Auctioning countermeasures in the WTO

Kyle Bagwell, Petros C. Mavroidis, Robert W. Staiger

Abstract

We offer a first formal analysis of auctioning retaliation rights within the WTO. We show that the auctions exhibit externalities among bidders, and we characterize equilibrium bidder behavior under alternative auction formats. If the violating country is prevented from bidding to retire the right of retaliation against it, then the possibility of “auction failure” arises, whereby no bids are made despite positive valuation by bidders. If the violating country is instead permitted to bid, then auction failure is precluded, and indeed the right of retaliation is always retired. We evaluate these different auction formats from normative (revenue, compliance, efficiency) standpoints.

Keywords: GATT; WTO; Retaliation; Countermeasures; Auctions

JEL classification: F5; D13; D34

1. Introduction

A major accomplishment of the Uruguay Round of GATT negotiations in creating the WTO was the introduction of new dispute settlement procedures. These procedures were intended to
provide a significant step forward in the settling of trade disputes, in large part by ensuring that violations of WTO commitments would be met with swift retaliation ("suspension of concessions") by the affected trading partners. While the dispute settlement procedures of the WTO indeed represent a considerable improvement over those in GATT, significant problems of enforcement remain in the WTO.

One prominent problem is the practical difficulty faced by small and developing countries in finding the capacity to retaliate effectively against trading partners that are in violation of their WTO commitments. The difficulty is that, even if a small or developing country wins a WTO ruling against a trading partner, and is thus authorized to retaliate should the trading partner not comply with the ruling, the country may have little ability to bring teeth to the ruling with effective retaliation. Many small and developing countries thus voice frustration with their ability to negotiate meaningful commitments with trading partners in the WTO.\(^1\)

Recently, Mexico has proposed in the WTO (WTO, 2002) a number of changes to the dispute settlement procedures, including that the right of retaliation be made "tradeable." The idea is that, if a country wins a WTO ruling against a trading partner, and finds that it is unable or unwilling to retaliate itself, it should be able to trade that right to another country that would value and utilize the right of retaliation. In Mexico’s view, “...this concept might help address the specific problem facing Members that are unable to suspend concessions effectively.” (WTO, 2002, p. 6).

In this paper, we offer a first formal analysis of tradeable retaliation rights. We identify some potential benefits of tradeable retaliation rights, propose alternative structures for trading such rights, and then evaluate the proposed structures in terms of the identified potential benefits. Our work thus contributes to the ongoing policy discussions by providing a rigorous evaluation of the pros and cons of alternative structures for tradeable retaliation rights.

What are the potential benefits of tradeable retaliation rights? The Mexican proposal highlights two such benefits. First, such a system could facilitate the rebalancing of concessions, since the harmed country would then receive compensation in exchange for its rights to suspend. Second, the incentive for compliance could be improved, because the offending country may be more inclined to bring its policies into conformity with its WTO obligations when it faces a more realistic possibility of effective retaliation. We suggest here a third potential benefit; namely, when retaliation rights are tradeable, an existing right of retaliation may be more efficiently allocated to the WTO member who values this right most highly.

How might trade in retaliation rights be structured? While the Mexican proposal does not make any specific suggestions in this regard, a number of trading structures could be considered. One interesting possibility is that the right of retaliation might be auctioned. We explore this possibility here. While other trading structures are also worthy of consideration, we focus on auctions since auction theory is well developed and has been of great practical use in other policy arenas. As we discuss below, we consider two auction structures, which differ with regard to whether the offending country is allowed to bid to retire the right of retaliation against it. The auction structures are readily evaluated in terms of the three potential benefits of tradeable retaliation rights listed above. In particular, we may gauge the rebalancing of concessions on the basis of the expected revenue received by the government running the auction, the incentive for compliance on the basis of the cost inflicted on the offending country, and efficiency in terms of the combined welfares of the affected governments.

\(^1\) Bagwell, Mavroidis, and Staiger (2006) and Bown (2004a,b) report evidence consistent with the view that retaliation is less effective for such countries.
This exploration is novel from the perspective of the theory of trade agreements, where threatened retaliation plays a central role in enforcement, but where auctioning retaliation rights has not been considered. From the perspective of auction theory, retaliation rights within the WTO exhibit some novel features as well, because retaliation implies a rich pattern of both positive and negative externalities across trading partners. Recent work in the auction literature has focused on environments with externalities, and the case of auctioning countermeasures in the WTO can be viewed as a new and interesting environment within which to extend the study of auctions with externalities.

To undertake our analysis, we adopt a simple model in which two foreign countries import a common good from an exporting home country. We assume that each country has bound its tariffs in a previous GATT/WTO negotiation, that the home country has violated its WTO commitments, and that some other (unmodeled) country has been granted a right of retaliation against the home country but is unwilling or unable to exercise this right with a retaliatory tariff of its own. With this country as the “seller”, we then consider the implications of allowing the seller to sell the right of retaliation in a first-price sealed-bid auction. We consider two different auction structures. In our basic auction, we allow the two foreign countries to bid for the right to retaliate against the home country, but we do not allow the home country to bid to retire this right of retaliation. In our extended auction, we permit the home country to bid as well.

We assume that the two foreign countries experience privately observed political-economy shocks that determine their valuations of the right to impose a higher tariff. In our basic auction, the two foreign countries are the only bidders, and we observe that this is an auction with positive externalities: each foreign country would prefer that the other foreign country win the auction and retaliate against the home country over the alternative that no country wins the auction and no retaliation is imposed. Intuitively, both foreign countries enjoy a more favorable terms of trade when retaliation by either foreign country is imposed. We show further that whether a foreign country would in fact prefer to win the right of retaliation over the alternative that the other foreign country wins this right depends on the realization of its privately observed political-economy shock. Intuitively, the more favorable foreign terms of trade is enjoyed in either event, but the import-competing producers in the winning country enjoy as well the benefits of additional tariff protection at the expense of consumers in that country. Thus, a foreign country that is sufficiently politically motivated – and therefore values the implied redistribution from its consumers to its import-competing producers to a sufficient degree – prefers to win rather than lose to the other foreign country. Together, these features lead the basic auction to exhibit several unusual properties, including misallocation of the retaliation right across the foreign countries and even outright auction failure, in which no bids are made despite positive valuation by the bidders.

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2 See Bagwell and Staiger (2002, Chapter 6) for a review of the literature on enforcement of trade agreements.

3 Our formal analysis is closely related to that of Jehiel and Moldovanu (2000). They consider second-price sealed-bid auctions with externalities and derive several interesting results. Among these, they construct an equilibrium for a general family of payoffs that exhibits positive externalities. In our analysis of the “basic auction,” we feature an analogous equilibrium. Our work has several novel aspects, however. In particular, we characterize the necessary properties of equilibrium behavior and thereby establish that the constructed equilibrium is unique, analyze an “extended auction” wherein bidders are asymmetric and both positive and negative externalities exist, focus on first-price sealed-bid auctions, and develop a new trade-policy application. Other important contributions in this literature include Das Varma (2002), Ettinger (2002), Haile (2000) and Jehiel and Moldovanu (1996, 2001).

4 See Bown and Crowley (2006, 2007) and Chang and Winters (2002) for evidence consistent with the hypothesis that a tariff increase by one country may generate a positive terms-of-trade externality for another country that imports the relevant good.
When we extend the basic auction to permit the home country to bid to retire the right of retaliation against it, we observe that both positive and negative externalities arise among bidders. While each foreign country continues to impose a positive externality on the other foreign country if it wins the auction, each foreign country imposes a negative externality on the home country if it wins. We show that in this extended auction there can be no auction failure, and indeed the home country always wins and retires the retaliation right. Intuitively, the home country incurs the full cost of retaliation, while retaliation is a public good among the foreign countries; thus, the home country has the greatest incentive to win the auction.

Our analysis of the extended auction contributes to an ongoing policy debate about the role of monetary compensation in WTO dispute settlement procedures. It is sometimes argued that these procedures should be modified, so that retaliatory tariffs are not used and instead the violating country provides an appropriate cash payment to the harmed country. But it is not clear that monetary compensation would always be credible: What would happen if the harmed country is small and the violating country refuses to make the cash payment? Our analysis of the extended auction suggests that monetary compensation from the home (violating) country to the seller (the harmed country) becomes credible in this circumstance, when the seller offers the right of retaliation in an auction. Intuitively, the home country then understands that if it does not win the auction and make the corresponding cash payment, a (large) foreign country will win the auction and impose a tariff on home-country exports. Thus, the threat of a retaliatory foreign tariff induces the home country to offer actual cash compensation.

We next evaluate the two auction structures with respect to the three potential benefits listed above. First, we consider the extent to which the auctions facilitate the rebalancing of concessions. We find that this first criterion favors the extended auction, as the greatest expected revenue is generated when the home country is permitted to bid. Second, we explore the degrees to which the auctions encourage greater compliance and promote greater ex-ante efficiency. We find that the compliance and efficiency criteria favor the basic auction under some circumstances. We conclude that the ranking of different auction structures in the WTO-retaliation setting depends critically on the kind of benefits that are sought.

Our work provides a rigorous evaluation of the pros and cons of different structures for auctioning retaliation rights. It thus also offers valuable formal input to the larger question of whether the WTO dispute settlement system should be modified to include tradeable retaliation rights. We do not claim to answer this question, however, since auctioning retaliation rights in the WTO could also yield a number of important benefits and costs that are not included in our analysis. For example, a potential benefit is that the prospect of auction revenue might enable a small developing country to attract and finance private legal support for WTO legal actions. An additional cost is that the revenue generated by auctions could result in excessive use of the WTO dispute settlement system. As well, when bilateral disputes take multilateral dimensions, tensions may grow across governments and frustrate future negotiations.

