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Endogenous Sequencing of Tariff Decisions

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Abstract

This paper examines the timing of tariff decisions. We develop a two-stage, three-period model in which two competing importers can choose to select their tariffs with respect to an exporting country in one of two periods. We assume that governments are politically motivated regarding their import-competing industries. We further assume that the degree of their political motivation, captured by a political-economy parameter, is private information. We find that the countries endogenously choose to pick their tariffs sequentially if and only if their political-economy parameters differ in relation to a common critical threshold. Otherwise, the countries prefer to select their tariffs simultaneously.

Keywords: Trade policy; Antidumping; Cournot; Stackelberg; Endogenous timing; Incomplete information

JEL classification: F12; F13

1 Introduction

According to the World Trade Organization (WTO) webpage, "[i]f a company exports a product at a price lower than the price it normally charges on its own home market, it is said to be "dumping" the product," and in such instances, the WTO agreement allows governments to take legal action against the offender provided they can *additionally* demonstrate that "there is genuine ("material") injury to the competing domestic industry."[1] Nevertheless, nowadays, antidumping legislation is rarely used to combat unfair or illegal trade practices. It rather serves as the predominant instrument of trade protection, especially given the dramatic reduction in tariffs and quotas achieved under the auspices of the GATT/WTO since the end of World War II. As Stiglitz (1997, p. 411) argues, "the antidumping laws no longer have very much to do with the prevention of predatory pricing." Similarly, Blonigen and Prusa (2003, p. 252) claim that "[t]o politically powerful [import-competing] industries, losing

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[1]The address of the WTO webpage is: http://www.wto.org.

a[n antidumping] case is not a sign that the foreign competition is traded fairly; rather it is simply a sign that the [antidumping] law needs changing." Thus, the understanding of the ramifications of antidumping for the world trading system has become all-important.

A striking feature of the pattern of antidumping filings globally, originally noted by Maur (1998), is the presence of "echoing." In particular, we tend to observe in *different* countries either sequential or quasisimultaneous antidumping-petition filings against either the same foreign producer or different foreign firms that nevertheless produce *almost identical* goods and are located in the *same* (foreign) country. Maur (1998) points out that for example, the "echoing" cases to or from Europe and Canada amounted to about 15% of all the antidumping cases initiated in the United States between 1980 and 1996. In addition, in Canada during the same time frame, the number of the "echoing" cases solely to or from the United States equaled to about 13% of all the antidumping cases. "Echoing" is thus far from negligible; however, it has not received the deserved attention in the past literature on antidumping.

Maur (1998) provides three possible explanations for the existence of "echoing." First of all, he argues that it might be the result of attempts by multinational enterprises to use national antidumping laws to obtain protection in the different markets within which they operate,[2] or to even artificially segment the latter so that they eventually price-discriminate between them. Second, he suggests that the filing of an antidumping case might have a domino effect: once exports are hit by duties, they might be redirected towards a third country[3] causing material injury to its domestic industry, and hence, a new antidumping petition might be filed. Finally, he claims that "echoing" might stem from the willingness of firms to pursue lawsuits against certain exporters in imitation of foreign firms that have successfully done so.[4]

The preceding analysis points to interesting issues, but remains silent on the timing of the antidumping duty decisions. In other words, if two competing importers wish to impose duties on the same exporting country, will they find it optimal to do so simultaneously or sequentially?[5] If the latter, what factors determine which country will be the first mover (leader) and which one the follower? Note that in a tariff game with competing importers, the preference orderings of countries would normally work strongly against a country choosing

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[2] A similar point is made by Messerlin and Reed (1995).

[3] Bown and Crowley (2003) term this effect trade deflection.

[4] The natural explanation for "echoing" would be that certain exporters engage in unfair trade practices in more than one markets and therefeore, they face antidumping lawsuits in all of them. Nevertheless, antidumping should be treated as merely a modern instrument of protection. For example, Blonigen and Prusa (2003, p. 252) reveal that:

> Imports can now be deemed "unfair" even if foreign firms charge higher prices to their export market than they do at home and even if foreign firms earn healthy profits on each and every foreign sale.

[5] Antidumping petitions are filed at the firm level. However, for simplicity, we choose to carry out our analysis at the country level.

to be the leader. The reason is that in such settings countries typically face upward-sloping reaction curves and thus, they strictly prefer to be the second mover to being the first mover (i.e., such tariff games are similar to firm pricing games).[6][7][8]

To answer these questions, we consider a homogeneous-good, two-stage, three-period game in which two competing importers can choose to select their respective *optimal* specific import tariffs with regard to the same exporting country in one of two periods. In essence, in our model, countries need to make two *distinct sequential* decisions: (i) when to select their tariffs, and subsequently, (ii) what tariff to actually pick. We assume that governments are politically motivated with respect to their import-competing industries. Moreover, we assume that each government's political-economy parameter that captures the aforementioned effect is private information. Our modeling approach is clearly inspired by Farrell and Saloner (1985) who develop a two-period incomplete-information model in which two users choose to either stick to an old technology or adopt a new one. Furthermore, our work is at a broad level influenced by the extensive literature on endogenous sequencing (or not) of firm quantity or pricing decisions, such as Hamilton and Slutsky (1990), Robson (1990), Mailath (1993), and Daughety and Reinganum (1994).

