NBER WORKING PAPER SERIES

BACKWARD STEALING AND FORWARD MANIPULATION IN THE WTO

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Working Paper 10420
http://www.nber.org/papers/w10420

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 2004

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NBER Working Paper No. 10420
April 2004
JEL No. F1

ABSTRACT

Motivated by the structure of WTO negotiations, we analyze a bargaining environment in which

negotiations proceed bilaterally and sequentially under the most-favored-nation (MFN) principle.

We identify backward-stealing and forward-manipulation problems that arise when governments

bargain under the MFN principle in a sequential fashion. We show that these problems impede

governments from achieving the multilateral efficiency frontier unless further rules of negotiation

are imposed. We identify the WTO nullification-or-impairment and renegotiation provisions and its

reciprocity norm as rules that are capable of providing solutions to these problems. In this way, we

suggest that WTO rules can facilitate the negotiation of efficient multilateral trade agreements in a

world in which the addition of new and economically significant countries to the world trading

system is an ongoing process.

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I. Introduction

Under the auspices of the World Trade Organization (WTO) – and GATT, its predecessor organization created in 1947 – governments have met with remarkable success in liberalizing world trade. This success, however, was not immediate, and history suggests that it was not a forgone conclusion. The inter-war years witnessed numerous international conferences, convened to orchestrate a return to the liberal trade policies of the pre-war period. These conferences consisted largely of expressions of support for liberal trading ideals, and invariably they ended in failure (Hudec, 1990, pp. 3-45, and League of Nations, 1942, pp. 101- 155).[1] The creation of GATT marked a fundamental divergence from these earlier efforts. In effect, GATT provided a negotiating forum organized around market access interests, wherein the original 23 member-governments could seek to "buy" access rights to the markets of their trading partners and "sell" access to their own markets. This forum spawned a more-or-less continuous process of negotiations extending over 50 some years and now involving more than 140 countries.

The success of the GATT/WTO is all the more remarkable in light of three prominent features of the GATT/WTO negotiating environment. First, WTO negotiations must abide by the most favored nation (MFN) principle. Under this principle, a WTO-member country must provide all member-countries with the same conditions of access to its markets.[2] Second, WTO negotiations take place overwhelmingly among small numbers of countries.[3] And third, as observed above,

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[1]The League of Nations report describes the reasons for this failure: "...trade was consistently regarded as a form of warfare, as a vast game of beggar-my-neighbour, rather than as a co-operative activity from the extension of which all stood to benefit. The latter was the premise on which the post-war conferences based their recommendations – a premise accepted by all in theory but repudiated by almost all in practice. It was repudiated in practice because, as the issue presented itself on one occasion after another, it seemed only too evident that a Government that did not use its bargaining power would always come off second-best." (League of Nations, 1942, p. 120).

[2]The WTO does grant certain exceptions to MFN, for example to allow the formation of free trade agreements and customs unions. We abstract from these exceptions here. We also take as given the MFN clause, and do not offer here an explanation for its usefulness. For formal analyses of the role of the MFN clause in trade agreements, see Bagwell and Staiger (1999a, 1999b, forthcoming), Caplin and Krishna (1991), Choi (1995), Ethier (1998), Ludema (1991) and McCalman (1997). For a comprehensive survey, see Horn and Mavroidis (2000).

[3]This feature is noted, for example, by Horn and Mavroidis (2000), who observe: "...In the WTO, negotiations for the most part take place between subsets of Member countries. Sometimes this is 'officially sanctioned,' as in the case of Principal Supplier negotiations. But also in seemingly multilateral negotiations, the 'actual' negotiations occur between a very limited number of countries..." (Horn and Mavroidis, 2000, p. 34).

GATT/WTO negotiations have extended over half a century, during which time the addition of new and economically significant countries to the world trading system – via either the process of economic development or the act of accession to the GATT/WTO – has occurred on a continuing basis. Each new arrival marks in turn both a potential new buyer of market access and a potential new seller of market access. As a consequence of these three features, it is routine for a country to engage in market access negotiations on a product with one country, having previously negotiated tariff commitments on that product with another country, all subject to MFN.

In this sequential MFN negotiating environment, a pair of potential impediments to multilateral efficiency may be identified. First, under MFN, any market access concession that a country makes to an early negotiating partner is automatically available to future negotiating partners as well. To reduce the associated potential for "free-riding," a country might then engage in inefficient "foot-dragging," offering little in the way of trade liberalization to early negotiating partners, in order to maintain its bargaining position for later negotiations. A second impediment to multilateral efficiency might arise if later negotiating partners themselves engage in "bilateral opportunism," whereby these negotiating partners seek to alter the market access implications of earlier negotiations to their own advantage. More broadly, we may associate the first impediment with a *forward-manipulation* problem, in which early agreements are manipulated to alter the outcome of later negotiations, and the second impediment with a *backward-stealing* problem, in which later agreements are structured to take surplus from earlier negotiating partners.

Does the GATT/WTO owe its success to the fact that these potential impediments are simply unimportant? Or can its rules instead be credited with providing governments with some assurance that forward-manipulation and backward-stealing problems will not become severe? In this paper, we suggest that the potential impediments to efficiency created by these problems are important. And we identify GATT/WTO rules that can help governments overcome these impediments.

Our analysis is carried out within a three-country two-good world, in which a home-country government negotiates bilaterally and sequentially with each of two trading partners, subject to the

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MFN principle. We also permit governments to make direct international transfers as part of their bilateral negotiations. We do this for two reasons. The first reason is to ensure analytical tractability: the feasibility of direct international transfers simplifies our analysis considerably. The second reason is to endow governments with a reasonably flexible portfolio of policy instruments. While actual trade negotiations rarely if ever involve explicit transfers as part of the agreement, these negotiations do often involve more than just tariff reductions.[4] Our assumption that direct international transfers are feasible may be seen as an attempt to capture these additional policy dimensions in a simple model, with "reality" positioned somewhere in between the extremes of negotiations over tariffs only and negotiations over tariffs and direct international transfers.

Within this framework, we characterize the multilateral efficiency frontier, and we then explore whether this frontier can be reached in subgame-perfect equilibria of specific bargaining games that entail sequential and bilateral negotiations under MFN. We explore this issue in two broad steps. We first show that, in our basic sequential MFN bargaining game, the backward-stealing problem makes it impossible for governments to reach the multilateral efficiency frontier: beginning from any efficient combination of tariffs and transfers, the home government and its later negotiating partner can always alter the tariffs and transfers under their control in a way that benefits them at the expense of the (unrepresented) early negotiating partner. When we impose an exogenous "security requirement" that later agreements may not involve backward stealing, we find that the forward manipulation problem makes it generally impossible for governments to reach the efficiency frontier: as a general matter, the home government can engage in inefficient foot-dragging with its early negotiating partner by keeping its tariff high, and both the home government and its early negotiating partner can thereby benefit at the expense of the (unrepresented) later negotiating partner, who is stuck with a less-favorable disagreement point.

With the backward stealing and forward manipulation problems identified in our basic

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[4]For example, the Agreement on Trade-Related Aspects of Intellectual Property Rights negotiated in the Uruguay Round is often interpreted as a transfer from the developing world to industrialized countries that was granted in exchange for certain market access concessions (such as the phase-out of the Multifiber Arrangement).

sequential MFN bargaining game, we then turn to the second broad step of our analysis. We demonstrate that renegotiation opportunities such as those provided in the GATT/WTO can curtail the significance of early negotiation outcomes for the disagreement payoffs of subsequent negotiating partners, and thereby alleviate the inefficiency associated with forward manipulation. And we show that the GATT/WTO reciprocity norm and nullification-or-impairment provisions can mimic a security requirement, and thereby can be seen as helping to alleviate the backward stealing problem. Our main finding is then that the GATT/WTO rules analyzed in this second step permit governments engaged in sequential MFN bargaining to achieve efficient outcomes that are otherwise precluded by the backward stealing and forward manipulation problems identified in step one.

Our paper is directly related to earlier work in both Industrial Organization and in International Trade. In the Industrial Organization literature on contracting with externalities, our paper has links to both the common-seller models and the common-buyer models.

In a common-seller model, a single seller offers an input and sequentially contracts with two buyers. The buyers interact directly, through their subsequent product-market conduct. In the formulation that McAfee and Schwartz (1994) present, the seller makes take-it-or-leave-it offers, where an offer is comprised of a wholesale price and a fixed fee.[5] The buyers' product-market choices are non-contractible. Once the first buyer has sunk the fixed fee, the seller has possible incentive to offer the second buyer a lower wholesale price in exchange for a higher fixed fee. The wholesale-price reduction gives the second buyer an advantage in the product market, and the seller and the second buyer are thus tempted to "steal backwards" from the first buyer. McAfee and Schwartz provide findings suggesting that a non-discrimination clause is ineffective in curbing such opportunism, where such a clause ensures that any wholesale-price/fixed-fee pairing that is offered to the second buyer is also offered to the first buyer. Marx and Shaffer (2000a) show, however, that non-discrimination clauses in fact do enable efficient outcomes to be achieved in equilibrium.

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[5] For other important formulations, see Hart and Tirole (1990), O'Brien and Shaffer (1992) and Segal (1999). We describe the findings under sequential contracting, but similar themes also appear under simultaneous contracting.

We may think of our model as a common-seller model, in which the seller (country A) offers wholesale prices (tariffs) to the buyers (countries B and C) in exchange for fixed fees (transfers), where the buyers also make product-market (tariff) choices. Our model, however, introduces four key differences. First, we do not assume that payoffs are quasi-linear; consequently, efficiency imposes direct restrictions on the selection of transfers. Second, the contracts that we study only establish upper bounds on subsequent (non-fee) choices, in accord with GATT/WTO tariff commitments. Third, motivated by the trade-policy application, the non-discrimination clause that we consider ensures only that the seller offers a uniform wholesale price to both buyers. The buyers may pay different fixed fees. Fourth, the buyers' product-market choices are contractible in our model, and in fact the first buyer's product-market choice is fixed when the second negotiation commences. In our model, therefore, the first buyer is especially vulnerable: the non-discrimination clause is incomplete, the seller and second buyer negotiate over a larger range of payoff-relevant variables and the conduct of the first buyer cannot be adjusted in response to the second contract. In fact, we find that the backward-stealing problem is so severe that sequential contracting cannot deliver efficiency, even when the non-discrimination clause is in place.

Our work is also related to the common-buyer model, in which two sellers sequentially contract with the same buyer. In the initial formulation, given by Aghion and Bolton (1987), sellers make take-it-or-leave-it offers, and the buyer seeks only one unit and thus trades with just one seller. The sellers interact only indirectly, through their contracts with the common buyer. The first seller offers a contract that specifies a penalty payment if the buyer transacts with the second. This contract alters the reservation value that the buyer holds when the second seller approaches and thereby serves to manipulate the offer that the second seller makes. Indeed, when information is symmetric, the efficient seller supplies the good, and the buyer and first seller extract all of the surplus. Marx and Shaffer (2000b) generalize the common-buyer model and allow that the buyer may trade with both sellers. The buyer and first seller extract surplus (but not necessarily all surplus) by manipulating the buyer's future disagreement payoff, and their optimal efforts in this regard do

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not compromise efficiency.[6]

We may think of our model as a generalized common-buyer model, such as Marx and Shaffer (2000b) consider, in which the buyer (country A) offers fixed fees (transfers) to the sellers (countries B and C) in exchange for their production (tariffs). But our model introduces several new elements: the buyer makes a further choice (country A's tariff) that directly affects both sellers, contracts establish only upper bounds on subsequent (non-fee) choices, the sellers interact directly in that each seller's production affects the payoff of the other seller even when transfers are held fixed, the transfer to the first seller cannot be conditioned upon the production of the second seller, and payoffs are not quasi-linear and so efficiency also impinges on the selection of transfers. Our findings also differ in important respects. First, early negotiators in our trade-policy game manipulate the disagreement payoff of country C (i.e., the second seller). Second, in our model, the pursuit of rents through forward manipulation creates an inefficiency (absent further rules).

In the International Trade literature, we are aware of three papers that are closely related to the present analysis. A first paper is Bagwell and Staiger (forthcoming). In that paper, we are also concerned with the possibility of inefficient negotiating outcomes when pairs of countries can negotiate bilaterally. But there are two important differences between that paper and the present analysis. First, in our earlier paper we identify rules of negotiation that serve to protect the welfare of governments that are not participating in a bilateral negotiation, and we relate these rules to WTO principles, but we do not ask the central question of the present analysis: starting from an inefficient (non-cooperative) set of policies, can a simple set of rules be identified which (i) allow governments who engage in sequential bilateral MFN negotiations to arrive at an efficient arrangement, and (ii) have a counterpart in GATT articles? Providing an answer to this question requires a model of the sequential bargaining process, something that our earlier paper does not provide. A second important difference is that we do not permit direct international transfers in our earlier paper. We indicate below how the possibility of international transfers affects our earlier results.

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[6]For other important extensions of the Aghion-Bolton (1987) model, see Marx and Shaffer (1999, 2001) and Spier and Whinston (1995).

A second related paper in the International Trade literature is Limao (2002), who explores an idea related to our foot-dragging result. He shows that a government may engage in foot-dragging under MFN to enhance its bargaining position with regard to a subsequent negotiating partner. However, in Limao's model, foot-dragging arises in anticipation of a subsequent preferential agreement with non-trade objectives, while in our model foot-dragging arises in anticipation of subsequent MFN market access negotiations. A third related paper is Bond, Ching and Lai (2000). Their paper, which focuses specifically on the process of accession under WTO rules, models this process as one in which existing members first negotiate their MFN tariffs (and transfers) together, and then as a group negotiate with the acceding member over the terms that MFN tariff treatment will be extended to it. Within this negotiating environment, Bond, Ching and Lai study how WTO rules can affect the distribution of payoffs between existing WTO members and new members that are negotiating to join the agreement. But in contrast to the negotiating process we study below, in their bargaining model there is no stage at which a country that had previously negotiated a tariff agreement is absent from the bargaining table. It is this feature of negotiations that gives rise to the potential for bargaining inefficiencies in our model, and it is these inefficiencies and the WTO rules which may be interpreted as preventing them that are our primary concern.

The rest of the paper proceeds as follows. The three-country two-good model is introduced in section 2, where the efficiency frontier is also characterized. Section 3 introduces the basic sequential MFN bargaining game, and identifies the backward-stealing problem, while section 4 identifies the forward-manipulation problem. Sections 5 and 6 introduce renegotiation opportunities and nullification-or-impairment/reciprocity provisions as a means by which to alleviate the forward manipulation and backward stealing problems, respectively. Section 7 concludes. Proofs of all lemmas and propositions not established in the text are collected in an Appendix.

2. The Model

2.1 The Basic Setup

We consider a perfectly competitive general equilibrium environment. We assume that country A exports good y to countries B and C in exchange for imports of good x from B and C.

Country A may levy an MFN import tariff τ^A, while countries B and C may each levy their own import tariff, τ^B and τ^C, respectively.[7] We adopt the convention that τ^j represents one plus the ad valorem import tariff of country j, and we let τ denote the vector of tariffs (τ^A, τ^B, τ^C). Country A may also make direct (consumption) transfers to country B and/or country C. We denote the (positive or negative) transfer from A to B by t^B and from A to C by t^C, measured in units of good y. The total net transfers made from A to its trading partners is then $t^A \equiv t^B + t^C$, and we let t denote the vector of transfers (t^A, t^B, t^C).

Provided that country A's (MFN) tariff does not prohibit trade with either of its trading partners B and C, there will be a common exporter price for good x in countries B and C, and we denote this price by P_x^*. The export price for good y in country A is denoted by P_y^A. We may define the ratio of "world" prices (relative exporter prices) as $P^w \equiv P_x^* / P_y^A$. We refer to P^w as the world price or the *terms of trade* between country A and its trading partners B and C. Similarly, we let $P^j \equiv P_x^j / P_y^j$ denote the price of good x relative to the price of good y prevailing locally in country $j \in \{A, B, C\}$. We refer to P^j as the ratio of *local prices* in country j. With non-prohibitive tariffs, international arbitrage links world and local prices:

$$P^A = \tau^A P^w \equiv P^A(\tau^A, P^w); \quad P^j = P^w / \tau^j \equiv P^j(\tau^j, P^w) \text{ for } j \in \{B, C\}.$$

We assume that the international transfers have no secondary burden or blessing (i.e., that they do not affect the equilibrium terms of trade).[8] In each country, the sum of net transfers and tariff revenue is distributed to consumers in a lump-sum fashion.

For any world price, each country's trade must balance in light of its net transfers:

(1)
$$P^w M^A = E^A - t^A,$$
$$M^j - t^j = P^w E^j, \quad j \in \{B, C\},$$

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[7] In this 2-good MFN environment, countries B and C have no basis for trade between them.

[8] This is a strong assumption, and so we emphasize that while it significantly simplifies our analysis, it is not critical for our results.

where M^j and E^j for $j \in \{A,B,C\}$ denote, respectively, imports and exports for country j. We assume that transfers are never so large as to cause a country to export or import both goods (i.e., we do not allow a country's transfer to be larger than its trade in good y). Market clearing determines the equilibrium world price as a function of the vector of tariffs τ. With $\tilde{P}^w(\tau)$ denoting the equilibrium terms of trade, the x-market clearing condition is given by:

$$(2) \qquad M^A(P^A(\tau^A,\tilde{P}^w),\tilde{P}^w,t^A) = E^B(P^B(\tau^B,\tilde{P}^w),\tilde{P}^w,t^B) + E^C(P^C(\tau^C,\tilde{P}^w),\tilde{P}^w,t^C),$$

where we now express imports and exports as explicit functions of local and world prices and transfer levels. The y-market is assured to clear at $\tilde{P}^w(\tau)$ by (1)-(2). We assume that the Marshall-Lerner stability conditions are met globally (ensuring a unique $\tilde{P}^w$ given τ), so that an inward shift of a country's import demand curve improves its terms-of-trade, and that the Lerner and Metzler paradoxes are ruled out, so that $\partial\tilde{P}^w/\partial\tau^A < 0$, $dP^A/d\tau^A > 0$, $\partial\tilde{P}^w/\partial\tau^j > 0$ and $dP^j/d\tau^j < 0$ for $j \in \{B,C\}$.