In what follows, Section 2 lays out the economic model. The basic auction is defined in Section 3, and the equilibrium bids are characterized in Section 4. Section 5 defines the extended auction, and Section 6 characterizes the equilibrium bids. Section 7 compares the benefits offered under the two auction structures. Section 8 concludes.

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5 For further discussion, see Bronkers and van den Broek (2005) and O’Connor and Djordjevic (2005).
2. Model

In this section, we develop the economic framework that underlies our analysis. We present a three-country model, in which two symmetric foreign countries (1 and 2) import a single good from Home. In subsequent sections, we analyze auctions in which the foreign countries bid for the right to retaliate against Home on this good; therefore, we refer to this good as the “retaliation good.” Our goal in the present section is to develop an economic model of the retaliation-good sector, define the corresponding welfare functions for governments, and characterize best-response, Nash and efficient tariffs.6

The economic model of the retaliation-good sector is simple. For each foreign country \( j = 1, 2 \), let demand and supply be given as \( D(P_j) = 1 - P_j \) and \( Q(P_j) = 1/4 \), where \( P_j \) is the local price of the retaliation good in foreign country \( j \). In Home, there is a larger endowment (supply) of this good, but no demand: \( D^H(P) = 0 \) and \( Q^H(P) = 1/2 \), where \( P \) is the local price of the retaliation good in Home. Foreign country \( j \)'s import demand function is thus \( M(P_j) = D(P_j) - Q(P_j) \), and Home’s export supply function is \( E(P) = Q^H(P) - D^H(P) \).

Let \( \tau^j \) denote foreign country \( j \)'s specific import tariff. For simplicity, we assume that Home has no export policy. Thus, the world price, \( P^w \), for the retaliation good must equal Home’s local price: \( P = P^w \). The local price in foreign country \( j \) is \( P_j = P^w + \tau^j \). Market clearing for the retaliation good requires \( M(P_j) + M(P^j) = E(P^w) \), yielding the equilibrium world price, \( \bar{P}^w(\tau^1, \tau^2) \).

The equilibrium local price in foreign country \( j \), which we denote as \( \bar{P}^j(\tau^j, \bar{P}^w) \), is then determined as \( \bar{P}^j(\tau^j, \bar{P}^w) = \bar{P}^w(\tau^1, \tau^2) + \tau^j \). In our linear setting, \( \bar{P}^w(\tau^1, \tau^2) = (1 - \tau^1 - \tau^2)/2 \) and \( \bar{P}(\tau^j, \bar{P}^w) = (1 - \tau^1 + \tau^j)/2 \), where \( i, j = 1, 2 \) and \( i \neq j \). We assume that \( \tau^j \leq 1 \).

We consider next the welfare functions of the governments of the various countries, with regard to trade in the retaliation-good sector. In line with recent work, we allow that a government is motivated by both national-income and political-economy (i.e., distributional) concerns.7 The latter concern may reflect, e.g., the lobbying activities of import-competing firms.

We represent the welfare function for the government of foreign country \( j \) as

\[
W^j(\bar{P}^j, \bar{P}^w) = \int_{P^j}^1 (1 - P^j) dP^j + \zeta^j \Pi(\bar{P}^j) + [\bar{P}^j - \bar{P}^w]M(\bar{P}^j)
\]

(2.1)

where the first term is consumer surplus, the second term is profit weighted by a political-economy parameter, \( \zeta^j \), and the third term is tariff revenue. Foreign country \( j \)'s profit is \( \Pi(P^j) = P^j/4 \). As Eq. (2.1) reveals, the government of foreign country \( j \) experiences a welfare benefit from the world-price reduction (i.e., terms-of-trade improvement) that an increase in any import tariff implies. A higher import tariff also affects welfare by changing the local price, \( \bar{P}^j \), and thereby altering consumer surplus, profit and tariff revenue. With respect to the political-economy parameter, we assume:

**A1:** For each \( j \in \{1, 2\} \), \( \zeta^j \in [1, 2] \).

The government of foreign country \( j \) maximizes national income when \( \zeta^j = 1 \). Otherwise, the government weighs the profit of import-competing firms above consumer surplus and tariff revenue. Finally, it is sometimes convenient to regard welfare as a direct function of tariffs, and we thus define \( \bar{W}^j(\tau^j, \tau^1) = W^j(\bar{P}^j(\tau^j, \bar{P}^w(\tau^1, \tau^2)), \bar{P}^w(\tau^1, \tau^2)) \).

6 The best-response tariffs are used in Section 3, when we state a key assumption (A3) that underlies all of our analysis. An understanding of efficient tariffs is needed in Section 7, where we evaluate different auction structures on the basis of efficiency.

7 For discussion of this literature, see Bagwell and Staiger (1999, 2002 Chapter 2).
We consider next the welfare of Home. Letting $\zeta^h$ denote the political-economy parameter for Home, we represent Home’s welfare as

$$W(\tilde{P}^w) = \zeta^h (1/2) \tilde{P}^w.$$  \hfill (2.2)

Thus, Home weighs the profit of its export sector, $(1/2)\tilde{P}^w$, by a political-economy parameter, $\zeta^h$. Observe that Home suffers a welfare loss when foreign tariffs are increased and the world price declines. Maintaining symmetry with A1, we assume:

**A2**: $\zeta^h \in [1, 2]$.

This assumption plays no role in the analysis until Sections 5–7.

With the foreign country welfare functions defined, we may now characterize best-response (optimal) and Nash tariffs. As indicated by Eq. (2.1), when the government of foreign country $j$ selects its optimal tariff, it considers the impact of the tariff on the local price and the world price. We find that the best-response tariff function, $\tau^*_j(\tau^i)$, is given by $\tau^*_j(\tau^i) = (\zeta^j + 2\tau^i)/6$. This function is upward sloping, since the foreign countries are competing importers: as the tariff of one foreign country rises, more volume is diverted to the other foreign country, and the latter country thus greets the higher volume with a greater tariff as it thereby achieves a large welfare gain from the consequent terms-of-trade improvement.\(^8\)

The Nash equilibrium is a useful benchmark with which to identify the source of inefficiency in the absence of a trade agreement. Foreign country $j$’s Nash tariff, $\tau^N_j$, is defined by $\tau^*_j(\tau^N_i) = \tau^N_j$. We find that $\tau^N_j = (3\zeta^j + \zeta^i)/16$ and observe that $\tau^N_j \leq 1/2$ under A1. Observe further that $\tau^N_j - \tau^N_i = (1/8)(\zeta^j - \zeta^i)$. The foreign country with the higher political-economy parameter thus sets the higher Nash tariff, as it has greater incentive to raise the local price — and thus the profit of the import-competing sector. Fig. 1 illustrates the best-response and Nash tariffs.

We now characterize efficient tariffs, where efficiency is measured relative to the welfare functions of the three governments. A simplifying feature of our economic model is that Home always exports 1/2 units. Thus, foreign tariffs do not restrict trade in an aggregate sense; rather, tariffs influence the allocation of the fixed volume of Home exports across the foreign countries. This structure is advantageous for two reasons. First, it serves to highlight the externality across foreign countries that is a primary focus of our auction analysis, because with this structure retaliation by one foreign country cannot destroy trade volume but rather only diverts it to the other foreign country. Second, while it is well understood that tariffs may impact efficiency by altering the overall volume of trade, it is less well appreciated that tariffs also may enhance efficiency by allocating a greater share of aggregate trade volume to the importing country whose government most values trade (i.e., to the foreign country whose government weighs least heavily the interests of import-competing firms). This latter role is most easily seen when there is a fixed volume of trade to allocate.\(^9\)

To characterize the efficiency frontier, we begin by deriving the politically optimal tariffs. As discussed by Bagwell and Staiger (1999, 2002), a government’s politically optimal tariff is that

\(^8\) Bagwell and Staiger (1997) examine a related “competing importer” model and likewise find that import tariffs are strategic complements. See also Maggi (1999).

\(^9\) We emphasize, though, that the basic features of our auction analysis do not hinge on our assumption of fixed aggregate trade volume. In particular, the efficiency-enhancing role for tariffs that we identify here, and the externalities across bidders that we characterize below, would also arise in a more general model in which tariffs affect the aggregate volume of trade.
tariff which would be optimal, if governments were not motivated by the terms-of-trade implications of their trade policies. In other words, when the government of foreign country $j$ chooses its politically optimal tariff, it achieves its preferred local price: $W^j_{P^j}=0$. We find that the politically optimal tariff, $\tau^j_{PO}$, is given by $\tau^j_{PO}=(1/4)[\zeta^j-1]$. The politically optimal tariff is thus free trade when national income is maximized. Under A1, foreign country $j$’s Nash tariff exceeds its politically optimal tariff: $\tau^j_{N}>\tau^j_{PO}$. Intuitively, foreign country $j$ is motivated as well by terms-of-trade considerations when setting its Nash tariff.

We turn now to the efficiency frontier. Define joint welfare by $J(\tau^1, \tau^2) = W(\tilde{P}^w) + W^1(\tilde{P}^1, \tilde{P}^w) + W^2(\tilde{P}^2, \tilde{P}^w)$. When $\zeta^h=1$, the world price cancels from this sum, being entirely associated with the redistribution between Home export profit and foreign tariff revenue. For our present purposes, it is sufficient to examine the efficiency frontier when $\zeta^h=1$. Maximizing $J(\tau^1, \tau^2)$, we find that efficient tariffs, $(\tau^1_E, \tau^2_E)$, satisfy $\tau^1_E-\tau^2_E=(1/4)[\zeta^1-\zeta^2]$. The politically optimal tariffs are thus efficient.