We obtain a unique perfect Bayesian equilibrium in which the competing importers endogenously choose to select their tariffs sequentially if and only if their political-economy parameters are different in their relation to a common critical threshold. More specifically, each country prefers to select its tariff in period one, risking to become the leader, if and only if its political-economy parameter is above the critical threshold, since then, its expected payoff as the Stackelberg leader is sufficiently higher than its expected payoff as a symmetric Cournot player. Otherwise, countries prefer to pick their tariffs in period two. Therefore, one country chooses to assume the leader's role whereas the other one the follower's if and only if the former has a political-economy parameter above the common threshold and the latter below it.

Section 2 sets out the basics. Section 3 analyzes the Cournot game. Section 4 examines the Stackelberg game. Section 5 derives the unique perfect Bayesian equilibrium of the two-stage, three-period game. Finally, Section 6 concludes.

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[6] At the firm level, Gal-Or (1985) and Dowrick (1986) both prove that (i) with downward-sloping reaction curves, firms prefer to be the leader to being the follower, and (ii) with upward-sloping reaction curves, firms prefer to be the follower to being the leader. Their analysis naturally extends to our scenario.

[7] Note that at the firm level, in a quantity game, we obtain normally the exactly opposite result, i.e., firms prefer to be the first mover to being the second mover since they usually face downward-sloping reaction curves.

[8] For a model of price-setting duopoly where strategic timing is endogenous and information is complete, see Robson (1990).

2 Model Setup

We develop a partial equilibrium model of trade between three countries. More precisely, we consider countries A, X and Y that trade one good. In order to make our points as simple as possible, we do not rigorously examine the process of production in the countries, assuming instead that the different countries are simply endowed with certain amounts of the good. Specifically, we assume country A has an endowment of seven units whereas countries X and Y are symmetrically endowed with one unit each.

We assume that demand functions are identical across countries. In particular, the demand function in country i is given by:

$$C^i \left(P^i \right) = \alpha - \beta P^i, \tag{1}$$

where $\alpha > 3$, $\beta > 0$, and P^i is the price of the good in country i.

Thus, countries X and Y are competing importers whereas country A is the exporter. To see this, let's first characterize free trade. Under free trade, a single price P^f prevails in all markets so that $P^A = P^X = P^Y = P^f$. The equilibrium condition that world supply equals world demand, $9 = C^A \left(P^f \right) + C^X \left(P^f \right) + C^Y \left(P^f \right)$, determines the free-trade price. Thus, we have:

$$P^f = \frac{\alpha - 3}{\beta}. \tag{2}$$

As a result, the free-trade consumption levels are:

$$C^A \left(P^f \right) = C^X \left(P^f \right) = C^Y \left(P^f \right) = 3. \tag{3}$$

We let the importing countries choose specific import tariffs, and so τ^i is used to represent the import tariff levied by country $i \in \{X, Y\}$.[9] We do not allow for any export policy instruments and thus, given that the exporting country has no actual decisions to make, we mostly ignore it in all that follows.

Now, focusing only on the competing importers, we assume that each country's government is politically-motivated with respect to its import-competing domestic producers. This effect is captured by a political-economy parameter θ that enters into the objective function the governments seek to maximize. We assume that each country has incomplete information about the other country's parameter θ. Nevertheless, both θ's are a priori independently drawn from the uniform distribution on $\left[\underline{\theta}, \overline{\theta} \right]$, and this is common knowledge.

We assume that the countries face a two-stage, three-period horizon. In the first stage (period zero), they simultaneously decide whether to select their respective import tariffs in period one or period two, which together comprise stage two of the game. Once this timing decision is made, it then becomes common knowledge and is irreversible. Subsequently, each country must determine

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[9]Note that nonnegative tariffs cannot reverse the free direction of trade.

its import tariff during the period it has chosen in the first stage of the game.[10] We finally assume that payoffs accrue at the end of period two.[11]

We look for a symmetric perfect Bayesian equilibrium, in which (i) each country selects its import tariff in period one if and only if its political-economy parameter $\theta \geq \theta^*$, with θ^* being common for both countries; otherwise, it prefers to choose its import tariff in period two; (ii) the tariff selected by each country during the period determined by condition (i) is optimal given its beliefs about the other country's parameter θ; and (iii) the aforementioned beliefs are obtained from the countries' strategies and their observed actions using Bayes' rule.[12]

3 The Cournot Game

Let's start by looking at the equilibrium that would emerge if the countries selected their tariffs during the same period. If tariffs do not prohibit trade, then the effective prices to the producers of the exporting country must be equal across countries. In addition, world supply should equal world demand. The former condition requires that:

$$P^X = P^A + \tau^X \text{ and} \tag{4}$$

$$P^Y = P^A + \tau^Y. \tag{5}$$

The latter one simply requires that:

$$9 = \alpha - \beta P^A + \alpha - \beta P^X + \alpha - \beta P^Y =$$
$$= \alpha - \beta P^A + \alpha - \beta \left(P^A + \tau^X\right) + \alpha - \beta \left(P^A + \tau^Y\right). \tag{6}$$

Equation (6) implies that:[13]

$$P^X \left(\tau^X, \tau^Y\right) = \frac{\alpha - 3}{\beta} + \frac{1}{3} \left(2\tau^X - \tau^Y\right) \text{ and} \tag{7}$$

$$P^Y \left(\tau^X, \tau^Y\right) = \frac{\alpha - 3}{\beta} + \frac{1}{3} \left(2\tau^Y - \tau^X\right). \tag{8}$$

---

[10] If a country chooses to select its tariff during period 1, it can select a zero tariff, but it cannot use that as a pretext to select a nonzero tariff in the next period (i.e., it foregoes its chance to pick a positive tariff).