With P^A held fixed, a change in $\tilde{P}^w$ or t^A can affect M^A only through the effect on A's national income. But the income effect of a small change in $\tilde{P}^w$, measured in units of good y, is given by the import volume M^A. With analogous observations for B and C, we thus impose the following structure on each country's trade function (subscripts denote partial derivatives):

$$(2a) \qquad M^A_{\tilde{P}^w} \equiv M^A \times M^A_{t^A}; \qquad E^B_{\tilde{P}^w} \equiv E^B \times E^B_{t^B}; \text{ and } \qquad E^C_{\tilde{P}^w} \equiv E^C \times E^C_{t^C}.$$

Finally, we represent the objectives of each government as a general function of its local prices, its terms of trade, and the net transfers it grants or receives. In particular, we represent the welfare of the government of country j by $\hat{W}^j(P^j(\tau^j,\tilde{P}^w),\tilde{P}^w,t^j)$ for $j \in \{A,B,C\}$. We place the following basic restrictions on these objective functions. First, under analogous reasoning to that which leads to (2a), we impose the following structure on each country's objective function:

$$(3) \qquad \hat{W}^A_{\tilde{P}^w} \equiv M^A \times \hat{W}^A_{t^A}; \qquad \hat{W}^B_{\tilde{P}^w} \equiv E^B \times \hat{W}^B_{t^B}; \text{ and } \qquad \hat{W}^C_{\tilde{P}^w} \equiv E^C \times \hat{W}^C_{t^C}.$$

As before, this structure reflects the link between direct international transfers and the income effects of changes in $\tilde{P}^w$. And second, we assume that, holding its local prices and its terms of trade fixed, each government would prefer an increase in net transfers toward it: $\hat{W}^A_{t^A} < 0$; $\hat{W}^B_{t^B} > 0$; $\hat{W}^C_{t^C} > 0$. Under (3), this implies as well that, holding its local prices and its net transfer fixed, each country would

prefer a terms-of-trade improvement: $\hat{W}^A_{\tilde{P}^w}<0;\ \hat{W}^B_{\tilde{P}^w}>0;\ \hat{W}^C_{\tilde{P}^w}>0$. As we have argued extensively elsewhere (see Bagwell and Staiger, 1999a), by leaving government preferences over local prices unspecified, our representation of government objectives is very general and is consistent with national-income-maximizing governments as well as governments that are motivated by various political/distributional concerns.

Our three tariffs and two transfers provide one degree of freedom in achieving any level of welfare for the three governments. This means that any welfare triple can be achieved with an arbitrary market-clearing world price or with any one instrument set at an arbitrary level. To see this, consider an arbitrary set of policies (τ, t) and associated welfare levels $\hat{W}^j(P^j(\tau^j, \tilde{P}^w), \tilde{P}^w, t^j)$ for $j \in \{A,B,C\}$ and market-clearing world price $\tilde{P}^w(\tau)$. Suppose that we wish to achieve the same welfare levels with a different market-clearing world price. According to (2) and (2a), a small change $d\tilde{P}^w$ in the market-clearing world price can be engineered as follows: (i) define the change in τ^j for $j \in \{A,B,C\}$ according to $dP^j(\tau^j(\tilde{P}^w), \tilde{P}^w)/d\tilde{P}^w \equiv 0$; and (ii) define the change in t^j for $j \in \{B,C\}$ according to $dE^j(P^j(\tau^j(\tilde{P}^w), \tilde{P}^w), \tilde{P}^w, t^j(\tilde{P}^w))/d\tilde{P}^w \equiv 0$ implying $dt^j = -E^j d\tilde{P}^w$ by (2a), which by (2) then implies $dt^A = -M^A d\tilde{P}^w$ and therefore $dM^A(P^A(\tau^A(\tilde{P}^w), \tilde{P}^w), \tilde{P}^w, t^A(\tilde{P}^w))/d\tilde{P}^w = 0$ by (2a). Hence, the market-clearing condition (2) continues to be satisfied when these policy changes are made and the market-clearing world price changes by $d\tilde{P}^w$. But by (3), these policy changes leave $d\hat{W}^j = 0$ for $j \in \{A,B,C\}$. An analogous argument applies if we wish to achieve the same welfare levels with a different level for any one policy instrument.[9] As this feature is important later, we record it in:

Lemma 1: Any welfare triple can be achieved with an arbitrary market-clearing world price or with any one instrument set at an arbitrary level.

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[9]To see this, observe first that, if we wish to achieve the same welfare level with a different value of a particular tariff τ^j for $j \in \{A,B,C\}$, then the same changes in τ^j for $j \in \{A,B,C\}$ and t^j for $j \in \{B,C\}$ described just above for engineering a small change in $\tilde{P}^w$ can achieve the desired change in any particular tariff τ^j for $j \in \{A,B,C\}$, since changing τ^j for $j \in \{A,B,C\}$ according to $dP^j(\tau^j(\tilde{P}^w), \tilde{P}^w)/d\tilde{P}^w \equiv 0$ implies $d\tau^A/d\tilde{P}^w = -\tau^A/\tilde{P}^w$ and $d\tau^j/d\tilde{P}^w = 1/P^j$ for $j \in \{B,C\}$. And the ability to engineer a desired change in a particular transfer t^j for $j \in \{B,C\}$ is implied directly by the changes described just above, since according to those changes $dt^j = -E^j d\tilde{P}^w$.

2.2 The Efficiency Frontier

Defining $W^j(\tau, t^j) \equiv \hat{W}^j(P^j(\tau^j, \tilde{P}^w(\tau)), \tilde{P}^w(\tau), t^j)$, we may now characterize the efficiency frontier. We define the efficiency frontier with respect to the governments' own preferences, and it is characterized by the set of solutions to:

$$Max_{(\tau, t^B, t^C)} \qquad W^A(\tau, t^A \equiv t^B + t^C)$$

$$\text{s.t.} \qquad W^B(\tau, t^B) \geq \bar{W}^{BE}; \quad W^C(\tau, t^C) \geq \bar{W}^{CE},$$

where $\bar{W}^{BE}$ and $\bar{W}^{CE}$ denote the welfare of the governments of countries B and C, respectively, evaluated at the efficient policies. The five first-order conditions that characterize the efficient selection of (τ, t^B, t^C), given $\bar{W}^{BE}$ and $\bar{W}^{CE}$, can be written as:[10]

$$(4) \qquad \frac{W^A_{\tau^A}}{W^A_{t^A}} - \frac{W^B_{\tau^A}}{W^B_{t^B}} - \frac{W^C_{\tau^A}}{W^C_{t^C}} = 0;$$

$$(5) \qquad \frac{W^A_{\tau^B}}{W^A_{t^A}} - \frac{W^B_{\tau^B}}{W^B_{t^B}} - \frac{W^C_{\tau^B}}{W^C_{t^C}} = 0;$$

$$(6) \qquad \frac{W^A_{\tau^C}}{W^A_{t^A}} - \frac{W^B_{\tau^C}}{W^B_{t^B}} - \frac{W^C_{\tau^C}}{W^C_{t^C}} = 0;$$

$$W^B(\tau, t^B) = \bar{W}^{BE}; \text{ and } W^C(\tau, t^C) = \bar{W}^{CE}.$$

In words, efficiency conditions (4)-(6) state that, for $j = A, B, C$ respectively, a small change in τ^j which is accompanied by the change in t^B that keeps B indifferent and the change in t^C that keeps C indifferent must keep A indifferent as well.

Throughout the paper we restrict our focus to efficient policy combinations that call for tariffs positioned below the reaction curves of each country, and we ask whether such policy combinations can be implemented as equilibria of specific bargaining games. This below-the-reaction-curves

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[10]We assume throughout that W^j for $j \in \{A, B, C\}$ is everywhere (twice) differentiable, and that global concavity conditions are met.

restriction comes with little loss of generality. In each of the games we consider -- as in GATT/WTO negotiations -- governments agree to *bind* their tariffs at specified levels, and these bindings then place *upper limits* on permissible tariff choices. As a consequence, any efficient combination of policies that required at least one country to set its tariff *above* its reaction curve would be unattainable in the bargaining games we consider, provided only that subsequent to the conclusion of negotiations each government is permitted (as we assume) to set its tariff unilaterally subject to the constraint that it does not exceed its negotiated tariff binding. Efficiency might be achieved with a subset of countries *on* their tariff reaction curves, but the unilateral nature of the tariff commitments that efficiency would require of the remaining countries is at odds with the "reciprocal" nature of GATT/WTO tariff negotiations.[11] Rather than make these arguments repeatedly throughout the paper, we focus from the beginning on efficient policy combinations that call for tariffs positioned below the reaction curves of each country. We record this restriction as:

(A1) $dW^j/d\tau^j > 0, \; j \in \{A,B,C\}$.

In addition to (A1), we restrict our focus as well to efficient points that satisfy:

(A2) $sign(dW^B/d\tau^A) \; = \; sign(dW^C/d\tau^A)$.

At an efficient point satisfying (A2), B and C agree on the direction (if any) that each would like τ^A to move. Exploring cases where the incentives of B and C are opposed might also be of interest, but the aligned case seems to be a natural starting point for analyzing tariff bargaining between A and each of its trading partners under MFN.

We treat (A1)-(A2) as maintained assumptions throughout the paper that define the relevant region of the efficiency frontier. These assumptions imply the direction in which each government would prefer each policy to move beginning from an efficient point. In the Appendix we prove:

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[11]One reason for the reciprocal nature of GATT/WTO tariff commitments is to increase compliance with the negotiated commitments. In particular, enforcement in the GATT/WTO is achieved primarily through the threat of withdrawal of negotiated tariff commitments (see Bagwell and Staiger, 2002, and Bown, forthcoming), a threat that would be unavailable to a country that was already on its reaction curve. While we abstract from such enforcement issues in our formal analysis here, they provide an additional reason for our below-the-reaction-curve focus.

Lemma 2: At any efficient point, the following restrictions apply:

$$(i) \quad dW^{j}/d\tau^{j} > 0, \quad j \in \{A,B,C\};$$

(R1)
$$(ii) \quad dW^{j}/d\tau^{A} < 0, \quad dW^{A}/d\tau^{j} < 0, \quad j \in \{B,C\};$$

$$(iii) \quad dW^{j}/d\tau^{\backslash j} > 0, \quad j, \backslash j \in \{B,C\}.$$

2.3 The Bargaining Structure

In the following sections we explore whether the efficiency frontier can be reached in specific bargaining environments where MFN negotiations are sequential, and market access interests are the organizing principle. As we discussed in the Introduction, these are central features of WTO negotiations. Figure 1 illustrates the basic structure of the sequence of bargains for the governments of countries A, B and C that we consider. According to our economic model, exporters from countries B and C sell into A's market, while exporters from country A sell into the markets of B and C, but there are no (direct) market-access issues between countries B and C. As a consequence, Figure 1 depicts a sequence of bilateral MFN market access negotiations, first between A and B over the tariffs each controls and the transfer between them, and second between A and C over the tariffs each controls and the transfer between them.

With the basic bargaining structure illustrated in Figure 1, we seek to capture in a stylized way the issues that can arise in a number of possible WTO negotiating environments. One possibility is a sequence of bilateral negotiations that occur within a single multilateral negotiating "round." In this environment it is standard for one government (A) to negotiate MFN tariff commitments with a sequence of countries (B and C) with which it has mutual market access interests.[12] A second possibility is a sequence of bilateral negotiations that occur across multilateral negotiating rounds. That is, in each new round, it is routine for a government (A) to enter market access negotiations on a product with one trading partner (C) having negotiated MFN tariff bindings

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[12]For example, this would be standard procedure if country A were negotiating its accession to the WTO as part of a multilateral round of negotiations with the current members (B and C), although our accession interpretation abstracts from the possibility of A imposing discriminatory tariffs against B and C should its bid for accession fail. The sequential process of negotiations described in the text is also a standard procedure in the market access negotiations that occur within multilateral rounds, with country B then loosely interpreted as the "principal supplier" of A's import good (see, for example, Hoekman and Kostecki, 1995, pp. 66-77).

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on that product in a previous round with another trading partner (B).[13]

3. Backward Stealing and Bargaining Inefficiencies

According to Lemma 2, any point on the efficiency frontier must satisfy (R1), and under (R1) efficiency conditions (5) and (6) imply:

$$(7) \qquad - \frac{W_{t^j}^{\jmath}}{W_{\tau^j}^{\jmath}} = 0 > - \frac{W_{t^A}^{A}}{W_{\tau^j}^{A}} > - \frac{W_{t^j}^{j}}{W_{\tau^j}^{j}} \text{ for } j,\jmath \in \{B,C\},$$

where we use $dt^A/dt^j = 1$ for $j \in \{B,C\}$. With τ^j on the vertical axis and t^j on the horizontal axis, Figure 2 depicts the "lens" implied by (7). As Figure 2 illustrates, beginning from any efficient policy combination, the governments of country A and either of its trading partners can enjoy mutual gains – at the expense of the government of the third country – if A's transfer to this trading partner is increased slightly above the efficient level (denoted t^{jE}) and the trading partner's tariff is reduced slightly below the efficient level (denoted τ^{jE}). We summarize this observation with:

Lemma 3: At any point on the efficiency frontier, and for $j,\jmath \in \{B,C\}$, it is possible to reduce τ^j and increase t^j so as to increase W^A and W^j at the expense of $W^{\jmath}$.

The lens described in Lemma 3 is significant, because it signals the broad potential for a "backward stealing" problem when governments negotiate bilaterally and sequentially, *even when those negotiations are constrained to abide by MFN*. This problem admits a simple interpretation: in effect, with no change to its own tariff whatsoever, the government of country A can use its transfer policy to "pay" one of its trading partners to liberalize and generate a beneficial improvement in A's terms of trade, all at the expense of the third country.[14]

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[13]In this case, A's subsequent negotiation with C could arise as a result of C's accession to the WTO (C is a new member), or as a result of C's shifting comparative advantage (C is a new supplier). Here our efficiency results would apply to the long-run (not the "interim") bargaining outcomes.

[14]Lemma 3 is related to Propositions 5 and 8 of Bagwell and Staiger (forthcoming). As we mentioned in the Introduction, in that paper we did not allow governments to make bilateral international transfers. Proposition 5 of that paper established in a discriminatory tariff environment that any efficient tariff vector produces a "lens" that can be entered into by A and *j* through mutual reductions in the (discriminatory) tariffs that they apply to one another's imports.

We now define the Basic Sequential MFN Game or, for short, the *Basic Game*. In stage 1 of this game, country A makes a take-it-or-leave-it proposal to B concerning tariff *bindings* (i.e., permissible upper bounds) $\tilde{\tau}^A$ and $\overline{\tau}^B$, as well as a transfer from A to B, $\overline{t}^B$. Then, in stage 2, country A makes a take-it-or-leave-it proposal to C concerning bindings $\overline{\tau}^A$ (with the stage-2 binding $\overline{\tau}^A$ set no higher than its stage-1 level $\tilde{\tau}^A$) and $\overline{\tau}^C$, as well as a transfer from A to C, $\overline{t}^C$. The Basic Game has the following features:

Stage 1:   *A proposes* $(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$, *which B accepts or rejects.*

Stage 2:   *If B accepts, A proposes* $(\overline{\tau}^A \leq \tilde{\tau}^A, \overline{\tau}^C, \overline{t}^C)$, *which C accepts or rejects.*

Figure 3 illustrates the full extensive form of the Basic Game. Here and throughout the paper, we assume that, subsequent to the conclusion of negotiations (e.g., after stage 2 of the Basic Game), each government sets its tariff unilaterally and simultaneously with the other governments subject to the constraint that it does not exceed its negotiated tariff binding. We impose a "stability" condition on tariff reaction curves to rule out the possibility that the imposition of a binding might move governments from an "unstable" to a "stable" Nash equilibrium. Denoting j's best-response tariff function by $\tau^{jR}(\cdot)$ for $j \in \{A,B,C\}$ (and recalling that subscripts denote partial derivatives), this stability condition is contained in:

(A3)   Each country's best-response tariff function everywhere satisfies "reaction-curve stability,"

i.e., $1 > \dfrac{\{\tau^{iR}_{\tau^j}[\tau^{jR}_{\tau^i} + \tau^{jR}_{\tau^k}\tau^{kR}_{\tau^i}] \ + \ \tau^{iR}_{\tau^k}[\tau^{kR}_{\tau^i} + \tau^{kR}_{\tau^j}\tau^{jR}_{\tau^i}]\}}{[1 - \tau^{kR}_{\tau^j}\tau^{jR}_{\tau^k}]}$ for $i \neq j \neq k \in \{A,B,C\}$.

In words (A3) ensures, for example, that a given reduction in A's tariff below its reaction curve would not induce changes in the best-response tariffs of B and C which, together, would induce an even greater reduction in A's best-response tariff. As with (A1) and (A2), we treat (A3) as a

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Proposition 8 of that paper showed that the MFN restriction can reduce, but cannot eliminate, the possibility of a lens, in the particular sense that the existence of a lens is confined to a subset of points on the efficiency frontier when the MFN restriction is imposed. What Lemma 3 above implies is that even this limited effect of MFN on the existence of a lens is undone when international transfers are possible. This is because the possibility of joining MFN tariffs with bilateral international transfers effectively allows governments to replicate what is achievable with discriminatory tariffs alone. This implication may itself be of some independent interest, because it suggests a possible note of caution regarding the often-stated proposals to make direct international transfers an explicit part of the GATT/WTO system (see Kowalczyk and Sjostrom, 1994, for a particularly forceful statement of this proposal).

maintained assumption in what follows.

Consider the simplest subgame first. If B and C reject, no transfers are paid, no bindings are agreed to, and all countries play their Nash tariffs τ^{jN} yielding Nash payoffs W^{jN} for $j \in \{A,B,C\}$.[15]

Consider next the subgame in which B accepts and C rejects. In this case, there is no transfer between A and C, and C does not agree to bind its tariff, while A and B agree to bind their tariffs and agree as well to a transfer between them. Hence, in this subgame, C selects its best-response tariff, τ^{CR}, to the tariffs *applied* by A and B under their agreement. We denote the tariffs applied by A and B under their agreement by $\tau^{A\backslash C} \equiv \tau^{A\backslash C}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$ and $\tau^{B\backslash C} \equiv \tau^{B\backslash C}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$, respectively. The three tariffs τ^{CR}, $\tau^{A\backslash C}$ and $\tau^{B\backslash C}$ are defined by the three first order conditions

(8a) $\qquad W^C_{\tau^C} = 0; \qquad W^A_{\tau^A} + \lambda^{A\backslash C} = 0;$ and $\qquad W^B_{\tau^B} + \lambda^{B\backslash C} = 0,$

evaluated with $t^B = \overline{t}^B$ and $t^C \equiv 0$, and where $\lambda^{A\backslash C}$ and $\lambda^{B\backslash C}$ are the Lagrange multipliers on the constraints $\tau^{A\backslash C} \leq \tilde{\tau}^A$ and $\tau^{B\backslash C} \leq \overline{\tau}^B$, respectively.[16] By (8a), $\tau^{A\backslash C} = \min\{\tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^B), \tilde{\tau}^A\}$ is the applied tariff for A, and B's applied tariff is $\tau^{B\backslash C} = \min\{\tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^B), \overline{\tau}^B\}$. In this subgame, A receives $w^{A\backslash C}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B) \equiv W^A(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}, \overline{t}^B)$, B receives $w^{B\backslash C}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B) \equiv W^B(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}, \overline{t}^B)$, and C receives $w^{CD}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B) \equiv W^C(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}, t^C \equiv 0)$.