As Fig. 2 illustrates, the efficiency frontier is upward sloping. Intuitively, efficiency in our model is all about the allocation of a fixed volume of trade across foreign countries. If foreign country 1 has a higher political-economy parameter than does foreign country 2 (i.e., if $\zeta^1>\zeta^2$), then it is efficient for foreign country 1 to have a higher local price and thus greater profit in the import-competing sector. This is accomplished by allowing foreign country 1 to select a higher tariff.

Along the efficiency frontier, the foreign tariff differential is maintained. Of course, at higher tariff pairs along the frontier, the world price is lower, and so movements along the efficiency frontier correspond to redistributions from Home to the foreign countries. But how is the efficient tariff differential determined? At a given world price (i.e., for a given sum of tariffs, $\tau^1+\tau^2$), efficiency requires that the particular tariffs ($\tau^1$ and $\tau^2$) maximize the joint welfare of the foreign countries. This amounts to choosing the best local price pair ($\tilde{P}^1$, $\tilde{P}^2$), given the fixed world price. This choice involves a tradeoff. First, as discussed above, when political-economy differences are present across foreign countries, the welfare benefit of greater profit in the import-competing
sector is larger in the foreign country with the higher political-economy parameter. This force suggests that local prices should vary across foreign countries. Second, the joint consumer surplus and tariff revenue of foreign countries is maximized when local prices are equal across foreign countries. For a given world price, the efficient local price ratio thus represents a balance between the two considerations.

Why is the Nash equilibrium not efficient? As Fig. 2 illustrates, when \( \zeta^j > \zeta^i \), the Nash equilibrium entails tariffs for which the tariff differential, \( \tau^j - \tau^i \), is smaller than would be efficient. Intuitively, when foreign country \( i \) raises its tariff, it does not internalize that a greater share of imports is then diverted to foreign country \( j \), whose local price (and thus profit) falls as a result. When \( \zeta^j > \zeta^i \), this leads foreign country \( i \) to "under-value" the redistributive effect (on profit, across foreign countries) of its tariff increase on foreign country welfare for any given world price. By contrast, when \( \zeta^j = \zeta^i \), there is no efficiency basis to seek a redistribution of profit from one foreign country to another, and so the Nash equilibrium is efficient.

3. The basic auction: definition and payoffs

In this section, we define and interpret our basic auction. After identifying the different outcomes that may arise in this auction, we characterize and interpret the payoffs that are associated with these outcomes.

Our basic auction is a first-price sealed-bid auction, where the two foreign countries are the bidders. Each of the two foreign countries is privately informed of its political-economy parameter, where these parameters, \( \zeta^1 \) and \( \zeta^2 \), are independently and identically distributed according to a well-behaved (twice-continuously differentiable) distribution function, \( F(\zeta^i) \), over the support \([1, 2]\), with the density function given as \( F' \). After observing \( \zeta^j \), foreign country \( j \) makes a monetary bid for the right to retaliate. The foreign countries select their bids simultaneously. The bids are selected from the
set \( \{N\} \cup \{b_o, \infty\} \), where \( N \) corresponds to a decision to “not bid” and \( b_o \geq 0 \) is the exogenous reserve price for the auction. A case of particular interest is \( b_o = 0 \). If both countries make a bid (i.e., neither selects \( N \)), then the right of retaliation goes to the high bidder, with each foreign country having an equal chance of gaining the right of retaliation in a tie. If one foreign country makes a bid and the other does not, then the right of retaliation goes to the former. Finally, if neither foreign country makes a bid (i.e., both select \( N \)), then the right of retaliation is not assigned, and no retaliation occurs.

What does retaliation mean? As discussed in the Introduction, we imagine that Home has violated its WTO obligations against some country, but that this country elects not to retaliate on its own. Instead, the harmed country conducts an auction for the right to retaliate against Home. In our basic auction, we assume that two foreign countries bid for the right to retaliate against Home. We now suppose that, through prior negotiations with Home, the two foreign countries have agreed to set their tariffs on the retaliation good at \( \tau_o \equiv \tau_o^1 = \tau_o^2 \geq 0 \). If a foreign country obtains the right of retaliation, then it is permitted to raise its tariff on the retaliation good up to the higher value, \( \tau_o + \Delta \), where \( \Delta > 0 \). The size of \( \Delta \) is interpreted as reflecting the size of Home’s original violation.\(^{10}\) Here, we do not model the nature of Home’s original violation, or the selection of the retaliation good, though these are obviously important subjects for discussion and future analysis.\(^{11}\) Given this focus and the assumed symmetry of the foreign countries, we can regard \( \Delta \) as an exogenous number that characterizes the extent of permitted retaliation by the winner (if any) of the auction.

We are interested in the case in which any winner of the auction would, in fact, choose to carry out the permitted level of retaliation. Intuitively, we may imagine that Home and the foreign countries have negotiated lower tariffs over time, with the status quo being that each now sets its tariff below its reaction curve. Each foreign country would thus enjoy a small tariff hike, if such a hike did not induce a higher Home tariff on some (unmodeled) good that the foreign country exports to Home.\(^{12}\) Our focus here is on the auction of retaliation rights, and so we do not put forth a repeated-game model with which to endogenize the status quo tariffs. Using A1, however,

\(^{10}\) Under GATT/WTO rules, when it is found that a country has violated its obligations (e.g., by selecting a tariff above the level to which it had agreed), if the offending and harmed countries cannot agree upon “compensation” (e.g., the offending country may offer tariff reductions on other goods that it imports), then the harmed country is authorized to retaliate (e.g., the harmed country may raise its own tariffs), where the permitted level of retaliation is determined as that which restores the original balance of concessions. Working with a general-equilibrium model, Bagwell and Staiger (1999, 2002) show that the balance of concessions is restored when the retaliatory action is of a magnitude that restores the offending country’s original terms of trade. We consider here the possibility that the harmed country may hold an auction for retaliation of this size. GATT/WTO rules further provide that the retaliation must later be removed if the original violation is later removed, and so more generally we may think of the harmed country as auctioning the per-period rental of the right to retaliate.

\(^{11}\) As shown just below, the assumption of a single retaliation good enables us to analyze a simple model in which positive externalities arise across bidders. An alternative model would allow that both foreign countries import goods 1 and 2 from Home but that only foreign country 1 (2) has import-competing firms that supply good 1 (2). Then, good 1 (2) would be the natural retaliation good for foreign country 1 (2). In this alternative model, positive externalities would still arise across bidders: a retaliatory tariff by foreign country 1 (2) would lower the world price of this good and thereby benefit consumers of good 1 in foreign country 2 while also increasing tariff revenue in foreign country 2.

\(^{12}\) Our model does not provide an efficiency rationale for an agreement between Home and the foreign countries to lower tariffs. First, we do not model the good (or goods) that the foreign countries export to Home. Second, with regard to the good that Home exports, we have assumed that the total export volume is fixed, so that efficiency concerns only the allocation of this volume across foreign countries. As Bagwell and Staiger (1999, 2002) show, however, in more general settings, efficiency enhancing trade agreements must entail reciprocal tariff reductions. Motivated by this general finding and by the actual nature of trade-policy negotiations, we thus assume that the initial tariffs are below the respective reaction curves, so that each foreign country would carry out a small retaliation.
we do know that a small retaliation would be carried out if the initial tariffs entail free trade or are politically optimal. More generally, we impose the following assumption:

**A3:** \( \tau_o \geq 0, \Delta > 0 \) and \( \tau_o + \Delta < 1/6 \).

This assumption implies that \( \tau_o + \Delta \) is always below each foreign country’s reaction curve, since under A1 we have that \( 1/6 \leq \zeta' / 6 = \min_{\tau'} \tau_R^j (\tau') \). Thus, under A1 and A3, when a foreign country wins the right to retaliate, it will exercise this right in full, regardless of the current realization of its political-economy parameter.\(^\text{13}\)

From foreign country \( j \)'s perspective, there are three possible outcomes: it may “win” the auction, in which case \( \tau' = \tau_o + \Delta \) and \( \tau = \tau_o \); it may “lose” the auction to foreign country \( i \), in which case \( \tau' = \tau_o \) and \( \tau = \tau_o + \Delta \); or it may be that “nothing” happens (no country wins the auction), in which case \( \tau' = \tau_o \). The respective (gross) payoffs to foreign country \( j \) from these three outcomes are \( \omega (\zeta') = \bar{W}' (\tau_o + \Delta, \tau_o, \zeta') \), \( \lambda (\zeta') = \bar{W}' (\tau_o, \tau_o + \Delta, \zeta') \) and \( \eta (\zeta') = \bar{W}' (\tau_o, \tau_o, \zeta') \), where we now explicitly represent the dependence of welfare on \( \zeta' \).

We now characterize these payoffs. Our first observation is that each foreign country prefers retaliation to nothing, whether that country wins or loses: \( \omega (\zeta') > \eta (\zeta') \) and \( \lambda (\zeta') > \eta (\zeta') \). These inequalities follow easily from A1 and A3.\(^\text{14}\) Intuitively, provided that some foreign country wins the auction, retaliation will occur and the resulting reduction in the world price affords a terms-of-trade benefit to both foreign countries. The political-economy parameter cannot be too small (i.e., we use \( \zeta' \geq 1 \)), else the winning country might prefer the lower local price that comes with no retaliation; and the political-economy parameter also cannot be too large (i.e., we use \( \zeta' \leq 2 \)), else the losing country might prefer no retaliation to the low local price that occurs upon losing and thus absorbing diverted trade volume. Under A1 and A3, however, there is no ambiguity: the foreign countries agree that someone should retaliate.