[11] In other words, the payoff at the end of period one is taken as negligible.

[12] For a thorough exposition of the concept of perfect Bayesian equilibrium, see Cho and Kreps (1987), and Fudenberg and Tirole (1991).

[13] We also have that:

$$P^A \left(\tau^X, \tau^Y\right) = \frac{\alpha - 3}{\beta} - \frac{1}{3} \left(\tau^X + \tau^Y\right).$$

We also obtain the following market-clearing import volumes for countries X and Y respectively:[14]

$$M^X \left(\tau^X, \tau^Y \right) = 2 - \frac{\beta}{3} \left(2\tau^X - \tau^Y \right) \text{ and} \tag{9}$$

$$M^Y \left(\tau^X, \tau^Y \right) = 2 - \frac{\beta}{3} \left(2\tau^Y - \tau^X \right). \tag{10}$$

We are now ready to define welfare. For either of the importing countries, we represent welfare by the politically-weighted sum of consumer surplus, producer surplus, and import-tariff revenue. Thus, the welfare function of country X, for example, is given by:

$$W^X \left(\tau^X, \tau^Y, \theta^X \right) = \int_{P^X(\tau^X,\tau^Y)}^{\frac{\alpha}{\beta}} C(P) \, dP + \theta^X \int_0^{P^X(\tau^X,\tau^Y)} 1 \, dP$$
$$+ \tau^X M^X \left(\tau^X, \tau^Y \right), \quad (11)$$

where θ^X is the aforementioned political-economy weight on the surplus of producers. In other words, higher values of θ^X will be taken to indicate stronger government preferences for the domestic producers. As noted above, we assume that θ^X is uniformly distributed on $\left[\underline{\theta}, \overline{\theta} \right]$ with $\underline{\theta} \geq 1$. The welfare function of country Y as well as its parameter θ^Y are similarly defined. With some further algebra, the welfare functions may be rewritten in easier-to-use forms:

$$W^X \left(\tau^X, \tau^Y, \theta^X \right) = \frac{9}{2\beta} - \frac{4\beta}{9} \tau^{X^2} + \frac{\beta}{18} \tau^{Y^2} + \frac{\beta}{9} \tau^X \tau^Y + \tau^Y + \theta^X \frac{\alpha - 3}{\beta}$$
$$+ \frac{2}{3} \theta^X \tau^X - \frac{1}{3} \theta^X \tau^Y \text{ and} \quad (12)$$

$$W^Y \left(\tau^X, \tau^Y, \theta^Y \right) = \frac{9}{2\beta} - \frac{4\beta}{9} \tau^{Y^2} + \frac{\beta}{18} \tau^{X^2} + \frac{\beta}{9} \tau^X \tau^Y + \tau^X + \theta^Y \frac{\alpha - 3}{\beta}$$
$$+ \frac{2}{3} \theta^Y \tau^Y - \frac{1}{3} \theta^Y \tau^X. \quad (13)$$

Consider now the optimal tariffs for the competing importers when they choose their tariffs during the same period. Given both the incomplete information of each country about the other country's political-economy parameter and the simultaneity (in this case) of their decisions, we look for a Bayesian equilibrium, in which each country maximizes its *expected* welfare contingent on

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[14] The market-clearing export volume of country A equals:

$$X^A \left(\tau^X, \tau^Y \right) = 4 - \frac{\beta}{3} \left(\tau^X + \tau^Y \right).$$

its own political-economy parameter and taking the other country's political-economy-parameter-contingent strategy as given.

Taking expectations over θ^Y and θ^X correspondingly, we obtain:

$$
EW^X\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^X\right) = \frac{9}{2\beta} - \frac{4\beta}{9}\left[\tau^X\left(\theta^X\right)\right]^2 + \frac{\beta}{18}E\left[\tau^Y\left(\theta^Y\right)\right]^2
$$
$$
+ \frac{\beta}{9}\tau^X\left(\theta^X\right)E\tau^Y\left(\theta^Y\right) + E\tau^Y\left(\theta^Y\right) + \theta^X\frac{\alpha-3}{\beta} + \frac{2}{3}\theta^X\tau^X\left(\theta^X\right)
$$
$$
- \frac{1}{3}\theta^X E\tau^Y\left(\theta^Y\right) \text{ and } \quad (14)
$$

$$
EW^Y\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^Y\right) = \frac{9}{2\beta} - \frac{4\beta}{9}\left[\tau^Y\left(\theta^Y\right)\right]^2 + \frac{\beta}{18}E\left[\tau^X\left(\theta^X\right)\right]^2
$$
$$
+ \frac{\beta}{9}E\tau^X\left(\theta^X\right)\tau^Y\left(\theta^Y\right) + E\tau^X\left(\theta^X\right) + \theta^Y\frac{\alpha-3}{\beta} + \frac{2}{3}\theta^Y\tau^Y\left(\theta^Y\right)
$$
$$
- \frac{1}{3}\theta^Y E\tau^X\left(\theta^X\right). \quad (15)
$$