If B rejects and C accepts, then there is no transfer between A and B, and B does not agree to bind its tariff, while A and C agree to bind their tariffs and agree as well to a transfer between them. Hence, in this subgame, B selects its best-response tariff, τ^{BR}, to the tariffs applied by A and C under their agreement. We denote the tariffs applied by A and C under their agreement by $\tau^{A\backslash B} \equiv \tau^{A\backslash B}(\overline{\tau}^A, \overline{\tau}^C, \overline{t}^C)$ and $\tau^{C\backslash B} \equiv \tau^{C\backslash B}(\overline{\tau}^A, \overline{\tau}^C, \overline{t}^C)$, respectively. The three tariffs τ^{BR}, $\tau^{A\backslash B}$ and $\tau^{C\backslash B}$ are defined by the three first order conditions

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(8b) $\quad W_{\tau^B}^B = 0; \qquad W_{\tau^A}^A + \lambda^{A \backslash B} = 0; \text{ and } \quad W_{\tau^C}^C + \lambda^{C \backslash B} = 0,$

evaluated with $t^B \equiv 0$ and $t^C = \overline{t}^C$, and where $\lambda^{A \backslash B}$ and $\lambda^{C \backslash B}$ are the Lagrange multipliers on the constraints $\tau^{A \backslash B} \leq \overline{\tau}^A$ and $\tau^{C \backslash B} \leq \overline{\tau}^C$, respectively. By (8b), $\tau^{A \backslash B} = \min\{\tau^{AR}(\tau^{BR}, \tau^{C \backslash B}, \overline{t}^C), \overline{\tau}^A\}$ is A's applied tariff, and $\tau^{C \backslash B} = \min\{\tau^{CR}(\tau^{A \backslash B}, \tau^{BR}, \overline{t}^C), \overline{\tau}^C\}$ is C's applied tariff. In this subgame, A's payoff is $w^{A \backslash B}(\overline{\tau}^A, \overline{\tau}^C, \overline{t}^C) \equiv W^A(\tau^{A \backslash B}, \tau^{BR}, \tau^{C \backslash B}, \overline{t}^C)$, B's payoff is $w^{BD}(\overline{\tau}^A, \overline{\tau}^C, \overline{t}^C) \equiv W^B(\tau^{A \backslash B}, \tau^{BR}, \tau^{C \backslash B}, t^B \equiv 0)$, and C's payoff is $w^{C \backslash B}(\overline{\tau}^A, \overline{\tau}^C, \overline{t}^C) \equiv W^C(\tau^{A \backslash B}, \tau^{BR}, \tau^{C \backslash B}, \overline{t}^C)$.

Finally, if both B and C agree, then we denote the tariffs applied under the (full) agreement by $\tau^A \equiv \tau^A(\overline{\tau}, \overline{t})$, $\tau^B \equiv \tau^B(\overline{\tau}, \overline{t})$, and $\tau^C \equiv \tau^C(\overline{\tau}, \overline{t})$. The three tariffs τ^A, τ^B and τ^C are defined by the three first order conditions

(8c) $\quad W_{\tau^A}^A + \lambda^A = 0; \quad W_{\tau^B}^B + \lambda^B = 0; \text{ and } \quad W_{\tau^C}^C + \lambda^C = 0,$

evaluated with $t^B = \overline{t}^B$ and $t^C = \overline{t}^C$, and where λ^A, λ^B and λ^C are the Lagrange multipliers on the constraints $\tau^A \leq \overline{\tau}^A$, $\tau^B \leq \overline{\tau}^B$ and $\tau^C \leq \overline{\tau}^C$, respectively. By (8c), $\tau^A = \min\{\tau^{AR}(\tau^B, \tau^C, \overline{t}^A), \overline{\tau}^A\}$ is the applied tariff for A, B's applied tariff is $\tau^B = \min\{\tau^{BR}(\tau^A, \tau^C, \overline{t}^B), \overline{\tau}^B\}$, and C's applied tariff is $\tau^C = \min\{\tau^{CR}(\tau^A, \tau^B, \overline{t}^C), \overline{\tau}^C\}$. In this subgame, the payoffs for A, B and C, are respectively $w^A(\overline{\tau}, \overline{t}) \equiv W^A(\tau^A, \tau^B, \tau^C, \overline{t}^A)$, $w^B(\overline{\tau}, \overline{t}) \equiv W^B(\tau^A, \tau^B, \tau^C, \overline{t}^B)$, and $w^C(\overline{\tau}, \overline{t}) \equiv W^C(\tau^A, \tau^B, \tau^C, \overline{t}^C)$. Notice that, while we have taken the function $W^j(\tau, t^j)$ to be everywhere (twice) differentiable in τ, the function $w^j(\overline{\tau}, \overline{t})$ is not everywhere differentiable in $\overline{\tau}$, because the mapping from bindings to applied tariffs is not everywhere differentiable.

We focus on Subgame Perfect Equilibria (SGPE) of the Basic Game. We will say that the outcome is efficient (inefficient) when the payoffs correspond to a point on (off) the efficiency frontier. Under (A1), we are interested in points on the efficiency frontier where each country's (applied) tariff is constrained to lie below its reaction curve. From the discussion just above, achieving such a point as the outcome of the Basic Game requires that A reach agreement with both B and C, and at such a point each country's applied tariff is then set equal to the level of its binding, or $\tau^j = \overline{\tau}^j$ for $j \in \{A, B, C\}$. We must then have $w^A(\overline{\tau}, \overline{t}) = W^A(\overline{\tau}, \overline{t}^A)$, $w^B(\overline{\tau}, \overline{t}) = W^B(\overline{\tau}, \overline{t}^B)$, and $w^C(\overline{\tau}, \overline{t}) = W^C(\overline{\tau}, \overline{t}^C)$. Hence, we may ask whether there exists a SGPE of the Basic Game in which

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the associated choices of $(\bar\tau,\bar t)$ imply a triple $(W^A(\bar\tau,\bar t^A), W^B(\bar\tau,\bar t^B), W^C(\bar\tau,\bar t^C))$ that is efficient. We prove in the Appendix:

Proposition 1: There does not exist a SGPE of the Basic Game in which the outcome is efficient.

This result may be interpreted as follows. Starting from stage-2 choices that would achieve the efficiency frontier, A and C can do better for themselves if C liberalizes further (i.e., reduces $\bar\tau^C$). C's import liberalization benefits A by increasing the price of A's export good on world markets, and A can compensate C for C's implied welfare loss with an increased transfer to C (i.e., increased $\bar t^C$) while enjoying the gains from higher export prices against B. Hence, efficient outcomes are precluded by the backward-stealing problem identified in Lemma 3.

Finally, we observe that, while we have derived Proposition 1 in a take-it-or-leave-it bargaining context, it is clear from Figure 2 (with $j = C$) that the proposition holds in more general bargaining environments as well, provided only that the stage-2 bargain between A and C is efficient (i.e., exhausts all feasible gains from cooperation in that stage) and therefore leads to a tangency between the indifference curves of A and C in Figure 2.

4. Forward Manipulation and Bargaining Inefficiencies

Backward stealing prevents efficient outcomes in the Basic Game analyzed in the previous section. Suppose, then, that a "security constraint" were introduced into the Basic Game, wherein the governments of countries A and C were prevented from reducing the welfare of B with their negotiations. (We postpone the question of how such a constraint might be maintained until section 6.) Could governments achieve efficient outcomes in this augmented bargaining game? In this section, we show that the answer to this question is generally "No." More specifically, we identify an incentive for "forward manipulation" that can keep governments from the efficiency frontier.

To accomplish this, we require that the stage-2 agreement in the Basic Game must satisfy the following *security constraint*:

(9) $w^B(\bar\tau,\bar t) \geq w^{B\setminus C}(\tilde\tau^A, \bar\tau^B, \bar t^B)$.

When (9) is required, there certainly can be no backward stealing, because any agreement reached in stage-2 between A and C must leave B at least as well off as it would be if instead the negotiations between A and C ended in disagreement and only the stage-1 agreement were implemented. Hence, we say that a stage-1 agreement between A and B is *secure against backward stealing* if and only if, following an agreement between A and B in stage 1, any agreement between A and C satisfies (9).

We now define the *Secure-Contract Game*. In stage 1 of this game, country A makes a take-it-or-leave-it proposal to B concerning bindings $\tilde{\tau}^A$ and $\bar{\tau}^B$, as well as a transfer from A to B, $\bar{t}^B$. Then, in stage 2, country A makes a take-it-or-leave-it proposal to C concerning bindings $\bar{\tau}^A$ (with the stage-2 binding $\bar{\tau}^A$ set no higher than its stage-1 level $\tilde{\tau}^A$) and $\bar{\tau}^C$, as well as a transfer from A to C, $\bar{t}^C$, subject to ensuring that any agreement reached in stage 1 is secure against backward stealing. The Secure-Contract Game has the following features:

Stage 1:   *A proposes* $(\tilde{\tau}^A, \bar{\tau}^B, \bar{t}^B)$, *which B accepts or rejects.*

Stage 2:   *If B accepts, A proposes* $(\bar{\tau}^A \le \tilde{\tau}^A, \bar{\tau}^C, \bar{t}^C)$, *where* $\mathbf{w}^B(\bar{\tau}, \bar{t}) \ge w^{B\backslash C}(\tilde{\tau}^A, \bar{\tau}^B, \bar{t}^B)$, *which C accepts or rejects.*

The full extensive form of the Secure-Contract Game is the same as that illustrated in Figure 3, with the additional security constraint imposed on stage-2 negotiations.

To characterize the SGPE of the Secure-Contract Game, it is useful to first consider the disagreement welfare levels in this game for the governments of countries B and C, in the event that A reaches agreement with the other trading partner. For B, this disagreement welfare is determined by the equilibrium of the stage-2 subgame between A and C that follows stage-1 disagreement between A and B. Letting A's equilibrium stage-2 proposal to C in this subgame be denoted by $(\bar{\tau}^{A\backslash B}, \bar{\tau}^{C\backslash B}, \bar{t}^{C\backslash B})$, and observing that the equilibrium proposal will be accepted by C, B's disagreement welfare in its stage-1 negotiation with A is then given by $w^{BD}(\bar{\tau}^{A\backslash B}, \bar{\tau}^{C\backslash B}, \bar{t}^{C\backslash B})$. For future reference, we denote B's disagreement welfare by $\bar{W}^{BD}$. Importantly, as viewed from stage 1, $\bar{W}^{BD}$ is tied down by the requirement of subgame perfection, and A therefore has no means by which to (credibly) manipulate B's disagreement welfare to its own advantage.

Circumstances are different, however, for the government of country C. Its disagreement welfare is given by $w^{CD}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$. The key point is that C's disagreement welfare level depends on the stage-1 agreement reached between A and B and hence, in contrast to B, A can (credibly) manipulate C's disagreement welfare to its own advantage with its stage-1 policy proposal to B. Recalling that $w^{CD}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B) \equiv W^C(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}, t^C \equiv 0)$ and that $\tau^{A\backslash C} = \min\{\tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^B), \tilde{\tau}^A\}$ and $\tau^{B\backslash C} = \min\{\tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^B), \overline{\tau}^B\}$, we now present the next Lemma, which is proved in the Appendix and summarizes the important properties of w^{CD}:

Lemma 4: $w^{CD}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B) = W^C(\tilde{\tau}^A, \overline{\tau}^B, \tau^{CR}, t^C \equiv 0)$ for $\tilde{\tau}^A < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^B)$ and $\overline{\tau}^B < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^B)$, and for any such $(\tilde{\tau}^A, \overline{\tau}^B)$ that, together with τ^{CR}, fails to drive C to autarky, $w^{CD}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$ is strictly decreasing in $\tilde{\tau}^A$, strictly increasing in $\overline{\tau}^B$, and independent of $\overline{t}^B$.

In effect, with disagreement placing C on its reaction curve and for any $\tilde{\tau}^A < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^B)$ and $\overline{\tau}^B < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^B)$ that fail to drive C to autarky, C's disagreement welfare falls with a small adjustment in either $\tilde{\tau}^A$ or $\overline{\tau}^B$ that lowers the implied world price $\tilde{P}^w(\tilde{\tau}^A, \overline{\tau}^B, \tau^{CR})$. For future reference, we denote by $P^w_{C^a}$ the world price that must prevail when C disagrees if its disagreement welfare is driven to the minimum (autarky) level, which we denote by $\overline{W}^{CD}_{\min}$.

We wish to explore the conditions under which the SGPE of the Secure-Contract Game lead to efficient outcomes. We begin by considering when there exists a stage-1 proposal that efficiently delivers any (fixed) welfare levels $\mathring{W}^B \geq \overline{W}^{BD}$ for B and $\mathring{W}^C \geq \overline{W}^{CD}_{\min}$ for C. In this way, we characterize the set of efficient outcomes that are "feasible" (i.e, that would be induced by *some* stage-1 proposal) in the Secure-Contract Game. We then ask whether A would in fact choose to make a proposal that would induce an outcome from this set in a SGPE of the Secure-Contract Game.

More formally, we say that it is *feasible* in the Secure-Contract Game to efficiently deliver $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq \overline{W}^{CD}_{\min}$ if and only if there exists a triple $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, \overline{t}^{Bf})$ such that the outcome of the Secure-Contract Game is efficient, satisfies (A1) and (A2), and gives B the payoff $\mathring{W}^B$ and C the payoff $\mathring{W}^C$ when the stage-1 proposal is $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, \overline{t}^{Bf})$. Next, by Lemma 1, we observe that there exists a policy combination with τ^B fixed at an arbitrary level under which these welfare levels are

achieved. Thus, we define $\tau^{AE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$, $\tau^{CE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$, $t^{BE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$ and $t^{CE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$ as the tariffs and transfers that solve (4)-(6), $W^B(\tau,t^B)=\mathring{W}^B$ and $W^C(\tau,t^C)=\mathring{W}^C$ for any τ^B, $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq \overline{W}^{CD}_{\min}$. We say that a value of $\overline{\tau}^B$ is *consistent* with (A1) and (A2) for $\mathring{W}^B$ and $\mathring{W}^C$ if and only if (A1) and (A2) are satisfied at $\tau^{AE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$, τ^B, $\tau^{CE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$, $t^{BE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$ and $t^{CE}(\tau^B;\mathring{W}^B,\mathring{W}^C)$ when $\tau^B=\overline{\tau}^B$.

We prove in the Appendix:

Lemma 5 : It is feasible in the Secure-Contract Game to efficiently deliver $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq \overline{W}^{CD}_{\min}$ if and only if there exists $(\tilde{\tau}^{Af},\overline{\tau}^{Bf})$ with $\tilde{\tau}^{Af} \geq \tau^{AE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C)$ and $\overline{\tau}^{Bf}$ consistent with (A1)-(A2) for $\mathring{W}^B$ and $\mathring{W}^C$ such that

(10a) $w^{B\backslash C}(\tilde{\tau}^{Af},\overline{\tau}^{Bf},t^{BE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C)) = \mathring{W}^B$, and

(10b) $w^{CD}(\tilde{\tau}^{Af},\overline{\tau}^{Bf},t^{BE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C)) = \mathring{W}^C$.

The implied stage-1 proposal is then $(\tilde{\tau}^{Af},\overline{\tau}^{Bf},\overline{t}^{Bf} = t^{BE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C))$.

Intuitively, condition (10a) must be satisfied because otherwise the security constraint (9) would hold with strict inequality at the efficient point and this would give rise to backward stealing, while condition (10b) must be satisfied because otherwise A could deviate with a lower-than-efficient transfer to C in stage 2 and be better off (if "<") or C would reject A's stage-2 proposal (if ">").

We next introduce the following additional assumption:

(A4)   Each country's best-response tariff function everywhere satisfies "terms-of-trade stability,"

i.e., $\{\frac{\partial \tilde{p}^w}{\partial \tau^i}\} \times \{\frac{\partial \tilde{p}^w}{\partial \tau^i} + \frac{\partial \tilde{p}^w}{\partial \tau^j}\frac{[\tau^{jR}_{\tau^i} + \tau^{jR}_{\tau^k}\tau^{kR}_{\tau^i}]}{[1 - \tau^{kR}_{\tau^j}\tau^{jR}_{\tau^k}]} + \frac{\partial \tilde{p}^w}{\partial \tau^k}\frac{[\tau^{kR}_{\tau^i} + \tau^{kR}_{\tau^j}\tau^{jR}_{\tau^i}]}{[1 - \tau^{kR}_{\tau^j}\tau^{jR}_{\tau^k}]}\} > 0$ for $i \neq j \neq k \in \{A,B,C\}$.

In words (A4) ensures, for example, that the drop in the market-clearing terms-of-trade implied by a reduction in B's tariff below its reaction curve would not be completely reversed by the best-response tariff adjustments of A and C that B's tariff reduction would induce.

With Lemma 5 describing the set of efficient outcomes that are feasible in the Secure-Contract Game, we may now ask whether A would in fact choose to make a stage-1 proposal that

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would induce an outcome from this set in a SGPE of the Secure-Contract Game. We divide the possibilities into two cases.

Consider first the possibility that there exists a $(\tilde{\tau}^{Af},\overline{\tau}^{Bf})$ that satisfies the conditions of Lemma 5 for some $\mathring{W}^B$ and $\mathring{W}^C$ and that, in addition, satisfies:

(11) $\quad \tilde{\tau}^{Af}<\tau^{AR}(\tau^{B\backslash C},\tau^{CR},\overline{t}^{Bf})$, and/or $\quad \overline{\tau}^{Bf}<\tau^{BR}(\tau^{A\backslash C},\tau^{CR},\overline{t}^{Bf})$.

In this case, if A and C were to disagree in stage 2, then A would grant B the transfer $\overline{t}^{Bf}=t^{BE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C)$ and A's applied tariff would be $\tau^{A\backslash C}=\min\{\tau^{AR}(\tau^{B\backslash C},\tau^{CR},\overline{t}^{Bf}),\tilde{\tau}^{Af}\}$ while B's applied tariff would be $\tau^{B\backslash C}=\min\{\tau^{BR}(\tau^{A\backslash C},\tau^{CR},\overline{t}^{Bf}),\overline{\tau}^{Bf}\}$, with (11) ensuring that $\tau^{A\backslash C}=\tilde{\tau}^{Af}$ and/or $\tau^{A\backslash B}=\overline{\tau}^{Bf}$. We prove in the Appendix:

Lemma 6: Under (A4), there does not exist a SGPE of the Secure-Contract Game in which the outcome is (generically) efficient and satisfies (11) and with $\mathring{W}^B>\overline{W}^{BD}$ and/or $\mathring{W}^C>\overline{W}^{CD}_{\min}$.

Intuitively, beginning from proposals that efficiently deliver $\mathring{W}^B$ and $\mathring{W}^C$, if $\mathring{W}^B>\overline{W}^{BD}$ and/or $\mathring{W}^C>\overline{W}^{CD}_{\min}$, then (11) and (A4) together ensure that there exists (generically) an adjustment in $\tilde{\tau}^A$ or $\overline{\tau}^B$ which reduces B's payoff and/or C's payoff and, along with adjustments in $\overline{t}^B$, $\overline{\tau}^A$, $\overline{\tau}^C$, and $\overline{t}^C$, improves A's payoff.

Consider next the remaining possibility that there exists a $(\tilde{\tau}^{Af},\overline{\tau}^{Bf})$ that satisfies the conditions of Lemma 5 for some $\mathring{W}^B$ and $\mathring{W}^C$ and that, in addition, violates (11). In this case, if A and C were to disagree in stage 2, then A would still grant B the transfer $\overline{t}^{Bf}=t^{BE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C)$, but the applied tariffs of all three governments would be on their respective reaction curves. Denoting by $\tau^{jN}(t^B)$ for $j\in\{A,B,C\}$ the three Nash tariffs defined by the three equations $\tau^{AN}=\tau^{AR}(\tau^{BN},\tau^{CN},t^A\equiv t^B)$, $\tau^{BN}=\tau^{BR}(\tau^{AN},\tau^{CN},t^B)$, and $\tau^{CN}=\tau^{CR}(\tau^{AN},\tau^{BN},t^C\equiv 0)$, conditions (10a) and (10b) of Lemma 5 then require that there exists a $\overline{\tau}^{Bf}\geq\tau^{BN}(\overline{t}^{Bf})$, $\mathring{W}^B\geq\overline{W}^{BD}$ and $\mathring{W}^C\geq\overline{W}^{CD}_{\min}$ that solve:

(12a) $\quad W^B(\tau^{AN}(\overline{t}^{Bf}),\tau^{BN}(\overline{t}^{Bf}),\tau^{CN}(\overline{t}^{Bf}),\overline{t}^{Bf}) = \mathring{W}^B$,

(12b) $\quad W^C(\tau^{AN}(\overline{t}^{Bf}),\tau^{BN}(\overline{t}^{Bf}),\tau^{CN}(\overline{t}^{Bf}),t^C\equiv 0) = \mathring{W}^C$, and

(12c) $\quad \overline{t}^{Bf}=t^{BE}(\overline{\tau}^{Bf};\mathring{W}^B,\mathring{W}^C)$.