But might there be a free-riding problem? This seems plausible if a foreign country would rather lose than win. In this case, retaliation has the aspect of a public good among the foreign countries. Intuitively, whether a foreign country wins or loses, it obtains the benefit of a lower world price. The difference between the two outcomes rests with the local price. If foreign country \( j \) wins, then it imposes the retaliatory tariff and obtains a higher local price; whereas, if foreign country \( j \) loses, then it absorbs diverted trade volume, and its local price thus drops. Given that the world price is the same in either outcome, the comparison thus boils down to whether foreign country \( j \) prefers the higher local price that comes with winning or the lower local price that comes with losing. Now, foreign country \( j \)'s preferred local price comes about when its tariff is set at its politically optimal level, \( \tau'_{PO} \). This discussion thus suggests that foreign country \( j \) prefers to win rather than lose if \( \tau_o + \Delta \) is “closer” to \( \tau'_{PO} \) than is \( \tau_o \).

\(^{13}\) In the context of a larger game in which the status quo tariffs are endogenized, it is natural to associate our model with a later stage that follows the negotiation of the status quo tariffs. After this negotiation is completed, the respective countries may experience political-economy shocks. Such a shock may, for example, motivate Home to violate its agreement. Likewise, the foreign countries receive political-economy shocks that may alter the benefit of a unilateral tariff hike. From this perspective, A3 means that the political-economy parameter for a foreign country would never drop (as compared to its level at the time of the original negotiation) to such an extent that the appeal of a unilateral tariff hike would be lost. This discussion provides some additional context within which to consider our analysis, but we emphasize that such a game would require a separate analysis and is well beyond the reach of the present paper.

\(^{14}\) Observe that \( \omega (\zeta') - \eta (\zeta') = \bar{W}' (\tau_o + \Delta, \tau_o, \zeta') - \bar{W}' (\tau_o, \tau_o + \Delta, \zeta') > \frac{1}{8} (\zeta' - 4 \tau_o - 3 \Delta) > 0 \), where the inequality uses A1 (\( \zeta' \geq 1 \)) and A3 (\( \Delta > 0, \tau_o + \Delta < 1/6 \)). Likewise, \( \lambda (\zeta') - \eta (\zeta') = \bar{W}' (\tau_o, \tau_o + \Delta, \zeta') - \bar{W}' (\tau_o, \tau_o, \zeta') > \frac{4}{8} (4 \tau_o + 2 - \zeta' + \Delta) > 0 \), where the inequality uses A1 (\( \zeta' \leq 2 \)) and A3 (\( \tau_o \geq 0, \Delta > 0 \)).
We now present a second observation, which confirms this suggestion. In particular, if we let \( \zeta_c \in (1, 2) \) be defined by

\[
\frac{1}{4} \left( \tau_o + \frac{4}{2} \right) + 1,
\]

then we find that \( \text{sign} \{ \omega(\zeta^j) - \lambda(\zeta^j) \} = \text{sign} \{ \zeta^j - \zeta_c \} \). Observe now that \( \tau_o \) is “closer” to \( \tau_{PO} \) than is \( \tau_o + \Delta \) when \( \tau_{PO} - \tau_o < \tau_o + \Delta - \tau_{PO} \), which is in turn true if and only if \( \zeta^j < \zeta_c \). Thus, our informal discussion indicates that when \( \zeta^j < \zeta_c \), foreign country \( j \) would rather lose (select \( \tau_o \)) than win (select \( \tau_o + \Delta \)). But this is just what our second observation says as well.

Our third observations concerns the relative slopes of the three payoffs. Specifically, we find that the slopes of \( \omega(\zeta^j) \), \( \lambda(\zeta^j) \) and \( \eta(\zeta^j) \) are positive and satisfy

\[
\frac{1}{8} > \frac{1}{8} > \frac{1}{8}.
\]

This result is illustrated in Fig. 3 and captures a simple idea. When the foreign country wins, its local price is higher, and so its import-competing industry earns greater profit. This is especially valuable when the government places a greater welfare weight on these profits. Thus, \( \omega(\zeta^j) \) increases swiftly with the political-economy parameter. By contrast, when the foreign country loses, the resulting reduction in the local price works to reduce profit in the import-competing industry and is thus particularly painful when the political-economy parameter is large. It follows that \( \lambda(\zeta^j) \) increases slowly with the political-economy parameter. Finally, if no retaliation occurs, then the foreign country’s payoff rises with the political-economy parameter at an intermediate speed, corresponding to the direct effect of a higher weight on profit.

The basic auction is an auction with positive externalities: as indicated by our first observation above, any foreign country \( j \) prefers that foreign country \( i \) win the auction to the situation in which neither foreign country wins the auction (i.e., \( \lambda(\zeta^j) > \eta(\zeta^j) \)). This is because retaliation is a public good among foreign countries. As we discuss in the next section, the presence of a positive externality has interesting implications for equilibrium bidding behavior.

4. The basic auction: equilibrium bids

In this section, we characterize the symmetric (Bayes–Nash) equilibria of the basic auction. Such an equilibrium is described by a bidding function, \( b(\zeta^j) \), that maps from \([1, 2]\) into \( \{N\} \cup [b_o, \infty) \). We begin by characterizing the necessary properties of a symmetric equilibrium. With the necessary
properties identified, we then establish the existence of a unique symmetric equilibrium. The results reported here are all formally proved in Bagwell, Mavroidis, and Staiger (2003).

Throughout, we maintain the assumption that $b_o$ is sufficiently small:

\[ \Lambda 4: \omega(2) - b_o > \lambda(2). \]

This ensures that the net benefit of winning exceeds that of losing, at least for the highest type. Of course, $\Lambda 4$ is satisfied when $b_o=0$; moreover, $\omega(1) - b_o > \eta(1)$ is sufficient for $\Lambda 4$.\(^{15}\)

Our analysis of the necessary properties of a symmetric equilibrium starts with two basic findings. The first finding is that the equilibrium bidding function must be “monotonic.” Specifically, in any symmetric equilibrium, if a type bids (i.e., does not select $N$), then any higher type must bid, too, and in fact the higher type must choose a weakly higher bid. The second finding is that “auction failure” is a feature of any symmetric equilibrium. In other words, in any symmetric equilibrium, the probability that any foreign country $j$ does not bid (i.e., selects $N$) is greater than zero. It is thus possible that the auction will fail, in the sense that no foreign country makes a bid. This result holds even if $b_o=0$. To see the intuition, suppose instead that all types bid. Foreign country $j$ would then win with positive probability even when its type is low. Further, if foreign country $j$ were to deviate and not bid (i.e., free ride), then it would enjoy the payoffs from losing (i.e., $\lambda(\zeta_j')$), since the other foreign country is sure to bid and thus win. But foreign country $j$ would gain from such a deviation if its type were sufficiently low, because it then prefers losing to winning.

With these two basic findings in place, we may provide three further characterizations of symmetric equilibria. The first characterization is that there must exist a critical low type $\zeta_L \in (1, 2)$ such that types below $\zeta_L$ do not bid while types above $\zeta_L$ do bid. The second characterization concerns the form of the bidding function for types above $\zeta_L$: there must exist a critical high type $\zeta_H \in (\zeta_L, 2)$ such that the intermediate types pool at the reserve bid $b_o$ (i.e., $b(\zeta') = b_o$ for all $\zeta' \in (\zeta_L, \zeta_H)$) while types above $\zeta_H$ bid above the reserve bid. Finally, the third characterization offers further information about the bidding behavior of the highest types: the critical high type $\zeta_H$ joins the pool at the reserve bid (i.e., $b(\zeta_H) = b_o$), and the bidding function rises continuously and strictly as the type rises above $\zeta_H$.

At an intuitive level, the first and third characterizations are easily understood. The first characterization builds naturally from the monotonicity and auction-failure findings just described. The third characterization reflects the insight that higher types prefer winning to losing and thus bid aggressively. Over the range of higher types, the equilibrium bidding function is thus strictly increasing, just as it is in a standard first-price auction.

The second characterization is more subtle and reflects the following logic. First, it is not possible for an interval of types to pool at any $b > b_o$. If such a pooling bid were posited, then all types on that interval could not be indifferent between winning and losing; thus, there would exist some type that prefers to deviate to a slightly higher or lower bid. By contrast, pooling at $b_o$ is possible, since a slightly lower bid is then not possible. Second, an interval of types, beginning at $\zeta_L$, must pool at the bid $b_o$. Intuitively, if $b$ were strictly increasing over $(\zeta_L, 2]$, then it would be necessary that type $\zeta_L$ is indifferent between bidding $b_o$ and not bidding: $\omega(\zeta_L) - b_o = \eta(\zeta_L)$. But this implies that $\omega(\zeta_L) - b_o < \lambda(\zeta_L)$, and so types just above $\zeta_L$ would gain from deviating to a lower bid (such as $b_o$), since they then benefit by losing more often (and paying less when

\[^{15}\] If $\omega(1) - b_o > \eta(1)$, then $\omega(2) - \lambda(2) - b_o > (\omega(2) - \lambda(2)) - (\omega(1) - \eta(1)) = \frac{d}{2} \left( \frac{1}{4} - \lambda_o - \frac{4}{3} \right) > 0.$
winning). Third, the highest types are unwilling to pool at \( b_o \), since under A4 such types would gain from deviating to a higher bid and winning more often.