Taking the first-order derivatives of $EW^X\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^X\right)$ and $EW^Y\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^Y\right)$ with respect to $\tau^X\left(\theta^X\right)$ and $\tau^Y\left(\theta^Y\right)$ correspondingly, we get:

$$
\frac{\partial EW^X\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^X\right)}{\partial \tau^X\left(\theta^X\right)} = -\frac{8\beta}{9}\tau^X\left(\theta^X\right) + \frac{\beta}{9}E\tau^Y\left(\theta^Y\right) + \frac{2}{3}\theta^X \text{ and}
$$
$$
(16)
$$

$$
\frac{\partial EW^Y\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^Y\right)}{\partial \tau^Y\left(\theta^Y\right)} = -\frac{8\beta}{9}\tau^Y\left(\theta^Y\right) + \frac{\beta}{9}E\tau^X\left(\theta^X\right) + \frac{2}{3}\theta^Y. \quad (17)
$$

It follows that $EW^X\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^X\right)$ is strictly concave in $\tau^X\left(\theta^X\right)$. Similarly, $EW^Y\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^Y\right)$ is strictly concave in $\tau^Y\left(\theta^Y\right)$.[15] The welfare-maximizing responses are:

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[15] We have that:

$$
\frac{\partial^2 EW^X\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^X\right)}{\partial\left[\tau^X\left(\theta^X\right)\right]^2} = -\frac{8\beta}{9} =
$$
$$
\frac{\partial^2 EW^Y\left(\tau^X\left(\theta^X\right), \tau^Y\left(\theta^Y\right), \theta^Y\right)}{\partial\left[\tau^Y\left(\theta^Y\right)\right]^2}
$$

$$\tau^{X^R}\left(\theta^X\right) = \frac{E\tau^Y\left(\theta^Y\right)}{8} + \frac{3\theta^X}{4\beta} \text{ and} \tag{18}$$

$$\tau^{Y^R}\left(\theta^Y\right) = \frac{E\tau^X\left(\theta^X\right)}{8} + \frac{3\theta^Y}{4\beta}. \tag{19}$$

Straightforward calculations reveal that:

$$E\tau^X\left(\theta^X\right) = E\tau^Y\left(\theta^Y\right) = \frac{3\widetilde{\theta}}{7\beta}, \tag{20}$$

where $\widetilde{\theta} = \underline{\theta} + \overline{\theta} > 1$. This results in the following unique Bayesian equilibrium for the Cournot game:

$$\tau^{X^C}\left(\theta^X\right) = \frac{3\widetilde{\theta}}{56\beta} + \frac{3\theta^X}{4\beta} \text{ and} \tag{21}$$

$$\tau^{Y^C}\left(\theta^Y\right) = \frac{3\widetilde{\theta}}{56\beta} + \frac{3\theta^Y}{4\beta}. \tag{22}$$

4 The Stackelberg Game

In this section, country X is restricted to selecting its import tariff in period one and country Y in period two. Thus, the game is Stackelberg, with country X being the leader and country Y the follower.

Since country Y determines its tariff *after* observing country X's choice, the best-response function of country Y is derived by setting $\frac{\partial W^Y\left(\tau^X\left(\theta^X\right),\tau^Y\left(\theta^X,\theta^Y\right),\theta^Y\right)}{\partial \tau^Y\left(\theta^X,\theta^Y\right)} = 0$, which results in:

$$\tau^{Y^R}\left(\theta^X,\theta^Y\right) = \frac{\tau^X\left(\theta^X\right)}{8} + \frac{3\theta^Y}{4\beta}. \tag{23}$$

Thus, country X maximizes:

$$EW^X\left(\tau^X\left(\theta^X\right),\tau^Y\left(\theta^X,\theta^Y\right),\theta^X\right)=\frac{9}{2\beta}-\frac{4\beta}{9}\left[\tau^X\left(\theta^X\right)\right]^2$$

$$+\frac{\beta}{18}E\left[\tau^Y\left(\theta^X,\theta^Y\right)\right]^2+\frac{\beta}{9}\tau^X\left(\theta^X\right)E\tau^Y\left(\theta^X,\theta^Y\right)+E\tau^Y\left(\theta^X,\theta^Y\right)+\theta^X\frac{\alpha-3}{\beta}$$

$$+\frac{2}{3}\theta^X\tau^X\left(\theta^X\right)-\frac{1}{3}\theta^X E\tau^Y\left(\theta^X,\theta^Y\right)=$$

$$=\frac{9}{2\beta}-\frac{4\beta}{9}\left[\tau^X\left(\theta^X\right)\right]^2+\frac{\beta}{18}E\left[\frac{\tau^X\left(\theta^X\right)}{8}+\frac{3\theta^Y}{4\beta}\right]^2$$

$$+\frac{\beta}{9}\tau^X\left(\theta^X\right)E\left[\frac{\tau^X\left(\theta^X\right)}{8}+\frac{3\theta^Y}{4\beta}\right]+E\left[\frac{\tau^X\left(\theta^X\right)}{8}+\frac{3\theta^Y}{4\beta}\right]+\theta^X\frac{\alpha-3}{\beta}$$

$$+\frac{2}{3}\theta^X\tau^X\left(\theta^X\right)-\frac{1}{3}\theta^X E\left[\frac{\tau^X\left(\theta^X\right)}{8}+\frac{3\theta^Y}{4\beta}\right].\quad(24)$$