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Maintaining our focus on the interior Nash equilibrium (see note 15), it follows from (12b) that when (11) is violated, we must have $\mathring{W}^C > \bar{W}^{CD}_{\min}$. Moreover, when the three equations (12a)-(12c) have a solution in the three unknowns $\bar{\tau}^{Bf} \geq \tau^{BN}(\bar{t}^{Bf})$, $\mathring{W}^B \geq \bar{W}^{BD}$ and $\mathring{W}^C \geq \bar{W}^{CD}_{\min}$, this solution will (generically) imply $\mathring{W}^B > \bar{W}^{BD}$.

We now introduce the following additional assumption:

(A5) Each country's best-response tariff function is sensitive to its transfer, i.e., $\partial \tau^{jR}/\partial t^j \neq 0$ for $j \in \{A,B,C\}$.

We prove in the Appendix:

Lemma 7: Under (A5), there does not exist a SGPE of the Secure-Contract Game in which the outcome is (generically) efficient and violates (11).

Lemma 7 holds because (A5) ensures that, beginning from a stage-1 proposal that would achieve efficiency but that violates (11), it is (generically) possible for A to adjust $\bar{t}^{Bf}$ and reduce B's payoff and/or C's payoff (by altering the best-response tariffs), and A can make adjustments to its other instruments to assure that it gains from these adjustments.

Finally, as A can do no better for itself in the Secure-Contract Game than to efficiently deliver $\bar{W}^{BD}$ to B and $\bar{W}^{CD}_{\min}$ to C, this outcome will be achieved in any SGPE of the Secure-Contract Game if it is feasible. We may therefore state:

Proposition 2: Under (A4) and (A5), in any SGPE of the Secure-Contract Game, the outcome is (generically) efficient if and only if there exists a $(\mathring{\tau}^{Af}, \bar{\tau}^{Bf})$ satisfying the conditions of Lemma 5 for $\mathring{W}^B = \bar{W}^{BD}$ and $\mathring{W}^C = \bar{W}^{CD}_{\min}$.

That $\mathring{W}^B = \bar{W}^{BD}$ is required for efficiency in the Secure-Contract Game is neither particularly surprising nor particularly demanding. However, efficiency in the Secure-Contract Game also requires that $\mathring{W}^C = \bar{W}^{CD}_{\min}$, and this requirement places rather extreme demands on the environment within which the Secure-Contract Game delivers governments to the efficiency frontier.

To further interpret the conditions for efficiency expressed in Proposition 2, we next observe that achieving $\mathring{W}^C = \overline{W}_{\min}^{CD}$ requires that C face its autarky terms-of-trade $P_{C^a}^w$ in the event that it rejects A's stage-2 proposal, and therefore by (A3) and (A4) a stage-1 proposal that achieves efficiency requires in turn that $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A \backslash C}, \tau^{CR}, \overline{t}^{Bf})$. With this observation, conditions (10a) and (10b) of Lemma 5 – which must hold under the efficient $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf})$ identified in Proposition 2 – may be rewritten as:

(13a) $\hat{W}^B(P^B(\overline{\tau}^{Bf}, P_{C^a}^w), P_{C^a}^w, t^{BE}(\overline{\tau}^{Bf}; \overline{W}^{BD}, \overline{W}_{\min}^{CD})) = \overline{W}^{BD}$, and

(13b) $\tilde{P}^w(\tau^{A \backslash C}, \overline{\tau}^{Bf}, \tau^{CR}) = P_{C^a}^w$.

By Lemma 1 there exists a policy combination $(\tau^{A*}, \tau^{B*}, \tau^{C*}, t^{B*}, t^{C*})$ under which the welfare levels $\overline{W}^{BD}$ and $\overline{W}_{\min}^{CD}$ are delivered efficiently and $\tilde{P}^w(\tau^{A*}, \tau^{B*}, \tau^{C*}) = P_{C^a}^w$. Setting $\overline{\tau}^{Bf} = \tau^{B*}$ implies $t^{BE}(\tau^{B*}; \overline{W}^{BD}, \overline{W}_{\min}^{CD}) = t^{B*}$ and ensures that (13a) is satisfied. Provided that $\overline{\tau}^{Bf} = \tau^{B*}$ is consistent with (A1)-(A2) for $\overline{W}^{BD}$ and $\overline{W}_{\min}^{CD}$, the key remaining question then becomes: Does there exist a $\tilde{\tau}^{Af} \geq \tau^{A*}$ such that (13b) is satisfied , i.e., such that $\tilde{P}^w(\tau^{A \backslash C}, \tau^{B*}, \tau^{CR}) = P_{C^a}^w$? If not, and provided that $\overline{\tau}^{Bf} = \tau^{B*}$ is the unique solution to (13a), we may then conclude under (A4) and (A5) that there cannot exist a SGPE of the Secure-Contract Game in which the outcome is efficient.[17]

If there exists a $\tilde{\tau}^{Af} \geq \tau^{A*}$ such that $\tilde{P}^w(\tau^{A \backslash C}, \tau^{B*}, \tau^{CR}) = P_{C^a}^w$, then with B's tariff fixed at τ^{B*} and with C on its tariff reaction curve, A's own best-response tariff must be sufficiently high so that, if A were to select this best-response tariff, C's natural trade pattern would be halted (when $\tau^{A \backslash C} = \tau^{AR}(\tau^{B*}, \tau^{CR}, t^{B*}) \leq \tilde{\tau}^{Af}$) and potentially *reversed* (when $\tau^{A \backslash C} = \tilde{\tau}^{Af} < \tau^{AR}(\tau^{B*}, \tau^{CR}, t^{B*})$). That such an outcome could in principle be optimal for A can be seen by considering the example where A's government seeks to maximize national income with its tariff choice, and where with B's tariff fixed at τ^{B*} and C on its reaction curve, the implied terms of trade when A adopts a policy of free trade happens to be just slightly higher than C's autarky price. In this circumstance, C's trade volume with A is small, and even a small tariff by A would reduce the terms of trade and reverse C's trading

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[17]The solution to (13a) must be unique provided that $\hat{W}^B$ is sufficiently insensitive to changes in P^B. We emphasize this case in our discussion, but the case where multiple solutions to (13a) exist may be accommodated as well (at the expense of additional notation), and does not alter our qualitative conclusions.

pattern, but this could nevertheless be optimal for A if B is a big trading partner relative to C and A enjoys the associated terms-of-trade gains on its trade volume with B. This example, though, also reveals that this outcome could not be optimal if C accounts for a sufficiently sizable fraction of A's multilateral trade. In light of this discussion, we may therefore state:

Corollary: Under (A4) and (A5), there cannot exist a SGPE of the Secure-Contract Game in which the outcome is (generically) efficient unless C is sufficiently small relative to B.

Proposition 2 and its Corollary reflect a simple point. If it is feasible for A to propose a set of tariffs and transfers that is efficient and gives B and C their minimal possible payoffs in the Secure-Contract Game, then A will surely propose this set of tariffs and transfers. But the demands placed on $\tilde{\tau}^A$ to ensure feasibility are substantial. In particular, with $\overline{\tau}^B$ tied down by the combination of policies to which A must navigate to achieve this outcome, it must then be feasible for A to position $\tilde{\tau}^A$ so that C faces autarky if it rejects A's stage-2 proposal. If this cannot be accomplished with a choice of $\tilde{\tau}^A$, because for example accomplishing this would require A to set an applied tariff $\tau^{A\backslash C}$ that was above its best-response level, then A cannot both give C its minimal payoff $\overline{W}^{CD}_{\min}$ and achieve efficiency, and in this case A will find it desirable to sacrifice efficiency in order to lower C's payoff toward $\overline{W}^{CD}_{\min}$. More generally, Proposition 2 and its Corollary suggest that governments will achieve efficient bargaining outcomes in the Secure-Contract Game under some special circumstances, but under many plausible circumstances the outcome of the Secure-Contract Game is inefficient.

The source of inefficiency identified in Proposition 2 arises from A's desire to use its stage-1 negotiations with B to position itself more favorably for stage-2 negotiations with C by sticking C with a less-favorable disagreement point. Figure 4 illustrates. With $\tilde{\tau}^A$ on the vertical axis and $\overline{t}^B$ on the horizontal axis, we consider a triple $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, \overline{t}^{Bf})$ under which it is feasible in the Secure-Contract Game to efficiently deliver $\mathring{W}^B = \overline{W}^{BD}$ and $\mathring{W}^C > \overline{W}^{CD}_{\min}$. Under (A5), we have shown by Lemma 7 that attention may be restricted to stage-1 proposals that satisfy (11), and for purposes of illustration we assume that $\tilde{\tau}^{Af} < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$ *and* $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$. According to Proposition 2, A would not choose $\tilde{\tau}^{Af}$ and $\overline{t}^{Bf}$ if it chooses $\overline{\tau}^{Bf}$. We wish to illustrate in this case that it is

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always possible for A to raise its welfare by proposing $\tilde{\tau}^{A'} > \tilde{\tau}^{Af}$. To understand why, let us fix $\overline{\tau}^{B}$ at $\overline{\tau}^{Bf}$ and consider varying the proposed $\tilde{\tau}^{A}$ and $\overline{t}^{B}$ around $\tilde{\tau}^{Af}$ and $\overline{t}^{Bf}$, respectively, so as to hold $w^{B\backslash C}(\tilde{\tau}^{A}, \overline{\tau}^{Bf}, \overline{t}^{B})$ fixed at $\overline{W}^{BD}$. Under the security constraint, B will accept any such proposal. Further, let the stage-2 proposal of $(\overline{\tau}^{A}, \overline{\tau}^{C}, \overline{t}^{C})$ that is associated with any $(\tilde{\tau}^{A}, \overline{\tau}^{Bf}, \overline{t}^{B})$ maximize $W^{A}(\overline{\tau}, \overline{t}^{A})$ subject to $W^{B}(\overline{\tau}, \overline{t}^{B}) = w^{B\backslash C}(\tilde{\tau}^{A}, \overline{\tau}^{Bf}, \overline{t}^{B})$ and $W^{C}(\overline{\tau}, \overline{t}^{C}) = w^{CD}(\tilde{\tau}^{A}, \overline{\tau}^{Bf}, \overline{t}^{B})$ and $\overline{\tau}^{A} \leq \tilde{\tau}^{A}$. Clearly, C will accept the stage-2 proposal, and so by construction the welfare level for A associated with $W^{A}(\overline{\tau}, \overline{t}^{A})$ is attainable in the Secure-Contract Game. In effect, then, with $\overline{\tau}^{B}$ fixed at $\overline{\tau}^{Bf}$, any change in $\tilde{\tau}^{A}$ and $\overline{t}^{B}$ implies by this construction an associated change in $(\overline{\tau}^{A}, \overline{\tau}^{C}, \overline{t}^{C})$, and Figure 4 depicts the welfare consequences of these associated changes.

Consider, then, the indifference curves associated with $W^{A}(\overline{\tau}, \overline{t}^{A})$, $W^{B}(\overline{\tau}, \overline{t}^{B})$ and $W^{C}(\overline{\tau}, \overline{t}^{C})$ under this construction which pass through the efficient point ($\tilde{\tau}^{Af}$, $\overline{t}^{Bf}$) in Figure 4. C's indifference curve is horizontal through this point, since $W^{C}(\overline{\tau}, \overline{t}^{C}) = w^{CD}(\tilde{\tau}^{A}, \overline{\tau}^{Bf}, \overline{t}^{B})$ is strictly decreasing in $\tilde{\tau}^{A}$ but independent of $\overline{t}^{B}$ by Lemma 4. B's indifference curve through this point could have positive or negative slope (it is depicted in the figure with positive slope) but, importantly, it cannot be horizontal, since $W^{B}(\overline{\tau}, \overline{t}^{B}) = w^{B\backslash C}(\tilde{\tau}^{A}, \overline{\tau}^{Bf}, \overline{t}^{B})$ is strictly increasing in $\overline{t}^{B}$. Therefore, the indifference curves associated with $W^{B}(\overline{\tau}, \overline{t}^{B})$ and $W^{C}(\overline{\tau}, \overline{t}^{C})$ are not tangent to each other as they pass through the efficient point ($\tilde{\tau}^{Af}$, $\overline{t}^{Bf}$) in Figure 4, and as a consequence, by efficiency conditions (4) and (6), A's indifference curve cannot be tangent to either B's or C's indifference curve at this point. Moreover, A's indifference curve must be flatter than B's at this point, since otherwise a "downward" lens would exist between the indifference curves of A and B into which A and B could move and all three governments would gain, contradicting the efficiency of this point. Therefore, as Figure 4 depicts, there is an "upward" lens created by the indifference curves of A and B at this point, implying that A can gain by raising $\tilde{\tau}^{A}$ above $\tilde{\tau}^{Af}$ and adjusting $\overline{t}^{B}$ to maintain B's welfare. A's gain from this maneuver comes at the expense of C's welfare (and multilateral efficiency).[18]

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[18]As noted, Figure 4 illustrates the case where $\mathring{W}^{B} = \overline{W}^{BD}$ and $\mathring{W}^{C} > \overline{W}^{CD}_{\min}$. If there exists a ($\tilde{\tau}^{Af}, \overline{\tau}^{Bf}$) under which it is feasible to efficiently deliver $\mathring{W}^{B} = \overline{W}^{BD}$ and $\mathring{W}^{C} = \overline{W}^{CD}_{\min}$ in the Secure-Contract Game, then at this point there is no lens between A and B. For example, in the case where $\tilde{\tau}^{Af} < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$ and $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, a small change in $\tilde{\tau}^{A}$ and an accompanying change in $\overline{t}^{B}$ that left B indifferent would leave C indifferent as well (C would be indifferent to any small change in $\tilde{\tau}^{A}$ and $\overline{t}^{B}$ by the first-order condition that defines $\overline{W}^{CD}_{\min}$), and so by efficiency conditions (4) and (6) A's indifference curve must be tangent to B's indifference curve as well in this case.

We observe that this logic is related to a concern about the "foot-dragging" maneuver for handling "free-riders" as this maneuver was described in the Introduction. According to this concern, country A might be induced under MFN to offer "too little" in the way of trade liberalization to its early negotiating partners, in order to maintain its bargaining position for later negotiations. Proposition 2 can be interpreted as providing a formal justification for this concern, and Figure 4 illustrates the foot-dragging incentive to maintain $\tilde{\tau}^A$ above its efficient level.

In summary, Proposition 2 and its Corollary indicate that the Secure-Contract Game can deliver efficient bargaining outcomes only in a very limited set of circumstances. In the circumstances where inefficiency arises, this inefficiency is associated with forward manipulation. In the next section, we consider how this new source of inefficiency might be handled.

5. Preventing Forward Manipulation through GATT/WTO Rules

One way to correct the inefficiency associated with forward manipulation is to eliminate the possibility of forward manipulation itself. In principle, this might be achieved by introducing *renegotiation* opportunities, provided that these renegotiation opportunities are sufficiently "sweeping" so that they separate C's disagreement payoff from the stage-1 determination of $(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$. Indeed, the GATT/WTO explicitly allows for renegotiation. This is true both within a multilateral round of negotiation, when agreements reached between negotiating pairs early in the round are viewed as tentative and may be revisited if subsequent negotiations with other partners do not go as expected (e.g., Jackson, 1969, p. 220), and it is also true outside of multilateral rounds, where explicit renegotiations of previous agreements are permitted (e.g., Jackson, 1969, pp. 229-238). Just how sweeping these renegotiating opportunities are is a question of degree, and presumably depends on circumstances. In this section, we consider whether introducing sweeping renegotiation possibilities into the Secure-Contract Game can solve the forward manipulation problem and lead (in the presence of the security constraint) to efficient outcomes.

We first describe the novel features of the *Contract Renegotiation Game*:

Stage 1:   *A proposes* $(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$, *which B accepts or rejects.*

Stage 2:   *If B accepts, A proposes* $(\overline{\tau}^A \leq \tilde{\tau}^A, \overline{\tau}^C, \overline{t}^C)$, *where* $w^B(\overline{\tau}, \overline{t}) \geq w^{B\backslash C}(\tilde{\tau}^A, \overline{\tau}^B, \overline{t}^B)$, *which C accepts or rejects.*

Stage 3:   *If B accepts in Stage 1 and C rejects in Stage 2, then A proposes* $(\overline{\tau}^{Ar}, \overline{\tau}^{Br}, \overline{t}^{Br})$, *which B accepts or rejects.*

The full extensive form of the Contract Renegotiation Game is given in Figure 5.

In the Secure-Contract Game, the source of inefficiency can be traced to the problem of forward manipulation, whereby A's stage-1 proposal to B influences C's disagreement payoff in its stage-2 negotiations with A. In the Contract Renegotiation Game, this linkage has been curtailed, but it has not been eliminated. To see this, note that if B accepts A's stage-1 proposal, then if C rejects in stage 2 its disagreement payoff will be determined by the renegotiation between A and B in stage 3. In this case, the details of A's stage-1 proposal to B are immaterial for C's disagreement payoff in its stage-2 negotiations with A, provided only that B accepts A's stage-1 proposal and therefore "locks in" a stage-3 renegotiation opportunity with A should C disagree in stage 2. However, if B does not accept A's stage-1 proposal, then B has no renegotiation rights with A in stage 3, and so in this case C's disagreement payoff in its stage-2 negotiations with A will be its Nash payoff. As a consequence, in the Contract Renegotiation Game the possibility of forward manipulation has been reduced to the question of "bypass": Might A choose to make an unacceptable proposal to B in stage 1 in order to bypass B and negotiate with C against a Nash disagreement payoff? The question of bypass can also be seen to arise with C: Having made a stage-1 proposal that was accepted by B, might A choose to make an unacceptable proposal to C in stage 2 in order to bypass C and renegotiate with B against a Nash disagreement payoff in stage 3?

To ensure that the bypass problem does not prevent governments from reaching the efficiency frontier in the Contract Renegotiation Game, an additional condition is needed. To state this condition, consider the particular disagreement welfare levels in this game for the governments of countries B and C, in the event that A reaches agreement with the other trading partner. For the government of country B, this disagreement welfare is determined by the equilibrium of the stage-2

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subgame between A and C that follows stage-1 disagreement between A and B. This subgame is identical to that in the Secure-Contract Game, and we previously recorded B's payoff in this subgame as $w^{BD}(\bar{\tau}^{A\backslash B},\bar{\tau}^{C\backslash B},\bar{t}^{C\backslash B})\equiv W^B(\tau^{A\backslash B},\tau^{BR},\tau^{C\backslash B},t^B\equiv 0)$, which we denoted by $\bar{W}^{BD}$. For the government of country C, this disagreement welfare is determined by the equilibrium of the stage-3 (renegotiation) subgame between A and B that follows stage-1 agreement between A and B and stage-2 disagreement between A and C. Denoting A's equilibrium proposal in this subgame by $(\bar{\tau}^{A\backslash C},\bar{\tau}^{B\backslash C},\bar{t}^{B\backslash C})$, C's payoff in this subgame is $w^{CD}(\bar{\tau}^{A\backslash C},\bar{\tau}^{B\backslash C},\bar{t}^{B\backslash C})\equiv W^C(\tau^{A\backslash C},\tau^{B\backslash C},\tau^{CR},t^C\equiv 0)$, which for future reference we denote by $\bar{W}^{CD}$.