As we show in Bagwell, Mavroidis, and Staiger (2003), the critical values, \( \zeta_L \) and \( \zeta_H \), may be defined in terms of the parameters of the model. In particular, \( \zeta_H = \bar{\zeta}(b_o) \) and \( \zeta_L = \tilde{\zeta}(b_o) \) in any symmetric equilibrium, where the value \( \bar{\zeta}(b_o) \) is the solution to

\[
\omega(\zeta') - \lambda(\zeta') = b_o. \tag{4.1}
\]

Using A4, we may confirm that \( \bar{\zeta}(b_o) = 1 + 4\tau_o + 2\Delta + \frac{4}{A} b_o \in (1, 2) \). Given \( \tilde{\zeta} = \bar{\zeta}(b_o) \), we define \( \tilde{\zeta}(b_o) \) as the solution to

\[
(F(\bar{\zeta}) - F(\zeta')) \left[ \frac{\lambda(\zeta') - (\omega(\zeta') - b_o)}{2} \right] = F(\zeta') [\omega(\zeta') - b_o - \eta(\zeta')]. \tag{4.2}
\]

Using Eq. (4.1) and A4, we may confirm that \( \tilde{\zeta}(b_o) \) is uniquely defined, \( \tilde{\zeta}(b_o) \in (1, \bar{\zeta}(b_o)) \) and \( \frac{d\tilde{\zeta}}{db_o} > 0 \).

We now report the form that the bidding function must take over \( \zeta' \in [\zeta_H, 2] \). Fortunately, over this range of types, standard tools from auction theory can be used to derive the bidding function. Recall that \( \zeta_H = \bar{\zeta} \). In any symmetric equilibrium, when foreign country \( j \) has type \( \zeta' \in [\bar{\zeta}, 2] \), it bids

\[
b(\zeta') = \omega(\zeta') - \lambda(\zeta') - \frac{A}{4} \int_{\bar{\zeta}}^{\zeta'} F(x) dx. \tag{4.3}
\]

Intuitively, a bidder in a first-price auction “shades” the bid relative to the true valuation, where in the present context the bidder’s valuation over the range of focus corresponds to the value of winning relative to losing, \( \omega(\zeta') - \lambda(\zeta') \).

We may now summarize the various findings above into a single proposition that states the necessary properties of a symmetric equilibrium:

**Proposition 4.1.** In any symmetric equilibrium of the basic auction,

(i). for all \( \zeta' \in [1, \tilde{\zeta}] \), \( b(\zeta') = N \),
(ii). for all \( \zeta' \in (\tilde{\zeta}, \bar{\zeta}] \), \( b(\zeta') = b_o \), and
(iii). for all \( \zeta' \in (\bar{\zeta}, 2] \), \( b(\zeta') \) is strictly increasing and given by Eq. (4.3).

The values \( \tilde{\zeta} \) and \( \bar{\zeta} \) depend upon \( b_o \) and are defined by Eqs. (4.2) and (4.1). They satisfy \( \bar{\zeta} \in (1, 2) \) and \( \tilde{\zeta} \in (1, \bar{\zeta}) \).

**Fig. 4** illustrates the bidding function.

With the necessary features established, we next report that the stated bidding function indeed constitutes a symmetric equilibrium.

**Proposition 4.2.** The bidding function defined in Proposition 4.1 constitutes a symmetric equilibrium of the basic auction.

Together, Propositions 4.1 and 4.2 indicate that we have now characterized the unique symmetric equilibrium for our basic auction. Summarizing:
Corollary 4.1. For the basic auction, there exists a unique symmetric equilibrium. In this equilibrium, the governments of the foreign countries use the bidding function defined in Proposition 4.1.

In auctions without externalities, the first-price auction is allocatively efficient: the bidding function is strictly increasing, and so the highest-valuation bidder always obtains the item. In the setting considered here, however, positive externalities exist. A first-price auction then no longer ensures that retaliation is efficiently allocated: auction failure may result, so that no bidder wins the right to retaliate; and even when bidding occurs, it may be that both foreign countries bid at the reserve price and the right of retaliation is misallocated. On the other hand, when at least one foreign country has a high political-economy parameter, then bidding is more aggressive and the auction efficiently allocates retaliation across the foreign countries.

5. The extended auction: definition and payoffs

As discussed in the Introduction, an extended auction may facilitate a credible cash payment from Home (the violating country) to the seller (the harmed country). In this section, we begin our analysis of the extended auction. We define and interpret the extended auction, and we also characterize Home’s payoffs in this auction.

We consider an extended auction, in which Home can bid to retire the right of retaliation. Home places a bid at the same time that the foreign countries make their respective bids, where the space of possible bids for each country is \( N \cup [b_o, \infty) \). If no country bids at or above \( b_o \), then no retaliation occurs and no auction revenue is received. If some country bids \( b_o \) or more, then the highest bidder wins the auction. In the event of a tie, the auction treats foreign countries symmetrically, but Home
may be treated differently than the foreign countries. For example, Home may win all ties. If Home wins the auction, then the right of retaliation is retired, and Home transfers its bid to the seller. If a foreign country wins, then, as in the basic auction, the winning foreign country retaliates and transfers its bid to the seller. To keep our analysis tractable, we assume that Home’s political-economy type is publicly known and constant at some value \( \zeta_h \in [1, 2] \). The foreign countries’ respective types are privately known.

The payoffs to the foreign countries are defined as in the basic auction. We focus here on Home’s payoff under the different outcomes (retaliation, no retaliation). If Home does not face retaliation (whether because both foreign countries select \( N \) or Home bids more), the equilibrium world price is \( \tilde{P}_{\text{NR}} = \tilde{P}_o (\tau_o, \tau_o) = \frac{1}{2} - \tau_o \). Likewise, if Home does face retaliation, then the equilibrium world price is \( \tilde{P}_{\text{R}} = \tilde{P}_o (\tau_o + \Delta, \tau_o) = \frac{1}{2} - \tau_o - \frac{\Delta}{2} \). Now recall from Eq. (2.2) that Home’s welfare is \( W(\tilde{P}_o) = \zeta_h (1/2) \tilde{P}_o \), where \( \zeta_h \in [1, 2] \) under A2. Thus, Home’s (gross) payoff under no retaliation and retaliation is given as:

\[
W_{\text{NR}} = \zeta_h (1/2) \tilde{P}_{\text{NR}} = \zeta_h (1/2) \left( \frac{1}{2} - \tau_o \right) .
\]

\[
W_{\text{R}} = \zeta_h (1/2) \tilde{P}_{\text{R}} = \zeta_h (1/2) \left( \frac{1}{2} - \tau_o - \frac{\Delta}{2} \right) .
\]

Using Eqs. (5.1) and (5.2), we may thus define Home’s “valuation” of no retaliation as:

\[
W_{\text{NR}} - W_{\text{R}} = \zeta_h \frac{\Delta}{4} .
\]

We now recall A4, which ensures that the reserve bid is small relative to the value that a foreign country of the highest type places on winning versus losing. As we show next, A4 also has implications for Home’s willingness to bid.

**Lemma 5.1.** For any \( \zeta_h \geq 1 \), \( W_{\text{NR}} - W_{\text{R}} > \omega(2) - \eta(2) > \omega(2) - \lambda(2) > b_o \).

This lemma follows directly from A2, A3 and A4.\(^{17}\) It indicates a sense in which Home gains the most from winning the auction. Intuitively, Home receives all of the cost of a reduction in the world price, while each foreign country enjoys only a share of the benefit.

A novel feature of our extended auction is that both positive and negative externalities are present. As in the basic auction, a positive externality arises across foreign countries: each foreign country prefers that the other foreign country win to the possibility that neither foreign country wins (i.e., \( \lambda(\zeta^f) > \eta(\zeta^f) \)). In the extended auction, however, Home is also a bidder, and a negative externality arises between Home and the foreign countries: Home prefers that no country win to the possibility that a foreign country wins, since retaliation is avoided only in the former case (i.e., \( W_{\text{NR}} > W_{\text{R}} \)).

6. The extended auction: equilibrium bids and revenue

We again look for symmetric equilibria, where symmetry in the extended auction means that foreign countries adopt symmetric strategies. Home may adopt an asymmetric strategy, and recall,

\(^{16}\) Our results hold as well under the requirement that Home and foreign countries are treated symmetrically when ties occur. By allowing that Home is treated differently in ties, we are able to state a simple specification for equilibrium strategies.

\(^{17}\) Specifically, using Eq. (5.3), \( W_{\text{NR}} - W_{\text{R}} = \zeta_h (1/4) \tilde{P}_o (\tau_o, \tau_o) = \frac{1}{2} - \tau_o - \frac{\Delta}{2} \geq \frac{4}{6} [4 \tau_o + 3 \Delta] = \omega(2) - \eta(2) > \omega(2) - \lambda(2) > b_o \), where the first inequality uses A2, the second inequality uses A3, and the final inequality uses A4.
too, that the extended auction may treat Home differently than the foreign countries, in the event that Home ties with one or both foreign countries. As above, we focus on pure-strategy equilibria. Let \( b^h \in \{N\} \cup [b_o, \infty) \) denote Home’s bid.

Our first step is to determine whether a symmetric equilibrium exists in which Home always loses (i.e., a foreign country wins the right of retaliation with probability one).

**Lemma 6.1.** In any symmetric equilibrium of the extended auction, if \( b_o \) is sufficiently close to zero, then \( b^h \neq N \) and Home cannot always lose.

**Proof.** Assume to the contrary that \( b^h = N \). The foreign countries then bid as characterized above for the basic auction. Home’s payoff from \( b^h = N \) is thus \( F^2(\tilde{\zeta})W_{NR} + [1 - F^2(\tilde{\zeta})]W_R \). If Home were to deviate and bid \( b_o + \epsilon \), for \( \epsilon > 0 \) and small, then Home’s payoff would be \( F^2(\tilde{\zeta})[W_{NR} - b_o] + [1 - F^2(\tilde{\zeta})]W_R \), approximately. Thus, using Eq. (5.3), Home does better by deviating if and only if

\[
1 - \frac{F^2(\tilde{\zeta})}{F^2(\zeta)} \left[ \frac{\epsilon H}{4} \right] > b_o.
\]

Since \( \tilde{\zeta} > \zeta \) and \( \frac{\epsilon H}{4} > b_o \) (by Eq. (5.3) and Lemma 5.1), this inequality holds when \( b_o \) is sufficiently close to zero.