Taking the first-order derivative of (24) with respect to $\tau^X\left(\theta^X\right)$, we obtain:[16]

$$\frac{\partial EW^X\left(\tau^X\left(\theta^X\right),\tau^Y\left(\theta^X,\theta^Y\right),\theta^X\right)}{\partial\tau^X\left(\theta^X\right)}=-\frac{55\beta}{64}\tau^X\left(\theta^X\right)+\frac{1}{8}+\frac{3}{64}\widetilde{\theta}+\frac{5}{8}\theta^X.\quad(25)$$

Thus, we obtain the unique perfect Bayesian equilibrium:

$$\tau^{X^L}\left(\theta^X\right)=\frac{8}{55\beta}+\frac{3\widetilde{\theta}}{55\beta}+\frac{8\theta^X}{11\beta}\text{ and}\quad(26)$$

$$\tau^{Y^F}\left(\theta^X,\theta^Y\right)=\frac{1}{55\beta}+\frac{3\widetilde{\theta}}{440\beta}+\frac{\theta^X}{11\beta}+\frac{3\theta^Y}{4\beta}.\quad(27)$$

If instead country Y is restricted to picking its import tariff in period one and country X in period two, then, to get country X's best-response function, we set $\frac{\partial W^X\left(\tau^X\left(\theta^X,\theta^Y\right),\tau^Y\left(\theta^Y\right),\theta^X\right)}{\partial\tau^X\left(\theta^X,\theta^Y\right)}=0$, which gives us:

$$\tau^{X^R}\left(\theta^X,\theta^Y\right)=\frac{\tau^Y\left(\theta^Y\right)}{8}+\frac{3\theta^X}{4\beta}.\quad(28)$$

Thus, country Y maximizes:

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[16] Once again, $EW^X\left(\tau^X\left(\theta^X\right),\tau^Y\left(\theta^X,\theta^Y\right),\theta^X\right)$ is strictly concave in $\tau^X\left(\theta^X\right)$ since:

$$\frac{\partial^2 EW^X\left(\tau^X\left(\theta^X\right),\tau^Y\left(\theta^X,\theta^Y\right),\theta^X\right)}{\partial\left[\tau^X\left(\theta^X\right)\right]^2}=-\frac{55\beta}{64}<0.$$

$$EW^Y\left(\tau^X\left(\theta^X,\theta^Y\right),\tau^Y\left(\theta^Y\right),\theta^Y\right)=\frac{9}{2\beta}-\frac{4\beta}{9}\left[\tau^Y\left(\theta^Y\right)\right]^2$$

$$+\frac{\beta}{18}E\left[\tau^X\left(\theta^X,\theta^Y\right)\right]^2+\frac{\beta}{9}\tau^Y\left(\theta^Y\right)E\tau^X\left(\theta^X,\theta^Y\right)+E\tau^X\left(\theta^X,\theta^Y\right)+\theta^Y\frac{\alpha-3}{\beta}$$

$$+\frac{2}{3}\theta^Y\tau^Y\left(\theta^Y\right)-\frac{1}{3}\theta^YE\tau^X\left(\theta^X,\theta^Y\right)=$$

$$=\frac{9}{2\beta}-\frac{4\beta}{9}\left[\tau^Y\left(\theta^Y\right)\right]^2+\frac{\beta}{18}E\left[\frac{\tau^Y\left(\theta^Y\right)}{8}+\frac{3\theta^X}{4\beta}\right]^2$$

$$+\frac{\beta}{9}\tau^Y\left(\theta^Y\right)E\left[\frac{\tau^Y\left(\theta^Y\right)}{8}+\frac{3\theta^X}{4\beta}\right]+E\left[\frac{\tau^Y\left(\theta^Y\right)}{8}+\frac{3\theta^X}{4\beta}\right]+\theta^Y\frac{\alpha-3}{\beta}$$

$$+\frac{2}{3}\theta^Y\tau^Y\left(\theta^Y\right)-\frac{1}{3}\theta^YE\left[\frac{\tau^Y\left(\theta^Y\right)}{8}+\frac{3\theta^X}{4\beta}\right].\quad(29)$$

Taking the first-order derivative of (29) with respect to $\tau^Y\left(\theta^Y\right)$, we get:[17]

$$\frac{\partial EW^Y\left(\tau^X\left(\theta^X,\theta^Y\right),\tau^Y\left(\theta^Y\right),\theta^Y\right)}{\partial\tau^Y\left(\theta^Y\right)}=-\frac{55\beta}{64}\tau^Y\left(\theta^Y\right)+\frac{1}{8}+\frac{3}{64}\widetilde{\theta}+\frac{5}{8}\theta^Y.\quad(30)$$