Importantly, as viewed from stage 1 (stage 2), $\bar{W}^{BD}$ ($\bar{W}^{CD}$) is tied down by the requirement of subgame perfection, and A therefore has no means by which to manipulate these disagreement payoff levels to its own advantage. Bypass, however, concerns the possibility that A might choose to confront a negotiating partner with the disagreement payoff W^{jN} rather than $\bar{W}^{jD}$ for $j\in\{B,C\}$.

We now state a sufficient condition to rule out the bypass problem:

(A6) $\quad \bar{W}^{BD}\leq W^{BN}$; $\bar{W}^{CD}\leq W^{CN}$.

Under (A6), the minimal disagreement payoffs for B and C in the Contract Renegotiation Game are given by $\bar{W}^{BD}$ and $\bar{W}^{CD}$, respectively, and each of these disagreement payoffs is achieved only when A reaches an initial agreement with the other trading partner.[19] Condition (A6) essentially requires that B and C not be too asymmetric with A when they participate in a multilateral Nash tariff war.[20]

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[19]It might be wondered why (A6) is not needed to rule out bypass in the Secure-Contract Game. The reason is that, after B accepts, A can pin C at a welfare level that is lower than W^{CN}, since no further negotiations follow, and so A has no incentive to bypass B in the Secure-Contract Game.

[20]Formally, for $j,\bar{y}\in\{B,C\}$, and with $t^j\equiv 0\equiv t^{\bar{y}}$, consider the three tariffs defined by $\hat{W}^A_{pA}=0$, $\hat{W}^j_{pj}=0$ and $W^{\bar{y}}_{\tau\bar{y}}=0$. Country j may be said to be a symmetric participant with A in a multilateral Nash tariff war if the terms of trade implied by these three tariffs is equal to the terms of trade implied by the Nash tariffs defined by $W^i_{\tau i}=0$ for $i\in\{A,B,C\}$. Intuitively, with country $\bar{y}$ positioned on its reaction curve, when countries A and j are symmetric participants in a multilateral Nash tariff war, neither succeeds in moving the terms of trade in its favor relative to the terms of trade that would obtain if each chose its tariff "without terms-of-trade considerations in mind," i.e, so as to solve $\hat{W}^A_{pA}=0$ for A and $\hat{W}^j_{pj}=0$ for j. With this definition in hand, it may now be seen that, if A and j are symmetric participants in the multilateral Nash tariff war, then a bilateral agreement between them could achieve $\hat{W}^A_{pA}=0$ for A and $\hat{W}^j_{pj}=0$ for j while preserving the Nash terms of trade, thereby preserving as well the welfare of $\bar{y}$; but from here A could do better yet with

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We next consider the feasibility of efficiently delivering $\mathring{W}^B \geq \overline{W}^{BD}$ to B and $\mathring{W}^C \geq \overline{W}^{CD}$ to C in the Contract Renegotiation Game. We say that it is *feasible* in the Contract Renegotiation Game to efficiently deliver $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq \overline{W}^{CD}$ if and only if there exists a triple $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{Bf})$ such that the outcome of the Contract Renegotiation Game is efficient, satisfies (A1) and (A2), and gives B the payoff $\mathring{W}^B$ and C the payoff $\mathring{W}^C$ when the stage-1 proposal is $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{Bf})$. Our finding is proved in the Appendix and contained in the following:

Lemma 8 : Under (A6), it is feasible in the Contract Renegotiation Game to efficiently deliver $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq \overline{W}^{CD}$ if and only if there exists $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf})$ with $\tilde{\tau}^{Af} \geq \tau^{AE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$ and $\overline{\tau}^{Bf}$ consistent with (A1)-(A2) for $\mathring{W}^B$ and $\mathring{W}^C$ such that

(14a) $\quad w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) = \mathring{W}^B$, and

(14b) $\quad \overline{W}^{CD} = \mathring{W}^C$.

The implied stage-1 proposal is then $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{Bf} = t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C))$.

Intuitively, as with conditions (10a) and (10b) of Lemma 5, (14a) must be satisfied because otherwise the security constraint (9) would hold with strict inequality at the efficient point and this would give rise to backward stealing, while condition (14b) must be satisfied because otherwise A could deviate with a lower-than-efficient transfer to C in stage 2 and be better off (if "<") or C would reject A's stage-2 proposal (if ">").

With Lemma 8 describing the set of efficient outcomes that are feasible in the Contract Renegotiation Game, we may now ask whether A would in fact choose to make a stage-1 proposal that would induce an outcome from this set in a SGPE of the Contract Renegotiation Game. Condition (14b) of Lemma 8 requires that $\mathring{W}^C = \overline{W}^{CD}$, so suppose there exists a $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf})$ satisfying the conditions of Lemma 8 for $\mathring{W}^B > \overline{W}^{BD}$. By (14a), we have $w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) = \mathring{W}^B > \overline{W}^{BD}$. Choose a small adjustment in $\overline{\tau}^{Bf}$ to $\overline{\tau}^{Bf'}$ and $\tilde{\tau}^{Af}$ to $\tilde{\tau}^{Af'}$ and a $\mathring{W}^{B'} \in [\overline{W}^{BD}, \mathring{W}^B)$ that solves

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an alternative proposal that worsened j's terms of trade below the Nash terms of trade and compensated j with a higher transfer t^j, and the lower-than-Nash terms of trade under this alternative proposal would leave $\mathbb{y}$ with a lower-than-Nash welfare (for the proof that a government positioned on its tariff reaction curve experiences welfare changes that are the same sign as changes in its terms of trade, see the proof of Lemma 4 in the Appendix). Arguing in this fashion, it can be seen that (A6) holds if B and C are not too asymmetric with A when they participate in a multilateral Nash tariff war.

$w^{B\backslash C}(\tilde{\tau}^{Af'},\overline{\tau}^{Bf'},t^{BE}(\overline{\tau}^{Bf'};\mathring{W}^{B'},\overline{W}^{CD})) = \mathring{W}^{B'}$ while maintaining $\tilde{\tau}^{Af'}\geq\tau^{AE}(\overline{\tau}^{Bf'};\mathring{W}^{B'},\mathring{W}^{C})$. Generically, such an adjustment exists, and for a sufficiently small adjustment we have as well that $\overline{\tau}^{Bf'}$ is consistent with (A1)-(A2) for $\mathring{W}^{B'}$ and $\overline{W}^{CD}$. Therefore, by Lemma 8, it is (generically) feasible for A to efficiently deliver $\mathring{W}^{B'}<\mathring{W}^{B}$ to B and $\mathring{W}^{C} = \overline{W}^{CD}$ to C whenever it is feasible for A to efficiently deliver $\mathring{W}^{B}>\overline{W}^{BD}$ to B and $\mathring{W}^{C} = \overline{W}^{CD}$ to C, and so A would never choose the latter. As A can do no better for itself in the Contract Renegotiation Game than to efficiently deliver $\overline{W}^{BD}$ to B and $\overline{W}^{CD}$ to C, it will do so when it is feasible to do so, and we may therefore conclude:

Proposition 3: Under (A6), in any SGPE of the Contract Renegotiation Game, the outcome is (generically) efficient if and only if there exists a $(\tilde{\tau}^{Af},\overline{\tau}^{Bf})$ satisfying the conditions of Lemma 8 for $\mathring{W}^{B} = \overline{W}^{BD}$.

In effect, under (A6), the key to attaining efficient outcomes in the Contract Renegotiation Game is condition (14a) of Lemma 8, which derives from the security constraint to prevent backward stealing: attaining efficiency does not require that further conditions be met to avoid the hazards of forward manipulation. When viewed in light of Proposition 2 and its Corollary, Proposition 3 therefore suggests that renegotiation provisions such as those provided in the GATT/WTO can alleviate the efficiency costs associated with forward manipulation, in the sense that efficient bargaining outcomes may be anticipated in a wider set of circumstances, at least so long as these provisions allow for sufficiently "sweeping" renegotiation opportunities as we have modeled them here. Still, as (A6) indicates, as a general solution to forward manipulation, renegotiation has its limits, as it may introduce a bypass problem into negotiations in some circumstances (i.e., in the circumstances where (A6) is violated).[21]

6. Preventing Backward Stealing through GATT/WTO Rules

We now reconsider and interpret the security constraint imposed in section 4 and maintained throughout section 5 (i.e., the requirement that $w^{B}(\overline{\tau},\overline{t})\geq w^{B\backslash C}(\tilde{\tau}^{A},\overline{\tau}^{B},\overline{t}^{B})$). As suggested by our

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[21]As a general solution to the forward manipulation problem, a further possible limitation of the kind of sweeping renegotiation opportunities that we have considered here is that, in a broader model, such renegotiation opportunities might themselves impede the negotiation of meaningful market access commitments.

"terms-of-trade manipulation" interpretation of the backward stealing problem offered in section 3, there is a link between this security constraint and a requirement that stage-2 negotiations between A and C leave unaltered the terms-of-trade implied as a result of stage-1 negotiations. This link is suggestive of a role for GATT/WTO rules in this regard, because as we have shown elsewhere (Bagwell and Staiger, 1999a, 2002) the GATT/WTO norm of *reciprocity* can be interpreted as fixing the terms of trade, in the sense that "reciprocal" changes in market access, i.e., changes that preserve the balance of market access rights and obligations, leave the terms of trade unaltered.[22] Guided by this suggestion, we ask: Is there something in GATT/WTO rules that might work along the lines of such a security constraint?

To answer this question within our bargaining games, we focus on B's opportunity to respond to subsequent negotiations between A and C that upset B's original balance of market access rights and obligations in a way that is unfavorable to B (i.e., that worsen B's terms of trade from the level implied by B's agreement with A). In this circumstance, we consider the possibility that B has the opportunity to respond with a tariff increase above its bound level that restores this original balance (i.e., that restores the original terms of trade). This opportunity can be seen to exist in the GATT/WTO under the "within rounds" interpretation of these games, in the sense that governments may choose to modify or withdraw tentatively offered concessions when imbalances arise at the conclusion of a round of GATT/WTO negotiations. And it can be seen to exist as well under the "between rounds" interpretation of these games, because governments have the opportunity to seek redress under the "non-violation nullification-or-impairment" provisions contained in GATT Article XXIII when they experience nullification or impairment of their market access rights as a result of a negotiating partner's subsequent (and GATT-legal) actions. In this section, we seek to capture this opportunity formally, and ask whether it might serve an analogous role to the security constraint analyzed above. For concreteness, we focus explicitly on the between-rounds interpretation, and in particular on the possible role for non-violation complaints in this context.

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[22]Shirono (2004) provides empirical evidence of this form of reciprocity in GATT/WTO negotiations.

We introduce B's opportunity to respond to a non-violation nullification-or-impairment of its market access rights as follows. First, we define τ^{BNV} as the level of B's tariff which, in combination with $\overline{\tau}^A$ and $\overline{\tau}^C$, would maintain the terms of trade at the level implied by A's stage-1 agreement with B. Thus, for example, in the event that $\overline{\tau}^A$ and $\overline{\tau}^C$ bind A and C below their respective reaction curves, τ^{BNV} is defined implicitly by $\tilde{P}^w(\overline{\tau}^A,\tau^{BNV},\overline{\tau}^C) = \tilde{P}^w(\tau^{A\backslash C},\tau^{B\backslash C},\tau^{CR})$. We then provide B with the opportunity to increase its tariff binding from an initially agreed-upon level $\hat{\tau}^B$ to τ^{BNV} whenever A and C reach agreement in stage-2 that implies a worsening of B's terms of trade (i.e., that implies $\tilde{P}^w(\overline{\tau}^A,\hat{\tau}^B,\overline{\tau}^C) < \tilde{P}^w(\tau^{A\backslash C},\tau^{B\backslash C},\tau^{CR})$). In this way, we endow B with the opportunity to restore the original balance of market access rights and obligations between it and country A if this balance is upset by A's subsequent negotiations with C.[23]

We now describe the *WTO-Contract Game*:

Stage 1:   *A proposes* $(\tilde{\tau}^A,\hat{\tau}^B,\overline{t}^B)$, *which B accepts or rejects.*

Stage 2:   *If B accepts, A proposes* $(\overline{\tau}^A \leq \tilde{\tau}^A,\overline{\tau}^C,\overline{t}^C)$, *which C accepts or rejects.*

Stage 3:   *If B accepts in Stage 1 and C accepts in Stage 2, then B selects* $\overline{\tau}^B \leq \max[\hat{\tau}^B,\tau^{BNV}]$.

Stage 4:   *If B accepts in Stage 1 and C rejects in Stage 2, then A proposes* $(\tau^{Ar},\tau^{Br},t^{Br})$, *which B accepts or rejects.*

The full extensive form of the WTO-Contract Game is given in Figure 6.

As compared to the Contract Renegotiation Game, the WTO-Contract Game displays two

[23]Formally, we may define the market access that one country affords to a second by the first country's volume of import demand for the exports of the second country at a given world price. Hence, the market access that countries B and C each afford to A at a given world price $\overline{p}^w$ is defined by their respective import demands at that world price: $MA^j(\tau^j,t^j;\overline{p}^w) \equiv M^j(p^j(\tau^j,\overline{p}^w),\overline{p}^w,t^j)$ *for* $j \in \{B,C\}$. Similarly, the market access that country A affords to country j is A's residual import demand for j's exports – after the other country's export supply to A has been netted out – at a given world price: $MA^{Aj}(\tau^A,\tau^y,t^B,t^C;\overline{p}^w) \equiv M^A(p^A(\tau^A,\overline{p}^w),\overline{p}^w,t^A) - E^y(p^y(\tau^y,\overline{p}^w),\overline{p}^w,t^y)$ *for* $j \in \{B,C\}$. Finally, we define the *balance of market access rights and obligations* between A and j that is implied by a vector of negotiated tariffs and transfers at a given world price by $B^{Aj}(\tau,t^B,t^C;\overline{p}^w) \equiv [MA^j(\tau^j,t^j;\overline{p}^w) - \overline{p}^w \times MA^{Aj}(\tau^A,\tau^y,t^B,t^C;\overline{p}^w)]$ for $j \in \{B,C\}$, where all tariffs are evaluated at their applied levels. With this definition, it is then straightforward to show that two vectors of tariffs imply the same balance of market access rights and obligations if and only if they imply the same terms of trade. For further discussion of the relationship between the balance of market access rights and obligations and the terms of trade, see Bagwell and Staiger (2002).

differences. First, in stage 2, the security constraint is no longer imposed. And second, immediately after stage 2 (in the new stage 3), B's non-violation nullification-or-impairment response is inserted, permitting B to choose to increase its tariff binding if this is required to prevent A's stage-2 agreement with C from eroding B's terms of trade.[24]

We seek conditions under which any SGPE of the WTO-Contract Game will achieve a point on the efficiency frontier. We focus on the feasibility of efficiently delivering $\overline{W}^{BD}$ to B and $\overline{W}^{CD}$ to C under (A6), since if this is feasible in the WTO-Contract Game then A will surely make proposals that implement it. We say that it is *feasible* in the WTO-Contract Game to efficiently deliver $\overline{W}^{BD}$ and $\overline{W}^{CD}$ if and only if there exists a triple $(\tilde{t}^{Af}, \hat{t}^{Bf}, \overline{t}^{Bf})$ such that the outcome of the WTO-Contract Game is efficient, satisfies (A1) and (A2), and gives B the payoff $\overline{W}^{BD}$ and C the payoff $\overline{W}^{CD}$ when the stage-1 proposal is $(\tilde{t}^{Af}, \hat{t}^{Bf}, \overline{t}^{Bf})$.

Further progress can be made by considering a particular combination of efficient policies that we have elsewhere (e.g., Bagwell and Staiger, 1999a) referred to as *politically optimal* policies. More specifically, for any level of transfers the politically optimal tariffs solve $\hat{W}^j_{Pj} = 0$ for $j \in \{A,B,C\}$, and it can be shown that politically optimal tariffs achieve the efficiency frontier defined

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[24]In the interests of simplification, we have abstracted from a number of the legal/institutional elements associated with non-violation complaints in the GATT/WTO (see Bagwell, Mavroidis and Staiger, 2002, for a recent discussion of non-violation complaints in the GATT/WTO). Among them is the notion of what level of market access B could *reasonably anticipate* it had attained in its stage-1 negotiation with A. Arguably, as the WTO is a forum for bilateral negotiations, it would be *un*reasonable for B *not* to anticipate that countries A and C might engage in subsequent negotiations. But these subsequent negotiations may be structured in a variety of ways, some of which could potentially have large adverse impacts on B's interests. If the GATT/WTO norm of *reciprocity* is seen to define what B can reasonably anticipate concerning the outcome of A's subsequent negotiations with C, then it may be concluded that the anticipated stage-2 negotiations will leave B unaffected, and hence the level of market access that country B can reasonably anticipate as a result of its stage-1 negotiations with country A is simply that which is implied by their stage-1 negotiations. Notice that, according to this argument, reciprocity is not being imposed as an additional restriction on the outcome of stage-2 agreements. Instead, reciprocity is introduced as a negotiating norm: if a bilateral negotiation does not satisfy this norm, then the parties to the negotiation may be vulnerable to claims of nullification or impairment by a third party, if the third party had previously negotiated a market access agreement with one of them. In this regard, Hudec (1990, pp. 23-24) notes that the designers of GATT added nullification-or-impairment provisions precisely out of a concern for maintaining reciprocity established by negotiated market access agreements. Examples of bilateral agreements triggering non-violation complaints include (i). The U.S. complaint regarding tariff preferences negotiated by the EC on citrus products from certain Mediterranean countries, and (ii). The EC complaint regarding aspects of the bilateral agreement between the U.S. and Japan concerning trade in semiconductor products.

by (4)-(6).[25] Intuitively, politically optimal tariffs are efficient, because the incentive of governments to manipulate the terms of trade with their tariff choices is the source of international inefficiency in the Nash equilibrium and politically optimal tariffs do not reflect this incentive. We denote by τ^{po} the vector of politically optimal tariffs τ^{jpo} for $j \in \{A,B,C\}$ that, along with associated transfers t^{jpo}, efficiently deliver $\overline{W}^{BD}$ and $\overline{W}^{CD}$, and let $P_{po}^w \equiv \tilde{P}^w(\tau^{po})$.[26]

By the first-order conditions that define them, politically optimal tariffs satisfy (A1)-(A2).[27] Suppose, then, that there exists a $\tilde{\tau}^{Apo} \geq \tau^{Apo}$ and a $\hat{\tau}^{Bpo} \leq \tau^{Bpo}$ such that the stage-1 proposal $(\tilde{\tau}^A = \tilde{\tau}^{Apo}, \hat{\tau}^B = \hat{\tau}^{Bpo}, \overline{t}^B = t^{Bpo})$ satisfies the condition $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) = P_{po}^w$. If A were to make this proposal in stage-1 and B accepted, then the level of τ^{BNV} which defines B's stage-3 non-violation right in response to a stage-2 agreement reached between A and C is defined implicitly by $\tilde{P}^w(\overline{\tau}^A, \tau^{BNV}, \overline{\tau}^C) = P_{po}^w$. Turning now to stage 2, if A were to make a stage-2 proposal of $(\overline{\tau}^A = \tau^{Apo}, \overline{\tau}^C = \tau^{Cpo}, \overline{t}^C = t^{Cpo})$ and if C were to accept this proposal, then $\tau^{BNV} = \tau^{Bpo}$ and in stage 3 B would select $\overline{\tau}^B = \tau^{Bpo}$, and in this way $\overline{W}^{BD}$ and $\overline{W}^{CD}$ would be delivered efficiently with politically optimal policies. Hence, we may conclude that, provided there is no alternative stage-2 proposal which would be preferred by A, the existence of the stage-1 proposal described above is sufficient to ensure that it is feasible in the WTO-Contract Game to efficiently deliver $\overline{W}^{BD}$ and $\overline{W}^{CD}$, and therefore that the outcome of the WTO-Contract Game will be efficient.