Next, we suppose that \( b^h \neq N \) and yet Home always loses. This is possible only if \( b^h \geq b_o \) and \( b(\zeta^i) \geq b^h \) for all \( \zeta^i \in [1, 2] \). In that event, though, a foreign country with type close to 1 wins with positive probability and would do better by deviating to \( N \). The other foreign country would then win with probability one, and so the deviating foreign country would enjoy the payoff \( \lambda(\zeta^i) \), which exceeds the value of the weighted sum of \( \omega(\zeta^i) - b(\zeta^i) \) and \( \lambda(\zeta^i) \) that it receives in the putative equilibrium. 

It is tempting to conjecture that this lemma holds for any \( b_o \). One might argue that, if a foreign country is willing to bid, then surely Home would be willing to bid more. After all, as Lemma 5.1 establishes, Home gets more from stopping retaliation than any foreign country gains from having retaliation occur (whether as a winner or a loser). This argument, however, is incomplete, as it ignores the fact that Home may enjoy no retaliation even when not bidding. This happens when the foreign countries get stuck in an auction failure. Thus, it is not obvious that Home would always outbid the lowest type of foreign country. We show in the lemma, however, that Home will certainly do so if \( b_o \) is sufficiently small.

Our second step is to consider whether symmetric equilibria exist in which Home always wins (i.e., a foreign country wins the right to retaliate with probability zero). In fact, it is simple to construct equilibria of this kind.

**Lemma 6.2.** There exist symmetric equilibria of the extended auction in which Home always wins. One set of such equilibria is specified as follows: \( b^h \in [\omega(2) - \eta(2), \frac{\epsilon H}{4}] \), \( b(\zeta^i) = b^h \) for all \( \zeta^i \in [1, 2] \), and Home wins all ties. In any symmetric equilibrium of the extended auction in which Home always wins, \( b^h \in [\omega(2) - \eta(2), \frac{\epsilon H}{4}] \).

**Proof.** We begin by establishing existence. Consider Home. A higher bid is clearly not an attractive deviation. A lower bid is also an unattractive deviation. Such a bid ensures certain retaliation, which implies a loss for Home since \( W_{NR} - b_h \geq W_{NR} - \frac{\epsilon H}{4} = W_R \). Consider next a foreign country. Of course, such a country is unable to gain from a lower bid, since then it would only continue to lose. A higher bid would be most attractive to a foreign country of type \( \zeta^i = 2 \). But if this type were to bid \( b^h + \epsilon \), for \( \epsilon > 0 \) and small, then its payoff would be \( \omega(2) - (b^h + \epsilon) < \omega(2) - b^h \leq \omega(2) - [\omega(2) - \eta(2)] = \eta(2) \), and so the deviation is less attractive than bidding \( b^h \) and losing to Home. Thus, the specified strategies constitute a symmetric equilibrium for the extended auction.

Next, we establish that any such equilibrium must have \( b^h \in [\omega(2) - \eta(2), \frac{\epsilon H}{4}] \). Suppose Home always wins and \( b^h < \omega(2) - \eta(2) \). Then when a foreign country has a type near 2, it would gain by
deviating to \( b^h + \epsilon \), for \( \epsilon \) positive and small, as it thereby receives approximately \( \alpha (2) - b^h > \eta (2) \). Suppose next that Home always wins and \( b^h > \frac{4h}{3} \). Then \( W_{NR} = b^h < W_{NR} - \frac{4h}{3} = W_R \), and so Home would gain by deviating and selecting \( N \), as it then either enjoys \( W_{NR} \) (in the event of auction failure) or \( W_R \).

An attractive feature of the specification in Lemma 6.2 is that the associated symmetric equilibrium exists without any further assumptions on the parameters of the model. A potential objection to this specification, however, is that the foreign countries use dominated strategies. For a foreign country of type \( \zeta' \), any bid \( b \) such that \( b > \max \{ \alpha (\zeta') - \eta (\zeta'), b_0 \} \) is dominated by the alternative strategy of selecting \( N \). Thus, the specification used in Lemma 6.2 involves the use of a dominated strategy by all types of foreign country other than the type \( \zeta' = 2 \).

This objection raises the issue of whether an equilibrium can be established without the use of dominated strategies. Home will resist cutting its bid from \( b^h \) if enough foreign types bid at or near \( b^h \). Intuitively, when \( b^h < \frac{4h}{3} \), a lower bid generates a higher Home payoff when Home wins, but reduces Home’s payoff when Home loses. Thus, if Home faces a sufficient probability of losing when it shades its bid, then Home will not shade. For this to be true, it is not necessary that the foreign country types all bid \( b^h \). It is necessary only that the probability is sufficiently high that a foreign country bid will fall at or just below \( b^h \).

Fortunately, for a wide range of parameters, it is possible to construct symmetric equilibria in which Home always wins and foreign countries do not use dominated strategies. To illustrate, suppose \( b_0 \) is small and consider the following specification: \( b^h = \omega (2) - \eta (2) \) and \( b (\zeta') = \omega (\zeta') - \eta (\zeta') \) for all \( \zeta' \in [1, 2] \). Under this specification, we can show that Home will resist cutting its bid from \( b^h \) if two conditions hold: (A) \( F'' (\zeta') F'' (\zeta) / F'' (2) / F (2) / F (2) < 3 \) for all \( \zeta'^2 > 2 \), and (B) \( 1 / F (2) \leq 4 (\zeta^h - 1) / 3 + 6 \lambda \). Condition A is implied if \( F (\zeta') \) is log-concave and thus holds for many popular distributions. For example, it holds if \( F (\zeta') = (\zeta - 1)^2 \) for any \( \alpha > 0 \). This family of power distributions includes the uniform distribution (\( \alpha = 1 \)), convex distributions (\( \alpha > 1 \)) and concave distributions (\( \alpha < 1 \)). Condition A ensures that Home will not find a large bid reduction attractive, if it does not gain from a slight cut in its bid. Condition B then ensures that Home will not gain by shading its bid a slight amount. The latter condition is more restrictive, and it is more likely to hold when \( F'' (2) \) and \( \zeta^h \) are large. Intuitively, Home is deterred from shading its bid slightly, if doing so would significantly increase its probability of losing (i.e., \( F'' (2) \) is large) and losing would be quite costly (i.e., \( \zeta^h \) is large). If \( F (\zeta') \) is a power distribution, then \( F'' (2) = \alpha \), and so Condition B is sure to hold if \( \alpha \) is sufficiently large. Likewise, if \( F (\zeta') \) is a power distribution and \( \alpha \geq 1 / 4 \), then Condition B must hold if \( \zeta^h \in [1 / 4, 1, 2] \). Conditions A and B are thus satisfied in the case of a uniform distribution when \( A2 \) is strengthened slightly so that \( \zeta^h \in [5 / 4, 2] \).

At the same time, it must be noted that it is sometimes impossible to construct a symmetric equilibrium in which Home always wins and foreign countries do not use dominated strategies. As we establish in Bagwell, Mavroidis, and Staiger (2003), if the foreign countries do not use dominated strategies and \( F'' (2) < 3 / 16 \), then there does not exist a symmetric equilibrium in which Home always wins. Intuitively, it is impossible to stop Home from slightly reducing its bid from

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18 The selection of \( N \) yields payoff \( \eta (\zeta') \) or \( \lambda (\zeta') \), depending upon whether the other foreign country wins. The bid of \( b \) yields payoff \( \alpha (\zeta') - b < \eta (\zeta') < \lambda (\zeta') \) when \( b \) is the winning bid, yields the payoff \( \lambda (\zeta') \) when the other foreign countries wins, and yields the payoff \( \eta (\zeta') \) otherwise. Thus, the strategy of selecting \( N \) yields a greater payoff than the strategy of selecting \( b \) whenever \( b \) would be the winning bid, and the strategy of selecting \( N \) yields the same payoff as the strategy of selecting \( b \) whenever \( b \) would not be the winning bid.

19 Details are available from the authors upon request. The conclusions developed here also apply if the foreign bidding function is made slightly steeper while satisfying \( h (2) = \omega (2) - \eta (2) \). For \( \zeta < 1 \), a winning bid by foreign country \( j \) could then provide a strictly higher payoff than not bidding.
\[ b^h = \omega(2) - \eta(2), \] if it is unlikely that a foreign country bids at or just below \( b^h \). In turn, if there are not too many foreign country types that are high (i.e., if \( F'(2) \) is small) and if foreign countries do not use dominated strategies, then it is unlikely that a foreign country bids at or just below \( b^h \).

For distribution functions that place sufficiently little weight on the highest types, the requirement that dominated strategies not be used can have important existence implications. As just noted, for such distributions, this requirement can preclude the existence of symmetric equilibria in which Home always wins. We show above that, when \( b_o \) is small, symmetric equilibria do not exist in which Home always loses, and we establish just below that symmetric equilibria then also fail to exist in which Home sometimes wins (i.e., a foreign country wins the right to retaliate with probability between zero and one). If a symmetric equilibrium exists when \( b_o \) is small, then it must involve Home always winning. Thus, if the distribution function is such that the highest types occur with very low probability, then existence of a symmetric equilibrium is not assured unless we allow that dominated strategies may be used.\(^{20}\)

We now move to our third step and consider whether symmetric equilibria exist in which Home sometimes wins.