This results in the following unique perfect Bayesian equilibrium:

$$\tau^{X^F}\left(\theta^X,\theta^Y\right)=\frac{1}{55\beta}+\frac{3\widetilde{\theta}}{440\beta}+\frac{\theta^Y}{11\beta}+\frac{3\theta^X}{4\beta}\quad\text{and}\quad(31)$$

$$\tau^{Y^L}\left(\theta^Y\right)=\frac{8}{55\beta}+\frac{3\widetilde{\theta}}{55\beta}+\frac{8\theta^Y}{11\beta}.\quad(32)$$

5 Endogenous Sequencing

In the game with endogenous sequencing, either country's choice of the tariff-selection period conveys important information. If, for example, country X in equilibrium prefers to select its tariff in period two only for some values of its political-economy parameter θ^X, then country Y appropriately conditions when country X chooses to select its tariff in period one.

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[17] $EW^Y\left(\tau^X\left(\theta^X,\theta^Y\right),\tau^Y\left(\theta^Y\right),\theta^Y\right)$ is strictly concave in $\tau^Y\left(\theta^Y\right)$ since:

$$\frac{\partial^2EW^Y\left(\tau^X\left(\theta^X,\theta^Y\right),\tau^Y\left(\theta^Y\right),\theta^Y\right)}{\partial\left[\tau^Y\left(\theta^Y\right)\right]^2}=-\frac{55\beta}{64}<0.$$

We now determine the perfect Bayesian equilibrium of the two-stage, three-period game. Let's first fix $\underline{\theta} \leq \theta^{Y^*} \leq \overline{\theta}$ and let's assume that in equilibrium country Y chooses its import tariff in period one if and only if $\theta^Y \geq \theta^{Y^*}$. We turn next to country X and derive the critical value of its parameter θ^X for which it is indifferent between a period-one and a period-two tariff selection *given* the aforementioned θ^{Y^*}. In particular, we need:

$$
\frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}} E\left[W^X \left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X \right) / \theta^Y < \theta^{Y^*} \right]
$$

$$
+ \left(1 - \frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}} \right) E\left[W^X \left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X \right) / \theta^Y \geq \theta^{Y^*} \right] =
$$

$$
= \frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}} E\left[W^X \left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X \right) / \theta^Y < \theta^{Y^*} \right]
$$

$$
+ \left(1 - \frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}} \right) E\left[W^X \left(\tau^{X^F}\left(\theta^X, \theta^Y\right), \tau^{Y^L}\left(\theta^Y\right), \theta^X \right) / \theta^Y \geq \theta^{Y^*} \right]. \quad (33)
$$

Intuitively, if country X chooses to select its tariff in period one, country Y also makes the same choice as long as $\theta^Y \geq \theta^{Y^*}$, which has probability $1 - \frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}}$. In this case, the Cournot outcome emerges and thus, country X's expected welfare is $E[W^X \left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X \right) / \theta^Y \geq \theta^{Y^*}]$. With probability $\frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}}$, however, country Y selects its import tariff in period two and country X receives the Stackelberg-leader expected payoff, i.e., $E[W^X \left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X \right) / \theta^Y < \theta^{Y^*}]$.

If country X chooses to select its import tariff in period two instead, country Y does the same as long as $\theta^Y < \theta^{Y^*}$, which has probability $\frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}}$. Then, once again, the countries engage in a Cournot game and country X's expected welfare is $E[W^X \left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X \right) / \theta^Y < \theta^{Y^*}]$. Nevertheless, with probability $1 - \frac{\theta^{Y^*} - \underline{\theta}}{\overline{\theta} - \underline{\theta}}$, $\theta^Y \geq \theta^{Y^*}$, and thus country X receives the Stackelberg-follower expected payoff, which equals $E[W^X \left(\tau^{X^F}\left(\theta^X, \theta^Y\right), \tau^{Y^L}\left(\theta^Y\right), \theta^X \right) / \theta^Y \geq \theta^{Y^*}]$.

Equation (33) can be rewritten as:

$$\left(\theta^{Y^*} - \underline{\theta}\right) \{E\left[W^X\left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]$$
$$- E\left[W^X\left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]\} =$$
$$= \left(\overline{\theta} - \theta^{Y^*}\right) \{E\left[W^X\left(\tau^{X^F}\left(\theta^X, \theta^Y\right), \tau^{Y^L}\left(\theta^Y\right), \theta^X\right)/\theta^Y \geq \theta^{Y^*}\right]$$
$$- E\left[W^X\left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X\right)/\theta^Y \geq \theta^{Y^*}\right]\}. \quad (34)$$

Straightforward algebra reveals that:

$$E\left[W^X\left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]$$
$$- E\left[W^X\left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right] =$$
$$= \frac{1}{110\beta} - \frac{3\widetilde{\theta}}{56\beta} - \frac{83\widetilde{\theta}^2}{172480\beta} + \frac{3\left(\underline{\theta} + \theta^{Y^*}\right)}{440\beta} - \frac{47\widetilde{\theta}\left(\underline{\theta} + \theta^{Y^*}\right)}{24640\beta}$$
$$+ \frac{3\theta^X}{44\beta} + \frac{3\widetilde{\theta}\theta^X}{224\beta} + \frac{\theta^X\left(\underline{\theta} + \theta^{Y^*}\right)}{352\beta}. \quad (35)$$