Consider, then, the possibility that A might deviate to an alternative stage-2 proposal. Observe first that politically optimal tariffs exhibit the special feature that no government would desire a different trade volume if this possibility were offered to it at fixed terms of trade (this is

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[25]This can be seen by inspection once the three efficiency conditions (4)-(6) are expressed in terms of the alternative $\hat{W}^j$ functions, yielding the following three conditions: $\hat{W}_{P^A}^A \times \tilde{P}^w \times [\partial \tilde{P}^w / \partial \tau^j] / [\partial \tilde{P}^w / \partial \tau^A] = \hat{W}_{P^j}^j \times (P^j / \tau^j) \times [\hat{W}_{t^A}^A / \hat{W}_{t^j}^j]$ for $j \in \{B,C\}$, and $\tau^A \hat{W}_{P^A}^A / \hat{W}_{t^A}^A = (1/\tau^B) \hat{W}_{P^B}^B / \hat{W}_{t^B}^B + (1/\theta^C) \hat{W}_{P^C}^C / \hat{W}_{t^C}^C$ where $\theta^C \equiv [\partial \tilde{P}^w / \partial \tau^C] / [dP^C / d\tau^C] < 0$.

[26]There must exist a set of politically optimal policies that delivers $\overline{W}^{BD}$ and $\overline{W}^{CD}$ provided only that the politically optimal tariffs are bounded from above and from below as transfers are altered.

[27]More specifically, (A1) and (A2) may be restated in terms of the $\hat{W}^j$ functions as, respectively, $\hat{W}_{P^j}^j \times [dP^j / d\tau^j] + \hat{W}_{\tilde{p}^w}^j \times [\partial \tilde{p}^w / \partial \tau^j] > 0$ for $j \in \{A,B,C\}$, and $sign[(\hat{W}_{P^B}^B / \tau^B + \hat{W}_{\tilde{p}^w}^B) \times \partial \tilde{P}^w / \partial \tau^A] = sign[(\hat{W}_{P^C}^C / \tau^C + \hat{W}_{\tilde{p}^w}^C) \times \partial \tilde{P}^w / \partial \tau^A]$. With politically optimal tariffs defined by $\hat{W}_{P^j}^j = 0$ for $j \in \{A,B,C,\}$, it is now direct to confirm that politically optimal tariffs satisfy (A1) and (A2).

what $\hat{W}_{p,j}^{j}= 0$ for $j\in\{A,B,C\}$ means). As a consequence, A could not do better under a deviant stage-2 proposal that satisfied $\tilde{P}^{w}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C})= P_{po}^{w}$ in light of B's stage-3 response, i.e., under a deviant stage-2 proposal that implies $\tau^{BNV}\in[\hat{\tau}^{B},\tau^{BR}(\tau^{A\backslash B},\tau^{C\backslash B},t^{Bpo})]$. There are two remaining possibilities.

One possibility is that A could deviate to a stage-2 proposal implying $\tau^{BNV}<\hat{\tau}^{B}$, in which case $\overline{\tau}^{B}>\tau^{BNV}$ and $\tilde{P}^{w}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C})>P_{po}^{w}$. But even if such a proposal could provide A and C with their ideal trade volumes (and therefore satisfy $\hat{W}_{p,j}^{j}= 0$ for $j\in\{A,C\}$) at the new terms of trade, the decline in A's terms of trade implied by $\tilde{P}^{w}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C})>P_{po}^{w}$ ensures that A cannot gain under such a deviation.[28]

The other possibility is that A could deviate to a stage-2 proposal implying $\tau^{BNV}>\tau^{BR}(\tau^{A\backslash B},\tau^{C\backslash B},t^{Bpo})$, in which case $\overline{\tau}^{B}= \tau^{BR}(\tau^{A\backslash B},\tau^{C\backslash B},t^{Bpo})$ and $\tilde{P}^{w}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C})<P_{po}^{w}$. The potential for A to gain from this kind of deviation arises because, with $\overline{t}^{B}= t^{Bpo}$ already determined in stage 1, A could conceivably achieve higher welfare with tariff levels for itself and C which placed B on its tariff reaction curve than with politically optimal tariffs. Letting $(\tau_{po}^{A\backslash B},\tau_{po}^{C\backslash B},t_{po}^{C\backslash B})$ denote the choices of $(\tau^{A},\tau^{C},t^{C})$ that maximize $W^{A}(\tau^{A},\tau^{BR},\tau^{C},t^{A}= t^{Bpo}+t^{C})$ while delivering $\overline{W}^{CD}$ to C, this potential is ruled out by:

(A7) $\quad W^{A}(\tau^{po},t^{Apo}= t^{Bpo}+t^{Cpo}) \geq W^{A}(\tau_{po}^{A\backslash B},\tau^{BR},\tau_{po}^{C\backslash B},t^{A}= t^{Bpo}+t_{po}^{C\backslash B})$.

If (A7) were violated, then by negotiating with C, A could "win the tariff war" with B (i.e, with the transfer to B t^{Bpo} paid in either case, A could do better under non-cooperative tariff interaction with B than under the politically optimal tariffs).[29] Assumption (A7) effectively rules out this extreme

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[28]To see that a stage-2 proposal by A implying $\tau^{BNV}<\hat{\tau}^{B}$ implies in turn that $\overline{\tau}^{B}>\tau^{BNV}$, observe that: (i) stage-3 *permits* $\overline{\tau}^{B}>\tau^{BNV}$ in this case; and (ii) $\tau^{BNV}<\tau^{Bpo}$ in this case, so that B's best-response tariff is strictly above τ^{BNV} (see note 27), and therefore B *desires* $\overline{\tau}^{B}>\tau^{BNV}$ in this case as well. That A's payoff must fall with a deviant stage-2 proposal which leads to a deterioration in its terms of trade (i.e., a rise in $\tilde{P}^{w}$) can be seen as follows. Beginning from the political optimum, A can do no better under a rising $\tilde{P}^{w}$ than if the tariffs of A and C are adjusted so as to maintain $\hat{W}_{p,j}^{j}= 0$ for $j\in\{A,C\}$ and $\overline{t}^{C}$ is adjusted so as to maintain $\hat{W}^{C}= \overline{W}^{CD}$. In this case, we have that $d\overline{t}^{C}/d\tilde{P}^{w}= -\hat{W}_{\tilde{P}^{w}}^{C}/\hat{W}_{t^{C}}^{C}= -E^{C}$, where the second equality follows from (3), and therefore $d\hat{W}^{A}/d\tilde{P}^{w}= \hat{W}_{\tilde{P}^{w}}^{A}+\hat{W}_{t^{A}}^{A}\times d\overline{t}^{C}/d\tilde{P}^{w}= E^{B}\times\hat{W}_{t^{A}}^{A}<0$, where the second equality follows from (2) and (3).

[29] The fact that a large country might potentially "win the tariff war" with a smaller country was pointed out originally by Johnson (1953-54) in the context of national-income-maximizing governments and explored further by Kennan and Riezman (1988). In those papers, a country's welfare under Nash tariffs is compared to its welfare under free trade, and a country is said to win the tariff war if the former is bigger than the latter. The comparison we make

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degree of asymmetry, by requiring that B is not so small that A could win the tariff war.

Having established that there is no alternative stage-2 proposal which would be preferred by A, we may now state:

Proposition 4: Under (A6)-(A7), in any SGPE of the WTO-Contract Game, the outcome is efficient if there exists a $\tilde{\tau}^{Apo} \geq \tau^{Apo}$ and a $\hat{\tau}^{Bpo} \leq \tau^{Bpo}$ such that the stage-1 proposal $(\tilde{\tau}^A = \tilde{\tau}^{Apo}, \hat{\tau}^B = \hat{\tau}^{Bpo}, \overline{t}^B = t^{Bpo})$ satisfies $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) = P_{po}^w$.

Proposition 4 provides a sufficient condition for efficient outcomes in the WTO-Contract Game. To get a sense of the circumstances under which this condition is met, we note that under (A3) and (A4), the highest value of $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR})$ consistent with $\tilde{\tau}^{Apo} \geq \tau^{Apo}$ and $\hat{\tau}^{Bpo} \leq \tau^{Bpo}$ is achieved at $\tilde{\tau}^{Apo} = \tau^{Apo}$ and $\hat{\tau}^{Bpo} = \tau^{Bpo}$. With $\tilde{\tau}^{Apo} = \tau^{Apo}$ and $\hat{\tau}^{Bpo} = \tau^{Bpo}$, (A3) and (A4) then imply $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) > P_{po}^w$.[30] On the other hand, the lowest value of $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR})$ is achieved at $\tilde{\tau}^{Apo} = \tau^{AR}(\hat{\tau}^{Bpo}, \tau^{CR}, t^{Bpo})$ and $\hat{\tau}^{Bpo} \to 0$, and unless B is sufficiently small relative to C we must then have $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) = \tilde{P}^w(\tau^{AR}, \tau^B \to 0, \tau^{CR}) < P_{po}^w$. As a consequence, we may state:

Corollary: Under (A4), (A6) and (A7), in any SGPE of the WTO-Contract Game, the outcome is efficient unless B is sufficiently small relative to C.[31]

Observe that, if $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) > P_{po}^w$ when $\tilde{\tau}^A = \tau^{AR}$ and $\hat{\tau}^B = \tau^{Bpo}$, then achieving efficient politically optimal tariffs in the WTO-Contract Game will require that B utilize its non-violation

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above is related, but with two differences. First, the definition of $(\tau_{po}^{A\backslash B}, \tau_{po}^{C\backslash B}, t_{po}^{C\backslash B})$ gives A a Stackelberg-leader position while B is the Stackelberg follower, so that A's welfare when it interacts non-cooperatively with B is its Stackelberg-leader welfare, rather than its Nash welfare. Hence, the first difference is that the "tariff war" we refer to here is the Stackelberg tariff war rather than the Nash tariff war. And second, rather than comparing the welfare under the tariff war to that under free trade, we compare it to welfare under politically optimal tariffs. We invoke the "win the tariff war" terminology in the text above, because in the special case of national-income-maximizing governments politically optimal tariffs correspond to free trade, and so in this case our comparison is between the (Stackelberg) tariff war and free trade.

[30]If both $\tilde{\tau}^{Apo}$ and $\hat{\tau}^{Bpo}$ impose a binding constraint on A and B, respectively, when C disagrees, then $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) = \tilde{P}^w(\tau^{Apo}, \tau^{Bpo}, \tau^{CR}) > P_{po}^w$. If only $\tilde{\tau}^{Apo}$ is non-binding, then $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) > \tilde{P}^w(\tau^{Apo}, \tau^{Bpo}, \tau^{CR}) > P_{po}^w$ by (A3) and (A4). Finally, if $\hat{\tau}^{Bpo}$ is non-binding, then $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) > P_{po}^w$ by (A3) and (A4).

[31]This is suggestive of an efficiency-enhancing role for the "principal supplier" rule of the GATT/WTO, whereby the largest suppliers to a market are typically granted the position of the early negotiating partners.

right (i.e., we must then have $\hat{\tau}^B < \tau^{Bpo}$). On the other hand, if $\tilde{P}^w(\tau^{A\backslash C}, \tau^{B\backslash C}, \tau^{CR}) \leq P_{po}^w$ when $\tilde{\tau}^A = \tau^{AR}$ and $\hat{\tau}^B = \tau^{Bpo}$, then achieving efficient politically optimal tariffs in the WTO-Contract Game can be achieved without the utilization of B's non-violation right (i.e., we may then have $\hat{\tau}^B = \tau^{Bpo}$), but in this case negotiations between A and C must conform to reciprocity (i.e., the movement from $\tilde{\tau}^{Apo}$ to τ^{Apo} and from τ^{CR} to τ^{Cpo} must leave the terms of trade unaltered).

More broadly, in light of this discussion it is evident that the backward stealing and forward manipulation problems which prevent governments from achieving efficient bargaining outcomes under sequential bilateral negotiations in MFN environments (Propositions 1 and 2) can in principle be addressed with the inclusion of features that have representation in the bargaining environment shaped by WTO rules. In particular, opportunities for renegotiation can in principle prevent the inefficiencies that arise as a result of the forward manipulation problem (Proposition 3), while non-violation nullification-or-impairment rights operating within a reciprocity norm can in principle prevent the inefficiencies associated with backward stealing (Proposition 4).

7. Conclusion

Motivated by the structure of WTO negotiations, we analyze a bargaining environment in which negotiations proceed bilaterally and sequentially under the MFN principle. Our analysis proceeds in two steps. In a first step, we identify backward-stealing and forward-manipulation problems that arise when governments bargain under the MFN principle in a sequential fashion. We show that these problems impede governments from achieving the multilateral efficiency frontier unless further rules of negotiation are imposed. In our second step, we identify the WTO reciprocity norm and its nullification-or-impairment and renegotiation provisions as rules that are capable of providing solutions to these problems. In this way, we suggest that WTO rules can facilitate the negotiation of efficient multilateral trade agreements in a world in which the addition of new and economically significant countries to the world trading system is an ongoing process.

We have shown that the backward-stealing and forward-manipulation problems arise under very general circumstances, and that these problems can be interpreted as reflecting underlying

incentives to manipulate the terms of trade. We reiterate here, though, that these problems can equally well be given an interpretation in terms of market access: each problem reflects the incentives of negotiating partners to position the balance of market access rights and obligations in a way that is disadvantageous for unrepresented governments. When interpreted from this perspective, the backward stealing and forward manipulation problems take on heightened practical relevance, because the balance of market access rights and obligations is a dominate theme in GATT/WTO discussions. And from this perspective, the potential importance of the role played by the WTO reciprocity norm and its nullification-or-impairment and renegotiation provisions in facilitating efficient bargaining outcomes may be appreciated.

Finally, while we have focused on the possibility of achieving efficient bargaining outcomes in various negotiating environments, we have not characterized equilibrium outcomes in the environments where efficiency cannot be achieved. Hence our results do not indicate the likely severity of the inefficiency that arises when backward stealing and forward manipulation problems are present. We leave this important task to future research.

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Appendix

In this Appendix, we provide proofs of all Lemmas and Propositions not established in the text.

Lemma 2: At any efficient point, the following restrictions apply:

(*i*) $dW^j/d\tau^j>0$, $j\in\{A,B,C\}$;

(R1)   (*ii*) $dW^j/d\tau^A<0$, $dW^A/d\tau^j<0$, $j\in\{B,C\}$;

(*iii*) $dW^j/d\tau^{\backslash y}>0$, $j,\backslash y\in\{B,C\}$.

Proof: (A1) states (R1)(i) directly. For (R1)(iii), note that (A1), (A2) and (4) imply $dW^j/d\tau^A<0$ for $j\in\{B,C\}$. But $dW^j/d\tau^A = [(1/\tau^j)\hat{W}^j_{P^j} + \hat{W}^j_{\tilde{P}^w}](\partial\tilde{P}^w/\partial\tau^A)$ and $dW^j/d\tau^{\backslash y} = [(1/\tau^j)\hat{W}^j_{P^j} + \hat{W}^j_{\tilde{P}^w}](\partial\tilde{P}^w/\partial\tau^{\backslash y})$ for $j,\backslash y\in\{B,C\}$, and so $\partial\tilde{P}^w/\partial\tau^A<0<\partial\tilde{P}^w/\partial\tau^{\backslash y}$ for $j,\backslash y\in\{B,C\}$ implies $sign[dW^j/d\tau^A] = -\ sign[dW^j/d\tau^{\backslash y}]$ for $j,\backslash y\in\{B,C\}$. We therefore have (R1)(iii). Finally, together with (5) and (6), (A1) and (R1)(iii) imply $dW^A/d\tau^j<0$ for $j\in\{B,C\}$, which gives (R1)(ii).   **QED**

Proposition 1: There does not exist a SGPE of the Basic Game in which the outcome is efficient.
Proof: As illustrated by Figure 2 when j is set to C, A could improve upon any stage-2 proposal $(\overline{\tau}^{AE},\overline{\tau}^{CE},\overline{t}^{CE})$ that, in combination with $(\overline{\tau}^{BE},\overline{t}^{BE})$, attained a point on the efficiency frontier, because with a slight reduction in $\overline{\tau}^C$ below $\overline{\tau}^{CE}$ and a slight increase in $\overline{t}^C$ above $\overline{t}^{CE}$, A could move into the lens depicted in Figure 2, and C would accept this proposal.   **QED**

Lemma 4: $w^{CD}(\tilde{\tau}^A,\overline{\tau}^B,\overline{t}^B)= W^C(\tilde{\tau}^A,\overline{\tau}^B,\tau^{CR},t^C\equiv 0)$ for $\tilde{\tau}^A<\tau^{AR}(\tau^{B\backslash C},\tau^{CR},\overline{t}^B)$ and $\overline{\tau}^B<\tau^{BR}(\tau^{A\backslash C},\tau^{CR},\overline{t}^B)$, and for any such $(\tilde{\tau}^A,\overline{\tau}^B)$ that, together with τ^{CR}, fails to drive C to autarky, $w^{CD}(\tilde{\tau}^A,\overline{\tau}^B,\overline{t}^B)$ is strictly decreasing in $\tilde{\tau}^A$, strictly increasing in $\overline{\tau}^B$, and independent of $\overline{t}^B$.