**Lemma 6.3.** In any symmetric equilibrium of the extended auction, if \( b_o \) is sufficiently close to zero, then Home cannot sometimes win.

The proof of this lemma is found in Bagwell, Mavroidis, and Staiger (2003). We sketch here the basic argument, which involves three steps. First, we show that it is impossible to have a pooling region over which foreign countries sometimes or always win, given that Home is allowed to bid in the extended auction. Second, we show that Home sometimes wins only if there exists \( \hat{\zeta} \in (1, 2) \) such that \( b(\hat{\zeta}) = b^h \) and, for all \( \zeta > \hat{\zeta}, b(\zeta) > b^h \) and \( b \) is strictly increasing. Third, we exploit the following tension. On the one hand, type \( \hat{\zeta} \) (perhaps plus \( \epsilon \)) has the option of mimicking lower types, and so must be indifferent between beating Home and not, indicating a relationship between \( \omega(\hat{\zeta}) \) and \( \eta(\hat{\zeta}) \). On the other hand, type \( \zeta \) has the option of mimicking higher types, and so must be indifferent between bidding its equilibrium bid and that assigned to a slightly higher type, indicating a relationship between \( \omega(\hat{\zeta}) \) and \( \lambda(\hat{\zeta}) \). In our basic auction, this tension is resolved with a pooling region at \( b_o \). But in the extended auction, as established in the first step, we cannot have a pooling region over which foreign countries sometimes or always win. A contradiction is thus suggested.

We may now use Lemmas 6.1–6.3 to conclude as follows:

**Proposition 6.1.** In any symmetric equilibrium of the extended auction, if \( b_o \) is sufficiently close to zero, then Home always wins and bids \( b^h \in [\omega(2) - \eta(2), \xi^h \frac{1}{2}] \). Furthermore, the resulting expected revenue is strictly greater than in the equilibrium outcome that occurs in the basic auction (as described in Propositions 4.1 and 4.2).

**Proof.** We need only confirm that expected revenue is higher in any symmetric equilibrium of the extended auction than in the symmetric equilibrium outcome of the basic auction. This is trivial to see.

\(^{20}\) Interestingly, the existence problem is absent in a second-price auction. In that case, if \( b^h \geq \omega(2) - \eta(2) \) and \( b(\zeta^*) = \omega(\zeta^*) - \eta(\zeta^*) \) for all \( \zeta^* \in [1, 2] \), then Home has no incentive to shade its bid. In particular, a bid below \( \omega(2) - \eta(2) \) would reduce Home’s probability of winning and would not reduce the bid that it would pay in states where it wins. First- and second-price auctions are both interesting formats in which to study tradeable retaliation rights. These formats are of independent interest even in auctions without externalities, as they generate different expected revenues and payoffs once it is allowed that bidders may be risk averse, asymmetric or budget constrained. We focus here on first-price auctions for two main reasons. First, first-price auctions are more commonly used. Second, as Klemperer (2004) emphasizes, first-price auctions offer important practical advantages: bidder collusion is very easy to enforce in second-price auctions (see also Robinson, 1985), and second-price auctions may discourage entry by bidders relative to first-price auctions.
When Home is allowed to bid, Home always wins and the seller thus always gets \( b_h \geq \omega(2) - \eta(2) \). By contrast, in the basic auction wherein Home does not bid, the seller sometimes (i.e., when there is no auction failure) gets \( b(\xi) \leq b(2) = \omega(2) - \hat{\lambda}(2) - \frac{4}{3} \int_\hat{\xi}^2 F(x) \text{d}x < \omega(2) - \hat{\lambda}(2) < \omega(2) - \eta(2) \). Thus, expected revenue is clearly higher when Home bids.

Intuitively, when \( b_o \) is small so that Home is sure to bid, expected revenue rises relative to that achieved in the basic auction, because (i) auction failure is avoided, and (ii) Home bids more than would any foreign country were Home not allowed to bid.

7. Policy: revenue, compliance and efficiency criteria

In this section, we present our normative analysis. As explained in the Introduction, the overall wisdom of a system of tradeable retaliation rights is difficult to assess and hinges on a variety of considerations. We thus are not able to resolve this issue here; however, we are able to provide valuable formal input by rigorously evaluating the pros and cons of two specific structures for auctioning retaliation rights. Specifically, we compare the basic and extended auctions under the criteria of expected revenue, compliance and ex-ante efficiency. We thereby formally explore the normative implications of permitting Home to bid to retire the right of retaliation.

7.1. Revenue

As discussed in the Introduction, in a system with tradeable retaliation rights, the harmed country may receive monetary compensation for its right to suspend; thus, a potential benefit of such a system is that it may facilitate the rebalancing of concessions. When retaliation rights are auctioned, we may associate this benefit with the expected revenue that is enjoyed by the seller. Expected revenue is thus a natural criterion for making normative comparisons across different auction designs, and we now discuss the implications for expected revenue of permitting Home to bid to retire the right of retaliation.

If the desirability of permitting Home to bid is evaluated on the basis of expected revenue, Proposition 6.1 provides a clear normative conclusion: Home should be permitted to bid to retire the right of retaliation against it. This follows because, as Proposition 6.1 indicates, if \( b_o \) is sufficiently small, Home always wins and the seller thus always gets \( b_h \geq \omega(2) - \eta(2) \). By contrast, in the basic auction, the seller never receives a bid this high, and sometimes receives no bid at all. Therefore, if \( b_o \) is sufficiently small, the seller’s expected revenue is strictly higher when Home is allowed to bid.

7.2. Compliance

A second potential benefit of a system with tradeable retaliation rights is that the incentive for compliance may be improved. It is an unsettled matter among WTO members and legal scholars whether the central purpose of retaliation within the WTO is in fact to facilitate rebalancing or induce compliance. Nevertheless, the differing compliance implications across the basic and extended auctions is bound to be an important feature of auction design regardless of one’s position on this matter. We thus next discuss the implications for compliance of permitting Home to bid to retire the right of retaliation.

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21 See, for example, Jackson (1997) and Sykes (2000).
To assess the compliance implications of the basic and extended auctions, we consider the difference in the expected costs of non-compliance faced by Home under each auction. When Home is given the opportunity to bid in the extended auction, it always wins and retires the right of retaliation. It might therefore be expected through the logic of revealed preference that Home must face higher expected costs of non-compliance under the basic auction where it is not permitted to bid, since in the extended auction Home could always choose not to bid but in fact bids aggressively. However, this reasoning is incomplete because, as our analysis of the extended auction confirms, the foreign governments bid more aggressively when Home is present (in the extended auction) than when it is not present (in the basic auction). Specifically, the positive externalities present in the basic auction lead the foreign governments to bid less aggressively than is efficient, and through this lead to the possibility of auction failure. This possibility is eliminated in the extended auction, where the foreign governments are induced to bid more aggressively and Home always places the winning bid. But from Home’s perspective, auction failure is an attractive feature of the basic auction, and since this feature is absent from the extended auction Home may prefer the basic auction to the extended auction. In fact, as this discussion suggests, the relative compliance implications of the two auctions hinge critically on the probability of auction failure in the basic auction.

To formalize this observation, we denote by $EW_B$ and $EW_E$ the expected welfare of Home under the basic and extended auctions, respectively. In the basic auction, $F^2(\zeta)$ gives the probability of auction failure, and so the expected welfare of Home is $EW_B = F^2(\zeta)W_{NR} + [1 - F^2(\zeta)]W_R$. On the other hand, as Proposition 6.1 demonstrates, in any symmetric equilibrium of the extended auction (for small $b_o$), Home always wins and bids $b^h \in \left[\omega(2) - \eta(2), \zeta^h \frac{\alpha}{\theta} \right]$. As a consequence, the expected welfare of Home under the extended auction is $EW_E = W_{NR} - b^h$. A measure of the difference in the expected costs of non-compliance faced by Home under the two auctions is then given by $EW_E - EW_B = [1 - F^2(\zeta)](\zeta^h \frac{\alpha}{\theta}) - b^h$: we may interpret a positive (negative) value of $EW_E - EW_B$ as indicating that the cost of non-compliance to Home is higher (lower) under the basic auction than under the extended auction.

The relative compliance implications of the two auctions hinge critically on the probability of auction failure in the basic auction ($F^2(\zeta)$). If the probability of auction failure in the basic auction is sufficiently high, then $EW_E - EW_B < 0$ indicating that the cost of non-compliance to Home is lower under the basic auction than under the extended auction. Intuitively, by free-riding on the prospect of auction failure, Home can expect under the basic auction to get away with non-compliance at relatively little cost in this case. If instead the probability of auction failure in the basic auction is sufficiently small, then $EW_E - EW_B > 0$ for at least some equilibria of the extended auction, indicating that the cost of non-compliance to Home is then higher under the basic auction than under the extended auction. Intuitively, in this case as the prospect of auction failure is insignificant, Home can expect little chance to free ride under the basic auction, and so is not much harmed by the absence of this possibility in the extended auction, where it enjoys the added possibility of bidding to retire the retaliation right.

If the desirability of permitting Home to bid is evaluated on the basis of compliance, our discussion above then provides a clear normative conclusion (at least for $b_o$ small): Home should not be permitted to bid to retire the right of retaliation against it unless the probability of auction failure in the basic auction is sufficiently high.

7.3. Efficiency

A third potential benefit of a system with tradeable retaliation rights is that such a system may enhance efficiency by appropriately allocating the right of retaliation. We thus next discuss the implications for ex-ante efficiency of permitting Home to bid to retire the right of retaliation, where ex-
ante efficiency is measured relative to the objective functions of the affected governments. In choosing between the basic and extended auctions, the affected governments are Home, the two foreign governments, and the seller (the harmed government). In our quasi-linear setting, ex-ante efficiency is achieved when the expected joint welfare among the four governments is maximized. We thus adopt as our normative criterion in this subsection the expected joint welfare of the affected governments.