Lemma 1

$$\frac{\partial}{\partial\theta^X}\{E\left[W^X\left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]$$
$$- E\left[W^X\left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]\} > 0.$$

Proof.

$$\frac{\partial}{\partial\theta^X}\{E\left[W^X\left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]$$
$$- E\left[W^X\left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]\} =$$
$$= \frac{3}{44\beta} + \frac{3\widetilde{\theta}}{224\beta} + \frac{\underline{\theta} + \theta^{Y^*}}{352\beta} > 0,$$

since β, θ^{Y^*}, $\underline{\theta}$ and $\widetilde{\theta} = \underline{\theta} + \overline{\theta}$ are all strictly bigger than zero, and this concludes our proof. $\blacksquare$

Corollary 1

$$\frac{\partial^2}{\partial\theta^{X^2}}\{E\left[W^X\left(\tau^{X^L}\left(\theta^X\right), \tau^{Y^F}\left(\theta^X, \theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]$$
$$- E\left[W^X\left(\tau^{X^C}\left(\theta^X\right), \tau^{Y^C}\left(\theta^Y\right), \theta^X\right)/\theta^Y < \theta^{Y^*}\right]\} = 0.$$

Similarly, we have:

$$E\left[W^X\left(\tau^{X^F}\left(\theta^X,\theta^Y\right),\tau^{Y^L}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]$$

$$-E\left[W^X\left(\tau^{X^C}\left(\theta^X\right),\tau^{Y^C}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]=$$

$$=\frac{444}{3025\beta}+\frac{333\widetilde{\theta}}{169400\beta}+\frac{18653\widetilde{\theta}^2}{18972800\beta}-\frac{149\left(\overline{\theta}+\theta^{Y^*}\right)}{38720\beta}-\frac{269\widetilde{\theta}\left(\overline{\theta}+\theta^{Y^*}\right)}{135520\beta}$$

$$-\frac{2\theta^X}{55\beta}-\frac{3\widetilde{\theta}\theta^X}{12320\beta}+\frac{\theta^X\left(\overline{\theta}+\theta^{Y^*}\right)}{352\beta}.\quad(36)$$

Lemma 2 *If* $\overline{\theta}<\frac{451}{67}$, *then:*

$$\frac{\partial}{\partial\theta^X}\{E\left[W^X\left(\tau^{X^F}\left(\theta^X,\theta^Y\right),\tau^{Y^L}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]$$

$$-E\left[W^X\left(\tau^{X^C}\left(\theta^X\right),\tau^{Y^C}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]\}<0.$$

Proof. *Given* $\widetilde{\theta}=\underline{\theta}+\overline{\theta}$, $\underline{\theta}\geq1$, $\overline{\theta}>\underline{\theta}$, *and* $\underline{\theta}\leq\theta^{Y^*}\leq\overline{\theta}$, *we have:*

$$\frac{\partial}{\partial\theta^X}\{E\left[W^X\left(\tau^{X^F}\left(\theta^X,\theta^Y\right),\tau^{Y^L}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]$$

$$-E\left[W^X\left(\tau^{X^C}\left(\theta^X\right),\tau^{Y^C}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]\}=$$

$$=-\frac{2}{55\beta}-\frac{3\widetilde{\theta}}{12320\beta}+\frac{\overline{\theta}+\theta^{Y^*}}{352\beta}\leq-\frac{2}{55\beta}-\frac{3\widetilde{\theta}}{12320\beta}+\frac{\overline{\theta}+\overline{\theta}}{352\beta}=$$

$$=-\frac{2}{55\beta}-\frac{3\left(\underline{\theta}+\overline{\theta}\right)}{12320\beta}+\frac{\overline{\theta}}{176\beta}\leq-\frac{2}{55\beta}-\frac{3\left(1+\overline{\theta}\right)}{12320\beta}+\frac{\overline{\theta}}{176\beta}=$$

$$=-\frac{451}{12320\beta}-\frac{3\overline{\theta}}{12320\beta}+\frac{\overline{\theta}}{176\beta}<0\Longleftrightarrow\overline{\theta}<\frac{451}{67},$$

and this concludes our proof. ■

Corollary 2

$$\frac{\partial^2}{\partial\theta^{X^2}}\{E\left[W^X\left(\tau^{X^F}\left(\theta^X,\theta^Y\right),\tau^{Y^L}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]$$

$$-E\left[W^X\left(\tau^{X^C}\left(\theta^X\right),\tau^{Y^C}\left(\theta^Y\right),\theta^X\right)/\theta^Y\geq\theta^{Y^*}\right]\}=0.$$