Proof: Utilizing the relationship $W^C(\tau,t^C)\equiv\hat{W}^C(P^C(\tau^C,\tilde{P}^w(\tau)),\tilde{P}^w(\tau),t^C)$, we observe that $\partial W^C/\partial\tau^A = d\hat{W}^C/d\tau^A = [\hat{W}^C_{P^C}/\tau^C + \hat{W}^C_{\tilde{P}^w}][\partial\tilde{P}^w/\partial\tau^A]$, while C's reaction curve is defined implicitly by $\hat{W}^C_{P^C} + \theta^C\hat{W}^C_{\tilde{P}^w} = 0$ where $\theta^C\equiv[\partial\tilde{P}^w/\partial\tau^C]/[dP^C/d\tau^C]<0$. It follows that, with $\tilde{\tau}^A<\tau^{AR}(\tau^{B\backslash C},\tau^{CR},\overline{t}^B)$ and $\overline{\tau}^B<\tau^{BR}(\tau^{A\backslash C},\tau^{CR},\overline{t}^B)$ and therefore $w^{CD}(\tilde{\tau}^A,\overline{\tau}^B,\overline{t}^B)= W^C(\tilde{\tau}^A,\overline{\tau}^B,\tau^{CR},t^C\equiv 0)$, and with C positioned on its reaction curve, $\partial w^{CD}/\partial\tilde{\tau}^A = [1-\theta^C/\tau^{CR}]\hat{W}^C_{\tilde{P}^w}[\partial\tilde{P}^w/\partial\tau^A]<0$ provided that $\tilde{\tau}^A$ and $\overline{\tau}^B$ are non-prohibitive. Analogous arguments applied to $\overline{\tau}^B$ imply $\partial w^{CD}/\partial\overline{\tau}^B = [1-\theta^C/\tau^{CR}]\hat{W}^C_{\tilde{P}^w}[\partial\tilde{P}^w/\partial\tau^B]>0$.
                    QED

Lemma 5 : It is feasible in the Secure-Contract Game to efficiently deliver $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq W_{\min}^{CD}$ if and only if there exists $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf})$ with $\tilde{\tau}^{Af} \geq \tau^{AE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$ and $\overline{\tau}^{Bf}$ consistent with (A1) and (A2) for $\mathring{W}^B$ and $\mathring{W}^C$ such that

(10a) $w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) = \mathring{W}^B$, and

(10b) $w^{CD}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) = \mathring{W}^C$.

The implied stage-1 proposal is then $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, \overline{t}^{Bf} = t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C))$.

Proof: If the conditions of the Lemma are satisfied, then a stage-1 proposal of $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C))$ will be followed by a stage-2 proposal of $\tau^{AE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$, $\tau^{CE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$ and $t^{CE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$, and each proposal will be accepted, delivering $\mathring{W}^B$ and $\mathring{W}^C$ efficiently. Given this stage-1 proposal, A can do no better for itself with an alternative stage-2 proposal, since that would require that either B get less than $\mathring{W}^B$, which would violate the security constraint, or that C get less than $\mathring{W}^C$, which C would not accept. Going the other way, if (10a) is violated, then the security constraint and $W^B(\tau, t^B) = \mathring{W}^B$ imply that $w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) < W^B(\tau, t^B)$, but then by Lemma 3 backward stealing in stage 2 would preclude efficiency. If (10b) is violated, then either $w^{CD}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) < \mathring{W}^C$, but then A could increase its welfare by deviating from the efficient policies to propose instead $t^C < t^{CE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$, or else $w^{CD}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) > \mathring{W}^C$, but then C would reject A's stage-2 offer.   **QED**

Lemma 6: Under (A4), there does not exist a SGPE of the Secure-Contract Game in which the outcome is (generically) efficient and satisfies (11) and with $\mathring{W}^B > \overline{W}^{BD}$ and/or $\mathring{W}^C > \overline{W}_{\min}^{CD}$.

Proof: Consider any efficient outcome that is feasible in the Secure-Contract Game and for which, by (11), $\tilde{\tau}^{Af} < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$ and/or $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$. Starting from the stage-1 proposal $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, \overline{t}^{Bf} = t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C))$, we must establish that A can find an alternative stage-1 proposal that it strictly prefers as long as $\mathring{W}^C > \overline{W}_{\min}^{CD}$ and/or $\mathring{W}^B > \overline{W}^{BD}$. (I) Suppose $\mathring{W}^C > \overline{W}_{\min}^{CD}$. (A) If $\tilde{\tau}^{Af} < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, then increase the proposed $\tilde{\tau}^A$ slightly; this leads to a strict reduction in w^{CD} by Lemma 4 if $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$ and by (A4) if instead $\overline{\tau}^{Bf} \geq \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, thereby ensuring that $\mathring{W}^C > w^{CD}$. Now adjust $\overline{t}^B$ to fix $w^{B\backslash C}$ at $\mathring{W}^B$. If $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, then by Lemma 4 w^{CD} is unaltered by the adjustment in $\overline{t}^B$. If instead $\overline{\tau}^{Bf} \geq \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, then w^{CD} may be altered by

the adjustment in $\overline{t}^B$, and the impact on w^{CD} of the described adjustments in $\tilde{\tau}^A$ and $\overline{t}^B$ is then ambiguous: generically, however, these adjustments do not leave w^{CD} unaltered; therefore, by choosing the direction of the original change in $\tilde{\tau}^A$, we may (generically) find an adjustment in $\tilde{\tau}^A$ and $\overline{t}^B$ that strictly lowers w^{CD} and fixes $w^{B\backslash C}$ at $\mathring{W}^B$, thereby assuring that B will accept this alternative proposal. Next, by combining the implied adjustment in $\overline{t}^B$ with adjustments in the stage-2 proposals for $\overline{\tau}^A$, $\overline{\tau}^C$ and $\overline{t}^C$ that fix the levels of W^B and W^C at $\mathring{W}^B$ and $\mathring{W}^C$ respectively, and maintain $\overline{\tau}^A \leq \tilde{\tau}^A$, the efficiency conditions (4) and (6) imply that there can be no (first-order) effect of these combined adjustments on W^A. But with $W^C = \mathring{W}^C > w^{CD}$ under this adjusted proposal, A can then reduce the level of $\overline{t}^C$ it proposes in stage-2 and enjoy a strict welfare benefit from this maneuver. (B) If $\overline{\tau}^{Bf} < \tau^{BR}(\tau^{A\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, then reduce the proposed $\overline{\tau}^B$ slightly; this leads to a strict reduction in w^{CD} by Lemma 4 if $\tilde{\tau}^{Af} < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$ and by (A4) if instead $\tilde{\tau}^{Af} \geq \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, thereby ensuring that $\mathring{W}^C > w^{CD}$. Now adjust $\overline{t}^B$ to fix $w^{B\backslash C}$ at $\mathring{W}^B$. If $\tilde{\tau}^{Af} < \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, then by Lemma 4 w^{CD} is unaltered by the adjustment in $\overline{t}^B$. If instead $\tilde{\tau}^{Af} \geq \tau^{AR}(\tau^{B\backslash C}, \tau^{CR}, \overline{t}^{Bf})$, then w^{CD} may be altered by the adjustment in $\overline{t}^B$, and the impact on w^{CD} of the described adjustments in $\overline{\tau}^B$ and $\overline{t}^B$ is then ambiguous: generically, however, these adjustments do not leave w^{CD} unaltered; therefore, by choosing the direction of the original change in $\overline{\tau}^B$, we may (generically) find an adjustment in $\overline{\tau}^B$ and $\overline{t}^B$ that strictly lowers w^{CD} and fixes $w^{B\backslash C}$ at $\mathring{W}^B$, thereby assuring that B will accept this alternative proposal. Next, by combining the implied adjustments in $\overline{\tau}^B$ and $\overline{t}^B$ with adjustments in the stage-2 proposals for $\overline{\tau}^A$, $\overline{\tau}^C$ and $\overline{t}^C$ that fix the levels of W^B and W^C at $\mathring{W}^B$ and $\mathring{W}^C$ respectively, and maintain $\overline{\tau}^A \leq \tilde{\tau}^A$, the efficiency conditions (4), (5) and (6) imply that there can be no (first-order) effect of these combined adjustments on W^A. But with $W^C = \mathring{W}^C > w^{CD}$ under this adjusted proposal, A can then reduce the level of $\overline{t}^C$ it proposes in stage-2 and enjoy a strict welfare benefit from this maneuver. (II) Suppose $\mathring{W}^C = \overline{W}^{CD}_{\min}$ and $\mathring{W}^B > \overline{W}^{BD}$. Feasibility then implies by Lemma 5 that $w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \overline{W}^{CD}_{\min})) = \mathring{W}^B$ and $w^{CD}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \overline{W}^{CD}_{\min})) = \overline{W}^{CD}_{\min}$. Choose a small adjustment in $\overline{\tau}^{Bf}$ to $\overline{\tau}^{Bf'}$ and $\tilde{\tau}^{Af}$ to $\tilde{\tau}^{Af'}$ that solves $w^{B\backslash C}(\tilde{\tau}^{Af'}, \overline{\tau}^{Bf'}, t^{BE}(\overline{\tau}^{Bf'}; \mathring{W}^{B'}, \overline{W}^{CD}_{\min})) = \mathring{W}^{B'}$ for $\mathring{W}^B > \mathring{W}^{B'} > \overline{W}^{BD}$ while maintaining $\tilde{\tau}^{Af'} \geq \tau^{AE}(\overline{\tau}^{Bf'}; \mathring{W}^{B'}, \mathring{W}^C)$. Generically, such an adjustment exists, and for a sufficiently small adjustment we have as well that $\overline{\tau}^{Bf'}$ is consistent with (A1)-(A2) for $\mathring{W}^{B'}$ and $\overline{W}^{CD}_{\min}$. By the first-order condition that defines $\overline{W}^{CD}_{\min}$, a small adjustment in $\overline{\tau}^{Bf}$ and $\tilde{\tau}^{Af}$ has no (first-order) impact on

w^{CD}, and so we also have $w^{CD}(\tilde{\tau}^{Af\prime},\overline{\tau}^{Bf\prime},t^{BE}(\overline{\tau}^{Bf\prime};\mathring{W}^{B\prime},\overline{W}^{CD}_{\min}))$ = $\overline{W}^{CD}_{\min}$. Therefore, by Lemma 5, it is (generically) feasible for A to efficiently deliver $\mathring{W}^{B\prime}<\mathring{W}^{B}$ to B and $\mathring{W}^{C}=\overline{W}^{CD}_{\min}$ to C whenever it is feasible for A to efficiently deliver $\mathring{W}^{B}>\overline{W}^{BD}$ to B and $\mathring{W}^{C}=\overline{W}^{CD}_{\min}$ to C, and so A would never choose the latter.   **QED**

Lemma 7: Under (A5), there does not exist a SGPE of the Secure-Contract Game in which the outcome is (generically) efficient and violates (11).

Proof: In the text we established that, if there exists a $(\tilde{\tau}^{Af},\overline{\tau}^{Bf})$ that satisfies the conditions of Lemma 5 for some $\mathring{W}^{B}$ and $\mathring{W}^{C}$ and that, in addition, violates (11), then $\mathring{W}^{C}>\overline{W}^{CD}_{\min}$ and (generically) $\mathring{W}^{B}>\overline{W}^{BD}$. Consider, then, a small reduction in $\overline{t}^{B}$. Observe that with (11) violated, both $w^{B\backslash C}$ and w^{CD} are differentiable in $\overline{t}^{B}$, and under (A5) a small reduction in $\overline{t}^{B}$ will (generically) alter both $w^{B\backslash C}$ and w^{CD}, leading to four possible cases. (I) $w^{B\backslash C}$ and w^{CD} are reduced. Then adjust $\overline{\tau}^{A}$ and $\overline{t}^{C}$ to keep W^{B} and W^{C} unchanged (and note that w^{CD} and $w^{B\backslash C}$ are independent of $\overline{\tau}^{A}$ and $\overline{t}^{C}$ and, with (11) violated, independent as well of any change in $\tilde{\tau}^{A}$ that may be required to maintain $\overline{\tau}^{A}\leq\tilde{\tau}^{A}$). By efficiency condition (4), these adjustments create a second-order reduction in W^{A}, and $W^{B}=\mathring{W}^{B}>w^{B\backslash C}>\overline{W}^{BD}$ while $W^{C}=\mathring{W}^{C}>w^{CD}>\overline{W}^{CD}_{\min}$. A can then reduce $\overline{t}^{C}$ while keeping $W^{C}\geq w^{CD}$ and enjoy a strict gain from this maneuver. (II) $w^{B\backslash C}$ and w^{CD} are increased. Then reverse the change in $\overline{t}^{B}$, i.e., increase $\overline{t}^{B}$, and this will reduce both $w^{B\backslash C}$ and w^{CD}. Then proceed as in (I). (III) $w^{B\backslash C}$ is increased while w^{CD} is reduced. First adjust $\overline{\tau}^{A}$ and $\overline{t}^{C}$ to keep W^{B} and W^{C} unchanged. By efficiency condition (4), these adjustments create a second-order reduction in W^{A}, and $W^{B}=\mathring{W}^{B}<w^{B\backslash C}>\overline{W}^{BD}$ while $W^{C}=\mathring{W}^{C}>w^{CD}>\overline{W}^{CD}_{\min}$. Then adjust $\overline{t}^{C}$, $\overline{\tau}^{A}$ and $\overline{\tau}^{C}$ to set $W^{B}=w^{B\backslash C}$ and $W^{C}=w^{CD}$ (and note that $w^{B\backslash C}$ and w^{CD} are unaffected by these further adjustments and, with (11) violated, independent as well of any change in $\tilde{\tau}^{A}$ that may be required to maintain $\overline{\tau}^{A}\leq\tilde{\tau}^{A}$). Together, these adjustments (generically) alter W^{A}. If W^{A} rises, then we have found a set of adjustments under which A gains. If W^{A} falls, then reverse the change in $\overline{t}^{B}$, i.e., increase $\overline{t}^{B}$, and reverse the sign of all the described adjustments, and W^{A} must then rise under these reversed adjustments. (IV) $w^{B\backslash C}$ is reduced while w^{CD} is increased. First adjust $\overline{\tau}^{A}$ and $\overline{t}^{C}$ to keep W^{B} and W^{C} unchanged. By efficiency condition (4), these adjustments create a second-order reduction in W^{A}, and $W^{B}=\mathring{W}^{B}>w^{B\backslash C}>\overline{W}^{BD}$ while $W^{C}=\mathring{W}^{C}<w^{CD}>\overline{W}^{CD}_{\min}$. Then adjust $\overline{t}^{C}$, $\overline{\tau}^{A}$ and $\overline{\tau}^{C}$ to set $W^{B}=w^{B\backslash C}$

and $W^C = w^{CD}$ (and note that $w^{B\backslash C}$ and w^{CD} are unaffected by these further adjustments and, with (11) violated, independent as well of any change in $\tilde{\tau}^A$ that may be required to maintain $\overline{\tau}^A \leq \tilde{\tau}^A$). Together, these adjustments (generically) alter W^A. If W^A rises, then we have found a set of adjustments under which A gains. If W^A falls, then reverse the change in $\overline{t}^B$, i.e., increase $\overline{t}^B$, and reverse the sign of all the described adjustments, and W^A must then rise under these reversed adjustments. With these four cases, we have therefore established that, if there exists a $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf})$ that satisfies the conditions of Lemma 5 for some $\mathring{W}^B$ and $\mathring{W}^C$ and that, in addition, violates (11), then A can (generically) find a better proposal. Hence, there does not exist a SGPE of the Secure-Contract Game in which the outcome is (generically) efficient and violates (11). **QED**

Lemma 8 : Under (A6), it is feasible in the Contract Renegotiation Game to efficiently deliver $\mathring{W}^B \geq \overline{W}^{BD}$ and $\mathring{W}^C \geq \overline{W}^{CD}$ if and only if there exists $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf})$ with $\tilde{\tau}^{Af} \geq \tau^{AE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$ and $\overline{\tau}^{Bf}$ consistent with (A1)-(A2) for $\mathring{W}^B$ and $\mathring{W}^C$ such that

(14a) $w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) = \mathring{W}^B$, and

(14b) $\overline{W}^{CD} = \mathring{W}^C$.

The implied stage-1 proposal is then $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, \overline{t}^{Bf} = t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C))$.

Proof: If the conditions of the Lemma are satisfied, then a stage-1 proposal of $(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C))$ will be followed by a stage-2 proposal of $\tau^{AE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$, $\tau^{CE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$ and $t^{CE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$, and each proposal will be accepted, delivering $\mathring{W}^B$ and $\mathring{W}^C$ efficiently. Given this stage-1 proposal, A can do no better for itself with an alternative stage-2 proposal, since that would require that either B get less than $\mathring{W}^B$, which would violate the security constraint, or that C get less than $\mathring{W}^C$, which C would not accept. Going the other way, if (14a) is violated, then the security constraint and $W^B(\tau, t^B) = \mathring{W}^B$ imply that $w^{B\backslash C}(\tilde{\tau}^{Af}, \overline{\tau}^{Bf}, t^{BE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)) < W^B(\tau, t^B)$, but then by Lemma 3 backward stealing in stage 2 would preclude efficiency. If (14b) is violated, then either $\overline{W}^{CD} < \mathring{W}^C$, but then A could increase its welfare by deviating from the efficient policies to propose instead $t^C < t^{CE}(\overline{\tau}^{Bf}; \mathring{W}^B, \mathring{W}^C)$, or else $\overline{W}^{CD} > \mathring{W}^C$, but then C would reject A's stage-2 offer.