Under this criterion, the expected revenue generated by each auction is irrelevant. This is because the revenue paid by the winning bidder to the seller is a pure transfer from one government to another. Hence, when ex-ante efficiency is the criterion, expected revenue differences cannot be used to select among auction designs. Instead, differences in the allocation of the right of retaliation across auctions become the critical feature. Moreover, since the seller is only affected through the expected revenue, we may restrict our measure of joint welfare to the sum of the (gross) welfare levels of Home and the two foreign governments.

In this regard, it might be thought that any retaliation would reduce efficiency. This perspective suggests that ex-ante efficiency is greater when Home can bid. It must be remembered, however, that we allow governments to be motivated by political-economy concerns, and so if a foreign country experiences a sufficiently large political-economy shock it might be efficient to permit that country to raise its tariff level. Hence, to assess whether the basic auction -- which results in retaliation unless there is auction failure -- can lead to greater ex-ante efficiency than the extended auction -- which never results in retaliation for sufficiently small $b_o$ -- we need to derive an expression for the expected joint welfare under each auction.

Consider first the extended auction. For sufficiently small $b_o$, Home always makes the winning bid and retires the retaliation right. Hence, letting $EJ_E$ denote the expected joint welfare under the extended auction, recalling the definition of joint welfare $J(\tau^1, \tau^2)$ for any two tariffs $\tau^1$ and $\tau^2$, and letting $EJ(\tau_o, \tau_o)$ denote the expected joint welfare when there is no retaliation (i.e., when $\tau^1 \equiv \tau_o$ and $\tau^2 \equiv \tau_o$), we have that, for sufficiently small $b_o$, $EJ_E = EJ(\tau_o, \tau_o)$.

We now develop an analogous expression for the basic auction. When foreign country 1 wins the right to retialte, joint welfare is given by

$J(\tau_o + \Delta, \tau_o) = J(\tau_o, \tau_o) + \frac{A}{8} [2(1 - \zeta_h - \Delta) + (\zeta_1 - \zeta_2)]. \tag{7.1}$

Similarly, when foreign country 2 wins, joint welfare is given by

$J(\tau_o, \tau_o + \Delta) = J(\tau_o, \tau_o) + \frac{A}{8} [2(1 - \zeta_h - \Delta) + (\zeta_2 - \zeta_1)]. \tag{7.2}$

Finally, Eqs. (7.1) and (7.2) imply that

$\frac{1}{2} J(\tau_o + \Delta, \tau_o) + \frac{1}{2} J(\tau_o, \tau_o + \Delta) = J(\tau_o, \tau_o) + \frac{A}{8} [2(1 - \zeta_h - \Delta)]. \tag{7.3}$

Let $EJ_B$ denote the expected joint welfare under the basic auction. Using Eqs. (7.1)–(7.3), and after some manipulation, we find that

$EJ_B = EJ(\tau_o, \tau_o) + \frac{A}{4} \left( [1 - F^2(\zeta)] [1 - \zeta_h - \Delta] + \int_{\zeta_o}^{\zeta} \left[ \int_{\zeta_o}^{\zeta} (\zeta - \zeta_o) F'(\zeta_o) d\zeta_o \right] F'(\zeta) d\zeta \right.$

$\left. + \int_{\zeta_o}^{\zeta} \int_{\zeta_o}^{\zeta} (\zeta - \zeta_o) F'(\zeta_o) d\zeta_o \right] F'(\zeta) d\zeta.$
Intuitively, the difference between the expected joint welfare under the basic auction \((EJB)\) and the expected joint welfare when there is no retaliation \((EJ(\tau_o, \tau_o))\) is composed of the sum of three terms, which can be understood with the help of Eqs. (7.1)–(7.3). A first term \([1-F^2(\tilde{\zeta})] [1-\zeta^h-\Delta]\) represents the “baseline” expected efficiency loss from protection with \(\zeta^i = \tilde{\zeta}^2\). This term is strictly negative, and it appears in Eqs. (7.1)–(7.3), since some foreign country wins the right to retaliate in each expression. The second and third terms are each double integrals, and these terms represent the expected efficiency gain from allocating retaliation to the high-\(\zeta^i\) foreign country. These two terms are each strictly positive. The first double integral measures this expected gain when the high-\(\zeta^i\) foreign country lies in the range \([\tilde{\zeta}, \zeta]\) and the low-\(\zeta^i\) foreign country lies in the range \([1, \tilde{\zeta}]\). Excluded from this double integral is the range of low-\(\zeta^i\) realizations that lie above \(\tilde{\zeta}\) but below the realization of the high-\(\zeta^i\) foreign country. This is because there is pooling over this region in the basic auction, with each foreign country receiving the right of retaliation with probability 1/2, and as indicated by Eq. (7.3) this pooling region adds no expected efficiency gain from allocating retaliation to the high-\(\zeta^i\) foreign country. The second double integral measures this expected gain when the high-\(\zeta^i\) foreign country lies in the range \([\tilde{\zeta}, 2]\). There is no pooling in the basic auction when the high-\(\zeta^i\) foreign country lies in this range, and so the range of low-\(\zeta^i\) realizations runs from 1 up to the high-\(\zeta^i\) foreign country realization.

With expressions for the expected joint welfare under the basic and extended auctions given by \(EJB\) and \(EJE\), respectively, we may now state:

**Proposition 7.1.** If \(1-\zeta^h-\Delta\) is sufficiently close to zero, then \(EJB > EJE\).

**Proof.** Under A4, \(\tilde{\zeta} < 2\). The proposition thus follows as a direct consequence of the expressions for \(EJB\) and \(EJE\) provided above. \(\square\)

Under our maintained assumptions, this proposition describes a parameter region in which \(\zeta^h \in [1, 2]\) is equal to or near unity, \(\Delta > 0\) is near zero, and \(b_o \geq 0\) is equal to or near zero (so that A4 holds, even though \(\Delta\) is small). For example, our maintained assumptions and the additional assumption in Proposition 7.1 hold if \(\zeta^h = 1\), \(b_o = 0\), and \(\Delta > 0\) is sufficiently small.

According to Proposition 7.1, greater ex-ante efficiency is achieved under the basic auction than under the extended auction (for small \(b_o\)) if Home’s political-economy weight is small (i.e. \(\zeta^h\) is close to one) and the degree of retaliation being auctioned is small (i.e., \(\Delta\) close to zero). Under these conditions, the expected benefit of allocating the retaliation right to the foreign country that experiences the biggest political-economy shock outweighs the expected cost imposed on the other two countries, and so expected joint welfare is higher under the basic auction than under the extended auction, where the right of retaliation is surely retired.

If the desirability of permitting Home to bid is evaluated on the basis of ex-ante efficiency, Proposition 7.1 then provides a clear normative conclusion (at least for \(b_o\) small): Home should not be permitted to bid to retire the right of retaliation against it unless the political costs of retaliation against Home (\(\zeta^h\)) and/or the size of the retaliation (\(\Delta\)) are sufficiently large.

### 7.4. Discussion

Based on the above findings, it is evident that the merit of allowing the violating (Home) government to bid to retire the right of retaliation against it depends on the purpose that auctions are expected to serve in the WTO-retaliation setting. If the central purpose of the auction is to facilitate rebalancing by enhancing the ability of harmed countries to collect compensation from violating countries, then the violating government should be allowed to bid and the extended auction is thus preferable to the basic auction. On the other hand, a preference for the basic auction over the
extended auction is indicated for the purpose of encouraging compliance with WTO obligations, unless the probability of auction failure in the basic auction is sufficiently great. Likewise, from the perspective of the goal of ex-ante efficiency, permitting the violating government to bid may not be advisable, and indeed the basic auction will be preferable to the extended auction unless the size of retaliation is sufficiently large and/or the violating government suffers a sufficiently great political cost if it faces retaliation. More broadly, these findings indicate the importance of understanding the purpose of introducing auctions in the WTO-retaliation setting for selecting the appropriate features of auction design.22

8. Conclusion

We offer a first formal analysis of the possibility that retaliation rights within the WTO system might be allocated through auctions. In our basic auction, two foreign countries bid for the right to retaliate against the home country. The basic auction is characterized by positive externalities, since retaliation by one foreign country improves the terms of trade for the other foreign country. We show that this auction exhibits some unusual properties: the retaliation right may be misallocated across the foreign countries, and it is also possible that auction failure occurs. We then consider an extended auction, in which the home country is also allowed to bid to retire the right of retaliation. The extended auction is again characterized by positive externalities between foreign countries. But the extended auction also features negative externalities, since the home country experiences a negative externality whenever a foreign country wins. In the extended auction, we find that auction failure does not occur; in fact, the home country always wins and the retaliation right is therefore always retired.

We also evaluate the different auction formats from a normative standpoint. The extended auction generates greater expected revenue for the seller than does the basic auction, and so the extended auction would be preferred under the compensation/rebalancing criterion. On the other hand, the basic auction may be preferred on both efficiency and compliance grounds. As a general matter, our analysis thus suggests that the desirability of key auction design features may hinge on the purpose that auctions are expected to serve in the WTO-retaliation setting.

References


22 A further consideration is how the WTO compensation provisions (see note 10) might alter the relative performance of the basic and extended auctions. In Bagwell, Mavroidis, and Staiger (2003), we show that the preference for the extended auction over the basic auction on the criterion of expected revenue is unaltered by this consideration. The relative merits of the basic and extended auctions could be altered by this consideration, however, when the concern is with ex-ante efficiency.


