_j) - \frac{1}{2}\left(\frac{\left(1+\lambda^2\right)\theta^2}{(1+\lambda)^2} - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2\right)\right].
\end{aligned}$$

We then express the equilibrium continuation welfare of a district on a per capita basis. Let s_{ij} denote the probability that legislator i chooses industry j as a coalition partner. Then, v_j can be expressed as

$$\begin{aligned}
v_j \;=\; & \frac{n_j}{N}[s_{ji}w_j^{proposer} + (1-s_{ji})w_j^{proposer}] + \frac{n_i}{N}[s_{ij}w_j^{partner} + (1-s_{ij})w_j^{outside}] \\
& + \frac{n_k}{N}[s_{kj}w_j^{partner} + (1-s_{kj})w_j^{outside}].
\end{aligned} \tag{9}$$

After simplification, this becomes

$$\begin{aligned} v_j &= w_j(\boldsymbol{\tau}^s) + \frac{\theta^2}{1+\lambda}\left(\frac{n_j}{N} + \left(s_{ij}\frac{n_i}{N} + s_{kj}\frac{n_k}{N}\right)\lambda\right) \\ &\quad -\theta(\tau_j^s + Q_j) - \frac{1}{2}\left(\frac{\left(1+\lambda^2\right)\theta^2}{\left(1+\lambda\right)^2} - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2\right). \end{aligned} \tag{10}$$

The maximization problem implies $w_j^{partner} = v_j$ in equilibrium, and thus

$$\sum_{j=1}^{3} w_j^{partner} = \sum_{j=1}^{3} v_j.$$

Also note that

$$\begin{aligned} \sum_{\substack{j=1 \\ i\neq k\neq j}}^{3}\left(s_{ij}\frac{n_i}{N} + s_{kj}\frac{n_k}{N}\right) &= \left(s_{12}\frac{n_1}{N} + s_{32}\frac{n_3}{N}\right) + \left(s_{13}\frac{n_1}{N} + s_{23}\frac{n_2}{N}\right) + \left(s_{21}\frac{n_2}{N} + s_{31}\frac{n_3}{N}\right) \\ &= \left(s_{12} + s_{13}\right)\frac{n_1}{N} + \left(s_{21} + s_{23}\right)\frac{n_2}{N} + \left(s_{31} + s_{32}\right)\frac{n_3}{N} \\ &= \frac{n_1 + n_2 + n_3}{N} = 1. \end{aligned}$$

The condition $\sum\limits_{j=1}^{3} w_j^{partner} = \sum\limits_{j=1}^{3} v_j$ can now be expressed as

$$\begin{aligned} &\frac{3\lambda\theta^2}{1+\lambda} - \theta\sum_{j=1}^{3}\left(\tau_j^s + Q_j\right) - \frac{3}{2}\left(\frac{\left(1+\lambda^2\right)\theta^2}{\left(1+\lambda\right)^2} - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2\right) \\ = &\frac{\theta^2}{1+\lambda}\left(1+\lambda\right) - \theta\sum_{j=1}^{3}\left(\tau_j^s + Q_j\right) - \frac{3}{2}\left(\frac{\left(1+\lambda^2\right)\theta^2}{\left(1+\lambda\right)^2} - \sum_{l=i,j,k}\left(\tau_l^s + Q_l\right)^2\right) \end{aligned}$$

$$\Leftrightarrow \lambda = \frac{1}{2}.$$

So, the value of λ can be determined without the knowledge of the randomization probabilities. Plugging the equilibrium value of λ into the tariffs we found earlier gives

$$\tau_i^{ij} = \frac{2\theta}{3} - Q_i, \quad \tau_j^{ij} = \frac{\theta}{3} - Q_j, \quad \tau_k^{ij} = -Q_k.$$

Plugging these into equation (4) gives the *ex post* per capita payoffs stated in the proposition.

The final step of the proof is to show that there is an interior solution to the randomization probabilities – what we assumed at the beginning of the proof. Since $v_j = w_j^{partner}$ by the maximization problem, we have

$$\frac{\theta^2}{1+\lambda}\left(\frac{n_j}{N}+\left(s_{ij}\frac{n_i}{N}+s_{kj}\frac{n_k}{N}\right)\lambda\right)=\frac{\lambda\theta^2}{1+\lambda}$$

$$\Leftrightarrow s_{ij}\frac{n_i}{N}+s_{kj}\frac{n_k}{N}=1-2\frac{n_j}{N}.$$

For simplicity, let $s_{12} = s_1$, $s_{23} = s_2$ and $s_{31} = s_3$. Then,

$$s_1\frac{n_1}{N}+(1-s_3)\frac{n_3}{N}=1-2\frac{n_2}{N},\qquad s_2\frac{n_2}{N}+(1-s_1)\frac{n_1}{N}=1-2\frac{n_3}{N},\qquad s_3\frac{n_3}{N}+(1-s_2)\frac{n_2}{N}=1-2\frac{n_1}{N}.$$

These equations are linearly dependent (two of them imply the third), so we lose one degree of freedom. It is easy to check that, when $\frac{n_3}{N} \le \frac{n_2}{N} \le \frac{n_1}{N} \le \frac{1}{2}$, there is an interior solution in which $s_i \in [0,1]$ for all i. To see this, fix s_3 and express s_1 and s_2 in terms of s_3:

$$s_1=\frac{1-2\frac{n_2}{N}-(1-s_3)\frac{n_3}{N}}{\frac{n_1}{N}},\qquad s_2=1-\frac{1-2\frac{n_1}{N}-s_3\frac{n_3}{N}}{\frac{n_2}{N}}.$$

Any value of $s_3 \in \left[0, \frac{1-2\frac{n_1}{N}}{\frac{n_3}{N}}\right]$ yields $s_1, s_2 \in [0,1]$.

It is important to note that an industry may select its coalition partner with pure strategy. However, there are limitations. Feasible solutions (in which $s_i \in [0,1]$ for all i) are

$$\begin{aligned}(s_1,s_2,s_3) &= \left(\frac{1-2\frac{n_2}{N}-\frac{n_3}{N}}{\frac{n_1}{N}}, 1-\frac{1-2\frac{n_1}{N}}{\frac{n_2}{N}}, 0\right),\\ (s_1,s_2,s_3) &= \left(\frac{1-\frac{n_1}{N}-\frac{n_2}{N}}{\frac{n_1}{N}}, 1, \frac{1-2\frac{n_1}{N}}{\frac{n_3}{N}}\right).\end{aligned}$$

All three industries may use pure strategies only when $\frac{n_1}{N} = \frac{n_2}{N} = \frac{n_3}{N} = \frac{1}{3}$. In this case, $s_1 = s_2 = s_3$ in all SSPE, so $(s_1, s_2, s_3) = (1,1,1)$ and $(s_1, s_2, s_3) = (0,0,0)$ are both possible. Similarly, when $\frac{n_1}{N} = \frac{1}{2}$, industries 2 and 3 may use pure strategies. In fact, $(s_1, s_2, s_3) = \left(1 - 2\frac{n_2}{N}, 1, 0\right)$ is the unique SSPE in this case. Other than these two special cases, only industry 2 or industry 3 may select its coalition partner with pure strategy. ■

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