QED
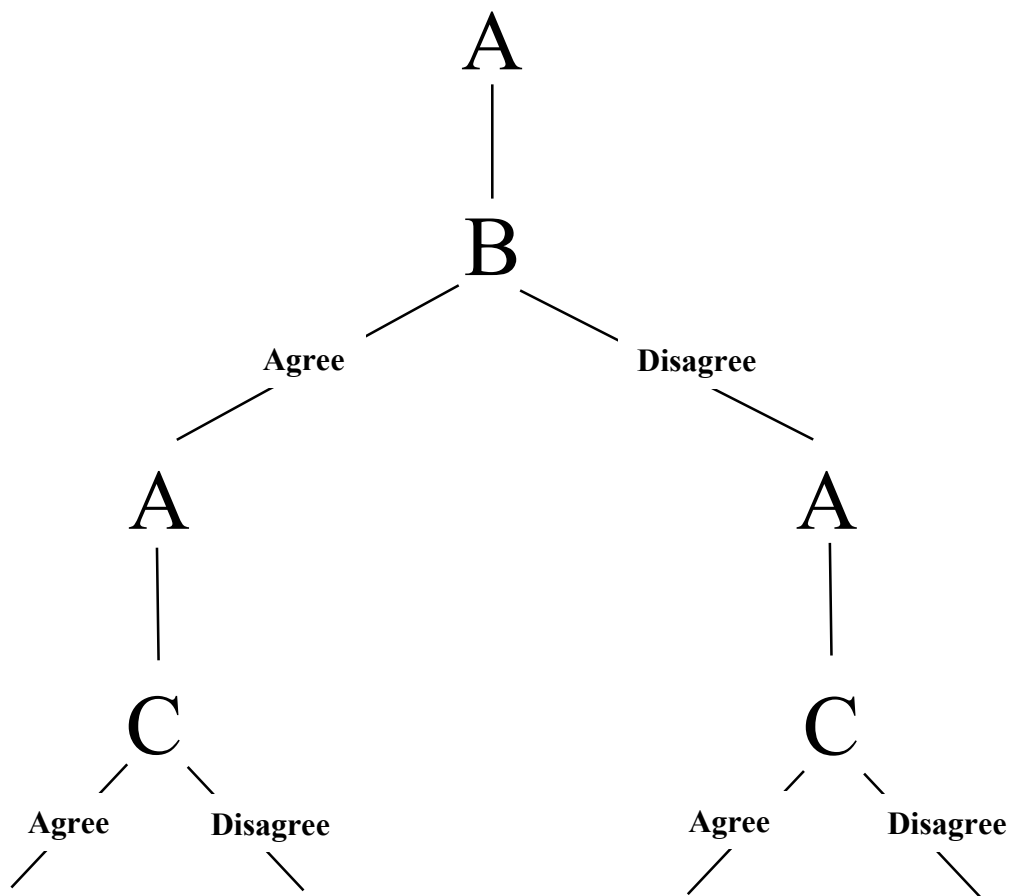
Figure 1

The Sequential Bargaining Structure
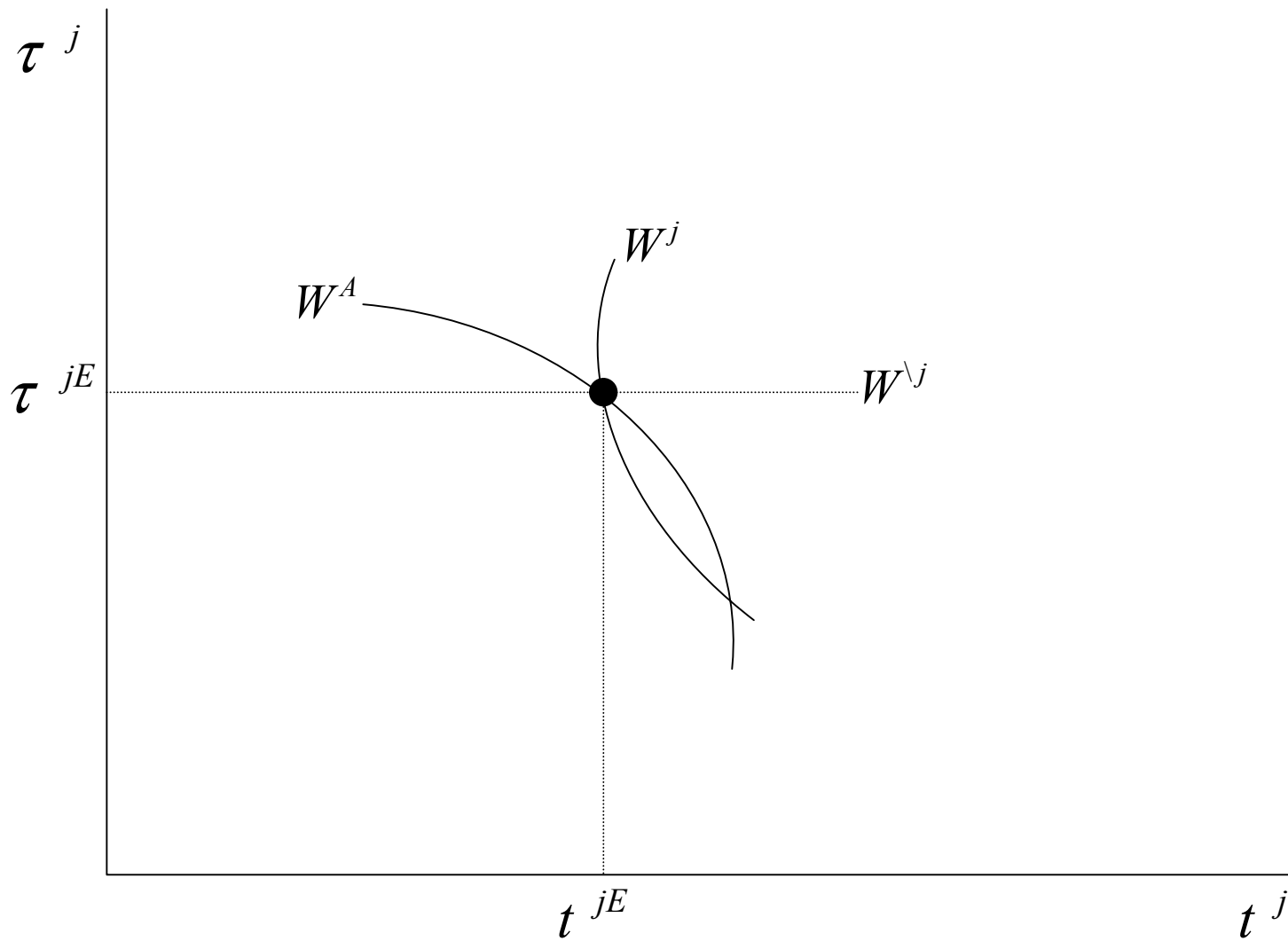
Figure 2
$(j \in \{B, C\})$
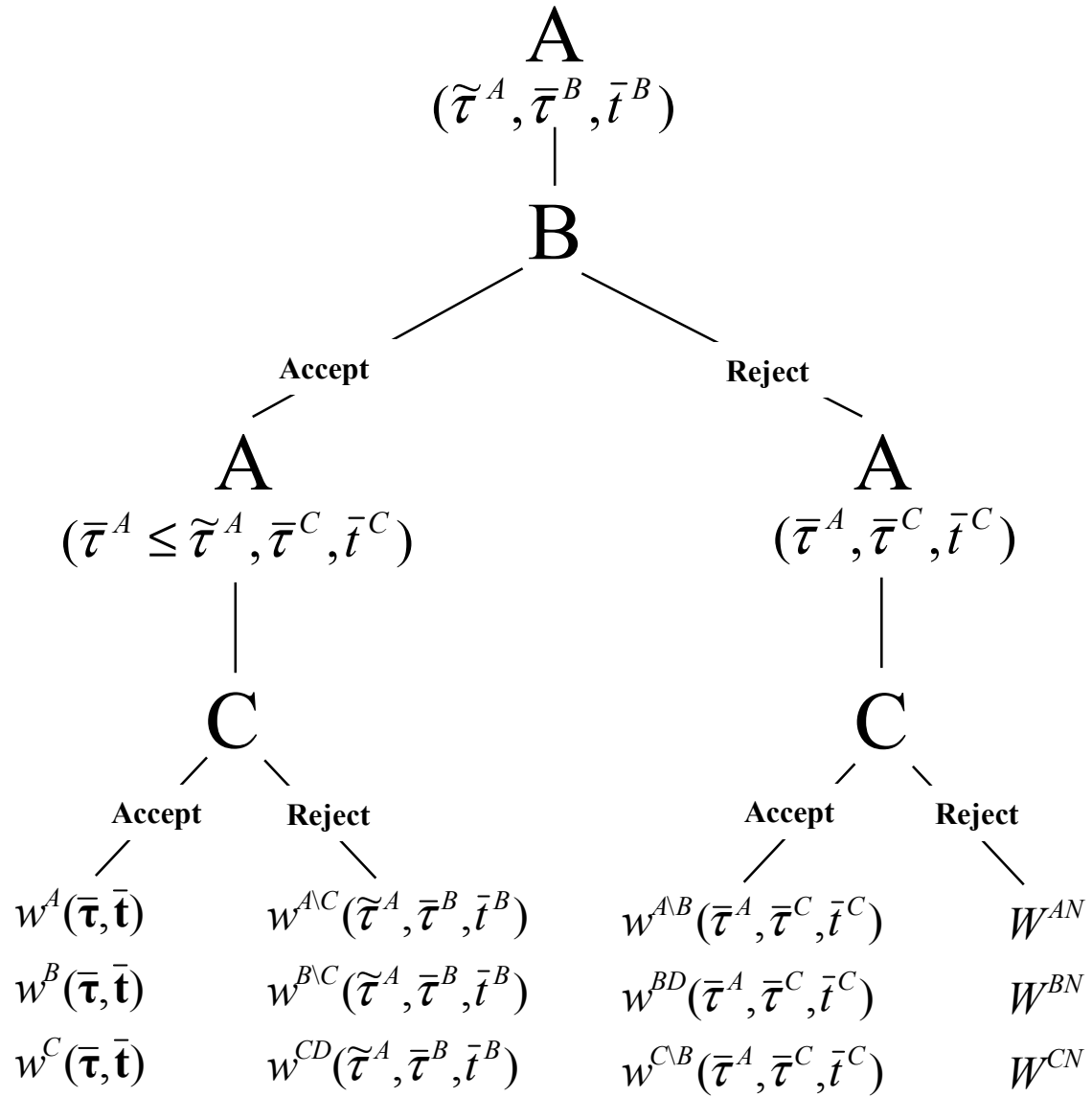
Figure 3

The Basic Game

Figure 4

$$A$$
$$(\widetilde{\tau}^{A},\overline{\tau}^{B},\overline{t}^{B})$$

$$B$$

Accept **Reject**

$$A$$
$$(\overline{\tau}^{A}\le\widetilde{\tau}^{A},\overline{\tau}^{C},\overline{t}^{C})$$
$$w^{B}(\overline{\tau},\overline{t})\ge w^{B\backslash C}(\widetilde{\tau}^{A},\overline{\tau}^{B},\overline{t}^{B})$$

$$A$$
$$(\overline{\tau}^{A},\overline{\tau}^{C},\overline{t}^{C})$$

$$C$$

Accept **Reject**

$$w^{A}(\overline{\tau},\overline{t})$$
$$w^{B}(\overline{\tau},\overline{t})$$
$$w^{C}(\overline{\tau},\overline{t})$$

$$A$$
$$(\overline{\tau}^{Ar},\overline{\tau}^{Br},\overline{t}^{Br})$$

$$B$$

Accept **Reject**

$$w^{A\backslash C}(\overline{\tau}^{Ar},\overline{\tau}^{Br},\overline{t}^{Br})$$
$$w^{B\backslash C}(\overline{\tau}^{Ar},\overline{\tau}^{Br},\overline{t}^{Br})$$
$$w^{CD}(\overline{\tau}^{Ar},\overline{\tau}^{Br},\overline{t}^{Br})$$

$$W^{AN}$$
$$W^{BN}$$
$$W^{CN}$$

$$C$$

Accept **Reject**

$$w^{A\backslash B}(\overline{\tau}^{A},\overline{\tau}^{C},\overline{t}^{C})$$
$$w^{BD}(\overline{\tau}^{A},\overline{\tau}^{C},\overline{t}^{C})$$
$$w^{C\backslash B}(\overline{\tau}^{A},\overline{\tau}^{C},\overline{t}^{C})$$

$$W^{AN}$$
$$W^{BN}$$
$$W^{CN}$$

Figure 5

The Contract Renegotiation Game

A

$(\widetilde{\tau}^{A},\hat{\tau}^{B},\bar{t}^{B})$

B

Accept   **Reject**

A

$(\overline{\tau}^{A}\le\widetilde{\tau}^{A},\overline{\tau}^{C},\bar{t}^{C})$

A

$(\overline{\tau}^{A},\overline{\tau}^{C},\bar{t}^{C})$

C

Accept   **Reject**

B

$\overline{\tau}^{B}\le\max[\hat{\tau}^{B},\tau^{BNV}]$

A

$(\overline{\tau}^{Ar},\overline{\tau}^{Br},\bar{t}^{Br})$

C

Accept   **Reject**

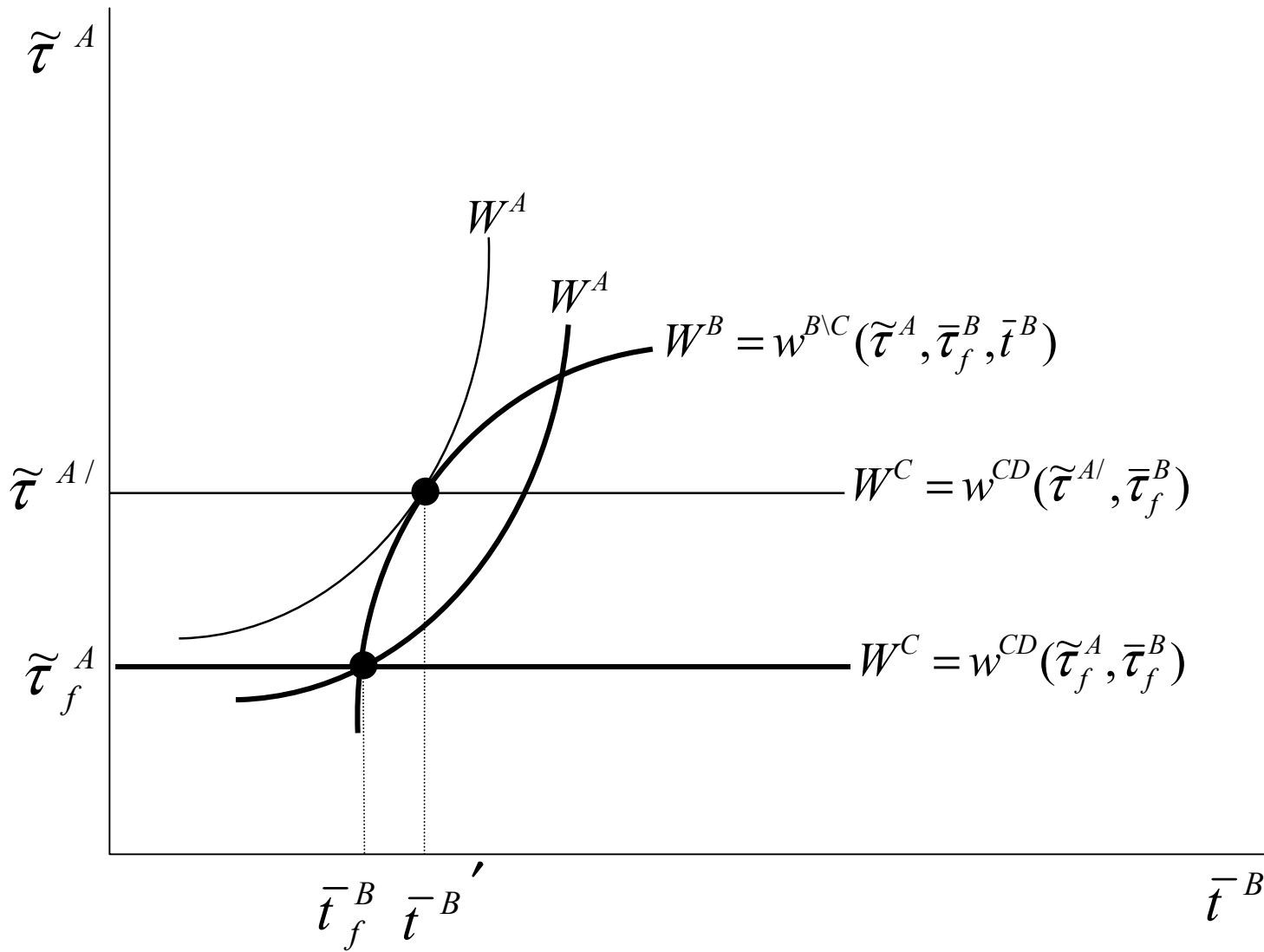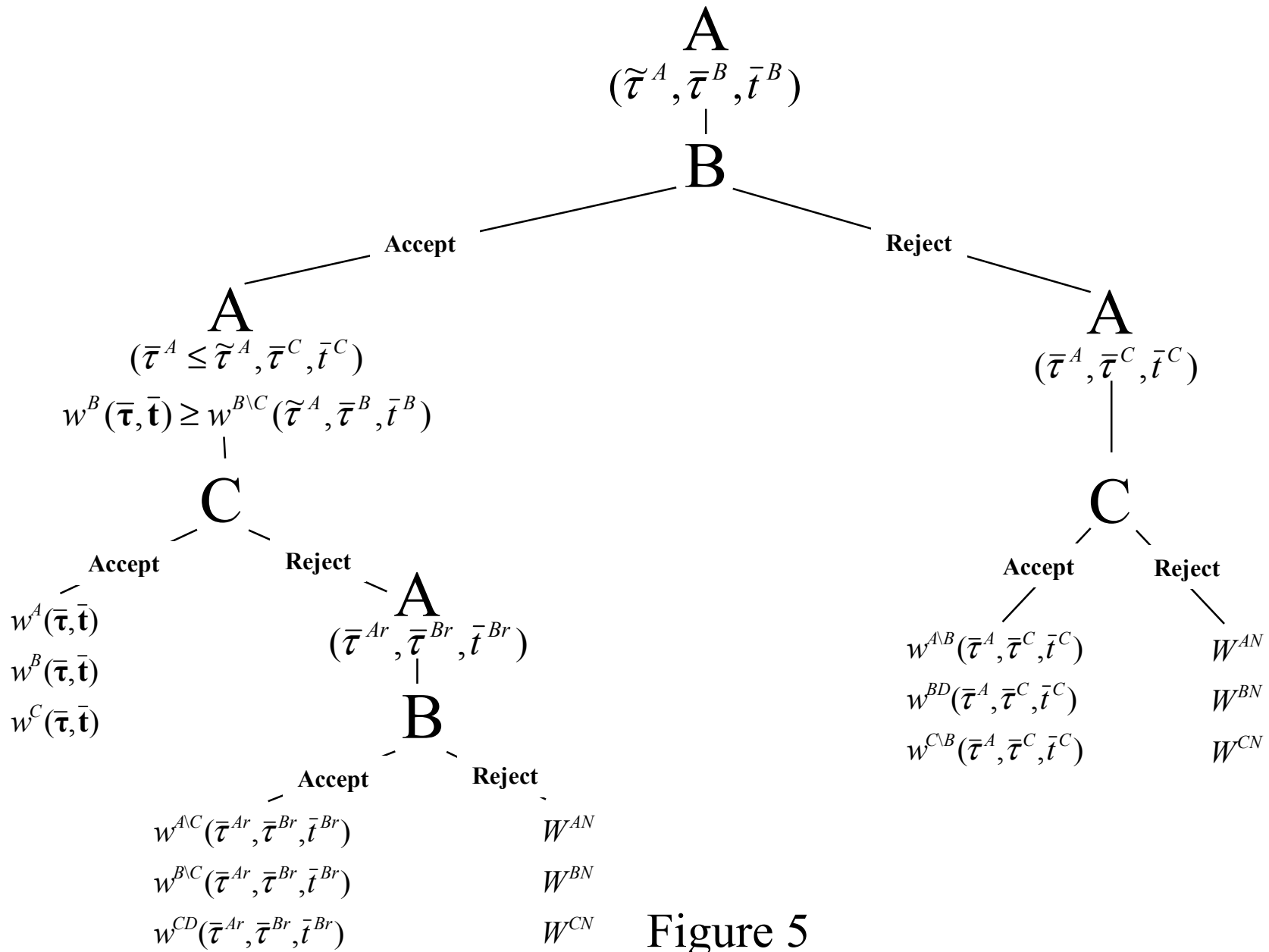$w^{A\backslash B}(\overline{\tau}^{A},\overline{\tau}^{C},\bar{t}^{C})$ W^{AN}

$w^{BD}(\overline{\tau}^{A},\overline{\tau}^{C},\bar{t}^{C})$ W^{BN}

$w^{C\backslash B}(\overline{\tau}^{A},\overline{\tau}^{C},\bar{t}^{C})$ W^{CN}

$w^{A}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C},\bar{\mathbf{t}})$

$w^{B}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C},\bar{\mathbf{t}})$

$w^{C}(\overline{\tau}^{A},\overline{\tau}^{B},\overline{\tau}^{C},\bar{\mathbf{t}})$

B

Accept   **Reject**

$w^{A\backslash C}(\overline{\tau}^{Ar},\overline{\tau}^{Br},\bar{t}^{Br})$ W^{AN}

$w^{B\backslash C}(\overline{\tau}^{Ar},\overline{\tau}^{Br},\bar{t}^{Br})$ W^{BN}

$w^{CD}(\overline{\tau}^{Ar},\overline{\tau}^{Br},\bar{t}^{Br})$ W^{CN}

Figure 6

The WTO Contract Game