We assume that $\overline{\theta} < \frac{451}{67}$ in all that follows. Now, with some further algebra we obtain the critical value of the political-economy parameter θ^X (as a function of θ^{Y^*}) for which country X is indifferent between selecting its import tariff in periods one and two. In particular, using equations (34), (35) and (36), we have:

$$\theta^{X^*}\left(\theta^{Y^*}\right) = \frac{A}{B}, \tag{37}$$

where:

$$
\begin{aligned}
A = {} & \left(\frac{1}{110} - \frac{3\widetilde{\theta}}{56} - \frac{83\widetilde{\theta}^2}{172480}\right)(\theta^* - \underline{\theta}) + \frac{3}{440}\left(\theta^{Y^{*2}} - \underline{\theta}^2\right) \\
& - \frac{47\widetilde{\theta}}{24640}\left(\theta^{Y^{*2}} - \underline{\theta}^2\right) - \left(\frac{444}{3025} + \frac{333\widetilde{\theta}}{169400} + \frac{18653\widetilde{\theta}^2}{18972800}\right)\left(\overline{\theta} - \theta^{Y^*}\right) \\
& + \frac{149}{38720}\left(\overline{\theta}^2 - \theta^{Y^{*2}}\right) + \frac{269\widetilde{\theta}}{135520}\left(\overline{\theta}^2 - \theta^{Y^{*2}}\right) \quad \text{and} \quad (38)
\end{aligned}
$$

$$
\begin{aligned}
B = {} & \frac{3\left(\underline{\theta} - \theta^{Y^*}\right)}{44} - \frac{3\widetilde{\theta}\left(\theta^{Y^*} - \underline{\theta}\right)}{224} - \frac{\theta^{Y^{*2}} - \underline{\theta}^2}{352} \\
& - \frac{2\left(\overline{\theta} - \theta^{Y^*}\right)}{55} - \frac{3\widetilde{\theta}\left(\overline{\theta} - \theta^{Y^*}\right)}{12320} + \frac{\overline{\theta}^2 - \theta^{Y^{*2}}}{352}. \quad (39)
\end{aligned}
$$

Since we are interested in a symmetric perfect Bayesian equilibrium, we need to assure that $\theta^{X^*}\left(\theta^{Y^*}\right) = \theta^{Y^*} = \theta^*$. In the rest of the paper, we assume that $\underline{\theta} = 1$ and $\overline{\theta} = 2$, or in other words that both θ's are uniformly distributed on $[1, 2]$. We choose to do this for a number of reasons. First of all, it simplifies significantly our exposition. Secondly, it does not invalidate our main assumption, i.e., that governments are politically motivated with respect to their import-competing producers; it just implies that governments are not overly motivated regarding the latter. Finally, assuming that $2 \leq \overline{\theta} \leq \frac{451}{67}$ would not affect the qualitative nature of our results.

Using that $\underline{\theta} = 1$ and $\overline{\theta} = 2$, equation (37) can be rewritten as:

$$\theta^{X^*}\left(\theta^*\right) = \frac{165200\theta^{*^2} + 2529176 - 1056430\theta^*}{107800\theta^{*^2} + 1352120\theta^* - 917840}. \tag{40}$$

Now, we have:

$$\frac{\partial \theta^{X^*}\left(\theta^*\right)}{\partial \theta^*} < 0, \tag{41}$$

$$\theta^{X^*}\left(\theta^* = 1\right) \approx 4.775, \tag{42}$$

14

$$\theta^{X^*} (\theta^* = 1.5) \approx 2.02 \text{ and} \tag{43}$$

$$\theta^{X^*} (\theta^* = 2) \approx 1.34, \tag{44}$$

which together imply that a unique fixed point θ^* does exist on $(1.5, 2)$.

Finally, we need to illustrate that country i does actually prefer to select its tariff in period one if and only if its $\theta^i \geq \theta^*$. Without loss of generality, let's look at the incentives country X faces. Note that θ^* satisfies by default equation (34), i.e., if the political-economy parameter of country X equals θ^*, then, country X is indifferent between choosing its import tariff in periods one and two. Nevertheless, if $\theta > \theta^*$, by Lemma 1, the left-hand side of the equation strictly increases. At the same time, by Lemma 2, the right-hand side of the equation strictly decreases. Thus, if $\theta > \theta^*$, country X strictly prefers to select its tariff in period one.

Conversely, if $\theta < \theta^*$, by Lemma 1, the left-hand side of equation (34) strictly decreases. Concurrently, by Lemma 2, the right-hand side of the equation strictly increases. Thus, if $\theta < \theta^*$, country X strictly prefers to pick its specific import tariff in period two, and this concludes our analysis.

6   Conclusions

This paper investigates the timing of tariff decisions. In particular, we answer the questions: If two competing importers wish to impose duties on the same exporting country, will they prefer to do so simultaneously or sequentially? If the latter, what factors determine which country will be the leader and which one the follower? We develop a homogeneous-good, two-stage, three-period model in which two competing importers can choose to select their respective optimal import tariffs with respect to an exporting country in one of two periods. We assume that their governments are politically motivated regarding their import-competing industries. Moreover, we assume that the degree of their political motivation, captured by a political-economy parameter, is private information.

We find that the countries endogenously choose to select their tariffs sequentially if and only if their political-economy parameters differ in relation to a common critical threshold. In particular, each country prefers to pick its tariff in period one, risking to be the leader, if and only if its political-economy parameter exceeds the threshold. Otherwise, countries choose their tariffs in period two.

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